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FISCAL SHOCKS AND REAL WAGES[††]

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ABSTRACT

This paper studies the impact of fiscal shocks in a panel of eleven euro area member countries. It contributes to the existing literature by providing new empirical evidence on the effects of different types of spending shocks on real wages. The main finding is that an increase in government spending raises the real wage. However, its magnitude depends on the spending type. Shocks to government investment and to the number of public employees generate responses that are at the extremes of the wage response spectrum. The former produces the greatest effect, whereas the latter has zero impact. Copyright © 2011 John Wiley & Sons, Ltd.

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KEY WORDS: government spending shocks; real wages; panel VAR; European Monetary Union

1. INTRODUCTION

This paper studies the effects of fiscal spending shocks on real wages. Its goal is to contribute to the research on expansionary fiscal policies by providing new empirical evidence for labor market variables. In particular, its focus is on the response of real wages to shocks in different types of government spending measures in European Monetary Union (EMU) member countries.

The study of these responses is interesting in the light of the contrasting theoretical predictions produced by different modelling strategies. On the one hand, neoclassical models such as Aiyagari *et al*. (1992) and Baxter and King (1993) show that shocks to government spending reduce wages through negative wealth effects that induce agents to increase labour supply. On the other hand, Neo-Keynesian models with price rigidities as in Rotemberg and Woodford (1992), Linnemann and Schabert (2003), Galí *et al*. (2007) or Ravn *et al*. (2007) predict a real wage increase.[1]

Empirically, this research question is also relevant because real wage responses are found to vary across strategies. Applications of the narrative approach as in Ramey and Shapiro (1998), Edelberg *et al*. (1999) or Burnside *et al*. (2004) show that real wages fall in response to military spending shocks. However, Perotti (2007) challenges these findings by showing that they depend on two implicit restrictions of this method. First, all episodes have the same dynamics. Second, fiscal policy explains all the deviations from 'normal' of all endogenous variables. He shows that after removing these real wages respond positively. This result is the same as in several papers using the structural approach to identify fiscal shocks (Fatás and Mihov, 2001; Blanchard and Perotti, 2002; Perotti, 2005, 2007).

The data frequency plays also an important role for the VAR predictions because anticipation effects are more likely to appear in quarterly data. If fiscal shocks are anticipated and the empirical model does account for this, the estimated wage response would miss the initial (negative) impact and capture only the subsequent wage increase.[2]

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Most of the empirical literature studying the dynamic response of wages focuses on four countries with true quarterly data (US, Australia, Canada and the UK) and identifies fiscal shocks using the method of Blanchard and Perotti (2002).

By contrast, this paper takes annual data, studies a panel of EMU member countries and identifies shocks with a recursive ordering. It contributes to the literature by analyzing the effects of different types of government spending and real wage measures.

The general finding is that most fiscal shocks increase wages with quantitative effects varying across spending types. Shocks to government investment produce the largest increase, whereas shocks to wage government consumption have the smallest effect.

The remainder of the paper is organized as follows: Section 2 presents the data and describes the construction of the main variables. Section 3 presents the empirical approach and the baseline results, whereas Section 4 shows the robustness checks on the baseline findings. In Section 5, I estimate the effect of these on a different set of countries. Section 6 studies the role of the price deflators. Finally, conclusions are presented in Section 7.

2. DATA

The literature dealing with the effects of fiscal shocks has considered a wide range of government spending measures. Blanchard and Perotti (2002) study the effects of public consumption shocks on GDP. Using the same spending measure, Monacelli and Perotti (2010) focus on the effects on trade balance, real exchange rate, GDP and private consumption. Several studies have also concentrated on the subcomponents of government consumption. For instance, Monacelli and Perotti (2008) consider shocks to the non-wage component and study the dynamic response of the terms of trade and the relative price of nontradables. Cavallo (2005, 2007) distinguishes between government spending on goods and wages in order to assess their effects on US private consumption and current account. Following a similar strategy, Giordano *et al*. (2007) focus on the impact of a shock to wage and non-wage consumption on Italian GDP. Other papers study the effects of shocks to public investment, public consumption or to the sum of these two (Pappa, 2005; Beetsma *et al*., 2006, 2008; Perotti, 2007).

Studies examining the dynamic effects of fiscal shocks typically take one or two of the above measures. The exceptions are Tagkalakis (2006) allowing for differences across types of government spending to study the UK labour market, Bénétrix and Lane (2009) taking different spending measures to study the effects on real exchange rate and Bénétrix and Lane (2010) using these to address the impact on the sectoral composition of output.

Here, I adopt the approach of Bénétrix and Lane (2009, 2010) and study a panel of eleven euro area member countries using five measures of government spending.[3] These are government absorption (GEXP), defined as the sum of government fixed investment (GINV) and total government consumption (GC), these two measures taken individually and the wage (WGC) and non-wage (NWGC) components of government consumption.[4]

The source of these variables is the OECD Economic Outlook, with the exception of government fixed investment for Greece (for this case, I use national sources).[5] All government variables are in real terms (log levels) and deflated with their own deflators. These are available at the OECD Economic Outlook. The exception is non-wage government consumption that is deflated with government consumption prices. The reason for using the specific deflator for each spending variable is that the focus of this paper is on shocks to the quantities purchased by the government.[6] However, Section 6 uses GDP prices to compare the effect of shocks in quantities with the effect of shocks combining changes in quantities and relative prices.

The time span of the data is 1970 to 2006. Although data coverage is good, I do not include wage government consumption for Belgium between 1970 and 1975, Germany in 1970 and Portugal between 1970 and 1977. This last country also lacks data for total government consumption and government fixed investment for the same period, whereas Germany lacks total government consumption for 1970.[7] The second variable used is gross domestic product in constant local currency units from the OECD Economic Outlook.

Following Lane and Perotti (2003), I define real wages as real compensation per employee because the focus of this paper is on the economy as a whole. Moreover, I take CPI-deflated real wages because it is the relevant

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measure to study labour supply and real labour income. The source is the Annual Macroeconomic Database of the European Commission.

3. BASELINE EMPIRICAL MODEL

3.1. Estimation Strategy

To assess the effects of shocks to government spending on wages, I first estimate the model in (1) for each government spending measure.

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

The associated structural model is given by $A_0 Z_{i,t} = A(L)Z_{i,t-1} + CX_{i,t} + \varepsilon_{i,t}$, where $A(L) = A_0 B(L)$, $C = A_0 D$, $\varepsilon_{i,t} = A_0 u_{i,t}$ and

$$Z_{i,t} = \begin{bmatrix} g_{i,t} \\ y_{i,t} \\ w_{i,t} \end{bmatrix} \quad A_0 = \begin{pmatrix} 1 & -\alpha_{yg} & -\alpha_{wg} \\ -\alpha_{gy} & 1 & -\alpha_{wy} \\ -\alpha_{gw} & -\alpha_{yw} & 1 \end{pmatrix} \quad X_{i,t} = \begin{bmatrix} c_i \\ t_{i,t} \\ d_t \end{bmatrix} \quad \varepsilon_{i,t} = \begin{bmatrix} \varepsilon^g_{i,t} \\ \varepsilon^y_{i,t} \\ \varepsilon^w_{i,t} \end{bmatrix}.$$

Subscripts i and t denote the country and the year. $Z_{i,t}$ is a vector of three endogenous variables: government spending ($g_{i,t}$), GDP ($y_{i,t}$) and wages ($w_{i,t}$).[8] Matrix A_0 captures the contemporaneous relations between the endogenous variables.

Matrix $A(L)$ is the matrix polynomial in the lag operator L that captures the relation between the endogenous variables and their lags. The lag length in each model is set to two according to the Akaike Information Criterion, Schwarz Bayesian Information Criterion and the absence of first-order autocorrelation, tested with the Durbin-Watson statistic. In selecting this lag length, I also follow the related literature (Beetsma *et al*., 2006, 2008; Bénétrix and Lane, 2009, 2010).

Because the goal of this paper is to provide empirical evidence for a panel of countries, it is important to deal with cross-country heterogeneity. To this end, each model includes fixed-effects and country-specific linear trends (the latter is also included to induce stationarity).[9] To eliminate cross-country contemporaneous residual correlation and to account for global factors, the model includes time fixed effects. c_i are the country-specific intercepts, $t_{i,t}$ the country-specific linear trends and d_t the year dummies. Vector $X_{i,t}$ contains all these, whereas matrix C the associated coefficients. Finally, vector $\varepsilon_{i,t}$, has the orthogonal structural shocks.

3.2. Identification Approach

Following several papers with a similar research question, I identify fiscal shocks using a recursive ordering. Among the studies using this strategy, some representative papers are Blanchard and Perotti (2002), Perotti (2005), Monacelli and Perotti (2010) and Ravn *et al*. (2007). To identify fiscal shocks, these implement the approach of Blanchard and Perotti (2002) that splits discretionary fiscal policy into its systematic and non-systematic parts. This is attained by assuming that systematic discretionary responses of fiscal variables are absent in quarterly data. Other studies use a recursive ordering but follow a different strategy (Beetsma *et al*., 2006, 2008; Bénétrix and Lane, 2009, 2010). These take annual data and assume that shocks to some variables do not have within year impact effects on government spending.

Because the countries considered here do not count with quarterly fiscal data, the Blanchard and Perotti's (2002) approach can not be implemented. This could be a disadvantage if we believe that the identification of fiscal shocks can be attained using quarterly data only. However, the use of annual data has some advantages (Beetsma *et al*., 2008). First, fiscal shocks can be better interpreted if these have annual frequency, because fiscal policy is not substantially revised within a year. Second, the likelihood of anticipation effects is smaller for annual frequency. Third, annual data is less affected by seasonal changes.

To recover the structural shocks from the reduced form model (1), I set $\alpha_{yg} = \alpha_{wg} = \alpha_{wy} = 0$ in matrix A_0. The use of these constraints is equivalent to assuming that fiscal spending does not react to GDP or wage shocks contemporaneously.[10]

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The plausibility for this ordering is studied in Beetsma *et al*. (2009). By using the estimates of a VAR model with quarterly data, they show that the assumption of no contemporaneous impact effects from GDP to government spending is reasonable.[11] Another reason for not placing GDP before government spending is that it implies that a shock to government spending would perfectly crowd out private output on impact. The reason for this is that ordering GDP before government spending imposes the former to have zero impact response to a shock in the latter. This is a strong assumption if we consider that government spending is one component of the GDP.

Alternative identification strategies are the narrative and sign restriction approaches. However, these are not well suited for the research question of this paper. On the one hand, the narrative approach developed by Ramey and Shapiro (1998) and also employed by Edelberg *et al*. (1999), Burnside *et al*. (2004) and Romer and Romer (2010) would be difficult to be implemented on this multi-country panel.[12] In addition, these data are not available for the countries considered here. On the other hand, the sign restriction approach in Canova and Pappa (2007) or Mountford and Uhlig (2009) would require taking a strong stand on the predicted sign impact of these shocks and also on the number of years for which these constrains ought to hold.

Another identification approach could be the implementation of short-run and long-run structural constraints derived from a theoretical model. However, as previously discussed, the predicted wage responses vary between theoretical paradigms. Thus, the implementation of these would require a strong theoretical stand. Moreover, because this paper takes a country-panel perspective, these assumptions would become stronger.

3.3. Impulse-response Analysis

In what follows, I study the effects of different government spending shocks of the same size (1% of GDP). To scale these, I take the cross-country mean of the government spending to GDP ratios.[13]

As in most of the literature and in line with the Neo-Keynesian predictions, government absorption (government consumption+investment) produces a positive wage response. A shock to this variable generates a wage impact response of 0.95% and a maximum of 1.18% in year two (see Figure 1 and Table 1).[14] Moreover, the wage response is positive for the whole impulse-response horizon.

When that spending variable is broken down into government investment and government consumption, I find similar qualitative results. However, the quantitative effect on wages differs. A shock to the former increases real wages by 1.37% on impact and produces a peak increase of 1.66%. As before, the response is positive in the whole impulse-response horizon. A shock to government consumption also increases wages but produces smaller impact and peak responses. The former equals to 1.04% and the latter to 1.4%.

This effect can be further studied by analyzing shocks to the wage and non-wage government consumption components. Figure 1 shows that wage responses are qualitatively different. On the one hand, a shock to government wage consumption reduces wages in the first 6 years. After that, the effect becomes statistically zero. The minimum is located in year two and it is -1.35%. On the other hand, non-wage government consumption has no impact effect on wages and becomes positive in subsequent years. The peak wage increase is in years five and six and equals to 0.83%.

Figure 1 and Table 1 also show that most of these shocks are expansionary. The largest GDP multiplier is produced by government investments. In terms of magnitude, this is followed by the multiplier associated to government absorption. Interestingly enough, innovations on wage government consumption have no effect on GDP.

3.4. Variance Decomposition

In order to study the contribution of the structural shocks to the h-step ahead forecast error variance, I present the variance decomposition of each model. This shows the proportion of forecast error variance attributable to each shock, and therefore, it complements the impulse-response analysis. Figure 2 shows this for a shock in two of the three endogenous variables.[15]

The forecast error variance attributable to a shock to government absorption in the wage equation is the largest and ranges between 6.2% and 22%. This is in line with the point estimate of the wage response being the most efficiently estimated. A shock of 1% of GDP to government investment explains an average of 6.3% of the forecast error variance in the wage equation and ranges from 4.3% to 7.9%.

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When the shock is to government consumption, the proportion attributable to it grows as the forecast horizon becomes larger. The minimum is 3.4%, whereas the maximum is 20.6%. By contrast, shocks to wage government

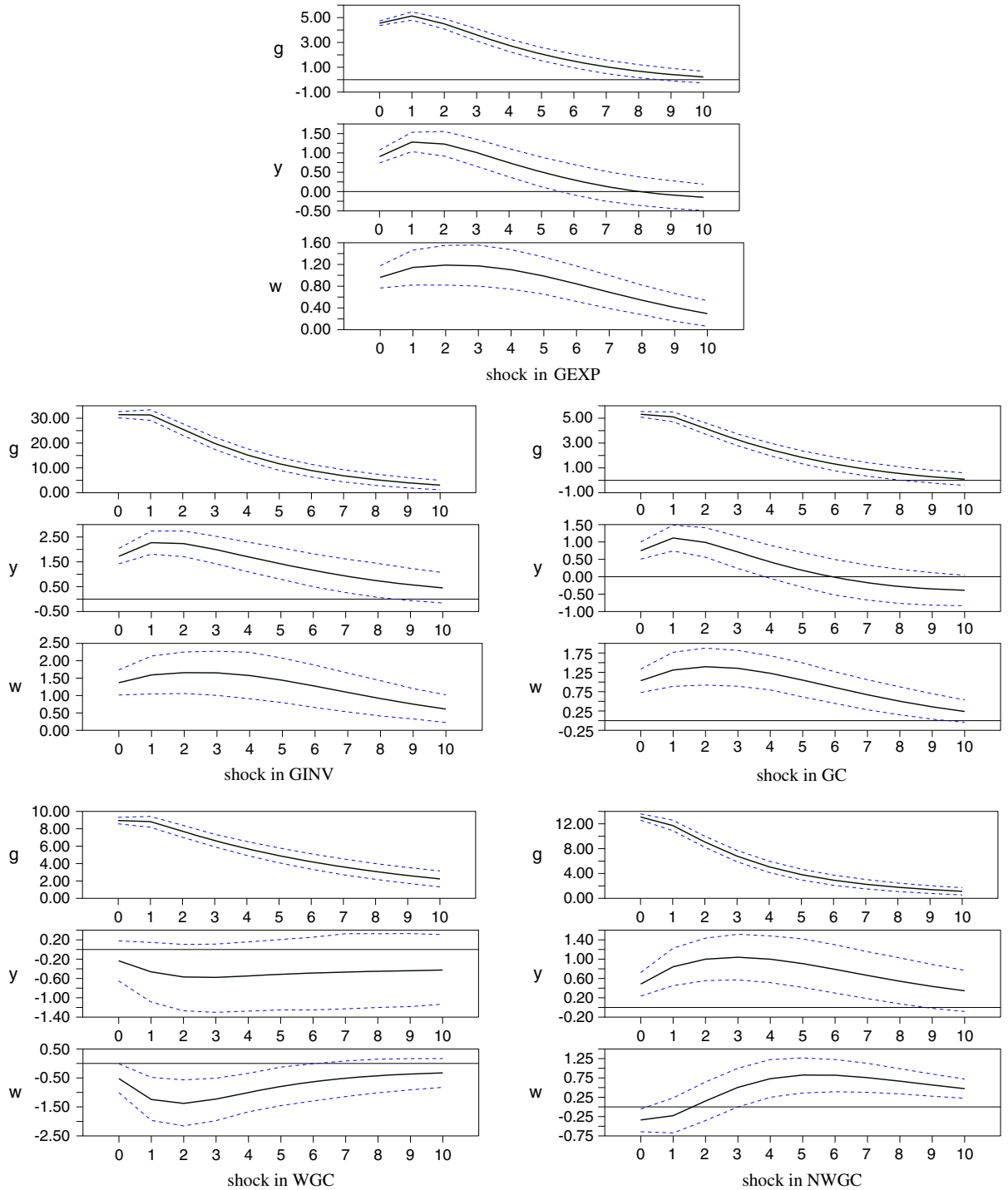

Figure 1. Baseline. Responses to a government spending shock (1% of GDP). Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real wages (w).

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Table 1. Real wage responses to fiscal spending shock equivalent to 1% of GDP

shock ↓	t	Baseline	4-var 2nd	4-var 1st	1980–2006	1970–1998	Debt	GDP-defl W
GEXP	0	0.95***			0.57***	1.10***	0.97***	0.89***
	1	1.13***			0.69**	1.22***	1.17***	1.07***
	2	1.18***			0.78**	1.03***	1.22***	1.14***
	3	1.17***			0.82**	0.80**	1.20***	1.17***
	4	1.10***			0.81**	0.59*	1.12***	1.16***
	5	0.99***			0.74**	0.41	0.99***	1.10***
	6	0.85***			0.64*	0.26	0.83***	1.01***
	7	0.70**			0.51 *	0.14	0.67**	0.89***
	8	0.55 **			0.38	0.05	0.52*	0.75***
	9	0.42*			0.26	−0.01	0.39*	0.62**
	10	0.30			0.16	−0.04	0.27	0.50**
GINV	0	1.37***	1.20***	1.42***	0.78**	1.44***	1.42***	1.04***
	1	1.60***	1.37***	1.65***	0.74	1.51***	1.70***	1.16***
	2	1.66***	1.38***	1.69***	0.78	0.94*	1.78***	1.32***
	3	1.65***	1.35**	1.67***	0.85	0.37	1.75***	1.49***
	4	1.57***	1.30**	1.59***	0.88	0.02	1.65***	1.58***
	5	1.44**	1.22**	1.47**	0.85	−0.11	1.49**	1.58***
	6	1.27**	1.11*	1.32**	0.75	−0.12	1.31**	1.50***
	7	1.09**	0.99*	1.16**	0.62	−0.07	1.12**	1.37***
	8	0.92**	0.87*	0.99**	0.48	−0.01	0.94*	1.21***
	9	0.76*	0.75*	0.83*	0.34	0.03	0.78*	1.04***
	10	0.62*	0.64*	0.69*	0.22	0.05	0.64*	0.88**
GC	0	1.04***	0.86***	1.09***	0.78***	1.26***	1.09***	1.10***
	1	1.31***	1.09***	1.35***	1.09**	1.51***	1.39***	1.41***
	2	1.40***	1.15***	1.41***	1.23**	1.41***	1.46***	1.46***
	3	1.35***	1.10**	1.37***	1.25**	1.19***	1.39***	1.43***
	4	1.22***	0.98**	1.25***	1.16**	0.93**	1.22***	1.34***
	5	1.05**	0.82**	1.07**	1.01**	0.68*	1.01**	1.21***
	6	0.85**	0.64*	0.87**	0.83*	0.45	0.79*	1.06***
	7	0.67*	0.47	0.68*	0.64	0.28	0.58	0.90**
	8	0.50*	0.31	0.49*	0.47	0.14	0.39	0.74**
	9	0.35	0.18	0.34	0.32	0.05	0.23	0.59**
	10	0.23	0.07	0.21	0.20	0.00	0.10	0.45*
WGC	0	−0.50	0.59	−0.68*	−0.13	−0.57	−0.45	−0.44
	1	−1.22*	0.38	−1.46**	−0.84	−1.18*	−1.13*	−0.83
	2	−1.35**	0.13	−1.59**	−1.02	−1.26**	−1.28*	−0.89
	3	−1.21*	0.00	−1.35**	−0.93	−1.07*	−1.18*	−0.82
	4	−0.99*	−0.06	−1.04*	−0.75	−0.84	−1.00*	−0.72
	5	−0.79	−0.09	−0.78	−0.55	−0.67	−0.83	−0.62
	6	−0.62	−0.13	−0.60	−0.37	−0.57	−0.69	−0.54
	7	−0.51	−0.17	−0.49	−0.22	−0.52	−0.59	−0.47
	8	−0.42	−0.20	−0.42	−0.09	−0.50	−0.51	−0.42
	9	−0.36	−0.24	−0.38	0.00	−0.48	−0.46	−0.38
	10	−0.32	−0.27	−0.36	0.06	−0.45	−0.43	−0.34
NWGC	0	−0.31	−0.32	−0.30	−0.80***	−0.14	−0.33	−0.03
	1	−0.19	−0.19	−0.17	−0.53	0.22	−0.21	0.01
	2	0.19	0.21	0.24	0.11	0.69	0.17	0.29
	3	0.53	0.60	0.62	0.67	0.98**	0.51	0.58
	4	0.75*	0.83**	0.85**	1.00**	1.04**	0.73*	0.78**
	5	0.83**	0.89**	0.91**	1.11**	0.94**	0.81*	0.87**
	6	0.83**	0.85**	0.87**	1.07**	0.76**	0.80**	0.88**
	7	0.76**	0.74**	0.76**	0.95**	0.56**	0.74**	0.83**
	8	0.67**	0.62**	0.63**	0.78**	0.39*	0.64**	0.75**
	9	0.57**	0.50**	0.51**	0.61**	0.26	0.54*	0.66**
	10	0.48**	0.39*	0.40*	0.46*	0.17	0.44*	0.57**

Notes: Point estimates of the impulse-response mean. *, ** and ***, denote statistical significance at 10%, 5% and 1%, respectively. Column 'Baseline' reports the responses for the baseline empirical specifications. '4-var 2nd' are the responses for models including the complement fiscal variable ordered in the first position and the shocked fiscal variable in the second position of the recursive ordering. Similarly, '4-var 1st' are the responses for models with the shocked spending variable in the first position. Columns '1980–2006' and '1970–1998' are the responses for models estimated with data for these subperiods. Column 'Debt' reports the responses for models including the debt feedback. Finally 'GDP-defl W' are the responses for models using real wages deflated with GDP prices.

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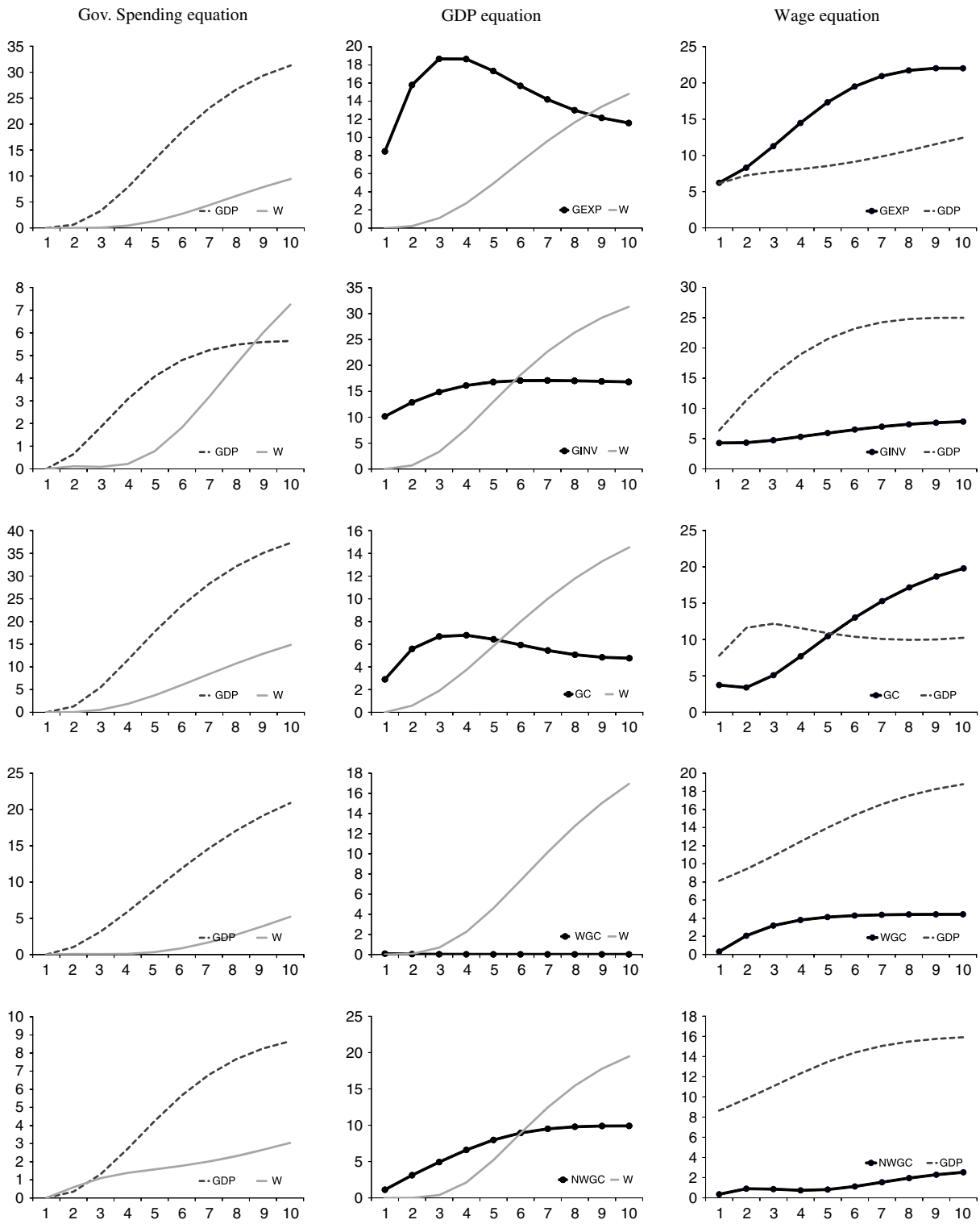

Figure 2. Variance decomposition. Note: Each row represents a VAR model for each definition of government spending. Vertical axis measures the percentage of forecast error variance attributable to a shock in the plotted endogenous variable.

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consumption explain a smaller share. After year five, it accounts for 4.4%. Finally, at 1.4% non-wage government consumption contributes to the smallest proportion of forecast error variance.

3.5. Summary

This section shows that the size of real wage and GDP responses depend on the type of spending shock. For most spending measures, real wages respond positively (as Neo-Keynesian models would predict).

The largest effect is produced by shocks to government investment. This could be associated with shifts in this item having demand-side and supply-side effects. A shock to government investments will increase the demand for intermediate goods and therefore, generate upward pressure in the wage level of the associated sectors. In addition, government investment can affect wage levels through its impact on labour supply. More specifically, a shock to government investment can affect the opportunity cost of people employed in similar projects by the private sector. Thus, such an increase in government spending can put further upward pressure on wages. By contrasts, shocks to other types of government spending are less likely to have supply-side effects.

Accordingly, shocks to government consumption produce positive wage responses that are smaller than those generated by public investment. Non-wage government consumption also increases real wages but with some delay. By contrast, shocks to the number of public employees (government wages deflated with its own government deflator) have a negative impact on wages. However, this result vanishes when shocks to wage government consumption are allowed to be correlated with other types of government spending, as it is shown in the next section.

The GDP responses also vary across spending types. In line with the above findings, the larger effect is produced by shocks to government investment. Government absorption, consumption and non-wage government consumption are also expansionary.[16] However, this is not the case for a shock to wage government consumption, which does not affect output.

4. ROBUSTNESS CHECKS

The first robustness check is motivated by the possibility that governments may increase expenditure in several items simultaneously. If this is the case, the omission of government spending items that are correlated with the variable of interest may bias the results.

Taking this into account, I check the robustness of the baseline findings by adding an additional spending measure. This extra variable changes between models because it is defined as the difference between total government absorption and the spending variable being considered. I call this the 'fiscal complement'. Its inclusion has an additional advantage. It aids identification by ensuring that a shock to the variable of interest is not confused with a shock to a different spending type, that is correlated with the former.

The identification is attained using two alternative recursive orderings. First, I place the fiscal complement variable in the first position and the shocked spending variable in the second position with GDP and wages in the third and fourth positions, respectively. This allows the spending variable to react contemporaneously to shocks to the fiscal complement. Figure 3 reports the impulse-response functions associated to this ordering. Second, I revert the position of the fiscal variables.[17] Thus, government spending can not react to shocks to the fiscal complement within the same period.

Tables 1 and 2 report the wage and GDP responses to all spending shocks for these two orderings. The results show that most of the previous findings do not change. However, the responses produced by shocks to government wages are affected. When wage government consumption is placed in the second position, the GDP response moves from zero to positive (on impact and years one to two), and the wage response changes from negative to zero. This qualitative change is explained by government wages being negatively correlated with the fiscal complement. By contrast, GDP and wage responses do not change when the wage government consumption is ordered in the first position.

An extra robustness check could have been the inclusion of a monetary policy variable, like a representative interest rate. However, this paper takes countries that shared similar exchange rate policies for some years and a common currency in the last 8 years of the sample. Therefore, the inclusion of a monetary policy variable would not be meaningful in the context of this study.[18]

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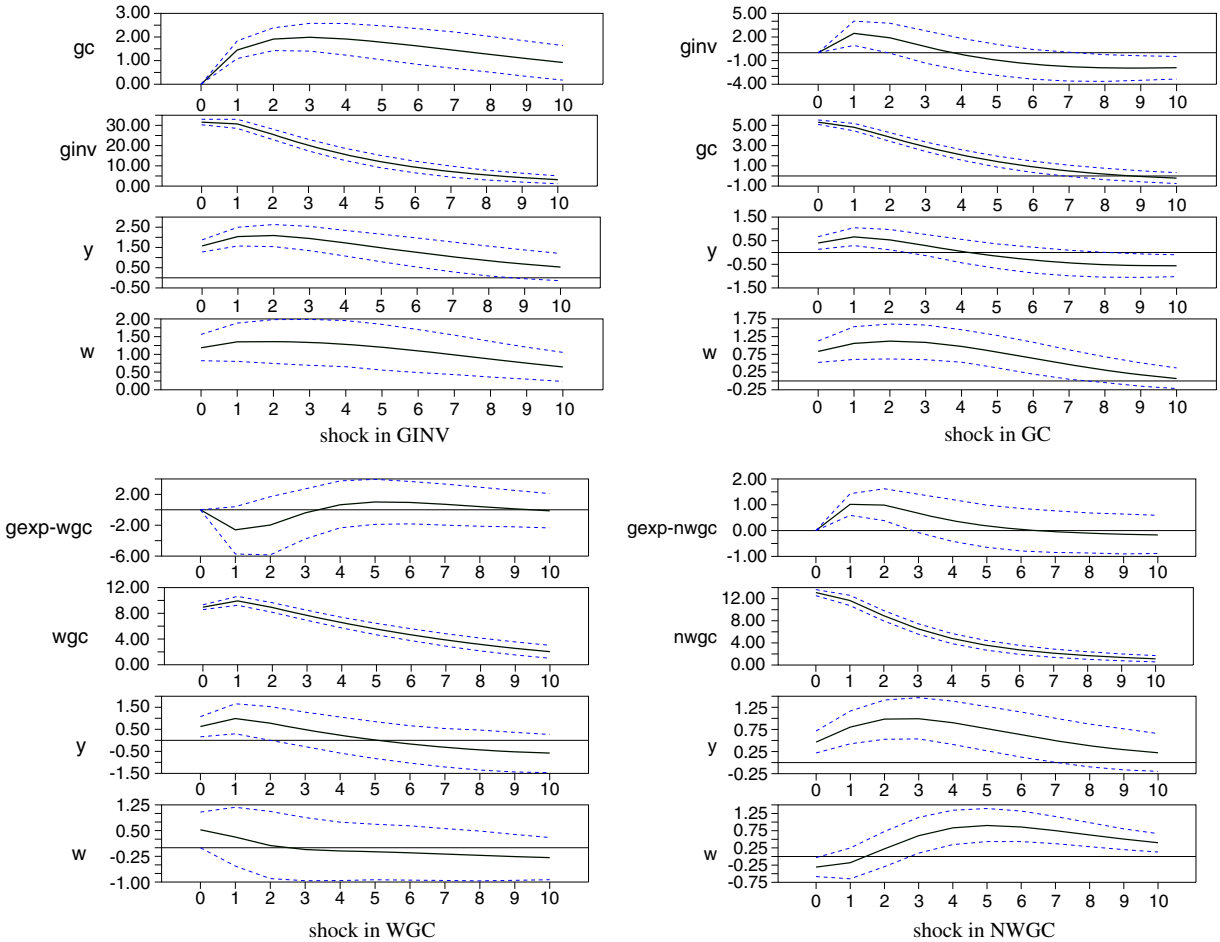

Figure 3. Robustness check. VAR including the 'complement government spending'. Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real wages (w).

The following robustness check analyzes whether wage and GDP responses change when the model is estimated for different subperiods. The first one takes the 1980–2006 period, whereas the second uses 1970–1998. The former is motivated by the evidence reported in Perotti (2005) and Romer and Romer (2010) that the variance of fiscal policy shocks and GDP decreased after 1980.

Tables 1 and 2 show that most of the wage and GDP responses are robust to this change. However, quantitative differences emerge between these and the baseline results. The general finding is that shocks to government absorption, investment and consumption yield smaller responses. In line with the above evidence, the estimates have larger standard errors. For shocks to the subcomponents of government consumption, the changes are different. A shock to non-wage government consumption produces greater wage responses in later years. The effect on GDP, however, is smaller for this shock.[19]

The second exercise takes the 1970–1998 period to assess the effect of the EMU. As before, only quantitative differences emerge. All shocks produce wage and GDP responses that are larger than those in the baseline.

These two experiments give mutually consistent results. The 1970–1998 period produces wage and GDP responses that are stronger than those for 1980–2006. Accordingly, the baseline results lie between these two.

Taking into account that government spending may systematically be affected by the stock of public debt (i.e. the latter putting downward pressure in the former), this section checks how this may change the baseline results. Following Beetsma *et al.* (2008) and Bénétrix and Lane (2009, 2010), I include the first two lags of general government consolidated gross debt as ratio to GDP in each equation of the system.[20]

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Table 2. Real GDP responses to fiscal spending shock equivalent to 1% of GDP

shock ↓	t	Baseline	4-var 2nd	4-var 1st	1980–2006	1970–1998	Debt	GDP-defl W
GEXP	0	0.91***			0.47***	1.11***	0.97***	0.90***
	1	1.28***			0.76***	1.42***	1.42***	1.25***
	2	1.23***			0.81***	1.19***	1.36***	1.19***
	3	1.01***			0.71**	0.81***	1.11***	0.97***
	4	0.75**			0.55*	0.47*	0.82**	0.70**
	5	0.51*			0.37	0.21	0.55	0.45
	6	0.30			0.21	0.04	0.32	0.23
	7	0.13			0.07	−0.06	0.12	0.05
	8	0.01			−0.04	−0.11	−0.03	−0.09
	9	−0.09			−0.11	−0.12	−0.15	−0.20
	10	−0.15			−0.15	−0.11	−0.24	−0.27
GINV	0	1.73***	1.61***	1.72***	1.21***	1.94***	1.79***	1.71***
	1	2.27***	2.08***	2.27***	1.83***	2.43***	2.43***	2.21***
	2	2.24***	2.13***	2.29***	1.86***	2.02***	2.40***	2.17***
	3	2.00***	1.98***	2.07***	1.61**	1.42**	2.13***	1.94***
	4	1.71***	1.75***	1.77***	1.25*	0.94*	1.81***	1.65***
	5	1.43**	1.51**	1.46**	0.89	0.62	1.51**	1.35**
	6	1.17**	1.27**	1.18*	0.58	0.43	1.24*	1.06*
	7	0.94*	1.05*	0.92	0.32	0.33	1.00	0.80
	8	0.75	0.86	0.70	0.13	0.26	0.81	0.57
	9	0.59	0.69	0.52	0.00	0.22	0.65	0.38
	10	0.46	0.54	0.37	−0.09	0.18	0.52	0.22
GC	0	0.74***	0.41**	0.72***	0.33*	1.01***	0.79***	0.72***
	1	1.10***	0.66**	1.07***	0.55*	1.30***	1.19***	1.07***
	2	0.97**	0.53*	0.96**	0.58	1.04**	1.02**	0.93**
	3	0.70*	0.29	0.69*	0.51	0.68*	0.69*	0.64*
	4	0.42	0.05	0.40	0.38	0.36	0.35	0.35
	5	0.17	−0.16	0.15	0.23	0.12	0.05	0.09
	6	−0.02	−0.32	−0.07	0.09	−0.03	−0.20	−0.12
	7	−0.18	−0.44	−0.23	−0.03	−0.12	−0.40	−0.29
	8	−0.28	−0.51	−0.34	−0.12	−0.16	−0.55	−0.40
	9	−0.35	−0.55	−0.41	−0.18	−0.17	−0.65	−0.48
	10	−0.39	−0.56	−0.45	−0.20	−0.16	−0.71	−0.52
WGC	0	−0.22	0.66*	−0.47	−0.02	−0.04	−0.16	−0.24
	1	−0.44	1.02*	−0.75	−0.59	0.03	−0.35	−0.53
	2	−0.55	0.81	−0.83	−0.74	−0.17	−0.50	−0.68
	3	−0.56	0.50	−0.68	−0.60	−0.33	−0.56	−0.74
	4	−0.54	0.25	−0.50	−0.35	−0.43	−0.58	−0.75
	5	−0.50	0.03	−0.40	−0.10	−0.49	−0.58	−0.74
	6	−0.48	−0.15	−0.38	0.09	−0.54	−0.58	−0.72
	7	−0.46	−0.31	−0.40	0.23	−0.55	−0.57	−0.70
	8	−0.44	−0.42	−0.44	0.30	−0.55	−0.57	−0.66
	9	−0.43	−0.51	−0.48	0.32	−0.53	−0.56	−0.63
	10	−0.41	−0.56	−0.51	0.32	−0.49	−0.55	−0.59
NWGC	0	0.51**	0.45**	0.48**	−0.08	0.71**	0.49**	0.44**
	1	0.87**	0.79**	0.82**	0.08	1.03**	0.88**	0.75**
	2	1.02**	0.97**	1.00**	0.34	1.06**	1.02**	0.91**
	3	1.06**	0.98**	1.01**	0.56	0.94**	1.05**	0.95**
	4	1.01**	0.89**	0.92**	0.67	0.74*	1.00**	0.91**
	5	0.92**	0.76*	0.79*	0.67	0.53	0.90*	0.81**
	6	0.80*	0.63*	0.64*	0.58	0.33	0.77*	0.69*
	7	0.67*	0.50	0.51	0.44	0.18	0.64	0.55
	8	0.55	0.39	0.39	0.29	0.07	0.52	0.42
	9	0.44	0.30	0.30	0.16	0.00	0.41	0.30
	10	0.35	0.23	0.23	0.05	−0.03	0.31	0.20

Notes: Point estimates of the impulse-response mean. *, ** and ***, denote statistical significance at 10%, 5% and 1%, respectively. Column 'Baseline' reports the responses for the baseline empirical specifications. '4-var 2nd' are the responses for models including the complement fiscal variable ordered in the first position and the shocked fiscal variable in the second position of the recursive ordering. Similarly, '4-var 1st' are the responses for models with the shocked spending variable in the first position. Columns '1980–2006' and '1970–1998' are the responses for models estimated with data for these subperiods. Column 'Debt' reports the responses for models including the debt feedback. Finally 'GDP-defl W' are the responses for models using real wages deflated with GDP prices.

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The general finding is that qualitative changes do not emerge. However, Tables 1 and 2 show that some quantitative changes appear. When the shocked variable is government absorption, the change in GDP is greater in the model including the debt feedback. Shocks to government investment or consumption produce greater wage and GDP responses. Finally, a shock to non-wage government consumption leads to a smaller real wage response.

In summary, the reliance of the empirical results is that shocks to most government spending types increase real wages. The exception is a shock to wage government consumption that exhibits a negative wage response in the baseline specification that becomes zero when the fiscal complement is included. This is the result of the negative correlation between these fiscal variables. The reading of it is that governments may cut expenditure in other items to increase public employees with a net effect generating a zero wage response.

5. ALTERNATIVE COUNTRY SAMPLE

Papers studying the dynamic effects of government spending on wages typically take a small set of countries or study the US economy alone.[21] One example is Pappa (2005) examining the effects of shocks to government consumption, investment and employment on the real wages. To this end, she defines real wages as the average wage per job deflated with the aggregate price deflator and estimates VARs with shocks being identified using sign constraints. This paper shows that the effects of fiscal shocks on wages depend on the underlying theoretical model.

Taking Canada, the UK and the US, Perotti (2007) studies shocks to government expenditure in goods and services (government expenditure including purchases of military equipment and excluding fixed capital formation). In that study, he takes quarterly data and uses the approach developed in Blanchard and Perotti (2002) to identify fiscal shocks. His findings are that real product wages (nominal wage deflated with GDP prices) increase in response to a government consumption shock.

A recent study by Bénétrix and Lane (2009) shows that the impact of fiscal shocks on real exchange rates varies across groups of countries. More precisely, it shows that fiscal shocks appreciate the real exchange rate in EMU countries and depreciate it in a panel formed by Australia, Canada, UK and US. Because the response of real wages is a central channel by which fiscal policy affects the structure or relative prices, and hence the real exchange rate, this section complements the above study by focusing on the wage responses in those four countries.

This exercise is also similar to the work of Monacelli and Perotti (2010) and Perotti (2007) that focus on real wages. However, I deviate from these by following the empirical strategy presented in Section 3, estimating a panel VAR and by using annual data.[22]

Figure 4 reports the impulse-response functions for shocks to government absorption, investment and consumption and shows that all these are expansionary.[23] However, the response of real wages is negative (after 2 years) for shocks to government absorption or government consumption and zero for shocks to government investment.[24] Although these results are in contrast to those of the EMU panel, they are consistent with the findings by Bénétrix and Lane (2009) for the real exchange rate responses. More specifically, wages increase in countries exhibiting a real exchange rate appreciation and fall in those showing a real depreciation.

6. ALTERNATIVE PRICE DEFLATORS

6.1. Government Spending Deflated with GDP Prices

As in Corsetti and Müller (2006) and Beetsma *et al.* (2008), this paper concentrated on the effects of shocks to the quantities purchased by governments. That is, real spending variables deflated with their specific price deflators. However, a different strategy is to deflate all fiscal variables with the same price index. For instance, Lane and Perotti (2003), Pappa (2005), Perotti (2005, 2007) and Monacelli and Perotti (2010) use the GDP deflator. Following this strategy implies that fiscal shocks are a combination of changes in quantities and relative prices.

This section examines how wages are affected by shocks to fiscal variables prices and quantities by estimating the baseline specification using fiscal variables deflated with GDP prices.[25]

The findings are that shocks to government absorption, consumption and non-wage consumption produce larger responses. By contrast, the impact of a shock to government investment is smaller. There is only one qualitative

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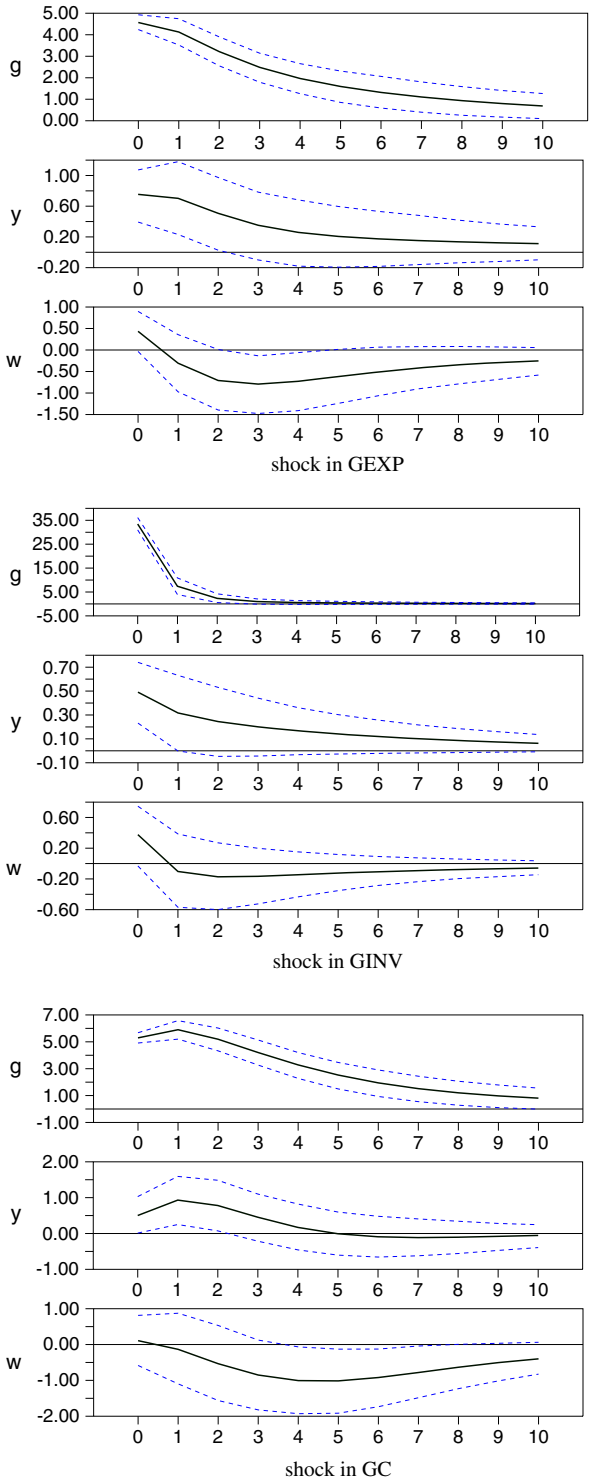

Figure 4. Responses to a spending shock equivalent to 1% of GDP. Panel formed by: Australia, Canada, UK and US. Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real wages (w).

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change and it is exhibited in the wage response to a shock in government wages. More precisely, a 1% of GDP shock to this fiscal measure increases real wages by 3.42% on impact with a peak of 3.95% in year one. This is the largest wage response across all shocks. However, the caveat here is that the use GDP prices to deflate government wages may be problematic. Because government nominal wages may be endogenous to private sector nominal wages, shocks to this variable would not be completely exogenous.

Following the previous section, I also estimated these for a panel including Australia, Canada, UK and US. The main finding is that there are not qualitative changes for shocks to government absorption or consumption. However, a shock to government investment reduces wages.

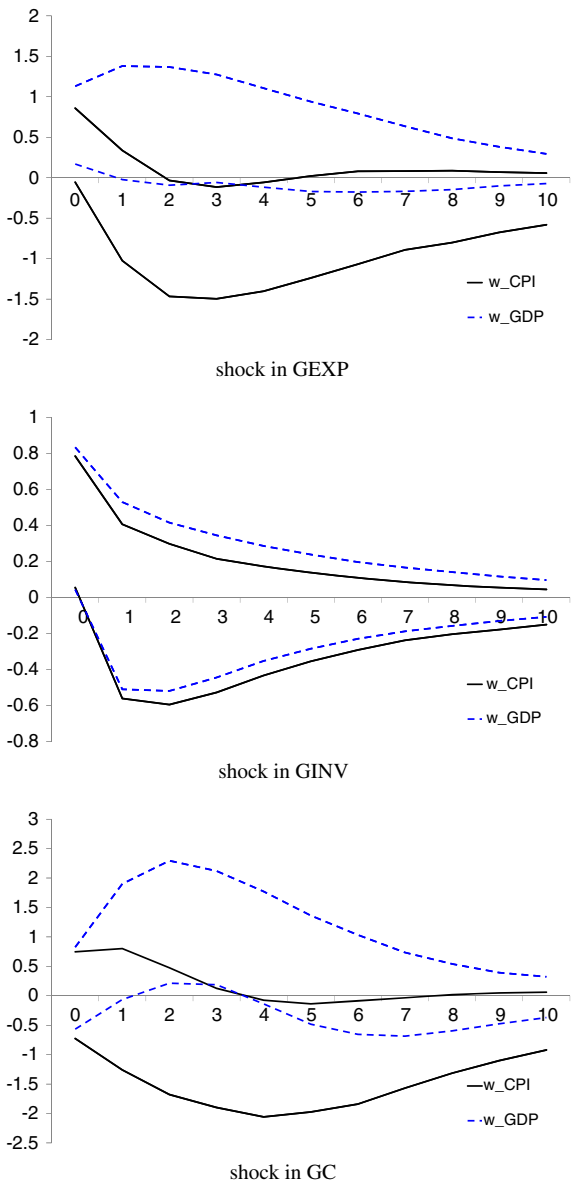

Figure 5. Comparison between CPI- and GDP- deflated wage responses to a spending shock equivalent to 1% of GDP. Panel formed by: Australia, Canada, United Kingdom and United States. Note: 16th and 84th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage change in CPI-deflated (wCPI) and GDP-deflated (wGDP) real wages.

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Table 3. Real wage responses to fiscal spending (GDP-deflated) shock equivalent to 1% of GDP

shock ↓	*t*	Baseline	4-var 2nd	4-var 1st	1980–2006	1970–1998	Debt	GDP-defl W
GEXP	0	1.17***			0.95***	1.32***	1.23***	1.30***
	1	1.34***			0.94***	1.38***	1.41***	1.38***
	2	1.31***			0.90***	1.11***	1.37***	1.27***
	3	1.22***			0.89***	0.82***	1.26***	1.16***
	4	1.10***			0.86***	0.58**	1.12***	1.06***
	5	0.95***			0.78***	0.38*	0.95***	0.95***
	6	0.79***			0.66**	0.23	0.78***	0.83***
	7	0.63**			0.54**	0.11	0.62**	0.70***
	8	0.49**			0.41**	0.03	0.48**	0.58***
	9	0.37**			0.29*	−0.02	0.36*	0.46**
	10	0.27*			0.20	−0.04	0.27	0.36**
GINV	0	1.17***	0.15	1.12***	0.53	1.28***	1.23***	1.16***
	1	1.24***	−0.08	1.11**	0.22	1.26**	1.37***	1.07**
	2	1.20**	−0.35	0.87*	0.12	0.66	1.35**	1.02**
	3	1.15**	−0.36	0.76	0.18	0.16	1.29**	1.06**
	4	1.08*	−0.15	0.77	0.26	−0.07	1.20**	1.10**
	5	0.99*	0.14	0.84*	0.31	−0.08	1.10*	1.10**
	6	0.89*	0.41	0.90*	0.31	0.02	0.99*	1.05**
	7	0.79*	0.60	0.93**	0.28	0.12	0.87*	0.97**
	8	0.69*	0.72*	0.91**	0.23	0.19	0.76	0.87**
	9	0.59*	0.77**	0.86**	0.17	0.22	0.66	0.76**
	10	0.50	0.77**	0.79**	0.11	0.21	0.57	0.65*
GC	0	1.55***	1.66***	1.68***	1.30***	1.75***	1.61***	1.72***
	1	1.85***	2.06***	2.03***	1.40***	1.86***	1.92***	1.91***
	2	1.87***	2.11***	2.04***	1.50***	1.59***	1.93***	1.81***
	3	1.74***	1.93***	1.86***	1.54***	1.23***	1.77***	1.64***
	4	1.51***	1.60***	1.57***	1.47***	0.85***	1.52***	1.43***
	5	1.24***	1.22***	1.25***	1.29***	0.53**	1.24***	1.22***
	6	0.97***	0.87***	0.95***	1.05***	0.28	0.96***	1.01***
	7	0.73**	0.58**	0.69***	0.81***	0.11	0.72**	0.81***
	8	0.53**	0.35*	0.49**	0.58**	0.01	0.51*	0.63**
	9	0.37*	0.18	0.33*	0.39*	−0.04	0.35	0.48**
	10	0.25	0.05	0.20	0.23	−0.07	0.22	0.34*
WGC	0	3.42***	3.50***	3.51***	3.53***	3.57***	3.54***	3.47***
	1	3.93***	4.03***	4.03***	3.64***	3.57***	4.08***	3.98***
	2	3.50***	3.50***	3.62***	3.05***	2.55***	3.62***	3.53***
	3	2.81***	2.67***	2.94***	2.40***	1.51***	2.88***	2.88***
	4	2.13***	1.88***	2.26***	1.83***	0.74	2.14***	2.25***
	5	1.54***	1.23**	1.65***	1.34**	0.23	1.49***	1.72***
	6	1.07**	0.74	1.15**	0.93*	−0.07	0.96*	1.28**
	7	0.70	0.38	0.76*	0.60	−0.23	0.55	0.92**
	8	0.42	0.14	0.47	0.35	−0.29	0.24	0.63*
	9	0.21	−0.04	0.24	0.17	−0.29	0.02	0.41
	10	0.06	−0.16	0.08	0.04	−0.27	−0.15	0.23
NWGC	0	0.50**	−0.03	0.50**	−0.06	0.73**	0.52**	0.80***
	1	0.72**	0.13	0.72*	0.15	1.01**	0.75**	0.86**
	2	1.01**	0.51	1.03**	0.76*	1.24***	1.03**	1.03***
	3	1.21***	0.85**	1.29***	1.29***	1.29***	1.22***	1.17***
	4	1.26***	1.02**	1.37***	1.53***	1.17***	1.26***	1.21***
	5	1.21***	1.02***	1.31***	1.53***	0.95***	1.20***	1.18***
	6	1.08***	0.92***	1.15***	1.36***	0.71**	1.07***	1.08***
	7	0.93***	0.77**	0.95***	1.12***	0.50*	0.91**	0.95***
	8	0.77**	0.62**	0.75**	0.87***	0.34*	0.75**	0.82***
	9	0.63**	0.48*	0.58**	0.64**	0.22	0.60**	0.69***
	10	0.51**	0.37*	0.45*	0.45*	0.14	0.48**	0.57**

Notes: Point estimates of the impulse-response mean. *, ** and ***, denote statistical significance at 10%, 5% and 1%, respectively. Column 'Baseline' reports the responses for the baseline empirical specifications. '4-var 2nd' are the responses for models including the complement fiscal variable ordered in the first position and the shocked fiscal variable in the second position of the recursive ordering. Similarly, '4-var 1st' are the responses for models with the shocked spending variable in the first position. Columns '1980–2006' and '1970–1998' are the responses for models estimated with data for these subperiods. Column 'Debt' reports the responses for models including the debt feedback. Finally 'GDP-defl W' are the responses for models using real wages deflated with GDP prices.

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Table 4. Real GDP responses to fiscal spending (GDP-deflated) shock equivalent to 1% of GDP

shock ↓	*t*	Baseline	4-var 2nd	4-var 1st	1980–2006	1970–1998	Debt	GDP-defl W
GEXP	0	0.73***			0.44***	0.86***	0.79***	0.71***
	1	0.97***			0.50**	1.06***	1.07***	0.91***
	2	0.92***			0.45*	0.84***	1.01***	0.84***
	3	0.76***			0.38	0.53**	0.82***	0.65***
	4	0.57**			0.30	0.26	0.61**	0.46**
	5	0.40			0.21	0.07	0.42	0.28
	6	0.24			0.13	−0.04	0.25	0.12
	7	0.12			0.05	−0.10	0.12	0.00
	8	0.03			−0.01	−0.12	0.02	−0.10
	9	−0.04			−0.05	−0.11	−0.06	−0.17
	10	−0.08			−0.08	−0.10	−0.12	−0.22
GINV	0	1.94***	1.80***	1.90***	1.38***	2.27***	2.03***	1.91***
	1	2.51***	2.29***	2.46***	1.84***	2.78***	2.71***	2.41***
	2	2.43***	2.20***	2.36***	1.78***	2.34***	2.62***	2.29***
	3	2.16***	2.01***	2.09***	1.52**	1.72***	2.32***	2.00***
	4	1.85***	1.85***	1.82***	1.19*	1.22**	1.99***	1.68***
	5	1.57***	1.71***	1.58**	0.89	0.88	1.70**	1.38**
	6	1.32**	1.59**	1.37**	0.62	0.68	1.44**	1.10*
	7	1.11*	1.45**	1.18**	0.41	0.54	1.22*	0.87
	8	0.93*	1.30**	1.00*	0.24	0.44	1.03	0.66
	9	0.77	1.14**	0.83	0.12	0.36	0.88	0.49
	10	0.64	0.99*	0.69	0.03	0.28	0.75	0.35
GC	0	0.56***	0.20	0.54***	0.28**	0.68***	0.60***	0.52***
	1	0.78***	0.34	0.77***	0.22	0.84***	0.83***	0.71***
	2	0.73***	0.31	0.73**	0.21	0.63**	0.75***	0.62**
	3	0.57**	0.17	0.56*	0.23	0.33	0.55*	0.44*
	4	0.38	−0.01	0.34	0.22	0.09	0.33	0.23
	5	0.20	−0.19	0.14	0.17	−0.08	0.13	0.05
	6	0.04	−0.33	−0.03	0.10	−0.16	−0.04	−0.10
	7	−0.07	−0.43	−0.15	0.01	−0.19	−0.17	−0.22
	8	−0.15	−0.48*	−0.23	−0.06	−0.19	−0.27	−0.30
	9	−0.21	−0.50*	−0.28	−0.12	−0.16	−0.33	−0.35
	10	−0.24	−0.50*	−0.30	−0.15	−0.13	−0.37	−0.38
WGC	0	0.76***	0.28	0.75***	0.76***	0.80**	0.86***	0.75***
	1	0.90**	0.23	0.89**	0.62*	0.82**	0.99**	0.87**
	2	0.61	−0.12	0.59	0.26	0.32	0.65	0.53
	3	0.19	−0.53	0.16	−0.07	−0.21	0.17	0.05
	4	−0.19	−0.87*	−0.23	−0.31	−0.57	−0.29	−0.39
	5	−0.49	−1.10**	−0.53	−0.45	−0.73	−0.65	−0.72
	6	−0.69	−1.23**	−0.74	−0.53	−0.75	−0.91	−0.95*
	7	−0.82	−1.27**	−0.87*	−0.54	−0.69	−1.07*	−1.08*
	8	−0.88*	−1.26**	−0.93*	−0.52	−0.57	−1.16*	−1.14**
	9	−0.89*	−1.21**	−0.94*	−0.47	−0.45	−1.19*	−1.15**
	10	−0.87*	−1.13**	−0.92*	−0.41	−0.33	−1.18*	−1.11**
NWGC	0	0.54**	0.23	0.54**	0.00	0.77**	0.58***	0.50**
	1	0.88***	0.49*	0.89***	0.04	1.06***	0.94***	0.79**
	2	1.03***	0.71**	1.06***	0.27	1.01**	1.07***	0.92**
	3	1.04***	0.80**	1.06***	0.52	0.83**	1.06***	0.93**
	4	0.97**	0.78**	0.95**	0.66*	0.60	0.97**	0.86**
	5	0.84**	0.69*	0.79**	0.66	0.39	0.84**	0.73*
	6	0.70*	0.58*	0.62*	0.56	0.21	0.69*	0.58
	7	0.56	0.46	0.46	0.41	0.09	0.55	0.43
	8	0.44	0.36	0.33	0.25	0.01	0.42	0.29
	9	0.33	0.28	0.23	0.10	−0.03	0.31	0.17
	10	0.24	0.22	0.15	−0.01	−0.04	0.22	0.08

Notes: Point estimates of the impulse-response mean. *, ** and ***, denote statistical significance at 10%, 5% and 1%, respectively. Column 'Baseline' reports the responses for the baseline empirical specifications. '4-var 2nd' are the responses for models including the complement fiscal variable ordered in the first position and the shocked fiscal variable in the second position of the recursive ordering. Similarly, '4-var 1st' are the responses for models with the shocked spending variable in the first position. Columns '1980–2006' and '1970–1998' are the responses for models estimated with data for these subperiods. Column 'Debt' reports the responses for models including the debt feedback. Finally 'GDP-defl W' are the responses for models using real wages deflated with GDP prices.

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6.2. CPI-deflated versus GDP-deflated Real Wages

This section compares the effects of government shocks on consumption wages and product wages. As noted before, the difference between these is that the former can be considered as the wage perceived by private agents, because it is defined as nominal compensation per employee deflated with private consumption prices. By contrast, the latter is deflated with GDP prices and, hence, can be thought as a measure of firm costs.

Table 1 shows the responses of real product wage to shocks to all government spending variables.[26] Although the change in the wage deflator does not affect the responses qualitatively, small quantitative differences emerge. Shocks to government absorption of government investment produce responses have a greater impact on consumption wages in the first years. By contrast, shocks to government consumption or to its subcomponents have a stronger effect on product wages.

In contrast to the previous case, the product and consumption wage responses are different in the alternative sample. This is the case for shocks to government absorption or government consumption. Interestingly enough, the sign of the wage response changes to positive when GDP prices are used (Figure 5 plots the confidence bands for these). Consistently with Perotti (2007), shocks to government absorption or consumption have positive effects on product wages.

7. CONCLUSIONS

The findings of this paper highlight that policymakers should take into account the impact on the labour market in determining the appropriate stance of fiscal policy. In one direction, the upward pressure on wages that is associated with an expansion in government spending means that some private sector activities may be crowded out by a fiscal stimulus, with possible adverse consequences for long-term productivity growth. In the other direction, these empirical results indicate that a contraction in government spending can play a role in generating an internal devaluation, by driving down wage levels. This mechanism is especially relevant for members of the euro area, because these are unable to conduct a nominal devaluation in response to a negative macroeconomic shock.

In addition, the variation across spending categories means that policymakers must carefully design the composition of a fiscal package in order to target the desired impact on the labour market. Accordingly, this paper shows that the response of the wage level depends on the composition of government spending. The greatest effect is associated with a shock to public investment. By contrast, a shock of the same size to the number of public employees does not affect this labour market variable. Wages also change in response to shifts in total government absorption, consumption and non-wage government consumption. Although the former two produce an immediate wage response, the latter generates a delayed change.

Finally, these results are consistent with some other recent work. In particular, Bénétrix and Lane (2009) find that fiscal expansion is associated with real appreciation and an increase in the relative price of nontradables for euro area countries, whereas Bénétrix and Lane (2010) find that fiscal expansion is associated with a contraction in the relative size of the tradables sector. Taken together, the results in this paper and the associated literature highlight the macroeconomic impact of government spending shocks and indicate that this line of research should be further pursued in future work.

NOTES

1. These contrasting results between neoclassical and Neo-Keynesian models are well documented in Pappa (2005).
2. Ramey (2011) estimates a VAR with long-run annual data to test if the positive wage responses generated by models with quarterly data are the result of anticipation effects. Her findings are consistent with neoclassical models. Wages and consumption fall on impact. However, Perotti (2007) runs a similar model using, instead, official BEA data and finds that private consumption and real wages increase. He suggests that these qualitative differences are explained by the fact that Ramey (2011) used interpolated data.
3. The considered countries are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.
4. Government spending is composed of government consumption, government investment and transfers (welfare payments and pensions). Because transfers just redistribute payments across citizens, it should not have short run impact on macroeconomic variables. Therefore, I exclude this from the analysis that follows.
5. I thank George Tavlas for providing these data.
6. Recall that the use of a single deflator for all government spending types, like GDP prices, would imply that fiscal shocks will be a combination of changes in quantities and prices. For instance, a positive shock to wage government consumption could be a change in the nominal wage pay, a change in the number of employees or a combination of these two.
7. Data from West Germany and East Germany are combined by splicing growth rates in 1991.

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8. Following other papers running VAR models for similar countries and data (Beetsma *et al*., 2008; Bénétrix and Lane, 2009, 2010), I also estimated the baseline specification including the following additional variables: direct tax revenues, private consumption, imports, exports and the real exchange rate. Because the qualitative wage responses are unchanged, I proceed with the analysis by focusing on the above more parsimonious three-variable system.
9. Although the introduction of fixed effects is needed to capture country-specific characteristics, it may generate problems in the context of dynamic panels. Nickell (1981) and Arellano (2003) show that the introduction of lagged regressors in panels with fixed effects induce serial correlation between the residuals and future values of these variables. When the time dimension of the panel is fixed and the cross-section dimension tends to infinity, this correlation produces a bias in the coefficient of the lagged dependent variable. Given the relatively small cross-section dimension of the dataset, if biases are present, these are likely to be small.
10. These constraints also imply that GDP does not respond to wages in the same year.
11. An application of this method can be found in Beetsma *et al*. (2006). This paper estimates a panel VAR in public spending (g) and output (y) for seven EU countries with non-interpolated quarterly fiscal data assuming that g does not react to a shock to y within a quarter. Using these results, the authors construct an estimate of the public spending response to output shocks at annual frequency and find that this is not statistically different from zero.
12. This approach uses dummy variables to identify years with large and unexpected changes in fiscal policy (e.g. sudden military buildups).
13. These are: GEXP (22%), GINV (3.2%), GC (18.8%), WGC (11.2%) and NWGC (7.6%).
14. The reported confidence bands are the 16th and 84th percentiles of the impulse-response distribution. To derive these, I perform Monte Carlo simulations and assume that the parameter distribution is normal. Thus, the point estimate of the mean response minus/plus one standard deviation corresponds to the 16th and 84th percentiles of the response distribution, respectively. This information is used to construct t-tests that show the statistical significance of the point estimates in Tables 1–4.
15. For instance, in the GDP equation I report the share of variance corresponding to a shock to government spending and to real wages. The proportion of forecast error variance attributable to a shock in the lagged dependent variable is the share which is not explained by shocks in the other two endogenous variables. For instance, if the proportion of forecast error variance in the wage equation attributable to shocks in government consumption and GDP are 15% and 35%, respectively, the proportion attributable to a shock in wages would be 50%.
16. This result is in contrast with the findings of Perotti (2007). This paper shows that the effects of government investment on output are not greater than those of government consumption. However, the focus of that study is on Australia, Canada, UK and US.
17. The figures for the impulse-response functions obtained with this recursive ordering are not reported here. However, these are available upon request.
18. In a similar empirical specification for EU countries, Beetsma *et al*. (2008) show that the inclusion of long-term or short-term interest rates does not alter the effects of spending shocks.
19. Because the previous robustness check showed that the impact of wage government consumption may be statistically zero, I omit the assessment of this shock. However, the point estimates of the impulse-response functions are reported for completeness.
20. The source of these data is the Annual Macroeconomic Database of the European Commission.
21. One exception is the work of Lane and Perotti (2003) that studies a panel of OECD countries. Their findings are that shocks to wage government spending increase the real product wage in the short run and that this effect is stronger under a flexible exchange rate regime.
22. Ravn *et al*. (2007) also study the effect of fiscal shocks by estimating a panel VAR. In contrast to this paper, they use quarterly data and identify shocks following with the Blanchard and Perotti (2002) method.
23. The wage and non-wage components of government consumption are not studied because these data are not available for Australia at the OECD Economic Outlook.
24. This seems to be in contrast with the findings of Perotti (2007). However, I later show that wages deflated with GDP prices (as used in that study) respond positively to these fiscal shocks.
25. I check the robustness of these results with the same set of tests. As for the baseline model, Tables 3 and 4 report these estimates.
26. For completeness, Tables 2, 3 and 4 report the real wage and GDP responses for the case in which real product wage is used.

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