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The Impact of Fiscal Shocks on the Irish Economy*

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Abstract: We study the short-run effects of shocks to government spending on Ireland's output and its real exchange rate. We show that the impact of government spending shocks critically depend on the nature of the fiscal innovation. Our main finding is that there are important differences between shocks to public investment and shocks to government consumption. Moreover, within the latter category, shocks to the wage and non-wage components also have dissimilar effects.

I INTRODUCTION

The goal of this paper is to estimate the short-run impact of government spending on the Irish economy. More specifically, we are interested in whether the impact depends on the type of government spending. Along these lines, we investigate whether public investment operates differently to government consumption. In relation to the latter category, we also explore the potential differences between non-wage government consumption (purchases of consumption goods and services from the private sector) and wage government consumption (whereby public services are produced by publicly-employed workers).

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There has been a renewal of interest in estimating the effectiveness of fiscal policy. In part, this relates to the development of VAR estimation techniques that were initially applied to the estimation of the effectiveness of monetary policy. From a policy perspective, fiscal policy is especially important for individual member countries of the Euro Area, since it is the only national stabilisation instrument in the event of a country-specific macroeconomic shock. Most recently, the pushing of interest rates towards zero and the blocking of the traditional credit channel of monetary policy means that fiscal policy has taken centre stage in tackling the current global recession.

We consider the impact of fiscal shocks on two key macroeconomic variables: the level of output and the real exchange rate. The former is included, since we wish to estimate the "fiscal multiplier" (the change in aggregate output that is associated with a given change in government spending). The latter is included since the real exchange rate is a key variable for an open economy. For instance, a policymaker may wish to deploy fiscal policy to engineer a real depreciation if she wishes to improve the trade balance and/or re-orientate the economy towards the export sector.

Theoretically, the dynamic effects of government spending shocks differ between approaches. Real business cycle models predict that spending shocks increase output and produce negative wealth effects that lead to an increase in the labour supply, a decrease in real wages and private consumption, and no change or depreciation of the real exchange rate. In contrast, New Keynesian models with nominal rigidities produce different responses. Government spending shocks increase labour demand, real wages, private consumption and output. Moreover, the real exchange rate appreciates. While the estimates that we obtain may help to shed light on the relative merits of alternative modelling approaches, our motivation in this paper is primarily empirical.

Our empirical method is to employ a structural vector autoregression (SVAR) model, with fiscal shocks identified by assuming a recursive ordering.[1] Under this approach, it is assumed that shocks to output and the real exchange rate do not affect fiscal policy contemporaneously, whereas a fiscal shock is allowed to have an immediate impact effect on these two variables. Accordingly, this ordering allows us to identify the impact of exogenous shifts in government spending on the level of output and the real exchange rate.

[1] This approach is shared by Beetsma *et al.* (2006; 2008); Blanchard and Perotti (2002); Monacelli and Perotti (2009); Ravn *et al.* (2007). The main alternatives are to identify fiscal shocks using a "narrative" approach or by imposing sign restrictions on the impulse-response functions. Examples of the former include Ramey and Shapiro (1998), while examples of the latter include Mountford and Uhlig (2009).

While Roberto Perotti and his various collaborators have argued the recursive approach is most appropriately applied to quarterly data, this has limited empirical analysis to four countries that have satisfactory quarterly data sets (United States, United Kingdom, Canada and Australia). Accordingly, it is necessary to employ annual data if we wish to study the impact of fiscal shocks on Ireland. In any event, Bénétrix and Lane (2009a) show that the results for the "Perotti" group of countries are very similar whether quarterly or annual data are employed. Moreover, annual data have some conceptual advantages over quarterly data. For instance, Beetsma *et al.* (2006) argue that it is less likely that annual measures are not as vulnerable to anticipation effects as is the case for quarterly data.

In addition to the main VAR model, we also explore the channels by which fiscal shocks may affect the real exchange rate. In particular, we estimate ancillary models in order to estimate the impact of fiscal shocks on the relative price of nontradables, the level of real wages and the sectoral composition of output.

The structure of the rest of this paper is as follows. Section II describes our empirical method, while Section III presents the results for the baseline model and some robustness tests. We study the impact of fiscal shocks on the relative price of nontradables in Section IV, on real wages in Section V and on the sectoral composition of output in Section VI. Conclusions are presented in Section VII.

II METHOD

2.1 *Data*

The literature dealing with fiscal shocks has considered a range of different measures of government spending.[2] Most papers have focused on government consumption, whether in the aggregate (Blanchard and Perotti, 2002; Monacelli and Perotti, 2009) or subcomponents (Monacelli and Perotti 2008 focus on non-wage government consumption, while Cavallo, 2005; 2007 studies wage government consumption and Giordano *et al.,* 2007 compare the effects of wage and non-wage government consumption). Beetsma *et al.* (2006; 2008) provide an important exception, by analysing total government absorption and also the individual public investment and public subcomponents.

[2] Government spending has three components: government consumption, government investment and transfers (welfare payments, pensions). Since transfers just redistribute spending across private citizens, it should not have a first-order short run impact on macroeconomic variables and we exclude that component from the analysis that follows.

We adopt a general approach and consider five measures of government spending: total government absorption (the sum of total government consumption and government fixed investment); government fixed investment; government consumption; wage government consumption; and non-wage government consumption. The time span of our data is 1970 to 2006 and the frequency is annual. The data are obtained from the OECD *Economic Outlook* database (version No. 82).

The second variable used in our baseline model is gross domestic product in constant local currency units. The source of this variable is also the OECD *Economic Outlook*. The last variable in our baseline estimations is the CPI-based real effective exchange rate vis-à-vis the rest of the EMU, published by the European Commission.

2.2 *Database in Relative Terms*

Since we are interested in evaluating how fiscal policy affects the real exchange rate, we measure the fiscal variables and the level of output in relative terms, as deviations from a weighted average of the values for other countries. In particular, we are especially interested in understanding real exchange rate movements vis-à-vis other members of the Euro Area, such that we construct a set of indices which measure the deviations of our variables of interest from the rest-of-EMU countries. The general index formula is

$$I_t = I_{t-1} * \frac{Z_t}{Z_{t-1}}, \tag{1}$$

where

$$\frac{Z_t}{Z_{t-1}} = \frac{X_t}{X_{t-1}} - \frac{X_t^{EMU}}{X_{t-1}^{EMU}}. \tag{2}$$

and X_t is the real value of the considered spending variable or real GDP at time t and X_t^{EMU} is the same variable for the EMU countries excluding Ireland. The last term of (2) is defined as

$$\frac{X_t^{EMU}}{X_{t-1}^{EMU}} \equiv \prod_j \left(\frac{X_{j,t}}{X_{j,t-1}} \right)^{\omega_j}. \tag{3}$$

The subindex j stands for other EMU countries. ω_j is the time-invariant trade weight of country j and it is given by[3]

$$\omega_j = \frac{\Sigma_{t=t_0}^{T} (EXP_{j,t} + IMP_{j,t})}{\Sigma_{t=t_0}^{T} (EXP_t + IMP_t)}. \tag{4}$$

[3] Since these trade weights are very stable in the 1970 to 2006 period, there is no significant change in the results by considering either $\omega_{j,t}$ or ω_j.

$EXP_{j,t}$ are nominal exports from Ireland to country j and $IMP_{j,t}$ are Ireland's nominal imports from country j, in period t.[4] Both are measured in current US dollars. EXP_t represents total exports to the EMU while IMP_t stands for total imports from the Euro Area. We set $t_0 = 1971$ and $T = 2006$.

We use trade weights instead of GDP weights because trade spillovers from discretionary fiscal policy are found to be important in EU countries (Beetsma *et al.,* 2006). Moreover, trade weights are more consistent with the measurement of the third variable of our model: the real effective exchange rate.[5]

Figure 1 shows the index in equation (1) for the types of government spending as well as for the GDP deviations from other EMU member countries. Moreover, it presents the evolution of the real effective exchange rate vis-à-vis the same countries. All variables are measured in log levels.

The first panel shows that the real exchange rate has shown trend appreciation. However, the evolution of this variable really consists of two phases: the first between 1971 and 1987 and the second between 1988 and 2006. Ireland experienced real depreciation between 1971 and 1976 and from 1982 to 1996. As regards the GDP differential, Ireland experienced an important acceleration at the beginning of the 1990s that sustains until 2006. For the case of government spending differentials this figure shows that all types had two peaks: the first in the late 1970s/early 1980s and the second in 2001. By contrast, these variables show substantial declines between 1988 and 1994.

2.3 *Shock Identification*

We follow the approach of Blanchard and Perotti (2002), Perotti (2004) and Beetsma (2006, 2008) by using a Choleski decomposition in order to identify the impact of fiscal shocks.[6] Under this approach, identification is obtained by

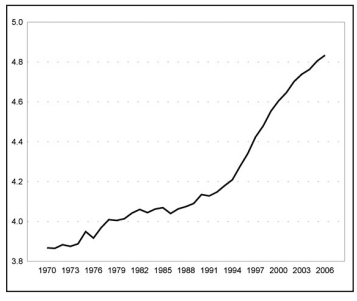
[4] The source of these data is the Direction of Trade Statistics (DOTS) of the International Monetary Fund.

[5] Trade weights used in the real effective exchange rate published by the European Commission are not exactly the same as those used to construct the rest-of-EMU variables. The former retrospectively includes Slovenia as an EMU country, while we exclude Slovenia from the output and fiscal measures, since its inclusion would be problematic in terms of data availability prior to the mid-1990s.

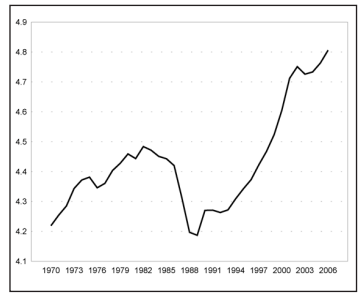
[6] One alternative approach that has been used for the US is the narrative approach that identifies fiscal shocks by including dummy variables to capture periods in which government spending increased for exogenous reasons (war time in the US case). However, it is not obvious that this can be easily implemented for Ireland. On the US case, see Ramey and Shapiro (1998), Edelberg *et al.* (1999), Burnside *et al.* (2004) and Romer and Romer (2009). Another alternative approach would be to use sign restrictions. However, this requires a high level of certainty in terms of signing the response of output to government spending shocks. See Canova and De Nicoló (2002), Uhlig (2005), Canova and Pappa (2007) and Mountford and Uhlig (2009). See also the survey in Beetsma (2008).

Figure 1: *Real Exchange Rate, GDP and Government Spending*

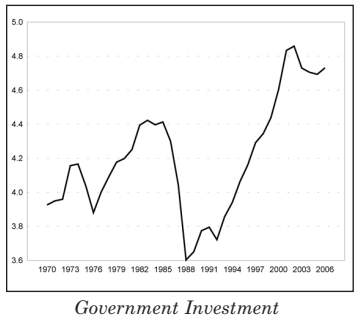
Real Exchange Rate



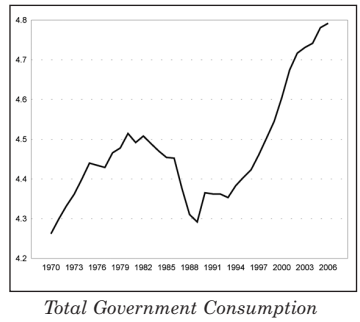
GDP



Government Expenditure



Government Investment



Total Government Consumption

Wage Government Consumption

Non-Wage Government Consumption

Note: Real exchange rate is real effective exchange rate vis-à-vis other EMU members. GDP and government spending are deviations from the rest of EMU countries. All variables are in log scale.

imposing that some variables are not allowed to react contemporaneously to shocks in others. While Blanchard and Perotti (2002) and Perotti (2004) use quarterly data, Ireland has non-interpolated quarterly data only from the first quarter of 1999 onwards. Since a longer span of quarterly data is not available, we are constrained to use annual frequency and a different identification strategy. However, the use of annual data has some advantages, as highlighted by Beetsma *et al.* (2008). First, shocks are closer to what may be properly interpreted as a real fiscal shock, since fiscal policy is typically not substantially revised within a year. Second, the use of annual data reduces the role of anticipation effects.[7] Third, the use of annual data makes seasonal effects to be less important than in quarterly data. The reason for this is that seasonal changes in fiscal variables are less likely to have cycles that last more than one year.

Although we identify shocks in a similar fashion, our baseline specification differentiates from Beetsma *et al.* (2008) in four main aspects. First, all variables are defined as deviations from the rest-of-EMU countries. Second, we specify a narrower VAR consisting of a measure of government spending, gross domestic product and real exchange rate. Third, we study the effect on the exchange rate of government expenditure (total government consumption plus investment), these two components separately, wage government consumption and non-wage government consumption. Finally, we study a single country, rather than a panel.

Our three-variables structural model in companion form can be written as follows

$$A_0 Z_t = A(L) Z_{t-1} + C X_t + \varepsilon_t . \tag{5}$$

[7] Blanchard and Perotti (2002) test for the existence of anticipated fiscal policy with future values of estimated fiscal shocks using quarterly frequency. To this end, they include future values of a dummy variable that measures fiscal shocks in their empirical model. They show that anticipation effects are not important in the United States. Studies suggesting the existence of anticipation effects find that fiscal policy may be anticipated one or two quarters in advance. Using a new variable based on narrative evidence that improves the Ramey-Shapiro military dates, Ramey (2008) shows the existence of anticipation effects that produce qualitative changes in the responses of consumption and real wages. To show this, she performs different Granger causality tests between the war dates and the VAR shocks. The latter were defined as the residual of a dynamic empirical model in which up to four lags of the dependent variable are included. In our dataset, the presence of anticipation effects could be tested by checking whether output differentials or the real exchange rate Granger causes future values of the government spending VAR shocks. Another strategy would be the implementation of tests similar to those used by Ramey (2008). However, this is not possible in our dataset because series of government spending shocks identified with the narrative approach are only available for the United States. Since we use annual frequency any anticipation of policy changes that are further than two quarters into the future becomes less likely.

Z_t is a vector of endogenous variables containing: the government spending differential from the rest-of-EMU countries (g_t), the real GDP differential (y_t) and the real effective exchange rate (e_t). X_t is a vector with the intercept (c) and linear trend (t_t). 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. Matrix C contains the coefficients of the intercept and the linear trend. The vector ε_t, contains the orthogonal structural shocks to each equation of the VAR and var(ε_t) = Ω. Thus,

$$Z_t = \begin{bmatrix} g_t \\ y_t \\ e_t \end{bmatrix} \quad A_0 = \begin{pmatrix} 1 & -\alpha_{yg} & -\alpha_{eg} \\ -\alpha_{gy} & 1 & -\alpha_{ey} \\ -\alpha_{ge} & -\alpha_{ye} & 1 \end{pmatrix} \quad X_{i,t} = \begin{bmatrix} c \\ t_t \end{bmatrix} \quad \varepsilon_t = \begin{bmatrix} \varepsilon_t^g \\ \varepsilon_t^y \\ \varepsilon_t^e \end{bmatrix}.$$

Premultiplying (5) by A_0^{-1} we obtain our model in reduced-form,

$$Z_t = B(L)Z_{t-1} + DX_t + u_t; \tag{6}$$

where $B(L) = A_0^{-1}A(L)$, $D = A_0^{-1}C$, $u_t = A_0^{-1}\varepsilon_t$, $u_t = [u_t^g \; u_t^y \; u_t^e]'$ and var $(u_t) = \Sigma$.

In order to recover $\varepsilon_{i,t}$ and Ω from the reduced-form, we impose $\alpha_{yg} = \alpha_{eg} = \alpha_{ey} = 0$ to matrix A_0.

Imposing these restrictions is equivalent to assuming that the fiscal spending deviations from the rest of the EMU countries do not react contemporaneously to shocks in the real GDP differentials or the real exchange and that the GDP differential does not react contemporaneously to shocks to the real exchange rate. Therefore, the Choleski ordering to identify shocks is: government spending deviations, GDP differential and real effective exchange rate.

These identification assumptions are in line with papers dealing with the effects of discretionary fiscal shocks in the sense that we order *g* before *y*. This ordering is motivated by the fact that government spending is planned before the period starts. Moreover, Beetsma *et al.* (2006) estimate 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 *y* within a quarter. From these results they construct an estimate of the response of public spending to output at annual frequency finding that it is not significantly different from zero.

III BASELINE MODEL

3.1 *Main Results*

This section presents the responses of Ireland's output and real exchange rate to shocks in different types of government spending. To this end, we estimate a series of models, one for each type of government spending variable. Since we use annual data, we set the lag length of each endogenous variable to two. Moreover, the Durbin Watson statistic shows that first-order autocorrelation is absent at this lag length. We also include linear trends.

In our baseline specification, we consider the impact of shocks to real fiscal variables – that is, we deflate the fiscal variables with the relevant fiscal deflators.[8]

Figure 2 shows the responses of all endogenous variables to a fiscal shock of 1 per cent of GDP.[9] Government absorption (GEXP) is defined as the sum of government consumption and government fixed investment. Recall that all government spending measures as well as the GDP are defined as deviations from the rest of the EMU countries. Therefore, GEXP measures the deviation of the Irish government absorption from the trade-weighted average level of government absorption in other EMU member countries.

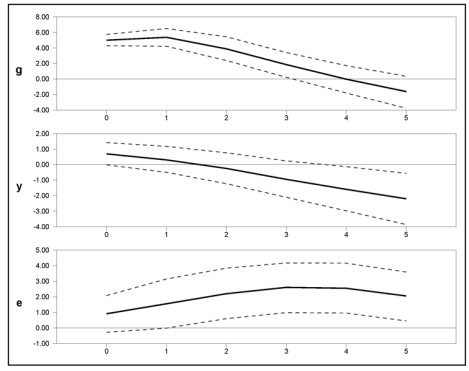
A positive shock to this government spending variable generates a positive impact response in the output differential, which subsequently turns negative between three and four years after the realisation of the shock. By contrast, the response of the real exchange rate is positive along the whole impulse-response horizon. It appreciates 0.9 per cent on impact and continues appreciating in the subsequent three years. The peak is equivalent to a 2.6 per cent appreciation in the third year.

Once we turn to subcomponents of total government absorption, we see some marked contrasts across different items. In particular, a shock to government investment has a positive fiscal multiplier, whereas innovations in government consumption do not increase the level of output. In relation to the real exchange rate, a public investment shock generates a peak real appreciation of 6 per cent in the third year, whereas a shock to government consumption generates a more persistent real appreciation (even if the peak value is lower).

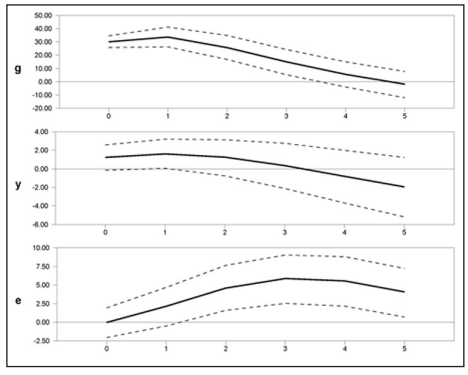
[8] For government consumption excluding wages, we use the deflator of total government consumption. We consider alternative approaches in Section 3.3.

[9] Over the sample period, the average levels of each component of government absorption (expressed as a ratio to GDP) were 20.0, 3.3, 16.7, 10.1 and 6.6 per cent for government absorption, investment, consumption, wage consumption and non-wage consumption respectively. Accordingly, a 1 per cent of GDP shift would represent a relatively small shock in terms of total government absorption but a relatively large shock if it were fully concentrated in public investment.

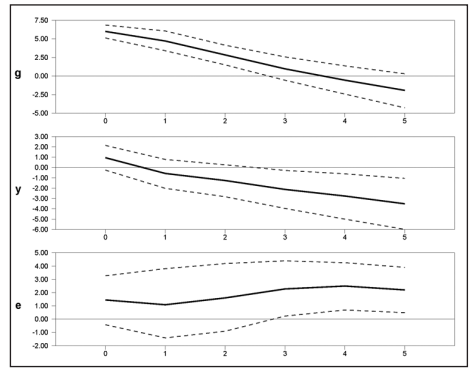
Figure 2: *Baseline. Responses to 1 Per Cent of GDP Government Spending Shock*



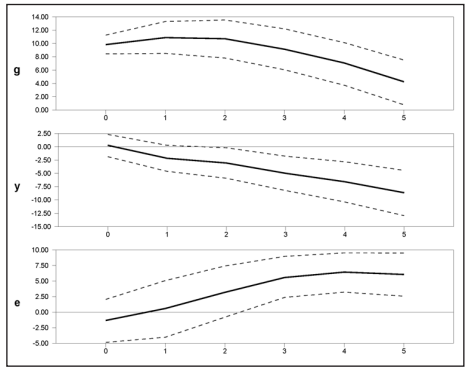
Shock in GEXP



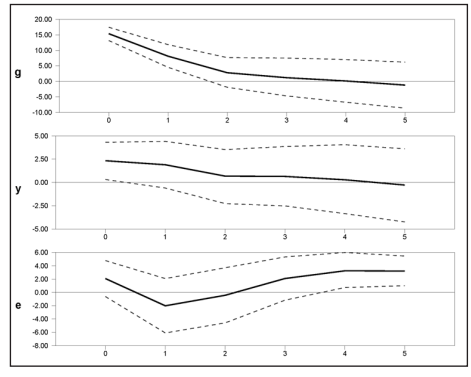
Shock in GINV



Shock in GC



Shock in WGC



Shock in NWGC

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 effective exchange rate vis-à-vis other EMU countries (e).

Taking a closer look at government consumption, we see that the subcomponents of government consumption produce different responses. A positive shock to wage government consumption (WGC) has a negative fiscal multiplier, generating a negative output differential while also producing substantial real appreciation (peaking at 6.6 per cent in the fourth year). By contrast, shocks to non-wage government consumption (NWGC) have a positive fiscal multiplier, with no effect on the real exchange rate.

Our discussion so far has focused on the point estimates of the impulse-response functions. Figure 2 also shows plus/minus one standard deviation bands, in line with the approach of most of the fiscal VAR literature.[10] Given the relatively limited degrees of freedom, it is not too surprising that the level of precision in the estimates of the impulse-response functions is not uniformly strong.

3.2 *Robustness Checks*

3.2.1 Four-Variable System

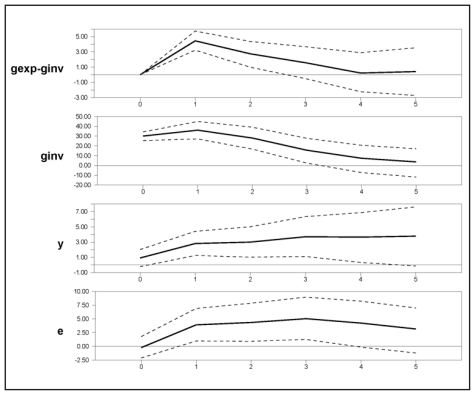
In order to check the robustness of the baseline results, we follow two strategies. The first one is to check whether the measured fiscal shocks in the baseline model might be distorted by not controlling for other components of government spending. This is relevant in examining the impact of subcomponents of aggregate government absorption, since a shock to public investment may be correlated with shocks to non-investment spending, which would not be picked up in the three-variable system. Accordingly, we consider an expanded four-variable system, in which the "complement" of the fiscal variable in question is also included. The "fiscal complement" variable is defined as the difference between total government absorption and the spending variable being considered. That is, if we take government investment, the fourth variable of the system would be government absorption minus government investment.

The advantage of including this fourth variable is that it minimises potential biases in the reduced form coefficients due to the omission of other types of government spending that are correlated with the spending variable being studied. We adopt the conservative approach of assuming that the fiscal variable of interest is ordered after the complement fiscal variable. (However, we have also run the system with the opposite ordering of the fiscal variables and the impulse response functions are similar across the two specifications.)

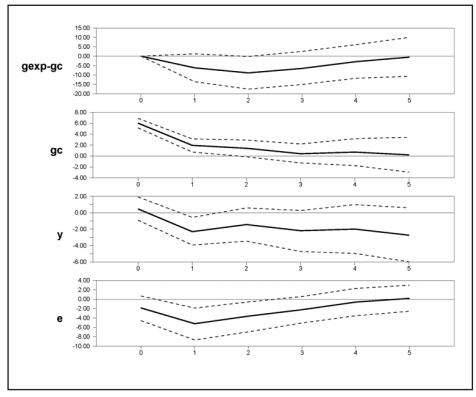
[10] The standard deviations of the estimates are generated through 1,000 replications of a Monte Carlo simulated, as encoded in RATS 7.0.

Figure 3 shows the responses of the four endogenous variables to shocks in government investment, consumption, wage government consumption and non-wage government consumption. Consistent with the baseline model, Figure 3 shows that a shock in government investment produces real appreciation. This real exchange rate response has a maximum of 5.2 per cent in the third year. Moreover, the output response is positive along the whole impulse-response horizon and is more persistent than in the baseline model.

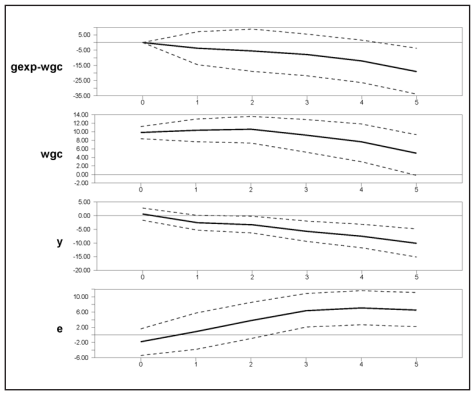
Figure 3: *Four-Variable System. Responses to 1 Per Cent of GDP Government Spending Shock. Shocked Spending Variable Ordered Second*



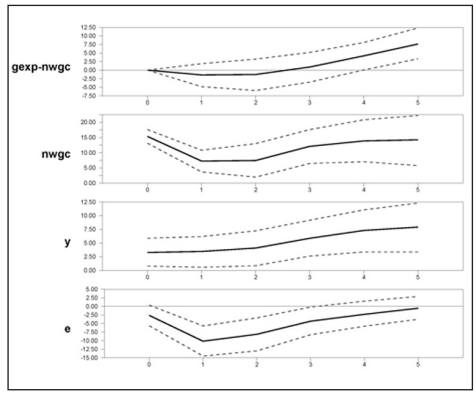
Shock in GINV



Shock in GC



Shock in WGC



Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real effective exchange rate vis-à-vis other EMU countries (e).

A shock to total government consumption has a negative fiscal multiplier in terms of its impact on output and produces real depreciation in the four-variable system, rather than real appreciation. The largest depreciation is one year after the realisation of the shock and it is equivalent to a 5.4 per cent depreciation.

In line with the baseline specification, innovations in wage government consumption generate a negative output differential and produce real appreciation in latter years. Moreover, this shock gives the largest real appreciation across all government spending types. This is equivalent to 6.8 per cent in the fourth year.

Finally, a shock to non-wage government consumption component has a positive fiscal multiplier. In terms of the real exchange rate, this shock generates real depreciation on impact and in the subsequent four years. By contrast, the exchange rate response in the baseline specification was close to zero.

3.2.2 Debt Feedback

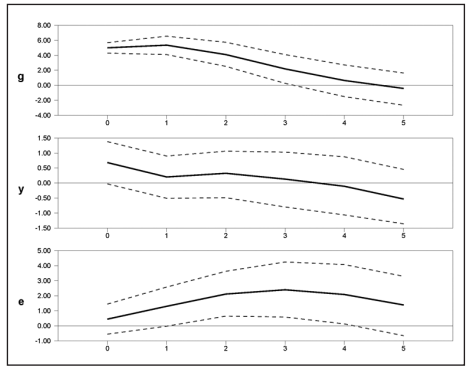
Following Beetsma *et al.* (2008), we further test the results of the baseline specification by including the general government consolidated gross debt as a ratio of GDP from the Annual Macroeconomics Database of the European Commission (AMECO). More precisely, we include the logarithm of the first two lags of this variable in each equation of the model. This is included since government spending may systematically respond to the level of public debt (higher debt placing downward pressure on spending levels). Figure 4 shows that the introduction of the government debt as a ratio of GDP does not generate qualitative changes in the responses. Moreover, the response of output is larger in this specification than in the baseline model in the case of a shock to public investment.

3.2.3 Summary

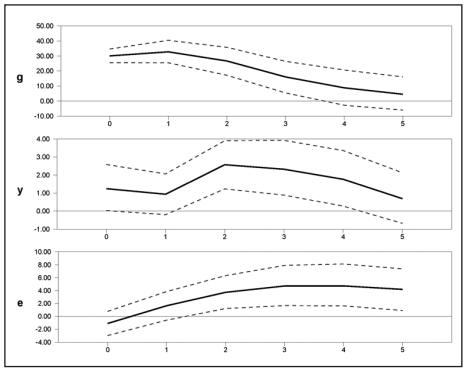
Overall, these robustness checks show that some responses are quantitatively sensitive to changes in the empirical specification but that the general pattern of results is relatively stable in terms of the ranking of the different types of government spending.

The exchange rate responses that survive all tests are those produced by shocks in government investment or wage government consumption. These generate real appreciation independently of the empirical specification. By contrast, the robustness check based on the four-variable system shows that the real exchange rate appreciation produced by a shock in government consumption in the baseline specification turns to real depreciations. Moreover, the zero exchange rate response to shocks in non-wage government consumption turns also to real depreciation in the four-variable system.

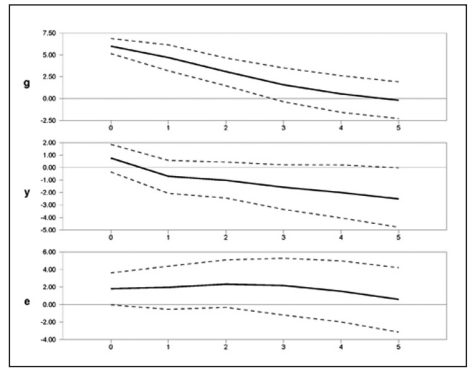
Figure 4: *Responses to 1 Per Cent of GDP Government Spending Shock (Var Model Includes Two Lags of Public Debt Over GDP)*



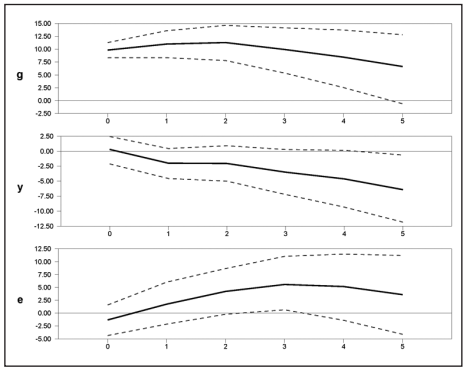
Shock in GEXP



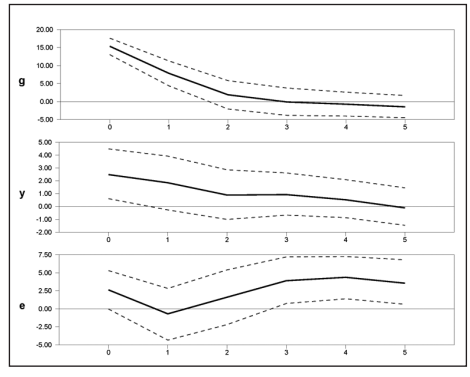
Shock in GINV



Shock in GC



Shock in WGC



Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real effective exchange rate vis-à-vis other EMU countries (e).

3.3 *Alternative Fiscal Measures*

Up to now, we have deflated government spending data using each specific government price deflator. This is the strategy followed by Corsetti and Müller (2006) and Beetsma *et al.* (2006; 2008), among others. Under this approach, the fiscal shock refers only to a shock to the volume of government spending.

In this subsection, we allow fiscal shocks to also take the form of shocks to the relative price of government spending. We do this deflating fiscal variables with the GDP deflator, such that the fiscal variables will shift in line with either a change in relative prices or a change in quantities.[11] This follows the strategy of Lane and Perotti (2003); Pappa (2005); Perotti (2004, 2007) and Monacelli and Perotti (2009).

Figure 5 shows the real exchange rate responses to these shocks in the five types of government spending.

As in the baseline model, a shock to total government absorption has an initially positive impact on output that subsequently turns negative. However, it generates a larger and more persistent exchange rate appreciation than in the baseline model.

The impact on output and the real exchange rate is similar to the baseline model in the cases of shocks to government investment, government consumption and wage government consumption. By contrast, a shock in the non-wage government consumption produces a larger real depreciation in the first two years relative to the baseline model. Moreover, the output response is more persistent than in the baseline.

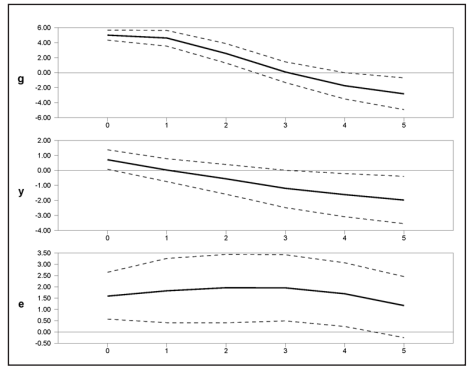
Moreover, Figure 6 presents the responses in the four-variable system. The inclusion of the complement government spending variable eliminates the real exchange rate appreciation that is produced by a shock to government consumption. As in the baseline model, the real depreciation generated by a shock to the non-wage government consumption component becomes larger when the fourth variable is included.

IV RELATIVE PRICE OF NONTRADABLES

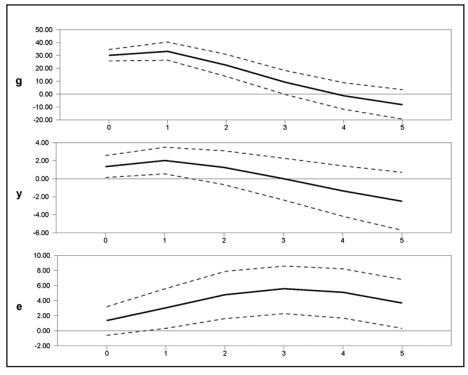
Since the relative price of nontradables plays an important role in real exchange rate fluctuations (especially for members of a currency union), we study its responses to positive government spending shocks. To this end, we re-run the baseline model but replace the real effective exchange rate with the ratio of nontradable to tradable prices.

[11] For parsimony, this imposes that the effects of relative price shocks and quantity shocks are the same.

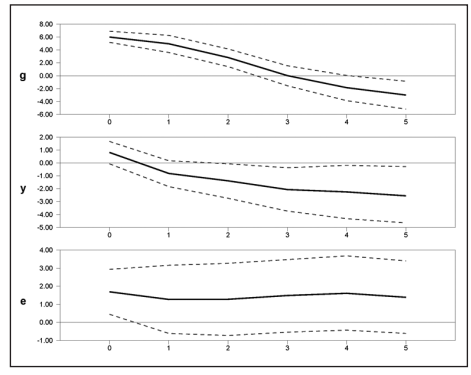
Figure 5: *Responses to 1 Per Cent of GDP Government Spending Shock. GDP-Deflated Government Data*



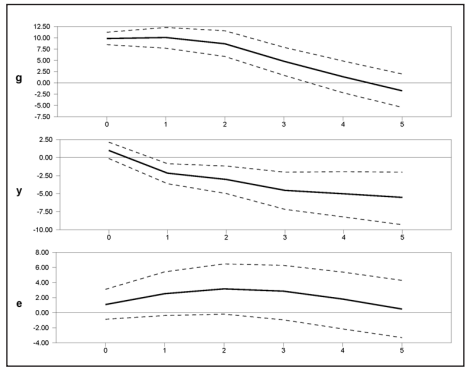
Shock in GEXP



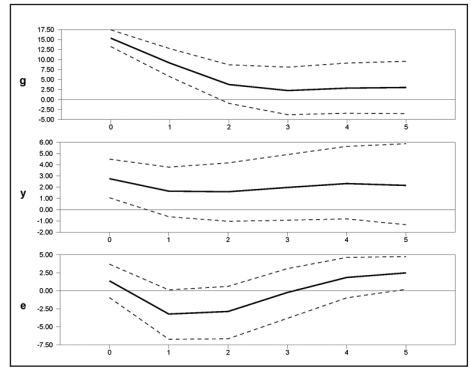
Shock in GINV



Shock in GC



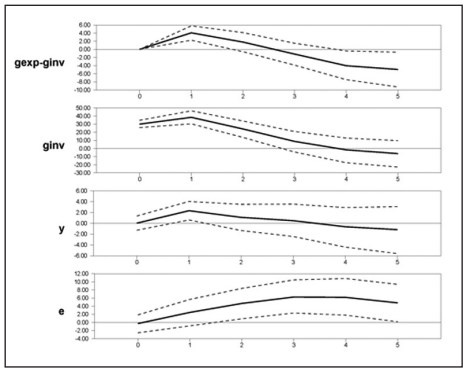
Shock in WGC



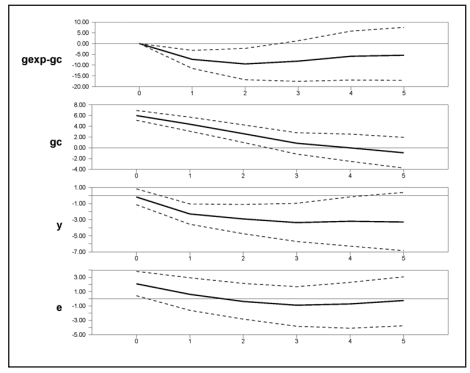
Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending deflated using GDP deflator (g), GDP (y) and CPI-deflated real effective exchange rate vis-à-vis other EMU countries (e).

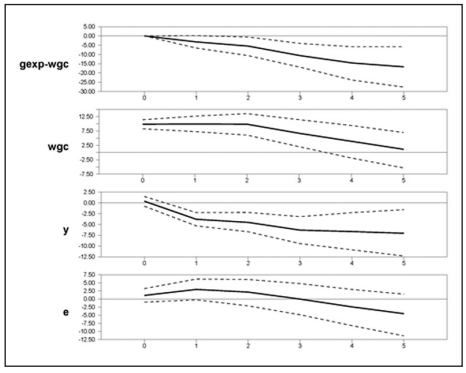
Figure 6: *Four-Variable System. Responses To 1 Per Cent of GDP Government Spending Shock. GDP-Deflated Government Data. Shocked Spending Variable Ordered Second*



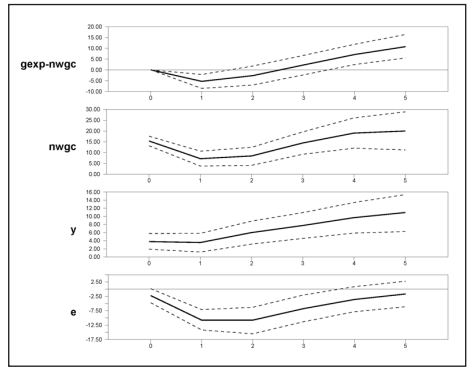
Shock in GINV



Shock in GC



Shock in WGC



Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real effective exchange rate vis-à-vis other EMU countries (e).

To construct this ratio, we assign sectors to the tradable and nontradable categories following Canzoneri *et al.* (1999), Galstyan and Lane (2009a, 2009b), Obstfeld (2009) and Bénétrix and Lane (2009b).[12] To construct nontradable and tradable prices we take a weighted average of the price indices in each of these sectors, using sectoral value added as weights. The

[12] That is, the nontradable sector is formed by "Construction", "Wholesale and Retail Trade", "Hotels and Restaurants", "Transport and Storage and Communication", "Finance, Insurance, Real Estate and Business Services", "Public Administration and Defence; Compulsory Social Security", "Education", "Health and Social Work" and "Other Community, Social and Personal Services". The tradable sector includes "Agriculture, Hunting, Forestry and Fishing", "Mining and Quarrying", "Total Manufacturing" and "Electricity, Gas and Water Supply".

source of these data is the EU KLEMS database and the time span goes from 1970 to 2005.

Figure 7 shows that most of the spending shocks do not affect the relative price of nontradables. The exception is a shock to non-wage government consumption that produces a negative impact on this variable.[13] These results are confirmed by the models including the complement government spending variable of Figure 8. However, the negative impact produced by a shock to non-wage government consumption is larger for this specification.

V REAL WAGE CHANNEL

The labour market is a central channel by which fiscal policy affects the structure of relative prices. Accordingly, this section extends our analysis by studying the effect of positive government spending shocks on real wages.

To this end, we take annual data in log levels for the period 1970 to 2006. As in Lane and Perotti (2003), we define real wages as CPI-deflated real compensation per employee. The source of these data is the AMECO database.

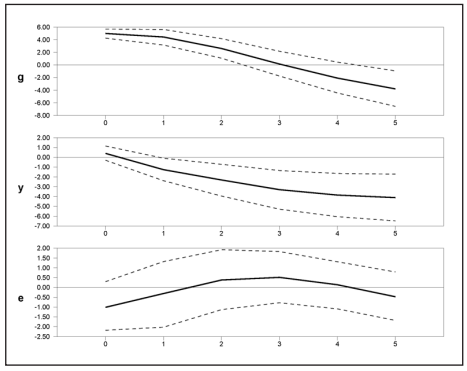
Figure 9 presents the responses of real wages to shocks equivalent in magnitude to 1 per cent of GDP in each type of government spending variable, while Figure 10 shows the wage responses in the four-variable empirical specification.

An inspection of Figure 9 shows that a shock to total government absorption has a negligible impact on real wages. This masks a striking contrast between shocks to public investment and government consumption. A positive shock to public investment is associated with a decline in real wages, whereas a positive shock to government consumption tends to raise real wages. Moreover, this holds true for both wage government consumption and non-wage government consumption.

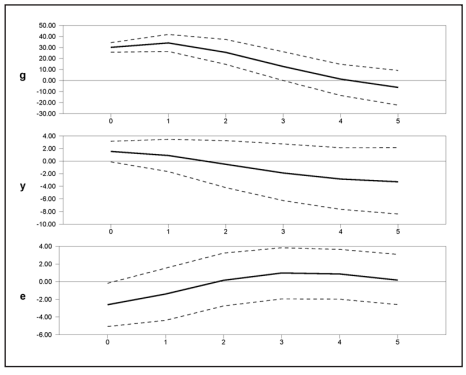
When we turn to the four-variable empirical specifications in Figure 10, the differences between shocks to public investment and government consumption are amplified. Shocks to government investment produce larger and more persistent negative real wage responses, while shocks to government consumption and its two subcomponents produce larger positive real wage responses.

[13] As an additional exercise we have also estimated these models but taking variables as deviations from trading-partner average values (as in the previous section). Our findings are that the response of the relative price of nontradables is qualitatively similar to the response of the real exchange rate in the baseline model. For the cases of government absorption and government investment, the impact of fiscal shocks on the relative price of nontradables is positive, albeit with a lag. In contrast, shocks to non-wage government consumption generates a relative decline in the relative price of nontradables. Finally, government consumption and its wage subcomponent do not affect this variable.

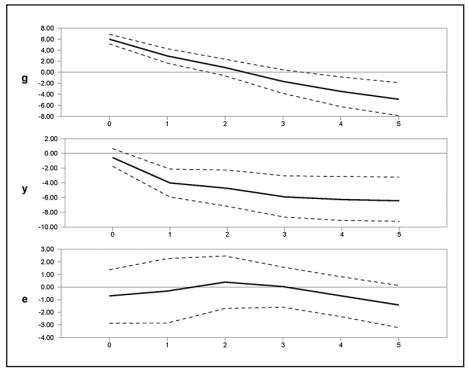
Figure 7: *Response Of Relative Price of Nontradables to 1 Per Cent of GDP Government Spending Shock*



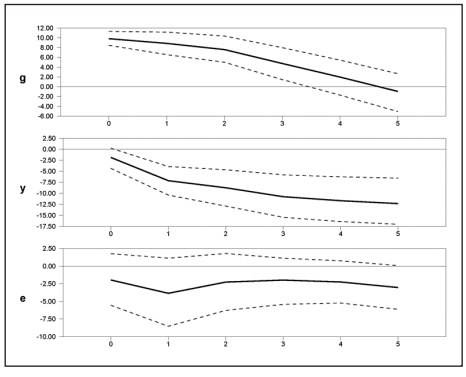
Shock in GEXP



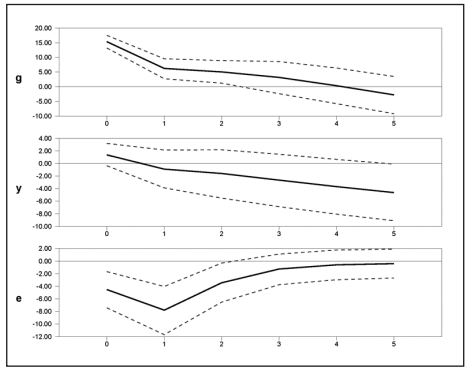
Shock in GINV



Shock in GC



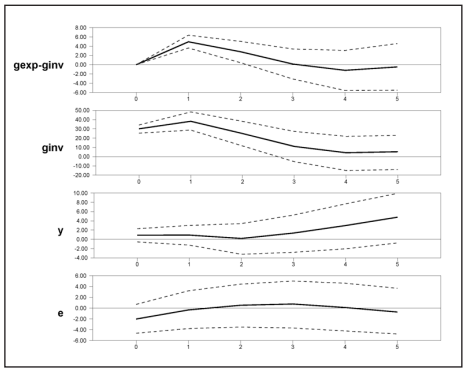
Shock in WGC



Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and relative price of nontradables (e).

Figure 8: *Four-Variable System. Response of Relative Price of Nontradables To 1 Per Cent of GDP Government Spending Shock. Shocked Spending Variable Ordered Second*



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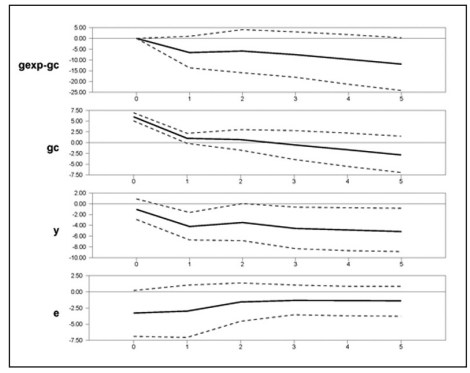
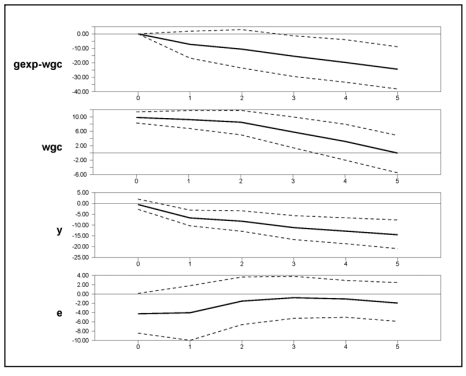


Shock in GC



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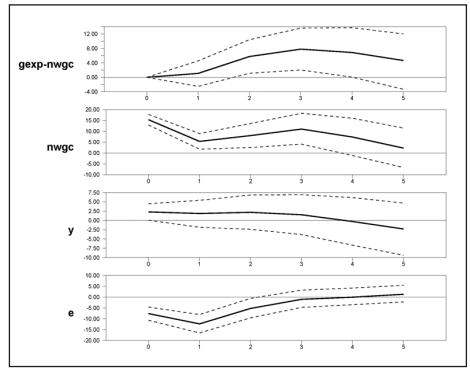


Shock in NWGC

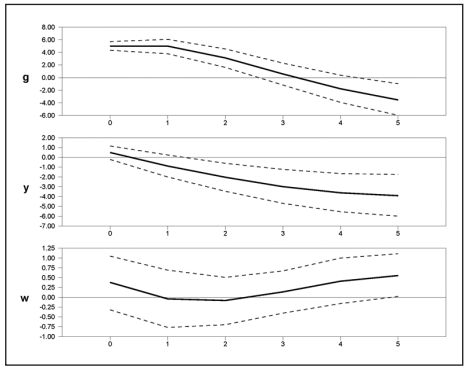
Note: Solid lines are the point estimates of the Impulse-Response mean. Dotted lines are the 16th and 84th percentiles from Monte Carlo simulations based on 1,000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and relative price of nontradables (e).

VI THE SECTORAL COMPOSITION OF OUTPUT

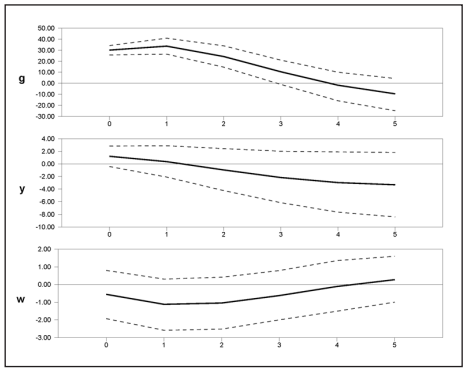
This section studies the effect of government spending shocks from a different angle. More precisely, we focus on the sectoral composition of output by examining the response of tradable and nontradable level of output.[14]

[14] We construct nontradable and tradable output taking the same sectors of Section IV.

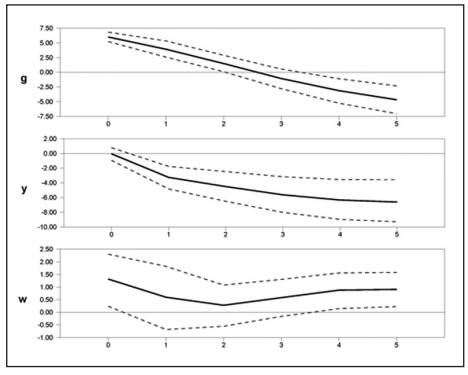
Figure 9: *Real Wage Model. Responses to 1 Per Cent of GDP Government Spending Shock*



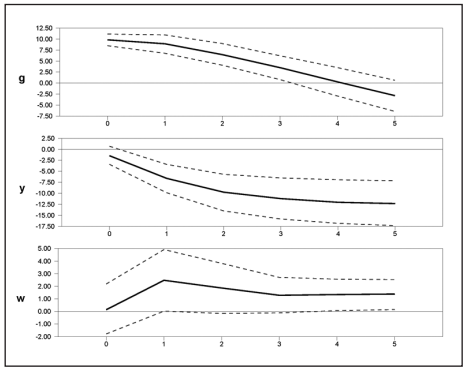
Shock in GEXP



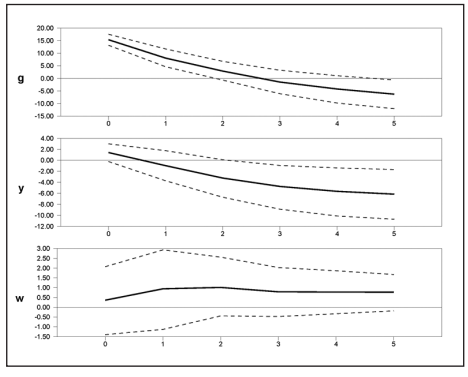
Shock in GINV



Shock in GC



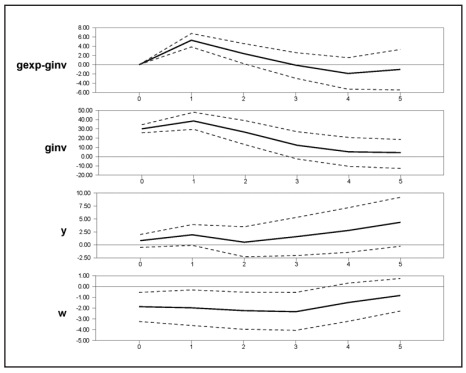
Shock in WGC



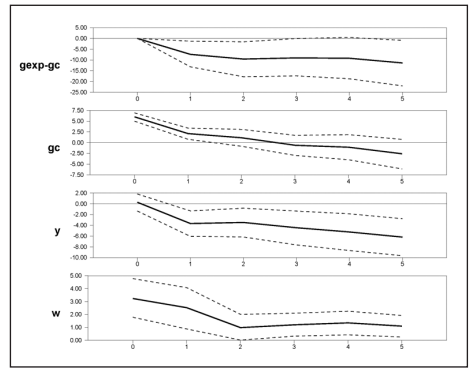
Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real wages (w).

Figure 10: *Four-Variable System for Real Wage Model. Responses to 1 Per Cent of GDP Government Spending Shock. Shocked Spending Variable Ordered Second*



Shock in GINV



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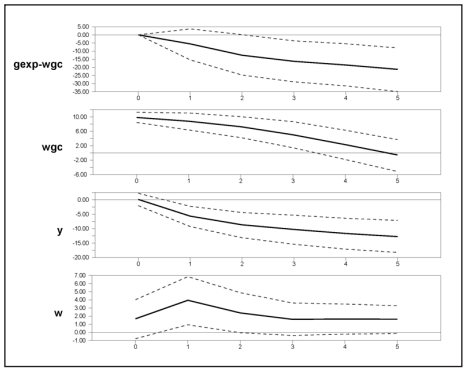

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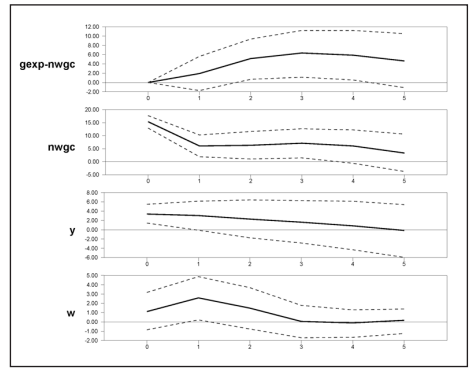


Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending (g), GDP (y) and CPI-deflated real wages (w).

The impact of fiscal policy on the sectoral composition of output is also informative in relation to the modelling of the open economy. In particular, the sectoral mix of output can shift quite rapidly in models in which the inter-sectoral factor mobility is costless. Obstfeld and Rogoff (1996, Chapter 4) lay out such a canonical model: in that setup, demand shocks are entirely absorbed via shifts in the sectoral mix of output. At the other extreme, macroeconomic analysis may often rely on models in which there is zero short-term intersectoral factor mobility (Obstfeld and Rogoff, 2001; 2005; 2007) in such models, a demand shock only operates on relative prices and the sectoral

composition of output remains unchanged. Accordingly, the study of the sectoral composition of output may be viewed as complementary to the study of how fiscal shocks affect the structure of relative prices (the real exchange rate, the relative price of nontradables).

Figure 11 presents the sectoral output responses to spending shocks and shows that government absorption persistently increases nontradable output but produces no effect on the tradable sector. By contrast, a shock to government investment increases both. In line with government absorption, the effect of a shock to government consumption differs across sectors. It produces a positive response in nontradable output (on impact and year one) and a negative response in tradable output.

A closer look to the components of government consumption reveals that a shock to the government wages produces a positive nontradable response on impact. By contrast, a shock to non-wage government consumption generates a positive and persistent response. Output in the tradable sector reacts negatively to shocks in wage government consumption and it is not affected by shocks to non-wage government consumption.

As in the previous sections, we check the robustness of these findings by estimating the four-variable system that includes the fiscal complement. Figure 12 shows that these are not altered by the inclusion of this additional endogenous variable.[15] [16]

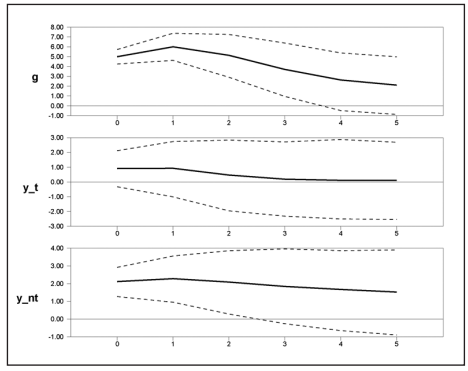
VII CONCLUSIONS

The main message from the empirical analysis in this paper is that the impact of government spending shocks on the level and composition of output and the real exchange rate critically depend on the nature of the fiscal innovation. In particular, there are important differences between shocks to public investment and shocks to government consumption. Moreover, it is also

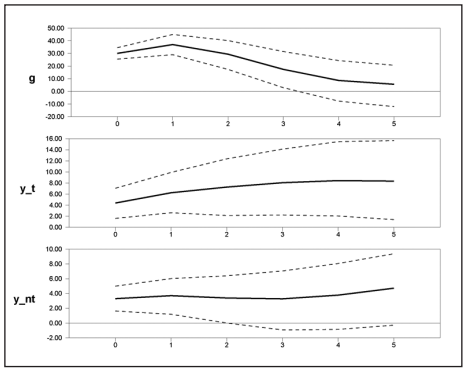
[15] Following Bénétrix and Lane (2009b), we also examined the dynamic effect of these shocks on the "market-based" nontradable output. That is, we excluded the government-dominated sectors from the nontradable sector. These are "Public Administration and Defence; Compulsory Social Security", "Education", "Health and Social Work" and "Other Community, Social and Personal Services". Our findings are that "market-based" nontradable output responses are qualitatively the same but slightly larger for most of the fiscal shocks.

[16] To further examine the responses of quantities we also studied the effect on trade volumes. To do this, we take "Exports of goods and services – volume – national accounts basis" and "Imports of goods and services – volume – national accounts basis" (both come from OECD *Economic Outlook*). This exercise shows that a shock to wage government consumption has a positive impact response on imports.

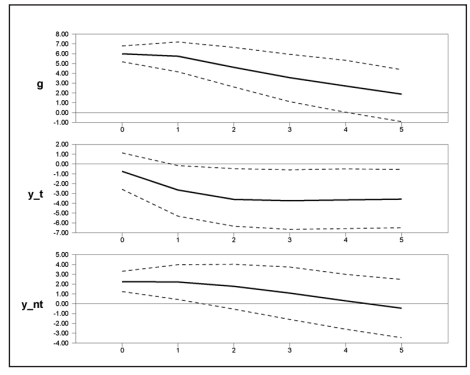
Figure 11: *Sectoral Output Model. Responses to 1 Per Cent of GDP Government Spending Shock*



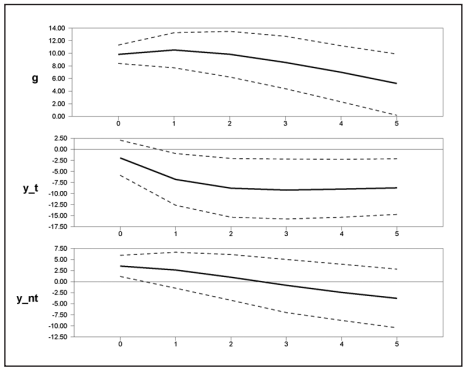
Shock in GEXP



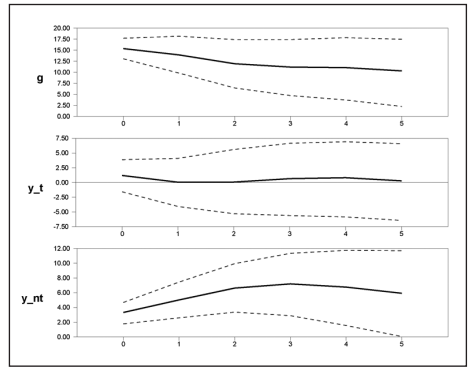
Shock in GINV



Shock in GC



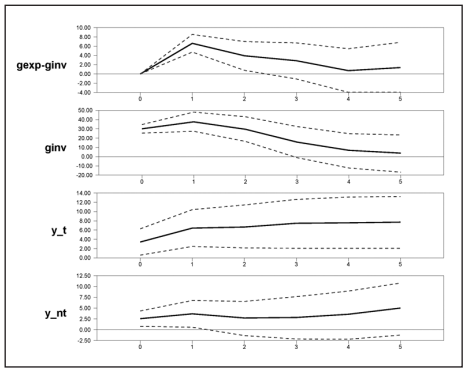
Shock in WGC



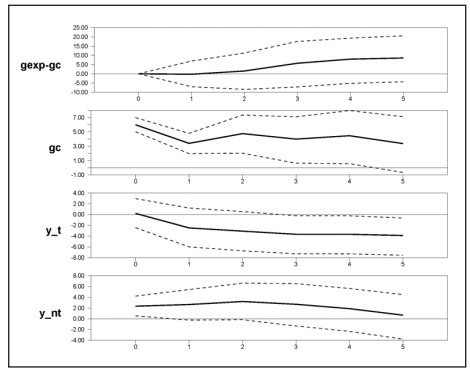
Shock in NWGC

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 1,000 replications. Vertical axis indicates government spending (g), value added in tradable sector (Y_t) and value added in nontradable sector (Y_{nt}).

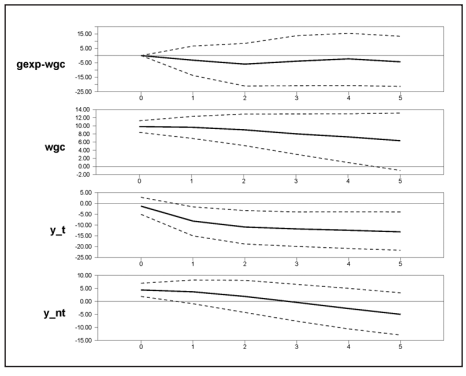
Figure 12: *Four-Variable System for the Sectoral Output Model. Responses to 1 Per Cent of GDP Government Spending Shock. Shocked Spending Variable Ordered Second*



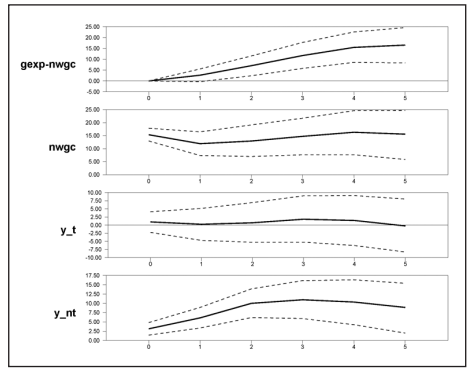
Shock in GINV



Shock in GC



Shock in WGC



Shock in NWGC

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 1,000 replications. Vertical axis indicates the percentage change in government spending (g), value added in tradable sector (Y_t) and value added in nontradablesector (Y_{nt}).

important to distinguish between wage and non-wage components of government consumption.

These results come with important caveats. First, the model is estimated over the 1970-2006 period, such that the fiscal multipliers are average effects across the range of economic conditions faced by Ireland over that interval. In particular, the size of the fiscal multiplier surely varies with the level of slack in the labour market and the perceived sustainability of the fiscal position.

This paper has focused on the short-run impact of fiscal shocks. However, Galstyan and Lane (2009a, 2009b) show that the composition of government

spending also matters for the long-run behaviour of the real exchange rate, with public investment associated with real depreciation and government consumption associated with real appreciation. Accordingly, in evaluating the short- and long-run impact of fiscal adjustment programmes on the level of output and the level of external competitiveness, it is essential to take into account the composition of shifts in government spending.

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