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Abstract

We study the impact of shocks to different types of government spending on the composition of sectoral output for a panel of EMU member countries. We find that fiscal shocks lead to an increase in the relative size of the nontraded sector. There is typically no significant impact on the level of production in the tradables sector but the level of imports increases and the level of exports declines in most cases. Overall, the results show that fiscal shocks matter not only for aggregate variables but also for the sectoral composition of output.

JEL Classification: E24; E62.

Keywords: government spending shocks; tradables; nontradables; European Monetary Union; panel VAR.

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1 Introduction

Our goal in this paper is to estimate the impact of shocks to government spending on the sectoral composition of output. The sectoral impact of fiscal policy is important for several reasons. First, the sectoral composition of output matters for long-term productivity growth, in view of the different rates of total factor productivity growth across sectors. Second, one goal of fiscal policy in an open economy may be to re-structure the composition of output. For example, Blanchard (2007) lays out a model in which government spending is deployed in order to avert excessive contraction of the traded sector during episodes of capital inflows, where the policy motivation can be linked to hyteresis dynamics by which is it is difficult to reverse a contraction in traded-sector output. Third, the sectoral impact of fiscal policy is also important for political economy reasons, since different sectors will have different incentives to lobby for fiscal spending if these are differentially affected by fiscal shocks.

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 there 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, our focus in this paper on the sectoral composition of output may be viewed as complementary to those studies that have examined the impact of fiscal shocks on the structure of relative prices (the real exchange rate, the relative price of nontradables): a list of recent contributions includes Bénétrix and Lane (2009), Beetsma et al. (2006, 2008), Monacelli and Perotti (2006, 2008) and Ravn et al. (2008).

To address this question, we employ a structural VAR model that jointly models the levels of output in different sectors and the level of government spending. Our focus is on member countries of the euro area, since the role of national-level fiscal policy has attained increased importance inside a monetary union. Since the sectoral impact of fiscal shocks may vary depending on the type of government spending, we run a series of alternative models and allow for variation across different types of government spending.

The structure of the rest of this paper is as follows. In Section 2, we explain our empirical strategy to identify fiscal shocks. In Section 3, we present our empirical results and conduct a battery of robustness checks. In section 4, we examine the impact of these shocks on trade volumes. Section 5 concludes.

2 Empirical Approach

We adopt a simple identification approach, by which we assume that government spending does not respond contemporaneously to shifts in sectoral output. This Choleski ordering has also been employed in similar fashion by Beetsma et al. (2006, 2008), Blanchard and Perotti (2002) and Perotti (2004), amongst others.[1] A long time series of true quarterly data are not available for the individual member countries of the euro area, such that we are constrained to employ annual data. However, Bénétrix and Lane (2009) show that the choice of quarterly versus annual data makes little difference for the set of countries that have both good-quality quarterly data and annual data. Moreover, Beetsma et al. (2008) highlight that the use of annual data has some advantages over quarterly data. First, shocks are closer to what a real fiscal shock is since fiscal policy is not substantially revised within a year. Second, the use of annual data reduces the role of anticipation effects. Studies suggesting the existence of these find that fiscal policy may be anticipated one or two quarters in advance, therefore any anticipation of policy changes that are further than two quarters into the future is less likely.[2] Finally, the use of annual data makes seasonal effects to be less important than in quarterly data because seasonal changes in fiscal variables are less likely to have cycles that last more than one year.

Our three-variable structural model in companion form is given by equation (1)

$$A_0 Z_{i,t} = A(L) Z_{i,t-1} + C X_{i,t} + \varepsilon_{i,t} \tag{1}$$

where $Z_{i,t}$ is a vector of endogenous variables including a government spending measure ($\mathrm{g}_{i,t}$), real output in the tradable sector ($\mathrm{y}^{\mathrm{T}}_{i,t}$) and real output in the nontradable sector ($\mathrm{y}^{\mathrm{NT}}_{i,t}$). $X_{i,t}$ is a vector with the country-specific intercepts (c_i), country-specific linear trends ($\mathrm{t}_{i,t}$) and year dummies (d_t). Subscripts i and t denote the country and the year, respectively. 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 country fixed effects, the country-specific linear trends and the time fixed effects. The vector $\varepsilon_{i,t}$, contains the orthogonal structural shocks to each equation of the VAR and $\mathrm{var}(\varepsilon_{i,t}) = \Omega$. Thus,

$$Z_{i,t} = \begin{bmatrix} \mathrm{g}_{i,t} \\ \mathrm{y}^{\mathrm{T}}_{i,t} \\ \mathrm{y}^{\mathrm{NT}}_{i,t} \end{bmatrix} \quad A_0 = \begin{pmatrix} 1 & -\alpha_{\mathrm{y^T g}} & -\alpha_{\mathrm{y^{NT} g}} \\ -\alpha_{\mathrm{g y^T}} & 1 & -\alpha_{\mathrm{y^{NT} y^T}} \\ -\alpha_{\mathrm{g y^{NT}}} & -\alpha_{\mathrm{y^T y^{NT}}} & 1 \end{pmatrix} \quad X_{i,t} = \begin{bmatrix} \mathrm{c}_i \\ \mathrm{t}_{i,t} \\ \mathrm{d}_t \end{bmatrix} \quad \varepsilon_{i,t} = \begin{bmatrix} \varepsilon^{\mathrm{g}}_{i,t} \\ \varepsilon^{\mathrm{y^T}}_{i,t} \\ \varepsilon^{\mathrm{y^{NT}}}_{i,t} \end{bmatrix}.$$

[1] Alternative approaches to identification are not well suited for our purposes. The 'narrative' or 'dummy variable' approach developed by Ramey and Shapiro (1998) and latter implemented by Edelberg et al. (1999), Burnside et al. (2004) and Romer and Romer (2007) has focused on the U.S. case and would be difficult to implement for a multi-country panel. The 'sign restriction' approach implemented by Mountford and Uhlig (2008) and Canova and Pappa (2007) requires taking a strong stand on the predicted sign impact of fiscal shocks on the sectoral composition of output and the diversity of theoretical models does not support taking a strong stand on the sign of the response.

[2] Ramey (2008) shows that fiscal policy in the U.S. may be anticipated one or two quarters in advance and that this produces qualitative changes in the responses of consumption and real wages.

The reduced-form version of the model can be obtained by premultiplying (1) by A_0^{-1}.

$$Z_{i,t} = B(L)Z_{i,t-1} + DX_{i,t} + u_{i,t} \tag{2}$$

Here, $B(L) = A_0^{-1}A(L)$, $D = A_0^{-1}C$, $u_{i,t} = A_0^{-1}\varepsilon_{i,t}$, $u_{i,t} = \begin{bmatrix} u_{i,t}^{\mathrm{g}} & u_{i,t}^{\mathrm{y^T}} & u_{i,t}^{\mathrm{y^{NT}}} \end{bmatrix}'$ and $\mathrm{var}(u_{i,t}) = \Sigma$.

As in Beetsma et al. (2006, 2008), Bénétrix and Lane (2009) and Bénétrix (2009), fiscal shocks are identified using a Choleski ordering. To recover these, we set $\alpha_{\mathrm{y^T g}} = \alpha_{\mathrm{y^{NT} g}} = \alpha_{\mathrm{y^{NT} y^T}} = 0$ in matrix A_0. That is, we impose the following Choleski ordering: government spending, output in the tradable sector and output in the nontradable sector. This is equivalent to assume that fiscal spending does not react contemporaneously to shocks to output of tradable or nontradable sectors. In all cases, government spending is placed in the first position since this is usually planned before the period starts and because empirical evidence suggests that government spending does not react contemporaneously to shocks in output.[3] This ordering also implies that output in the tradable sector cannot react contemporaneously to shocks to output in the nontradable sector. However, we also reverse the positions of traded output and nontraded output in the vector in order to check the sensitivity of results to that assumption.

3 Empirical Analysis

3.1 Data

We examine different types of government spending. We consider an aggregate measure of government absorption (GEXP), which is the sum of government consumption and government investment. However, we also separately examine the impact of public consumption (GC) and public investment (GINV). In addition, we further discriminate between the subcomponents of public consumption - wage government consumption (WGC) and non-wage government consumption (NWGC). The former relates to the publicly-produced services (where the government is the employer), whereas the latter relates to public purchases of consumption goods and services from the private sector.

Allowing for differences across different types of government spending has been highlighted in relation to the real exchange rate by Bénétrix and Lane (2009).[4] Among the wider literature that examines fiscal shocks, Blanchard and Perotti (2002) and Monacelli and Perotti (2006) study the effects of shocks to government consumption, while Monacelli and Perotti (2008) examine non-wage government consumption. Lane and Perotti (2003), Cavallo (2005, 2007) and Giordano et al. (2007) distinguish between wage and non-wage government consumption. Shocks to government investment are studied in Pappa (2005), Perotti (2007) and

[3] To show this, 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.

[4] In a study of the U.K. labour market, Tagkalakis (2006) also allows for differences across different types of government spending.

Beetsma et al. (2006, 2008).

The source of the fiscal expenditure variables is the OECD Economic Outlook, with the exception that government fixed investment for Greece is taken from national sources.[5] All government variables are in real terms (log levels) and deflated with their own deflators. The exception is non-wage government consumption that is deflated with the price index of total government consumption.

The second and third variables included in our three-variable system are the levels of value added in the tradable and nontradable sectors, which are constructed from the EU KLEMS database. We allocate sectors to the nontradables and tradables categories following Canzoneri et al. (1999), Galstyan and Lane (2008) and Obstfeld (2009). That is, real output in the nontradable sector is the sum of the real added value in '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'. Real output in the tradable sector is the aggregate of the real added value in 'Agriculture, Hunting, Forestry and Fishing', 'Mining and Quarrying', 'Total Manufacturing' and 'Electricity, Gas and Water Supply'. The coverage of KLEMS database goes from 1970 to 2005.

In an additional exercise, we also examine the impact of fiscal shocks on the volumes of exports and imports. The source of these data is also the OECD Economic Outlook. For the former, we take 'Exports of goods and services - volume - national accounts basis,' while we use 'Imports of goods and services - volume - national accounts basis' for the latter. These data go from 1970 to 2006.

3.2 Empirical Specification

We estimate a panel VAR for each measure of government spending taking annual data for a sample of eleven member countries of the euro area. To deal with country-specific heterogeneity, each panel VAR includes country fixed effects and country-specific linear trends. Furthermore, to eliminate cross-country contemporaneous residual correlation, we include time fixed effects. 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.

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 the regressors. 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. Our panel has eleven countries and annual data for the period 1970 to 2006. This means that, if

[5]We thank George Tavlas for providing these data. The database has some missing entries. These are 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, while Germany lacks total government consumption for 1970. Data from West Germany and Germany are combined by splicing growth rates in 1991.

present, biases in the coefficients may be small.

In order to derive the 16th and 84th percentiles of the impulse-response distribution in the figures, we perform Monte Carlo simulations and assume that the parameter distribution is normal. Therefore, the mean of the impulse response minus/plus one standard deviation corresponds to the 16th and 84th percentiles of its distribution, respectively.

3.3 Impulse-Response Analysis

In this section, we present the responses of real output in the nontradable and tradable sectors to shocks in different types of government spending. Within each sector, responses differ depending on the measure of government spending that is being used. To scale the responses, we take the cross-country mean shares of each of these five measures of government spending in GDP. In this panel, GEXP, GINV, GC, WCG and NWGC represent 22, 3.2, 18.8, 11.2 and 7.6 percent of GDP in the period between 1970 and 2006, respectively.

Figure 1 shows the impulse-response functions to a one percent of GDP shock in each definition of government spending. Figure 1 shows that output responses in the nontradable sector are positive for all shocks and highly significant (the least significant response is the one produced by shocks to wage government consumption). The largest expansions are produced by shocks to government investment and government consumption. According to the point estimates, the level of output in the tradable sector responds positively to almost all shocks, with the exception provided by wage government consumption. However, the only response that is significant is that produced by shocks to non-wage government consumption. We also computed all these responses for the alternative specification by which the order of tradable and nontradable output in the vector is flipped. For this case, sectoral output responses are similar to those previously presented.[6]

Since government spending may have different effects on the different industries within the nontradables set, we also estimate the responses to government spending shocks replacing aggregate nontradable output by 'market-based' nontradable real output . That is, we exclude government-dominated sectors from the nontradable set. The 'market-based' nontradable sector is composed of the following sectors: 'Construction', 'Wholesale and Retail Trade', 'Hotels and Restaurants', 'Transport and Storage and Communication' and 'Finance, Insurance, Real Estate and Business Services'.

This change produces results that are quantitatively different from those presented before. Shocks to most government spending types produce larger increases in market-based nontradable output. The largest difference is generated by shocks to non-wage government consumption (this shock produces nontradable output responses that are, on average, 22 percent larger).

[6]Since all responses produced by this alternative Choleski ordering are similar to those previously presented, we do not report these figures.

By contrast, shocks to wage government consumption seem to produce smaller responses for market-based nontradable output. However, this difference is statistically insignificant in latter years.[7]

3.4 Robustness Checks

We examine the robustness of the baseline results by using two different empirical specifications. First, we estimate a four-variable panel VAR in which the fourth variable, which we term the 'fiscal complement', is defined as the difference between government absorption and the government spending variable under consideration. For instance, if we are studying shocks to government consumption, the fiscal complement would be equal to government investment, since government absorption is the sum of these two.

This robustness check is also implemented in Bénétrix and Lane (2009) and Bénétrix (2009). Its aim is to control for contemporaneous correlations with other government spending. That is, by placing the complement fiscal variable in the first position of the Choleski ordering and the shocked spending variable in the second position, we allow for the spending variable being studied to react contemporaneously to shocks in the complement fiscal. In this way we ensure that a shock in, say, wage government consumption is indeed a shock to that variable and not a shock to other measures of government spending that may be correlated with wage government consumption.

Figure 2 shows the responses of real output in the nontradable and tradable sectors for this specification. These are qualitatively similar to baseline result. As in the baseline case, the point estimates of the mean responses in the nontradable sector are statistically significant. By contrast, the point estimates for the response of output in the tradable sector are insignificant. In terms of magnitude, real output responses of the nontradable sector are smaller than in the baseline case for shocks to government investment or government consumption but larger for shocks to wage government consumption.

Another robustness check is to include the debt feedback in the baseline specification. The rationale for this test is that government spending may systematically respond to the level of public debt. That is, higher debt to GDP ratios would generate downward pressure on the level of public expenditure. Examples of studies following this strategy are Beetsma et al. (2008), Bénétrix and Lane (2009) and Bénétrix (2009).

Our results show that nontradable and tradable output responses are qualitatively robust to this change in the empirical specification. In terms of the magnitude of the responses, nontradable output increases more under this specification than in the baseline. However, this difference does not exceed ten percent in most periods of the impulse-response horizon. The output response in the tradable sector is also larger for all government shocks but wage government consumption. For the former shocks, this difference is 35 percent larger (on average)

[7]To compute these differences we take the point estimates of the mean responses. We then test the statistical significance of these using the 1000 impulse responses produced by the Monte Carlo experiment used to derive the error bands.

than in the baseline.

In summary, the overall thrust of the empirical evidence is that increases in government spending are associated with an increase in the size of the nontraded sector relative to the traded sector. Since the expansion is strongest for the market-based nontradables sector, this pattern is not just the result of an expansion in the size of the public sector. It is also noteworthy that the output of the traded sector also expands in response to most types of fiscal shocks. Not surprisingly, the main exception is a shock to wage government consumption, since it is this type of spending that is most heavily concentrated on the non-market element of the nontraded sector.

4 Trade Volumes

As an extra exercise, we also examine the impact of fiscal shocks on the volumes of exports and imports. This is especially relevant in terms of understanding how shifts in the level of traded-sector output may have knock on effects on the levels of exports and imports. The closest precursor is the study of Beetsma et al. (2008) that takes a panel of EU countries and studies the effects of shocks to government absorption on exports and imports (scaled by GDP).

Figure 3 shows the responses of the volumes of exports and imports to these shocks. To identify shocks, we order the government spending in the first position followed by exports and imports in the second and third positions, respectively. The point estimates show that a positive shock to government absorption produces a decline in the volume of exports in the four years that follow the spending shock, while the volume of imports increases. While the point estimates of the mean export responses are statistically insignificant, those for imports are significant on impact and the following five years.

In relation to particular components of government spending, shocks to government consumption produce export and import responses that are qualitatively similar to those produced by aggregate government absorption. However, the contraction in the volume of exports is larger and the increase in imports is slightly smaller. For this shock, the response of imports becomes less significant from a statistical point of view.

A shock to government investment produces the largest increase in imports. Moreover, the statistical significance of its mean point estimate is the largest across all spending shocks (the import response is statistically significant at one percent until year five). Export responses to this shock are not statistically different from zero.

In relation to shocks to wage and non-wage government consumption, these generate quite different responses. On the one side, a shock to wage government consumption leads to a significant contraction in exports and a close-to-zero response of imports. On the other side, a shock to non-wage government consumption produces a close-to-zero export response in the initial years but that become positive at longer horizons. In contrast, there is a positive and very persistent increase in imports at all horizons.

As a robustness check, we re-estimated these responses using the 4-variable specification

described in section 3.4. Figure 4 shows that these responses are robust to this change in the empirical specification. The main difference, however, is present in the import response to a shock in aggregate government consumption. In contrast to the previous case, imports respond negatively to this shock.

Overall, the pattern of results is that fiscal shocks typically lead to an increase in imports and (depending on the exercise in question) a decrease in exports. The increase in imports is consistent with an increased level of domestic aggregate demand, whether from consumption or higher demand for intermediates from firms in the nontraded and traded sectors. A contraction in exports is plausible if the increase in domestic aggregate demand and the decline in the relative size of the traded sector means that domestic firms switch from exporting to meeting demand from domestic customers. We note also that the results of this section are in line with the finding of Beetsma et al. (2008) that government spending shocks are associated with a deterioration in the trade balance for this group of countries.

5 Conclusions

The results in this paper show that fiscal spending shocks generate a shift in the sectoral composition of output. In particular, the typical pattern is that a boost to government spending disproportionately benefits the nontraded sector, with the scale of the effect varying across different categories of government spending. In line with this evidence, the impact of trade volumes is intuitive: imports rise, while exports fall in response to some types of fiscal shock. Accordingly, the main message from this paper is that the analysis of fiscal policy should take into account that fiscal spending shocks may not only affect the overall level of output and the structure of relative prices but also the sectoral composition of output.

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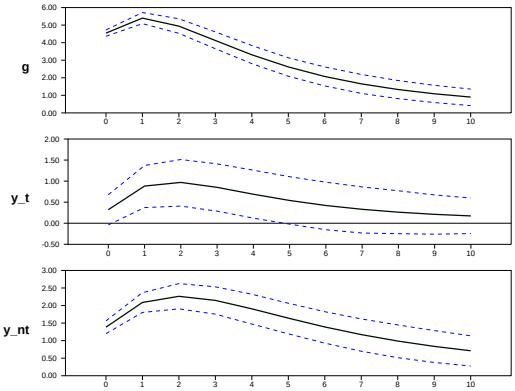
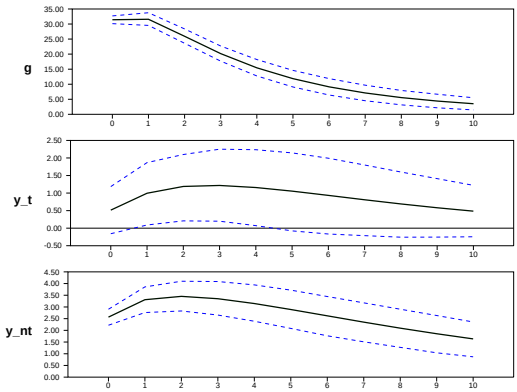
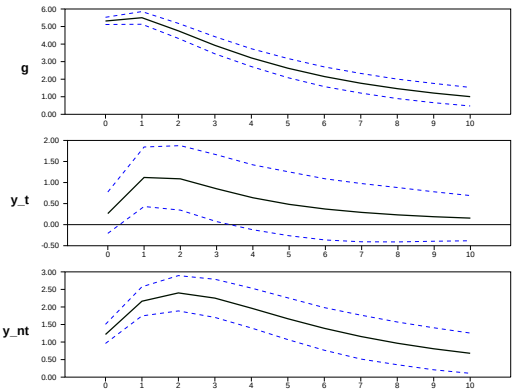
Figure 1: Responses to a spending shock equivalent to 1% of GDP.



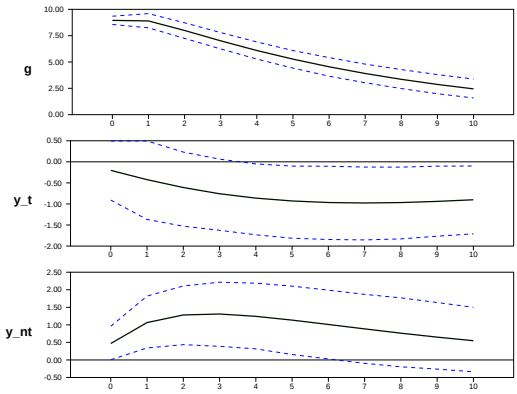
shock in GEXP



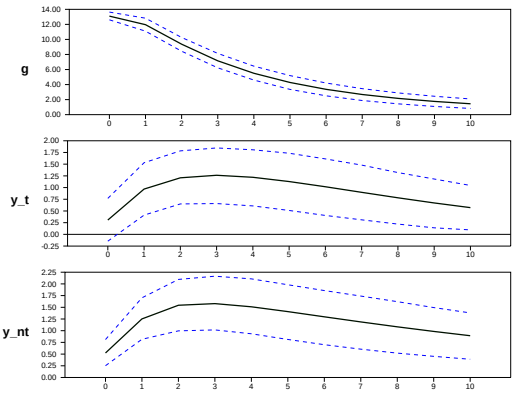
shock in GINV



shock in GC



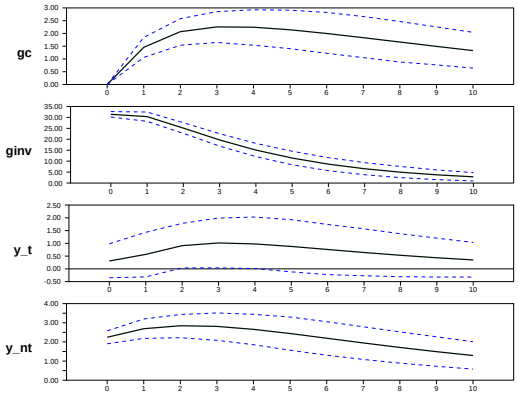
shock in WGC



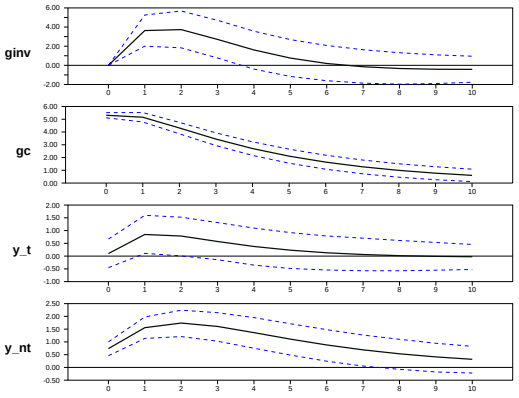
shock in NWGC

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 1000 replications. Vertical axis indicates government spending (g), value added in the tradable sector (Y_t) and value added in the nontradable sector (Y_{nt}).

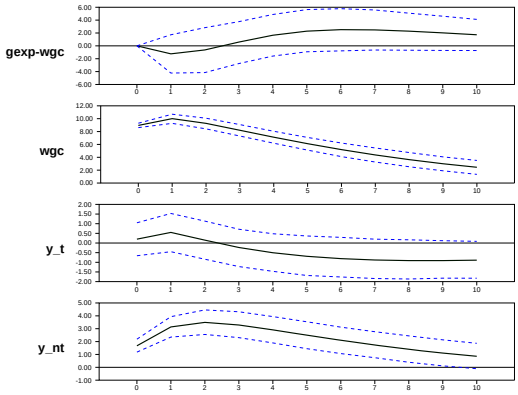
Figure 2: Responses to a spending shock equivalent to 1% of GDP, 4-variable systems.



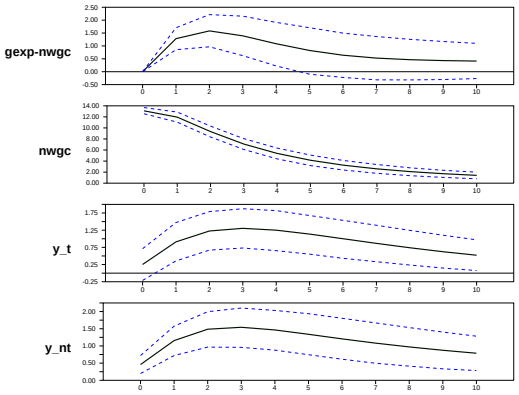
shock in GINV



shock in GC



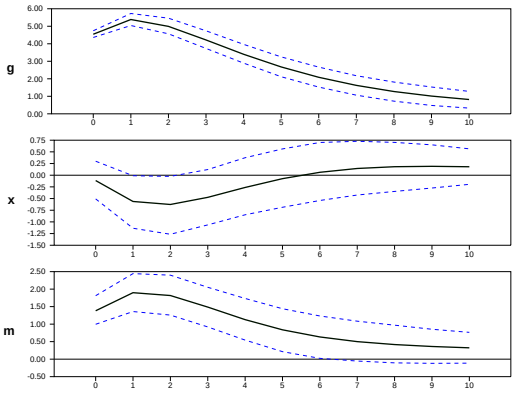
shock in WGC



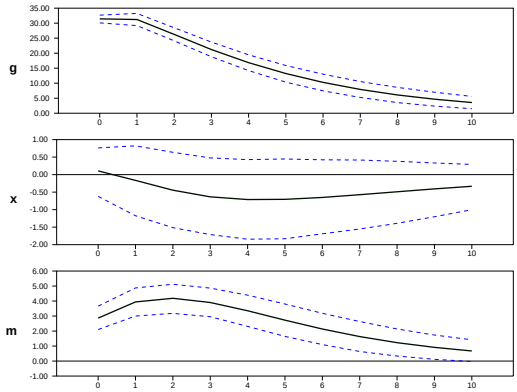
shock NWGC

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), value added in the tradable sector (Y_t) and value added in the nontradable sector (Y_{nt}).

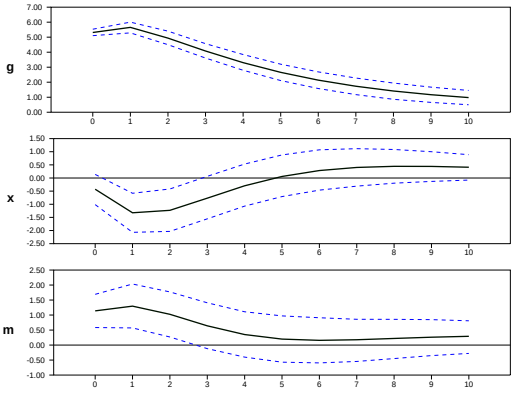
Figure 3: Responses to a spending shock equivalent to 1% of GDP. Exports and Imports.



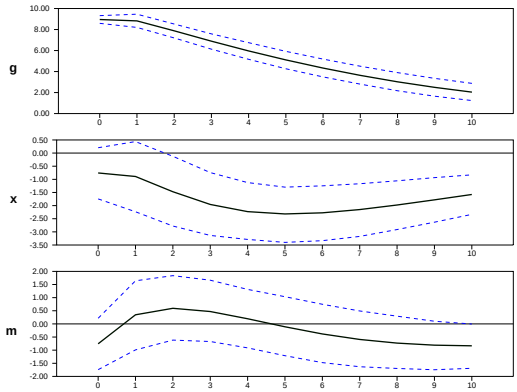
shock in GEXP



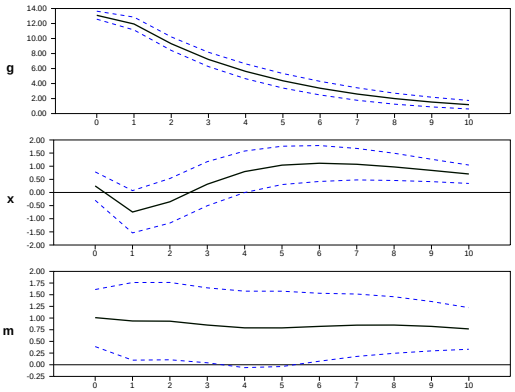
shock in GINV



shock in GC



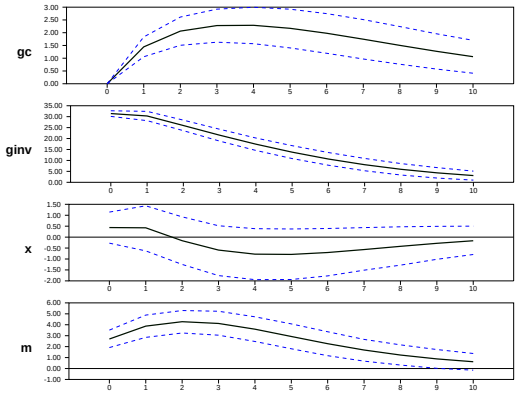
shock in WGC



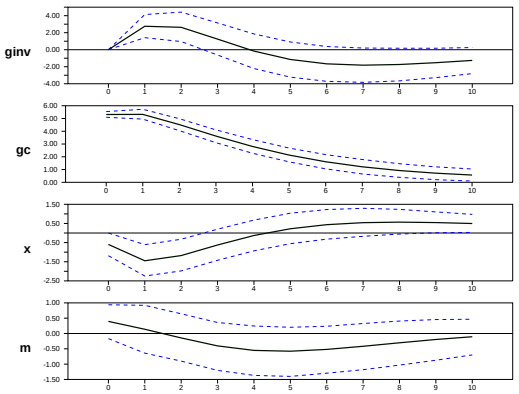
shock in NWGC

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 government spending (g), exports (x) and imports (m).

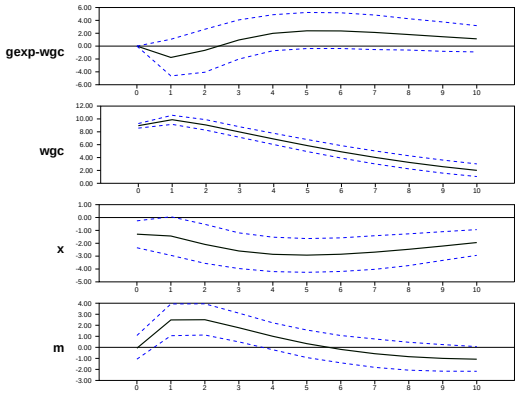
Figure 4: Responses to a spending shock equivalent to 1% of GDP, 4-variable systems. Exports and Imports.



shock in GINV



shock in GC



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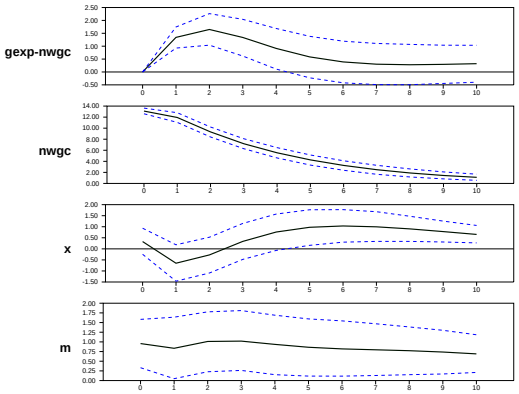

shock NWGC

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), exports (x) and imports (m).

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