The effects of fiscal expansions: an international comparison

Evi Pappa

February 16, 2009

Barcelona Economics Working Paper Series

Working Paper n° 409

The effects of fiscal expansions: An international comparison*

Evi Pappa†

February 16, 2009

Abstract

We compare the transmission of fiscal shocks in four OECD countries and in the Euro area. Fiscal shocks are identified in a SVAR by the restrictions that disturbances to government consumption, government investment and government employment increase output and deficits contemporaneously. These restrictions hold in both prototype RBC and New-Keynesian models. All spending shocks increase private consumption and employment, while the responses of private investment and the real wage are mixed. The output effects of government consumption and investment shocks are smaller than those of government employment shocks for all countries and all samples. The transmission of fiscal shocks has changed features over time.

JEL classification: C11, E12, E32, E62, H30.

Key Words: fiscal policy shocks, SVARs, sign restrictions, stability.

*Evi Pappa, Universitat Autonoma de Barcelona and CEPR, email: evi.pappa@uab.es

†I would like to thank the Spanish Ministry of Education and Science and FEDER through grant SEC2003-306 from the Generalitat de Catalunya through the Barcelona Economics program (CREA) and grant SGR2005-00447 for financial support.

1 Introduction

How does the economy react to fiscal shocks? The answer typically depends on the methodology used to extract fiscal shocks and on the identification restrictions employed. The "Dummy Variable" approach, which considers fiscal shocks as episodes of significant exogenous and unforeseen increases in government spending for national defense (see, e.g., Rotemberg and Woodford (1992), Ramey and Shapiro (1998), Edelberg et al. (1999), Burnside et. el. (2004) and Cavallo (2005) among others) find that a positive shock to spending for national defense makes private consumption and the real wage fall while employment and nonresidential investments increase. The Structural Vector Autoregression (SVAR) methodology, which identifies fiscal shocks by assuming that fiscal variables do not contemporaneously react to changes in economic conditions (see, e.g.,Blanchard and Perotti (2002), Fatas and Mihov (2001) and Perotti (2004)) concludes that private consumption, output, employment and the real wage positively comove with the spending shock. The evidence that the Dummy Variable approach delivers is consistent with basic neoclassical Real Business Cycle (RBC) models which predict that increases in government consumption should crowd out the private sector and reduce the real wage. The evidence of the SVAR approach, on the other hand, is consistent with traditional Keynesian models, which typically predict that an increase in government expenditure should be accompanied by an increase in labor demand, generating an increase in the real wage, in output and consumption.

Perotti (2007) has shown that the different conclusions the two approaches yield are in part due to the strong restrictions that the Dummy variable approach imposes. When these restrictions are relaxed, he finds that the dynamics in response to exogenous government expenditure increases are similar to those of the SVAR literature. Caldara and Kamps (2008), on the other hand, show that part of the differences among approaches is due to important differences in the specification of the empirical model: once these differences are removed, responses to government expenditure shocks look similar in the two approaches.

The Dummy and the standard SVAR approaches are not the only method used to identify fiscal shocks in the empirical literature. For example, Canova and Pappa (2006) and (2007), Pappa (2009) and Mountford and Uhlig (forthcoming) have used sign restrictions to identify fiscal shocks. Sign restrictions are preferable to those of the standard SVAR approach because they are valid with data at any frequency; because they are shared by

models with different microfundations, and because they circumvent problems connected with the endogeneity and the predictability of movements in fiscal variables. The evidence that this literature produces is somewhat mixed, but, in general, shocks to government expenditure tend to increase employment and real wages.

With the exclusion of Perotti (2004) and Canova and Pappa (2007), the focus of the analysis has been on the US, primarily because it is difficult to find comparable international data and because fiscal variables measure different aggregates in different countries. We use quarterly data for Canada, Japan, UK and US from 1970 until 2007 and for the Euro area since 1991. In order to account for potential structural breaks (See, Kim and Nelson (1999), McConell and Perez-Quiros (2000), and Stock and Watson (2003)), we also split the sample at the beginning of the 1980s.

Using a structural VAR for the log of real per capita GDP, the log of real per capita government expenditure in either (a) goods purchases, (b) capital outlays, or (c) government employment and the log of real per-capita net tax revenues, the log of average real production wage per job, the log of total employment, the log of real per capita private consumption and investment, a measure of a short term interest rate and oil prices we identify fiscal shocks using sign restrictions. The identification scheme is based on the idea that shocks to government spending raise output and the deficit contemporaneously. We show that the impact responses of output and the deficit to government consumption, government investment and government employment disturbances satisfy these restrictions in both a prototypical RBC and a New-Keynesian model and that these restrictions do not typically hold for other disturbances, such as technology, or monetary policy shocks. Since tax cuts might also increase output and deficits, we require a zero or small positive correlation between the identified shock and tax revenues, so as to exclude the possibility that the identified shocks are combinations of government spending and tax cut shocks. Once shocks are identified, we examine the dynamics of the other macroeconomic variables in response to the fiscal shocks.

Our findings can be summarized as follows. All spending shocks typically increase private consumption contemporaneously and employment with some delay. The responses of private investment and real wages are mixed. However, at least in response to government employment shocks, the real wage increases on impact in all the countries. Hence, our results appear to reinforce those of the standard SVAR literature and, notwithstanding the

criticism of Chari et. al. (2005), they appear to be broadly in line with the predictions of Keynesian models.

In all the countries, government employment shocks have the largest output multiplier, regardless of the horizon we consider. Interestingly, government consumption shocks have small output multiplier in all countries, but the US and Canada where, in fact, medium run output multipliers are larger than one. Government investment shocks generate medium run output multipliers larger than one only in Japan, while for government employment shocks multipliers are larger than one for all countries and all horizons. When we split the sample, to take into account potential time heterogeneity problems, we find that the transmission of fiscal policy shocks has changed over time. In particular, we find that the effects of government investment shocks on output and its components have significantly declined over time, while the effects of government employment shocks have been strengthened in the post 1980 period and that the transmission of fiscal shocks to the labor markets display a significant change since the early 1980s.

We believe the facts we uncover are useful to policymakers in at least two ways. First, they highlight that unexpected expansions in government employment are the most effective tool for stimulating output in all the five economies we consider. Contrary to the common wisdom, increases in government investments do not generate stronger output effects at the horizons of interest. However, since they are likely to increase labor productivity and private investment more than government consumption shocks, they enjoy longer run implications that the other type of shocks do not have. Second, the facts we uncover stress that the expansionary effects of government investment shocks have been significantly reduced during the last two decades, while the opposite is true for government employment shocks. This change provides additional support for using unexpected government employment expansions to stimulate economies in difficulties.

The rest of the paper is organized as follows: The next section describes the methodology for extracting fiscal shocks. Section 3 presents the econometric framework. Results appear in section 4 and section 5, and Section 6 concludes.

2 Identifying fiscal shocks: The methodology

The methodology used to extract fiscal shocks in the data consists of four steps:

1. We establish that shocks to government expenditures for consumption, investment and employment increase output and the deficit contemporaneously both in a prototypical flexible price RBC and in a New-Keynesian sticky price setup for a wide range of parameterizations.

2. We establish that the restrictions used to identify fiscal shocks cannot be produced by other shocks.

3. We identify fiscal shocks in the data imposing model-based restrictions.

4. We study the effects of the identified fiscal shocks on key macroeconomic variables.

2.1 The Model

Following Finn (1998), we distinguish between government expenditure for consumption and investment, and also consider government employment (wage) expenditures. The model features a single final good and productive government inputs[1]. There are five agents in the economy: a representative household, a final good firm, a continuum of monopolistically competitive intermediate good firms, a monetary and a fiscal authority.

Households

Households derive utility from private consumption, C_t^p, public consumption, C_t^g and leisure, $1 - N_t$. Their preferences are defined by:

$$E_0 \sum_{t=0}^{\infty} \beta^t u(C_t^p, C_t^g, N_t) = E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[\left\{ \omega C_t^{p\frac{\eta-1}{\eta}} + (1-\omega) C_t^{g\frac{\eta-1}{\eta}} \right\}^{\frac{\phi\eta}{\eta-1}} (1-\lambda_{nt} N_t)^{1-\phi} \right]^{1-\sigma} - 1}{1-\sigma} \tag{1}$$

where $0 < \phi, \omega < 1$, and $\sigma > 0$ are preference parameters, $0 < \beta < 1$ is the subjective discount factor and λ_{nt} is a labor supply shock.

Public consumption is regarded as exogenous. The degree of substitutability between private and public consumption is regulated by η. The share parameter ω determines how much public consumption affects utility: when $\omega = 1$, public consumption is useless from the agents' point of view. Available time is normalized to unity each period. Households have

[1] Although the one-sector framework may seem restrictive, Pappa (2009) shows that it provides a good approximation of a more general two-sector set-up, in which one sector produces private goods using private inputs and the other produces public goods using public inputs.

access to a complete set of nominal state-contingent claims and maximize their objective function subject to an intertemporal budget constraint that is given by:

$$P_t((1+\tau^c)C_t^p + I_t^p) + B_{t+1}R_t^{-1} \leq (1-\tau^l)P_t w_t N_t + [r_t - \tau^k(r_t - \delta^p)]P_t K_t^p + D_t + B_t - T_t P_t + \Xi_t \tag{2}$$

Current income consists of after tax nominal labor income, $(1-\tau^l)P_t w_t N_t$; after tax nominal capital income (allowing for depreciation), $[r_t - \tau^k(r_t - \delta^p)]P_t K_t^p$; the net cash inflow from participating in state contingent securities at time t, denoted by D_t; the dividends derived from the imperfect competitive intermediate good firms Ξ_t, minus nominal lump-sum taxes, $T_t P_t$. Households hold their financial wealth in terms of government bonds, B_t. Total income can be used for private consumption C_t^p, which is subject to a tax τ^c and investment I_t^p. Private capital accumulates according to:

$$K_{t+1}^p = I_t^p + (1-\delta^p)K_t^p - \xi\left(\frac{K_{t+1}^p}{K_t^p}\right)K_t^p \tag{3}$$

where δ^p is a constant depreciation rate and $\xi\left(\frac{K_{t+1}^p}{K_t^p}\right) = \frac{b}{2}\left[\frac{K_{t+1}^p - (1-\delta^p)K_t^p}{K_t^p} - \delta^p\right]^2$, where b determines the size of the adjustment costs that private capital is subject to. Since households own and supply capital to the firms, they bear the adjustment costs.

Production

Final good firm In the production sector, a competitive firm aggregates intermediate goods into a final good using the following constant-returns-to-scale technology:

$$Y_t = \left[\int_0^1 Y_t(j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{4}$$

where $\varepsilon > 1$ is the constant elasticity of demand for intermediate goods. The final good can be used for private and government consumption and investment.

Intermediate firms There is a continuum of intermediate good firms in the (0,1) interval. Each intermediate firm j produces output according to:

$$Y_t(j) = (Z_t N_t^p(j))^{1-\alpha} K_t^p(j)^{\alpha} (K_t^g)^{\mu} (N_t^g)^{\nu} \tag{5}$$

where $K_t^p(j)$ and $N_t^p(j)$ are private capital and labor inputs hired by firm j, Z_t is an aggregate technology shock and K_t^g and N_t^g are the government's capital and labor inputs, respectively. The parameters μ and ν regulate how public inputs affect private production: when $\mu(\nu)$ is zero, government capital (employment) is unproductive.

We assume that firms are perfectly competitive in the input markets [2]: they minimize costs by choosing private inputs, taking wages, the rental rate of capital, government employment and capital as given. Since firms are identical, they all choose the same amount of private inputs and cost minimization implies: $\frac{K_t^p}{N_t^p} = \frac{\alpha}{(1-\alpha)}\frac{w_t}{r_t}$. The common (nominal) marginal costs are $MC_t = \frac{1}{\Upsilon} Z_t^{\alpha-1} K_t^{g(-\mu)} N_t^{g(-\nu)} w_t^{1-\alpha} r_t^{\alpha} P_t$, where $\Upsilon = \alpha^{\alpha}(1-\alpha)^{1-\alpha}$.

In the intermediate goods market firms are monopolistic competitors. The strategy firms use to set prices depends on whether prices are flexible or sticky. In the latter case we use the standard Calvo (1983) setting and denote by $(1-\gamma)$ the probability for an intermediate good producer to reset her price. When a producer receives a signal to change her price, she chooses her new price, P_t^*, to maximize:

$$\max_{P_t^*} E_t \sum_{k=0}^{\infty} (\beta\gamma)^k q_{t+k} (P_t^* - MC_{t+k}) Y_{t+k}(j) \tag{6}$$

subject to the demand curve for type j good $Y_{t+k}(j) = \left(\frac{P_t^*}{P_{t+k}}\right)^{-\varepsilon} Y_{t+k}$, where q_t is the marginal value of a currency unit to the household, which is treated as exogenous by the firm.

The solution to the profit-maximizing problem gives the optimal pricing rule:

$$P_t^* = \frac{\varepsilon}{\varepsilon - 1} \frac{\mathrm{E}_t \sum_{k=0}^{\infty} (\beta\gamma)^k q_{t+k} MC_{t+k} Y_{t+k}^d(j)}{\mathrm{E}_t \sum_{k=0}^{\infty} (\beta\gamma)^k q_{t+k} Y_{t+k}^d(j)} \tag{7}$$

and the aggregate price index evolves according to $P_t = [\gamma P_{t-1}^{1-\varepsilon} + (1-\gamma) P_t^{*1-\varepsilon}]^{\frac{1}{1-\varepsilon}}$.

For the flexible-RBC version of the model, the fraction of firms that can reset their price at each t is equal to one and prices are set as a constant markup over marginal costs[3].

[2] The sign of the responses used for identification are independent of the presence of sticky wages, or labor unions, and, hence, this assumption is not essential for our analysis.

[3] Usually a subsidy $\tau^{\varepsilon} = -(\varepsilon - 1)^{-1}$ that neutralizes the monopolistic competitive distortion is assumed. We do not use this assumption for two reasons. First, it is not necessary for comparing the two models. As shown by Hornstein (1993), the qualitative implications of a monopolistic competitive RBC model are identical to those of a competitive one. Second, such a subsidy would predict strong procyclicality in deficits which is inconsistent with the empirical evidence.

Fiscal Policy

Government's income consists of tax revenues and the proceeds from new debt issue; expenditures consist of consumption and investment purchases, salaries and wages, and repayment of debt. The government budget constraint is:

$$P_t(C_t^g + I_t^g + w_t N_t^g) - \tau^c P_t C_t^p - \tau^l w_t P_t N_t - \tau^k (r_t - \delta^p) P_t K_t^p - P_t T_t + B_t = R_t^{-1} B_{t+1} \quad (8)$$

where I_t^g is government's investments. The government capital stock evolves according to:

$$K_{t+1}^g = I_t^g + (1 - \delta^g) K_t^g - \xi \left(\frac{K_{t+1}^g}{K_t^g} \right) K_t^g \quad (9)$$

where δ^g is a constant depreciation rate and the functional form of $\xi(.)$ which controls adjustment costs to public capital is the same as in the private sector.

Since we focus on the effects of spending shocks, we treat tax rates on labor and capital income and on consumption parametrically. We also assume that the government takes market prices, private hours and private capital as given, and that B_t endogenously adjusts to ensure that the budget constraint is satisfied.

The government may use each of the expenditure components to react to changes in output growth. In particular, if $\Psi^g = C^g, I^g, N^g$ denotes the different expenditure components, we assume fiscal rules of the form:

$$\Psi_t^g = \overline{\Psi}^g \Psi_{t-1}^{g \, \boldsymbol{\varrho}_g^{\psi}} \exp(\boldsymbol{\varrho}_g^{\psi y} \Delta y_t + u_t^{\psi^g}) \quad \text{where } \Psi^g = C^g, I^g, N^g \quad (10)$$

where Δy_t is output growth and $u_t^{\psi^g}$ is a zero-mean, white noise disturbance.

In order to ensure determinacy of equilibrium and a non-explosive solution for debt (see e.g., Leeper (1991)), we assume a debt targeting rule of the form:

$$T_t = \overline{T} \exp(\zeta_b (b_t - \overline{b})) \quad (11)$$

where $\overline{b}$ is the steady state level of $b_t = \frac{B_t}{Y_t}$.

The predictions we derive do not depend on the exact fiscal rule we assume. Moreover, the rule in (11) implies that deficit in equilibrium is small in size and has low volatility. This feature of (11) is important since our empirical analysis examines data where, implicitly, or explicitly, fiscal rules may require balance budgets, see for example, the Maastricht treaty in the Euro area, the Federal Spending Control Act in Canada and the Fiscal Consolidation

Agreement in Japan. In the US Bohn (1998) has found that the debt to GDP ratio is mean reverting and that US fiscal policy satisfies an intertemporal budget constraint. For more recent evidence on the issue, see Favero and Giavazzi (2007) and Chung and Leeper (2007).

Monetary Policy

There is an independent monetary authority which sets the nominal interest rate as a function of current inflation, according to the rule:

$$R_t = \overline{R} \exp(\zeta_\pi \pi_t + \epsilon_t^R) \tag{12}$$

where ϵ_t^R is a monetary policy shock and π_t measures inflation in deviation from the steady state. Adding a weight in output growth, or to output gap stabilization in the monetary policy rule would not change qualitatively the dynamics to fiscal shocks. We do not include it here since the UK and Canada have explicitly adopted an inflation targeting regime and, as Gambetti and Pappa (2008) showed, also Japan, the Euro area and the US behave very much like inflation targeters.

Closing the model

There are two types of aggregate constraints: labor supply must equate labor employed by the private and the public sectors:

$$N_t = N_t^p + N_t^g \tag{13}$$

Aggregate production must equal private and public demand:

$$Y_t = C_t^p + I_t^p + C_t^g + I_t^g \tag{14}$$

The model features six exogenous disturbances. The shocks to the fiscal rules for each government component described in (10), a productivity, a labor supply and a monetary policy shock. The vector of the non-fiscal shocks, $S_t = [Z_t, \lambda_{nt}, \epsilon_t^R]'$, is parametrized as:

$$\log(S_t) = (I - \boldsymbol{\varrho}) \log(\overline{S}) + \boldsymbol{\varrho} \log(S_{t-1}) + V_t \tag{15}$$

where V is a (3x1) vector of innovations, I is a (3x3) identity matrix, $\boldsymbol{\varrho}$ is a (3x3) diagonal matrix and $\overline{S}$ is the mean of S. The innovation vector V is a stationary, zero-mean, white noise process and the roots of $\boldsymbol{\varrho}$ are all less than one in modulus.

We solve both models by approximating the equilibrium conditions around a non-stochastic steady state in which all prices are flexible and inflation is zero.

2.2 Robust restrictions

In this step we are seeking for theoretical restrictions that are robust across models and parameterizations. An implication is called robust if it holds independently of parameterization and of the functional forms for the primitives used and the assumption on nominal rigidities. Robustness is not generic since many dynamic properties are sensitive to the exact parameterization employed and to specific features added or subtracted to the model. Here, we establish that the restrictions on output, deficit and the spending component after a government spending shock are similar in both RBC and NK models, regardless of the parameterization used, and cannot be generated by other shocks in the model.

Formally speaking, let $h(y_t(\theta|x_t)))$ be a $J \times 1$ vector of functions of the data y_t produced by the model, when the $N \times 1$ vector of structural parameters θ is employed, conditional on the shock x_t. We let θ be uniformly distributed over Θ, where $\Theta = \prod_i \Theta_i$ is the set of admissible parameter values and Θ_i is an interval for each parameter i. We draw $\theta_i^l, i = 1, \ldots, N$ from each Θ_i, construct $h(y_t(\theta^l|x_t))$ for each draw $l = 1, \ldots, 10000$ and order them increasingly. Then $h_j(y_t(\theta|x_t))$, $j = 1, \ldots J$ is robust if $sgn[(h_j^U(y_t(\theta|x_t))] = sgn[h_j^L(y_t(\theta|x_t))]$, where h^U and h^L are the 84 and 16 percentiles of the simulated distribution of $h(y_t(\theta|x_t))$.

Since we restrict the range of Θ_i on the basis of theoretical and practical considerations and draw uniformly, our approach is intermediate between calibrating the parameters to a point and assuming informative subjective priors (see, e.g., Schorfeide (2000)). Our approach also formalizes, via Monte Carlo methods, standard sensitivity analysis conducted in calibration exercises.

Parameter ranges

The model period is a quarter. We let $\theta = (\theta_1, \theta_2)$, where θ_1 represents the parameters which are fixed to a particular value, either to avoid indeterminacies or because of steady state considerations, while θ_2 are the parameters which are allowed to vary. In the first set of parameters we have the discount factor, which is set so that the annual real interest rate equals 4%, while $\overline{b}$ is chosen so that the debt to output ratio in the model matches an average value of 40% in the data. Table 1 gives the ranges for the parameters in θ_2. The intervals for most parameters are centered around calibrated values and include values that have been either estimated in the literature, or assumed in calibration exercises.

2.3 Dynamics

Figure 1 plots pointwise 68-percent probability bands for the responses of output, the deficit, private consumption and investment and total employment and the real wage to a one percent increase in government consumption (first column), government investment (second column) and government employment (last column) when parameters are allowed to vary over the ranges reported in Table 1. Solid lines represent response bands obtained in the RBC version of the model; dotted lines represent response bands of the sticky price version of the model.

All the fiscal shocks we consider increase output and deficits contemporaneously in both models, while the responses of private consumption and investment, real wages and employment differ depending on the parameters regulating price flexibility, the productivity of public inputs and preferences.

A shock to government consumption

A positive government consumption shock, financed by a deficit increase, increases labor supply contemporaneously because of a negative wealth effect: households feel poorer because the fiscal expansion lowers their income. Since leisure is a normal good, labor supply rises. In turn, given the unchanged labor demand, this increase induces a decline in real wages and an expansion of output in the flexible price model. Private consumption can move in any direction after an expansion of government expenditure, while private investment falls. The sign of private consumption responses in the impact period depends on the size of the wealth effect and hence on ω and the degree of substitutability/ complementarity between private and public goods, η. While it is known that persistent government consumption shocks crowd-out private consumption (especially when $\omega = 1$), it is typical to find small, or insignificant negative responses of private investments to such disturbances (see Baxter and King (1993), Ludvingson (1996)) unless the government shock is permanent. Since we do not allow for permanent shocks, positive investments responses fail to appear in our simulations. In principle, the increase in employment increases the expected return of capital and therefore might stimulate investment, regardless of the persistence of the shock. However, the unitary elasticity of substitution between capital and labor in production implies that this effect, if it exists, is quite small. Hence, investment falls after

the shock due to the increased absorption of resources.

In the sticky price model output is mainly demand determined. Hence, an increase in government spending financed by a deficit increase, increases labor demand and output. Since private consumption declines for some parameterizations, a negative wealth effect that shifts the labor supply curve to the right must be present also in this case. However, the demand effect is, in general, much stronger and the increase in labor demand pushes real wages up. Note that, quantitatively, the increases in employment, output and private consumption are larger than those obtained in the RBC model. Here the upper range of the response band of private consumption is larger than the one obtained in the RBC model. This is because increases in government consumption may raise expectations of future inflation typically making agents consume more immediately. Gali et al. (2007) have argued that the latter mechanism is not enough to generate positive responses in private consumption to a government consumption shock and suggest that a combination of price rigidities and "rule of thumbconsumers" can bring about such private consumption responses. Here it is the complementarity between public and private consumption that produces such a pattern of responses (See also, Bouakez and Rebei (2007)). A sticky price model can also generate positive responses of private investment after a government consumption shock since the higher increase in employment relative to the RBC case raises substantially the expected return of capital.

A shock to government investment

The contemporaneous responses induced by government investment shocks are qualitatively similar to the ones produced by a government consumption shock for both models, but the lagged effects are quite different. An increase in government investment has two contrasting effects on private wealth. The first, similar to the one produced by government consumption shocks, is contractionary, since government absorption increases. The second is expansionary, since a higher I_t^g increases public capital and, thus, enhances the productivity of private factors. Clearly if, $\mu = 0$ and $\omega = 0$, the latter effect disappears and the responses to the government consumption and investment shocks would be identical. When μ is very high, the positive effect dominates. The second column of Figure 1 shows that the contractionary effect dominates in the impact period in the RBC model but as time goes by the expansionary effect comes into play. As a result, private consumption, investment and real wages all

reduce on impact, but become positive in periods subsequent to the shock. In the NK model, the two wealth effects present in the RBC model interact with the positive demand effect induced by price stickiness. In the impact period, the demand effect is stronger leading to an increase of output, real wages and employment, while in subsequent periods the positive effect induced by the larger stock of public capital leads to persistent increases in output and real wages. In both models, however, the effect of government investment shocks in output and its components and employment are quite limited and more persistent relative to the case of government consumption shocks. Both these features are due to the accumulative effect of public investment in public capital that affects future private's sector productivity. That is, the positive wealth effect induced by future increases in public capital reduces the impact of the shock in the labor supply in the RBC model, and in the labor demand in the sticky price model (since the shock increases future output for constant private inputs and output is demand determined), consequently decreasing the overall impact of the shock on output.

A shock to government employment

An increase in government employment also has a negative effect on private wealth, since it expands the government's usage of private resources. This negative wealth effect tends to increase labor supply. However, while total employment increases, there is a sectoral reallocation involving a shift of labor out of the private sector and into the government sector. Also, real wages increase since for given capital stock, private employment falls. Other things equal, the decrease in private employment should cause also output to contract. However, the productive nature of public employment deters this and output generally increases in the impact period of the shock when prices are flexible. Increases in government employment tend to be expansionary and increase private consumption and investment since they increase the marginal product of private capital and the real wage.

The mechanics of transmission of shocks to government employment are similar in the NK model. Increases in government employment increase output and real wages, yet, the productive nature of government employment coupled with price stickiness narrows the range of responses of these variables relative to the previous shocks. This is because the increase in productivity due to increases in the government employment increases output for constant private inputs. Although the increase in government absorption increases demand,

firms do not need to augment their labor input in response to the shock. Actually, for some parameterization they can even decrease it. As a result, real wages and output do not increase by as much as in the RBC model and total employment may even fall. The higher is the productivity of public employment, ν, and/or the degree of price stickiness, γ, the stronger the need to decrease private labor demand after a shock to public employment and, thus, the more likely is aggregate employment to fall. Private consumption and investment increase also under sticky prices both because the increase in the public input increases the returns to the private inputs and because of the induced increase in inflationary expectations from the rise in government's absortion.

2.4 Other disturbances

To make sure that the identifying restrictions we use are not a feature of other shocks, figure 2 presents the dynamics induced by technology, labor supply and monetary shocks on output, deficits and the components of government expenditure. In particular, the figure plots pointwise 68-percent probability bands for the responses of output, the deficit and the different fiscal spending components obtained in the RBC (solid line) and the NK (dotted line) versions of the model. The effects of technology shocks are in the first column, of labor supply shocks in the second column and of monetary shocks in the last column of the figure. For all shocks and in both versions of the model the responses of the deficit are key for distinguishing fiscal disturbances from other shocks: fiscal shocks increase deficits; the other shocks decrease them at least on impact.

A negative shock to the tax rate could also increase both output and deficits. Hence, one may wonder whether the disturbances we identified as shocks that move government spending, output and deficits in the same direction could potentially be a combination of positive government spending and negative tax shocks. To avoid this possibility, in the exercises we have conducted we require a zero or (small) positive correlation between the identified shock and tax revenues. Positive correlation may arise since government spending shocks increase output and therefore tax revenues. On the other hand, tax cuts on the left side of the Laffer curve will decrease tax revenues. Tax cuts that occur on the right side of the Laffer curve may increase tax revenues, but given a level of expenditure, deficits must decrease. In this situation, deficits can increase only if the increase in government spending is larger than the increase in tax revenues. Hence, by requiring that government spending

and tax revenues are not highly positively correlated such event can be excluded.

We think this assumption is reasonable since tax cuts accompanied by contemporaneous increases in expenditures are events rare in our sample (with the exception of the Reagan tax cut).

2.5 Identifying restrictions

To summarize, the responses of output and the deficit to fiscal shocks are qualitatively similar in the RBC and the New Keynesian versions of the model. Hence, we will use sign restrictions on the contemporaneous effect of spending shocks on output and deficits to identify the disturbances of interest. To avoid the possibility of indentifying a combination of positive expenditure and negative tax shocks we also require a zero or (small) positive correlation between the identified shock and tax revenues. Once the disturbances are obtained, we trace out their effect on interesting macroeconomic variables.

3 The Econometric framework

3.1 The reduced form model

The reduced form model contains nine variables and a constant: The log of real per capita GDP, the log of real per capita government expenditure in either (a) goods purchases, defined as government expenditures minus government wage expenditures, minus transfers and minus debt interest payments (b) capital outlays, given by real government fixed investment (c) government employment, given by government wage expenditure; the log of real per-capita net tax revenues, the log of average real production wage per job, the log of total employment, the log of real per capita private consumption and investment, a measure of a short term interest rate and oil prices. We treat the latter as exogenous, and the remaining eight variables as endogenous.

As mentioned, we use quarterly real, seasonally adjusted data for Canada, Japan, the US and the UK from 1970 to 2007 and data for the Euro area from the first quarter of 1991 to 2007. The series come from the OECD Economic Outlook, the IMF International Financial Statistics and the FRED databases. Output is measured by real gross domestic product, consumption by real total private consumption and investment by real private fixed investment, which excludes changes in inventories. Total employment series were

constructed by multiplying the employment rate with the labor force, while for the real wage we have used four alternative definitions: (a) wages and salaries of employees divided by the GDP deflator, (b) wages and salaries of employees divided by the CPI index, (c) gross wages received by the employee divided by the GDP deflator and (d) gross wages received by the employee divided by the CPI index. Since conclusions are similar, we present results using option (a) as a measure of the real wage.

Since all data sets are short, we limit the lag length of the VAR to four. We have examined several variants of the model (e.g. a VAR with revenues and expenditures in percentage of GDP, a model where we include the log of debt to GDP ratio as an endogenous variable, a model in which we control for net exports as a percentage of GDP, or for the exchange rate and a model where variables are expressed in growth rates (but not per-capita terms)). The results we present are unaffected by all of these changes.

3.2 Identifying the shocks

To identify the shocks in the data, we employ the theoretical sign restrictions we have derived only in the impact period, since as shown in Figures 1 and 2 the short run dynamics of output and the deficit are typically sensitive to parameter choices.

Let Σ be the covariance matrix of the VAR shocks and let $PP' = \Sigma$ an orthogonal decomposition of Σ. Then, structural shocks ε_t are constructed as $\varepsilon_t = P^{-1}u_t$, where u_t are reduced form shocks and, for each element of ε_t, we check if the required restrictions are satisfied. If no structural shock produces the required comovements in the variables, the orthogonal decomposition is rotated by an orthonormal matrix $H(\lambda)$, with $H(\lambda)H(\lambda)' = I$, where λ measures the angle of rotation, and the comovements in response to the new set of shocks is examined (see Canova (2007)). This search process continues, randomly varying λ in the range $(0, \pi)$, and randomly rotating the columns of $H(\lambda)$. Since many $H(\lambda)$'s can in principle produce the required pattern, the error bands we report reflect not only the uncertainty in Σ and the reduced form parameter estimates but also how responses vary with different λ's and H's.

Besides making the link between the model and the data tighter, the use of robust sign restrictions avoids, in principle, typical problems associated with the identification of economically meaningful fiscal shocks. In particular, problems concerning the endogeneity of fiscal variables, the delays between planning, approval and implementation of fiscal

policies, which may give rise to predictability problems and the scarceness of reasonable zero-identifying restrictions are to a large extent solved. In fact, all relevant variables are endogenous here and since we control for the state of the business cycle, there is no need to produce cyclically adjusted estimates of fiscal variables. Furthermore, since theory defines the features of the fiscal disturbances we are looking for and the timing of the responses of the endogenous variables is largely unrestricted, the other two problems are also considerably eased. Sign restrictions resolve to some extent the problem of predictability of fiscal shocks since identification does not rely on delay restrictions. Finally, since monetary policy and fiscal shocks move deficits in opposite directions the question of fiscal and monetary policy interaction does not arise when identifying fiscal shocks.

4 The Full Sample Evidence

We present the responses of output, private consumption and investment, real wages and employment to a 1% increase in government spending on consumption, investment and government employment in Figures 3, 4 and 5. Each box presents median estimates (solid line) and pointwise 68-percent probability bands (dotted lines).

4.1 A shock to government consumption

The responses in Figure 3 are quantitatively and qualitatively different across countries: A government consumption shock generates sizeable responses in the US, while the effects in the rest of the countries are, at best, moderate. In these economies, the responses of almost all variables are comparable in terms of size, except for investment.

The sign of the impact responses of private consumption and real wages is similar across countries and both variables increase. Total employment increases on impact in all units but the UK and the US, where employment responses are negligible on impact and become significant about six quarters after the shock. The responses of private investments are mixed. Government consumption shocks crowd private investment out in the Euro area, in Japan and the UK, while they crowd in private investment in Canada (significantly) and the US. The output responses to this shock are larger in these two countries, probably as a consequence of this effect.

Hence, government consumption shocks significantly increase output, private consump-

tion, employment and the real wage in most units. The responses of private investment are, however, heterogeneous and outside the North American continent these shocks tend to crowd private investment out.

4.2 A shock to government investment

The responses of macroeconomic variables to surprise increases in government investment are comparable in size and, surprisingly, no more persistent than those produced by increases in government consumption.

The responses of output and private consumption are similar across countries. Both variables contemporaneously increase after the fiscal shock, the increase is significant and the magnitude of the response comparable in the five countries. Responses in Canada, Japan and the Euro area display a hump shaped pattern; in the UK and the US the impact response is the largest and the effect lasts approximately one year. Comparatively speaking, and except for the US, shocks to government investment and government consumption induce similar quantitative effects.

The responses of private investment are mixed. Shocks to government investment have negligible impact effects on private investment in the UK and the US, while in the other three countries the effect is positive (on impact in Canada and the Euro area, and with some delay in Japan).

Shocks to government investment significantly increase employment and the real wage in Canada, UK and the Euro area, but generate no significant effects in the US. In the UK employment responses are insignificant at all horizons, while the response of the real wage is significantly negative only on impact. Quantitatively speaking the labor market effects of these shocks are smaller than those induced by government consumption shocks.

As for the case of government consumption shocks, US responses to government investment shocks are different than in the other four countries. Hence, it seems very important to have a cross country perspective when evaluating the effects of fiscal shocks and the relevance of various theories of the business cycle.

4.3 A shock to government employment

The shape of the responses to government employment shocks is heterogeneous across countries. Nevertheless, government employment shocks have sizeable effects in both the goods

and the labor markets of all countries. The effects of the shock are stronger in the Euro area, Japan and the UK, while they are more moderate in Canada and the US. Interestingly, government employment shocks generate sizeable and persistent deficit responses, especially in the former three economies. Hence, in terms of present value balance calculations, these appear to be the shocks needing the largest adjustments in other parts of the government budget.

Output increases substantially and significantly in all units for several quarters. Consumption tracks output responses and it increases significantly in all units, but the US. Private investment responses are, once again, heterogeneous: they are positive and significant in Canada, the Euro area and the UK, positive and insignificant in the US and negative but hardly significant in Japan.

Government employment shocks positively affect the real wage in all the countries. However, the timing at which the responses become significant varies across countries. For example, in the US responses are significant only on impact; in the Euro area and Japan they are significant on impact and several quarters after the shock; in Canada it takes some quarters before the response of real wages becomes significant; in the UK real wage responses become significant one quarter after the shock.

The responses of employment are relatively similar: they are all positive (except for a negative delayed effect in the Euro area), significant and persistent and reach their peak at different time horizons in the different countries. In the Euro area and in the US the peak is three quarters after the shock; in Canada, Japan and the UK it is six quarters after the shock. Relative to the other two shocks, the real wage and employment responses are quantitatively much stronger in all countries.

4.4 Summary and discussion

To summarize, shocks to different government expenditure components expand economic activity across countries but they also generate heterogeneous responses of certain macrovariables across countries. Surprise increases in any component of government spending are expansionary in Canada and the US. In the Euro area they are expansionary: but only temporarily so (the positive impact on private consumption, investment and employment is reversed in subsequent periods). In Japan deficit financed fiscal expansions expand output, private consumption and employment but generally crowd out private investment. In the

UK fiscal expansions increase output and private consumption, but employment and private investment expand only after employment shocks.

Can the different economic and institutional characteristics of the five economies explain the cross country differences in the responses? The degree of openness, the monetary regime, or the relative size of the government do not seem to matter for the patterns of impulse responses. For example, in small open economies, like Canada and the UK, government consumption and investment shocks induce output dynamics which are comparable to those of the US or the Euro area. On the other hand, the size of the government is relatively smaller in Japan and the US than in the rest of the countries, but there is no pattern in the responses that can be associated with such a variable. Similarly, the responses of the macrovariables to fiscal shocks appear to be largely independent of the monetary policy regime a country follows.

4.5 Output multipliers

To compare the effect of the various types of fiscal shocks, we present in table 2 the annualized cumulative output multipliers on impact, one and three years after the shock. Multipliers are computed by multiplying the response of output with the sample mean of the share of each fiscal component in GDP, dividing by four and then cumulating up to the required horizon.

Regardless of the horizon we consider, shocks to government employment have the largest output multipliers. Except for Japan, government investment shocks are the least effective in stimulating the real economy and output multipliers are never larger than one. Fatas and Mihov (2001) find that shocks in government consumption induce a higher multiplier than shocks to government investment in the US. Our analysis shows that their result holds for other economies as well, except for Japan.

Finally, for almost all the shocks and all the countries, the three years ahead multipliers are larger than the impact multipliers implying that fiscal shocks typically take time to exercise their full effects on real variables.

5 Subsample analysis

There are several reasons to believe that the sample of data we consider is not homogeneous in any of the countries we consider. For example, it is well known that the volatility and the persistence of US real and nominal variables has fallen after 1980 (see e.g. Stock and Watson (2003) and Canova et al.(2007) have shown that such a pattern is shared by the UK and, to a smaller extent, the Euro area. To take into account sample heterogeneity, we split the sample into two from the starting date up to 1979:4 and from 1982:1 to the end of the sample. In Table 3 we present annualized cumulative output multipliers on impact, one and three years after the shock for each of the two subperiods. We also present the difference in the multipliers between the two subperiods with the statistical significance of the difference.

The structural change that occurred in the early part of the 1980s has not changed significantly the transmission of government consumption shocks in all four countries. However, the effects of government investment shocks have weakened substantially in all the countries except for the UK, where the effects of government investment shocks have remained small. Surprisingly, the effects of government employment shocks have substantially increased in the second subsample for all countries and almost all horizons considered.

To further investigate the variations induced by the structural change occurred in the 80s on the dynamics of fiscal shocks, we present in table 4 the annualized cumulative responses of private consumption, investment and total employment and the real wage to a fiscal shock equal to 1% of GDP[4] in the period before the break of the 80s ("pre80") and the difference in the cumulative responses of the pre 80s versus the post 80s sample ("dif"). The numbers give the percentage annual change of each variable to a one-percent shock to each of the government spending components considered. Statistically significant differences in the two subperiods are marked by asterisks.

Although the sign of the impact responses for output and its components to any spending shock hardly changes across subsamples, the magnitude of the responses is substantially affected. The responses of private consumption and investment after a government consumption shock in Canada and Japan after 1982 are considerably increased, and the responses of

[4] Cumulative responses for these variables are calculated by dividing the impulse responses of these variables with the ratio of the respective variable with the shocked fiscal variable evaluated at the sample mean.

private investment and consumption to public investment shocks is significantly weakened in the post 1980s period for Canada, Japan and the US. Also, the responses of private consumption to a government employment shock are significantly higher in the second subsample for all the countries except for Japan and the responses of private investment are higher for the UK and the US, while they are significantly lower for Canada and Japan one and three years after the shock.

Changes are noticeable also in the labor market variables. Employment and the real wage cumulative responses after a shock to government consumption and government employment change significantly for all units in the post 1980 period. The response of employment to a government investment shock does not display significant changes except for Canada, while the response of the real wage to this shock changes significantly in Canada and the US.

The structural break of the 1980s does not only affect the magnitude but also the direction of the responses of labor markets variables. In fact, the sign of the responses of the real wage is reversed in some countries (from negative to positive in Canada and the US and from positive to negative in Japan after government consumption shocks; from negative to positive in the US after government investment shocks; and from negative to positive in Canada and the US after government employment shocks).

The change in the responses of the macrovariables to shocks in government employment is consistent with a major shift in the structure of the economies from say a more keynesian type to a more neoclassical type in the second subsample. Such an interpretation, however, needs to be verified against other potential ones such as a change in the productivity of public inputs.

Overall, the analysis reveals that the responses of labor market variables to fiscal shocks were most affected by the structural break. Shocks to government investment have weaker expansionary effects on output and its components. Perotti (2004) documents also a decline in the effects of government consumption shocks in this period that standard explanations fail to justify, a decline we do not find. However, we document significant changes in the transmission of government employment shocks. We conjecture that the literature studying the causes of Great Moderation (see e.g. Gambetti et al. (2008)) can provide useful insights about the reasons for the structural changes we document here.

6 Conclusions

This paper analyzes the dynamics of transmission of different types of government expenditure shocks financed through deficit increases in five different countries. We restrict attention to expenditure shocks for two reasons. First, while the effects of expenditure shocks in the literature is controversial, there is somewhat more agreement on the dynamic effects induced by tax shocks. Second, although not often appreciated in the empirical literature, the qualitative features of the dynamics in response to government shocks crucially depend on the way expenditure is financed (see, e.g., Baxter and King (1993)). Since the implications produced by deficit financed expenditure increases are relatively robust across model specifications and across different components of expenditures, while this is not the case for tax financed expenditure increases and since robustness gives credibility to our identification methodology, we consider only deficit financed expenditure shocks in our exercises. A cross country perspective can help us to understand whether the controversy present in the literature is solely a US phenomena, or if instead is shared in a number of developed economies. The countries we have chosen differ in size, degree of openness, size of the government sector, monetary policy regime and degree of flexibility of the labor market relative to the US but we fail to explain differences in the responses to fiscal shocks across countries using these features.

To identify deficit financed expenditure shocks we use constraints on the sign of output and deficit responses. In particular, the identification scheme we employ requires that government spending shocks raise output and the deficit contemporaneously. The identification restrictions we use are relatively uncontroversial since they hold in both Keynesian and RBC frameworks. Once the shocks are identified, we examine the dynamics of consumption, investment, employment and real wages, which are left unrestricted in the identification process.

Almost all spending shocks increase private consumption contemporaneously and employment with some delay. The responses of private investment and real wages are mixed. However, at least in response to government employment shocks, the real wage increases on impact. Hence, our results appear to reinforce those of the standard SVAR literature and they appear to be broadly in line with the predictions of Keynesian models. We find that in all the countries government employment shocks have the largest output multiplier. Inter-

estingly, government investment shocks have the smallest output multiplier in all countries, but Japan where, in fact, output multipliers are larger than one three years after the shock. Government consumption shocks generate output multipliers larger than one in Canada and in the US in the medium run while for government employment shocks multipliers larger than one are the rule for all countries and all horizons.

There are substantial differences in the transmission of fiscal shocks pre and after the beginning of the 80s. First, shocks to government investment have significantly weaker effects in the last two decades. Second, the opposite is true for government employment shocks. Third, the response of the real wage to fiscal policy shocks changes in the two subsamples. Determining whether these facts have a common underlying explanation is a challenging task. We plan to study this issue in future work on the subject.

Tables and Figures

Table 1: Parameter ranges		
σ	risk aversion coefficient	[1,6]
$1-\omega$	share of public goods in consumption	[0.0,0.1]
η	elasticity of substitution public/private goods	[-0.5,2.5]
ϕ	preference parameter	[0.1,0.9]
b	adjustment cost parameter	[1,15]
δ^p	private capital depreciation rate	[1.25%,2.5%]
δ^g	public capital depreciation rate	[1.0%,2.5%]
μ	productivity of public capital	[0,0.30]
ν	productivity of public employment	[0,0.3]
α	capital share	[0.2,0.4]
τ^l	average labor tax rate	[0,0.3]
τ^k	average capital tax rate	[0,0.3]
τ^c	average consumption tax	[0.0,0.2]
C^g/Y	steady state C^g/Y ratio	[0.05,0.15]
I^g/Y	steady state I^g/Y ratio	[0.01,0.05]
N^g/N^p	steady state N^g/N^p ratio	[0.05,0.25]
ζ_π	Taylor's coefficient	[1,3]
ζ_b	coefficient on debt rule	[0,1.5]
γ	degree of price stickiness	0, or [0.5,0.85]
$\frac{\varepsilon}{\varepsilon-1}$	steady state markup	[1.09, 1.16]
$\boldsymbol{\varrho}_g^{\psi y}, \psi = c, i, n$	output growth coefficient of fiscal rule	[-0.1,0.1]
$\boldsymbol{\varrho}_g^{\psi}, \psi = c, i, n$	persistence of fiscal shock	[0.0,0.95]
$\boldsymbol{\varrho}$	persistence of non-fiscal shocks	[0.0,0.95]

Table 2: Output multipliers															
	Canada			EU			Japan			UK			US		
	1	4	12	1	4	12	1	4	12	1	4	12	1	4	12
C^g	0.18	0.63	**1.02**	0.16	0.38	0.33	0.13	0.26	0.38	0.13	0.39	0.07	0.74	**1.46**	**2.52**
I^g	0.05	0.36	0.61	0.06	0.22	0.07	0.16	0.83	**1.93**	0.03	0.08	0.09	0.07	0.17	0.23
N^g	0.73	**3.69**	**9.34**	**2.03**	**4.62**	-0.61	**1.64**	**3.19**	**2.93**	**1.30**	**6.60**	**13.7**	0.89	**2.93**	**4.30**

Table 3: Output multipliers, subsamples

		Canada			Japan			UK			US		
horizon		1	4	12	1	4	12	1	4	12	1	4	12
	pre80	0.11	0.28	0.60	0.20	0.30	0.58	0.17	0.63	1.57	0.22	0.37	-0.48
C^g	post80	0.13	0.58	0.07	0.34	0.42	1.04	0.09	0.76	2.33	0.20	0.38	1.02
	dif	-0.02	-0.30	0.53	0.14	-0.12	-0.46	0.08	-0.13	-0.76	0.02	-0.01	-1.50
	pre80	0.19	0.54	1.09	0.27	0.91	1.71	0.03	0.05	-0.15	0.07	0.16	-0.17
I^g	post80	0.02	0.07	-0.96	0.05	0.10	-0.30	0.01	0.01	0.05	0.12	0.28	-0.35
	dif	0.17*	0.47*	2.05*	0.22	0.81*	2.01*	0.02	0.04	-0.20	-0.05	-0.12	0.18*
	pre80	0.82	2.02	4.21	0.21	2.98	2.15	0.87	1.43	3.47	0.78	-4.14	-9.60
N^g	post80	1.28	5.77	9.17	0.30	1.32	4.08	2.38	5.66	15.7	2.03	1.12	-2.50
	dif	-0.46*	-3.75*	-4.96*	-0.09	1.66*	-1.93*	-1.51*	-4.23*	-12.3*	-1.25*	-5.26*	-7.1*

Table 4: Annualized Cumulative responses, subsample analysis

countries		Canada			Japan			UK			US		
horizon		1	4	12	1	4	12	1	4	12	1	4	12
private consumption													
C^g	pre80	0.14	0.34	0.55	0.01	0.34	1.16	0.03	0.52	1.04	0.17	-0.11	-2.43
	dif	-0.36	-1.58*	-2.84*	-1.16*	-2.53*	-4.42	0.03	0.50*	0.61*	-0.07	-0.65	-3.62*
I^g	pre80	0.46	1.66	3.04	0.05	0.14	0.19	0.03	-0.08	-0.48	0.06	0.01	-0.56
	dif	0.43*	1.54*	3.81*	0.04	0.07*	0.14*	0.03	-0.13	-0.74	-0.16	-0.08	0.26*
N^g	pre80	-0.04	0.14	0.52	0.46	6.76	15.4	-0.74	0.64	3.89	0.63	-8.52	-14.6
	dif	-0.17*	-0.46*	-1.08	0.07	5.54*	10.2*	0.42	-3.08*	-6.51*	1.88*	-3.92*	-11.3*
private investment													
C^g	pre80	0.11	0.36	0.87	0.10	0.13	-0.23	0.31	1.93	3.18	0.50	1.76	0.42
	dif	-1.22*	-2.44*	-2.12*	-0.42	-0.47	0.18	-0.63*	0.56	-0.19	0.09	1.37*	0.66*
I^g	pre80	0.32	0.94	1.36	-0.06	0.12	0.72	-0.02	-0.03	-0.38	0.16	0.36	-0.36
	dif	0.25*	0.78*	3.06*	0.18*	0.59*	2.87*	0.02	0.02	-0.53	0.08	0.40*	2.24*
N^g	pre80	0.27	7.41	12.1	-0.18	3.86	10.6	0.12	0.37	0.97	-0.19	-20.1	-37.7
	dif	0.35	6.76*	14.4*	-0.78*	1.72*	4.36*	0.47*	-12.4*	-8.5*	-0.15	-16.2*	-35.2*
total employment													
C^g	pre80	0.02	0.15	0.47	-0.02	-0.05	-0.22	0.00	0.02	0.08	0.05	0.18	-0.33
	dif	0.04	-0.08	-0.39	0.01	0.15	0.88	0.00	0.01	-0.34	0.07	0.22*	-0.66*
I^g	pre80	-0.03	0.00	0.23	0.04	0.04	0.14	0.01	0.03	-0.09	0.01	0.02	-0.16
	dif	-0.05	0.06	0.38*	0.04	-0.02	0.04	0.01	0.03	-0.19	0.00	-0.06	-0.08
N^g	pre80	-0.11	0.45	1.63	-0.05	0.20	0.86	0.03	0.01	0.10	0.09	-1.26	-9.86
	dif	-0.57*	-1.80*	-4.9*	-0.09	0.07	0.15	0.82*	2.51*	-1.90*	-0.08	-0.98*	-5.0*
real wage													
C^g	pre80	0.00	-0.02	-0.02	0.01	0.01	-0.68	0.02	0.17	0.51	-0.08	-1.19	-4.31
	dif	0.07	-0.15	0.08	0.02	-0.12	-0.36	-0.26*	-0.43*	-0.60	-0.25*	-1.28*	-5.66*
I^g	pre80	0.01	0.04	0.17	0.06	0.08	-0.38	0.01	0.02	-0.04	0.00	-0.10	-0.56
	dif	0.01	0.04	0.32*	0.05	0.06	-0.22	0.01	0.01	-0.05	-0.06	-0.30*	-0.86*
N^g	pre80	-0.06	0.00	0.22	-0.54	-1.32	4.92	0.04	0.30	1.04	-0.27	-9.45	-16.2
	dif	-0.39*	-0.80*	0.10	-0.43*	-1.2*	3.96	0.39*	0.17	-4.94*	-0.56*	-9.00*	-16.6*

References

Baxter M. and R. King, 1993. Fiscal Policy in General Equilibrium, American Economic Review, 83, 315-335.

Blanchard O.J. and R. Perotti, 2002. An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output, Quarterly Journal of Economics, 117, 4, 1329-1368.

Bohn, H. 1998 The behavior of US public debt and deficits. Quarterly Journal of Economics, 113, 949-963.

Bouakez, H. and N. Rebei, 2007. Why does private consumption rise after a government spending shock? Canadian Journal of Economics, 40, 954-979.

Burnside, C., Eichenbaum, M., and J. Fisher, 2004. Fiscal shocks and their consequences, Journal of Economic Theory, 115, 89-117.

Caldara, D. and C. Kamps, 2008. What are the effects of fiscal policy shocks? A VAR based comparative analysis, European Central Bank Working Paper Series, No. 877.

Calvo, G., 1983. Staggered pricing in a utility maximizing framework, Journal of Monetary Economics, 12, 383-96.

Canova F., 2002. Validating Monetary DSGE models through VARs, CEPR Working Paper, No. 3442.

Canova, F., 2007. Methods for applied Macroeconomic Research, Princeton University Press.

Canova F. and E. Pappa, 2007. Price Differentials in Monetary Unions: The Role of Fiscal Policy, The Economic Journal, 117, 713-737.

Canova F. and E. Pappa, 2006. The elusive costs and the immaterial gains of fiscal constraints, Journal of Public Economics, 90, 1391-1414.

Canova, F., Gambetti, L. and E. Pappa, 2007. The structural dynamics of output growth and inflation: some international evidence, Economic Journal , 519 V. 117 C167-C191.

Cavallo M., 2005. Government employment and the dynamic effects of fiscal policy shocks, Federal Reserve Bank of San Francisco Working Paper Series, No 16.

Chari, V.V., Kehoe, P. and E. McGrattan. 2005. Are Structural VARs with Long-Run Restrictions Useful in Developing Business Cycle Theory?, Reserve Bank of Minneapolis Staff Report 364,

Chung, H. and E. Leeper, 2007. What has financed government debt? CAEPR Working Paper No. 2007-015

Edelberg, W., Eichenbaum, M. and J. Fisher, 1999. Understanding the effects of Shocks to Government Purchases, Review of Economic Dynamics, 2, 166-206.

Fatas Antonio and Ilian Mihov, 2001. The effects of fiscal policy on consumption and employment: Theory and Evidence, CEPR Discussion Paper Series, No. 2760.

Favero, C. and F. Giavazzi, 2007. Debt and the effects of fiscal policy, CEPR Discussion Paper Series, No DP6092.

Finn, G.M., 1998. Cyclical effects of government employment and goods purchases, International Economic Review, 39, 635-657.

Gali, J., Lopez-Salido, J.D. and J. Valles, 2007. Understanding the effects of government spending on consumption, Journal of the European Economic Association, 5, 227-270.

Gambetti, L. Canova, F. and Evi Pappa, 2008. Structural Dynamics of US Output and Inflation: What explains the changes? Journal of Money, Credit and Banking, 40, 369 – 388.

Gambetti, L. and E. Pappa, 2008. To target inflation or not to target: A conditional answer, mimeo UAB.

Hornstein, A., 1993. Monopolistic Competition, increasing returns to scale, and the importance of productivity shocks, Journal of Monetary Economics, 31, 299-316.

Kim, Chang-Jin, and Charles R. Nelson 1999. Has the U.S. Economy Become More Stable? A Bayesian Approach Based on a Markov-Switching Model of the Business Cycle, Review of Economics and Statistics, 81, 608–616.

Leeper, E., 1991. Equilibria under Active and Passive Monetary and Fiscal Policies, Journal of Monetary Economics, 27, 129-147.

Ludvigson C. S., 1996. The Macroeconomic Effects of Government Debt in a Stochastic Growth Model, Journal of Monetary Economics, 38, 25-45.

McConnell, M. and Perez Quiroz, G., 2001. Output fluctuations in the US: what has changed since the early 1980s? American Economic Review, 90, 1464-1476.

Mountford, A. and Uhlig, H., forthcoming. What are the Effects of Fiscal Policy Shocks? Journal of Applied Econometrics.

Pappa, E. 2009, The effects of fiscal shocks on the real wage and employment, International Economic Review, Vol 50, 217-244 .

Perotti, R., 2004. Estimating the effects of fiscal policy in OECD countries, mimeo IGIER, Bocconi University.

Perotti, R., 2007. In search of the transmission mechanism of fiscal policy, NBER Macro Annual, No. 22.

Ramey, V. and M.D. Shapiro, 1998. Costly Capital Reallocation and the Effects of Government Spending, Carnegie Rochester Conference Series on Public Policy, 48, 145-94.

Rotemberg J. and M. Woodford, 1992. Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity, Journal of Political Economy, 100, 1153-1206.

Schorfheide, F., 2000. Loss Function-based Evaluation of DSGE Models, Journal of Applied Econometrics, 15, 645-670.

Stock, J. and M. Watson, 2003. Has the business cycle changed? Evidence and explanations. In: Monetary policy and uncertainty, Federal Reserve Bank of Kansas City, 9-56.

Figure 1

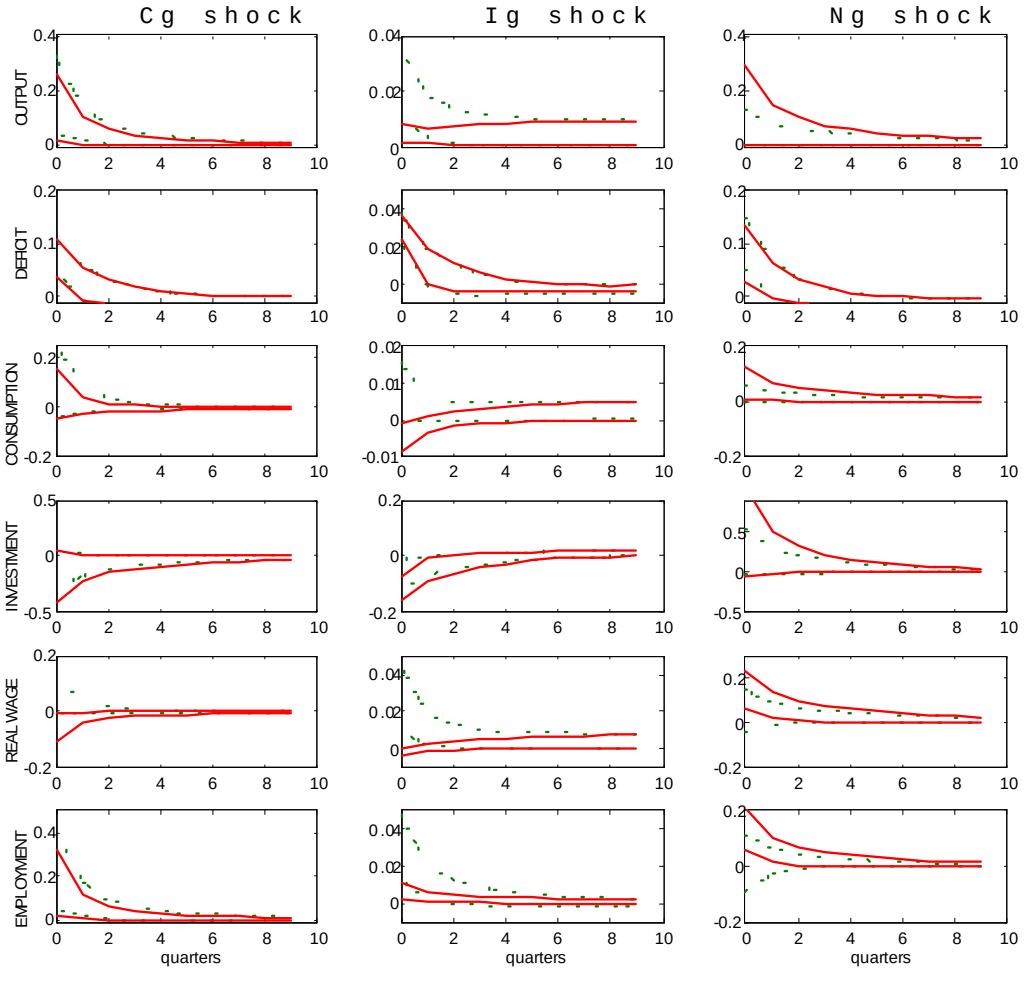

Figure 1:Responses to government expenditure shocks, solid RBC, dotted New – Keynesian.

Figure 2

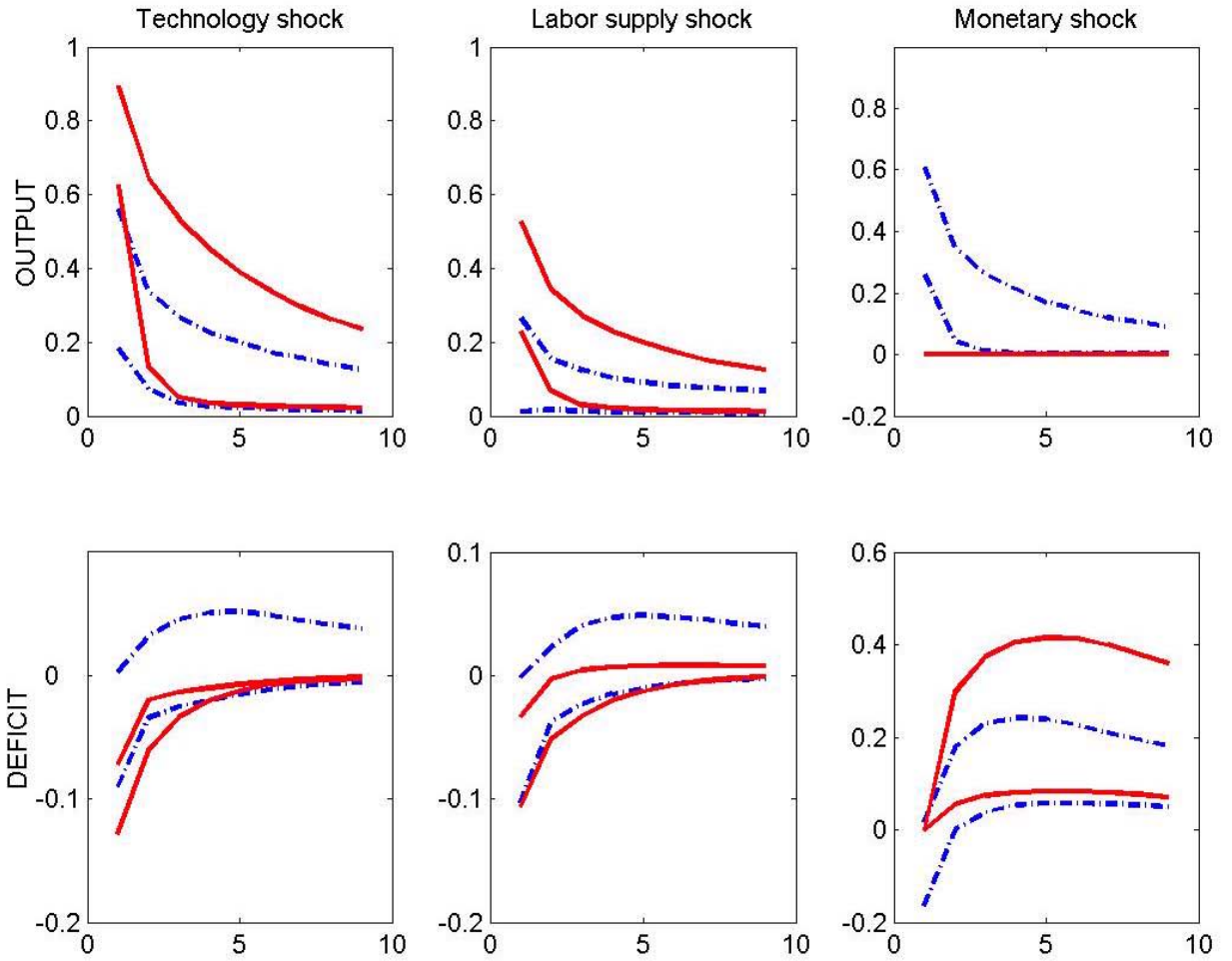

Figure 2: Responses to technology, labor supply and monetary shocks, solid RBC, dotted NK.

Figure 3

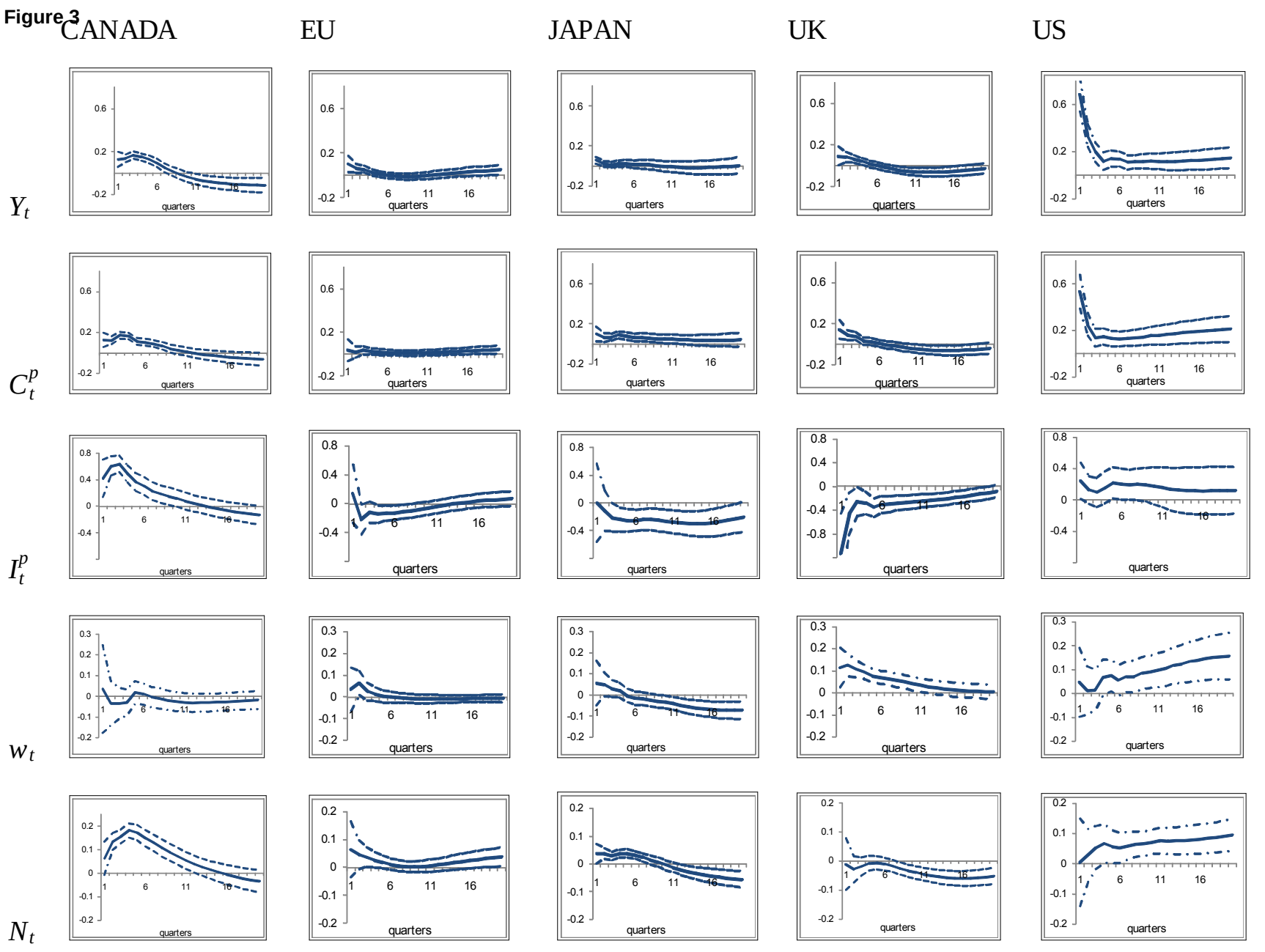

Figure 3: Responses to a government consumption shock

Figure 4

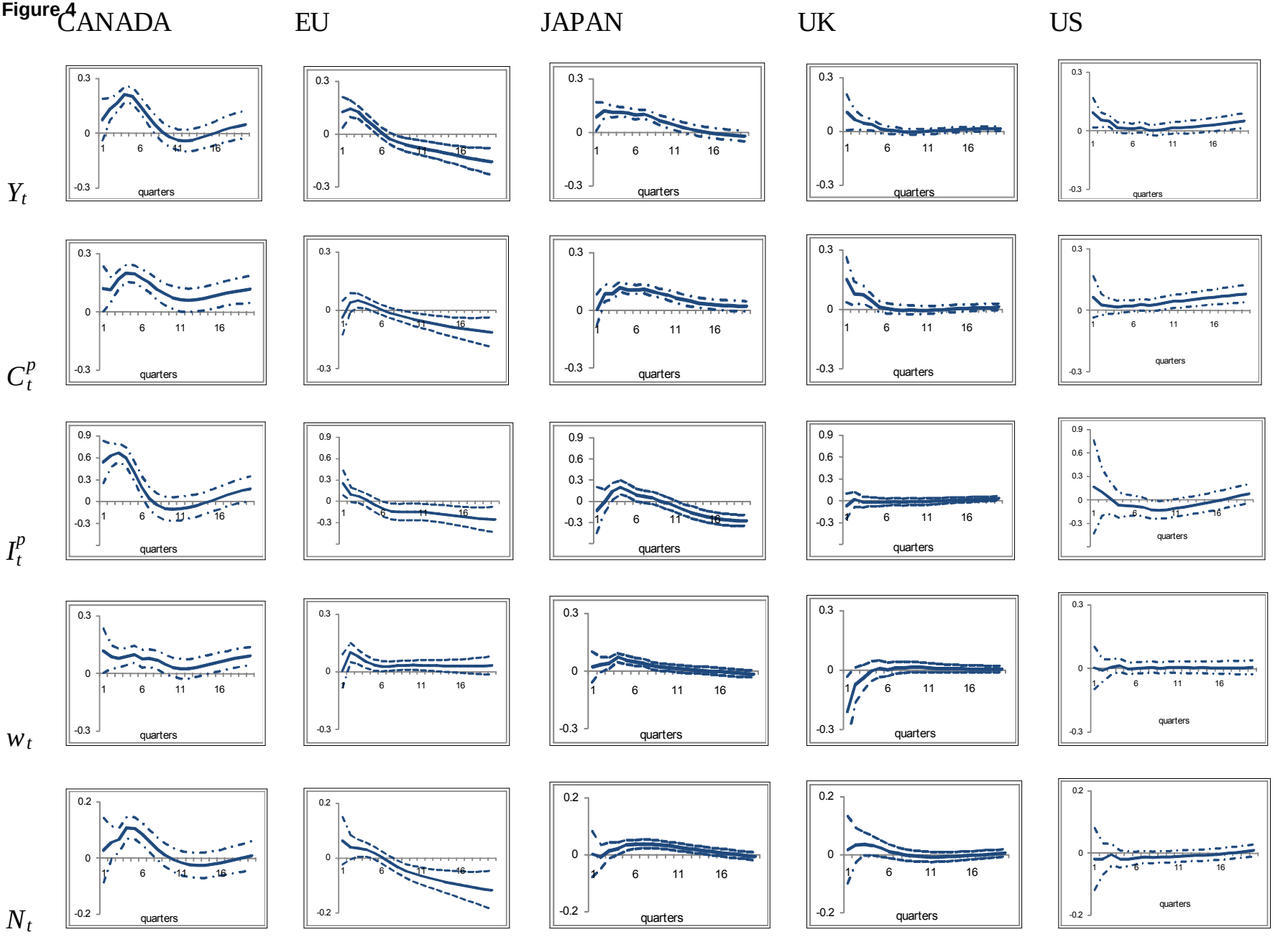

Figure 4: Responses to a government investment shock

Figure 5

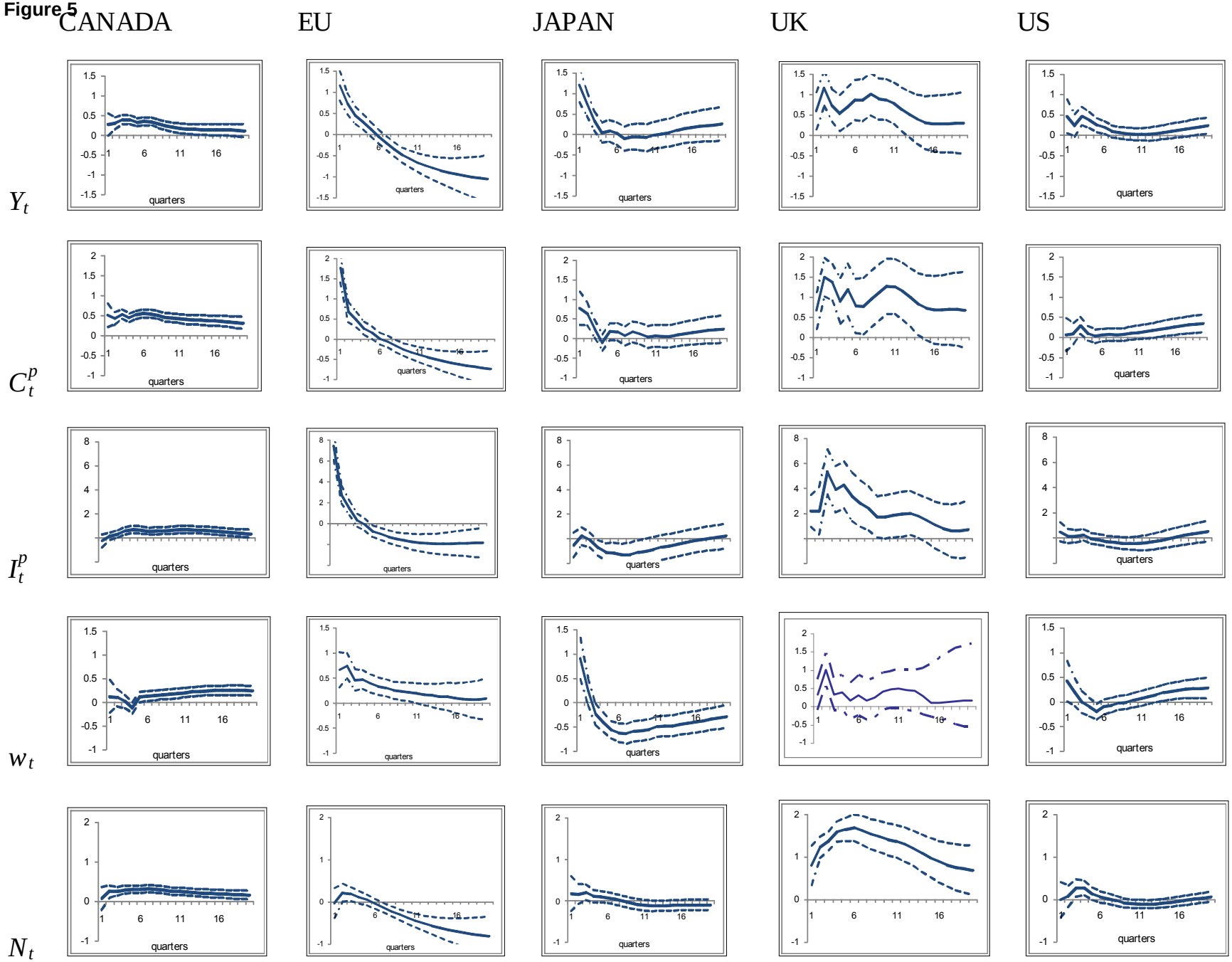

Figure 5: Responses to a government employment shock