Analyzing the Effects of Fiscal Policy Shocks: an International Comparison using Long-Run Identifying Restrictions

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Abstract

In this paper I explore the effects of fiscal policy on the main macroeconomic variables from a different perspective. I use long-run restrictions in the permanent - transitory shocks framework developed by Pagan and Pesaran (2008). The results from several countries indicate that spending shocks have positive effects on the economic activity, while tax shocks negative. These results survive despite the use of different identification restrictions. The general outcome of the analysis supports the results obtained by the many studies that have used the SVAR approach with contemporaneous restrictions only. Importantly, in contrast with some recent research, the spending multiplier appears to be bigger in absolute value than the tax multiplier regardless of the identification scheme used, casting doubt on the relevance of several economic theories as well as policy prescriptions. In addition, differences in the effectiveness of fiscal policy among the countries in the sample do not seem to depend on the factors that economists and policy makers usually consider relevant. Finally, there is not significant evidence to support the widely held view that the effectiveness of spending increases has fallen after 1980.

Keywords: Fiscal Policy, Government Spending, Multipliers, Structural Vector Error Correction Models, Long-run restrictions

JEL *Classification*: C32, E2, E3, E62

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1 Introduction

It is hard to overstate the practical importance of knowing what are actually the effects of fiscal policy in the economy. As the recent crisis has shown, there are limitations to the ability of central banks to stabilize the economy, and this is much more evident in the case of EMU, where in some countries the crisis is far from over. The importance of the topic has led to a renewed interest of the economic profession regarding the effects of fiscal policy during the last decade; this area of research, although neglected previously, has produced numerous papers in the last years. However, until recently there was no consensus on what are actually the effects of fiscal policy shocks on economic activity. The majority of studies finds positive effects of government spending shocks and negative effects of tax shocks on the main macroeconomic variables, supporting a predominantly Keynesian view for the economy, at least in the short run. Yet, a smaller number of papers using different identification methods suggest that the economy reacts in a way that is well described by a neoclassical model.

There are several important and interrelated issues concerning the effects of fiscal policy. The first is what are the sizes of the multipliers, i.e. the effect of changes in the policy variable to output; the spending multiplier is considered to be close to one, as the majority of studies in Ramey (2011) find; however, it is notoriously difficult to estimate the tax multiplier, because in the data taxes are very highly correlated with GDP, so are mostly driven by the cyclical movements of output. Blanchard and Perotti (2002) were the first who actually developed a convincing methodology to estimate the cyclical movement of taxes based on institutional information outside the model, but after the work of Romer and Romer (2010), the literature has moved toward seeking plausible exogenous instruments to estimate tax effects and multipliers.

The second issue is what is the transmission mechanism of fiscal policy. The typical neoclassical model, and most of current DSGEs, predict that spending has a multiplier lower than one, since the increase in useless government consumption (that will eventually lead to higher taxes) forces consumption to fall. This is unlike the results of the majority of SVAR studies, which predict that consumption rises after increases in spending. It takes a different mechanism to generate a positive consumption response; most common mechanisms to generate this effect is the addition of rule-of-thumb consumers in a sufficient proportion to give such an effect, or the assumption that government spending generates some positive externality to the productivity of the private sector (or non-separability of the utility function). The tax multiplier naturally depends heavily on the nature of taxes in the model: for example, a lump-sum tax has very different effects compared to a distortionary income tax, while taxes on capital are considered to be highly recessionary.

Lately, some papers have conducted counterfactual experiments comparing the response of more than one DSGEs used by international organizations or central banks - typically these models assume (and calibrate or estimate) that a fraction of population is not optimizing and simply consumes all its income (rule-of-thumb consumers). Coenen et al (2012) give spending multipliers for a temporary spending increase between 1 and 2, depending on the existence of monetary accommodation. Cogan et al (2010) report multipliers to permanent spending increases of less than one, similar to those of the previous paper in the permanent case. Freedman et al (2010), using IMF's GIMF model, report multipliers from 0 to 2 depending on the fiscal instrument used and the presence of monetary accommodation.

The third is whether it is possible to consolidate without too much pain. In an famous paper, Alesina and Perotti (1995) advocated that a fiscal consolidation based on spending cuts is preferable to tax increases, since the former has a negative effect on interest rates, that lead to increases in private sector's investment and consumption. Naturally, such a view considers government spending as predominantly useless, and reducing it does not deteriorate the equilibrium of the economy.

In this paper I will try, like many others before, to give some answers to the first two issues, and as a byproduct of the analysis to the third. To do that, I employ a methodology different to those already used; I follow the recent literature in that I try to estimate the effects using IV methods instead of the reduced form covariance matrix. Following Pagan and Pesaran (2008), instead of trying to find exogenous instruments to estimate responses to fiscal shocks, I use the instruments that become available by employing the main identification restrictions: that some shocks have permanent and some other have transitory effects. This procedure generates quite good instruments, that allow reliable estimates of the structural equations while needing fewer restrictions in the contemporaneous relations. Several countries are used, the choice of which is mainly due to the availability of long enough fiscal data - especially taxes and transfers.

The basic results from the various models confirm the basic findings from the SVAR methodology: in response to a spending shock, economic activity (measured by output) is higher. Importantly, the spending shock has a positive effect on consumption, suggesting the the simple neoclassical model is not consistent with the data. In addition, inflation and the nominal interest rate fall, something that is consistent with a New Keynesian model where spending shocks lead to a fall in markups. A tax shock has a negative effect on economic activity; both consumption and output fall; additionally, it tends to have a positive effect on prices and the interest rate.

Spending multipliers are positive and quite high in some cases, and not as uniform among countries as those estimated using SVAR methods. Tax multipliers are consistently lower than the ones of spending in absolute value; the tax multipliers for US and UK are much lower than those estimated using exogenous tax shocks. Also, despite differences in estimates in a shorter sample starting in 1981, there does not seem to exist a general trend towards lower spending multipliers, contrary to what Perotti (2004) finds.

An important finding is that the size of spending multipliers depends on the policy coefficients. The countries with more countercyclical spending policies have bigger spending multipliers. A similar thing happens with taxes - the countries with the highest elasticity of taxes with respect to output (more progressive tax system) also have higher tax multipliers.

The remaining of the paper is structured in the following way. Section 2 presents the methodology. Section 3 presents the identification assumptions and the results from various specifications. Section 4 extends the results and discusses in depth certain aspects of them. Section 5 concludes.

2 Methodology

2.1 Theory

This paper used Structural Vector Autoregression models (SVAR - in particular Structural Vector Error Correction models, SVECM) to estimate the effects of fiscal policy shocks. The typical implementation of SVAR models is to estimate the effects of "structural" shocks by utilizing enough restrictions in the variance-covariance matrix of the reduced form residuals to make estimation of the matrix of contemporaneous effects possible. In this paper I will use a different approach, proposed by Pagan and Pesaran (2008) that bases estimation of contemporaneous effects on the separation of structural shocks into those that have long lasting effects on the economy - permanent shocks, and to those that only affect the economy for a limited period - transitory shocks. This procedure has the advantage that it potentially allows more parameters of the structural form to be estimated, but its implementation depends on the availability of suitable instruments. Ultimately, the estimation procedure resembles very much that of traditional Keynesian Structural Econometric Models, but otherwise estimates are used to perform typical SVARs analysis.

To begin with, assume that the true model is an SVAR in n *I(1)* variables like the following[1]

$$\mathbf{A_0 z_t} = \mathbf{A_1 z_{t-1}} + \mathbf{A_2 z_{t-2}} + \varepsilon_\mathbf{t}, \tag{1}$$

which, like all VARs, can be transformed to the following form

[1]The presentation follows closely the paper.

$$\mathbf{A_0}\Delta\mathbf{z_t} = -(\mathbf{A_0} - \mathbf{A_1} - \mathbf{A_2})\mathbf{z_{t-1}} - \mathbf{A_2}\Delta\mathbf{z_{t-1}} + \varepsilon_\mathbf{t} = -\mathbf{A(1)}\mathbf{z_{t-1}} - \mathbf{A_2}\Delta\mathbf{z_{t-1}} + \varepsilon_\mathbf{t}, \quad (2)$$

and, if there exist $r<n$ cointegrating relations, the reduced form of the model can be written as

$$\begin{aligned}\Delta\mathbf{z_t} = -\mathbf{A_0^{-1}}\mathbf{A(1)}\mathbf{z_{t-1}} - \mathbf{A_0^{-1}}\mathbf{A_2}\Delta\mathbf{z_{t-1}} + \mathbf{A_0^{-1}}\varepsilon_\mathbf{t} &= -\Pi\mathbf{z_{t-1}} + \Psi\Delta\mathbf{z_{t-1}} + \mathrm{e}_\mathbf{t} \\ &= -\alpha\beta' \mathrm{z}_\mathbf{t-1} + \Psi\Delta\mathbf{z_{t-1}} + \mathbf{e_t} \quad (3)\end{aligned}$$

while the structural one as

$$\mathbf{A_0}\Delta\mathbf{z_t} = -\tilde{\alpha}\beta'\mathbf{z_{t-1}} - \mathbf{A_2}\Delta\mathbf{z_{t-1}} + \varepsilon_\mathbf{t},\ \tilde{\alpha} = \mathbf{A_0}\alpha. \quad (4)$$

The idea is that knowledge of some elements of $\tilde{\alpha}$ allows to use the relevant cointegrating relations, $\beta'\mathbf{z_{t-1}}$, as instruments to estimate some of the contemporaneous effects in $\mathbf{A}^0$ matrix. The authors, making use of the assumption that some shocks are permanent while other are transitory, and partitioning all matrices conformably, manage to derive that “the structural equations for which there are known permanent shocks must have no error correction terms present in them”, so the first n-r rows of $\tilde{\alpha}$ are filled with zeros[2]. Our system is thus represented by two sets of equations, the first n-r having the unit roots of the system and the other r having the *I(0)* structural shocks. One can easily depict these in matrix form (by partitioning the matrices in (1) accordingly) as

$$\begin{bmatrix} \mathbf{A}_{11}^0 & \mathbf{A}_{12}^0 \\ \mathbf{A}_{21}^0 & \mathbf{A}_{22}^0 \end{bmatrix} \begin{bmatrix} \mathbf{z}_{1t} \\ \mathbf{z}_{2t} \end{bmatrix} = \begin{bmatrix} \mathbf{A_{11}^1} & \mathbf{A_{12}^1} \\ \mathbf{A_{21}^1} & \mathbf{A}_{22}^1 \end{bmatrix} \begin{bmatrix} \mathbf{z}_{1,t-1} \\ \mathbf{z}_{2,t-1} \end{bmatrix} + \begin{bmatrix} \mathbf{A}_{11}^2 & \mathbf{A_{12}^2} \\ \mathbf{A}_{21}^2 & \mathbf{A}_{22}^2 \end{bmatrix} \begin{bmatrix} \mathbf{z}_{1,t-2} \\ \mathbf{z}_{2,t-2} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}.$$

This system has *I(1)* variables, as well as shocks; to render the system stationary, one needs to first difference the first set of equations (as no cointegration terms appear in these equations) and impose the cointegration restrictions in the second set. Thus the stationary system can be written as

$$\begin{bmatrix} \mathbf{A}_{11}^0 & \mathbf{A}_{12}^0 \\ \mathbf{A}_{21}^0 & \mathbf{A}_{22}^0 \end{bmatrix} \begin{bmatrix} \Delta\mathbf{z}_{1t} \\ \Delta\mathbf{z}_{2t} \end{bmatrix} = \begin{bmatrix} 0 \\ -\tilde{\alpha}_2\beta' \end{bmatrix} \mathbf{z_{t-1}} + \begin{bmatrix} \mathbf{A_{11}^1} & \mathbf{A}_{12}^1 \\ -\mathbf{A_{21}^2} & -\mathbf{A_{22}^2} \end{bmatrix} \begin{bmatrix} \Delta\mathbf{z}_{1,t-1} \\ \Delta\mathbf{z}_{2,t-1} \end{bmatrix}$$

[2]This assumes that equations with permanent shocks are placed first, and it will be an assumption maintained for the rest of this exposition.

$$+\begin{bmatrix} \mathbf{A}_{11}^2 & \mathbf{A}_{12}^{\mathbf{2}} \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \Delta \mathbf{z}_{1,t-2} \\ \Delta \mathbf{z}_{2,t-2} \end{bmatrix} + \begin{bmatrix} \Delta \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}. \quad (5)$$

With some simple algebra[3], one can see that the system can be transformed to the MA representation of the stationary time series $\Delta \mathbf{z_t}$ to the transformed shock vector $\mathbf{w_t}$

$$\begin{aligned}
\mathbf{A(L)}\Delta \mathbf{z_t} &= \begin{bmatrix} \mathbf{0} \\ -\tilde{\alpha}_2\beta' \end{bmatrix} \mathbf{z_{t-1}} + \begin{bmatrix} \Delta \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \Rightarrow \\
\Delta \mathbf{z_t} &= \mathbf{A(L)}^{-1} \begin{bmatrix} \mathbf{0} \\ -\tilde{\alpha}_2\beta' \end{bmatrix} \mathbf{z_{t-1}} + \mathbf{A(L)}^{-1} \begin{bmatrix} \Delta \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \Rightarrow \\
\Delta \mathbf{z_t} &= \mathbf{C(L)} \begin{bmatrix} \mathbf{0} \\ -\tilde{\alpha}_2\beta' \end{bmatrix} \mathbf{z_{t-1}} + \mathbf{C(L)} \begin{bmatrix} \Delta \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \\
&= \begin{bmatrix} \mathbf{C_{11}(L)0} - \mathbf{C_{12}(L)}\tilde{\alpha}_2\beta' \\ \mathbf{C_{21}(L)0} - \mathbf{C_{22}(L)}\tilde{\alpha}_2\beta' \end{bmatrix} \mathbf{z_{t-1}} + \begin{bmatrix} \mathbf{C_{11}(L)}\Delta \varepsilon_{1t} + \mathbf{C_{12}(L)}\varepsilon_{2t} \\ \mathbf{C_{21}}(L)\Delta \varepsilon_{1t} + \mathbf{C_{22}(L)}\varepsilon_{2t} \end{bmatrix} \\
&= -\begin{bmatrix} \mathbf{C_{12}(L)} \\ \mathbf{C_{22}(L)} \end{bmatrix} \tilde{\alpha}_{\mathbf{2}}\beta' \mathbf{z_{t-1}} + \begin{bmatrix} \mathbf{C_{11}(L)}\Delta \varepsilon_{1t} + \mathbf{C_{12}(L)}\varepsilon_{2t} \\ \mathbf{C_{21}(L)}\Delta \varepsilon_{1t} + \mathbf{C_{22}(L)}\varepsilon_{2t} \end{bmatrix} \Rightarrow \\
\Delta \mathbf{z_t} &= \begin{bmatrix} \mathbf{C_{11}(L)}\Delta \varepsilon_{1t} + \mathbf{C_{12}(L)}(\varepsilon_{2t} - \tilde{\alpha}_{\mathbf{2}}\beta' \mathbf{z_{t-1}}) \\ \mathbf{C_{21}(L)}\Delta \varepsilon_{1t} + \mathbf{C_{22}(L)}(\varepsilon_{2t} - \tilde{\alpha}_{\mathbf{2}}\beta' \mathbf{z_{t-1}}) \end{bmatrix} \\
&= \mathbf{C(L)} \begin{bmatrix} \Delta \varepsilon_{1t} \\ (\varepsilon_{2t} - \tilde{\alpha}_{\mathbf{2}}\beta' \mathbf{z_{t-1}}) \end{bmatrix} = \mathbf{C(L)w_t}
\end{aligned}$$

In fact, because $\mathbf{C_{12}(1)}$ has the long run effects of transitory shocks on variables with unit root shocks, it must hold that $\mathbf{C_{12}(1)} = \mathbf{0}$. In addition, $\mathbf{A(L)}^{-1} = \mathbf{C(L)} \Rightarrow \mathbf{A(1)C(1)} = \mathbf{I_n}$ and since $\mathbf{A_{11}(1)C_{12}(1)} + \mathbf{A_{12}(1)C_{22}(1)} = \mathbf{0}$, the facts that $\mathbf{C_{12}(1)} = \mathbf{0}$ and $\mathbf{C_{22}(1)} \neq \mathbf{0}$ (it has to be nonzero otherwise $\mathbf{C(1)}$ would not be invertible) lead us to find that $\mathbf{A_{12}(1)} = \mathbf{0}$: *in the structural equations with permanent shocks, the coefficients on current values and lags of **all** variables with transitory shocks must sum to zero.* Both $\mathbf{C(1)}$ and $\mathbf{A(1)}$ are block lower diagonal.

However, these are not the only restrictions that are allowed by separating the shocks in permanent and transitory. It can be the case that a variable with a permanent shock is not affected by all other permanent shocks in the long run, and that the permanent shock it contains does not affect other variables with permanent shocks in the long run. A commonly used assumption of this type is the monetary dichotomy - neither nominal nor real variables affect the other in the long run. This has the effect to render $\mathbf{C_{11}(1)}$ block diagonal, and necessarily give $\mathbf{A_{11}(1)}$ the same block diagonal structure. As a

[3]The derivation is very similar to section 3.3 of Pagan & Pesaran (2008).

consequence, *when a variable with a permanent shock has zero long run effects on the other variables with permanent shocks and vice versa, the coefficients of its current and lagged values in these equations as well as the coefficients of the other variables with permanent shocks on its own equation must also sum to zero.*

To have a better understanding of the effect of restrictions, this is how the first set of equations in the structural form (5) will transform to when the restrictions are imposed.

$$\begin{aligned}
\mathbf{A^0_{11}}\Delta\mathbf{z_{1t}} + \mathbf{A^0_{12}}\Delta\mathbf{z_{2t}} &= \mathbf{A^1_{11}}\Delta\mathbf{z_{1,t-1}} + \mathbf{A^1_{12}}\Delta\mathbf{z_{2,t-1}} \\
&\quad + \mathbf{A^2_{11}}\Delta\mathbf{z_{1,t-2}} + \mathbf{A^2_{12}}\Delta\mathbf{z_{2,t-2}} + \Delta\varepsilon_{1t} \Rightarrow \\
\mathbf{A^0_{11}}\Delta\mathbf{z_{1t}} + \mathbf{A^0_{12}}\Delta\mathbf{z_{2t}} - \mathbf{A^0_{12}}\Delta\mathbf{z_{2,t-1}} + \mathbf{A^0_{12}}\Delta\mathbf{z_{2,t-1}} &= \ldots \Rightarrow \\
\mathbf{A^0_{11}}\Delta\mathbf{z_{1t}} + \mathbf{A^0_{12}}\Delta^2\mathbf{z_{2t}} + \mathbf{A^0_{12}}\Delta\mathbf{z_{2,t-1}} &= \ldots \Rightarrow \\
\mathbf{A^0_{11}}\Delta\mathbf{z_{1t}} + \mathbf{A^0_{12}}\Delta^2\mathbf{z_{2t}} + (\mathbf{A^1_{12}} + \mathbf{A^2_{12}})\Delta\mathbf{z_{2,t-1}} &= \ldots \Rightarrow \\
\mathbf{A^0_{11}}\Delta\mathbf{z_{1t}} + \mathbf{A^0_{12}}\Delta^2\mathbf{z_{2t}} &= \mathbf{A^1_{11}}\Delta\mathbf{z_{1,t-1}} - \mathbf{A^2_{12}}\Delta^2\mathbf{z_{2,t-1}} \\
&\quad + \mathbf{A^2_{11}}\Delta\mathbf{z_{1,t-2}} + \Delta\varepsilon_{1t}.
\end{aligned}$$

This form, since the variables with transitory shocks (and permanent shocks with zero long run effects) appear in second differences, readily allows the use of two kinds of instruments for the estimation of the elements of $\mathbf{A^0_{11}}$ and $\mathbf{A^2_{11}}$: the lagged cointegrating errors $\beta'\mathbf{z_{t-1}}$ and lagged first differences $\Delta\mathbf{z_{2,t-1}}$ of the variables with transitory shocks. As it is evident, the equations with the permanent shocks are at least just identified - in addition, in subsequent estimations, the already estimated structural errors can (and probably should) be used as instruments. In the second set of equations, only the estimated structural errors are available as instruments, so here one would need additional restrictions to identify the model, or valid instruments outside the model. Yet, this procedure allows more coefficients of the $\mathbf{A}^0$ matrix to be estimated.

2.2 Weak Instruments

As with all IV exercises, this one too may be plagued by the presence of weak instruments; for the problems caused by their presence, a good introduction is Stock, Wright and Yogo (2002). The previous analysis has shown that it is possible to find many instruments to estimate the $\mathbf{A^0}$ matrix consistently with a minimum of restrictions. However, there is no guarantee the these instruments will be sufficiently strong for the purpose. In fact, this is an empirical question, that cannot be answered a priori.

Specifically, for the potential problems of using long-run identifying restrictions, the interested reader may consult Faust and Leeper (1997), and especially Pagan and Robertson (1998) and Fry and Pagan (2005), who demonstrate how identification restrictions, and in particular long-run ones, lead to finding suitable instruments to estimate $\mathbf{A}^0$; this procedure may lead to valid yet weak instruments, that could weaken subsequent analysis. An estimator that is robust to weak instruments can be a partial solution to this problem.

In brief, in the presence of weak instruments the relevant literature has shown that it is better to avoid the IV estimator in such a case - Stock and Yogo (2002) are among the authors documenting the disadvantages of its use. The most common alternatives to the IV estimator are LIML and Fuller-k estimators, but the relevant (quite big) literature is still experimenting with other estimators, commonly based on the jackknife principle. There are no still no widely accepted methods to estimate in such an environment.

In this work, I depart form standard treatments of IV estimation in two ways: the first departure is that I use single equation methods to assess the strength of the instruments instead of using matrix rank statistics, as typically done in modern uses of IV estimation; the reason is that the loss in power from using the full system methods is quite high, even when the instruments are of acceptable quality; consequently, Shea's (1997) partial R^2 statistic will be reported. For more details and discussion see Zervas (2015).

In addition, unlike most attempts in the SVAR literature, I do not use the IV estimator, but instead a newly proposed one - see Hausman et al (2012), the Heteroskedastic Fuller (HFUL). This estimator, which is a modification of Fuller based on the jackknife principle, has much more desirable properties; it has low median bias, the confidence intervals it generates have good coverage rates and it is more closely concentrated around the true value than its competitors, including the median unbiased LIML, and keeps these desirable properties under heteroskedasticity; all in all, it is as good as the Fuller-k in homoskedasticity, but much better in heteroskedasticity, as documented by the aforementioned authors. It can be written as (see Bekker and Crudu 2013 equation 9)

$$\begin{aligned} \beta &= [\mathbf{X}'(\mathbf{P}-\mathbf{D})\mathbf{X} - \mathrm{k}\mathbf{X}'\mathbf{X}]^{-\mathbf{1}}[\mathbf{X}'(\mathbf{P}-\mathbf{D})\mathbf{X} - \mathrm{k}\mathbf{X}'\mathbf{y}] \\ \mathrm{k} &= \frac{(T+1)\alpha-1}{T+\alpha-1},\ \alpha = mineig(\{[\mathbf{y}\,\mathbf{X}]'[\mathbf{y}\,\mathbf{X}]\}^{-\mathbf{1}}\{[\mathbf{y}\,\mathbf{X}]'(\mathbf{P}-\mathbf{D})[\mathbf{y}\,\mathbf{X}]\}), \end{aligned} \tag{6}$$

where $\mathbf{y}$ is the endogenous variable, $\mathbf{X}$ the regressors, $\mathbf{P} = \mathbf{Z}(\mathbf{Z}'\mathbf{Z})^{-\mathbf{1}}\mathbf{Z}'$ is the projection matrix of the instruments $\mathbf{Z}$, $\mathbf{D}$ is a diagonal matrix with the elements of the main diagonal of $\mathbf{P}$, and T is the sample length.

2.3 Impulse Responses

Typical SVAR analysis aims to generate the impulse responses of the system to the structural shock(s) of interest. I will not deviate form this tradition. Since the interest lies on the effects of fiscal policy, I estimate the $\mathbf{A}^0$ matrix with the procedure described in the previous subsection and then feed (the relevant columns of) its inverse to the companion matrix generated by the reduced form VECM, in order to get the impulses to innovations in government spending and taxes. Confidence intervals for these impulse responses are generated in a Bayesian way (Koop and Korobilis 2010 is a useful introduction to the literature), assuming an uninformative natural conjugate Normal-Wishart prior given by the HFUL estimates of each structural equation separately and the OLS estimates of the reduced form VECM (assuming known - not estimated - cointegrating relations for reasons explained later). The prior has the form

$$\Sigma = \mathrm{iW}(\mathrm{V},\ \nu),\ \mathrm{B}|\Sigma = N(B,\ \Sigma) \tag{7}$$

where $\mathrm{iW}(\mathrm{V}, \nu)$ is the inverse Wishart distribution centered at V with ν degrees of freedom, B and V are the estimated coefficient vector (or vectorized system in the case of VECM) and variance covariance matrix of parameters respectively; ν is equal to the number of columns of V plus 3, so as to be uninformative[4]. Confidence intervals are generated by Monte Carlo integration: in each iteration, a draw form the iW distribution gives a variance covariance matrix for each equation (or the VECM), which is then used to get a draw for the coefficient vector, assemble the $\mathbf{A}^0$ matrix as well as the companion matrix and calculate the IRFs for this iteration.

3 Results

3.1 Data, model setup and identification restrictions

The dataset includes 6 countries, US, UK, EMU, France, Canada and Australia. The choice of countries was dictated by the availability of fiscal, and especially tax data, publicly in the internet covering a time period sufficient to estimate a VAR - the shortest sample available, in the case of France, begins in 1980. Frequency is quarterly. More details on the data are available in Appendix A.

The sample is not uniform in all countries, but differs primarily according to data availability. In all countries it stops at the end of 2006 (end of 2005 in EMU case, as the database has not been updated further) - this date was chosen in order to avoid possible nonlinearities from the crisis. The beginning of the sample is 1960:1 in US and UK; 1963:1 in Canada; 1970:1 in Australia (no interest rate is available before late 60's); 1981:1 in France and EMU - in the later case the database starts at 1970, but it is more reasonable

[4]There are no clear guidelines for the selection of ν, except that it has to be low so as not to drive the results, with no explicit numbers, and at least equal to the columns of V, in order for the distribution to have support. 3 was chosen as it is low, yet not as low as to make IRFs meaningless.

to treat the initial EMU countries as a unified economy only after ERM had essentially fixed the exchange rates and harmonized monetary policy across them.

For each country, a VECM with 7 variables[5] was estimated; the variables are real government spending in goods and services (consumption and investment) - g, real GDP - y, inflation (from GDP deflator) - pi, real private consumption - c, real private investment - ip, real net taxes - t, and a short term interest rate - i; real variables are in logs. All models have two lags in VAR form. In all VECMs 4 cointegrating restrictions are imposed: g - t (stationarity of fiscal deficit), ip - y and c - y (balanced growth path - great ratios are stationary) and i - pi (stationarity of the real interest rate). In all cases, the necessary deterministic variables to make the cointegrating relations (as close as possible to being) stationary are used - fortunately breaks appear to have an economic significance - these break variables are restricted in the cointegrating relations. For more details on lag selection and cointegrating properties of the data, the interested reader should read Appendix B.

With 4 cointegrating relations, the identifying assumption in section 2.1 means that in the structural form, there are 3 equations having the permanent shocks - the unit roots of the system, and 4 equations with transitory shocks[6]. The assumption is that the variables with the permanent shocks are g, y and pi, so we have a permanent fiscal (spending shock), a permanent real ("supply") shock and a permanent nominal shock (like the central bank's inflation target). The other variables carry the transitory shocks - t has the transitory fiscal (tax) shock - the fiscal authority first decides about the level of spending, and then adjusts taxes to maintain solvency.

There is another identifying assumption concerning the permanent shocks: the permanent nominal shock does not affect g and y in the long run, and pi is not affected by real shocks in the long run. Then, as shown in section 2.1, in the equation for pi all other endogenous variables (including g and y) appear in second differences, allowing to use lagged differences as instruments, while in the equations for g and y, pi appears in second differences, so its lagged difference is once again a valid instrument. Thus, the structural equations with permanent shocks are always overidentified, as the available instruments to estimate the 6 unknown coefficients of the first 3 rows of the $\mathbf{A}^0$ matrix are, at the very least, the lagged cointegrating errors (4) and the lagged first differences (4, 6 in the equation for pi), and progressively the estimated structural errors become available. In addition, since lagged differences are likely to be quite good instruments for the second

[5]One thing to mention here is that there is a tradeoff between the VAR dimension and the appropriate lag length - bigger VARs typically allow one to use less lags, as truncated VARs have an infinite VAR representation, so many lags are needed to approximate the infinite polynomial sufficiently well.

[6]I also assume that the structural errors are uncorrelated within the period and impose that assumption by including these errors as instruments even if they are not needed.

differences[7], it seems reasonable to start the estimation of structural equations from the equation for *pi*, followed by the one for g and then the one for y.

Turning now to the equations with transitory shocks, we see that there are less instruments than necessary to estimate all the elements of the last 4 rows of the $\mathbf{A}^0$ matrix - the only available instruments to begin with are the 3 estimated permanent shocks, and as estimation progresses the estimated transitory shocks will become available. Thus, some more restrictions are necessary. The most obvious ones are possible in the equations for i and t: a central bank following a Taylor rule (in general, a c.b. with a mandate to stabilize the economy and fight inflation) would only react on output and inflation - if it also tends to accommodate the fiscal authority, then it would react to spending increases - but no reaction to c, *ip* or t are expected, therefore the relevant coefficients are set to 0. If the tax equation follows the interest rate equation, 4 instruments (the estimated structural errors) are available; the minimum for a tax equation (tax reaction function) would consist of the reaction of taxes to output and inflation, but also adding spending (it is conceivable that the fiscal authority changes taxes in response to spending changes) and interest rate (either reaction to market pressure to close deficits or countercyclical fiscal policy - when c.b. tightens to fight inflation, government tries to mitigate the pain) seems justified. Finally, one more restriction is needed, and it is placed in the equation for consumption, where I assume that consumption is not affected by investment contemporaneously - consumption decisions precede those for investment. In total, this procedure requires 6 restrictions in the $\mathbf{A}^0$ matrix, instead of 21 that would be necessary if covariance restrictions were used. The pattern of the estimated matrix is the following (with * are the estimated elements):

$$\begin{bmatrix} 1 & * & * & * & * & * & * \\ * & 1 & * & * & * & * & * \\ * & * & 1 & * & * & * & * \\ * & * & * & 1 & 0 & * & * \\ * & * & * & * & 1 & * & * \\ * & * & * & 0 & 0 & 1 & * \\ * & * & * & 0 & 0 & 0 & 1 \end{bmatrix}$$

However, this order is not kept if it does not result in good instruments, and equations are reordered so as to find overall better instruments[8]. The method should be viewed as quite successful in generating both valid and strong instruments, suitable to estimate

[7] This is verified in the data, as it will become evident in Appendix C.

[8] In the case of UK, the coefficient of output in equation of spending is not identified, so the equation of output is estimated before the one of spending - the latter is better identified in the equation for output.

the contemporaneous relations. The Sargan and Anderson - Rubin tests, as well as the partial R^2 statistics presented in tables 13 and 14 in Appendix C, for all countries and identification patterns, confirm this. As it is evident, in only a few coefficient cases instruments are rather (but not very) weak, and it is for these cases that I opted to use the HFUL estimator.

In addition, it is usually (and reasonably) argued that spending does not react to other variables contemporaneously due to the time it takes to parliaments to enact legislation, as well as due to implementation lags - this is the argument used to justify the Cholesky decomposition with spending ordered first as an appropriate way to identify spending shocks. For this reason, an alternative identification pattern is used, which is like the baseline, except that in the first line only the third element, the response of spending to inflation, is estimated; this is a pattern analogous to the one used in Blanchard and Perotti (2002) and Perotti (2004) - except that the response to inflation is estimated, not imposed.

Finally, in the equation for taxes, the aforementioned authors fix the elasticities based on information outside the model, e.g. on the tax structure. In the current implementation, the procedure generates instruments that allow estimating these elasticities.

3.2 Results

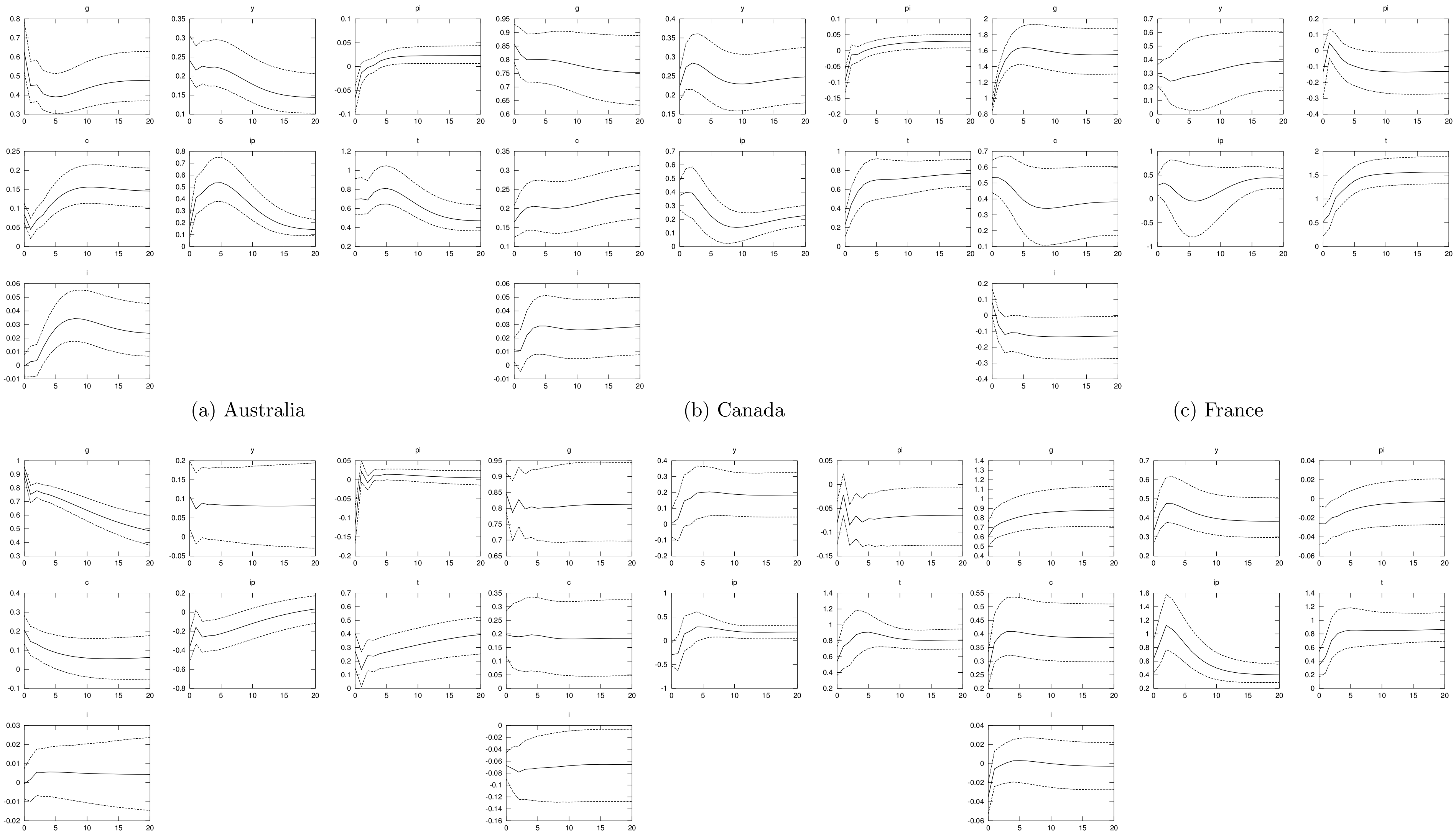
This section presents the results of both specifications. To begin with, figure 1 presents the impulse responses from the baseline specification spending shocks for all countries with 80% posterior intervals. Spending increases cause output to rise significantly in all countries, with the exception of UK where the increase is marginally insignificant. Importantly, consumption rises significantly in all cases. In most countries, private investment rises significantly, with the exception of UK and (the first periods of) EMU; in fact, it is this particular response that seems to determine the strength of the output response - since consumption always rises, it is the response of private investment that will determine the total output response. Taxes rise, as the cointegration restriction forces them to match the spending increase eventually - however, initially we get a deficit. In what concerns nominal variables, spending increases force inflation to fall significantly in all countries; this effect is consistent with with a baseline NK model where all shocks with positive effects on output work through the fall in markups, and consequently inflation. Lastly, the effects on interest rates are not uniform - they fall in France, EMU and US, a response consistent with the fall in inflation, do not move significantly in UK and rise significantly in Australia and Canada.

Next, figure 2 shows the responses to tax increases in the baseline specification. In all cases, taxes rise, yet there is an important distinction in these responses: in Australia, France, EMU and the US, taxes eventually return to zero; in Canada and the UK, they set in a positive value. This is a fundamental difference, as the workings of cointegration restrictions force the system to settle on a different equilibrium; in the first case, spending does not move significantly, so output is rather free to move and falls driving consumption and investment down. In the other case, spending settles in a higher equilibrium, and forces output to increase, as a predominantly spending increase would do - the consumption response is negative in Canada or essentially zero in the UK, leaving private investment to do the adjustment; one might not want to consider these cases as having proper tax shocks; alternatively, one might want to consider these cases as a combination of a tax shock and a permanent fiscal expansion. In what concerns the nominal variables, inflation and interest rates rise in France and EMU, consistently with a baseline NK model where recessions are linked with increases in markups and inflation. In the other countries inflation (after an initial positive response in UK, Australia an Canada) and interest rates fall, consistently with a Keynesian view of the economy.

Turning now to the alternative identification, one has to bear in mind that spending is identified similarly to typical SVAR implementations, and responses to spending shocks are expected to behave similarly to those generated from conventional Cholesky decompositions with spending first - unless the estimated inflation coefficient has some significant effect. Tax shocks are identified as in the previous case, so no big differences are expected between them. These expectations are verified in the data, if one compares the IRFs in figures 3 with those in figure 5 in Appendix D and those in figure 4 with those in 2. Therefore, I will only discuss spending results here: once again, spending increase causes output and consumption to increase significantly in all cases; taxes rise to close the deficit. Private investment responses are positive in the end of the forecasting period, but in most cases negative initially. Inflation and interest rates fall in all cases. These responses are quite uniform and their similarity in all countries of the sample, their similarity with a modified NK model and their simplicity, both in implementation as well as in justification, are probably the reasons for the widespread use of Cholesky identification to spending shocks.

In table 1 the cumulative output multipliers[9] of all aforementioned cases are presented; The multipliers of Cholesky shocks are in table 15 in Appendix D, and their similarity with those of alternative identification for spending shocks is striking. Output multipliers of spending are much higher in the baseline identification in Australia, Canada and US, are essentially the same in the two identifications in France and UK, and are lower in the baseline identification in EMU. In the alternative identification they are close to one in

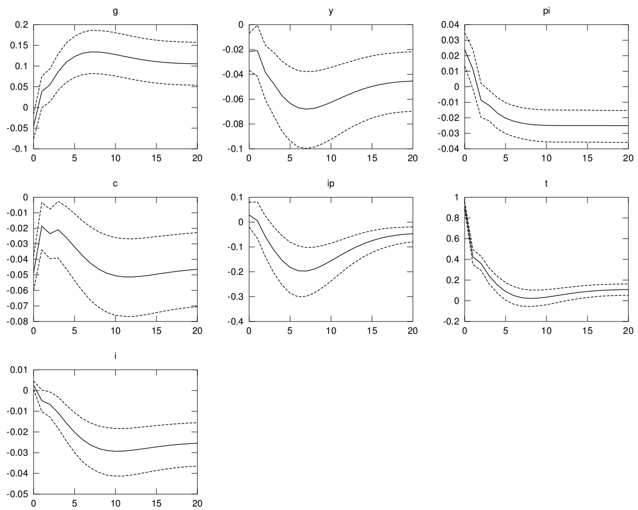
[9]The cumulative sum of the IRFs of output divided by the same sum of the fiscal variable, divided by the average share of the fiscal variable in GDP.



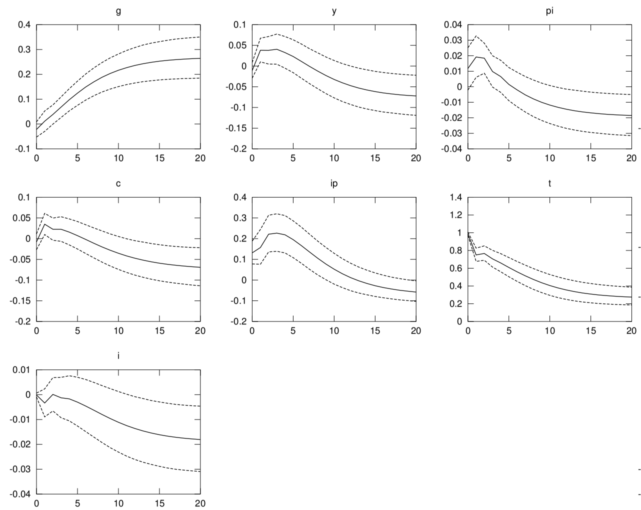
(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

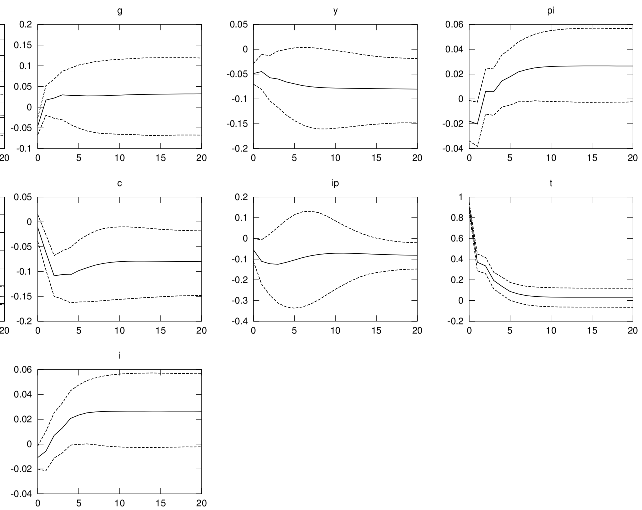
Figure 1: Responses to spending increases with 80% posterior intervals - baseline identification



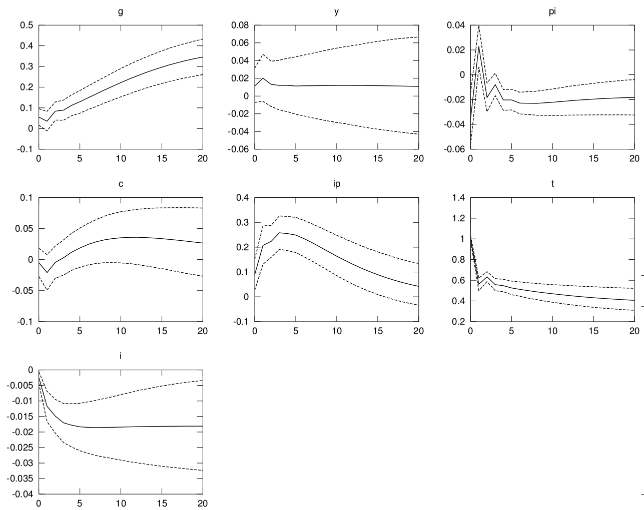
(a) Australia



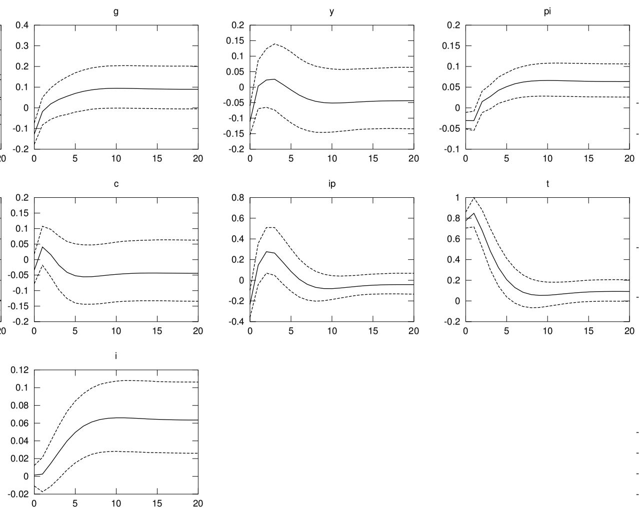
(b) Canada



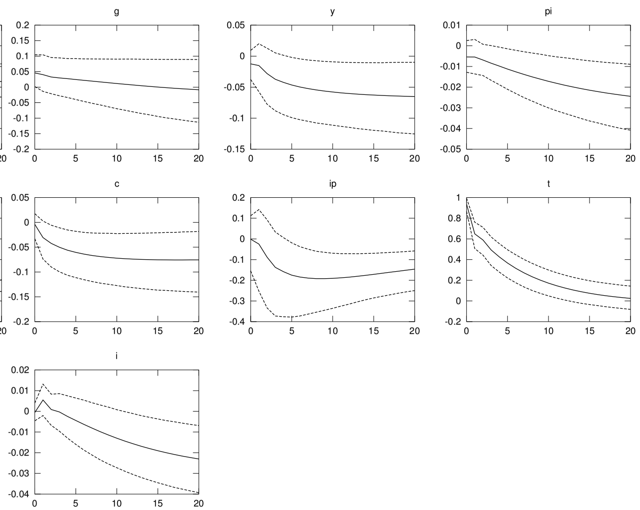
(c) France



(d) UK

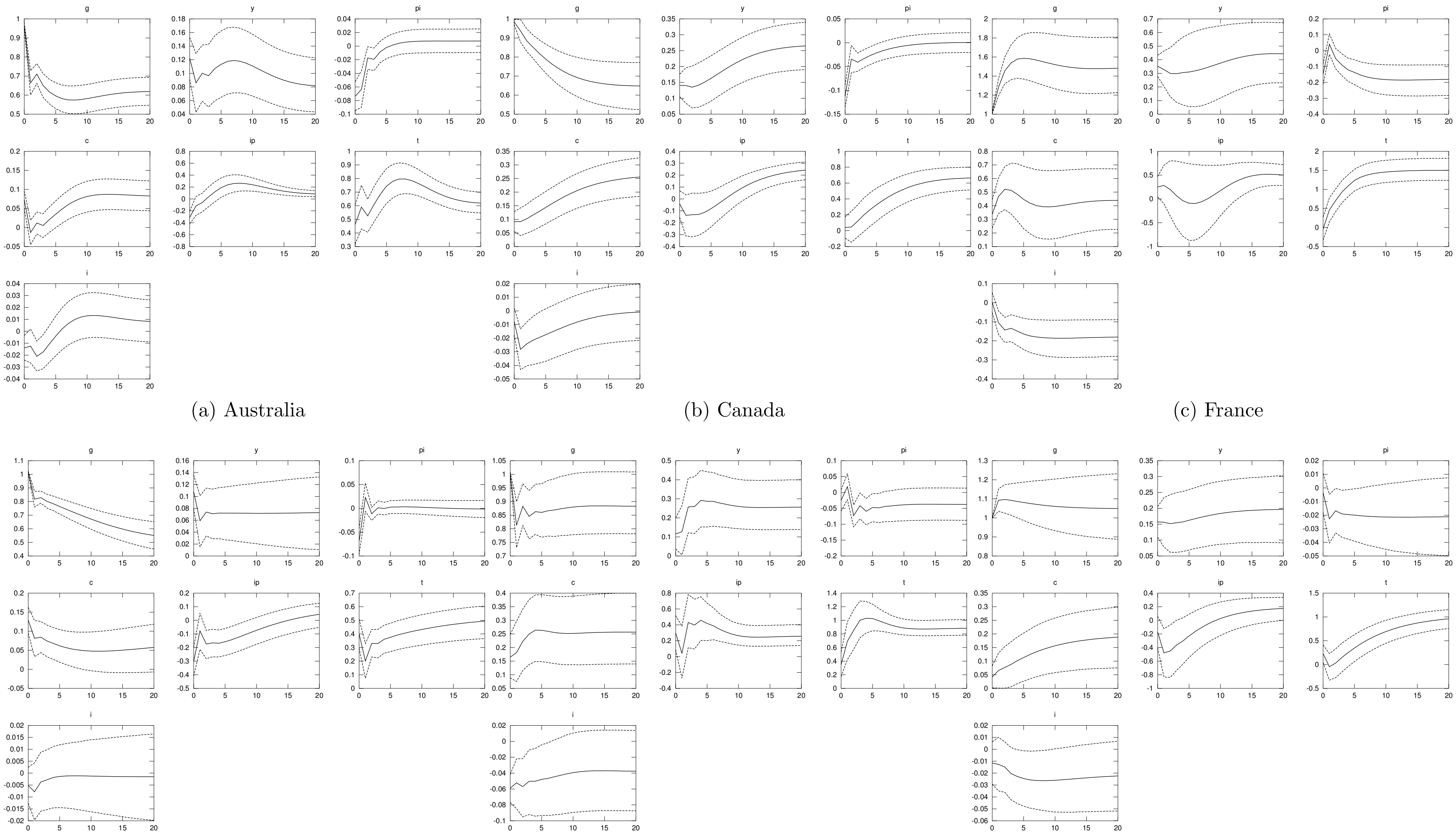


(e) EMU



(f) US

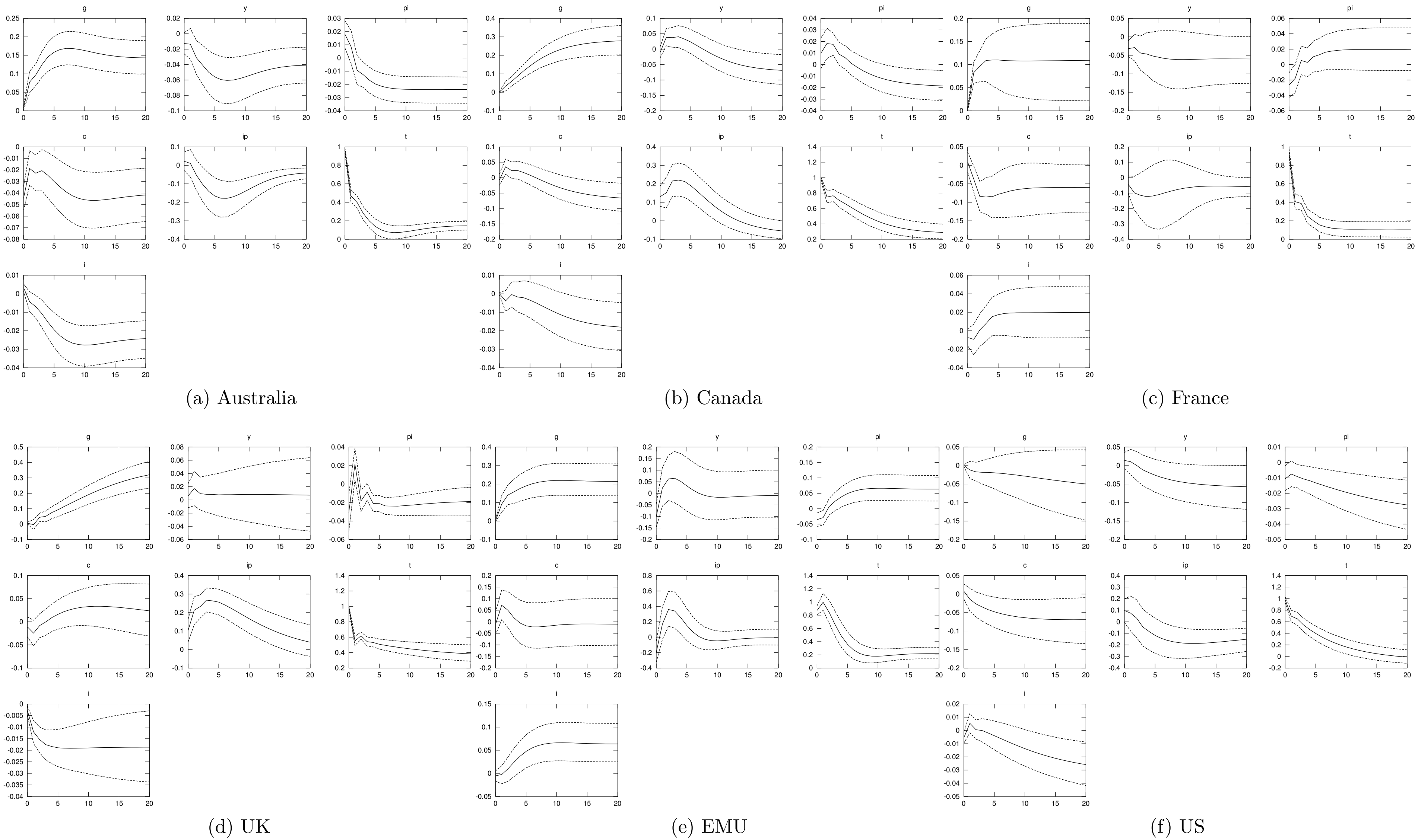
Figure 2: Responses to tax increases with 80% posterior intervals - baseline identification



(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

Figure 3: Responses to spending increases with 80% posterior intervals - alternative identification



(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

Figure 4: Responses to tax increases with 80% posterior intervals - alternative identification

Table 1: Output multipliers

	Australia			**Canada**			**France**			**UK**			**EMU**			**US**		
baseline	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	1.64	**1.86**	2.07	0.92	**1.10**	1.29	0.81	**1.08**	1.36	0.10	**0.52**	0.97	-0.42	**0.03**	0.47	2.33	**2.70**	3.11
t=4	1.94	**2.34**	2.76	1.07	**1.39**	1.72	0.28	**0.67**	1.08	-0.01	**0.49**	1.02	-0.16	**0.59**	1.31	2.51	**2.97**	3.47
t=8	1.95	**2.41**	2.96	1.02	**1.35**	1.69	0.18	**0.65**	1.12	-0.03	**0.51**	1.08	0.06	**0.81**	1.52	2.35	**2.77**	3.21
t=16	1.66	**2.09**	2.62	1.01	**1.33**	1.65	0.24	**0.71**	1.19	-0.08	**0.55**	1.21	0.17	**0.90**	1.56	2.13	**2.50**	2.88
alternative	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	0.45	**0.61**	0.76	0.46	**0.61**	0.76	0.95	**1.20**	1.48	0.35	**0.47**	0.60	0.16	**0.51**	0.88	0.54	**0.78**	1.02
t=4	0.42	**0.69**	0.96	0.41	**0.68**	0.94	0.40	**0.80**	1.25	0.21	**0.40**	0.60	0.47	**1.05**	1.67	0.37	**0.72**	1.06
t=8	0.48	**0.80**	1.13	0.52	**0.82**	1.10	0.28	**0.76**	1.29	0.19	**0.42**	0.64	0.63	**1.21**	1.84	0.39	**0.75**	1.10
t=16	0.49	**0.80**	1.14	0.78	**1.11**	1.42	0.35	**0.85**	1.38	0.17	**0.45**	0.73	0.68	**1.24**	1.85	0.44	**0.81**	1.17

(a) Spending

	Australia			**Canada**			**France**			**UK**			**EMU**			**US**		
baseline	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.22	**-0.12**	-0.04	-0.14	**-0.05**	0.04	-0.22	**-0.15**	-0.08	-0.03	**0.04**	0.11	-0.97	**-0.65**	-0.32	-0.22	**-0.07**	0.05
t=4	-0.82	**-0.47**	-0.20	-0.01	**0.17**	0.33	-0.77	**-0.39**	-0.09	-0.06	**0.07**	0.20	-0.76	**-0.07**	0.50	-0.69	**-0.23**	0.08
t=8	-1.97	**-1.05**	-0.46	-0.12	**0.12**	0.34	-1.68	**-0.72**	-0.06	-0.10	**0.07**	0.24	-1.57	**-0.21**	0.75	-1.13	**-0.42**	0.04
t=16	-3.51	**-1.72**	-0.70	-0.51	**-0.12**	0.20	-3.83	**-1.34**	0.00	-0.16	**0.08**	0.30	-3.26	**-0.61**	1.03	-2.26	**-0.83**	-0.01
alternative	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.15	**-0.07**	0.01	-0.14	**-0.05**	0.04	-0.16	**-0.09**	-0.03	-0.04	**0.02**	0.08	-0.81	**-0.52**	-0.22	-0.05	**0.08**	0.19
t=4	-0.62	**-0.34**	-0.10	0.00	**0.17**	0.33	-0.56	**-0.25**	0.01	-0.08	**0.05**	0.18	-0.42	**0.12**	0.59	-0.32	**-0.01**	0.24
t=8	-1.39	**-0.76**	-0.29	-0.10	**0.13**	0.33	-1.10	**-0.44**	0.06	-0.12	**0.05**	0.22	-0.75	**0.13**	0.83	-0.66	**-0.16**	0.21
t=16	-2.19	**-1.18**	-0.47	-0.47	**-0.10**	0.22	-1.92	**-0.70**	0.09	-0.20	**0.06**	0.29	-1.30	**0.02**	1.07	-1.65	**-0.53**	0.18

(b) Tax

all countries but UK.

The output multipliers of tax shocks are higher in the baseline identification in Australia, France, EMU and the US, and they are the same in Canada and UK. Importantly, the absolute values of tax multipliers are always lower than those of spending multipliers, especially in the first two years, in all countries. One thing to remember is that, as shown in Appendix C, if one accepts the validity of the identifying restrictions then one has to admit that tax equations are very well identified, since the quality of IVs for this equation is very good, and the estimates have to be close to true parameter values. Another is that it is possible to generate responses compatible with usual a priori views on tax shocks (negative output and consumption responses), unlike typical SVAR models, in which this is quite hard to achieve.

An interesting thing to note, deserving further scrutiny, is that in the SVAR models with short-run restrictions in Appendix D, in two countries one is able to generate conventional responses to shocks in taxes and significantly negative (and quite big) output tax multipliers: in Australia and the US. Although this is just a conjecture, perhaps it has to do with a characteristic that is unique to these two countries: they constitute the most closed economies in the sample. It may be possible that this kind of structural shocks, that occur in variables highly correlated with real activity, like taxes or interest rates, are only identifiable using SVAR methods in closed economies, where external shocks do not complicate things any further.

3.3 Why do spending multipliers across identifications differ?

The answer is off course that the estimates differ. But which estimates drive the results? Obviously, the prime suspect is the spending equation. In table 2 the estimated contemporaneous coefficients from spending equations (the first line of $\mathbf{A}^0$) of all countries are presented. A few things are worth mentioning. First, the inflation coefficients in the alternative identification, the one resembling the Blanchard and Perotti approach, are insignificant in most cases and their values are much lower in absolute value than the baseline value considered by Perotti (-0.5); additionally, in the full equations no coefficient of inflation is ever significant, casting doubt on the true significance of inflation coefficients in the two cases (Australia and UK) where they were significant.

The most important thing however is the estimates of the full equations. In most cases, there are significant estimates, some of which are highly so; especially the coefficients of private consumption are significant in 4 out of 6 countries. These estimates suggest the implementation of some kind of countercyclical policy in real time, unlike the usual arguments suggesting that the fiscal authority is not reacting contemporaneously to changing economic environment. The estimates also suggest that the size of multipliers is

Table 2: Spending equations estimates

	Baseline						Alternative
Country	y	pi	c	ip	t	i	pi
Australia	-1.2245	0.16216	0.0057431	-0.090879	**-0.076016**	-0.96463	**0.44939+**
Canada	-0.25456	0.087817	-0.099398	**-0.14293**	-0.0079698	-0.58892	0.1444
France	**0.35299**	-0.10364	**-0.2678+**	-0.082346	**-0.044098**	-0.18186	-0.11382
UK	0.23702	-0.069004	**-0.55235+**	0.045219	0.04114	-0.88331	**-0.27122***
EMU	0.20944	0.064692	**-0.30542**	**0.13343**	-0.10404	-0.090416	-0.079025
US	0.44249	0.20997	**-1.5081***	**-0.18325***	0.050065	**1.2137***	-0.041856

Significance (one sided): at 10% level bold, at 5% level bold and star, at 1% level bold and cross

roughly analogous to the strength of that countercyclical policy. US that has the strongest countercyclical policy and the strongest output multiplier.

In addition, the estimates suggest that the usual identification of spending shocks by government spending ordered first in the Cholesky ordering is likely to be misspecified in several occasions. In fact, eliminating some insignificant regressors (inflation in all cases, output in UK, US, France and EMU[10], consumption in Australia and Canada) reveals that the results obtained in these restricted models (presented in section F.1 of the Appendix) do not change substantially from those in the baseline specification. The most notable differences are that the spending multipliers of Australia and EMU rise - in EMU the multiplier becomes very similar to the one obtained by the alternative identification, and that both US multipliers fall slightly. Additionally, in sections E and F.2 of the Appendix, more results from extending the information set to include foreign variables or from using other identifying assumptions are presented; these results do not differ in essence from those presented so far, giving further support to the conclusions.

4 Further issues

4.1 Stability of responses - do the exchange rate regime or policy changes affect the outcomes?

In Perotti (2004) it was documented that there was a fall in government spending multipliers, that was attributed by the author and by Bilbiie et al (2008) mostly to the change in monetary policy, that became more anti-inflationary after 1980, and consequently less accommodative to fiscal expansions; in addition, a contributing factor was also the fall in the percentage of credit constrained consumers. Canzoneri et al (2012) argue for a related, yet different explanation: the change in exchange rate regime that led to a change

[10]Eliminating output in the spending equation of France allows spending multiplier to reach 2 on impact and 1.55 in the long run.

Table 3: Multipliers: estimation sample 1981 - 2006

	Australia			**Canada**			**UK**			**US**		
baseline	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.06	**0.09**	0.25	1.72	**2.30**	2.90	0.21	**0.36**	0.52	1.10	**1.62**	2.40
t=4	0.15	**0.42**	0.70	1.77	**2.65**	3.64	0.59	**0.88**	1.18	1.77	**2.49**	3.49
t=8	0.24	**0.53**	0.81	1.28	**2.12**	2.99	0.69	**1.05**	1.40	2.02	**2.71**	3.63
t=16	0.34	**0.60**	0.88	1.11	**1.93**	2.76	0.82	**1.21**	1.59	2.09	**2.71**	3.49
alternative	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	0.08	**0.24**	0.38	-0.13	**0.08**	0.28	-0.03	**0.08**	0.19	-0.15	**0.21**	0.51
t=4	0.19	**0.46**	0.73	-1.04	**-0.58**	-0.15	0.11	**0.33**	0.55	-0.73	**-0.07**	0.45
t=8	0.30	**0.59**	0.88	-1.25	**-0.63**	-0.09	0.15	**0.43**	0.70	-0.83	**0.00**	0.63
t=16	0.39	**0.68**	0.97	-0.85	**-0.05**	0.66	0.21	**0.56**	0.89	-1.09	**0.05**	0.82

(a) Spending

	Australia			**Canada**			**UK**			**US**		
baseline	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.03	**0.04**	0.11	-0.02	**0.07**	0.16	-0.05	**0.00**	0.06	-0.55	**-0.36**	-0.14
t=4	-0.21	**0.06**	0.28	0.06	**0.27**	0.44	-0.29	**-0.10**	0.07	-1.08	**-0.48**	0.04
t=8	-0.87	**-0.25**	0.18	0.00	**0.26**	0.48	-0.44	**-0.16**	0.08	-1.61	**-0.53**	0.20
t=16	-3.33	**-1.20**	-0.10	-0.43	**-0.02**	0.33	-0.66	**-0.23**	0.10	-2.96	**-0.65**	0.57
alternative	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.04	**0.04**	0.11	-0.03	**0.05**	0.13	-0.07	**-0.01**	0.05	-0.12	**0.00**	0.13
t=4	-0.20	**0.07**	0.28	0.09	**0.27**	0.42	-0.33	**-0.14**	0.02	-0.15	**0.16**	0.43
t=8	-0.80	**-0.22**	0.18	0.01	**0.25**	0.46	-0.50	**-0.21**	0.02	-0.28	**0.20**	0.58
t=16	-2.68	**-1.03**	-0.12	-0.47	**-0.07**	0.28	-0.77	**-0.30**	0.04	-0.67	**0.27**	0.86

(b) Tax

in monetary policy target, from exchange rate stabilization to interest rate stabilization, and secondarily increased openness.

Do these findings survive the change in identification restrictions? Table 3 presents the spending and tax multipliers from estimating the models of Australia, Canada, UK and US in a shorter sample, 1981 - 2006[11]; one may compare the relevant entries with those of Cholesky identification presented in table 15 in Appendix D. Once again, the results from the alternative identification are similar to those from the Cholesky.

However, the baseline identification does not reveal any general trend towards reduced effectiveness of spending increases. Only in Australia can one clearly observe such an effect. In US, the multiplier falls only on the first few periods, while in Canada and the UK it actually rises. Tax multipliers do not change substantially, yet they increase a bit (in absolute value) in UK and US. It seems that the fall in the effectiveness of spending policy is an artifact of the changes in the variance-covariance matrix after 1980, which naturally

[11]France and EMU are omitted since the short sample was used form the beginning.

affect any identification method based on the residuals; both the Cholesky decomposition of the residual variance-covariance matrix and the method of Blanchard and Perotti are using residuals. These findings echo the finding of Sims and Zha (2006) that the best model for US is the one with break only in the variance-covariance matrix, not in the coefficients of the VAR. Overall, these results considered jointly with those in section 3 suggest that changes in monetary policy or differences in openness[12] do not seem to affect the results in any unambiguous way.

4.2 Output elasticities of taxes and the size of tax multipliers

In the last years a consensus seems to have been reached over the size of the spending multiplier (defining spending as purchases of goods and services - public consumption and investment), which is is considered around, perhaps slightly higher than 1. However, there is an ongoing debate on value of the tax multiplier; this is sparkled by the difficulty to find proper instruments to estimate the parameters of the tax equation[13] and the inability to resort to some easy way out, like placing taxes e.g. second or third in the Cholesky ordering. As argued by Caldara and Kamps (2012) the elasticities of policy variables (government spending and taxes) to output are of great importance for the estimation of the relevant output multiplier, and the different identification restrictions are in effect priors for these parameters. A Cholesky ordering imposes an output elasticity of government spending equal to 0, while the different ways to estimate output elasticities of net taxes lead to estimates ranging from 0 to infinity (in the pure sign restrictions case). They conclude however that the spending multiplier should be higher than the one of taxes for reasonable values of the elasticities.

Perhaps the most convincing way to estimate the output elasticity of taxes is to find a proper exogenous tax shock and either use it directly to estimate the output response, or indirectly as an instrument for structural tax shocks. Romer and Romer (2010) are the first who have presented an exogenous tax shock for the US and followed the first route to directly estimate output responses. Mertens and Ravn (2013, 2014) take an extended version of these shocks[14] and follow the second, estimating output elasticities of taxes around 3. In all these papers output multipliers of taxes are very high, typically higher

[12]Schematically, the countries in the sample can be divided in the following groups with respect to how open they are: a) more closed economies, US and Australia, b) relatively open, UK and France and c) open, Canada and EMU. Openness is defined as the sum of imports and exports to GDP ratio.

[13]A reminder: typical SVAR analysis is usually done not for the $\mathbf{A}^0$ matrix of contemporaneous relations but for the $\mathbf{B}$ matrix that relates reduced form residuals with the underlying "structural" shocks. Most authors mentioned in this section work with the latter matrix. For more details, an excellent introduction to the SVAR methodology is chapter 9 of Lütkepohl (2005).

[14]They distinguish between anticipated and unanticipated tax changes based on the time it took for implementation after legislation. They use unanticipated shocks in their estimates.

Table 4: Tax equations estimates of baseline identification

	Baseline			
Country	g	y	pi	i
Australia	**0.41823***	**1.5057+**	**-1.0807***	-1.1132
Canada	-0.0065107	**0.94668+**	-0.1481	0.98888
France	0.068446	**1.6555+**	0.3204	0.45749
UK	**0.24049***	**0.93411+**	**0.36805**	**2.7481+**
EMU	**0.70528+**	**1.266+**	-0.13391	1.1179
US	**-0.47542***	**2.221+**	**2.4491+**	**1.2539**

Significance (one sided): at 10% level bold, at 5% level bold and star, at 1% level bold and cross

than 2 and even higher than 3 in some specifications. Cloyne (2013) finds very similar results for the UK. Perotti (2012) extends the Romer and Romer dataset for the US and finds output elasticities of taxes around 1.8 and output tax multipliers around 1.5 after 3 years.

These results are at odds with those obtained by the implementation of Blanchard - Perotti approach, which gives much lower multipliers (typically lower than spending). The main difference is the output elasticity of taxes which, for the countries of the sample, is calculated as follows: US=1.85, UK=0.76, Canada=1.86, Australia=0.81 (Perotti 2004); EMU=1.54 (Burriel et al 2009); France=0.8 (Biau and Girard 2004).

From section 3.2 one may recall that in the present study the estimated effects of taxes resemble those of the Blanchard - Perotti SVAR approach, and that the estimated tax equations are well identified[15]. What are the estimated output elasticities of taxes? The estimates are presented in table 4 for the baseline case of all countries. As it is evident, the estimated output elasticities of taxes are very significant, but not high enough to generate the very high output multipliers of taxes found in studies using exogenous tax shocks - their values are not that different from those calculated using the Blanchard - Perotti approach. One may observe that these elasticities of taxes with respect to output are broadly analogous to the size of the tax multiplier - countries with higher elasticities have higher tax multipliers. Further supporting results are presented in section F of the Appendix.

To compare results from this work with those generated by the use of exogenous tax shocks, I reestimated the baseline specification for the US adding the Mertens - Ravn unanticipated shocks as instruments. The multipliers are presented in table 5. A quick comparison between them and those in table 1 allow one to easily see that they do not change the baseline results in any fundamental way; spending multipliers are slightly lower, tax multipliers are higher but spending multipliers are still big, definitely much

[15]The interested reader may check Appendix C.

Table 5: Output multipliers for the US

	spending			**taxes**		
	0.1	**base**	0.9	0.1	**base**	0.9
t=0	1.70	**1.98**	2.27	-0.28	**-0.12**	0.00
t=4	1.82	**2.18**	2.57	-0.85	**-0.38**	-0.07
t=8	1.74	**2.09**	2.45	-1.41	**-0.63**	-0.16
t=16	1.63	**1.95**	2.27	-2.99	**-1.20**	-0.28

Mertens-Ravn unanticipated shocks included

bigger than those of taxes. IRFs (not presented) do not differ from those of the baseline.

In addition, following Mertens and Ravn, I estimate their tax equation as would be written in the current specification: $\mathrm{u}^{\mathrm{t}}_{\mathrm{t}} = \vartheta_{\mathrm{g}}\varepsilon^{\mathrm{g}}_{\mathrm{t}} + \vartheta_{\mathrm{y}}\mathrm{u}^{\mathrm{y}}_{\mathrm{t}} + \vartheta_{\mathrm{pi}}\mathrm{u}^{\mathrm{pi}}_{\mathrm{t}} + \vartheta_{\mathrm{c}}\mathrm{u}^{\mathrm{c}}_{\mathrm{t}} + \vartheta_{\mathrm{ip}}\mathrm{u}^{\mathrm{ip}}_{\mathrm{t}} + \vartheta_{\mathrm{t}}\varepsilon^{\mathrm{t}}_{\mathrm{t}} + \vartheta_{\mathrm{i}}\mathrm{u}^{\mathrm{i}}_{\mathrm{t}}$, where u denote residuals from the relevant equations and ε the estimated structural errors; the coefficient of interest is θ_y and the equation is estimated by IV, using two different sets of instruments: all structural errors and the Mertens and Ravn unanticipated tax shocks, or all structural errors except the one from output equation and the aforementioned shocks; the elasticity of taxes to output is estimated to be 2.15 (S.E. 0.041) in the first case or 2.19 (S.E. 0.117) in the second. These elasticities are almost equal to the one estimated in the baseline case; it could be the case that their results depend on the different specifications they used, in which they do not include so many macroeconomic variables and could be more vulnerable to non-invertibility problems.

4.3 Discussion - what are the policy implications of the results?

As mentioned in the introduction, a fundamental issue with fiscal policy is whether it is possible to consolidate without too much pain. A rather large literature has taken this issue. One strand of it asserts that it is possible to consolidate without (much) pain, if the chosen policy is to cut expenses and not raise taxes - in fact such a policy is associated with expansions (expansionary fiscal contractions); representative papers of this view are Alesina and Perotti (1995) and Alesina and Ardagna (2010). The mechanism behind this effect is that cutting state helps to reduce the interest rate and also has a negative effect on wages, that helps to spur a supply driven expansion.

However, this view is seriously contested. Perotti (2011) suggests that in major episodes of expansionary fiscal contractions no such effects were present, but rather whatever growth happened was simply the export led growth that followed the large depreciations after the fiscal consolidations. In addition, using a new dataset on fiscal consolidations, Guajardo et al (2011) argue that fiscal consolidations are associated with large contractions and that any positive effects on economic activity found by the opposite view is simply the artifact of using wrong measures of fiscal policy stance (typically cyclically adjusted deficits) that generate positive bias.

The results obtained in this paper suggest that the expansionary austerity theory is highly unlikely to actually hold. Spending multipliers are consistently bigger than tax ones, even when the are not big. Thus, in all cases cutting spending will do more harm than raising taxes, even when that harm will be small.

Another thing worth discussing is what determines these multipliers. An mentioned in the introduction, currently economists typically think that the extend of monetary accommodation and the number of rule-of-thumb consumers determines the outcome. However, no particular monetary accommodation is seen in the responses and it seems hard to argue that US have the largest percentage of such consumers, even though they lack many elements of the welfare state of Europe. Another mechanism is required to generate the observed responses, especially the positive ones of consumption and investment. In the sample, the size of the multiplier is related to the sizes of the elasticity of spending with respect to economic activity and the elasticity of taxes with respect to output - the bigger these elasticities are, the stronger the relevant multiplier[16].

Another thing worth mentioning is that in most countries countercylclical policy is conducted using spending - arguably, since the bulk of spending is not related to the cycle, such policies will have small magnitude. On the other hand, the positive coefficient of spending in the tax equation is probably because taxes are not used to manage demand, but to satisfy fiscal solvency - only in US one observes a negative coefficient in spending.

5 Conclusion

In this paper I have tried to estimate the effects of fiscal policy in economic activity with particular emphasis to spending and tax multipliers. For this, I have used the tools of typical SVAR methodology but with novel identifying restrictions, based on the separation of structural shocks to permanent and transitory; these allow to find proper instruments to estimate the contemporaneous relations. It turned out in most cases that the instruments are quite good for the purpose.

The results confirm the findings of SVAR methodology, that spending causes an increase in economic activity, and importantly an increase in consumption; taxes cause economic activity to fall. Importantly, like in SVAR studies, spending multipliers are higher; this is an important result, as it casts doubt on the results of some important recent papers, that have found very high output multipliers of taxes using exogenous tax shocks. This kind of results obtained in this paper support a predominantly Keynesian

[16]One may argue that also the degree of openness is relevant, as Australia and US, which are the most closed economies, had the biggest multipliers. However Canada has the third strongest multiplier, despite the fact that it is the most open economy in the sample.

view of the economy.

Also, they do not support a common view lately, that fiscal policy has been less effective after 1980 that it was before. The findings of previous studies are probably due to breaks in the correlations of residuals, not the underlying model. In addition, the common view, founded in the Mundell - Flemming model, that fiscal policy is more potent in fixed exchange rates finds no support in the results.

Furthermore, such results strongly refute the empirical relevance of theories like the expansionary fiscal consolidation - fiscal adjustments, necessary as they may be, are never easy or painless, and this is probably the reason policy makers postpone them as much as they can. In any case, the advice to cut government consumption in consolidations seems to be a bad one. This is particularly relevant in current consolidations in Eurozone countries - it seems that the adjustment programs could be more successful if they were better designed.

Lastly, this work can be extended in various ways, like adding countries, changing variables etc. However, the most important extension seems to be the implementation of this identification method to datasets consisting of annual data. If anything, tax data are frequently available in annual frequency, for quite some time, but only rarely can one find data covering more than 20 years on quarterly frequency; long run restrictions can be implemented in principle with annual data, allowing to vastly increase the country coverage and obtaining more general results. It remains to be seen if it is possible to successfully implement it in lower frequency - if it is possible to generate good instruments to estimate the contemporaneous relations in such an environment.

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Appendix

A Variable Sources and Definitions

As a reminder, all models include 7 variables: total real government spending in goods and services (consumption + investment), real GDP, inflation (from GDP defoliator), real private consumption, real private investment, net taxes and the nominal interest rate. Data frequency is quarterly. Needless to say that countries in the study are those for which quarterly non-interpolated fiscal data are freely available and the relevant time series start at least in the 80's. Except from interest rate and inflation, which are in quarterly rates, all other data are in log levels.

In EMU, data are those used in the estimation of ECB's Area Wide Model - available at http://www.eabcn.org/data/awm/index.htm. The interested reader should consult Fagan et al (2001) for details. The data are treated in a manner completely analogous to the one described below for the other countries to derive the needed variables.

For the other countries, data come from OECD - Quarterly National counts or Main Economic Indicators (depending on availability of the particular variable and the sample given) and fiscal data from country sources, typically the quarterly sector accounts of each country. When data are not seasonally adjusted by the source, seasonal adjustment is performed using X12 procedure in Gretl.

In particular, real GDP, real private and government consumption, real total investment, GDP deflator (and investment deflator when needed) and the nominal interest rate are taken from the aforementioned OECD sources. The interest rate is a short-run one; either the overnight rate (typically the Central Bank target rate) or the 3 month market rate; the one with the longest sample is used.

OECD reports only government consumption in the sources used. In order to get the variables used, one needs government investment, total revenues (or at least total taxes, including social security contributions) and social benefits (or transfers to the private sector in general). So country sources are used to find these series. Tax data are deflated using GDP deflator, government investment data are deflated using investment deflator - then this variable is subtracted from total real investment to give total private investment, and added to government consumption to give total spending in good and services.

For Australia, I use tables 5206.3 - Expenditure on Gross Domestic Product (GDP), Current prices; 5206.15 - General Government Income Account, Current prices; 5206.18 - Taxes, Current prices. For Canada, I use tables 380-0002 - Gross domestic product (GDP), expenditure-based, quarterly; and 380-0007 - Sector accounts, all levels of government, quarterly. For France, I use the quarterly government sector accounts - uses and resources. There were tables with 2005 base that had much longer time series, but the data there were not similar to the current tables, so the most recent were used. For UK, I use the following variables (downloaded from Navidata™ program of ONS): ANBOQ (transfers), ANBTQ (total taxes), ANLYQ (transfers), NNBFQ (government investment). The reason is that these series are much longer than other with similar data. For US, I use table 3.1 - Government Current Receipts and Expenditures, of National Income and Product Accounts (NIPA).

Government spending comprises of real total government consumption and investment. Net taxes, T = Total revenues (personal taxes + taxes on production and imports + corporate taxes + social security contributions + other revenues) - social benefits. However, if total taxes only are available, they are used.

B Model selection and cointegration analysis

In this Appendix I present: a) information selection criteria and autocorrelation tests used to choose lag length of the VAR, b) info criteria and trace statistics to choose the cointegration rank of the VECMs and c) unit root tests for the cointegrating relations, for all countries. I follow Pesaran and Smith (1998) for the choice of VECM. Lütkepohl (2005) is an excellent choice for the details of model selection in general.

As it is evident in table 7, the info criteria support VECM models of case 4[17] in most cases, usually with one lag (of levels VAR) in the case of HQ and BIC, but typically two lags are needed to remove autocorrelation from the residuals. However, the data are quite uninformative with respect to the cointegration rank, as shown in tables 8 to 12; trace tests support 3 cointegrating relations in most case, while the info criteria also diverge - AIC supports 5 relations in most countries, HQ 4 and BIC 3 relations; the likelihood is quite flat with respect to differences in cointegration rank.

The cointegrating relations in the specifications are four, as mentioned in the text, and include one to ensure long-run fiscal solvency (g - t), the great ratios (c - y and ip - y) and stationarity of the real interest rate (i - pi). In US, these relations appear to be stationary, according to the unit root tests presented below. Only the real interest rate can be considered stationary in all cases. Nevertheless, allowing for the following breaks renders the other cointegrating relations stationary (or very close to) in most cases:

Table 6: Breaks

Australia	1981:1 - macroeconomic reforms	1993:2 - beginning of inflation targeting	
Canada	1981:1 - macroeconomic reforms / moderation	1994:1 - NAFTA	
France	1986:1 - common market	1993:1 - Maastricht	1999:1 - Euro
UK	1981:1 - macroeconomic reforms / moderation	1993:1 - Maastricht / Floating exchange rate	
EMU	1986:1 - common market	1993:1 - Maastricht	1999:1 - Euro
US		1994:1 - NAFTA	

Breaks consist by both a break in level and the trend in the specific date. Table 10 has the results of the unit root tests of the cointegrating relations. In most cases, the break in 90's helps to achieve stationarity in the shorter sample (1981 - 2006), and was added to the full sample for consistency of the specifications. The are many breaks in EMU and France, yet given the economic history of the EMU counties, I feel these are justified - in any case, they are needed to make the cointegrating relations stationary. Finally, the trends and the breaks are restricted in the cointegrating relations in the estimated models.

[17]Case 1: no constant; case 2: constant restricted in cointegrating relation; case 3: unrestricted constant; case 4: unrestricted constant and trend restricted in contegrating relation; case 5: unrestricted constant and trend.

Table 7: VAR selection

(a) Information Criteria for VAR

	Australia			Canada			France			UK			EMU			US		
	AIC	HQ	BIC	AIC	HQ	BIC	AIC	HQ	BIC	AIC	HQ	BIC	AIC	HQ	BIC	AIC	HQ	BIC
1 lag	-41.71	-41.17	-40.39	-45.21	-44.75	-44.06	-55.92	-55.25	-54.28	-41.87	-41.43	-40.77	-57.67	-57.00	-56.03	-53.41	-52.96	-52.31
2 lags	-41.77	-40.82	-39.44	-45.43	-44.59	-43.38	-56.27	-55.08	-53.35	-41.98	-41.19	-40.02	-57.73	-56.55	-54.82	-55.64	-54.84	-53.68
3 lags	-41.70	-40.34	-38.35	-45.31	-44.12	-42.37	-56.25	-54.55	-52.06	-41.89	-40.75	-39.08	-57.64	-55.94	-53.45	-55.83	-54.69	-53.02
4 lags	-41.71	-39.94	-37.34	-45.14	-43.58	-41.30	-55.95	-53.74	-50.48	-41.86	-40.37	-38.19	-57.75	-55.53	-52.28	-55.77	-54.28	-52.10

(b) LM autocorrelation tests for VAR: p-values

	Australia		Canada		France		UK		EMU		US	
	LM 1 lag	LM 4 lags	LM 1 lag	LM 4 lags	LM 1 lag	LM 4 lags	LM 1 lag	LM 4 lags	LM 1 lag	LM 4 lags	LM 1 lag	LM 4 lags
1 lag	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 lags	1.00	0.01	1.00	0.69	1	0.74	1	0.44	1	0.17	1.00	0.00
3 lags	1.00	0.93	1.00	1.00	1	1.00	1	1.00	1	0.83	1	0.94
4 lags	1.00	1.00	1.00	1.00	1	1.00	1	1	1	1.00	1	1

Table 8: Trace tests for Cointegration: p-values

Australia																
	1 lag				2 lags				3 lags				4 lags			
Rank	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.20	0.09	0.03	0.00	0.19	0.05	0.01
2	0.00	0.01	0.00	0.00	0.01	0.34	0.10	0.03	0.06	0.56	0.35	0.16	0.09	0.43	0.47	0.26
3	0.00	0.08	0.18	0.05	0.16	0.57	0.55	0.33	0.39	0.87	0.80	0.59	0.24	0.58	0.50	0.28
4	0.06	0.49	0.54	0.24	0.23	0.72	0.82	0.59	0.48	0.81	0.89	0.72	0.21	0.55	0.73	0.48
5	0.16	0.79	0.63	0.21	0.34	0.70	0.76	0.37	0.43	0.81	0.87	0.49	0.16	0.59	0.71	0.34
6	0.42	0.71	0.65	0.03	0.48	0.76	0.61	0.03	0.56	0.91	0.66	0.03	0.29	0.54	0.40	0.03

Canada																
	1 lag				2 lags				3 lags				4 lags			
Rank	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.10	0.07
2	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.06	0.08	0.06	0.17	0.19	0.14
3	0.05	0.07	0.13	0.08	0.17	0.27	0.23	0.19	0.32	0.33	0.38	0.28	0.27	0.39	0.38	0.24
4	0.19	0.36	0.34	0.23	0.43	0.54	0.30	0.28	0.62	0.73	0.57	0.42	0.60	0.76	0.57	0.37
5	0.39	0.24	0.38	0.11	0.47	0.30	0.52	0.21	0.46	0.48	0.67	0.43	0.47	0.57	0.68	0.39
6	0.48	0.18	0.33	0.01	0.47	0.13	0.32	0.02	0.31	0.18	0.45	0.04	0.38	0.28	0.51	0.04

France																
	1 lag				2 lags				3 lags				4 lags			
Rank	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.00	0.10	0.10	0.11	0.00	0.06	0.11	0.16
3	0.00	0.01	0.03	0.03	0.03	0.14	0.11	0.14	0.04	0.31	0.20	0.23	0.04	0.18	0.22	0.29
4	0.07	0.62	0.66	0.36	0.17	0.74	0.49	0.33	0.24	0.56	0.25	0.32	0.16	0.37	0.42	0.65
5	0.20	0.65	0.92	0.59	0.66	0.74	0.70	0.56	0.76	0.80	0.58	0.54	0.34	0.55	0.62	0.39
6	0.29	0.26	0.78	0.08	0.47	0.30	0.67	0.04	0.59	0.38	0.70	0.04	0.24	0.25	0.50	0.05

Table 9: Trace tests for Cointegration: p-values

UK																
	1 lag				2 lags				3 lags				4 lags			
Rank	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.01	0.00
1	0.00	0.02	0.00	0.00	0.00	0.04	0.00	0.00	0.05	0.16	0.06	0.02	0.02	0.09	0.04	0.01
2	0.02	0.24	0.03	0.00	0.04	0.10	0.09	0.02	0.16	0.19	0.22	0.10	0.11	0.17	0.15	0.05
3	0.45	0.53	0.22	0.06	0.22	0.41	0.24	0.08	0.31	0.41	0.30	0.11	0.34	0.39	0.25	0.10
4	0.67	0.63	0.41	0.14	0.62	0.69	0.39	0.13	0.65	0.80	0.41	0.15	0.56	0.64	0.52	0.25
5	0.71	0.74	0.55	0.17	0.86	0.92	0.56	0.17	0.82	0.87	0.67	0.22	0.64	0.79	0.48	0.13
6	0.47	0.44	0.73	0.05	0.61	0.51	0.83	0.08	0.57	0.48	0.79	0.08	0.45	0.42	0.66	0.06

EMU																
	1 lag				2 lags				3 lags				4 lags			
Rank	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.03	0.00	0.03	0.15	0.08	0.00	0.00	0.03	0.02
2	0.00	0.00	0.00	0.00	0.00	0.07	0.17	0.09	0.01	0.08	0.35	0.24	0.01	0.03	0.18	0.16
3	0.00	0.03	0.07	0.02	0.04	0.17	0.33	0.15	0.02	0.11	0.42	0.32	0.17	0.19	0.51	0.53
4	0.03	0.55	0.56	0.31	0.14	0.59	0.62	0.37	0.06	0.35	0.66	0.53	0.19	0.12	0.37	0.45
5	0.53	0.78	0.56	0.23	0.60	0.79	0.55	0.28	0.31	0.38	0.70	0.62	0.28	0.12	0.37	0.53
6	0.64	0.13	0.88	0.28	0.61	0.16	0.86	0.32	0.40	0.06	0.57	0.62	0.37	0.04	0.38	0.61

US																
	1 lag				2 lags				3 lags				4 lags			
Rank	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5	case 2	case 3	case 4	case 5
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
1	0.00	0.07	0.10	0.05	0.01	0.11	0.17	0.08	0.04	0.33	0.14	0.06	0.04	0.31	0.10	0.04
2	0.12	0.23	0.32	0.20	0.18	0.71	0.69	0.53	0.22	0.87	0.79	0.64	0.28	0.60	0.49	0.35
3	0.57	0.65	0.58	0.37	0.81	0.89	0.81	0.65	0.80	0.94	0.92	0.85	0.61	0.89	0.86	0.79
4	0.80	0.91	0.70	0.42	0.81	0.93	0.79	0.58	0.69	0.88	0.93	0.75	0.62	0.80	0.90	0.73
5	0.77	0.97	0.81	0.37	0.79	0.95	0.85	0.46	0.63	0.84	0.87	0.43	0.58	0.60	0.85	0.42
6	0.72	0.74	0.93	0.19	0.66	0.55	0.91	0.19	0.66	0.16	0.92	0.15	0.56	0.13	0.74	0.05

Table 10: P-values or test value for ADF-GLS with trend

(a) Australia

		c-y	ip-y	g-t	i-pi
constant	ADF	0.08	0.76	0.08	0.09
	ADF-GLS	0.10	0.74	0.02	0.05
	PP	0.06	0.86	0.02	0.00
trend	ADF	0.26	0.08	0.14	0.26
	ADF-GLS	-2.35	-2.00	-2.49	-2.58
	PP	0.20	0.22	0.03	0.00
	ADF break	0.10	0.04	0.18	0.00

(b) Canada

		c-y	ip-y	g-t	i-pi
constant	ADF	0.20	0.51	0.42	0.04
	ADF-GLS	0.28	0.83	0.10	0.00
	PP	0.14	0.56	0.37	0.00
trend	ADF	0.54	0.16	0.62	0.13
	ADF-GLS	-2.13	-2.36	-1.93	-2.98
	PP	0.29	0.22	0.56	0.00
	ADF break	0.03	0.01	0.03	0.00

(c) France

		c-y	ip-y	g-t	i-pi
constant	ADF	0.46	0.18	0.59	0.13
	ADF-GLS	0.15	0.28	0.23	0.10
	PP	0.46	0.61	0.42	0.01
trend	ADF	0.45	0.15	0.75	0.02
	ADF-GLS	-1.77	-0.89	-1.21	-1.97
	PP	0.40	0.50	0.58	0.00
	ADF break	0.00	0.58 (0.03)	0.25 (0.03)	0.00

(modified specifications with more lags reject unit root in the break case)

(d) UK

		c-y	ip-y	g-t	i-pi
constant	ADF	0.92	0.70	0.40	0.00
	ADF-GLS	0.59	0.86	0.12	0.09
	PP	0.91	0.67	0.26	0.00
trend	ADF	0.35	0.16	0.42	0.01
	ADF-GLS	-1.24	-2.58	-2.11	-2.49
	PP	0.31	0.04	0.21	0.00
	ADF break	0.05	0.14	0.56	0.00

(e) EMU

		c-y	ip-y	g-t	i-pi
constant	ADF	0.09	0.51	0.41	0.71
	ADF-GLS	0.22	0.27	0.11	0.20
	PP	0.06	0.57	0.59	0.26
trend	ADF	0.07	0.19	0.24	0.45
	ADF-GLS	-3.00	-1.21	-1.81	-1.68
	PP	0.04	0.22	0.43	0.04
	ADF break	0.01	0.31 (0.04)	0.05	0.00

(a modified specification with more lags rejects unit root in the break case)

(f) US

		c-y	ip-y	g-t	i-pi
constant	ADF	0.90	0.37	0.01	0.09
	ADF-GLS	0.81	0.44	0.00	0.01
	PP	0.87	0.39	0.02	0.00
trend	ADF	0.15	0.03	0.03	0.28
	ADF-GLS	-2.47	-3.59	-3.79	-2.63
	PP	0.04	0.05	0.08	0.00
	ADF break	0.03	0.00	0.00	0.19

ADF is the augmented Dickey-Fuller unit root test; PP is the Phillips Perron unit root test; ADF break is an ADF test with constant and trend including the break variables as regressors. In all specifications 2 lagged differences are included.
Critical values for ADF-GLS with trend unit root tests of cointegrating relations (full samples): -2.64 (10%) and -2.93 (5%).

Table 11: Info criteria for selecting model and cointegration restrictions - AIC and HQ

		Minimum AIC								Minimum HQ							
		rank 0	rank 1	rank 2	rank 3	rank 4	rank 5	rank6	rank7	rank 0	rank 1	rank 2	rank 3	rank 4	rank 5	rank6	rank7
Australia	value	-61.19	-61.51	-61.67	-61.72	**-61.78**	-61.76	-61.72	-61.66	-60.37	-60.91	-61.19	-61.40	**-61.43**	-61.38	-61.29	-61.17
	lag	4	5	5	2	**2**	2	2	2	1	1	1	1	**1**	1	1	1
	case	4	4	4	4	**4**	4	4	4	3	4	4	4	**4**	4	4	4
Canada	value	-64.83	-65.11	-65.29	-65.44	-65.48	**-65.50**	-65.47	-65.43	-64.40	-64.65	-64.89	-65.00	**-65.01**	-64.97	-64.90	-64.81
	lag	1	2	2	2	2	**2**	2	2	1	2	1	1	**1**	1	1	1
	case	5	4	4	4	4	**4**	4	4	3	4	4	4	**4**	4	4	4
France	value	-73.96	-74.54	-74.92	-75.10	-75.25	**-75.28**	-75.23	-75.14	-73.36	-73.80	-74.18	-74.39	**-74.56**	-74.53	-74.38	-74.21
	lag	1	3	3	2	2	**2**	2	2	1	2	2	1	**1**	1	1	1
	case	5	4	4	4	4	**4**	4	4	3	4	4	4	**4**	4	4	4
UK	value	-61.51	-61.74	-61.91	-62.00	-62.05	**-62.06**	-62.05	-62.00	-61.06	-61.50	-61.61	-61.68	**-61.69**	-61.65	-61.59	-61.49
	lag	3	3	2	2	2	**2**	2	2	1	1	1	1	**1**	1	1	1
	case	4	4	4	4	4	**4**	4	4	3	4	4	4	**4**	4	4	4
EMU	value	-76.83	-77.39	-77.62	-77.82	-77.87	**-77.90**	-77.85	-77.75	-76.24	-76.78	-77.10	-77.30	-77.43	**-77.47**	-77.35	-77.16
	lag	1	2	4	4	2	**2**	2	4	1	1	1	1	1	**1**	1	1
	case	3	4	4	4	4	**3**	4	4	3	4	4	4	2	**2**	2	2
US	value	-68.21	-68.48	-68.66	-68.72	**-68.73**	-68.71	-68.69	-68.62	-67.57	-67.80	-67.91	**-67.92**	-67.88	-67.83	-67.76	-67.65
	lag	2	3	3	3	**3**	3	3	3	1	2	2	**2**	2	2	1	1
	case	4	4	4	4	**4**	4	4	4	3	4	4	**4**	4	4	4	4

Bold indicates the minimum

Table 12: Info criteria for selecting model and cointegration restrictions - BIC

		Minimum BIC							
		rank 0	rank 1	rank 2	rank 3	rank 4	rank 5	rank6	rank7
Australia	value	-59.70	-60.74	-60.94	**-61.06**	-61.01	-60.88	-60.71	-60.50
	lag	1	1	1	**1**	1	1	1	1
	case	3	4	4	**4**	4	4	4	4
Canada	value	-63.80	-64.45	-64.67	**-64.70**	-64.64	-64.52	-64.37	-64.21
	lag	1	1	1	**1**	1	1	1	1
	case	3	4	4	**4**	4	4	4	4
France	value	-72.52	-73.45	-73.78	-73.99	**-74.05**	-73.91	-73.70	-73.44
	lag	1	1	1	1	**1**	1	1	1
	case	3	4	4	2	**2**	2	2	2
UK	value	-60.49	-61.36	-61.40	**-61.43**	-61.34	-61.22	-61.09	-60.91
	lag	1	1	1	**1**	1	1	1	1
	case	3	4	2	**2**	2	4	4	4
EMU	value	-75.37	-76.56	-76.78	-76.91	**-77.00**	-76.93	-76.69	-76.40
	lag	1	1	1	1	**1**	1	1	1
	case	3	4	4	2	**2**	2	2	2
US	value	-67.00	-67.64	**-67.64**	-67.63	-67.53	-67.40	-67.26	-67.07
	lag	1	1	**1**	1	1	1	1	1
	case	3	4	**4**	2	2	4	4	4

Bold indicates the minimum

C Further results not included in main text

In this Appendix AR tests for the specification and the overidentifying restrictions, as well as partial R^2 statistics for the strength of identification of each endogenous regressor for all equations are presented. As it is evident in tables 13 and 14, almost all structural estimations are well estimated and in almost all cases instruments are at least adequate. Importantly, there almost always exist good instruments for spending and taxes in the estimated equations. In the structural equations, invalid instruments (correlated with structural errors) have been removed, so as to make the Sargan TR^2 statistic insignificant. The Sargan test is performed by regressing the residuals from the HFUL estimation on the instruments, just like the IV case; the TR^2 statistic from this equation is distributed as χ^2_{q-r}, where q is the number of instruments, r the number of endogenous variables and q - r the number of overidentifying restrictions.

The Anderson - Rubin (AR) statistic tests both specification and the overidentifying restrictions and it is almost always not significant. Only in the baseline specification for US and UK we observe rather weak instruments for g in the output equation; in the case for US the estimated coefficients are insignificant and close to zero (as in the alternative specification, where g is very well identified) and setting the estimates at zero does not substantially alter the results in either case; in the case for UK, the estimates are

Table 13: Results concerning identification and IV estimation

		Sargan		AR tests		partial R^2 - baseline							partial R^2 - alternative						
	equation	p-value base	p-value alt.	p-value base	p-value alt.	g	y	pi	c	ip	t	i	g	y	pi	c	ip	t	i
Australia	g	0.45	0.84	0.75	0.62	nan	0.10	0.79	0.40	0.33	0.59	0.56	nan	nan	0.79	nan	nan	nan	nan
	y	0.18	0.23	0.77	0.97	0.66	nan	0.90	0.39	0.25	0.55	0.50	0.88	nan	0.60	0.38	0.20	0.52	0.47
	pi	0.18	0.30	0.64	0.69	0.37	0.45	nan	0.46	0.39	0.59	0.50	0.73	0.45	nan	0.46	0.39	0.60	0.52
	c	0.78	0.72	1.00	1.00	0.95	0.89	0.89	nan	nan	1.00	0.99	0.95	0.84	0.89	nan	nan	1.00	0.99
	ip	0.48	0.35	0.88	0.70	0.98	0.93	0.98	1.00	nan	1.00	1.00	1.00	0.92	0.99	1.00	nan	1.00	1.00
	t	0.30	0.36	0.70	0.76	0.96	0.90	0.98	nan	nan	nan	0.99	0.99	0.86	0.98	nan	nan	nan	0.99
	i	0.63	0.23	0.99	0.62	0.89	0.86	0.84	nan	nan	nan	nan	0.95	0.80	0.84	nan	nan	nan	nan
Canada	g	0.49	0.93	1.00	0.72	nan	0.24	0.87	0.44	0.27	0.46	0.45	nan	nan	0.74	nan	nan	nan	nan
	y	0.07	0.21	0.66	0.92	0.44	nan	0.17	0.34	0.21	0.47	0.45	0.80	nan	0.15	0.31	0.18	0.47	0.44
	pi	0.09	0.13	0.30	0.35	0.34	0.43	nan	0.44	0.37	0.49	0.50	0.87	0.43	nan	0.45	0.37	0.50	0.50
	c	0.49	0.49	0.81	0.82	0.99	0.81	0.93	nan	nan	1.00	1.00	0.96	0.80	0.93	nan	nan	1.00	1.00
	ip	0.70	0.65	0.98	0.97	1.00	0.95	0.94	0.99	nan	1.00	1.00	0.97	0.95	0.94	0.99	nan	1.00	1.00
	t	0.66	0.67	0.91	0.92	0.97	0.80	0.93	nan	nan	nan	1.00	0.95	0.79	0.92	nan	nan	nan	1.00
	i	0.79	0.85	0.96	0.98	0.95	0.72	0.88	nan	nan	nan	nan	0.95	0.72	0.89	nan	nan	nan	nan
France	g	0.97	0.48	1.00	0.22	nan	0.24	0.80	0.53	0.20	0.47	0.74	nan	nan	0.76	nan	nan	nan	nan
	y	0.22	0.24	0.39	0.43	0.82	nan	0.85	0.40	0.16	0.45	0.74	0.96	nan	0.86	0.36	0.16	0.45	0.73
	pi	0.49	0.59	0.79	0.85	0.15	0.35	nan	0.37	0.20	0.44	0.52	0.78	0.38	nan	0.50	0.20	0.48	0.54
	c	0.80	0.32	1.00	0.75	0.89	0.78	0.86	nan	nan	0.99	0.97	0.86	0.79	0.88	nan	nan	0.99	0.98
	ip	0.27	0.61	0.82	0.96	0.99	0.95	0.98	0.99	nan	0.99	1.00	1.00	0.90	0.96	0.98	nan	0.99	1.00
	t	0.74	0.89	0.94	0.99	0.89	0.81	0.87	nan	nan	nan	0.97	0.98	0.80	0.87	nan	nan	nan	0.97
	i	0.80	0.80	0.97	0.97	0.81	0.76	0.70	nan	nan	nan	nan	0.94	0.75	0.71	nan	nan	nan	nan

Table 14: Results concerning identification and IV estimation

		Sargan		AR tests		partial R^2 - baseline							partial R^2 - alternative						
	equation	p-value base	p-value alt.	p-value base	p-value alt.	g	y	pi	c	ip	t	i	g	y	pi	c	ip	t	i
UK	g	0.44	0.51	0.95	0.20	nan	0.68	0.83	0.43	0.42	0.45	0.37	nan	nan	0.77	nan	nan	nan	nan
	y	0.93	0.96	1.00	1.00	0.07	nan	0.77	0.23	0.44	0.45	0.40	0.94	nan	0.81	0.32	0.45	0.46	0.41
	pi	0.62	0.68	0.98	0.96	0.36	0.40	nan	0.42	0.46	0.45	0.36	0.84	0.40	nan	0.43	0.46	0.45	0.36
	c	0.82	0.93	0.99	1.00	0.96	0.97	0.91	nan	nan	1.00	1.00	0.99	0.97	0.91	nan	nan	1.00	1.00
	ip	0.39	0.41	0.89	0.90	0.99	1.00	0.99	1.00	nan	1.00	1.00	0.99	1.00	0.99	1.00	nan	1.00	1.00
	t	0.10	0.16	0.56	0.63	0.91	0.94	0.89	nan	nan	nan	1.00	0.98	0.94	0.89	nan	nan	nan	1.00
	i	0.49	0.07	0.78	0.31	0.92	0.95	0.92	nan	nan	nan	nan	0.98	0.94	0.86	nan	nan	nan	nan
EMU	g	0.32	0.56	0.62	0.39	nan	0.39	0.70	0.53	0.45	0.44	0.47	nan	nan	0.77	nan	nan	nan	nan
	y	0.47	0.46	0.97	0.97	0.51	nan	0.68	0.33	0.16	0.42	0.10	0.45	nan	0.68	0.34	0.16	0.40	0.10
	pi	0.51	0.59	0.92	0.87	0.39	0.45	nan	0.51	0.42	0.39	0.39	0.81	0.45	nan	0.53	0.42	0.41	0.40
	c	0.84	0.90	0.97	1.00	0.94	0.97	1.00	nan	nan	1.00	0.99	0.99	0.98	0.99	nan	nan	1.00	0.99
	ip	0.52	0.51	0.94	0.93	0.96	0.99	0.99	1.00	nan	1.00	0.99	0.99	0.99	1.00	1.00	nan	1.00	0.99
	t	0.61	0.33	0.63	0.49	0.91	0.96	0.99	nan	nan	nan	1.00	0.99	0.89	0.97	nan	nan	nan	0.98
	i	0.99	0.99	1.00	1.00	0.89	0.64	0.58	nan	nan	nan	nan	0.97	0.60	0.56	nan	nan	nan	nan
US	g	0.82	0.56	1.00	0.43	nan	0.31	0.66	0.14	0.25	0.40	0.21	nan	nan	0.65	nan	nan	nan	nan
	y	0.03	0.25	0.00	0.50	0.13	nan	0.67	0.14	0.20	0.38	0.26	0.93	nan	0.63	0.06	0.12	0.36	0.15
	pi	0.36	0.50	0.89	0.93	0.31	0.31	nan	0.26	0.30	0.36	0.38	0.59	0.31	nan	0.26	0.30	0.36	0.38
	c	0.18	0.42	0.85	0.97	0.52	0.42	0.75	nan	nan	0.87	0.55	0.92	0.59	0.89	nan	nan	1.00	0.79
	ip	0.66	0.48	0.95	0.89	0.82	1.00	0.90	0.78	nan	0.96	0.86	0.99	0.99	0.95	0.95	nan	1.00	0.95
	t	0.11	0.04	0.33	0.15	0.59	0.42	0.85	nan	nan	nan	0.68	0.95	0.63	0.89	nan	nan	nan	0.84
	i	0.65	0.65	0.92	0.92	0.61	0.33	0.72	nan	nan	nan	nan	0.94	0.49	0.80	nan	nan	nan	nan

very close in both cases, despite the dramatically different quality of instruments across specifications. These two cases illustrate the point made in Zervas (2015) that instruments with partial R^2 of approximately 0.1 are likely to give usable estimates of the relevant structural coefficient.

The following will illustrate the calculation of the AR statistic. A common way to present the IV regression model is to write it as a simultaneous equations model:

$$y = Y\beta + X\gamma + u \quad \text{(I)}$$

$$Y = X\Gamma + Z\Pi + V \quad \text{(II)}$$

where (I) is the structural equation, (II) is the reduced form equation, y is a T×1 vector with the endogenous variable, Y is a T×G matrix of endogenous regressors, X is a T×M matrix of exogenous regressors, Z is a T×K matrix of excluded instruments, u is a T×1 vector with the structural residuals and V is a T×G matrix of reduced form residuals; β and γ are G×1 and M×1 vectors of structural coefficients, while Γ and Π are M×G and K×G matrices with the coefficients of reduced form equations; the full matrix of residuals $U = [u \;\; V] \sim \text{iid}(0,\ \Sigma)$, and Σ is not block diagonal; this last assumption makes u and V correlated, thus creates endogeneity and necessitates the use of an IV procedure for consistent estimation of β. The Anderson-Rubin statistic (Anderson and Rubin 1949) is a test that $\beta = \beta_0$, and is given by:

$$AR(\beta_0) = \frac{(\tilde{y} - \tilde{Y}\beta_0)' P(\tilde{Z})(\tilde{y} - \tilde{Y}\beta_0)/K}{(\tilde{y} - \tilde{Y}\beta_0)' M(\tilde{Z})(\tilde{y} - \tilde{Y}\beta_0)/(T - K - M)}$$

where $\tilde{y}$, $\tilde{Y}$ and $\tilde{Z}$ are the residuals from projecting y, Y and Z respectively on X; *P(A)* is the projection matrix $A(A'A)^{-1}A'$ and *M(A)* is the matrix generating the residuals from the linear projection $I - P(A)$. This statistic has a χ^2_K/K distribution or an *F(K,T-K-M)* under normality.

D Results of SVARs with short run restrictions

SVAR results (IRFs and multipliers) of the models using a Cholesky decomposition - variables are ordered as in the main text. In these models, I change the parameter of the inverse Wishart distribution and use v = 20 (instead of 3 in the main text), because now the variance-covariance matrix of the VAR is used directly to calculate the impact responses, and not only in the draw for the reduced form coefficients.

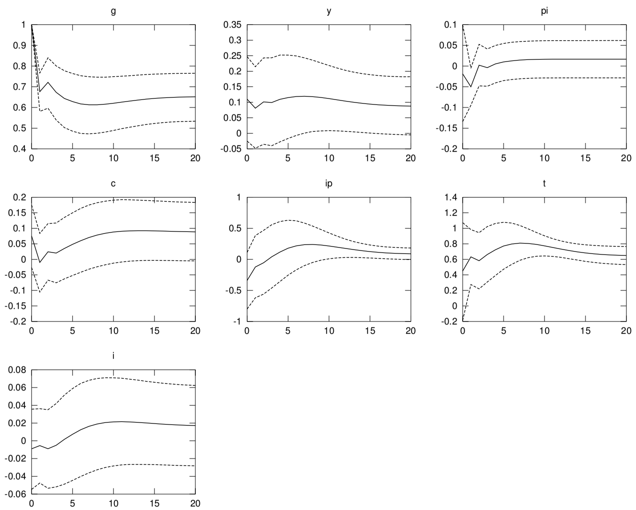
Table 15: Output multipliers - Cholesky identification

	Australia			**Canada**			**France**			**UK**			**EMU**			**US**		
full sample	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.12	**0.53**	1.19	0.17	**0.77**	1.35	0.12	**0.91**	1.70	-0.17	**0.46**	1.09	-0.39	**0.69**	1.72	-0.10	**0.87**	1.86
t=4	-0.21	**0.65**	1.64	0.08	**0.94**	1.74	-0.53	**0.40**	1.35	-0.35	**0.39**	1.15	-0.17	**1.36**	2.74	-0.24	**0.84**	1.86
t=8	-0.14	**0.76**	1.81	0.18	**1.05**	1.84	-0.61	**0.36**	1.32	-0.38	**0.41**	1.22	0.04	**1.51**	2.78	-0.15	**0.86**	1.78
t=16	-0.04	**0.77**	1.69	0.41	**1.26**	2.07	-0.43	**0.49**	1.36	-0.44	**0.44**	1.35	0.15	**1.51**	2.66	-0.01	**0.91**	1.72
post 81 sample	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.27	**0.27**	0.81	-0.44	**0.21**	0.87				-0.23	**0.16**	0.54				-0.64	**0.27**	1.18
t=4	-0.27	**0.56**	1.40	-1.56	**-0.35**	0.72				-0.16	**0.46**	1.11				-1.35	**0.10**	1.39
t=8	-0.11	**0.69**	1.50	-1.90	**-0.40**	0.80				-0.16	**0.59**	1.32				-1.59	**0.23**	1.59
t=16	0.05	**0.75**	1.45	-1.56	**0.13**	1.50				-0.12	**0.74**	1.51				-1.99	**0.34**	1.72

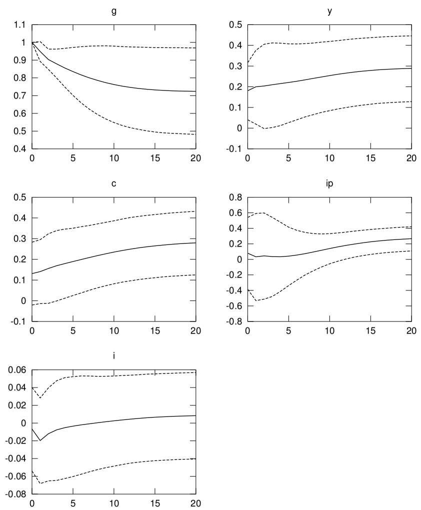
(a) Spending

	Australia			**Canada**			**France**			**UK**			**EMU**			**US**		
full sample	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0
t=4	-0.40	**-0.32**	-0.24	0.20	**0.23**	0.26	-0.01	**0.06**	0.13	-0.01	**0.03**	0.06	0.68	**0.75**	0.83	-0.24	**-0.17**	-0.11
t=8	-1.01	**-0.78**	-0.60	0.20	**0.26**	0.31	-0.12	**0.03**	0.18	-0.03	**0.02**	0.07	0.83	**0.98**	1.12	-0.59	**-0.43**	-0.26
t=16	-1.40	**-1.04**	-0.76	0.05	**0.15**	0.25	-0.34	**-0.07**	0.19	-0.07	**0.02**	0.10	0.95	**1.18**	1.41	-1.41	**-1.02**	-0.64
post 81 sample	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	0	**0**	0	0	**0**	0				0	**0**	0				0	**0**	0
t=4	-0.21	**-0.06**	0.09	0.20	**0.24**	0.28				-0.22	**-0.14**	-0.07				0.09	**0.14**	0.18
t=8	-0.76	**-0.38**	-0.08	0.23	**0.30**	0.36				-0.40	**-0.26**	-0.13				0.02	**0.10**	0.18
t=16	-2.32	**-1.10**	-0.43	-0.09	**0.03**	0.14				-0.61	**-0.39**	-0.21				-0.16	**0.05**	0.23

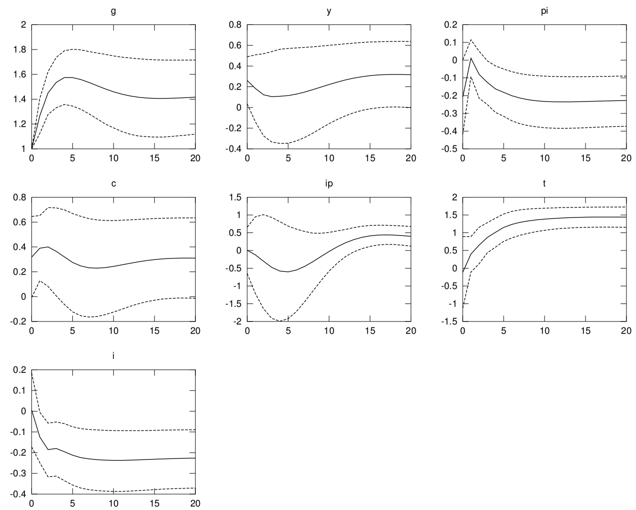
(b) Tax



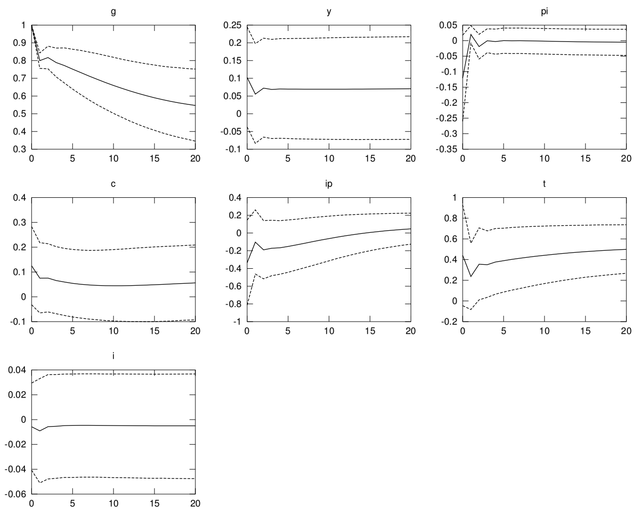
(a) Australia



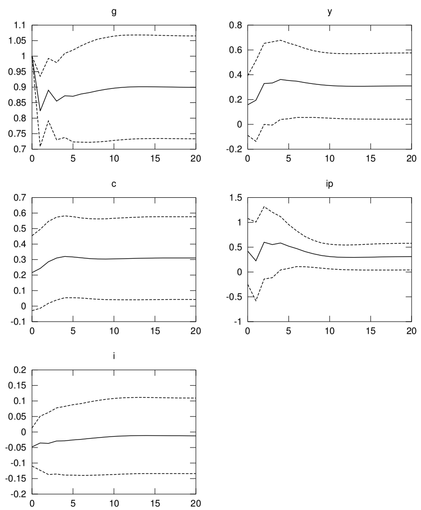
(b) Canada



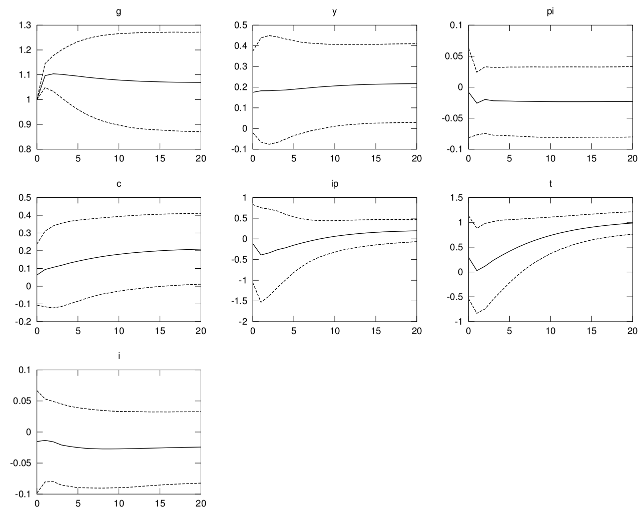
(c) France



(d) UK

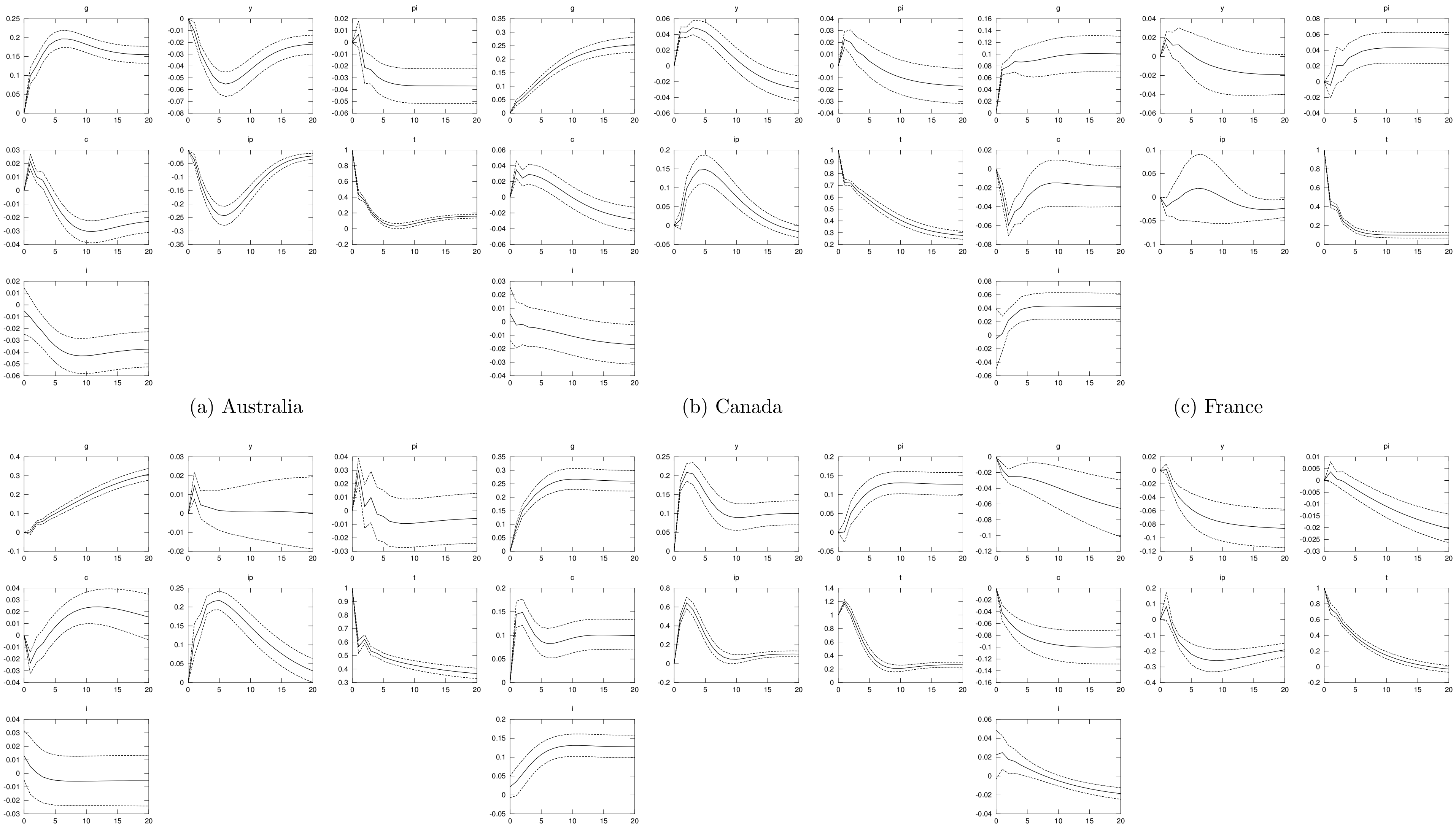


(e) EMU



(f) US

Figure 5: Responses to spending increases with 80% posterior intervals



(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

Figure 6: Responses to tax increases with 80% posterior intervals

E Adding foreign variables

In this section of the Appendix the results from models including Kilian's (AER 2009) global activity measure (GAM) are presented; in particular, in the baseline specification for all countries the current value and two lags of this variable are included, in order to account for foreign shocks in the model; sample has to start after 1969:1, as GAM is not available previously. In table 16 LR test and info criteria for the inclusion of these exogenous variables in the country models are included.

As it is obvious from this table, information criteria do not favour the addition of GAM in the model (with the exception of AIC in case of UK and US in the full sample); LR tests also reject the presence of GAM in the models in the short sample (with the exception of UK). It seems that in the post 81 period, for some reason, the influence of foreign variables has fallen. One can rationalize such an effect by e.g. noting that flexible exchange rates stabilize economies from foreign shocks or that Governments and Central Banks were free to focus on domestic economy in the latter period - in any case the turbulent 70's are excluded from the shorter sample.

In table 17 spending and tax multipliers for cases[18] were LR tests reject the omission of (current and two lags of) GAM are presented - baseline identification is assumed in all cases. As it is obvious from the table, all major results (higher spending than tax multipliers, not particularly high tax multipliers) remain unaffected - in fact, spending multipliers are higher now in all countries (altough the big increase in the case of US might indicate some endogeneity issues, since US accounts for a big part of global output, especially in the first part of the sample).

Estimates of the contemporaneous coefficients of equations for g and t are presented in tables 18 and 19 respectively. As shown in table 18, as in section 3.3 of main text, spending multipliers are roughly analogous to the strength of countercyclical fiscal policy, and are bigger now since the estimated coefficients are bigger in absolute value. In addition, similarly to the results of section 4.2, tax multipliers tend to be bigger as output elasticities rise.

[18]AUS, CA, UK and US for 1969 - 2006 period and UK only for 1981 - 2006 period.

Table 16: Tests and info criteria for inclusion of GAM in models

		LR			AIC		BIC		HQ	
		1969-2006	1981-2006		1969-2006	1981-2006	1969-2006	1981-2006	1969-2006	1981-2006
AUS	test	31.77	26.02	with GAM	-41.25	-43.47	-38.70	-40.27	-40.22	-42.18
	p-value	0.06	0.21	GAM excluded	-41.32	-43.63	-39.20	-40.96	-40.46	-42.55
CA	test	55.80	23.97	with GAM	-45.25	-46.87	-42.75	-43.67	-44.23	-45.57
	p-value	0.00	0.29	GAM excluded	-45.16	-47.04	-43.07	-44.37	-44.31	-45.96
EMU	test		21.00	with GAM		-57.30		-54.02		-55.97
	p-value		0.46	GAM excluded		-57.51		-54.78		-56.40
FR	test		27.12	with GAM		-54.42		-51.22		-53.12
	p-value		0.17	GAM excluded		-54.56		-51.89		-53.48
UK	test	51.89	41.85	with GAM	-42.03	-45.67	-39.52	-42.46	-41.01	-44.37
	p-value	0.00	0.00	GAM excluded	-41.96	-45.67	-39.87	-43.00	-41.11	-44.59
US	test	55.77	29.46	with GAM	-48.46	-51.29	-45.96	-48.08	-47.45	-49.99
	p-value	0.00	0.10	GAM excluded	-48.37	-51.41	-46.28	-48.74	-47.52	-50.33

Table 17: Output multipliers - Baseline identification with GAM

Spending Multipliers															
	Australia 1969-2006			**Canada 1969-2006**			**UK 1969-2006**			**UK 1981-2006**			**US 1969-2006**		
	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	2.29	**2.56**	2.85	1.38	**1.62**	1.87	0.66	**0.81**	0.96	0.58	**0.75**	0.94	4.67	**5.53**	6.73
t=4	2.80	**3.30**	3.86	1.56	**1.98**	2.42	0.70	**0.92**	1.14	1.10	**1.42**	1.79	4.20	**5.10**	6.27
t=8	2.74	**3.30**	3.99	1.42	**1.82**	2.26	0.76	**1.01**	1.27	1.21	**1.55**	1.94	3.25	**3.93**	4.81
t=16	2.28	**2.83**	3.53	1.33	**1.73**	2.14	0.92	**1.24**	1.58	1.27	**1.58**	1.92	2.45	**2.99**	3.66

Tax Multipliers															
	Australia 1969-2006			**Canada 1969-2006**			**UK 1969-2006**			**UK 1981-2006**			**US 1969-2006**		
	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.26	**-0.16**	-0.07	-0.04	**0.05**	0.13	-0.09	**-0.02**	0.06	-0.13	**-0.06**	0.00	-0.11	**0.02**	0.16
t=4	-0.89	**-0.52**	-0.24	0.09	**0.25**	0.41	-0.24	**-0.09**	0.05	-0.41	**-0.22**	-0.06	-0.27	**0.01**	0.26
t=8	-2.05	**-1.12**	-0.51	0.00	**0.22**	0.42	-0.34	**-0.14**	0.04	-0.60	**-0.31**	-0.09	-0.57	**-0.12**	0.23
t=16	-3.82	**-1.87**	-0.77	-0.34	**0.00**	0.29	-0.49	**-0.23**	0.02	-0.87	**-0.44**	-0.14	-1.62	**-0.56**	0.14

Table 18: Spending equations estimates - GAM included

Country	y	pi	c	ip	t	i
Australia	-1.794	0.064	-0.035	-0.125	**-0.092**	-0.772
Canada	**-0.952***	0.134	0.091	**-0.191**	0.048	-0.248
UK 1969-2006	-0.313	-0.128	**-0.467***	0.027	0.041	-0.409
UK 1981-2006	-1.579	0.165	**-1.780***	-0.044	-0.073	2.160
US	**1.082**	**0.648**	**-2.768+**	**-0.342+**	0.002	**1.455***

Significance (one sided): at 10% level bold, at 5% level bold and star, at 1% level bold and double star

Table 19: Tax equations estimates - GAM included

Country	g	y	pi	i
Australia	**0.359***	**1.617+**	**-1.147+**	-1.272
Canada	0.061	**0.742***	-0.120	0.667
UK 1969-2006	**0.252***	**1.134+**	0.067	**3.264+**
UK 1981-2006	0.142	**3.023+**	**-0.987***	0.334
US	**0.383**	**1.828+**	**2.892+**	**1.915+**

Significance (one sided): at 10% level bold, at 5% level bold and star, at 1% level bold and cross

F Other identifying assumptions

F.1 Results for the restricted models in section 3.3

In these section the results for the restricted models mentioned in section 3.3 are presented. In table 20 the restriction patterns of $\mathbf{A}^0$ are presented (* for unrestricted elements). In table 21 the estimates of the contemporaneous coefficients of spending and tax equations are presented. In table 22 the multipliers are presented. In table 23 IV statistics are presented, while in figures 7 and 8 the IRFs of these models are shown.

Table 20: Identification patterns of restrictions in section 3.3

EMU, FR, UK, US							AUS, CAN						
1	0	0	∗	∗	∗	∗	1	∗	0	0	∗	∗	∗
∗	1	∗	∗	∗	∗	∗	∗	1	∗	∗	∗	∗	∗
∗	∗	1	∗	∗	∗	∗	∗	∗	1	∗	∗	∗	∗
∗	∗	∗	1	0	∗	∗	∗	∗	∗	1	0	0	∗
∗	∗	∗	∗	1	∗	∗	∗	∗	∗	∗	1	0	∗
∗	∗	∗	0	0	1	∗	∗	∗	∗	∗	∗	1	∗
∗	∗	∗	0	0	0	1	∗	∗	∗	0	0	0	1

Order of variables: *g, y, pi, c, ip, t, i*

Table 21: Contemporaneous coefficients of restricted models in section 3.3

(a) Spending equations estimates

Country	*y*	*pi*	*c*	*ip*	*t*	*i*
Australia	**-2.096***	0	0	-0.141	**-0.091**	-0.392
Canada	-0.371	0	0	**-0.158***	-0.005	-0.688
France	0	0	**-0.238***	-0.135	**-0.059***	-0.115
UK	0	0	**-0.405***	0.061	0.027	**-1.219**
EMU	0	0	**-0.251**	**0.158+**	-0.107	0.080
US	0	0	**-0.467**	**-0.037**	0.035	0.442

(b) Tax equations estimates

Country	*g*	*y*	*pi*	*i*
Australia	**0.396***	**1.521+**	**-1.068***	-1.184
Canada	-0.061	**1.100+**	-0.204	0.955
France	0.017	**1.676+**	0.302	0.475
UK	**0.280***	**0.936+**	0.361	**2.811+**
EMU	**0.648+**	**1.275+**	-0.133	1.166
US	-0.184	**1.779+**	**2.714+**	**1.935+**

Significance (one sided): at 10% level bold, at 5% level bold and star, at 1% level bold and cross

Table 22: Output multipliers of the restricted models in section 3.3

	Australia			**Canada**			**France**		
	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	2.32	**2.62**	2.91	0.94	**1.12**	1.31	1.75	**2.04**	2.35
t=4	2.90	**3.48**	4.13	1.08	**1.39**	1.72	1.32	**1.76**	2.24
t=8	2.87	**3.55**	4.40	1.01	**1.34**	1.68	1.20	**1.69**	2.25
t=16	2.34	**2.95**	3.76	0.98	**1.31**	1.63	1.11	**1.57**	2.09
	UK			**EMU**			**US**		
	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	0.12	**0.55**	0.98	-0.04	**0.39**	0.85	1.14	**1.42**	1.69
t=4	0.01	**0.52**	1.05	0.30	**0.98**	1.68	1.19	**1.55**	1.92
t=8	-0.02	**0.54**	1.11	0.49	**1.17**	1.85	1.19	**1.55**	1.91
t=16	-0.05	**0.59**	1.24	0.58	**1.24**	1.86	1.19	**1.54**	1.88

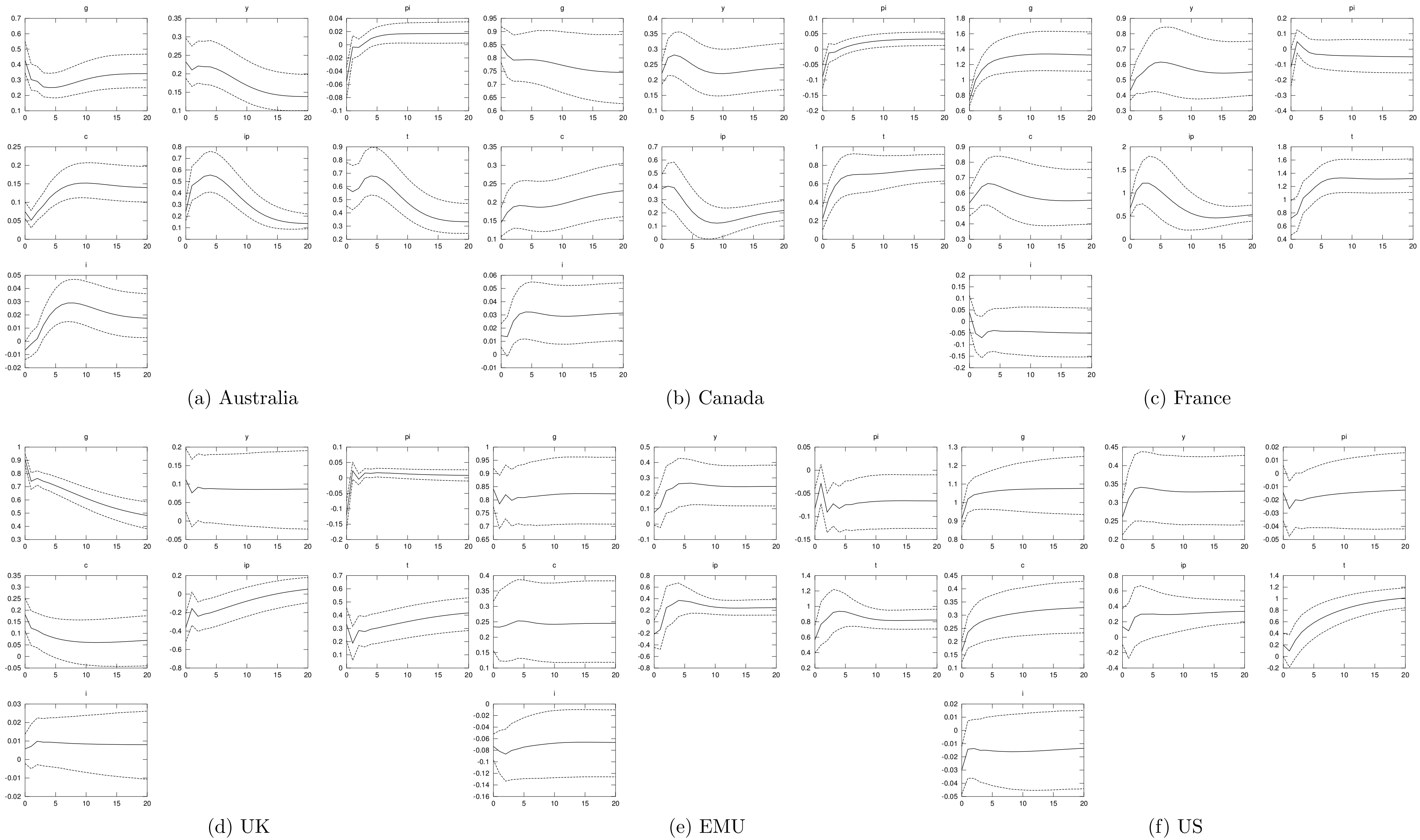
(a) Spending

	Australia			**Canada**			**France**		
	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.22	**-0.13**	-0.05	-0.17	**-0.09**	0.00	-0.97	**-0.65**	-0.33
t=4	-0.82	**-0.48**	-0.21	-0.06	**0.12**	0.29	-0.75	**-0.07**	0.48
t=8	-1.97	**-1.07**	-0.49	-0.18	**0.07**	0.29	-1.50	**-0.19**	0.71
t=16	-3.47	**-1.72**	-0.74	-0.61	**-0.18**	0.16	-2.98	**-0.55**	0.96
	UK			**EMU**			**US**		
	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.03	**0.03**	0.10	-0.97	**-0.65**	-0.33	-0.07	**0.07**	0.18
t=4	-0.06	**0.06**	0.19	-0.75	**-0.07**	0.48	-0.34	**-0.01**	0.25
t=8	-0.10	**0.07**	0.23	-1.50	**-0.19**	0.71	-0.69	**-0.16**	0.23
t=16	-0.17	**0.07**	0.30	-2.98	**-0.55**	0.96	-1.58	**-0.49**	0.23

(b) Tax

Table 23: Results concerning identification and IV estimation of the restricted models in section 3.3

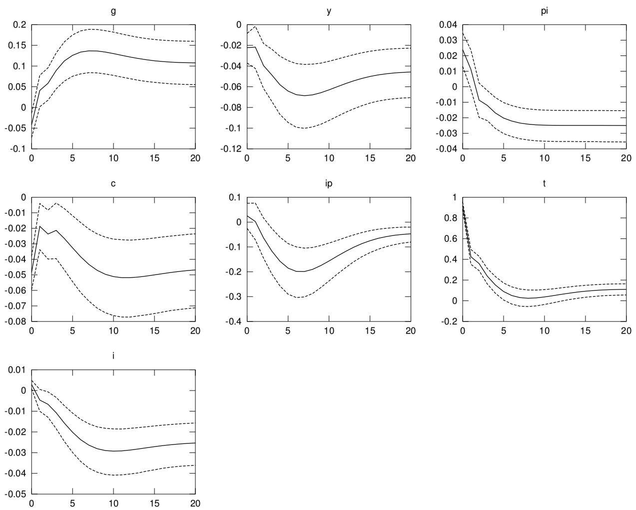
		Sargan	AR tests	partial R^2									Sargan	AR tests	partial R^2						
	equation	p-value	p-value	g	y	pi	c	ip	t	i		equation	p-value	p-value	g	y	pi	c	ip	t	i
Australia	g	0.78	0.98	nan	0.09	nan	nan	0.28	0.59	0.51	UK	g	0.11	0.39	nan	nan	nan	0.51	0.44	0.47	0.41
	y	0.20	0.83	0.43	nan	0.88	0.40	0.25	0.56	0.46		y	0.93	1.00	0.07	nan	0.77	0.23	0.44	0.45	0.40
	pi	0.18	0.64	0.37	0.45	nan	0.46	0.39	0.59	0.50		pi	0.62	0.98	0.36	0.40	nan	0.42	0.46	0.45	0.36
	c	0.84	1.00	0.95	0.92	0.89	nan	nan	1.00	0.99		c	0.85	0.99	0.98	0.97	0.91	nan	nan	1.00	1.00
	ip	0.46	0.86	0.98	0.94	0.98	1.00	nan	1.00	1.00		ip	0.38	0.89	0.99	1.00	0.99	1.00	nan	1.00	1.00
	t	0.32	0.72	0.95	0.92	0.98	nan	nan	nan	0.99		t	0.10	0.56	0.94	0.94	0.89	nan	nan	nan	1.00
	i	0.62	0.99	0.90	0.89	0.84	nan	nan	nan	nan		i	0.05	0.09	0.95	0.98	0.95	nan	nan	nan	nan
Canada	g	0.87	1.00	nan	0.18	nan	nan	0.27	0.46	0.47	EMU	g	0.55	0.53	nan	nan	nan	0.48	0.48	0.39	0.43
	y	0.25	0.98	0.40	nan	0.15	0.29	0.19	0.46	0.44		y	0.44	0.96	0.43	nan	0.68	0.36	0.16	0.43	0.10
	pi	0.09	0.30	0.34	0.43	nan	0.44	0.37	0.49	0.50		pi	0.51	0.92	0.39	0.45	nan	0.51	0.42	0.39	0.39
	c	0.46	0.79	0.98	0.82	0.93	nan	nan	1.00	1.00		c	0.86	0.98	0.93	0.97	0.99	nan	nan	1.00	0.99
	ip	0.72	0.98	1.00	0.95	0.94	1.00	nan	1.00	1.00		ip	0.53	0.95	0.94	0.99	0.99	1.00	nan	1.00	0.99
	t	0.66	0.92	0.96	0.81	0.93	nan	nan	nan	1.00		t	0.59	0.60	0.91	0.95	0.99	nan	nan	nan	1.00
	i	0.78	0.96	0.94	0.74	0.88	nan	nan	nan	nan		i	0.99	1.00	0.89	0.64	0.59	nan	nan	nan	nan
France	g	0.87	0.98	nan	nan	nan	0.48	0.17	0.51	0.70	US	g	0.72	0.91	nan	nan	nan	0.23	0.50	0.49	0.35
	y	0.26	0.50	0.59	nan	0.81	0.39	0.17	0.46	0.72		y	0.07	0.10	0.38	nan	0.65	0.08	0.14	0.36	0.18
	pi	0.49	0.79	0.15	0.35	nan	0.37	0.20	0.44	0.52		pi	0.36	0.89	0.31	0.31	nan	0.26	0.30	0.36	0.38
	c	0.80	1.00	0.87	0.78	0.86	nan	nan	0.99	0.97		c	0.21	0.88	0.86	0.55	0.86	nan	nan	1.00	0.75
	ip	0.28	0.83	0.99	0.95	0.98	0.99	nan	0.99	1.00		ip	0.54	0.91	0.96	0.99	0.94	0.93	nan	1.00	0.93
	t	0.75	0.95	0.88	0.81	0.87	nan	nan	nan	0.97		t	0.05	0.18	0.89	0.58	0.88	nan	nan	nan	0.80
	i	0.79	0.97	0.79	0.77	0.70	nan	nan	nan	nan		i	0.65	0.92	0.89	0.45	0.78	nan	nan	nan	nan



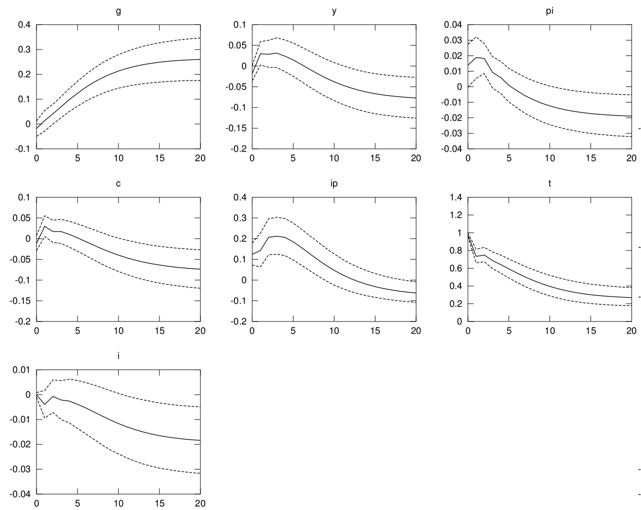
(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

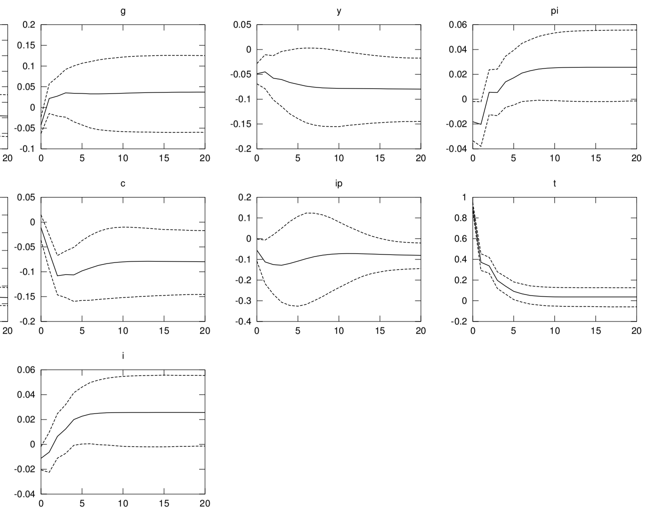
Figure 7: Responses to spending increases with 80% posterior intervals - restricted models of section 3.3



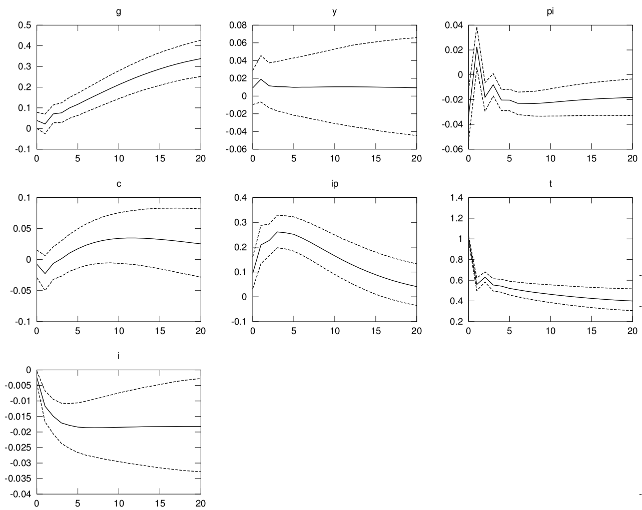
(a) Australia



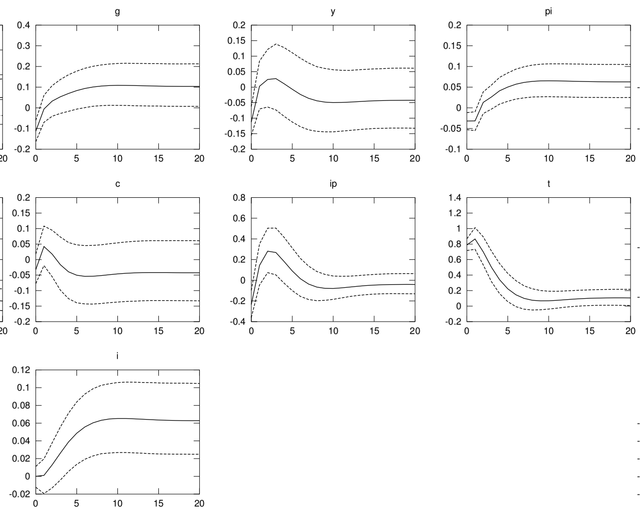
(b) Canada



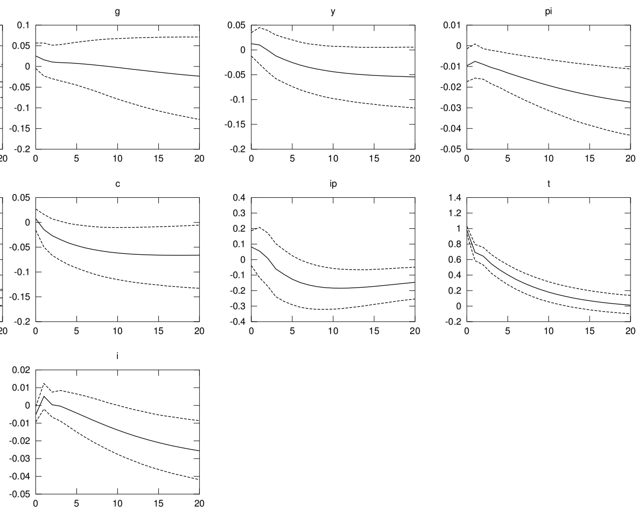
(c) France



(d) UK



(e) EMU



(f) US

Figure 8: Responses to tax increases with 80% posterior intervals - restricted models of section 3.3

F.2 Other identifying assumptions

In this section I present results from 3 different identification assumptions for the full sample lengths - all are estimated for two reasons: to see how robust are the results to different identification assumptions, and to try to increase the quality of instruments in the equations for g and y. In the first case (case 1 henceforth), it is assumed that all the variables with permanent shocks do not affect the other ones with permanent shocks too in the long run - this makes the upper left part of the long run effects matrix, $\mathbf{C_{11}}(\mathbf{1})$, diagonal, and all the explanatory variables except the lags of the endogenous variable in these equations appear in second differences in equations for g, y and pi. In the second case (case 2), some short run restrictions are placed in the equation for g: in particular, it is assumed that c, ip and t do not have contemporaneous effects on g - this leaves only 3 coefficients needing IVs to estimate in this equation. In the third case (case 3), the emphasis is on taxes - spending is as in baseline, but the tax equation is estimated last, so that all its elements are identified. The pattern in case 1 is like the one in section 3.1 (with restrictions in the sums of coefficients), but for the other two cases the estimation patterns of $\mathbf{A}^0$ are presented in table 24 (with * are the unrestricted elements).

Table 24: Identification patterns in cases 2 and 3

case 2							case 3						
1	*	*	0	0	0	*	1	*	*	*	*	*	*
*	1	*	*	*	*	*	*	1	*	*	*	*	*
*	*	1	*	*	*	*	*	*	1	*	*	*	*
*	*	*	1	0	*	*	*	*	*	1	0	0	*
*	*	*	*	1	*	*	*	*	*	*	1	0	*
*	*	*	0	0	1	*	*	*	*	*	*	1	*
*	*	*	0	0	0	1	*	*	*	0	0	0	1

Order of variables: g, y, pi, c, ip, t, i

In tables 25 and 26 the IV statistics are presented for cases 1 and 2, while in table 27 the same statistics for case 3. As it is obvious from the results, assuming the identification restrictions are correct, the vast majority of contemporaneous structural coefficients are at least well identified (partial R^2 statistics in excess of 0.2). In all cases the instruments are valid, as verified by the Sargan statistics, and the AR statistics suggest that the models are compatible with the data.

In table 28 output multipliers of spending and tax shocks are shown - they are constructed as described in the main text. It is clear that the results discussed in the main text continue to hold in most cases; Spending multipliers are higher than tax ones in the cases of Australia, Canada, UK, US and in France for the most part of the forecast horizon - only in EMU one now observes the opposite pattern, that tax multiplies are higher. In addition, spending multipliers are usually significant, while tax ones are not in most cases.

The explanation of these multipliers is evident from table 29, where the contemporaneous coefficients of spending and tax equations in all these cases for all countries are presented. Again, higher spending multipliers tend to coexist with more countercyclical spending policies. Elasticities of taxes with respect to output are quite high in many cases, yet not as high as needed to generate strong output responses to tax increases; these elasticities are not very different from those calculated using external information about the tax system. Graphical analysis in figures 9 to 14 supports further the concusions; importantly, once again consumption is always positive after spending shocks, and the size of spending multipliers is determined by the response of investment: lower spending multipliers are associated with negative investment responses, while big spending multipliers with strong positive investment responses. All in all, these results give further support to the ones presented in the main text; the latter results and their interpretation appear robust to deviations in the identification restrictions.

Table 25: Results concerning identification and IV estimation - cases 1 & 2

		Sargan		AR tests		partial R^2 - case 1							partial R^2 - case 2						
	equation	p-val. case 1	p-val. case 2	p-val. case 1	p-val. case 2	g	y	pi	c	ip	t	i	g	y	pi	c	ip	t	i
Australia	g	0.13	0.69	0.47	0.38	nan	0.47	0.91	0.44	0.40	0.59	0.58	nan	0.10	0.81	nan	nan	nan	0.58
	y	0.13	0.16	0.46	0.95	0.41	nan	0.89	0.42	0.21	0.55	0.55	0.66	nan	0.61	0.38	0.19	0.54	0.43
	pi	0.18	0.18	0.64	0.64	0.37	0.45	nan	0.46	0.39	0.59	0.50	0.37	0.45	nan	0.46	0.39	0.59	0.50
	c	0.81	0.76	1.00	1.00	0.96	0.88	0.89	nan	nan	1.00	0.99	0.92	0.87	0.88	nan	nan	1.00	0.99
	ip	0.31	0.36	0.63	0.71	1.00	0.94	1.00	1.00	nan	1.00	1.00	0.96	0.94	0.99	1.00	nan	1.00	1.00
	t	0.24	0.35	0.65	0.73	0.95	0.89	0.95	nan	nan	nan	0.99	0.92	0.90	0.98	nan	nan	nan	0.99
	i	0.20	0.59	0.59	0.99	0.90	0.86	0.84	nan	nan	nan	nan	0.85	0.84	0.84	nan	nan	nan	nan
Canada	g	0.26	0.67	0.75	0.61	nan	0.45	0.91	0.51	0.38	0.50	0.51	nan	0.24	0.96	nan	nan	nan	0.51
	y	0.06	0.27	0.82	0.99	0.40	nan	0.17	0.30	0.21	0.47	0.43	0.58	nan	0.15	0.29	0.18	0.46	0.44
	pi	0.09	0.09	0.30	0.30	0.34	0.43	nan	0.44	0.37	0.49	0.50	0.34	0.43	nan	0.44	0.37	0.49	0.50
	c	0.17	0.45	0.81	0.78	0.96	0.74	0.87	nan	nan	1.00	1.00	0.93	0.83	0.93	nan	nan	1.00	1.00
	ip	0.72	0.65	0.98	0.97	1.00	0.97	0.95	1.00	nan	1.00	1.00	0.96	0.96	0.95	1.00	nan	1.00	1.00
	t	0.81	0.67	0.99	0.92	0.97	0.81	0.89	nan	nan	nan	1.00	0.93	0.82	0.93	nan	nan	nan	1.00
	i	0.81	0.94	0.97	0.99	0.96	0.75	0.89	nan	nan	nan	nan	0.92	0.82	0.93	nan	nan	nan	nan
France	g	0.99	0.57	1.00	0.12	nan	0.39	0.82	0.54	0.22	0.50	0.74	nan	0.17	0.84	nan	nan	nan	0.72
	y	0.13	0.73	0.35	1.00	0.74	nan	0.80	0.38	0.09	0.43	0.73	0.91	nan	0.75	0.44	0.07	0.47	0.57
	pi	0.49	0.49	0.79	0.79	0.15	0.35	nan	0.37	0.20	0.44	0.52	0.15	0.35	nan	0.37	0.20	0.44	0.52
	c	0.81	0.62	1.00	0.99	0.90	0.78	0.86	nan	nan	0.99	0.97	0.76	0.37	0.85	nan	nan	0.92	0.95
	ip	0.09	0.61	0.33	0.90	1.00	0.94	1.00	1.00	nan	1.00	1.00	0.91	0.61	0.97	0.95	nan	0.95	0.98
	t	0.58	0.92	0.94	0.99	0.88	0.76	0.85	nan	nan	nan	0.97	0.87	0.37	0.85	nan	nan	nan	0.96
	i	0.80	0.77	0.97	0.97	0.82	0.77	0.70	nan	nan	nan	nan	0.76	0.31	0.66	nan	nan	nan	nan

Table 26: Results concerning identification and IV estimation - cases 1 & 2

		Sargan		AR tests		partial R^2 - case 1							partial R^2 - case 2						
	equation	p-val. case 1	p-val. case 2	p-val. case 1	p-val.case 2	g	y	pi	c	ip	t	i	g	y	pi	c	ip	t	i
UK	g	0.08	0.74	0.51	0.36	nan	0.42	0.84	0.45	0.46	0.47	0.42	nan	0.93	0.85	nan	nan	nan	0.85
	y	0.95	0.93	1.00	1.00	0.47	nan	0.75	0.28	0.38	0.45	0.38	0.07	nan	0.77	0.23	0.44	0.45	0.40
	pi	0.62	0.62	0.98	0.98	0.36	0.40	nan	0.42	0.46	0.45	0.36	0.36	0.40	nan	0.42	0.46	0.45	0.36
	c	0.86	0.94	1.00	1.00	0.94	0.93	0.91	nan	nan	1.00	1.00	1.00	0.97	0.91	nan	nan	1.00	1.00
	ip	0.47	0.41	0.91	0.90	1.00	1.00	1.00	1.00	nan	1.00	1.00	0.99	1.00	0.99	1.00	nan	1.00	1.00
	t	0.06	0.10	0.18	0.56	0.94	0.95	0.97	nan	nan	nan	1.00	0.98	0.94	0.88	nan	nan	nan	1.00
	i	0.06	0.75	0.29	1.00	0.93	0.93	0.87	nan	nan	nan	nan	0.97	0.91	0.83	nan	nan	nan	nan
EMU	g	0.22	0.54	0.63	0.27	nan	0.46	0.73	0.53	0.45	0.45	0.51	nan	0.44	0.72	0.58	nan	nan	0.50
	y	0.04	0.00	0.04	0.00	0.53	nan	0.71	0.43	0.43	0.41	0.50	0.76	nan	0.66	0.48	0.35	0.37	0.39
	pi	0.51	0.51	0.92	0.92	0.39	0.45	nan	0.51	0.42	0.39	0.39	0.39	0.45	nan	0.51	0.42	0.39	0.39
	c	0.81	0.70	1.00	0.97	0.79	0.64	0.91	nan	nan	0.90	0.81	0.92	0.98	0.99	nan	nan	1.00	0.98
	ip	0.07	0.42	0.20	0.87	1.00	0.85	1.00	0.94	nan	0.95	0.93	0.98	0.99	0.99	1.00	nan	1.00	1.00
	t	0.75	0.58	0.99	0.87	0.82	0.47	0.96	nan	nan	nan	0.87	0.91	0.85	0.97	nan	nan	nan	0.97
	i	0.93	0.95	1.00	0.97	0.87	0.41	0.52	nan	nan	nan	nan	0.92	0.70	0.66	nan	nan	nan	nan
US	g	0.65	0.74	0.94	0.58	nan	0.31	0.74	0.27	0.30	0.40	0.39	nan	0.26	0.93	nan	nan	nan	0.54
	y	0.05	0.20	0.19	0.41	0.34	nan	0.63	0.08	0.18	0.37	0.17	0.75	nan	0.64	0.06	0.13	0.36	0.16
	pi	0.36	0.36	0.89	0.89	0.31	0.31	nan	0.26	0.30	0.36	0.38	0.31	0.31	nan	0.26	0.30	0.36	0.38
	c	0.28	0.44	0.93	0.98	0.94	0.77	0.94	nan	nan	0.99	0.93	0.87	0.59	0.89	nan	nan	1.00	0.78
	ip	0.35	0.50	0.87	0.90	0.96	0.99	0.97	1.00	nan	1.00	1.00	0.98	0.99	0.95	0.95	nan	1.00	0.94
	t	0.87	0.04	1.00	0.16	0.94	0.74	0.94	nan	nan	nan	0.89	0.91	0.63	0.89	nan	nan	nan	0.83
	i	0.65	0.65	0.92	0.92	0.93	0.58	0.87	nan	nan	nan	nan	0.89	0.49	0.80	nan	nan	nan	nan

Table 27: Results concerning identification and IV estimation - case 3

		Sargan	AR tests	partial R^2						
	equation	p-value	p-value	g	y	pi	c	ip	t	i
Australia	g	0.45	0.75	nan	0.10	0.79	0.40	0.33	0.59	0.56
	y	0.18	0.77	0.66	nan	0.90	0.39	0.25	0.55	0.50
	pi	0.18	0.64	0.37	0.45	nan	0.46	0.39	0.59	0.50
	c	0.86	1.00	0.94	0.88	0.88	nan	nan	nan	0.99
	ip	0.33	0.59	0.98	0.94	0.99	1.00	nan	nan	1.00
	t	0.36	0.88	0.99	0.99	0.98	1.00	1.00	nan	1.00
	i	0.63	0.99	0.89	0.86	0.84	nan	nan	nan	nan
Canada	g	0.37	0.93	nan	0.29	0.91	0.51	0.36	0.50	0.51
	y	0.05	0.59	0.38	nan	0.18	0.34	0.22	0.47	0.44
	pi	0.09	0.30	0.34	0.43	nan	0.44	0.37	0.49	0.50
	c	0.15	0.67	0.94	0.71	0.86	nan	nan	nan	1.00
	ip	0.65	0.96	0.99	0.95	0.94	1.00	nan	nan	1.00
	t	0.71	0.98	0.98	1.00	1.00	1.00	1.00	nan	1.00
	i	0.80	0.97	0.94	0.73	0.88	nan	nan	nan	nan
France	g	0.97	1.00	nan	0.24	0.80	0.53	0.20	0.47	0.74
	y	0.18	0.45	0.79	nan	0.81	0.40	0.10	0.44	0.72
	pi	0.49	0.79	0.15	0.35	nan	0.37	0.20	0.44	0.52
	c	0.76	0.99	0.88	0.70	0.85	nan	nan	nan	0.97
	ip	0.10	0.27	0.98	0.88	0.99	0.99	nan	nan	1.00
	t	0.71	0.98	0.97	0.99	0.89	1.00	0.98	nan	0.97
	i	0.80	0.97	0.81	0.73	0.70	nan	nan	nan	nan

		Sargan	AR tests	partial R^2						
	equation	p-value	p-value	g	y	pi	c	ip	t	i
UK	g	0.44	0.95	nan	0.68	0.83	0.43	0.42	0.45	0.37
	y	0.93	1.00	0.07	nan	0.77	0.23	0.44	0.45	0.40
	pi	0.62	0.98	0.36	0.40	nan	0.42	0.46	0.45	0.36
	c	0.89	1.00	0.91	0.94	0.88	nan	nan	nan	1.00
	ip	0.38	0.81	1.00	1.00	0.99	1.00	nan	nan	1.00
	t	0.08	0.72	0.97	0.98	0.91	1.00	1.00	nan	1.00
	i	0.74	1.00	0.90	0.91	0.83	nan	nan	nan	nan
EMU	g	0.32	0.62	nan	0.39	0.70	0.53	0.45	0.44	0.47
	y	0.05	0.03	0.89	nan	0.72	0.43	0.47	0.40	0.51
	pi	0.51	0.92	0.39	0.45	nan	0.51	0.42	0.39	0.39
	c	0.78	1.00	0.82	0.36	0.86	nan	nan	nan	0.81
	ip	0.13	0.30	0.93	0.58	0.99	0.83	nan	nan	0.91
	t	0.36	0.71	0.97	0.74	0.98	0.94	0.84	nan	0.99
	i	0.90	0.99	0.88	0.34	0.49	nan	nan	nan	nan
US	g	0.82	1.00	nan	0.31	0.66	0.14	0.25	0.40	0.21
	y	0.03	0.00	0.13	nan	0.67	0.14	0.20	0.38	0.26
	pi	0.36	0.89	0.31	0.31	nan	0.26	0.30	0.36	0.38
	c	0.17	0.75	0.51	0.33	0.81	nan	nan	nan	0.59
	ip	0.75	0.96	0.81	0.99	0.92	0.80	nan	nan	0.89
	t	0.06	0.36	0.99	0.91	0.94	0.87	0.89	nan	0.96
	i	0.65	0.92	0.61	0.33	0.72	nan	nan	nan	nan

Table 28: Output multipliers - identification cases 1, 2 & 3

	Australia			**Canada**			**France**			**UK**			**EMU**			**US**		
case 1	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	0.24	**0.40**	0.56	0.77	**0.94**	1.13	0.70	**0.97**	1.29	0.26	**0.39**	0.52	0.23	**0.63**	1.04	1.19	**1.43**	1.71
t=4	0.10	**0.35**	0.61	0.91	**1.21**	1.53	0.21	**0.58**	1.03	0.15	**0.35**	0.55	0.59	**1.23**	1.86	1.29	**1.60**	1.98
t=8	0.13	**0.40**	0.69	0.88	**1.19**	1.52	0.12	**0.56**	1.08	0.13	**0.35**	0.58	0.76	**1.40**	2.01	1.28	**1.58**	1.96
t=16	0.17	**0.45**	0.74	0.88	**1.19**	1.51	0.15	**0.62**	1.13	0.08	**0.37**	0.66	0.84	**1.43**	2.00	1.25	**1.54**	1.90
case 2	0.1	**base**	0.9	0.1	**0.61**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	1.71	**1.93**	2.15	0.91	**1.08**	1.25	0.47	**0.77**	1.08	0.17	**0.58**	1.01	-0.82	**-0.31**	0.15	0.87	**1.12**	1.37
t=4	2.09	**2.51**	2.97	1.00	**1.31**	1.63	-0.20	**0.24**	0.70	0.05	**0.55**	1.08	-0.79	**0.08**	0.83	0.69	**1.05**	1.39
t=8	2.19	**2.69**	3.32	1.09	**1.42**	1.76	-0.32	**0.21**	0.74	0.02	**0.58**	1.15	-0.58	**0.35**	1.12	0.66	**1.02**	1.37
t=16	1.93	**2.41**	3.03	1.26	**1.60**	1.95	-0.24	**0.35**	0.90	0.00	**0.64**	1.29	-0.47	**0.46**	1.21	0.64	**1.02**	1.37
case 3	0.1	**base**	0.9	0.1	**0.61**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	1.63	**1.84**	2.05	1.09	**1.28**	1.47	0.78	**1.04**	1.34	0.09	**0.52**	0.96	-0.30	**0.09**	0.51	2.36	**2.74**	3.18
t=4	1.94	**2.32**	2.75	1.28	**1.61**	1.95	0.27	**0.65**	1.08	-0.02	**0.49**	1.02	-0.01	**0.64**	1.28	2.53	**3.01**	3.54
t=8	1.94	**2.39**	2.91	1.19	**1.53**	1.87	0.17	**0.63**	1.12	-0.05	**0.50**	1.08	0.20	**0.86**	1.51	2.38	**2.81**	3.28
t=16	1.64	**2.07**	2.58	1.11	**1.44**	1.76	0.21	**0.69**	1.17	-0.09	**0.55**	1.21	0.31	**0.96**	1.56	2.16	**2.53**	2.94

(a) Spending

	Australia			**Canada**			**France**			**UK**			**EMU**			**US**		
case 1	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.13	**-0.05**	0.03	-0.15	**-0.06**	0.03	-0.20	**-0.12**	-0.06	0.04	**0.02**	0.09	-1.94	**-1.37**	-0.90	0.10	**0.21**	0.33
t=4	-0.59	**-0.30**	-0.05	-0.03	**0.15**	0.32	-0.70	**-0.30**	0.01	0.08	**0.05**	0.18	-2.13	**-0.92**	-0.15	-0.10	**0.16**	0.41
t=8	-1.53	**-0.76**	-0.24	-0.15	**0.11**	0.32	-1.53	**-0.57**	0.08	-0.12	**0.05**	0.21	-4.01	**-1.47**	-0.15	-0.38	**0.04**	0.39
t=16	-2.87	**-1.35**	-0.46	-0.57	**-0.15**	0.19	-3.60	**-1.11**	0.19	-0.19	**0.05**	0.28	-7.87	**-2.59**	-0.20	-1.15	**-0.25**	0.38
case 2	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.08	**-0.02**	0.03	-0.14	**-0.06**	0.02	-0.21	**-0.13**	-0.06	-0.05	**0.02**	0.08	-2.01	**-1.23**	-0.68	-0.06	**0.06**	0.17
t=4	-0.47	**-0.24**	-0.03	0.00	**0.16**	0.31	-0.76	**-0.39**	-0.08	-0.09	**0.05**	0.17	-2.22	**-0.76**	0.08	-0.34	**-0.02**	0.22
t=8	-1.11	**-0.59**	-0.20	-0.11	**0.12**	0.32	-1.46	**-0.66**	-0.08	-0.13	**0.05**	0.22	-3.96	**-1.17**	0.20	-0.69	**-0.18**	0.19
t=16	-1.82	**-0.96**	-0.36	-0.48	**-0.11**	0.20	-2.50	**-0.99**	-0.05	-0.21	**0.05**	0.29	-6.73	**-1.95**	0.32	-1.71	**-0.56**	0.15
case 3	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9	0.1	**base**	0.9
t=0	-0.13	**-0.05**	0.03	-0.08	**0.00**	0.08	-0.18	**-0.10**	-0.04	-0.04	**0.02**	0.09	-1.34	**-0.95**	-0.62	-0.05	**0.06**	0.15
t=4	-0.74	**-0.39**	-0.09	0.06	**0.24**	0.40	-0.77	**-0.33**	-0.01	-0.08	**0.05**	0.18	-1.17	**-0.43**	0.12	-0.35	**-0.02**	0.22
t=8	-2.08	**-0.99**	-0.31	0.03	**0.27**	0.48	-1.81	**-0.67**	0.04	-0.13	**0.05**	0.21	-2.27	**-0.79**	0.16	-0.69	**-0.16**	0.21
t=16	-3.48	**-1.46**	-0.37	-0.23	**0.15**	0.46	-4.28	**-1.29**	0.26	-0.21	**0.05**	0.28	-4.81	**-1.64**	0.12	-1.65	**-0.48**	0.20

(b) Tax

Table 29: Estimates of contemporaneous coefficients of structural equations

(a) Estimates of spending equations

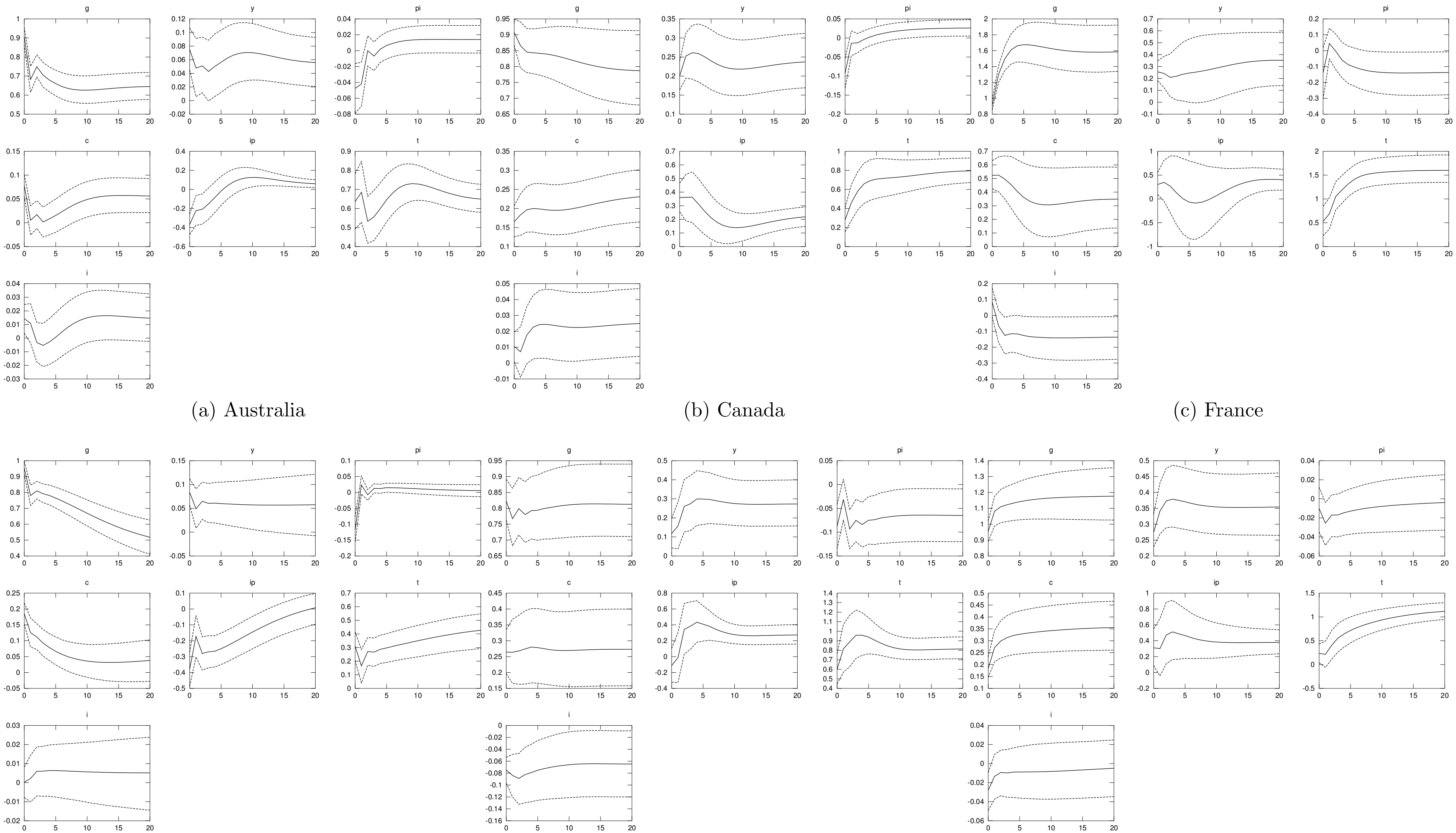
	case 1						case 2						case 3					
	y	*pi*	*c*	*ip*	*t*	*i*	*y*	*pi*	*c*	*ip*	*t*	*i*	*y*	*pi*	*c*	*ip*	*t*	*i*
AUS	0.271	**0.280***	-0.303	0.015	**-0.081***	**-1.272***	**-1.619**	0.187	0.000	0.000	0.000	-0.919	-1.225	0.162	0.006	-0.091	**-0.076**	-0.965
CA	-0.043	0.095	-0.111	**-0.124***	-0.024	-0.499	**-0.510**	0.037	0.000	0.000	0.000	-0.420	-0.397	0.098	-0.136	**-0.152***	-0.027	-0.470
FR	**0.411***	-0.098	**-0.273+**	-0.075	**-0.042**	**-0.188**	0.047	**-0.141**	0.000	0.000	0.000	**-0.264**	**0.353**	-0.104	**-0.268+**	-0.082	**-0.044**	-0.182
UK	0.321	-0.082	**-0.437***	0.026	0.028	-0.878	-0.063	-0.085	0.000	0.000	0.000	-0.598	0.237	-0.069	**-0.552**	0.045	0.041	-0.883
EMU	0.058	0.014	**-0.299**	**0.139**	**-0.128**	0.143	**0.630+**	0.240	**-0.529+**[a]	0.000	0.000	-0.175	0.209	0.065	**-0.305**	**0.133**	-0.104	-0.090
US	0.394	0.000	**-0.650***	**-0.096**	0.032	0.409	-0.174	-0.049	0.000	0.000	0.000	0.045	0.442	0.210	**-1.508***	**-0.183***	0.050	**1.214***

(b) Estimates of tax equations

	case 1						case 2						case 3					
	g	*y*	*pi*	*c*	*ip*	*i*	*g*	*y*	*pi*	*c*	*ip*	*i*	*g*	*y*	*pi*	*c*	*ip*	*i*
AUS	**0.556+**	**1.172+**	**-1.179+**	0.000	0.000	-0.949	0.182	**1.285+**	**-1.015***	0.000	0.000	-1.321	**0.606+**	**1.556+**	**-1.072+**	**-1.638+**	0.072	-0.671
CA	0.082	**0.856***	-0.268	0.000	0.000	1.039	-0.149	**1.077+**	-0.202	0.000	0.000	0.886	0.119	**0.576**	-0.056	-0.275	**0.280+**	0.986
FR	0.183	**1.418+**	0.276	0.000	0.000	0.463	**-0.679**	**1.979+**	0.194	0.000	0.000	0.228	0.013	0.635	0.294	0.452	**0.257**	0.375
UK	**0.270***	**0.900+**	0.189	0.000	0.000	**2.671+**	**0.349+**	**0.941+**	**0.368**	0.000	0.000	**2.748+**	**0.352+**	**0.905+**	**0.355**	-0.225	**0.150***	**2.340***
EMU	**0.503***	**1.622+**	-0.524	0.000	0.000	0.669	**0.478***	**1.697+**	-0.166	0.000	0.000	0.623	**0.564+**	**1.712+**	-0.187	0.250	**-0.272***	**1.797***
US	0.110	**0.920+**	**3.121+**	0.000	0.000	**3.268+**	-0.004	**1.699+**	**2.785+**	0.000	0.000	**2.048+**	-0.084	**1.196**	**2.841+**	0.091	0.108	**2.041+**

Significance (one sided): at 10% level bold, at 5% level bold and star, at 1% level bold and cross

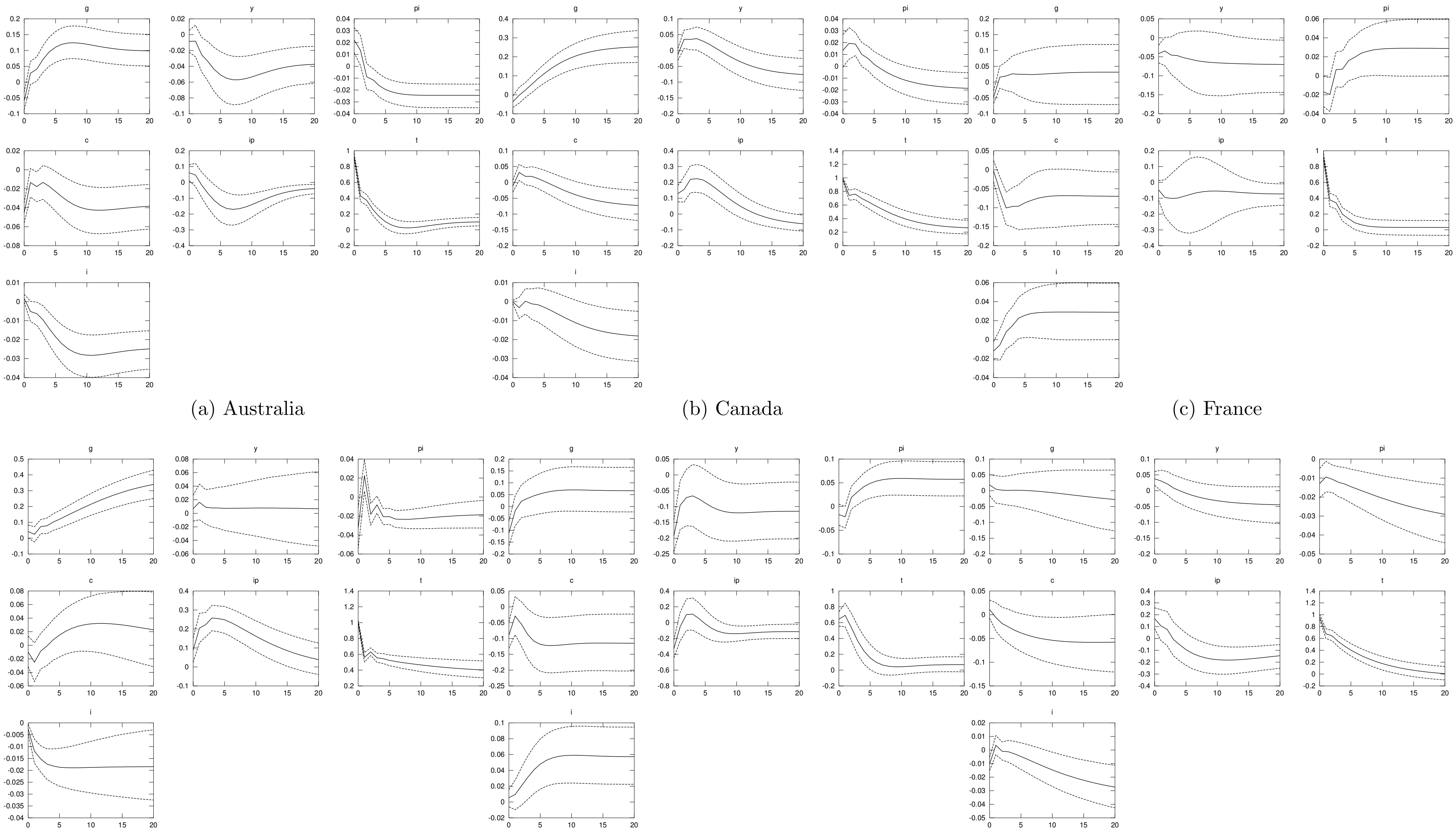
[a] Adding consumption in the specification was essential to remove correlation between the error and the instruments.



(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

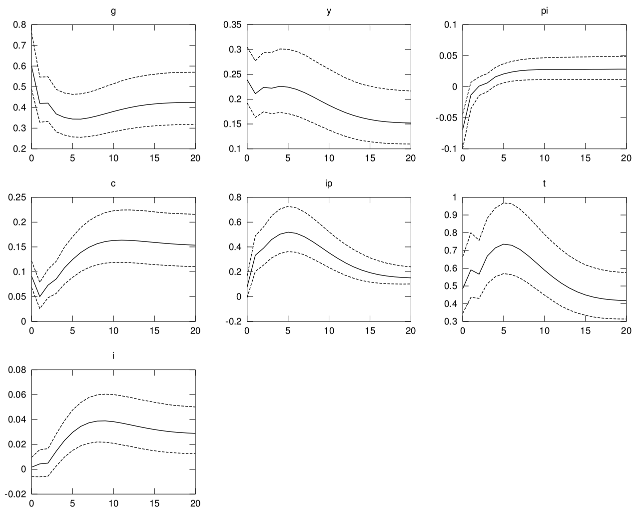
Figure 9: Responses to spending increases with 80% posterior intervals - case 1



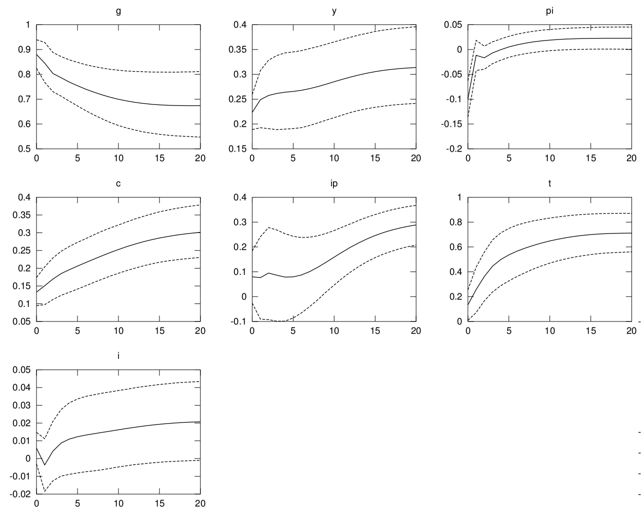
(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

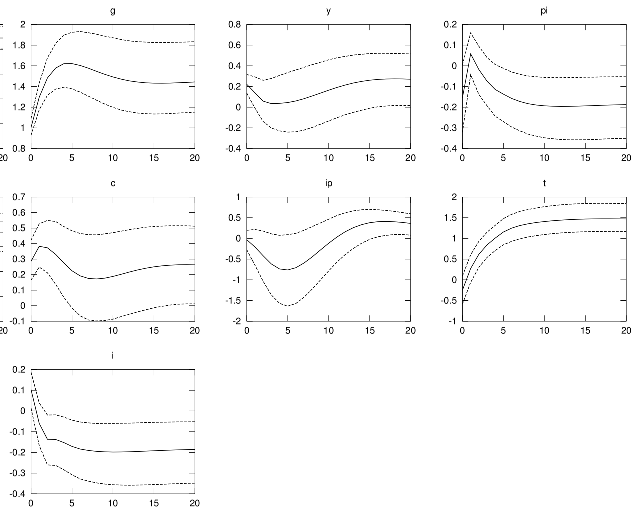
Figure 10: Responses to tax increases with 80% posterior intervals - case 1



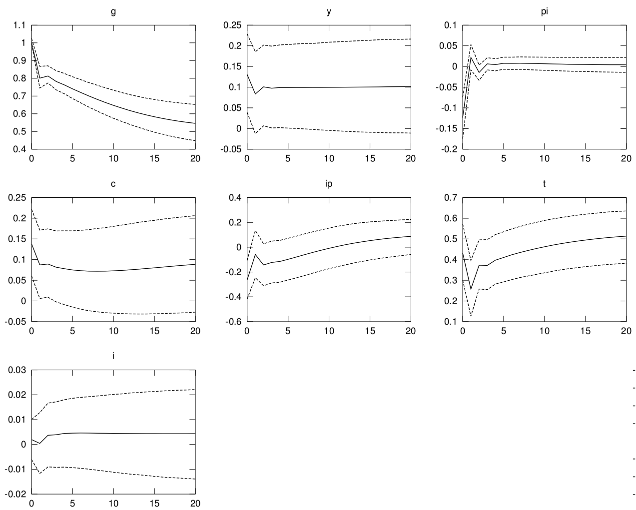
(a) Australia



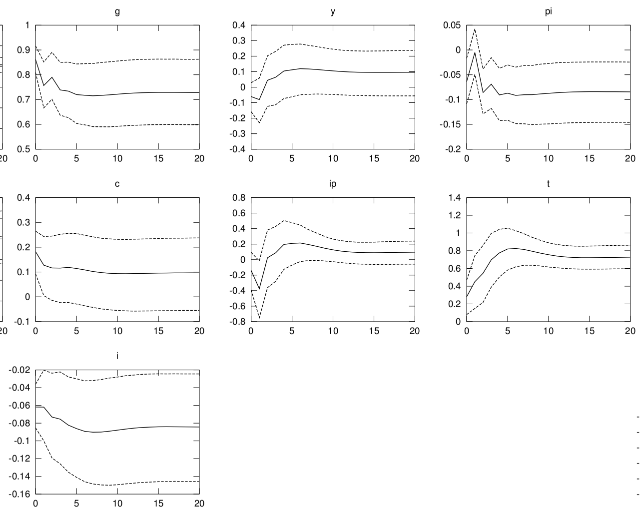
(b) Canada



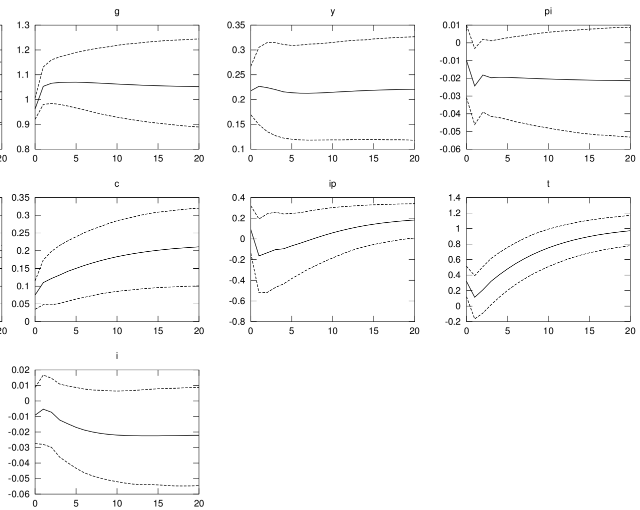
(c) France



(d) UK

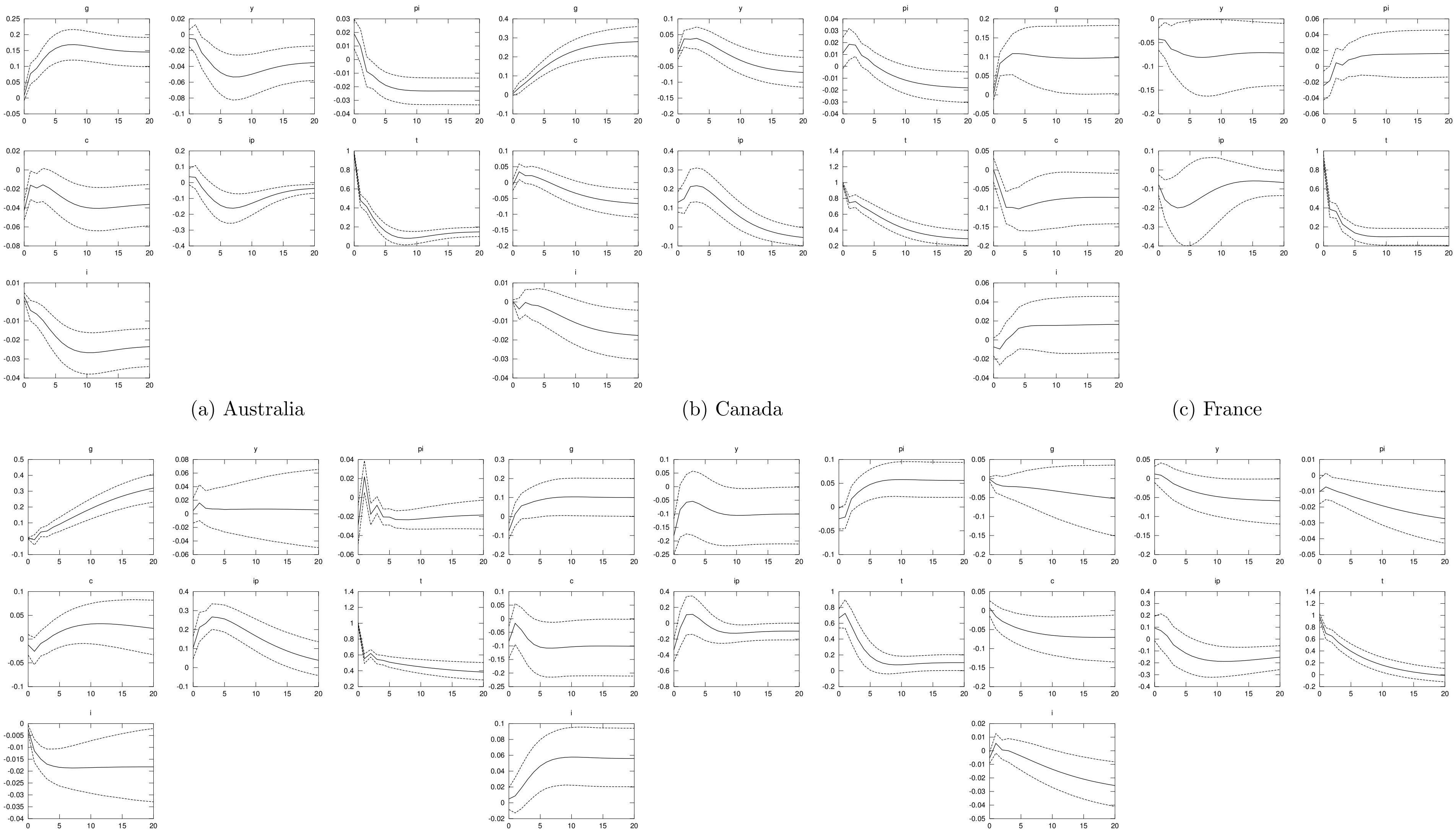


(e) EMU



(f) US

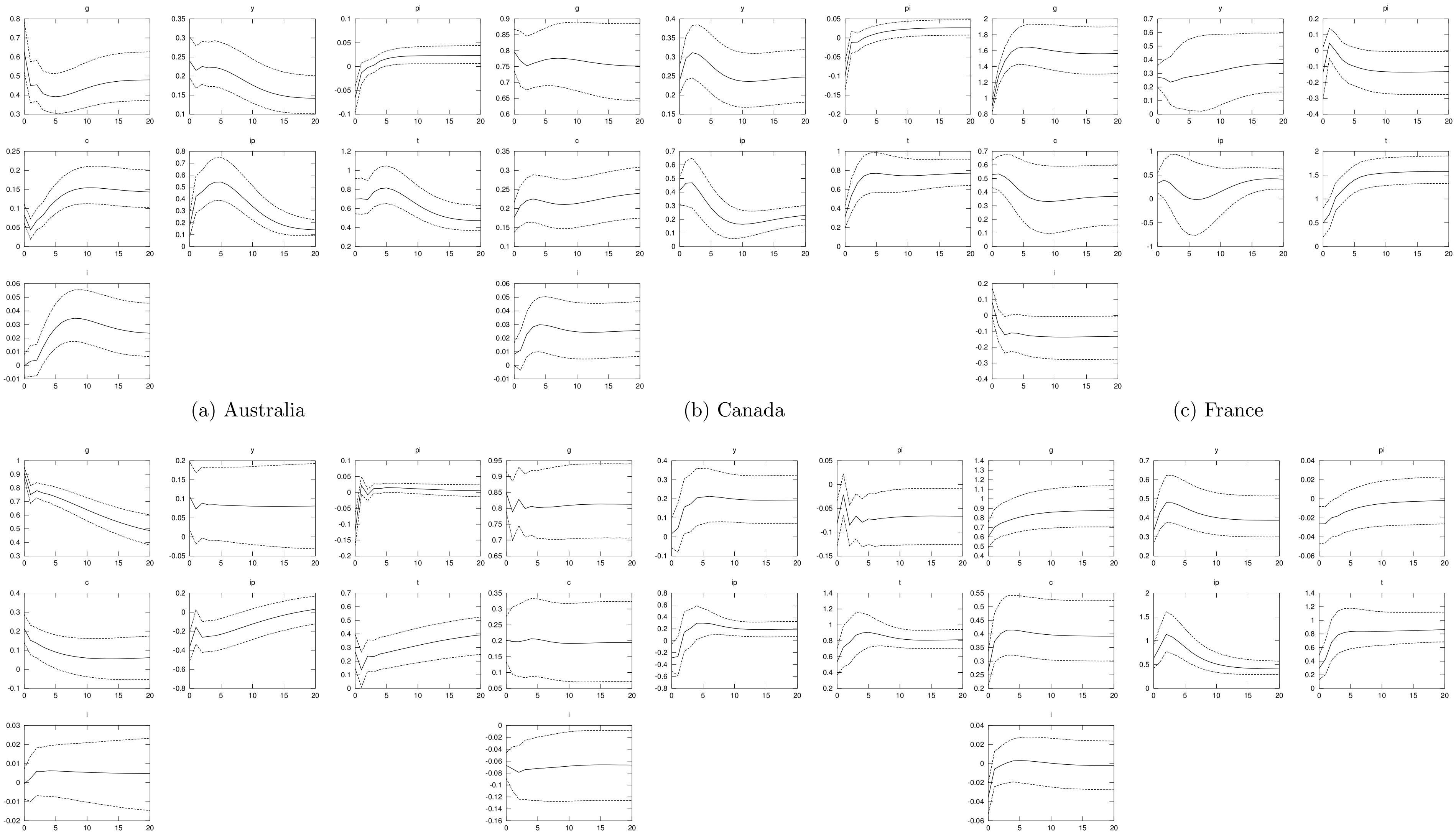
Figure 11: Responses to spending increases with 80% posterior intervals - case 2



(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

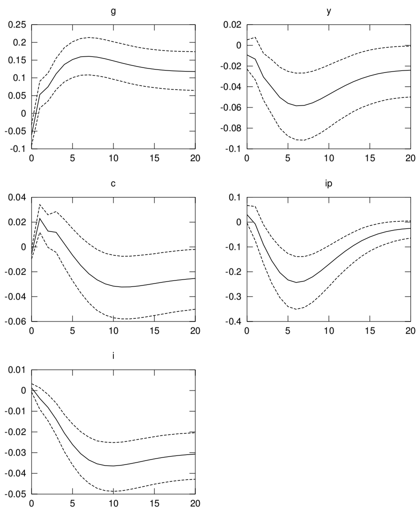
Figure 12: Responses to tax increases with 80% posterior intervals - case 2



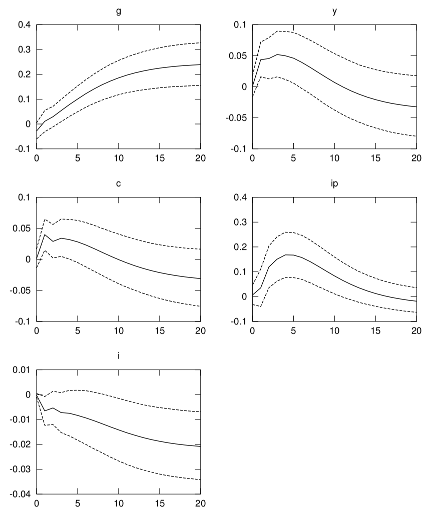
(a) Australia (b) Canada (c) France

(d) UK (e) EMU (f) US

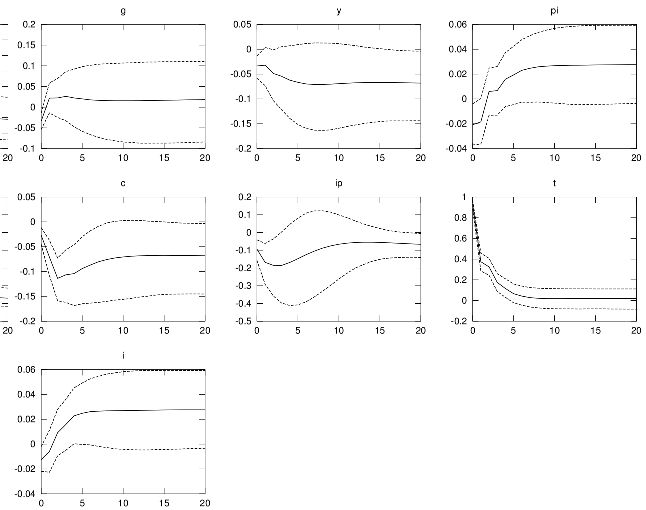
Figure 13: Responses to spending increases with 80% posterior intervals - case 3



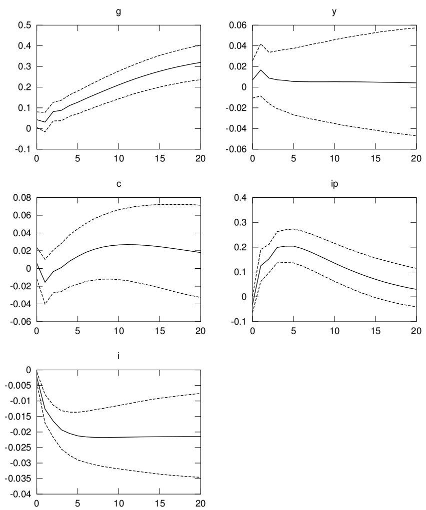
(a) Australia



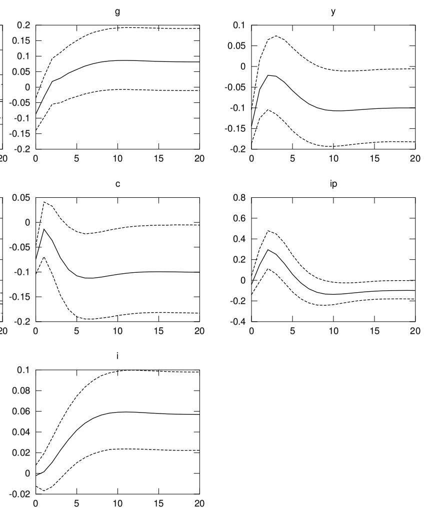
(b) Canada



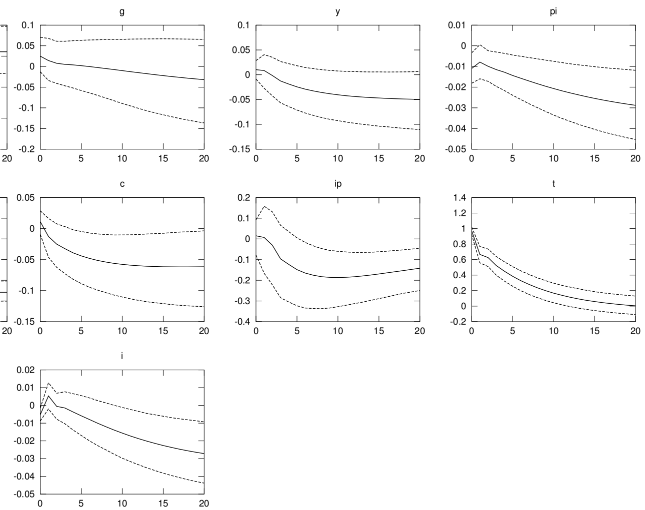
(c) France



(d) UK



(e) EMU



(f) US

Figure 14: Responses to tax increases with 80% posterior intervals - case 3