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JEL Classification: E62 and H60
Keywords: fiscal adjustment, fiscal plans and output growth

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What Do We Know About Fiscal Multipliers?

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1 Introduction

Fiscal multipliers measure the output effect of fiscal adjustments. This is undoubtedly a controversial issue. Different theoretical models give very different predictions on the magnitude and the sign of the effect of fiscal adjustment on output and other macro variables (see, for example, Baxter and King,1993, De Long and Summers 2012, Christiano et al. (2011). The empirical evidence has produced a plethora of different estimates (see Ramey, 2015). This survey concentrates on the empirical evidence and it is aimed at understanding its heterogeneity. We review the available literature by analyzing the design of the relevant empirical experiment that allows the measurement of multipliers.

Our tenet is that the role of empirical analysis of fiscal policy is to establish the evidence relevant to select the theoretical model capable of matching

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it. Policy simulation analysis should then be implemented by using the selected relevant model.

It is well understood by now that the validity of experimenting with reduced form empirical models requires that a number of conditions are satisfied. First, empirical reduced form models need to be simulated by keeping all parameters constant, in fact estimated parameters in reduced form model might depend on the parameters determining the economic policy rules. Simulating alternative parameterizations of the rules requires a structural model while simulating deviations from the rules, whilst keeping their systematic component constant, makes the empirical evidence robust to the Lucas (1972) critique. However, deviations from the rules must satisfy further conditions (Ramey 2015) for the investigator to be able to make valid inference on their effect: (i) they must be exogenous for the estimation of the parameters of interest,(ii) they must be uncorrelated with other relevant structural shocks so that their effect can be assessed by keeping all the other shocks constant and the causal effect of deviations from the rule can be uniquely identified, (iii) they must be unanticipated because the relevant response of agents to discriminate among models is the one to modifications in their information sets.

We argue that the relevant experiment to measure multipliers is to consider deviation from fiscal rules that come in the form of multi-year corrections: fiscal adjustment plans. Fiscal adjustment plans are a series of multi-period correlated one-period corrections (shocks). They describe closely the way in which deviation from fiscal rules are currently implemented by policy makers.

Plans consist of the announcement of a sequence of fiscal actions, some to be implemented the same period of the announcement (unanticipated) and some to be implemented in following periods (announced). Plans are also a mix of measures on government expenditures and revenues. The design of plans generates intertemporal and intratemporal correlations among fiscal variables. The intertemporal correlation is the one between the announced (future) and unanticipated (current) components of a plan. The intratemporal correlation is that between the changes in revenues and spending that determines the composition of a plan.

Traditionally the empirical fiscal literature concentrates on shocks. Interestingly plans nest shocks and taking the perspective of plans will allow us to write down a general empirical model and derive virtually all the different specifications adopted as special cases of this model. The general "nesting" empirical model that we will set up is too heavily parameterized to be estimated empirically but it is useful in that it allows to the evaluate the different identification and specification strategies adopted in the literature as choices on the relevant dimensions of the empirical models and therefore to put the heterogeneity of the findings in the empirical evidence in a more general context.

In the next section we will describe exactly how plans are designed and how the most general empirical model can be constructed, we shall then assess the available literature in terms of the restrictions imposed on such a general model.

In a fourth section we shall give an illustration of the relevance of different strategic choices on the measured multipliers.

The last section concludes.

2 A general framework

In this section we build a general framework to describe the empirical evidence on fiscal multipliers. Such a framework is constructed in two steps: the identification of the relevant experiment and the specification of the empirical model to assess its effects.

2.1 The Relevant Experiment: Fiscal Stabilization Plans

The analysis of the output effects of economic policy requires – for the correct estimation of the relevant parameters – identifying policy shifts that are exogenous. If the object of interest is the output effect of fiscal stabilization measures, then exogeneity of the shifts in fiscal policy for the estimation of their output effect requires that they are not correlated with news on output growth.

Fiscal policy is conducted through rare decisions and it is typically implemented through multi-year plans: modelling a standard set of US variables with a medium-scale structural model that allows for foresight up to eight quarters, Schmitt-Grohe and Uribe (2012) find that about 60% of the variance of government spending is due to anticipated shocks. A fiscal plan typically contains three components: (i) unexpected shifts in fiscal variables (announced upon implementation at time t), (ii) shifts implemented at time t but announced in previous years, and (iii) shifts announced at time t, to be implemented in future years. Consider, for simplicity, the case in which the forward horizon of the plan is only one year with reference to a specific country i, and assume that corrections exogenous for the estimation of the parameters of interest can be observed. An exogenous plan can be described as follows:

$$
\begin{array}{l}
f_{i,t} = e^u_{i,t} + e^a_{i,t,0} + e^a_{i,t,1} \\
e^u_{i,t} = \tau^u_{i,t} + g^u_{i,t} \\
e^a_{i,t+1,0} = e^a_{i,t,1} \\
\tau^a_{i,t,1} = \varphi_{1,i}\ \tau^u_{i,t} + v_{1,i,t} \quad \tau^a_{i,t,1} = \varphi_{2,i}\ g^u_{i,t} + v_{2,i,t} \\
g^a_{i,t,1} = \varphi_{3,i}\ \tau^u_{i,t} + v_{3,i,t} \quad g^a_{i,t,1} = \varphi_{4,i}\ g^u_{i,t} + v_{4,i,t} \\
g^u_{i,t} = \varphi_{5,i}\ \tau^u_{i,t} + v_{5,i,t}
\end{array}
\tag{1}
$$

Total fiscal corrections in each year consist of increases in taxes and cuts in expenditures. Unexpected shifts in fiscal variables by the fiscal authorities in country i are labeled respectively $\tau^u_{i,t}$ and $g^u_{i,t}$. We define $\tau^a_{i,t,j}$ and $g^a_{i,t,j}$ the tax and expenditure changes announced at date t with an anticipation horizon of j years (*i.e.* to be implemented in year $t+j$). Finally, $\tau^a_{i,t,0}$ ($g^a_{i,t,0}$) denotes the tax (expenditure) changes implemented in year t that had been announced in the previous years. The fiscal plan is completed by making explicit the relation between the predictable and the unpredictable components and the taxation and the expenditure components. The parameters $\varphi_{1,i}$ to $\varphi_{5,i}$ pin down the intratemporal and the intertemporal correlations of the different components of the fiscal plan. Note the framework allows for modifications of an announced measure upon implementation recording them as an unexpected shift in policy.

2.2 The Empirical Model

Simulation of plans requires to embed them in a dynamic model for macroeconomic variables. We consider, for the sake of illustration, an a overparameterized general model that does not have a sufficient number of degrees of freedom to be estimated but nests most of the specification considered in the empirical literature so far. The main purpose of this general model is to make explicit the specification and identification choices adopted by the different authors. Consider modelling the macroeconomic impact of fiscal policy in i countries as follows

$$
\begin{aligned}
\mathbf{z}_{i,t} &= A_{1,i}(L,S_t)\,\mathbf{z}_{i,t-1} + A_{2,i}(L,S_t)\,\mathbf{z}^*_{i,t-1} + A_{3,i}(L,S_t)\,d_{it-1} \qquad (2)\\
&\quad + B_1(S_t)\,\tau^u_{i,t} + B_2(S_t)\,g^u_{i,t} + C_1(S_t)\,\tau^a_{i,t,0} + C_2(S_t)\,g^a_{i,t,0} + \\
&\quad + D_1(S_t)\,\tau^a_{i,t,1} + D_2(S_t)\,g^a_{i,t,1} + \mathbf{u}_{i,t} \\
d_{it} &= \frac{1+i_{it}}{(1+x_{it})}d_{it-1} + \frac{(g_{it})-(t_{it})}{(y_{it})} \qquad (3)\\
x_{it} &\equiv \Delta p_{it} + \Delta y_{it} + \Delta p_{it}\Delta y_{it} \\
\mathbf{u}_{i,t} &\sim N(0,\Sigma_t)
\end{aligned}
$$

$$
\begin{array}{l}
f_{i,t} = e^u_{i,t} + e^a_{i,t,0} + e^a_{i,t,1} \\
e^u_{i,t} = \tau^u_{i,t} + g^u_{i,t} \\
e^a_{i,t+1,0} = e^a_{i,t,1} \\
\tau^a_{i,t,1} = \varphi_{1,i}\ \tau^u_{i,t} + v_{1,i,t} \quad \tau^a_{i,t,1} = \varphi_{2,i}\ g^u_{i,t} + v_{2,i,t} \\
g^a_{i,t,1} = \varphi_{3,i}\ \tau^u_{i,t} + v_{3,i,t} \quad g^a_{i,t,1} = \varphi_{4,i}\ g^u_{i,t} + v_{4,i,t} \\
g^u_{i,t} = \varphi_{5,i}\ \tau^u_{i,t} + v_{5,i,t}
\end{array}
$$

where $\mathbf{z}_{i,t}$ is the vector of domestic macro variable that, in order to be able to dynamically simulate (3), must include i_t, the average nominal cost of financing the debt , Δy_t, real GDP growth, Δp_t, inflation, t_t and g_t are, respectively, government revenues and government expenditure net of interest.

From (3) it is immediately obvious that the dynamics of the debt is fully determined at any point in time by the dynamics of a subset of the variables included in the vector $\mathbf{z}_{i,t}$, moreover the relationship between the debt and the variables in $\mathbf{z}_{i,t}$ is non-linear.

Several comments on this specification are in order.

1) The endogenization of the debt-deficit dynamics allows to check that impulse response functions are not computed of diverging paths for fiscal fundamentals. The explicit inclusion of d_{it} in the dynamic model allows to pin down explicitly the debt stabilization motive in the fiscal reaction function and the impact of debt in the macro dynamics

2) The coefficients in the dynamic macro model depend on a regime S_t. For example in a Smooth Transition VAR for $\mathbf{z}_{i,t}$ only the regime switch is modelled as follows:

$$
\begin{aligned}
\mathbf{z}_t &= (1 - F(s_{t-1}))A_1(L, E)\,\mathbf{z}_{t-1} + F(s_{t-1})A_1(L, R)\,\mathbf{z}_{t-1} + \mathbf{u}_t \\
\mathbf{u}_t &\sim N(0, \Sigma_t) \\
\Sigma_t &= \Sigma_E(1 - F(s_{t-1})) + \Sigma_R F(s_{t-1}) \\
F(s_t) &= \frac{\exp(-\gamma s_t)}{1 + \exp(-\gamma s_t)}, \gamma > 0 \\
var(s_t) &= 1, E(s_t) = 0
\end{aligned}
$$

where s_t is an observable (standardized) index of the business cycle.

3) Foreign variables $\mathbf{z}^*_{i,t}$ are allowed to have an impact.

4) Fiscal plans are modelled as described in the previous section and, for simplicity, the foresight horizon is limited to one-period. Exogenous fiscal plans are observable and they are available to the econometricians

5) Heteroscedasticity is allowed in the component of fiscal plans and in the model residuals.

6) The model is non linear but impulse responses can be computed as the difference between two forecasts:

$$IR\left(t,s,d_i\right)=E\left(\mathbf{z}_{i,t+s}\left|v_t=d_i;I_t\right.\right)-E\left(z_{i,t+s}\left|v_t=0;I_t\right.\right)\quad s=0,1,2,...$$

Once impulse response are available multipliers, as argued by Mountford and Uhlig (2009), Uhlig (2010) and Fisher and Peters (2010), can be calculated as the integral of the output response divided by the integral government adjustment (spending or taxation) response.

3 Empirical Models

The available contribution in the literature can be discussed by classifying them according to the restrictions they impose on the general structure described in the previous section.

3.1 Early SVAR Models

The early studies of the macroeconomic impact on fiscal variables concentrate on shocks by neglecting the intertemporal nature of fiscal plans. therelevant policy shift are identified with shocks. However, The analysis of the output effects of economic policy requires – for the correct estimation of the relevant parameters – identifying policy shifts that are exogenous. Exogeneity of the shifts in fiscal policy for the estimation of their output effect requires that they are not correlated with news on output growth. The traditional steps to identify such exogenous shifts were to first estimate a joint dynamic model for the structure of the economy and the variables controlled by the policymakers (typically estimating a VAR). The residuals in the estimated equation for the policy variables approximate deviations of policy from the rule. Such deviations, however, do not yet measure exogenous shifts in policy because a part of them represents a reaction to contemporaneous information on the state of economy. In order to recover structural shocks from VAR innovations some restrictions are required. So empirical models can be classified via the restrictions they impose on the specification and the identification restrictions.

3.1.1 Traditional SVAR

Blanchard and Perotti (2002) (BP) is the traditional benchmark for the literature of VAR-based investigation of the output effect of fiscal policy:

BP specify the following restricted model to measure fiscal multipliers:

$$\begin{bmatrix} 1 & 0 & -a_{13} \\ 0 & 1 & -a_{23} \\ -a_{31} & -a_{32} & 1 \end{bmatrix} \begin{bmatrix} T_t \\ G_t \\ Y_t \end{bmatrix} = A_1(L) \begin{bmatrix} T_{t-1} \\ G_{t-1} \\ Y_{t-1} \end{bmatrix} + \begin{bmatrix} \sigma^T & b_{12} & 0 \\ b_{21} & \sigma^G & 0 \\ 0 & 0 & \sigma^Y \end{bmatrix} \begin{bmatrix} e_t^T \\ e_t^G \\ e_t^Y \end{bmatrix}$$

where T_t, G_t and Y_t are the log of real quarterly taxes, spending and GDP all in real per capita terms. Taxes are net taxes defined as the sum of Personal Tax and Non tax Receipts, Corporate Profits Tax Receipts, Indirect Business Tax and Non tax accruals, Contributions for Social Insurance less Net Transfer Payments to Persons and Net Interest Paid by the Government. Government Spending is defined as Purchases of Goods and Services, both current and capital. Data are quarterly and seasonally adjusted for the period 1947:1 to 1997:4. The $e's$ are non observable mutually uncorrelated structural shocks normalized to be of variance 1. However, they can be identified by imposing some restrictions on the $a's$ and the $b's$. Estimate a reduced form VAR in the three variables of interest, the VAR residuals $u's$ will be related to the $e's$ as follows:

$$\begin{aligned} \begin{bmatrix} 1 & 0 & -a_{13} \\ 0 & 1 & -a_{23} \\ -a_{31} & -a_{32} & 1 \end{bmatrix} \begin{bmatrix} u_t^T \\ u_t^G \\ u_t^Y \end{bmatrix} &= \begin{bmatrix} \sigma^T & b_{12} & 0 \\ b_{21} & \sigma^G & 0 \\ 0 & 0 & \sigma^Y \end{bmatrix} \begin{bmatrix} e_t^T \\ e_t^G \\ e_t^Y \end{bmatrix} \\ A\mathbf{u}_t &= B\mathbf{e}_t \end{aligned}$$

from which we can derive the relation between the variance-covariance matrices of $\mathbf{u}_t$ (observed) and $\mathbf{e}_t$ (unobserved) as follows:

$$\begin{aligned} E(\mathbf{u}_t \mathbf{u}_t') &= \mathbf{A}^{-1}\mathbf{B}E(\mathbf{e}_t\mathbf{e}_t')\mathbf{B}'\mathbf{A}^{-1} \\ &= \mathbf{A}^{-1}\mathbf{B}\mathbf{B}'\mathbf{A}^{-1} = \mathbf{C}\mathbf{C}' = \Sigma \end{aligned}$$

Substituting population moments with sample moments we have:

$$\widehat{\sum} = \widehat{\mathbf{A}}^{-1}\widehat{\mathbf{B}}\mathbf{I}\widehat{\mathbf{B}}'\widehat{\mathbf{A}}^{-1}, \tag{4}$$

$\widehat{\sum}$ contains $n(n+1)/2$ different elements (where n is the dimension of the VAR), which is the maximum number of identifiable parameters in matrices **A** and **B.** Therefore, a necessary condition for identification of the structural shocks is that the maximum number of parameters contained in the two matrices equals $n(n+1)/2$, such a condition makes the number of equations equal to the number of unknowns in system . As usual, for such a condition also to be sufficient for identification no equation in (4) should be a linear combination of the other equations in the system.

As there are 9 parameters in the BP model at least three identifying restrictions are needed. First, BP rely on institutional information about tax, transfer and spending programs to restrict the parameters a_{13} and a_{23}. These coefficients, in quarterly data, are assumed to exclusively driven by the automatic effects of economic activity on taxes and spending and they are restricted to the output elasticities of government purchases and net taxes. Using information on the feature of the spending and tax and transfer system BP set $a_{13} = 2.08, a_{23} = 0$.[1]The last restrictions is obtained by considered two alternative scenarios, $b_{12} = 0$ and $b_{21} = 0$,that are observed to have a negligible impact on the final results.

The identification restrictions are combined with the specification restrictions on the general model. Namely, only one country is considered (US), the vector of variables $\mathbf{z}_{US,t}$ consists only of three variables, constant parameters are assumed $A_{1,US}(L, S_t) = A_{1,US}(L)$, no foreign variable enter the specification $A_{2,US}(L, S_t) = 0$, there is no explicit debt feedback $A_{3,US}(L, S_t) = 0$ and the debt dynamics is not modelled, plans are not introduced and shocks are combination of announced, unanticipated and anticipated corrections which are restricted to have the same effect $B_1(S_t) = C_1(S_t) = D_1(S_t) = B_1, B_2(S_t) = C_2(S_t) = D_2(S_t) = B_2$.

Impulse response are then computed and multipliers are calculated by first multiplying the estimates by the sample mean of government spending and net taxes to GDP ratios, and then by comparing the peak output response to the initial government spending or tax impact effect. Note that this is different from computing the integral multipliers described in the previous section.

Two sets of empirical results are reported generated respectively by allowing for stochastic trends (and specifying the model in first differences) or by considering a specification in level with deterministic trends. The Tax multiplier is around one (-1.33 in the ST against -0.78 under DT) and similar in size to the spending multiplier (0.90 in the ST against 1.29 under DT). Some evidence of subsample instability emerges. Follow-up work, such as by Fatas-Mihov(2001), Perotti(2005), Pappa(2005) and Gali, Lopez-Salido and Valles(2007), found similar results.

The BP specification is very restrictive: the set of variables considered is very limited, the model does not allow for debt feedback and tracking of the debt dynamics and identified shocks are convolution of unanticipated,

[1] Caldara(2011) shows that the sensitivity of estimated multipliers to changes in these elasticities can be very large.

anticipated and announced corrections. The first set of restrictions have not been extensively debated in the literature, the second set can be rationalized by considering that the US debt dynamics has never deviated from stability and therefore the model can be thought of as including a linearized version of the identity driving the debt dynamics. However, Leeper (2010) stresses the importance of avoiding analyses of "unsustainable fiscal policies" and of making sure that the question "What is the fiscal multiplier" is not asked along a path for the debt dynamics that is at odds with the beliefs of government bond-holders.

As a matter of fact the restrictions that has elicited more debate is the one that implies that identified shocks to government spending and taxation are anticipated. Ramey (2011a, b) argues that distinguishing between announced and unanticipated shifts in fiscal variables, and allowing them to have different effects on output, is crucial for evaluating fiscal multipliers. Leeper et al.(2013) illustrates explicitly that fiscal foresight makes the number of shocks to be mapped out of the VAR innovations is too high to achieve identification: technically the Moving Average representation of the VAR becomes non-invertible (see also Lippi and Reichlin(1994)).

3.1.2 SVAR with sign restrictions

Mountford and Uhlig(2009) (MU) apply to the analysis of fiscal policy the methodology originally introduced by Uhlig(2005) to identify monetary policy shocks. MU represents the VAR of interest as follows

$$
\begin{aligned}
\mathbf{z}_t &= \sum_{i=1}^{p} \mathbf{A}_i \mathbf{z}_{t-i} + \mathbf{u}_t \\
\mathbf{u}_t &= \mathbf{C}\mathbf{e}_t \\
\Sigma &= \mathbf{C}\mathbf{E}\left(\mathbf{e}_t \mathbf{e}_t'\right)\mathbf{C}' = \mathbf{C}\mathbf{C}'
\end{aligned}
$$

Consider now C as the Cholesky decomposition of Σ.

The impulse response function, given the Cholesky decomposition could be written as :

$$
\mathbf{z}_t = \left[\mathbf{I} - \mathbf{A}(L)\right]^{-1} \mathbf{C}\mathbf{e}_t
$$

All the possible rotations of the Cholesky decomposition are obtained as follows:

$$
\begin{aligned}
& \left[\mathbf{I} - \mathbf{A}(L)\right]^{-1} \mathbf{C}\mathbf{Q}\mathbf{Q}'\mathbf{e}_t \\
\mathbf{Q}\mathbf{Q}' &= I
\end{aligned}
$$

The impulse response for $\mathbf{Q}'\mathbf{e}_t$, is then $[\mathbf{I} - \mathbf{A}(L)]^{-1}\mathbf{CQ}$.

The imposition of the sign restrictions then considers $\mathbf{Q}$ to generate all possible identification and then select only those that satisfy some restriction on their sign.

The vector $\mathbf{y}_t$ contains many more variables than the corresponding one in BP; in fact Mountford-Uhlig specify a VAR in GDP, private consumption, total government expenditure, total government revenue, real wages, private non-residential investment, interest rate, adjusted reserves, the producer price index for crude materials and the GDP deflator. These 10 variables are considered at a quarterly frequency from 1955 to 2000, the VAR has 6 lags, no constant or a time trend, and uses the logarithm for all variables except the interest rate which is specified level. The definition of the two fiscal variables is the same with BP. Sign restrictions are used to identify shocks of interest. (i) A business cycle shock is defined as a shock which jointly moves output, consumption, non-residential investment and government revenue in the same direction for four quarters following the shock[2]; (ii) A monetary policy shock, which is taken to be orthogonal to the business cycle shock, moves interest rates up and reserves and prices down for four quarters after the shock iii) fiscal policy shocks are orthogonal to business cycle and monetary policy shocks, government spending shocks and government revenue shocks are identified by a positive response of the corresponding variables such response is restricted to be delayed (to take into account fiscal foresight) and permanent (to rule out temporary fiscal adjustment).

If we interpret MU in terms of our general model they take a close economy, constant parameters approach, they restrict $B_1 = B_2 = 0$, they do not track separately the response upon announcement and upon implementation and they impose the restrictions that all the φ parameters are positive, except those determining the cross correlation between revenue and expenditure adjustments, that are set to zero.

The tax multiplier (deficit-financed tax cuts) is almost three times larger than that computed by BP and stands at 3.57 (with a peak effect after 13 quarters) while the deficit-spending multiplier is slightly lower than that of BP as it stands at 0.65 (with a peak effect upon impact). Interestingly, by linearly combining their two base fiscal policy shocks MU analyze also the effect of a balanced budget tax cut. Comparing these three scenarios, they find that a surprise deficit financed tax cut is the best fiscal policy

[2] Note that this restrictions implies that when output and government revenues move in the same direction, this must be due to some improvement in the business cycle generating the increase in government revenue, not the other way around.

to stimulate the economy, giving rise to a maximal present value multiplier of five dollars of total additional GDP per each dollar of the total cut in government revenue five years after the shock.

3.1.3 Expectational VARs

Expectational VARs try and solve the problems posed by fiscal foresight and endogeneity by constructing an instrument for fiscal corrections using information outside the VAR. Ramey and Shapiro (1998) use narrative techniques to create a dummy variable capturing military buildups. *Business Week* is used as a source to isolate political events the led to buildups exogenous to the current state of the economy, the narrative approach was also used to make sure that the relevant shocks were unanticipated. The effect of the "war dates" was measured by estimating single equations for each variable of interest including current value and lags of the war dates and lags of the left hand side variable.

To understand this approach consider the structural representation of a constant parameter closed economy first-order VAR:

$$\mathbf{A}\mathbf{z}_t = \mathbf{C}\mathbf{z}_{t-1} + \mathbf{B}\mathbf{e}_t. \tag{5}$$

The MA representation of (5) is

$$\mathbf{z}_t = \mathbf{\Gamma}(L)\mathbf{e}_t \tag{6}$$

where $\mathbf{\Gamma}(L) \equiv \frac{\mathbf{A}^{-1}\mathbf{B}}{\mathbf{I}-\mathbf{A}^{-1}\mathbf{C}}$. The MA representation is not directly estimated in the VAR, but it can be derived by inversion, after having estimated (5).

We re-write (6) as follows

$$\begin{aligned}
\mathbf{z}_t &= \sum_{j=0}^{M} \mathbf{\Gamma}_0^j \mathbf{\Gamma}_1 \mathbf{e}_{t-i} + \mathbf{\Gamma}_1^{M+1} \mathbf{z}_{t-(M+1)} \\
\mathbf{\Gamma}_0 &\equiv \mathbf{A}^{-1}\mathbf{B},\ \mathbf{\Gamma}_1 \equiv \mathbf{A}^{-1}\mathbf{C}.
\end{aligned}$$

and extract from the above system the equation for a variable of interest, say output growth

$$\begin{aligned}
\Delta y_t &= \sum_{j=0}^{M} \gamma_j^{y,t} e_{t-j}^t + \sum_{j=0}^{M} \gamma_j^{y,g} e_{t-j}^g + \sum_{i=1}^{k} \sum_{j=0}^{M} \gamma_j^{y,i} e_{t-j}^i \\
&\quad + \mathbf{\Gamma}_1^{M+1} \mathbf{z}_{t-(M+1)}
\end{aligned} \tag{7}$$

where

$$\begin{aligned}
\gamma_j^{y,x} &= \mathbf{s}^x \mathbf{\Gamma}_0 \mathbf{\Gamma}_1^i \mathbf{s}^{t\prime} \qquad x = t, g, x^1, ...x^k \\
\mathbf{s}^g &= \left[\begin{array}{ccccc} 1 & 0 & 0 & 0 & 0 \end{array} \right], \ \mathbf{s}^t = \left[\begin{array}{ccccc} 0 & 1 & 0 & 0 & 0 \end{array} \right] \\
\mathbf{s}^k &= \left[\begin{array}{ccccc} 0 & 0 & ... & \underset{2+k}{1} & ...0 \end{array} \right]
\end{aligned}$$

Consider now the relation between the true unobservable expenditure shocks and the narrative instrument

$$\begin{aligned}
e_t^g &= e_t^{WAR} + \varepsilon_t \\
\varepsilon_t &\sim i.i.d. \left(0, \sigma_\varepsilon^2\right)
\end{aligned} \tag{8}$$

i.e.. assume that the difference between the expenditure shocks in the VAR and those identified via the narrative method is some error ε_t. This assumption has a number of testable implications, in particular e_t^{WAR} should be orthogonal to all the lags of all the variables included in the VAR.

We can now write

$$\begin{aligned}
\Delta y_t &= \sum_{j=0}^{M} \gamma_j^{y,g} e_{t-j}^{WAR} + \sum_{j=0}^{M} \gamma_j^{y,g} \varepsilon_{t-j} + \\
&\quad + \sum_{j=0}^{M} \gamma_j^{y,t} e_{t-j}^{t} + \sum_{i=1}^{k} \sum_{j=0}^{M} \gamma_j^{y,i} e_{t-j}^{i} \\
&\quad + \mathbf{\Gamma}_1^{M+1} \mathbf{z}_{t-(M+1)}
\end{aligned} \tag{9}$$

(9) makes clear that the limited information approach adopted by Ramey and Shapiro in which the variable of interest is regressed on a distributed lag of the instrument and lags of the left hand side since variables can be interpreted as a simplified version of (9) that omits variables that are thought of as orthogonal to the regressors (i.e. the distributed lags of other shocks and the measurement error). Within this framework of interpretation there is a potential problem related to the omission of lags M+1 and longer of all the other variables in the dynamic system. This omission is the less problematic the more the system is stationary and the inclusion of lags of the dependent variable might be thought of as a way of swamping this effect.

To overcome the limited information approach a number of follow-up papers (Edelberg, Eichenbaum, and Fisher (1999), Burnside, Eichenbaum, and Fisher (2004), and Cavallo 2005) embedded e_t^{WAR} in a VAR by ordering them first in a Cholesky decomposition. Fisher and Peters(2010) created an alternative forward looking series of news based on the excess returns of defense contractor shocks for the period starting in 1958. These applications typically found that government spending with a multiplier in the range 0.6-1.5 and therefore slightly higher than that of BP, but comparable especially after taking into account the effect of fiscal foresight in BP type models. Ramey (2011a) showed that the shocks from an SVAR were predictable by e_t^{WAR}. After correcting for this effect, the obtained impulse responses become more similar. Barro, Redlick(2011) also use military build-ups as an instrument for defense spending but they also include in the specification a measure for marginal tax rate and allow for non-linearities making the effects of revenue and expenditure shocks function of unemployment. Their estimated multiplier for defense spending is 0.6-0.7 at the median unemployment rate (while holding fixed average marginal income-tax rates) rising in unemployment to reach 1 when the unemployment rate is around 12 per cent. Increases in the average marginal income-tax rates have a significantly negative effect on GDP with an implied magnitude of the multiplier of 1.1.

3.2 Narrative Measures

Romer and Romer(2010) (R&R) proceed to non-econometric, direct identification of the shifts in fiscal variables. These are then plugged directly into an econometric specification capable of delivering the impulse response functions that describe the output effect of fiscal adjustments. In this “narrative” identification scheme a time-series of exogenous shifts in taxes or government is constructed using parliamentary reports and similar documents to identify the size, timing, and principal motivation for all major fiscal policy actions. Legislated tax changes are classified by R&R into endogenous for their estimation of their output effect (induced by short-run countercyclical concerns) and exogenous (responses to an inherited budget deficit, or to concerns about long-run economic growth or politically motivated). R&R construct time-series for the US considering quarterly observation over the period 1945:1-2007:1. There is an interesting fact about the two type of exogenous tax changes which is evident from the following figure reported by R&R. The deficit-driven tax changes are almost exclusively positive (episode of fiscal expansion motivated by inherited surplus are virtually non existent) while all the long-run tax changes are negative (i.e. expansionary).

If the perspective of plans is adopted to interpret the R&R narrative identification we can classify their tax shocks as the sum of corrections announced at time t and immediately implemented (therefore unanticipated) and corrections announced at time t to be implemented in future periods:

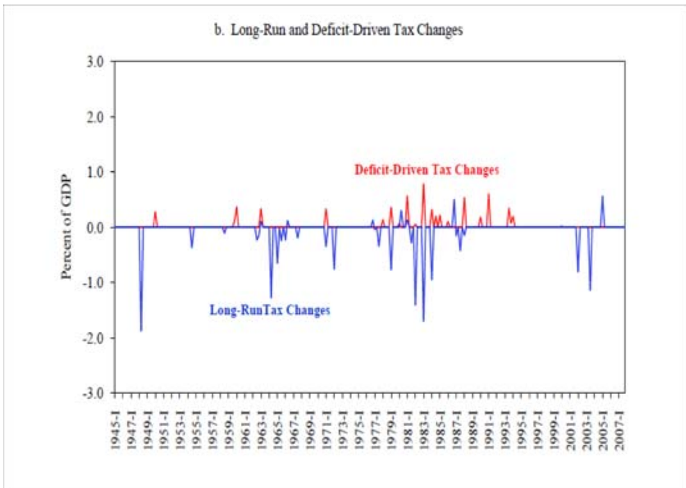

Figure 1

$$\tau_t^{RR} = \tau_t^u + \tau_{t,1}^a$$

The effect of tax shocks is then measured by running the following single-equation specification.

$$\Delta \ln Y_t = \alpha + B(L)\tau_t^{RR} + \epsilon_t \tag{10}$$

So a truncated constant parameter single country MA representation is adopted, where only the exogenous components of tax adjustments is considered with the restrictions that unanticipated and announced corrections have the same effect and announced corrections have no impact upon implementation. The resulting evidence is that tax increases are highly contractionary : a tax increase of 1% of GDP has a cumulative effect of a reduction of output over the next three years of nearly 3 %.

The narrative approach has been extended to the UK case by Cloyne (2013) who constructs a new narrative dataset of legislated tax changes in the UK, to apply the R&R empirical approach and find that a 1 percentage point cut in taxes as a proportion of GDP causes a 0.6 percent increase in GDP on impact, rising to a 2.5 percent increase over nearly three years.

Devries et al (2011, D&al) extend the narrative approach to a multi-country sample that identify episodes for 17 OECD countries between 1978 and 2009. These authors concentrate on deficit driven corrections to revenue and expenditure that are not compensated by long-run corrections. Adopting the perspective of plans the Devries et al corrections are constructed by adding up two components: unexpected shifts in fiscal variables occurring in year t (that is announced when they are implemented), e_t^u, and shifts in fiscal variables which also occur in year t but had been announced in previous years, $e_{i,t,0}^a$

$$\begin{aligned} e_{i,t}^{DV} &= e_{i,t}^u + e_{i,t,0}^a \\ e_{i,t}^u &= \tau_{i,t}^u + g_{i,t}^u \\ e_{i,t,0}^a &= \tau_{i,t,0}^a + g_{i,t,0}^a \end{aligned}$$

Guajardo et al (2014) have used these data to estimate fiscal multipliers using constant parameters panel data techniques on the international sample (and therefore by imposing the restrictions $A_{1,i} = A_1, A_{2,i} = A_{3,i} = 0, B_1 = C_1, B_2 = C_2, D_1 = D_2 = 0$) . In practice, in their baseline specification, they estimate the following panel version of the single equation model adopted by R&R:

$$\Delta z_{i,t} = \alpha + A_1(L)\Delta z_{i,t-1} + B_1(L)e_{i,t}^{DV} + \lambda_i + \chi_t + u_{i,t}$$

where λ_i denotes country fixed effect and χ_t denote year fixed-effects.

They estimate that the effect of a 1 per cent of GDP fiscal consolidation has a contractionary effect on GDP with a peak effect of -0.62 per cent within two years (t-stat=-3.82).

3.2.1 The Government Intertemporal Budget Constraint

Leeper(2010) states clearly that "...*Fiscal policy will shed its alchemy label when the question "What is the fiscal multiplier?" is no longer asked and detailed analyses of "unsustainable fiscal policies" are no longer conducted without explicit analysis of expectations and dynamic adjustments* ...".

The traditional VAR literature takes sustainability for granted and interprets the estimated VAR as linearized model around a stable debt/GDP path. Chung and Leeper(2007) impose this equilibrium condition on an identified VAR and characterize the way in which the present-value support of debt varies across various types of fiscal policy shocks and between fiscal and non-fiscal shocks. Favero and Giavazzi(2012) propose an extension of the standard VAR model augmented with observable narrative tax adjustments,e_t^{RR}, capable of explicitly tracking the dynamics of debt/GDP in response to fiscal shocks.

The following empirical specification is introduced for estimating tax multipliers

$$
\begin{aligned}
\mathbf{z}_t &= \sum_{i=1}^{k} \mathbf{C}_i \mathbf{z}_{t-i} + \boldsymbol{\delta} e_t^{RR} + \boldsymbol{\gamma}\left(d_{t-1} - d^*\right) + \mathbf{u}_t \qquad (11) \\
d_t &= \frac{1 + i_t}{\left(1 + \Delta p_t\right)\left(1 + \Delta y_t\right)} d_{t-1} + \frac{\exp\left(g_t\right) - \exp\left(t_t\right)}{\exp\left(y_t\right)} \\
\mathbf{z}_t^{'} &= \left[\begin{array}{ccccc} i_t & y_t & \Delta p_t & t_t & g_t \end{array}\right]
\end{aligned}
$$

where $\mathbf{Z}_t$ includes the five variables present in a fiscal VAR. Debt is explicitly introduced in the VAR. The estimated model on US data never delivers "unsustainable debt paths" and the model augmented with debt and the non-linear debt dynamics equation produces results which are very similar to those obtained by including the R&R shocks in a traditional fiscal VAR. U.S. data are drawn from a sustainable fiscal regime: within this regime it is likely that the feedback between fiscal variables and the (linearized) debt dynamics is captured in a linear VAR specification that includes all the variables that enter in the debt-deficit relationship. Nevertheless, having the possibility of checking that fiscal multipliers are computed along a sustainable path is an important step, that might become relevant for countries other than the US.

Corsetti, Meier and Muller(2012) analyze the effects of an increase in government spending under a plausible debt stabilizing policy that links current stimulus to a subsequent period of spending restraint. They show that accounting for such spending reversals of crucial importance to bring standard new Keynesian model in line with the stylized facts of fiscal transmission.

3.2.2 External Instrument SVARs

Mertens and Ravn(2013, 2014) propose to consider the series based on the narrative evidence as a noisy measure of the true unobservable fiscal shock. They identify exogenous tax changes in a VAR model by proxying latent tax shocks with narratively identified tax liability changes.

Given a VAR in n variables consider again the relationship between the variance covariance of the observed VAR innovations $\mathbf{u}_t$ and the unobserved structural shocks $\mathbf{e}_t$:

$$
\begin{aligned}
A\mathbf{u}_t &= B\mathbf{e}_t \\
E\left(\mathbf{u}_t \mathbf{u}_t'\right) &= \mathbf{A}^{-1}\mathbf{B}E\left(\mathbf{e}_t \mathbf{e}_t'\right)\mathbf{B}'\mathbf{A}^{-1} \\
&= \mathbf{A}^{-1}\mathbf{B}\mathbf{B}'\mathbf{A}^{-1} = \mathbf{C}\mathbf{C}' = \Sigma
\end{aligned}
$$

Substituting population moments with sample moments we have:

$$\widehat{\sum} = \widehat{\mathbf{A}}^{-1}\widehat{\mathbf{B}}\mathbf{I}\widehat{\mathbf{B}}'\widehat{\mathbf{A}}^{-1}, \tag{12}$$

$\widehat{\sum}$ contains $n(n+1)/2$ different elements (where n is the dimension of the VAR), which is the maximum number of identifiable parameters in matrices **A** and **B.**

Consider now the availability of a vector m_t of $k \times 1$ observable proxy variables that are correlated with the k structural shocks of interest $\mathbf{e}_{1t}$ and orthogonal to the other $n-k$ shocks $\mathbf{e}_{2t}$ (where $\mathbf{e}_t' = [\mathbf{e}_{1t}', \mathbf{e}_{2t}']$)**.** The proxy variables have zero mean and satisfy two conditions:

$$E\left(m_t\mathbf{e}_{1t}'\right) = \Phi, E\left(m_t\mathbf{e}_{2t}'\right) = 0 \tag{13}$$

where Φ is an unknown nonsingular $k \times k$ matrix.

Consider the following partitioning of C

$$\begin{aligned} C &= \left[\begin{array}{cc} \underset{nxk}{C_1} & \underset{nx(n-k)}{C_2} \end{array}\right] \\ C_1 &= \left[\begin{array}{cc} \underset{kxk}{C_{11}'} & \underset{kx(n-k)}{C_{21}'} \end{array}\right]' \\ C_2 &= \left[\begin{array}{cc} \underset{(n-k)xk}{C_{12}'} & \underset{(n-k)x(n-k)}{C_{22}'} \end{array}\right]' \end{aligned}$$

with nonsingular C_{11} and C_{22}. Conditions (13) together with the relation between structural shocks and VAR innovations imply that

$$\Phi C_1' = \Sigma_{mu'} \tag{14}$$

This system, which is of dimension $n \times k$, provides additional identifying restrictions but it also depends on the k^2 unknown elements of Φ. If one is not prepared to make any further assumptions on Φ other than nonsingularity, equation (14) provides really only $(n-k)k$ new identification restrictions. Partitioning $\Sigma_{mu'} = \left[\Sigma_{mu_1'}\Sigma_{mu_2'}\right]$, where $\Sigma_{mu_1'}$ is $k \times k$ and $\Sigma_{mu_2'}$ is $k \times (n-k)$ and using (14), these restrictions can be expressed as

$$C_{21} = \left(\Sigma_{mu_1'}^{-1}\Sigma_{mu_2'}\right)' C_{11} \tag{15}$$

which is a viable set of covariance restrictions as $\left(\Sigma_{mu_1'}^{-1}\Sigma_{mu_2'}\right)$ can be estimated.

In practice, estimation can proceed in three stages

- Estimate the reduced form VAR by least squares.
- Estimate $\left(\Sigma_{mu_1'}^{-1}\Sigma_{mu_2'}\right)$ from regression of VAR residuals on m_t
- impose (15) and estimate the objects of interest, if necessary in combination with further identifying assumptions.

Mertens and Ravn (2014) apply this methodology to the standard BP VAR to reconcile the apparently different size of multipliers obtained in BP and R&R, while Martens and Ravn (2013) discriminate between the effects of changes in average personal income tax rates and the effects of changes in average corporate income tax rates to find that unanticipated changes in either tax rates produce large short run effects on aggregate output. Moreover, tax revenue falls in response to cuts in personal income taxes while on average there is a little impact on tax revenues of the corporate income tax cuts.

3.2.3 The Average Treatment Effect of Fiscal Policy

Jorda-Taylor (2013) reinterpret fiscal multipliers in the logic of the measurement of treatment effects.

Consider a very simplified version of our general model which includes the narratively identified fiscal correction episodes:

$$\mathbf{z}_t = A\mathbf{z}_{t-1} + \boldsymbol{\beta}_1 e_t^{DV} + \epsilon_t$$

The MA if the VAR truncated at lag h is

$$\begin{aligned} \mathbf{z}_{t+h} &= A^{h+1}\mathbf{z}_{t-1} + A^h\boldsymbol{\beta}_1 e_t^{DV} + v_{t+h} \\ v_{t+h} &= \boldsymbol{\beta}_1 e_{t+h}^{DV} + ... + A^{h-1}\boldsymbol{\beta}_1 e_{t+1}^{DV} + \\ &\quad +\epsilon_{t+h} + A\epsilon_{t+h-1} + ...A^h\epsilon_t \end{aligned}$$

The impulse response describing the effect of the fiscal correction on the variable of interest, say output growth, is then

$$E\left(y_{t+h} - y_t \mid e_t^{DV} = 1, I_t\right) - E\left(y_{t+h} - y_t \mid e_t^{DV} = 0, I_t\right) = \sum_{i=0}^{h} \frac{\partial \Delta y_{t+i}}{\partial e_t^{DV}} = \sum_{i=0}^{h} e^y A^i \boldsymbol{\beta}_1$$

where e^y is a selector vector that extracts output growth for the vector of variables $\mathbf{z}_t$. This impulse response can be obtained via a series of h regressions by applying the Linear Projection method introduced by Jordà (2005)

$$y_{t+h} = \pi'_h \mathbf{z}_{t-1} + \theta^h e_t^{DV} + v_{t+h}$$

in practice the conditioning set $\mathbf{z}_{t-1}$ can be augmented in LPM as LPM is based on a single equation estimation (after the identification of the shocks) and more degrees of freedom are available:

$$y_{t+h} = \gamma'_h \mathbf{w}_{t-1} + \theta^h e_t^{DV} + v_{t+h}$$

Note also that the LP method also can easily accommodate non-linear impulse responses. The comparison of the LPM regression with the full truncated MA representation makes clear that LPM omits all structural shocks between time t and time t+h. This omitted variables problem would not lead to inconsistent estimates of the parameters of $A^h \boldsymbol{\beta}_1$ $(p \lim \hat{H}_h = A^h \beta_1)$ only if e_t^{DV} were orthogonal to all omitted variables, or if $\mathbf{w}_{t-1}$captures the relevant variation in all omitted variables.

The use of LPM to derive IR and multipliers leads naturally to interpret the effect of fiscal policy as the effect of a treatment. In fact the average policy effect on a variable y_t at horizon $t + h$ can be written as

$$E\left[\left(y_{t+h}\left(d_j\right) - y_t\right) - \left(y_{t+h}\left(d_0\right) - y_t\right) \mid w_t\right] = \theta^h$$

Where d_j is the policy intervention. Jorda-Taylor note that if the fiscal corrections are to be considered as a treatment, then it is crucial that the policy intervention is not predictable to avoid a standard allocation bias problem. As a matter of fact e_t^{DV} are predictable by their own past, and by past values of debt dynamics (see also Hernandez da Cos and Moral-Benito(2011)). To solve this problem JT propose to apply LPM after having purged the fiscal actions from predictability. They proceed as follows:

(i) redefine e_t^{IMF} innovations as a 0/1 dummy variable,

(ii) estimate a *propensity score* deriving the probability with which a correction is expected by regressing it on its own past and predictors,

(iii) use the propensity score to derive an Average Treatment Effect based on Inverse Probability Weighting.

Denote the policy propensity score $p^j\left(w, \psi\right)$ for $j = 1, 0$ (the predicted values from a probit projections of the policy indicator on the set of predictors w).

$$\begin{aligned}
\theta^h &= E\left[\left(y_{t+h}\left(d_1\right) - y_t\right) - \left(y_{t+h}\left(d_0\right) - y_t\right) \mid w_t\right] \\
&= E\left[\left(y_{t+h} - y_t\right)\left(\frac{1\left\{D_t = d_1\right\}}{p^1\left(w, \psi\right)} - \frac{1\left\{D_t = d_0\right\}}{1 - p^1\left(w, \psi\right)}\right) \mid w_t\right]
\end{aligned}$$

$$\hat{\theta}^{h} = \frac{1}{T}\sum\left(y_{t+h}-y_{t}\right)\hat{\delta}_{t}$$
$$\hat{\delta}_{t} = \frac{1\left\{D_{t}=d_{1}\right\}}{\hat{p}^{1}\left(w,\psi\right)} - \frac{1\left\{D_{t}=d_{0}\right\}}{1-\hat{p}^{1}\left(w,\psi\right)}$$

In the LP framework ATE can be combined with LP in the following estimator LP-IWPRA estimator

$$\hat{\theta}^{h} = \frac{1}{T}\sum\left[\left(y_{t,h}-y_{t}\right)\hat{\delta}_{t}-\hat{\phi}_{t}m\left(w_{t},\gamma^{h}\right)\right]$$
$$\hat{\phi}_{t} = \frac{1\left\{D_{t}=d_{1}\right\}-\hat{p}^{1}\left(w,\psi\right)}{\hat{p}^{1}\left(w,\psi\right)} - \frac{1\left\{D_{t}=d_{0}\right\}-\left(1-\hat{p}^{1}\left(w,\psi\right)\right)}{1-\hat{p}^{1}\left(w,\psi\right)}$$

where $m\left(w_{t},\gamma^{h}\right)$ is the mean of $\left(y_{t,h}-y_{t}\right)$ predicted by the LP

By applying the corrected estimator they find and average treatment effect of fiscal consolidation which is not very different form the one estimated by DeVries et al. with a peak effect in year 5 after the consolidation slightly larger than -1, and a cumulative effect after five years at about -3.

To understand this evidence two remarks are in order. First exogeneity in dynamic time-series models is different from predictability. The correct estimation of the effects on output of a fiscal adjustment within our specification requires the use exogenous fiscal shocks, i.e. shocks that cannot be predicted from past output growth, predictability from past shocks or other variables not directly related to output growth is irrelevant to determine the required exogeneity status. This requirement is satisfied by the original IMF shocks. It is no longer satisfied, however, if one transforms those continuous shocks into a 0/1 dummy variable, as in the paper quoted at the beginning. The reason, as a simple regression shows, is that transformation into a 0/1 dummy, and the loss of information it implies, introduces correlation with past output growth. Notice that the exogeneity required to estimate fiscal multipliers within a dynamic model is different from deriving the effect of a treatment randomly assigned, what matters in our model is weak exogeneity for the estimation of the parameters of interest rather then the random assignment of a treatment.

As a matter of fact the DV corrections can be predicted from past debt dynamics and from their past history by construction. They are predictable by debt dynamics as they are defined as shifts in fiscal policy, 'motivated by the objective of stabilizing or reducing the debt ratio'. Predictability in this sense is not inconsistent with exogeneity with respect to past output growth: for this reason Romer and Romer (2010), for instance, include tax shocks motivated by the objective of stabilizing or reducing the debt among their exogenous (for the estimation of the output effect of fiscal policy) shocks.

They are predictable from their past as these corrections are built adding up two components: unexpected shifts in fiscal variables occurring in year t (that is announced when they are implemented), e_t^u, and shifts in fiscal variables which also occur in year t but had been announced in previous years, $e_{t,0}^a$. Dropping the country index

$$e_t^{DV} = e_t^u + e_{t,0}^a$$

Based on this definition, the fact that the e_t^{DV} are correlated across time is not surprising.

A fiscal plan is specified by making explicit the relation between e_t^u, $e_{t,0}^a$ and the fiscal corrections announced in year t for years $t+i$ $(i > 1)$. Therefore

$$\begin{aligned} e_{t,1}^a &= \varphi \, e_t^u + v_t && (16) \\ e_{t+1,0}^a &= e_{t,1}^a && (17) \end{aligned}$$

The first equation describes the style with which fiscal policy is implemented. Plans along which shifts in fiscal variables are persistent will feature a positive value of φ; while temporary plans (*i.e.* plans along which fiscal actions are reversed, at least partially in the future) feature a negative φ. The second relationship simply states that the announced correction implemented at time t is equal to the correction that had been announced in the previous period with a fiscal foresight of one period.

Then

$$\begin{aligned} Cov\left(e_t^{DV}, e_{t-1}^{DV}\right) &= Cov\left(\left(e_t^u + e_{t,0}^a\right), \left(e_{t-1}^u + e_{t-1,0}^a\right)\right) \\ &= \varphi Var\left(e_{t-1}^u\right) \end{aligned}$$

as

$$e_{t,0}^a = e_{t-1,1}^a = \varphi e_{t-1}^u + v_{t-1}$$

However, in a dynamic time-series model, the requirement for valid estimation and simulation are respectively weak and strong exogeneity, that are different from predictability.

To illustrate the point consider the following simplified example:

$$\begin{array}{rcl} \Delta y_t & = & \beta_0 + \beta_1 e_t^{DV} + u_{1t} \\ e_t^{DV} & = & \rho e_{t-1}^{DV} + u_{2t} \\ \begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix} & \sim & N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{pmatrix} \right] \end{array}$$

The condition required for e_t^{DV} to be weakly exogenous for the estimation of β_1 is $\sigma_{12} = 0$, which is independent of ρ.When weak exogeneity is satisfied the existence of predictability does not have any effect on the consistency of the estimate of β_1, of course neglecting the existence of predictability of e_t^{DV} under simulation might lead to consider scenarios that were never observed in the data and therefore to unreliable results.

3.2.4 Fiscal Plans

A natural alternative approach to deal with the predictability of the e_t^{DV} corrections is to specify a dynamic specification for the variable of interests and the fiscal plans.

Martens and Ravn (2011) take a first step in this direction by studying the different effects of announced and unanticipated adjustments but they do so without modelling the interdependence between these two components.

Alesina, Favero and Giavazzi (2014, AFG) use the fiscal consolidation episodes identified by Devries et al (2011), but propose a methodological innovation. They start from the observation that the shifts in taxes and spending that contribute to a fiscal adjustment almost never happen in isolation: they are typically part of a multiyear plan, in which some policies are announced well in advance, while other are implemented unexpectedly and, importantly, both tax hikes and spending cuts are used simultaneously. Also, as these plans unfold, they are often revised and these changes have to be taken into account as they constitute new information available to economic agents. AFG stress the importance of modelling the connections between changes in taxes and expenditures, and between unanticipated and announced changes. In practice they consider a restricted version of the general model in which a quasi-panel is estimated allowing for two types of heterogeneity: within-country heterogeneity in the effects of Tax-Based(TB) and Expenditure-Based(EB) plans, and between-country heterogeneity in the style of a plan

$$\begin{aligned}\Delta z_{i,t} &= \alpha + B_1(L)e^u_{i,t} * TB_{i,t} + B_2(L)e^u_{i,t} * EB_{i,t} + \\ & C_1(L)e^a_{i,t,0} * TB_{i,t} + C_2(L)e^a_{i,t,0} * EB_{i,t} + \\ & + \sum_{j=1}^{3} \gamma_j e^a_{i,t,j} * EB_{i,t} + \sum_{j=1}^{3} \delta_j e^a_{i,t,j} * TB_{i,t} + \lambda_i + \chi_t + u_{i,t}\end{aligned} \tag{18}$$

$$\begin{aligned} e^a_{i,t,1} &= \varphi_{1,i}\ e^u_{i,t} + v_{1,i,t} \\ e^a_{i,t,2} &= \varphi_{2,i}\ e^u_{i,t} + v_{2,i,t} \\ e^a_{i,t,3} &= \varphi_{3,i}\ e^u_{i,t} + v_{3,i,t} \\ e^a_{i,t,0} &= e^a_{i,t-1,1} \\ e^a_{i,t,j} &= e^a_{i,t-1,j+1} + \left(e^a_{i,t,j} - e^a_{i,t-1,j+1}\right)\ j \geqslant 1 \end{aligned}$$

$$\begin{aligned} if\ \left(\tau^u_t + \tau^a_{t,0} + \sum_{j=1}^{horiz} \tau^a_{t,j}\right) &> \left(g^u_t + g^a_{t,0} + \sum_{j=1}^{horiz} g^a_{t,j}\right) \\ then\ TB_t &= 1\ and\ \ EB_t = 0, \\ else\ TB_t &= 0\ \ and\ \ EB_t = 1, \forall\ t \end{aligned}$$

where λ_i and χ_t are country and time fixed effects. A moving average representation for the variable of interest $\Delta z_{i,t}$ is considered in (18) with no debt feedback and constant parameters. Cross-country restrictions on the B, C and γ coefficients are imposed, but within- and between-country heterogeneity is allowed for. "Within" because responses of $\Delta z_{i,t}$ to fiscal adjustments will be different for TB and EB plans. "Between" because they will also differ across countries as the $\varphi's$ differ, according to each country's specific style. The dynamic effect of fiscal adjustment plans is different across countries because of the different styles of fiscal policy (as captured by the different φ_i) and within countries as a consequence of the heterogenous effects of plans as determined by their composition. The moving average representation is truncated because the length of the $B(L)$ and $C(L)$ polynomials is limited to three-years. The moving-average representation is specified to allow for different effects of unanticipated and anticipated adjustments. Shifts in fiscal policy affect the economy through three components. First, unanticipated changes in fiscal stance, $e^u_{i,t}$, announced at time t and implemented at time t; second, the implementation at time t of policy shifts that had been announced in the past, $e^a_{i,t,0}$; third, the anticipation of future changes in fiscal policy, announced at time t, to be implemented at a future date, $e^a_{i,t,j}$ for $j = 1, 2, 3$. Also different coefficients are allowed for adjustment announced in the past and implemented at time t and adjustments announced at time t for the future. To avoid double counting lags of future of $e^a_{i,t,j}$ are excluded, as their dynamic effect is captured by $e^a_{i,t+j,0}$. The parameters φ_i, are estimated on a country by country basis on the time series of the narrative fiscal shocks. Note that introducing total adjustment with different labeling (TB or EB) rather than introducing separately in the specification adjustments in revenue and in expenditure allows a much more parsimonious parameterization of the dynamic system defining the style of fiscal plans, making estimation viable.

The system is put at work in AFG to simulate the effect of TB and EB average plans on macroeconomic variables. Simulation of fiscal plans adopted by 16 OECD countries over a 30-year period supports the hypothesis that the effects of consolidations depend on their design. Fiscal adjustments based upon spending cuts are found much less costly, in terms of output losses, than tax-based ones and have especially low output costs when they consist of permanent rather than stop and go changes in taxes and spending. The difference between tax-based and spending-based adjustments appears not to be explained by accompanying policies, including monetary policy. It is mainly due to the different response of business confidence and private investment.

Alesina et al. (2015) use the system to perform out of sample simulations of the austerity plans adopted by different countries over the period 2009-2013. Model projections of output growth conditional only upon the fiscal plans implemented since 2009 do reasonably well in predicting the total output fluctuations of the countries in our sample over the years 2010-13 and are also capable of explaining some of the cross-country heterogeneity in this variable.

3.3 Non-linearities

Non-linearities in fiscal multipliers are investigated in a number of papers.

Corsetti, G., A. Meier and G.Mueller (2012b) study the determinants of government spending multipliers by investigating how the fiscal transmission mechanism depends on three dimension of economic environment: the exchange rate regime, the level of public debt and deficit, and the presence of a financial crisis. The analysis is implemented on annual data for 17 OECD countries within a sample period 1975–2008. A two-step approach is considered. In the first step the fiscal policy rule, which links government spending and macroeconomic variables, is identified and estimated. The parameters in fiscal policy rules are country-specific and fiscal policy shokcs are identified as the innovations in the rules. In a second step fixed-effects panel regression are estimated to trace the impact of the estimated government spending shocks on the relevant macroeconomic aggregates (output, private consumption, investment, trade balance, real effective exchange rate). To study non-linearities interaction terms of shocks with dummies capturing the exchange rate regime, the state of public finances, and the presence of financial crisis) are included in the regression. The estimated system can be represented as follows:

$$\begin{aligned}
\mathbf{g}_{t,i} &= \phi_i + \eta_i trend_i + \beta_{i,1} g_{t-1,i} + \beta_{i,2} g_{t-2,i} + \gamma_{i,1} y_{t-1,i} + \gamma_{i,2} y_{t-2,i} + \theta_i cli_{t-1,i} + \delta_i b_{t-1,i} \\
&\quad + \delta_i b_{t-1,i} + \rho_{i,1} peg_{t-1,i} + \rho_{i,2} strain_{t,i} + \rho_{i,3} crisis_{t-1,i} + \boldsymbol{\varepsilon}_{t,i} \\
\mathbf{z}_{t,i} &= \alpha_i + \mu_i trend_t + \chi_i \mathbf{z}_{t-1,i} + \sigma_1 \widehat{\varepsilon}_{t,i} + \sigma_2 \widehat{\varepsilon}_{t-1,i} + \sigma_3 \widehat{\varepsilon}_{t-2,i} + \sigma_4 \widehat{\varepsilon}_{t-3,i} + \kappa_1 (\widehat{\varepsilon}_{t,i} * d_{t,i}) + \\
&\quad + \kappa_2 (\widehat{\varepsilon}_{t-1,i} * d_{t-1,i}) + \kappa_3 (\widehat{\varepsilon}_{t-2,i} * d_{t-2,i}) + \kappa_4 (\widehat{\varepsilon}_{t-3,i} * d_{t-3,i}) + \lambda_1 d_{t,i} + \lambda_2 d_{t-1,i} + \\
&\quad + \lambda_3 d_{t-2,i} + \lambda_4 d_{t-3,i} + \mathbf{u}_{t,i}
\end{aligned}$$

where $g_{t,i}$ is government spending variable, $y_{t-1,i}, y_{t-2,i}$ - lags of log per capita output, $cli_{t-1,i}$ lag of a composite leading indicator which measures the expectation with respect to next-year growth, $b_{t-1,i}$ debt to gdp ratio. $peg_{t-1,i}$ is a dummy for an exchange rate, $strain_{t,i}$ - is a dummy for strained public finances, and $crisis_{t-1,i}$ is a financial crisis dummy. $\boldsymbol{\varepsilon}_{t,i}$ - is a fiscal policy shock which measures discretionary policy change. The methodoolgy does not allow to disentangle unanticipated corrections from announced and implemented, furthermore it is assumed that innovations in the projections of goverment spending on past information are orthogonal to deviations of all other macroecononomic variables (including government revenues) from their projections. $\mathbf{z}_{t,i}$ - is the macroeconomic variable of interest, $\widehat{\varepsilon}_{t,i}$ is an estimated fiscal shock from the first stage and $d_{t,i}$ - is a dummy for specific economic conditions in the particular year. Importantly σ parameters measure the baseline dynamic effect of the spending shocks, while κ measures additional marginal effects.

Corsetti, G., A. Meier and G.Mueller (2012b) model is multi country economy, however $A_{2,i}(L, S_t) = 0$,since foreign variables are not allowed to have an impact. $\mathbf{z}_{t,i}$ is not a vector of variables of interest, but it denotes one variable of interest at a time (output, private consumption, private fixed investment, trade balance, the real effective exchange rate, CPI inflation, the short-term nominal interest rate, and government spending itself). There is no debt feedback $A_{3,i}(L, S_t) = 0$. Debt dynamic is also absent in the model. The model does not uses plans, but relies instead on general spending shocks identified by imposing some (strong) restrcitions in the first stage regression.

There are three sources of non-linearities: exchange rate regimes, the state of public finances, and the state of the economy.

Baseline results feature persistency in government spending shocks and a sizeable response of aggregate output by about 0.7 percentage points. Under the currency peg multipliers are positive: impact and maximum is 0.6. Weak public finance produce negative multipliers, both impact -0.7, maximum 0.2 and cumulative after two years -1.2. The most quantitatively relevant results are for the case of financial crisis: the responses of output to a public spending increase is strongly positive, implying a fiscal multiplier of 2.3 - impact and 2.9 - maximum.

Auerbach, Gorodnichenko (2012) make an attempt to assess how the size of fiscal multipliers vary over the cycle by estimating regime-switching SVAR models, with smooth transitions across the relevant states of the economy (i.e., recession versus expansion).

The basic adopted specification is:

$$\begin{aligned}
\mathbf{z}_t &= (1 - F(s_{t-1}))A_1(L,E)\,\mathbf{z}_{t-1} + F(s_{t-1})A_1(L,R)\,\mathbf{z}_{t-1} + \mathbf{u}_t \\
\mathbf{u}_t &\sim N(0,\Sigma_t) \\
\Sigma_t &= \Sigma_E(1 - F(s_{t-1})) + \Sigma_R F(s_{t-1}) \\
F(s_t) &= \frac{\exp(-\gamma s_t)}{1+\exp(-\gamma s_t)}, \gamma > 0 \\
var(s_t) &= 1, E(s_t) = 0
\end{aligned}$$

where $\mathbf{z}_t = [G_t, T_t, Y_t]$, following Blanchard and Perotti (2002) G_t is government purchases, T_t government receipts of direct and indirect taxes net of transfers to businesses and individuals, Y_t is gross domestic product. All variables are in logs and are deflated. Estimation uses quarterly data. Structural shocks are identified form VAR innovations by assuming lower triangularity in the matrix that maps shocks into innovations. Importantly, the model allows for both contemporaneous differences in propagation of structural shocks as well as dynamic. The first one goes through Σ_E and Σ_R, while the second one goes through $A_1(L,E)$ and $A_1(L,R)$. s_t is an index, normalized to have mean of zero and variance of 1, indicating recessions if s is negative and expansion if s is positive. Auerbach, Gorodnichenko (2012) set s_t to a seven quarter moving average of the output growth rate. γ is calibrated to 1.5, which means that the economy spends around 20 percent of the time in recession $Pr(F(s_t) > 0.8) = 0.2$. Under the assumption that $\gamma > 0$, $A_1(L,E)$ and Σ_E characterizes the economy in expansion and $A_1(L,R)$ and Σ_R - in recession.

Auerbach, Gorodnichenko (2012) model is a single country a closed economy model, the vector $\mathbf{z}_t$ consists of three variables: G_t, T_t, Y_t, there are two states of the economy, expansion where $A_1(L, S_t) = A_1(L, E)$ and $\Sigma_t = \Sigma_E(1-F(s_{t-1}))$ with $F(s_{t-1}) = 0$ versus recession $A_1(L, S_t) = A_1(L, R)$ and $\Sigma_t = \Sigma_R F(s_{t-1})$ with $F(s_{t-1}) = 1$. There is no debt feedback $A_{3,US}(L, S_t) = 0$. The model does not uses plans, but relies instead on shocks restricting announced, unanticipated and anticipated corrections to have the same effect $B_1(S_t) = C_1(S_t) = D_1(S_t) = B_1(S_t), B_2(S_t) = C_2(S_t) = D_2(S_t) = B_2(S_t)$. In alternative to the basic model a more advanced specification is considered. This specification include professional forecasts of the relevant variable in the vector $\mathbf{z}_t = [\Delta G^{Forecast}_{t,t-1}, \Delta T^{Forecast}_{t,t-1}, \Delta Y^{Forecast}_{t,t-1}, G_t, T_t, Y_t]$.

Because of non-linearities the estimation as well as the inference is implemented using the Monte Carlo Markov Chain method with Hastings-Metropolis algorithm, where the parameters estimates as well as confidence intervals are computed directly from the generated chains. Computed multipliers are interpreted as indicating how by how many dollars output increase over time if government expenditure increases by \$1. The size of the shock is chosen in such a way that the integral of government spending response over 20 quarters is equal to one.

Baseline results show that in all cases linear, expansion and recession the impact output multiplier is around 0.5 in response to 1\$ spending increase. However, after 20 quarters under the recession regime the multiplier is 2.5 and under expansion regime the multiplier is -1. Average multiplier under the recession is 2.24 and under the expansion -0.33. Fiscal policy is considerably more effective in recessions than in expansions. This evidence refers to polar cases, as in the computation of impulse responses the initial regime is maintained constant: the policy innovation cannot cause a shift in s_t.

Ramey, Owyang and Zubairy(2013) remove this restrictions by computing regime-dependent multipliers using the Linear Projections (LP) method of Jordà(2005). In LP non-linearities are easily accommodated and there is no need to impose the restrictions that shock do not affect the state of the economy. A state-dependent model is estimated in which impulse responses and multipliers depend on the average dynamics of the economy in each state. They address the question of the relevance of non-linearities by analyzing new quarterly historical U.S. data covering multiple large wars and deep recessions. Differently from previous studies they do not find higher multipliers during times of slack in the US.

Ramey and Zubairy(2014) extend the investigation to consider the effect of two potentially important features of the economy: (1) the amount of slack and (2) whether interest rates are near the zero lower bound. The main findings indicate no evidence that multipliers are different across states, whether defined by the amount of slack in the economy or whether interest rates are near the zero lower bound.

Caggiano et al.(2015) also estimate non-linear VARs and address fiscal foresight by appealing to sums of revisions of expectations of fiscal expenditures. Their results, based on generalised impulse responses that allows a feedback from the simulated policy to the probability of the economy being in expansion and recession, suggest that fiscal spending multipliers in recessions are greater than one, but not statistically larger than those in expansions. However, non-linearities arise when focusing on 'extreme' events, that is, deep recessions versus strong expansionary periods.

3.4 Quasi Natural Experiments and Descriptive Evidence.

All the literature that we have been discussing so far fits in the general framework as all the empirical models adopted can be considered of specific cases of our general "encompassing" model, however there are exceptions that exploit "case studies" without specifying a dynamic model. Such studies are best interpreted as focusing on some direct measure of the causal effect of fiscal policy on output growth.

Acconcia, Corsetti and Simonelli (2013) exploit the introduction of a law issued to fight political corruption and mafia infiltration of city councils in Italy that has caused episode of large, temporary and unanticipated fiscal contractions arguably exogenous for the estimation on their effect on output. Using these episodes as instruments, while controlling for national monetary and fiscal policy and keeping the tax burden of local residents constant, the output multiplier of spending cuts at provincial level is estimated in the range 1.2-1.8.

Alesina and Ardagna(2010), adopting an approach introduced by Giavazzi and Pagano(1990), consider a case study of large changes in fiscal policy stance, namely large increase or reduction of budget deficits and analyze their effects on both the economy and the dynamics of the debt. In particular, they concentrate on episodes of large changes in fiscal policy. They use a panel of 20 OECD countries with annual data over the sample 1970-2007. Fiscal variables are cyclically adjusted by considering the difference between a measure of the fiscal variable in period t computed as if the predicted value from a regression of the fiscal policy variable as a share of GDP on a constant a time trend and the unemployment rate, where the unemployment rate at time t is kept at the value observed in time t-1. A period of fiscal adjustment (stimulus) is a year in which the cyclically adjusted primary balance improves (deteriorates) by at least 1.5 per cent of GDP.

Focussing on these episodes and using mainly descriptive evidence they find that tax cuts are more expansionary than spending increases in the cases of a fiscal stimulus, fiscal adjustments based upon spending cuts and no tax increases are more likely to reduce deficits and debt over GDP ratios than those based upon tax increases. Finally, adjustments on the spending side rather than on the tax side are less likely to create recessions.

The two very different approaches adopted by Acconcia et al.(2013) and Alesina and Ardagna(2010) have in common the direct analysis of episodes without the specification of a dynamic macro-model. The case of the exogeneity of the chosen episodes for the measurement of the relevant phenomenon is certainly much stronger in the Acconcia et al.(2013) case. In fact, Guajardo et al.(2011) argue convincingly that changes in cyclically adjusted fiscal variables often include non-policy changes correlated with other developments affecting economic activity. For the sake of illustration they consider a boom in the stock market, such a boom creates a cyclically adjusted surplus by increasing capital gains and cyclically adjusted tax revenues. This surplus can be associated with an increase in consumption and investment generated by the stock market boom. The resulting measurement error is likely to bias the analysis towards downplaying contractionary effects of fiscal consolidations.

However, even if the exogeneity of the episodes considered by Acconcia et al. is clearly robust to this type of considerations, the question on how the results produced in the case studies can be extended to the measurement of fiscal multipliers in presence of different dynamics, initial conditions and heterogeneity in the mechanism of formation of expectations remains unsolved.

4 The Impact of Different Identification and Specification Strategies. An illustration

To illustrate the relevance of different specification choices we consider quarterly US data over the period 1978:1 2012:4 and compare the BP SVAR approach with a dynamic model of fiscal adjustment plans. We use NIPA variables described in the Appendix. To be as close as possible to Blanchard, Perotti (2002) we use their definitions of the variables[3].

[3]From NIPA tables: output is nominal GDP (NIPA 1.1.5.1); government spending is General Government consumption expenditures and gross investment (NIPA 1.1.5.21); total tax revenue is General Government Current receipts (NIPA 3.1.1) less General Government Current Transfers to persons (NIPA 3.1.21) less General Government Interest Payments to persons (NIPA 3.1.25) plus General Government Income receipts on assets

The BP specification is the following one :

$$\begin{bmatrix} 1 & 0 & -2.08 \\ 0 & 1 & 0 \\ -a_{31} & -a_{32} & 1 \end{bmatrix} \begin{bmatrix} T_t \\ G_t \\ Y_t \end{bmatrix} = A_1(L) \begin{bmatrix} T_{t-1} \\ G_{t-1} \\ Y_{t-1} \end{bmatrix} + \begin{bmatrix} \sigma^T & 0 & 0 \\ b_{21} & \sigma^G & 0 \\ 0 & 0 & \sigma^Y \end{bmatrix} \begin{bmatrix} e_t^T \\ e_t^G \\ e_t^Y \end{bmatrix}$$

where $[T_t, G_t, Y_t]$ is a vector of quarterly taxes, spending, and output. All variables are in the logarithms and in real, per capita, terms. $\mathbf{e}_t = [e_t^T, e_t^g, e_t^y]$ are structural shocks, orthogonal to each other with. $A_1(L)$ is a lag polynomial with the length of four quarters. Following Blanchard, Perotti 2002 we include constant, linear and quadratic trends into the model. Sample period is 1978q1 to 2012q4. Since our sample starts with the first quarter of 1978 we do not need to include a dummy variable for the second quarter of 1975 as in Blanchard, Perotti 2002. BP identifying restrictions are imposed on the matrices relating the unobserved structural shocks to the VAR innovations.

Results are reported in the form of impulse response functions. Note that a unit shock to the structural innovations of taxes transforms to less than a unit change in the reduced form tax residuals, because output falls in response to the tax increase and in turn tax revenue falls. Figure 2 reports impulse responses where impulse response of output has an interpretation of the tax (expenditure) multipliers, i.e. dollar changes in GDP as a ratio of the dollar changes in tax revenues (expenditure). Following BP multipliers are obtained by expressing impulse responses as shares of average gdp with initial impulse normalized to 1% of average gdp. Unless mentioned otherwise, we provide one standard deviation confidence intervals that are computed using a bootstrap algorithm with 1000 replications. The solid line gives the point estimates, while the dotted lines are confidence bounds.

Insert Figure 2

the BP model produces response of output insignificant and close to zero in response to the 1% of structural tax shock . There is a negative response of output in the short run and positive in the long run in response to 1% cut of structural expenditure innovations.

We compare this impulse response with those obtained from a truncated MA in a model with plans. Plans for quarterly data are reconstructed for the US on the basis of DeVries et al. in Favero, Karamysheva(2015). In

(NIPA 3.1.8). All series are deflated by GDP deflator (NIPA 1.1.9.1) and by FRED Population (Midperiod, Thousands, Quarterly, Seasonally Adjusted Annual Rate).

the wording of R&R we consider only deficit driven plans and we adopt the following empirical model to assess their effects

$$\begin{gathered}
\Delta y_t = \alpha + B_1(L)(\tau_t^u + g_t^u) * TB_t + B_2(L)(\tau_{t,t}^a + g_{t,t}^a) * TB_t + \\
+ C_1(L)(\tau_t^u + g_t^u) * EB_t + C_2(L)(\tau_{t,t}^a + g_{t,t}^a) * EB_t + \\
+ \sum_{i=1}^{horz} D_i(\tau_{t,t+i}^a + g_{t,t+i}^a) * TB_t + \sum_{i=1}^{horz} E_i(\tau_{t,t+i}^a + g_{t,t+i}^a) * EB_t + \mathbf{u}_t \\
\mathbf{u}_t \sim N(0, \Sigma) \\
(\tau_{t,t+i}^a + g_{t,t+i}^a) * TB_t = \delta_i^{TB}(\tau_t^u + g_t^u) * TB_t + \nu_{t+i}^1, \; for \; i = \overline{1, horz} \\
(\tau_{t,t+i}^a + g_{t,t+i}^a) * EB_t = \delta_i^{EB}(\tau_t^u + g_t^u) * EB_t + \nu_{t+i}^2, \; for \; i = \overline{1, horz}
\end{gathered} \tag{19}$$

Δy_t is the growth rate of GDP (quantity index for real GDP, data source National Income and Product Accounts (NIPA) - table 1.1.3).

The specification generalizes the MA adopted by Romer and Romer by allowing different coefficients on the unanticipated expenditure, g_t^u, and revenue, τ_t^u adjustments (announced at time t and implemented at time t), on the anticipated correction currently implemented (announced before time t, and implemented at time t) $\tau_{t,t}^a, g_{t,t}^a$, and on the future corrections (announced at time t, to be implemented in the future),$\tau_{t,t+i}^a, g_{t,t+i}^a$. The length of the polynomials $B_1(L)$, $B_2(L)$, $C_1(L)$, $C_2(L)$ - is set to 6. The anticipating horizon is set by considering the median implementation lag, which is again six quarters. The MA representation is then augmented by a number of auxiliary equations that capture the nature of the plan via the correlation between the intertemporal and intratemporal component of fiscal adjustments.

EB_t and TB_t are dummies that label plans into Expenditure Based or Taxed Based according to the larger present value of the types of correction.

Results are in the form of the impulse response functions, which are obtained by forward simulation of the model. Since our dependent variable is in differences, we report cumulative impulse response functions. The length of the IRF is limited to the number of lags included into the system. One Standard deviation confidence intervals are built by bootstrap with 1000 replications . We use block bootstrap to take into account potential serial correlation in residuals, restricting the length of the block to 2. Working with the quarterly data we give a shock of 1% to the total plan. To do so we give initial shock to unanticipated component of the plan TB plan - 0.58%, and for unanticipated component of EB plan - 0.79%. Sample period is from 1978 quarter one to 2012 quarter four. Figure 3 shows the responses of output growth to the TB and EB plans.

Insert figure3

A positive shock to the tax based plan produces a significantly negative effect on the output growth. While the shock to the expenditure based plan gives a marginally significant exapnsionary effect. These results are very different from those obtained by applying the BP method on the same data-set with the difference being generated by different identification and specification strategies.

5 What Have We Learned ?

This paper represent an attempt to answer to the question "What do we know about Fiscal Multipliers?" by setting up a general "encompassing" model flexible enough to consider all the different empirical specifications adopted in the literature as specific cases that can be derived by imposing set of restrictions on the general model. This framework allows us to take into account of two crucial remarks on the empirical analysis of fiscal policy made by Ramey(2015) and Leeper(2010). First, the measurement of fiscal multipliers is a question for which dynamics are all-important, general equilibrium effects are crucial, and expectations have powerful effects. Second, multipliers depend on the type of spending or tax change, as well as on a host of other factors: expected sources and timing of future fiscal financing, whether the initial change in policy was anticipated or not, how monetary policy behaves, what is the state of cycle when the policy is implemented. There is not such a thing as a unique fiscal multiplier and the evidence obtained by a specific investigation on the multiplier can be understood only within a general dynamic framework which clearly indicates the specification and identification choices made in that investigation.

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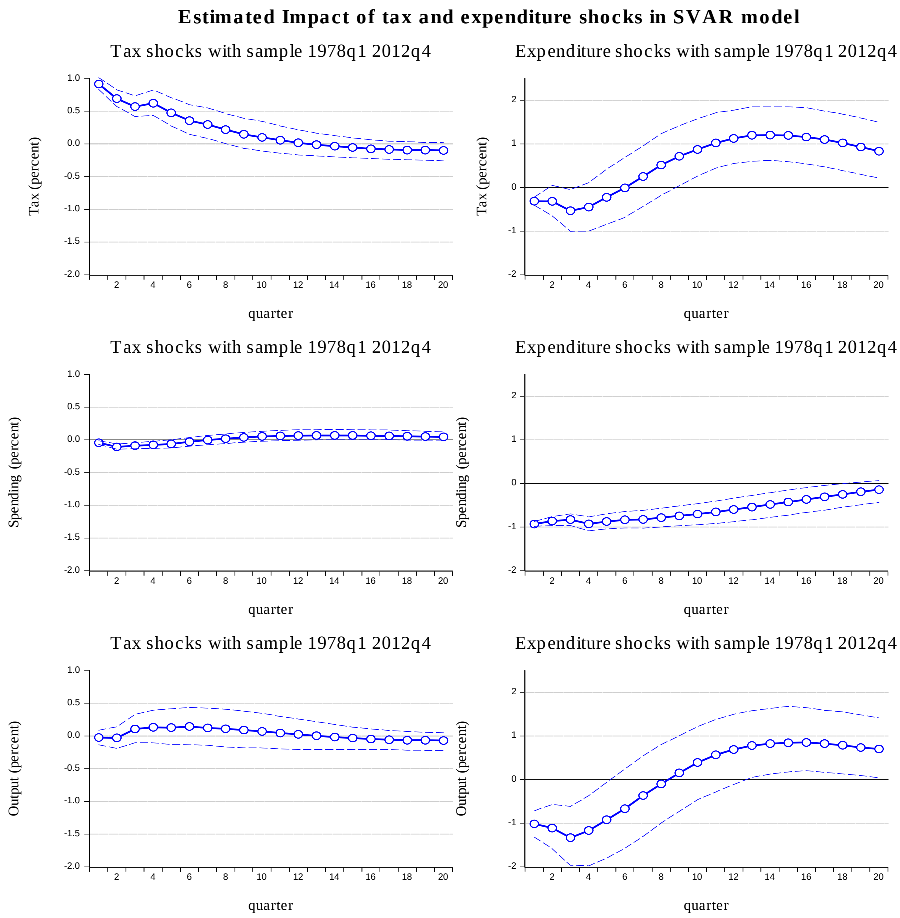

Figure 2: Impulse response functions to Tax and Spending Shocks with SVAR (Blanchard, Perotti 2002)

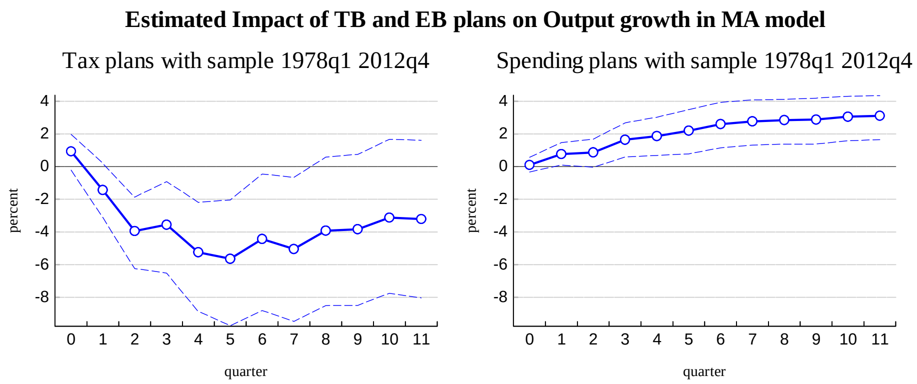

Figure 3: Impulse response function of output growth using truncated moving average with plans (Favero, Karamysheva 2015)