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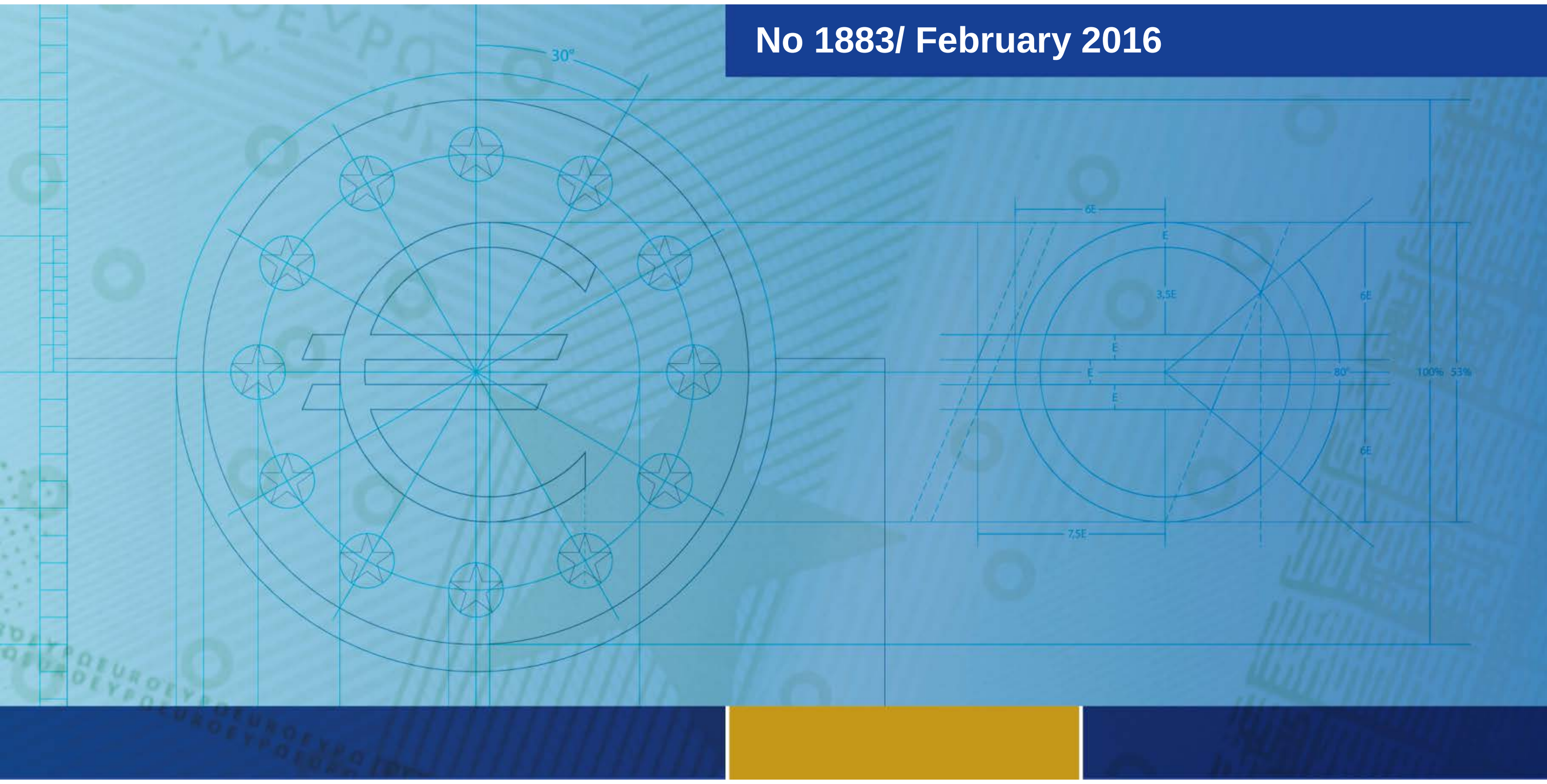
Is fiscal consolidation self-defeating?

A panel-VAR analysis for the euro area countries



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Abstract

This paper studies the effects of fiscal consolidation on the debt-to-GDP ratio of 11 Euro area countries. Using a quarterly fiscal Panel VAR allows us to trace out the dynamics of the debt-to-GDP ratio following a fiscal shock and to disentangle the main channels through which fiscal consolidation affects the debt ratio. We define a fiscal consolidation episode as self-defeating if the debt-to-GDP ratio does not decrease compared to the pre-shock level. Our main finding is that when consolidation is implemented via a cut in government primary spending, the debt ratio, after an initial increase, falls to below its pre-shock level. When instead the consolidation is implemented via an increase in government revenues, the initial increase in the debt ratio is stronger and, eventually, the debt ratio reverts to its pre-shock level, resulting in what we call self-defeating austerity.

JEL classification: E62, H6, C33

Keywords: Fiscal consolidation, Debt trajectory, Panel VAR, Fiscal stress

Non-technical summary

Since the start of the sovereign debt crisis, in early 2010, many Euro area countries have adopted fiscal consolidation measures in an attempt to reduce fiscal imbalances and preserve their sovereign creditworthiness. Nonetheless, in most cases, fiscal consolidation did not result, at least in the short run, in a reduction in the debt-to-GDP ratio whereas economic growth turned out weaker than expected. Against this background, calls for a more temperate approach to fiscal consolidation have increased on the ground that the drag of fiscal restraint on economic growth could lead to an increase rather than a decrease in the debt-to-GDP ratio, as such fiscal consolidation may turn out to be self-defeating. In particular, the fall in the GDP growth rate which follows a consolidation episode, would lead to an increase in the debt-to-GDP ratio not only via a denominator effect, but also via a numerator effect (i.e. adverse cyclical effects which, at least partially, offset the primary balance improvement generated by the consolidation effort).

The aim of this paper is to investigate the effects of fiscal consolidation on the general government debt-to-GDP ratio in order to assess whether and under which conditions self-defeating effects are likely to materialise and whether they tend to be short-lived or more persistent over time. We do so for a sample of Euro area countries for the period 2000Q1-2012Q1 using a panel VAR approach to which, following Favero and Giavazzi (2007), we add the government budget constraint. The main advantage of this approach is that it allows us to reconstruct the debt trajectory following a fiscal shock and to disentangle the main channels though which consolidation affects the evolution of debt in both the short and the long run. To our knowledge, this is the first paper to apply a debt-augmented panel VAR approach to a sample of Euro area countries and to explicitly account for the role of the composition of consolidation on the debt dynamics. In particular, the explicit reconstruction of the debt trajectory following a fiscal shock is another important contribution of our paper to the VAR literature on the macroeconomic effects of fiscal consolidations.

The main finding of our analysis is that following a fiscal consolidation episode, the debt-to-GDP ratio increases initially, for a period up to four quarters, and then starts to decline. The size and length of the initial debt increase depend on the composition of consolidation. In the case of revenue-based consolidations the increase in the debt-to-GDP ratio tends to be larger and to last longer than in the case of spending-based consolidations. The composition also matters for the long term effects of fiscal consolidations. Spending-based consolidations tend to generate a durable reduction of the debt-to-GDP ratio compared to the pre-shock level, whereas revenue-based consolidations do not produce any lasting improvement in the sustainability prospects as the debt-to-GDP ratio tends to revert to the pre-shock level.

The findings of our analysis are of particular policy relevance in the context of the ongoing debate about the merits of fiscal consolidation as the main tool to restore debt sustainability in the Euro area countries. They suggest that short term considerations, related to the detrimental impact of consolidation on growth and on the debt-to-GDP ratio, need to be weighed against the long term benefits of a rebound in output growth and a durable reduction in the debt-to-GDP ratio. This strategy is more likely to succeed when the consolidation strategy relies on a durable reduction of spending, whereas revenue-based consolidations do not appear to bring about a durable improvement in debt sustainability. Moreover, delaying fiscal consolidation until financial markets pressures threaten a country's ability to issue debt, may have a cost in terms of a less sizeable reduction in the debt-to-GDP ratio for given consolidation effort, even if it is undertaken on the spending side. This is an important policy lesson also in view of the fact that revenue-based consolidations tend to be the preferred form of austerity, at least in the short run, given also the political costs that a durable reduction in government spending entail.

1 Introduction

The start of the sovereign debt crisis, in early 2010, and the growing tensions in the sovereign debt markets have compelled several Euro area countries to take action in an attempt to reduce fiscal imbalances and preserve their sovereign creditworthiness. Nonetheless, in most of the countries which have undergone significant, and sometimes unprecedented, efforts to correct fiscal imbalances, fiscal consolidation did not result, at least in the short run, in a reduction in the debt-to-GDP ratio whereas economic growth turned out weaker than expected. Against this background, many authors and observers (e.g., Batini et al. (2012), IMF (2012)) have argued in favour of a more temperate approach to fiscal consolidation since the drag of fiscal restraint on economic growth could lead to an increase rather than a decrease in the debt-to-GDP ratio, as such fiscal consolidation may turn out to be self-defeating. In particular, the fall in the GDP growth rate which follows a consolidation episode, at least in the short run, would affect the debt-to-GDP ratio not only via a denominator effect, but also via a numerator effect. The intensity of the latter depends crucially on the size of the automatic response of fiscal policy to a decline in GDP growth (i.e. so-called automatic stabilisers) which offsets, at least partially, the positive impact of a fiscal consolidation on the primary balance. In this regard, the net effect on the debt ratio depends not only on the size of the fiscal multiplier (which measures the change in output following a reduction in the deficit) but also, among other factors, on the size of the automatic stabilisers in the economy.[1] Moreover, should market interest rates increase in reaction to a fiscal consolidation episode and its growth implications, the debt-to-GDP ratio could increase also via this channel[2] (Boussard et al. 2012).

The aim of this paper is to investigate the effects of a fiscal consolidation on the general government debt-to-GDP ratio in order to assess whether and under which conditions self-defeating effects are likely to materialise and whether they tend to be short-lived or more persistent over time. We do so for a sample of Euro area countries for the period 2000Q1-2012Q1 using a panel VAR approach to which, following Favero and Giavazzi (2007), we add the government budget constraint. The main advantage of estimating a debt augmented fiscal VAR is that it allows to trace out the dynamics of the debt-to-GDP ratio while accounting for the simultaneous effects of consolidation on GDP growth, the primary balance and the government interest rate. Moreover, the framework is able to take into account the debt

[1] The size of the automatic stabilisers is usually proxied by the share of government spending on GDP, for a more formal treatment of the effects of consolidation on the debt ratio see European Commission 2012.

[2] Regardless of the reaction of interest rates to fiscal consolidation, interest payments would increase if the debt ratio increases following a fiscal consolidation episode.

feedback effects, allowing the endogenous variables in the VAR to respond to changes in the debt-to-GDP ratio, as the fiscal rules theory (e.g. Bohn (1998)) suggests. To our knowledge, this is the first study to apply a debt-augmented panel VAR approach to a sample of Euro area countries and to explicitly account for the role of the composition of consolidation on the debt dynamics. In particular, the explicit reconstruction of the debt trajectory following a fiscal shock is another important contribution of our paper to the VAR literature on the macroeconomic effects of fiscal consolidations. In this literature, most of the issues related to the debt sustainability implications of fiscal consolidations have been largely left unaddressed. In fact, the effects of fiscal consolidations on the debt-to-GDP ratio have typically been investigated in the context of the literature on successful fiscal consolidations whose aim is to identify under which conditions a discretionary fiscal policy action is more likely to lead, among other things, to a reduction in the debt-to-GDP ratio compared to the pre-consolidation period. These studies typically use logit or probit specifications to evaluate the probability of successful consolidations (e.g. Alesina and Perotti (1995)). Although intuitive, this framework does not accurately account for the channels through which fiscal consolidation may affect the debt-to-GDP ratio, namely the implications for growth and the primary balance.[3]

The main finding of our analysis is that following a fiscal consolidation episode, the debt-to-GDP ratio increases initially, for a period up to four quarters, and then starts to decline. The size and length of the initial debt increase depend on the composition of consolidation. In particular, in the case of revenue-based consolidations, the increase in the debt-to-GDP ratio tends to be larger and to last longer than in the case of spending-based consolidations. The composition also matters for the long term effects of fiscal consolidations. Spending-based consolidations tend to generate a durable reduction of the debt-to-GDP ratio compared to the pre-consolidation level, whereas in a revenue-based consolidation the debt-to-GDP ratio tends to revert to the pre-consolidation level without producing any lasting impact in terms of improved sustainability prospects. These findings are driven by two factors: a more pronounced fall in output (denominator effect) and a more subdued improvement in the primary balance (numerator effect) in the case of a revenue-based consolidation compared to a situation in which spending is cut. Moreover, whereas the first factor is more important in explaining the different response of debt on impact, the second one becomes more relevant in explaining the path of debt in the subsequent periods.

[3]Although the use of a VAR methodology allows us to overcome the above shortcomings, it is worth noting that one limitation of the VAR approach in studying the growth effects of fiscal shocks is that it does not allow to differentiate between the effects of contractionary versus expansionary fiscal shocks. It follows that the growth effects of fiscal shocks are treated as symmetric.

We also control for the role of the initial conditions at the time fiscal consolidation is undertaken. In particular, since most of the recent consolidation efforts have been prompted by tensions in the sovereign debt market, we include in the VAR a fiscal stress indicator. We construct this indicator as a dummy variable equal to 1 if a country's market interest rate exceeds its average implicit interest rate by a certain threshold, and equal to zero otherwise. The aim of this indicator is to control for the role of tensions in the sovereign debt markets experienced by some Euro area countries since 2010Q2 (i.e. Greece) and which were triggered by increasing fears about their fiscal sustainability. We find that fiscal consolidation efforts undertaken during a period of fiscal stress tend to be less successful in terms of achieving a sizeable reduction in the debt-to-GDP ratio compared to countries that are not confronted to such a situation. This result holds in particular for spending-based consolidations as the spending shock seems to be less persistent in the fiscally stressed countries than in the other group. On the contrary, tax based consolidations tend to produce self-defeating effects in both groups of countries.

The paper is structured as follows. Section 2 presents a review of the fiscal VAR literature, section 3 describes our estimation methodology whereas section 4 describes the data. Section 5 presents the empirical results related to our baseline specification whereas section 6 illustrates the findings when distinguishing between countries that undertake consolidation at times of fiscal stress and those that are not fiscally stressed. Section 7 presents some robustness tests and section 8 concludes.

2 The macroeconomic effects of fiscal consolidation in the VAR literature

The macroeconomic effects of fiscal policy have been intensively debated over the last decade and the theoretical and empirical studies on the size of the fiscal multipliers have grown into a large body of literature. Existing evidence, however, is far from being conclusive as available estimates of fiscal multipliers span over a broad range of values for both government spending shocks and discretionary tax changes.[4] In their seminal paper on the growth impact

[4]Boussard et al. (2012) and Coenen et al. (2012) provide a summary of the main results of both the expenditures and net-taxes multipliers in both the based on the VAR literature and the structural models literature

of fiscal consolidations, Blanchard and Perotti (2002) apply a structural VAR to a dataset for the US in the postwar period. They find consistent evidence that positive government spending shocks have a positive effect on output, whereas positive tax shocks have a negative effect. They find that fiscal multipliers are often close to one for both instruments. The size and persistence of these effects vary across specifications and sub periods. In particular, the authors find that the size of the tax multiplier drops significantly (to about 0.5) when the eighties are excluded from the sample, whereas the opposite happens to the spending multiplier (it increases to about 1.8).

Burriel et al. (2009) use a structural VAR approach to analyse the effects of fiscal policy shocks on the output of the Euro area as a whole over the period 1981-2007, using a new dataset of quarterly fiscal data developed by Paredes et al. (2009). They find that output multipliers are, in general, very similar in both areas, small and typically below unity. The authors also provide evidence that output multipliers increased steadily after 2000 in both the EMU and the US. Using the same quarterly fiscal dataset as in Burriel et al. (2009), Kirchner et al. (2010) study the evolutions of the government spending multipliers for the Euro area over the period 1980-2008, using a Bayesian time-varying VAR. The main finding of their analysis is that the effectiveness of spending shocks in stimulating economic activity has substantially decreased over time, though in a non-monotonic way. In particular, until the late 1980s short-run spending multipliers increased to reach values above unity; they started to decline afterwards reaching values close to 0.5 in the current decade. At the same time, long-term multipliers show a substantial and continuous decline since the 1980s.

Using a narrative approach for a sample of OECD countries, Alesina, Favero and Giavazzi (2012) find that adjustments based on spending cuts are less recessionary than those based on tax increases and that the former are typically associated with milder and short lived recessions. Looking at the response of different components of aggregate demand to both types of shocks, the authors find that the faster recovery in private investment after a spending-based adjustment compared to a tax based one is the factor that explains best the difference in the response of output to spending-based and tax based adjustments. The possibility that the size of the fiscal multipliers is state and time dependent has received renewed attention since the onset of the ongoing sovereign debt crisis. In particular Auerbach and Gorodnichenko (2012), using a regime-switching structural VAR model, estimate the size of both tax and spending multipliers which vary over the business cycle. They find large differences in the size of fiscal multipliers across recessions and expansions compared to the linear case, with fiscal policy being more effective in times of recessions than in expansions.

However, most of the fiscal VAR studies mentioned above abstract from the implications of fiscal shocks on the debt dynamics. As pointed out in Favero and Giavazzi (2007) for the case of the US, this is an important weakness of standard VAR models, as the debt ratio evolves over time and the possibility that taxes and spending might respond to the level of the debt is not accounted for. The omission of a feedback from the debt level to changes in other fiscal variables causes the coefficients estimated and then used to compute impulse responses to be biased. As shown by the authors, an effect of such bias is that impulse responses are computed along unstable debt paths (i.e. paths along which the debt-to-GDP ratio diverges and the intertemporal budget constraint is not satisfied). Following the work of Favero and Giavazzi (2007), several other papers incorporate public debt in a VAR framework (e.g. Burriel et al. (2009)). Nonetheless, very few studies analyze explicitly the effect on debt of a fiscal shock and no one controls for the composition of the shock and whether it matters for the resulting debt trajectory. The closest paper to ours is Cherif and Hasanov (2012). They estimate the effect of primary surplus shocks on the public debt in the US, focusing on the post-1980 sample. The authors find that the public debt ratio falls in response to a shock to the primary surplus in the first 3 years and then reverts back to its pre-shock baseline in the long run. The lower growth resulting from the consolidation episode counteracts the austerity efforts. Moreover the authors find that when controlling for the initial conditions prevailing in 2011 (i.e. weak growth, low interest rates and inflation, high deficit and rising debt), fiscal consolidation is more likely to result in an increasing debt ratio. As a result, risks to a self-defeating consolidation are higher at times of weak economic growth than in normal times.

Differently from Cherif and Hasanov (2012) we find that, in the Euro area, fiscal consolidation is likely to lead to an increase in the debt-to-GDP ratio immediately after a fiscal shock materializes. In the long run the debt-to-GDP ratio falls to below the pre-shock level if consolidation is implemented on the expenditure side, whereas it reverts to the pre-shock level in case of revenue-based consolidations. Our finding, according to which the recessionary effects of spending-based consolidations are smaller and more short lived that those associated to tax based consolidations, is in line with the finding of Alesina, Favero and Giavazzi (2012).

3 Empirical Methodology

The estimation methodology we use is a panel VAR approach. As discussed above, most of the fiscal VAR literature does not consider debt as a variable in the VAR, although this is important for at least two reasons. First of all, the evolution of the debt level following a fiscal shock might affect the response of the main fiscal variables. Governments might react to a higher level of debt by decreasing expenditures or increasing taxation, as pointed out in the fiscal rules literature.[5] Second, changes in the debt ratio may lead to an increase in borrowing costs, thus affecting interest payments and the headline fiscal balance. Therefore, as suggested by Favero and Giavazzi (2007), failure to include the debt as a variable in the fiscal VAR may lead to biased coefficient estimates which in turn lead to biased impulse response functions.

The empirical literature suggests two methodologies to include a debt feedback in a fiscal VAR. The first one is the method adopted by Chung and Leeper (2007), which derive a log-linear approximation of the present value government budget constraint and impose it as a restriction on the coefficients of the VAR. The second one is the Favero and Giavazzi (2007) approach discussed above, which adds the government budget constraint as an identity to the model and traces out debt dynamics from it. In the remainder of this paper we follow the approach in Favero and Giavazzi (2007) and we estimate the following specification:

$$Y_{i,t} = \sum_{p=1}^{P} A_p Y_{i,t-p} + \sum_{p=1}^{P} \Gamma_p d_{i,t-p} + u_{i,t} \tag{1a}$$

$$d_{i,t} = \frac{1 + i_{i,t}}{(1 + \pi_{i,t}) * (1 + \Delta y_{i,t})} d_{i,t-1} - \frac{\exp(t_{i,t}) - \exp(g_{i,t})}{\exp(y_{i,t})} \tag{1b}$$

$Y_{i,t}$ is the vector of five variables $[t_{i,t} \;\; g_{i,t} \;\; y_{i,t} \;\; i_{i,t} \; \pi_{i,t}]$, expressed in logarithm, which include government total revenues $t_{i,t}$, expenditures $g_{i,t}$, output $y_{i,t}$, the implicit interest rate on outstanding government debt $i_{i,t}$ and inflation $\pi_{i,t}$. $d_{i,t}$ is the debt-to-GDP ratio, and $u_{i,t}$ is the vector of residuals. P represents the number of lags chosen, and A_p is the time invariant matrix of coefficients relative to the p lag. Γ_p is the coefficient relative to the weakly exogenous regressor d_{t-p}. The second equation, (1b), is a deterministic equation,

[5] See Bohn (1998)

necessary to reconstruct the debt series from the endogenous variables included in the VAR. This allows us to dynamically solve the model and analyse the response of the system to a shock to either government spending or revenues. Given the relatively short quarterly time series available for many of the Euro area countries in the sample, we estimate a PVAR instead of a country by country VAR. One advantage of the panel structure of the data is that we have a larger number of observations and more degrees of freedom. Moreover, in section 6 we also control for the impact of fiscal consolidation on the evolution of the debt-to-GDP ratio when a country is confronted to a situation of stress in the sovereign debt market. This would have not been possible by focusing on individual countries separately.[6] The panel VAR is estimated with OLS fixed effects. However, as a robustness check in section 7 we also use the Mean Group Estimator suggested by Pesaran and Smith (1995) which yields very similar results, lending support to our conclusions.

As the aim of the paper is to understand the effects of a consolidation episode on the evolution of the debt-to-GDP ratio and to assess under which conditions this ratio increases rather than decreases following a fiscal consolidation episode, it is insightful to look at the debt accumulation equation (2). In a more compact way ($1b$) can be written as:

$$d_t = \underbrace{\frac{1+i_t}{1+\Delta y_t^{nominal}} d_{t-1}} - \underbrace{\frac{T_t - G_t}{Y_t}} \tag{2}$$

The first part of the right hand side of the equation is the so called *snowball effect*. The second one is the *primary balance effect,* as $\frac{T_t - G_t}{Y_t} = pb_t$. Suppose the government reduces its expenditures by 1% of GDP. Will this imply a reduction in the debt-to-GDP ratio d_t by an equal amount? The answer is no. The reason for this is that the debt reducing effect of lower primary spending can be offset by two additional channels. The first channel affects the primary balance itself. Indeed, the primary balance pb can be decomposed as the sum of the cyclically adjusted primary balance ($capb$) plus the cyclical component(cc), such that $pb = capb + cc$. A fiscal consolidation of 1% of GDP (either on the spending or revenue side) is a 1% improvement in the $capb$. At the same time, however, the negative output effect of lower spending (or higher revenues) induces a deterioration in the cyclical component of the primary balance cc, via the so-called automatic stabilizers which operate via lower tax revenues (or higher spending) thus offsetting the positive effects of a decrease in spending. Therefore, the overall impact of a fiscal consolidation on the primary balance is milder.

[6] A possible solution to these problems could be using Bayesian VAR. We plan to do so in future research.

Following the calculations in European Commission (2012), the improvement in pb following a 1% increase in $capb$ can be approximated by $(1 - \epsilon\hat{M})$, where ϵ is the budget balance semi-elasticity and $\hat{M}$ is the adjusted fiscal multiplier, i.e. $\frac{\frac{\partial Y}{Y}}{\partial capb}$, the percentage variation of GDP over a unitarian increase in $capb$. The second channel works via the snowball effect. The fall in economic activity following the fiscal consolidation episode is represented by a lower g_t which, for a given implicit interest rate on outstanding debt and a given debt-to-GDP ratio in $t-1$, causes the first term in the right hand side of equation (2) to grow faster. After some algebraic manipulation of the debt accumulation equation it is possible to find the condition the adjusted fiscal multiplier must satisfy in order to prevent an increase of debt-to-GDP ratio on impact.[7]

$$\hat{M} < \frac{1}{d_{t-1}(1+g)+\epsilon} \tag{3}$$

For illustrative purposes, let's assume an elasticity of tax revenues to output $\epsilon = 0.5$ and $d_{t-1} = 120\%$ and $g = 0.02$, the above formula yields a value of the adjusted fiscal multiplier of 0.58: any value of the multiplier above this level leads to an increase rather than a decrease in the debt ratio on impact, hence to a self-defeating consolidation.[8,9]

Against the background of the interactions described above between the debt-to-GDP ratio and fiscal policy shocks, the use of a VAR methodology augmented with the debt accumulation equation represents a very suitable tool to account for these interactions, their relative magnitudes, and their impact on the evolution of debt.

3.1 Identification strategy and Inference

A central issue in the fiscal VAR literature is the strategy used to identify the structural shocks. Equation (1a) is a reduced form, and we need to impose $\frac{N*(N-1)}{2}$ restrictions in order

[7]For more details on the precise derivation of this result please see European Commission (2012).

[8]The standard fiscal multiplier, by definition, is $M = \frac{\partial Y}{\partial(T-G)}$. The relationship between M and $\hat{M}$ is the following, $\hat{M} = \frac{M}{1+capbM}$. This formula allows deriving the standard fiscal multiplier from equation 3.

[9]Another channel through which fiscal consolidation might affect the evolution of debt ratio is the interest rate.If the interest rate on government borrowing falls (raises) after a consolidation episode, this movement will progressively feed into the effective interest rate thus counteracting (reinforcing) the negative effect of a lower output growth thus causing the debt ratio to grow at a slower (faster) pace. The above derivation, however, abstracts from this effect .

to identify the system. What we are interested in is the structural form

$$AY_{i,t} = \sum_{p=1}^{P} A'_p Y_{i,t-p} + \sum_{p=1}^{P} \Gamma'_p d_{i,t-p} + B\varepsilon_{i,t}$$

In particular we want to identify two types of shocks: a spending shock and a tax revenue shock. To this purpose we use the sign restrictions approach developed by Canova and De Nicoló (2002). The use of sign restriction is motivated by the need to overcome a well-documented (though counterintuitive) result in the VAR literature, namely that output grows following a positive tax shock.[10] The use of sign restrictions allows us to impose that the response of output to a positive tax shock must be negative, overcoming the problem outlined above. At the same time we impose a positive response of output to a (positive) expenditure shock.[11,12] We can think of the residual $u_{i,t}$ as a linear combination of the true structural shocks $\varepsilon_{i,t}$, $u_{i,t} = B\varepsilon_{i,t}$. From the covariance matrix $\sum = E(u_{i,t}u'_{i,t}) = E(B\varepsilon_{i,t}\varepsilon'_{i,t}B)$ we can recover $\frac{N*(N+1)}{2}$ restrictions, while the remaining $\frac{N*(N-1)}{2}$ need to be imposed. This is achieved first through a Choleski decomposition. Then, sign restrictions[13] narrow down the set of acceptable B by restricting the sign of the impact response of the variable to a structural shock.[14]

The set of restrictions that we impose is summarized in Table 1.

[10] The measure of government revenues and spending we use in our VAR is a total measure, as such the variables $g_{i,t}$ and $t_{i,t}$ include also those components whose behaviour depends on the cycle (i.e. they are endogenous).

[11] In order to identify unambiguously the two shocks, we impose that tax revenues respond positively to a spending shock. This can be justified arguing that an increase in spending raises GDP and thereby increases taxable income and tax revenues.

[12] An issue in the identification of fiscal shocks has been recently highlighted by Ramey (2011). The author argues that government spending shocks estimated by the econometrician in SVAR models are likely to be anticipated, and that this can lead to spurious findings. To test for the presence of this effect, Ramey (2011) runs Granger-Causality tests to study whether government spending forecasts from the Survey of Professional Forecasters have any predictive power for the spending shocks estimated in the model. However, this information is not available at quarterly frequency for the Euro area countries and we cannot perform such test. We rely on the result of Perotti (2011), which shows that fiscal foresight does not alter the results of SVAR models.

[13] We impose the restrictions on impact only

[14] The exact procedure we follow is the following: we orthogonalize the residual matrix through a Choleski decomposition, obtaining a matrix Σ_0. We then draw a matrix X from a random orthonormal distribution. We apply the QR decomposition to matrix X, in order to obtain $X = Q * R$. We multiply $Q * \Sigma_0$ and we call it S. If S satisfies the sign restriction we imposed, we calculate the IRFs using S as our identified structural matrix and we store the results. We then repeat the procedure 10.000 times.

Table 1. Sign restrictions

Response	G	T	Y
G shock	+	+	+
T shock	?	+	-

Table 1 reports the sign restrictions imposed to identify the spending shock and the tax revenue shock

The uncertainty of the identification strategy, together with parameters uncertainty, is then used to construct the confidence bounds for the impulse response functions, as we explain later.

3.2 Lag structure

To determine the number of lags to include in the main specification of the model, we conduct various specifications tests. The Hannan-Quinn and Schwarts information criteria suggest to use 4 lags. The Schwarts criterion instead suggests 1 lag. To decide between these options we simulate the VAR in a pseudo out-of-sample fashion; the preferred number of lags is the one that produces the lowest RMSE.[15] Table 2 below reports the RMSE for different lag lengths. Since the model with 4 lags behaves better than the one with 2 lags and 1 lag, we select it as our baseline specification. Nonetheless, as shown in section 7, the main results of the paper are robust to different choices in the lag structure.

Table 2. Out-of-sample RMSE

	G	T	Y	i	π
RMSE 1 lag	0.0176	0.0134	0.0065	0.0005	0.0020
RMSE 2 lags	0.0119	0.0144	0.0055	0.0005	0.0018
RMSE 4 lags	0.0109	0.0124	0.0051	0.0004	0.0018

Table 2 reports the RMSE obtained simulating the model in a pseudo out-of-sample fashion

[15] To be more precise, we simulate the model out of sample, 1 step ahead

4 The data

We use quarterly data for eleven Euro area countries,[16] over the period 2000Q1-2012Q1.[17] The use of data at quarterly frequency allows us to assume that there are implementation lags in the response of fiscal policy to the cycle (i.e. fiscal policy cannot respond to changes in the cycle within the same quarter but only with a lag of one quarter).[18] We can thus apply first a Choleski structural decomposition and after the sign restriction approach outlined in section 3.1. We use EMU countries' data for two reasons. First of all the main focus of the paper is to understand the effects of fiscal consolidation in Europe, which is now at the center of the debate about debt reduction. Second, EMU countries have a common monetary policy, so we can better disentangle the effects of fiscal policy from the interactions with monetary policy. y_t is GDP, t_t is total tax revenues, and g_t is total government expenditure minus interest payment expenses.[19] The difference between t_t and g_t represents the primary balance. All variables are in real terms, deflated using the GDP deflator. i_t is the implicit interest rate, calculated as interest payments at time t over total stock of debt at time $t-1$. We use the implicit interest rate instead of the market interest rate because we need to be able to reconstruct the debt level from the primary surplus and the other variables present in the debt accumulation equation. The implicit interest rate can be seen as a moving average of the market interest rates, where the length of this moving average process depends on the average duration of public debt. π_t is inflation, calculated as first difference of the GDP deflator. Finally, d_t is the debt-to-GDP ratio at time t. All data are seasonally adjusted by the source. Only Greece, starting from 2011Q1 presents data NSA. In this case only we perform ourselves the seasonal adjustment, using the X11 procedure.

[16] The countries are Austria, Belgium, France, Finland, Germany, Greece, Ireland. Italy, Netherlands, Portugal and Spain.

[17] Since 1995 Eurostat started to collect quarterly data according to the ESA95 procedure. This makes us confident that the series we are using are not the result of interpolation from annual series, and thus they represent genuine quarterly data.

[18] Although the use of quarterly data for the Euro area countries has been challenged as Euro area budgetary plans are prepared following an annual budgetary cycle, a recent strand of the literature has shown that intraannual fiscal data contains valuable and useful information, e.g. Prez (2007) and Onorante et al (2009).

[19] y_t, t_t and g_t are real, per capita, and in natural logarithm.

4.1 Recovering Debt

As discussed in section 3, in our estimation framework the debt-to-GDP ratio at time $t-1$ is included as a weakly exogenous regressor in the VAR. Its trajectory is then reconstructed using a deterministic equation which includes the primary balance, the output growth rate, the implicit interest rate and the rate of inflation (equation 1b in section 3). In order to be able to use this framework correctly we need to check that the debt series obtained through the deterministic equation match the actual values as close as possible. In Figure 1 we plot the two series, the actual and the simulated debt-to-GDP ratio. In most of the cases the two match almost perfectly. Only for some countries the simulated and the actual debt series diverge. This is the case of Finland, Ireland and Greece for which the discrepancies are quite large. The main reason behind these inconsistencies is the fact that the debt accumulation equation used to reconstruct the debt series assumes that the size of the stock-flow adjustment is zero, whereas in some of these countries this item can be quite sizeable especially since the onset of the financial crisis.[20] As an example, in early 2000 Finland invested its budget surplus to buy financial assets instead of paying back debt. Once we take this effect into account, we are able to reconstruct the debt series in a rather accurate way. In particular, by subtracting the (cumulated) stock-flow adjustment on consolidated gross debt series from the original debt level series we are able to derive the adjusted debt level. Dividing this by nominal GDP it is possible to recover the adjusted debt-to-GDP ratio.[21] Overall, the maximum discrepancies between the actual and the reconstructed debt series is 2%, though for many of the countries considered this difference is much lower.[22]

5 Empirical Results

This section illustrates the results of our baseline specification. As it is common in most of the VAR studies, we report our results in the form of impulse response functions. IRFs are

[20] The debt accumulation equation typically includes a third variable which is the stock-flow adjustment. Normally, in empirical applications this items is assumed to be equal to zero owing also to the difficulty to obtain reliable data at a quarterly frequency for this variable.

[21] The adjusted debt series is the variable that we use in the estimation of our debt-augmented PVAR estimation for Finland, Ireland and Greece.

[22] Ilzetzki (2011) in a similar exercise accepts simulated debt series that on average differ from the actual one by not more than 2%.

computed as follows:[23]

- we solve the model dynamically[24] generating a baseline scenario.

- we solve the model dynamically again, adding the structural shock in the first period. (Specifically, this means setting the structural shock equal to one in the first period, generating a shocked scenario).[25]

- we compute the impulse responses as the difference between the shocked and the baseline scenarios

- we compute confidence intervals using identification uncertainty and parameters uncertainty.[26]

The resulting IRFs represent the behaviour of the average country in our sample. Initial conditions matter for the dynamics of the IRFs. In this analysis we choose as initial conditions the cross country average of the latest available data in our sample, i.e. 2011Q3-2012Q1.[27] This choice reflects our willingness to evaluate the system at the current conditions, in order to have results well suited to analyse the current European situation. In the next subsection we analyse how initial conditions and the size of the shocks affect the behaviour of the model.

Results are summarized in Figure 2.[28] In the left column we report variables' responses to a

[23]Because of the non-linear debt equation, it is not possible to invert the VAR obtaining a moving average representation.

[24]This means iterating forward the model with no shock, producing an out-of-sample baseline forecast.

[25]Although our model is non-linear, we believe that the non-linear effects of the VAR residuals are not significant.Indeed, the debt equation we add to the VAR model is deterministic. As this equation has no shocks, our model is barely sensitive to non-linear effects of VAR residuals. Thereby, when calculating the IRFs, we impose that our shock is equal to 1 in the first period of the IRF calculation, and equal to o from the second period onwards.

[26]Following Sims and Zha (1999), we assume that the posterior density of the regression coefficients and the covariance matrix belongs to the Normal-Wishart family. We draw all parameters jointly from the posterior, discarding explosive draws as in Cogley and Sargent (2005). For each draw of the parameters we calculate the IRFs using sign restrictions and we save the median, the upper and the lower percentile. This gives us a number of estimates of the median, the lower and the upper percentile. As baseline, we report the median of all medians. As confidence bands, we report two different statistics. The first statistic is the 16th and 84th percentile of the distribution of the medians. In this case the error bands account for parameter uncertainty and reflect the uncertainty about the true median that comes from a limited sample size. As a second statistic we report the median of the lower and upper percentile across all parameter draws. In this case the error bands reflect identification uncertainty.

[27]Given we have 4 lags, we need 4 data points for each variables in the VAR as initial conditions

[28]In each graph, the horizontal axis represents quarters and the vertical axis the size of the shock to each variable.

negative government spending shock. The right column analyses responses to a positive tax shock. The ordering of the variables along each column is: g, t, y and d. The first panel on the left represents the evolution of the spending shock itself. As for the other panels on the left, following the shock in expenditure, tax revenues decrease on impact, dampening the positive effect of the reduction in spending on the primary balance. In the subsequent quarters taxes revert back to zero. The behaviour of output, depicted in the third panel, is fairly standard. It falls on impact and starts to recover after one year.[29] The output response implies a fiscal multiplier on the spending side of 0.41 on impact. This size of the fiscal multiplier is consistent with a standard neoclassical model, which predicts a fiscal multiplier lower than one, contrary to the classic textbook Keynesian model. This value for the multiplier is also consistent with the existing empirical literature, in particular with Perotti (2004). The most interesting result in Figure 2 concerns the evolution of the debt-to-GDP ratio (fourth panel). Following a spending shock, debt increases on impact and remains on a upward trajectory in the subsequent quarters before starting to decline after approximately one year. In the long run the resulting debt-to-GDP ratio is below the pre-shock level. This means that a fiscal consolidation, when implemented on the expenditure side, generates an effective and lasting reduction in the debt-to-GDP ratio. The initial increase in public debt can be explained by two factors: the contemporaneous decrease in tax revenues, which offsets the positive effect of lower spending on the primary balance, and the negative effect on the output growth rate. To better understand the underlying dynamics, it is useful to look again at the debt accumulation equation

$$d_{i,t} = \frac{1 + i_{i,t}}{(1 + \pi_{i,t}) * (1 + \Delta y_{i,t})} d_{i,t-1} - \frac{\exp(t_{i,t}) - \exp(g_{i,t})}{\exp(y_{i,t})}$$

In the first quarters the snowball effect, driven by the recessionary effects of the government spending shock, dominates the improvement in the primary balance. After 4 quarters, the pick-up in output growth determines a (cyclical) improvement of the primary balance which, coupled with a shrinking snowball effect, leads to a reduction in the debt-to-GDP ratio. The effects on interest rate and inflation (not reported) are not significant.

We now turn to the analysis of the consequences of a tax revenues shock. Compared to a spending shock, the tax shock is not persistent, and after a few quarters it dies out. Government expenditure reacts increasing on impact and later stabilizes. The motivation behind this behaviour could lie in the fact that our data for government spending includes

[29] The horizontal axis represents quarters

transfers, such as unemployment subsidies which, in an economic downturn, automatically increase thus driving government expenditure up.[30] The response of output to a tax shock is stronger than to an expenditure shock. On impact output decreases by more and the recovery is more gradual. The resulting fiscal tax multiplier is 0.52. This strongest fall in output, combined with the behaviour of the primary balance following the tax shock, determines a path for debt as depicted in fourth panel on the right of Figure 2. As in the case of an expenditure shock, debt increases on impact and stays on an upward trend over the first four quarters. However, compared to the expenditure shock, the increase is much larger. From the fifth quarter onwards it starts declining, slowly reverting back close to the pre-shock level (i.e. approaching zero) at the end of the time horizon considered (20 quarters).

To better visualize the debt dynamics under the two shocks as well as the driving forces behind them, Figure 3 illustrates the behaviour of the primary balance and output growth, against the evolution of the debt-to-GDP ratio in the case of an expenditure shock (left panel) as well as a tax shock (right panel). On impact, the primary balance improves for both types of shocks. As a result, at least initially, the different magnitude of the increase in debt in the case of a tax shock is due to the stronger output response compared to a spending shock. In the subsequent quarters, the behaviour of the primary balance in the two cases diverges markedly. In the case of the spending shock, the primary balance recovers to the pre-shock level fairly quickly and then remains slightly positive until the end of the horizon considered. In the case of the tax shock, the deterioration in the primary balance is much more pronounced and it recovers back to the baseline level only after approximately two years. This different behaviour in the primary balance, which is also explained by the more dynamic recovery in the output level in the case of a spending shock, explains the more favorable evolution of debt-to-GDP ratio in the longer run in the case of spending-based consolidations.[31]

From the baseline scenario it is clear that there is a difference between a fiscal consolidation implemented on the revenue side and one implemented on the expenditure side. The former is successful in the objective of reducing the debt burden: after an initial increase in the first few quarters, debt starts to decrease and settles to a lower level than the baseline in the long run. The latter instead is more recessionary and leads to self defeating effects of

[30]Another explanation relies on political economy arguments. When a government implements a tax increase, it feels less pressure on the spending side. It might thus react increasing public expenditure to counter act the negative effect of increased taxation.

[31]A similar conclusion can be drawn from Figure 4, which illustrates the behaviour of the primary balance and output growth, for the 1 lag specification.

fiscal consolidation, as the level of debt increases for a longer period and does not manage to attain a significant reduction in the long run.

5.1 Initial conditions and size of the shock

As our model is non-linear, in theory the results presented so far could be highly dependent on the choice of the initial conditions and on the size of the shocks chosen when computing the IRFs. In this section we study how the results change when using different initial conditions and sizes of the shocks. In order to do this, we implement two sets of experiments. In the first one we change the size of the shocks, holding constant the baseline initial conditions. In the second one, we change the initial conditions, holding constant the size of the shocks.

From the first set of experiments it emerges that the size of the shocks impacts linearly on the results. Doubling the size of the shocks, the scale of the IRFs doubles. Figures 5, 6, and 7 report the IRFs calculated using three different sizes of the shocks.[32] Compared to the baseline (Figure 2), results are virtually the same once the different scaling is taken into account.

From the second set of experiments it emerges that initial conditions have a minor non-linear impact on the shape and magnitude of the IRF. We choose the alternative initial conditions as to represent a few possible economic conditions a country might face. We consider initial conditions that represent a country facing poor economic condition (low GDP, high interest rate, high debt-to-GDP ratio, high spending, low tax revenues) and initial conditions representing a country that faces good economic conditions (high GDP, low debt-to-GDP ratio, low interest rate, low spending, high tax revenue).[33] Results (Figure 8 and 9) are not substantially different across different initial conditions, as the shape of the IRFs is similar. However, different initial conditions have an impact on the magnitude of the increase in the trajectory of the debt-to-GDP ratio. In particular, our results show that if consolidation is undertaken under poor economic conditions, the decline in the long run debt-to-GDP ratio following consolidation is lower compared to a situation of good economic conditions. Finally, we test the influence on the results of each single variable as initial condition. We produce the IRFs changing just one initial condition at the time with

[32]The sizes of the shocks used to generate Figure 5, 6 and 7 are, respectively, 0.5, 2 and 0.2 times as big as the shocks in the baseline scenario.

[33]In our experiments, "high" and "low" are represented by the variable being 50% higher (lower) than the baseline level

respect to the baseline case. The initial level of debt is the only variable that influences the results, while the other variables do not play a significant role. Figure 10 and 11 report the IRFs calculated starting respectively from a high initial level of debt and from a low level of debt. When the starting level of debt is high, the self-defeating effect of fiscal consolidation (whether implemented through spending or through taxation) is bigger than in the baseline scenario. When the system starts from a low level of debt, fiscal consolidation is more self-defeating, compared to the baseline scenario, in case of a tax shock.

The two sets of experiments suggest the influence on our results of the initial conditions and the size of the shock is, at best, modest.

6 Controlling for fiscal stress

In this section we study whether the behaviour of the debt-to-GDP ratio after a fiscal shock differs when a country undertakes fiscal consolidation in a period of fiscal stress. The construction of our fiscal stress index is described in the following subsection whereas here we explain the methodology used to incorporate such an indicator into the fiscal VAR. Following Ilzetzki et al (2011), the construction of such an indicator amounts to splitting the sample according to whether a country is in a situation of fiscal stress or not. Once we construct this time varying index we interact it with the regressors and we add the index to the set of regressors. In this way we can account for the possible different slope and different intercept when the index is equal to one and when it is equal to zero. The regression we estimate is then :

$$Y_{i,t} = \sum_{p=1}^{P} A_p Y_{i,t-p} + \sum_{p=1}^{P} \Gamma_p d_{i,t-p} + D_{i,t} + \sum_{p=1}^{P} D_{i,t} A_p^D Y_{i,t-p} + \sum_{p=1}^{P} D_{i,t} \Gamma_p^D d_{i,t-p} + u_{i,t}$$

where $D_{i,t}$ is our index, A_p^D and Γ_p^D the coefficient relative to the interacted variables. The coefficient matrices A_p and Γ_p describe the dynamics for the non dummied countries, while $\overline{A_p} = A_p^D + A_p$ and $\overline{\Gamma_p} = \Gamma_p + \Gamma_p^D$ describe the dynamics for the dummied ones. Similarly for the constant term.

In this way we capture the difference, if any, between the average dummied country and the average non-dummied country. To save degrees of freedom, we use the one lag specification throughout the whole section. For this reason the results we obtain in this section are not directly comparable with the ones provided in the baseline with Figure 2. For comparison purposes, Figure 17 in the Appendix reports the baseline results when one lag is used.

In the next subsection we explore whether there are substantial differences in the behaviour of fiscally stressed countries with respect to non fiscally stressed countries.

6.1 Fiscal Stress

We define fiscal stress as a situation in which the market interest rate on 10-year government bonds (i.e. the secondary market interest rate) exceeds the implicit interest rate on outstanding government debt by a certain threshold. The aim of this measure is to account for those situations in which tensions in a sovereign's bond market may hinder its capacity to refinance outstanding debt or to issue new debt. Fiscal consolidation then becomes the main tool to restore sovereign creditworthiness and return to a normal functioning of the bond market. The purpose of our analysis is to assess whether these specific circumstances affect the findings of the previous section on the impact of consolidation on the evolution of the debt-to-GDP ratio. In our view this issue is of particular policy relevance as it resembles quite closely the developments in some Euro area countries since early 2010.

Most of the existing studies control for the role of initial conditions by looking at the initial debt-to-GDP ratio and whether this is above a certain threshold. This is often used as a measure of fiscal stress, with the debt threshold usually set at 90 per cent of GDP.[34] According to this criterion, countries like Italy and Greece would always be considered fiscally stressed in our sample, although until at least mid-2009 financial markets did not significantly differentiate these countries from countries with a lower debt-to-GDP ratio. At the same time, Spain would not be classified as being fiscally stressed, as its debt-to-GDP ratio was below 90%, despite the country having experienced significant bond market pressures.[35] Given these issues, we decide to define fiscal stress in the following way. For

[34]Perotti (1999), Corsetti et al (2011), Ilzetzki et al (2011)

[35]An alternative definition of fiscal stress is found in Burriel et al. (2009). They include the growth rate of the debt-to-GDP ratio in their VAR to control for fiscal stress and potential non-linearities.

every country, in each quarter we compute the difference between the market interest rate (10 years government bond) and the implicit interest rate. Whenever this difference is at least one standard deviation above its average value, we consider the country to be in a situation of fiscal stress and our index takes the value of 1. Otherwise the index takes the value of 0. Applying this measure to the sample of countries under consideration, we find that the subsample of fiscally stressed countries includes Greece, Ireland, Italy, Portugal and Spain over different time periods, starting from 2010Q2. Figure 12 reports the financial stress index for Spain, Italy and Greece.

Figure 13 illustrates the IRFs when including the fiscal stress indicator in our PVAR and compares the effects of a reduction in government spending in countries that undertake fiscal consolidation at time of fiscal stress (FS, on the left) and in those that are not fiscally stressed (NFS, on the right) according to our indicator. There are significant differences between the two groups of countries already in the pattern of the shocked variable. Indeed, the spending shock is much more persistent in the NFS countries, whereas in FS countries the initial reduction in primary spending is almost immediately reversed. In both groups of countries tax revenues fall in response to the spending shock, although in the NFS group the decline on impact is much larger. This is the consequence of a stronger fall in output in response to the spending shock in this group of countries. The larger response of economic activity to spending cuts in NFS countries might look difficult to interpret, as in principle one would assume that a country under financial markets pressure is also a country whose growth performance is weak and close to a recession. Since in the latter case the multiplier is thought to be higher than in normal times, one would also expect a more recessionary impact of fiscal consolidation in the group of fiscally stressed countries. In our case, however, the two situations do not always coincide. For many of the quarters in which the countries are considered as fiscally stressed according to our index, economic growth has been low but remained in a positive territory. Moreover, another factor that could explain the smaller multiplier in FS compared to NFS countries is the behaviour of the implicit interest rate. Although it is not statistically significant, the implicit interest rate of FS countries decreases on impact, whereas it increases in the other group. This result could be interpreted as evidence of favourable "confidence effects" materializing in the fiscally stressed countries that implement an expenditure based consolidation (i.e. the risk premium these countries pay to borrow from the financial market falls because the (perceived) default probability decreases). Given that the implicit interest rate is a moving average (which depends on the average debt maturity), it is plausible to assume that the actual effect of an expenditure shock on the market interest rate would be even higher. On the contrary, in the NFS countries, the implicit interest rate remains unchanged on impact and it increases in the subsequent quarters. This increase could be explained by a shift in the maturity structure of government debt as governments may try to lengthen the duration of their outstanding debt in order to reduce their refinancing risk. Finally, we consider the effect of the spending shock on the debt-to-GDP ratio. In the fiscally stressed countries the debt ratio decreases on impact. This initial decrease is quite steep and in the long run the debt ratio converges to a lower level than the pre-shock one. In the non fiscally stressed countries, the debt ratio increases almost imperceptibly on impact, before starting to decrease steadily to a much lower long run level compared to the pre-shock situation. The different response on impact of the debt-to-GDP ratio across the two groups of countries is due to the different responses of output and interest rate, which are more favorable in the case of stressed countries. In the long run, however, these positive effects die out, and the higher persistence of the fiscal shock in the NFS countries dominates.

Figure 14 reports the results following a tax shock, again for FS countries (left) and NFS (right). The response of output does not differ substantially across the two groups: it falls on impact and it does not revert to the pre-shock level in the long run. The evolution in the debt ratio is also qualitatively similar. In both cases we have self-defeating effects. However, for the group of fiscally stressed countries, debt increases more on impact and takes longer to revert to a downward path, without falling below the pre-shock level in the long run. This is due to a less favorable behaviour in the primary balance for fiscally stressed countries, driven by the strongest increase in spending after the tax shock.

What stands clear from Figure 13 and 14 is again, that a fiscal consolidation is more successful in reducing the debt burden when it is implemented on the expenditure side. Moreover, it is more effective, in the sense of being able to reduce more the long run debt-to-GDP ratio, when it is implemented in a period of non fiscal stress. In a period of fiscal stress it will have some immediate positive effects, but in the long run debt will decrease less. In order to be confident that the dynamics highlighted above are due to the fiscal crisis and not to the average behaviour of the countries included in the two groups, we provide the results for the two groups of countries over the whole sample period. Figure 15 and 16 in the appendix present the results. The dynamics for the two groups of countries are qualitatively similar at least in the case of a spending shock and in what concerns the response on impact of output and the long run reduction in the debt-to-GDP ratio achieved in both groups. This gives strength to the hypothesis that the results found in this section are actually due to a different behaviour for the countries that enter a period of fiscal stress.

7 Robustness checks

In this section we perform some robustness checks. We first check whether the use of a different number of lags affects the results of our baseline specification. In VAR analysis, results can change dramatically with the adoption of a different number of lags. Figure 17 reports the results for the specification with 1 lag. The effects of a negative spending shock are depicted on the left side, and those of a tax shock are on the right side. It is reassuring that the results of our baseline specification (i.e. four lags) still hold for the one lag case, in spite of less rich dynamics. In the long run the debt ratio decreases much more after an expenditure shock than after a tax shock, and the debt that starts declining already one quarter after the spending shock. For the revenue shock we observe a rise of debt on impact. The level of debt falls below the initial level only after twelve quarters. The output multipliers are basically the same as in the 4 lags case. Figure 18 reports the results for the two lags case, confirming the results we already commented.

Second, we control for the robustness of our results to the estimation technique. A particular concern is whether the OLS fixed effect estimator is a consistent estimator. Pesaran and Smith (1995) show that this estimator is in fact inconsistent if there is slope heterogeneity in a panel framework. To overcome this problem they propose an alternative estimator, called the Mean Group Estimator. This estimator takes into account the possible difference in the dynamics of the single countries. It basically assumes that the coefficient matrices in regression (1a) are country-specific, i.e. $A_{i,p} = A_p + \varepsilon_{i,k}$ where A_p is the average coefficient matrix and $\varepsilon_{i,k}$ captures the country specific variation. Figure 19 reports the results obtained using the mean group estimator. The results are very similar to those obtained using the fixed effect estimator, thus confirming the robustness of our findings.

Finally, we control for the effect of the financial crisis of 2008 by restricting the estimation period to 2000Q1-2007Q2. Figure 20 reports the results. For both the expenditure and the revenue shock the debt ratio takes more time to decrease, and decreases by less in the long run. The tax shock appears to be self-defeating across all the time horizon considered, while the expenditure shock brings a reduction in debt after the first few quarters. Overall the main conclusion of our baseline specification remains valid, namely that a fiscal consolidation is more effective in reducing the debt ratio in the long run when implemented through a reduction in expenditure side as opposed to an increase in revenues.

8 Conclusions

In this paper we analyse the effects of a fiscal consolidation on the behavior of the debt-to-GDP ratio for a panel of Euro area countries, over the period 2000-2012 using a PVAR estimation technique with sign restrictions. Although based on a different estimation framework, the findings of our analysis are in line with those of the literature on successful consolidation, namely that the composition of fiscal consolidation matters and that a durable reduction in the debt-to-GDP ratio is more likely to be achieved if consolidation is implemented on the expenditure side, rather than on the revenue side. In particular, when fiscal consolidation is implemented via an increase in taxation, the debt-to-GDP ratio reverts back to its pre-shock level only in the long run, thus failing to generate an improvement in the debt ratio, and producing what we call a self-defeating fiscal consolidation.

When controlling for the initial conditions, and in particular for whether a fiscal consolidation is implemented during period of fiscal stress, we find that fiscally stressed countries benefit from an immediate reduction in the level of debt when reducing spending. However, the long run benefits in terms of a lower debt ratio are more sizeable for countries that are not confronted to a situation of fiscal stress. A tax shock instead produces similar detrimental effects in the two groups of countries and always leads to self-defeating effects.

The findings of our analysis are of particular policy relevance in the context of the debate on the merits of fiscal consolidation as the main tool to restore debt sustainability in the Euro area countries. They suggest that short term considerations related to the detrimental impact of consolidation on growth and on the debt-to-GDP ratio need to be weighed against the long term benefits of a rebound in output growth and a durable reduction in the debt-to-GDP ratio. This strategy is more likely to succeed when the consolidation strategy relies on a durable reduction of spending, whereas revenue-based consolidations do not appear to bring about a durable improvement in the sustainability prospects of a country. Moreover, delaying fiscal consolidation until financial markets pressures threaten a country's ability to issue debt may have a cost in terms of a less sizeable reduction in the debt-to-GDP ratio for given consolidation effort, even if it is undertaken on the spending side. This is an important policy lesson also in view of the fact that revenue-based consolidations tend to be the preferred form of austerity, at least in the short run, given also the political costs that a durable reduction in government spending entails.

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Appendix

Figure 1. Actual and simulated debt

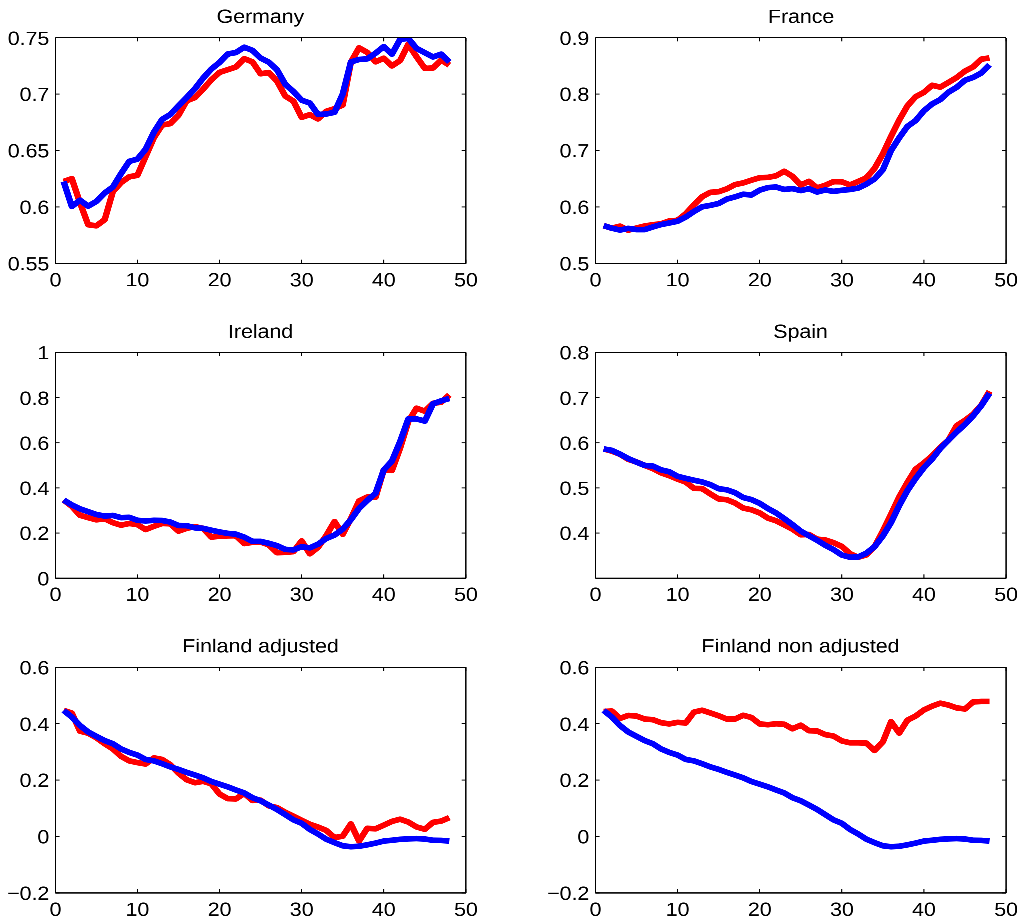

Figure 1 reports the actual debt (red line) and simulated debt (blue line)

Figure 2. Baseline: 4 lags

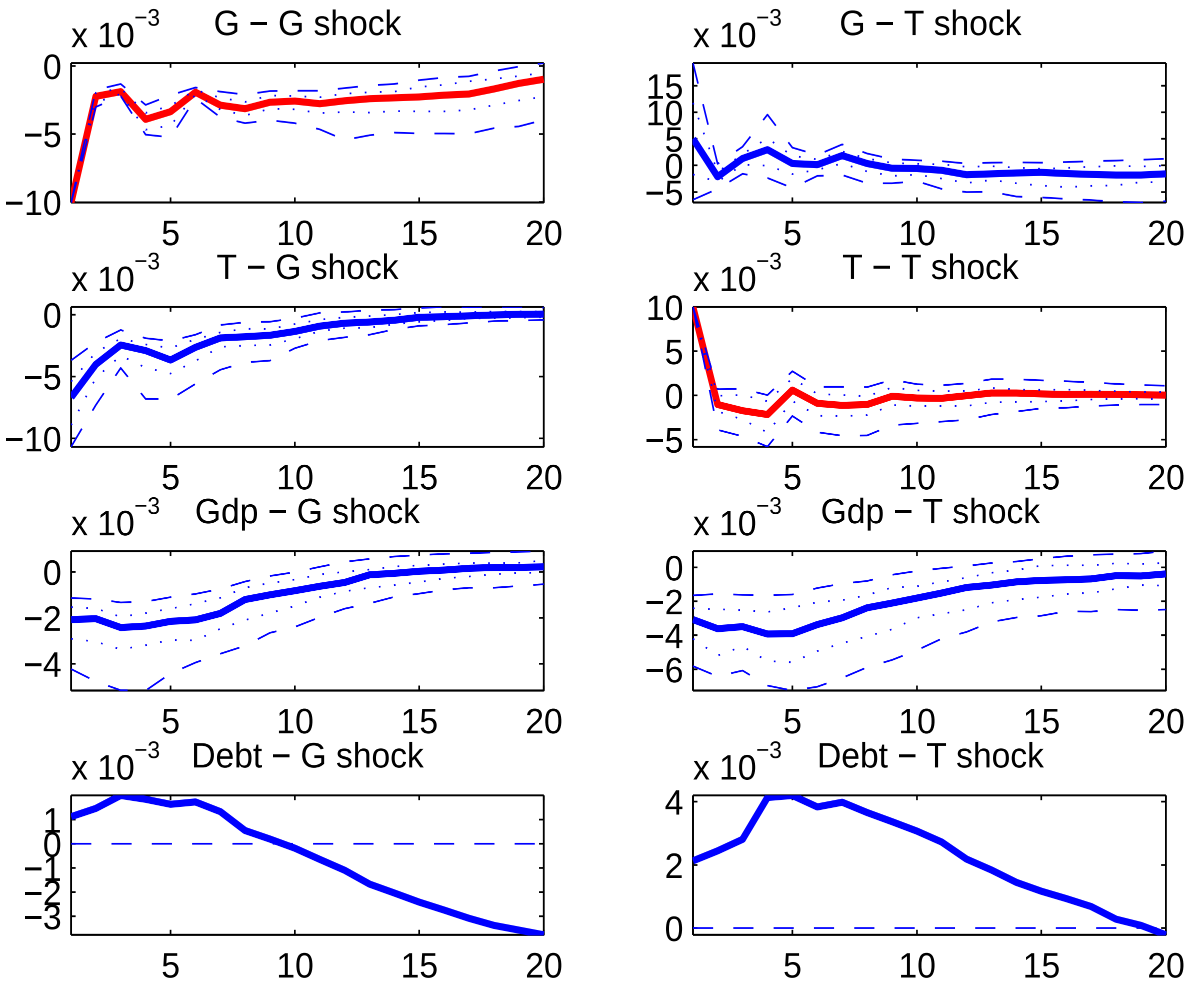

Figure 2 reports the IRFs for the baseline scenario, calculated using 4 lags. G shock on the left. T shock on the right

Figure 3. Evolution of Primary Balance and Output, 4 lags

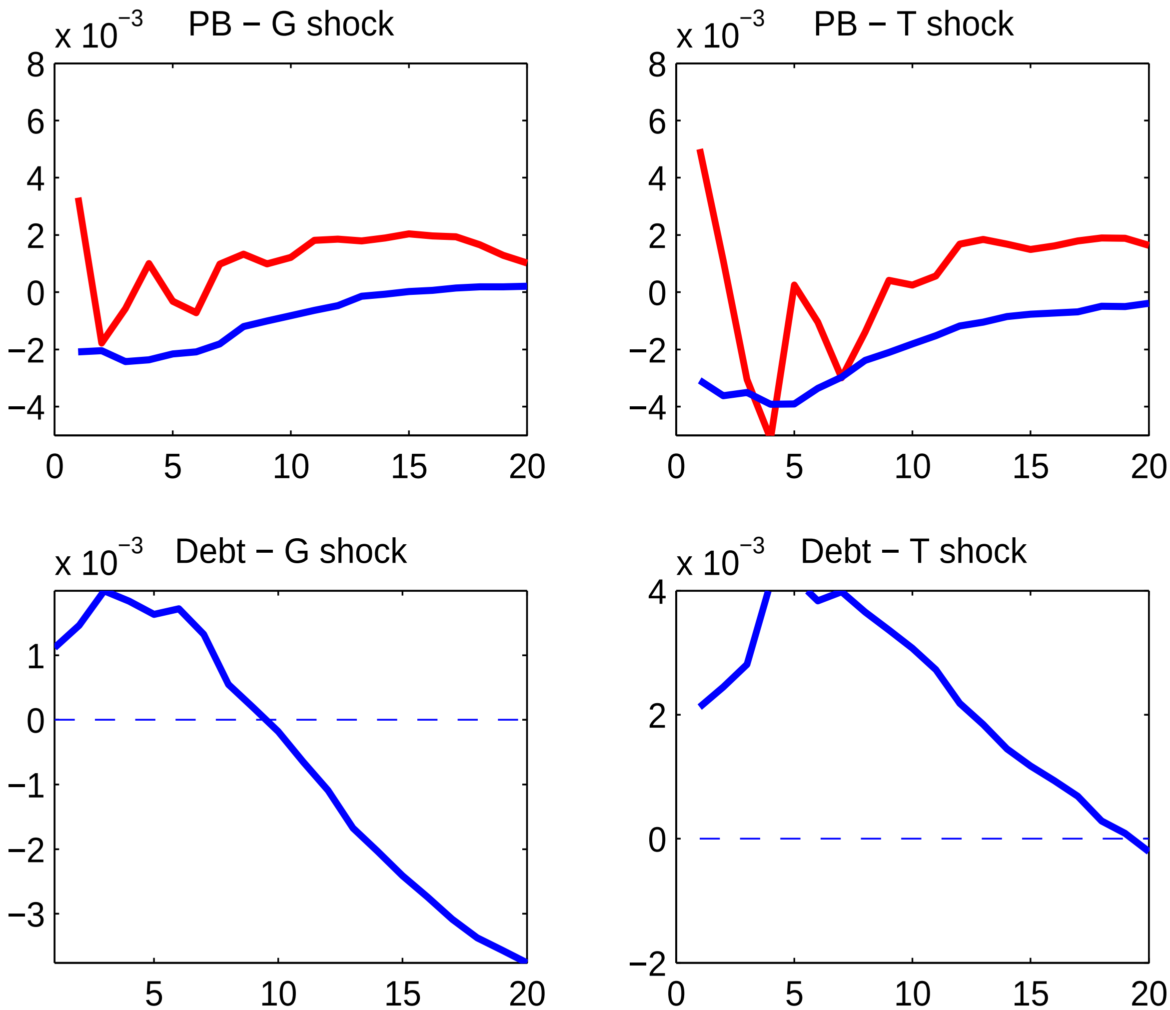

Figure 3 reports the IRFs (4 lags) in terms of the evolution of the Primary Balance PB (red line), output Y (blue line) and debt-to-GDP ratio. Spending shock on the left panels, tax shock on the right panels.

Figure 4. Evolution of Primary Balance and Output, 1 lag

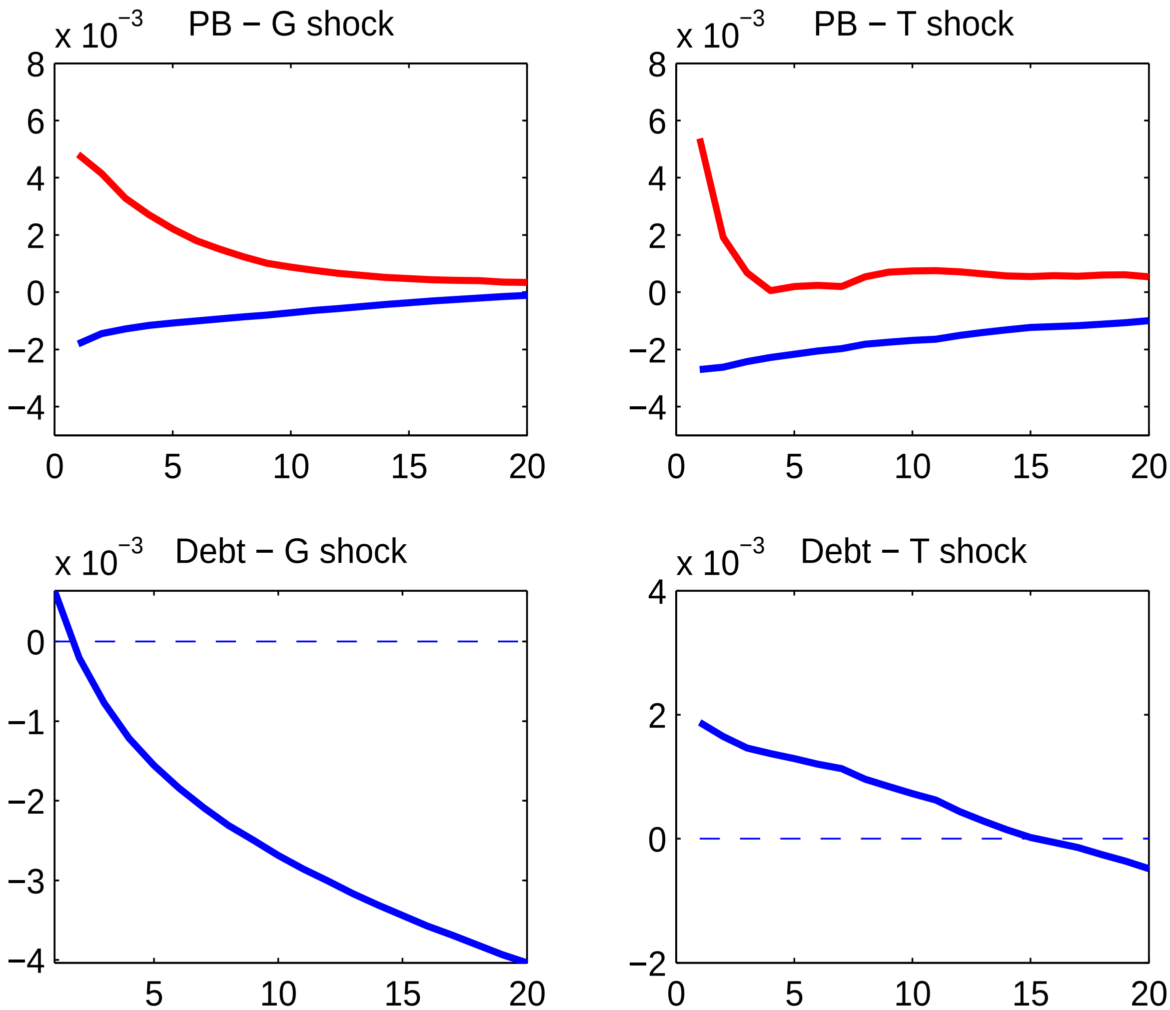

Figure 4 reports the IRFs (1 lag) in terms of the evolution of the Primary Balance PB (red line), output Y (blue line) and debt-to-GDP ratio. Spending shock on the left panels, tax shock on the right panels.

Figure 5. IRFs: Small shock

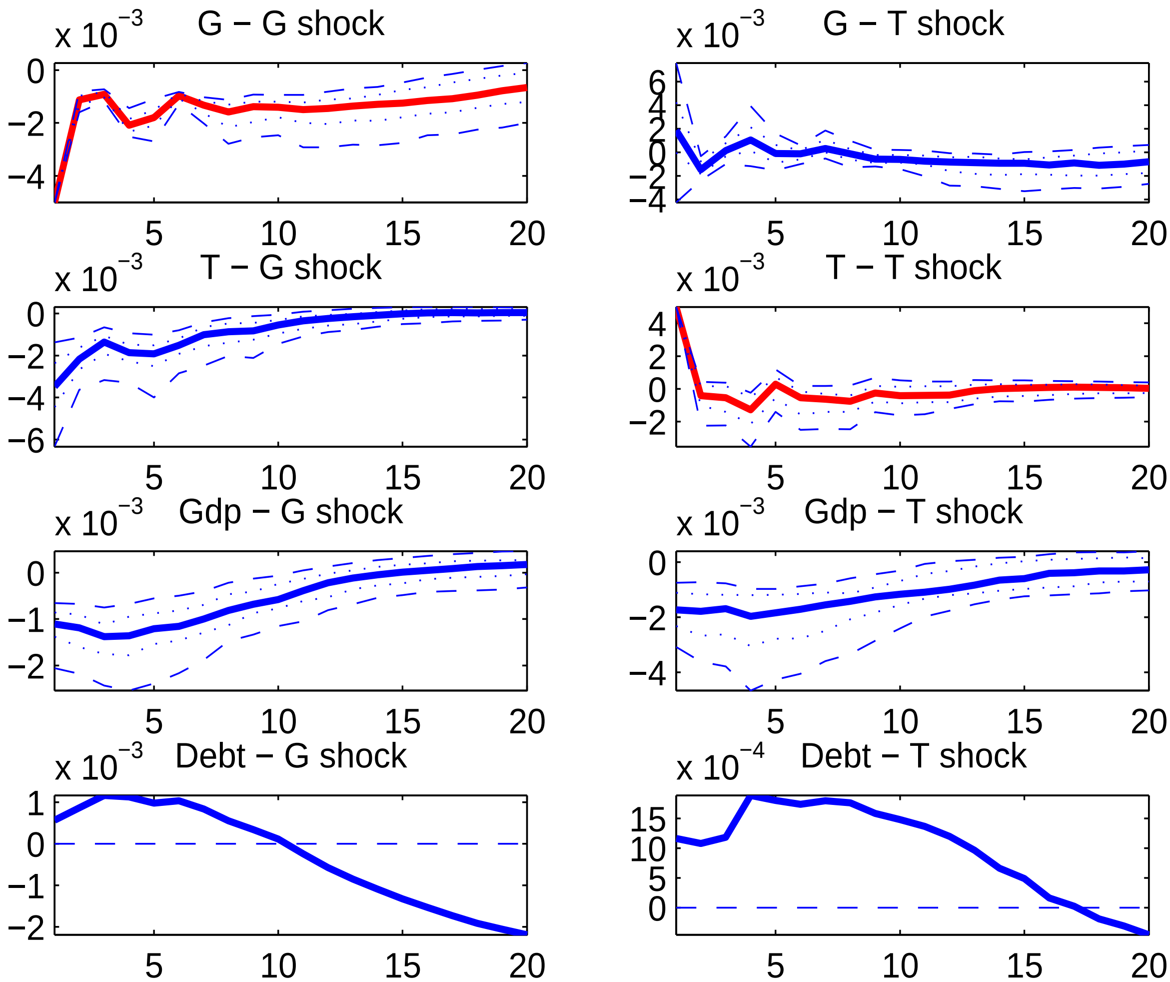

Figure 5 reports the IRFs calculated when the shocks (both spending shock and tax shock) are a 0.5 times as big as in the baseline scenario.(i.e the shocks are 0.5 standard deviations)

Figure 6. IRFs: Big shock

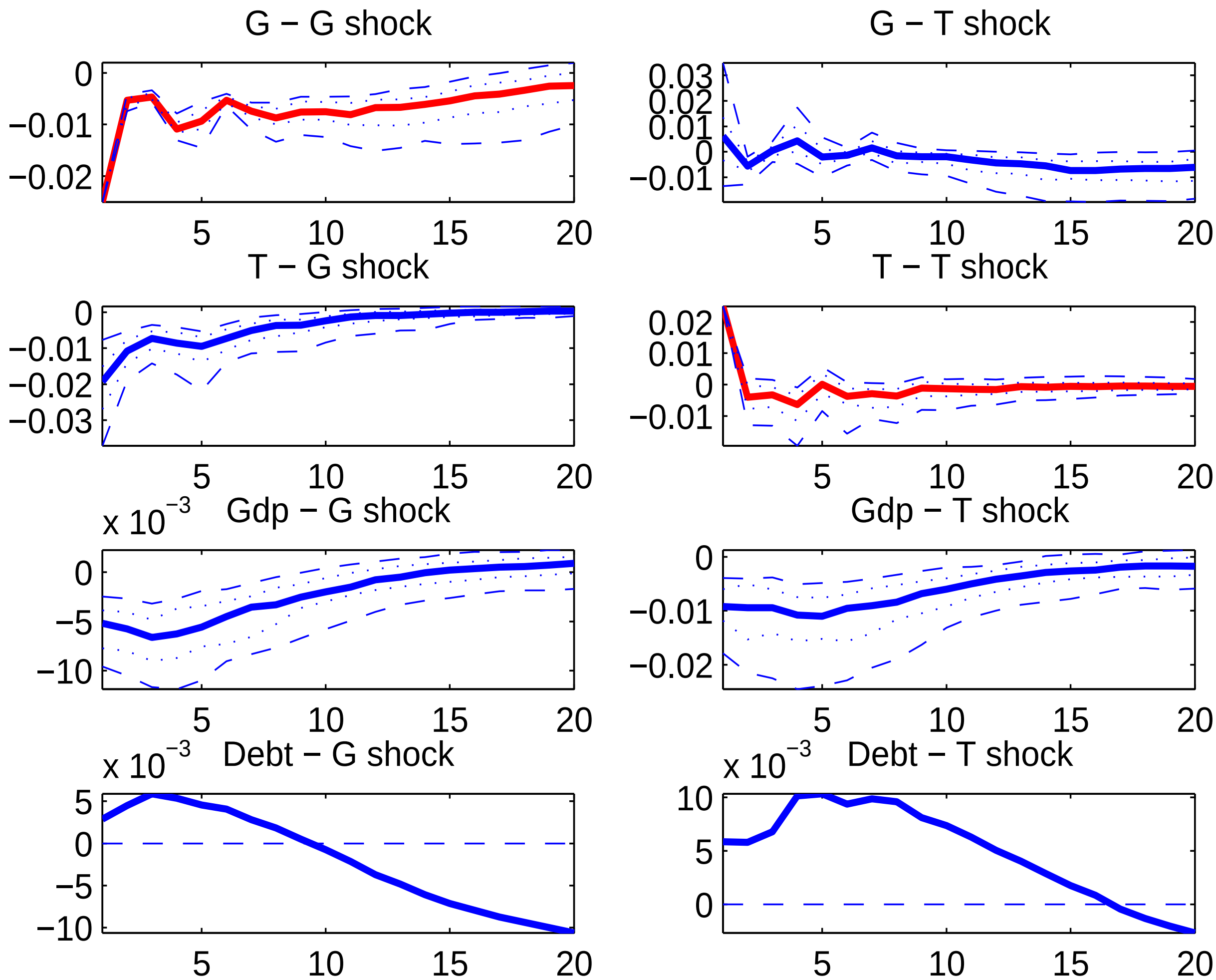

Figure 6 reports the IRFs calculated when the shocks (both spending shock and tax shock) are a 2 times as big as in the baseline scenario.(i.e the shocks are 2 standard deviations)

Figure 7. IRFs: Very small shock

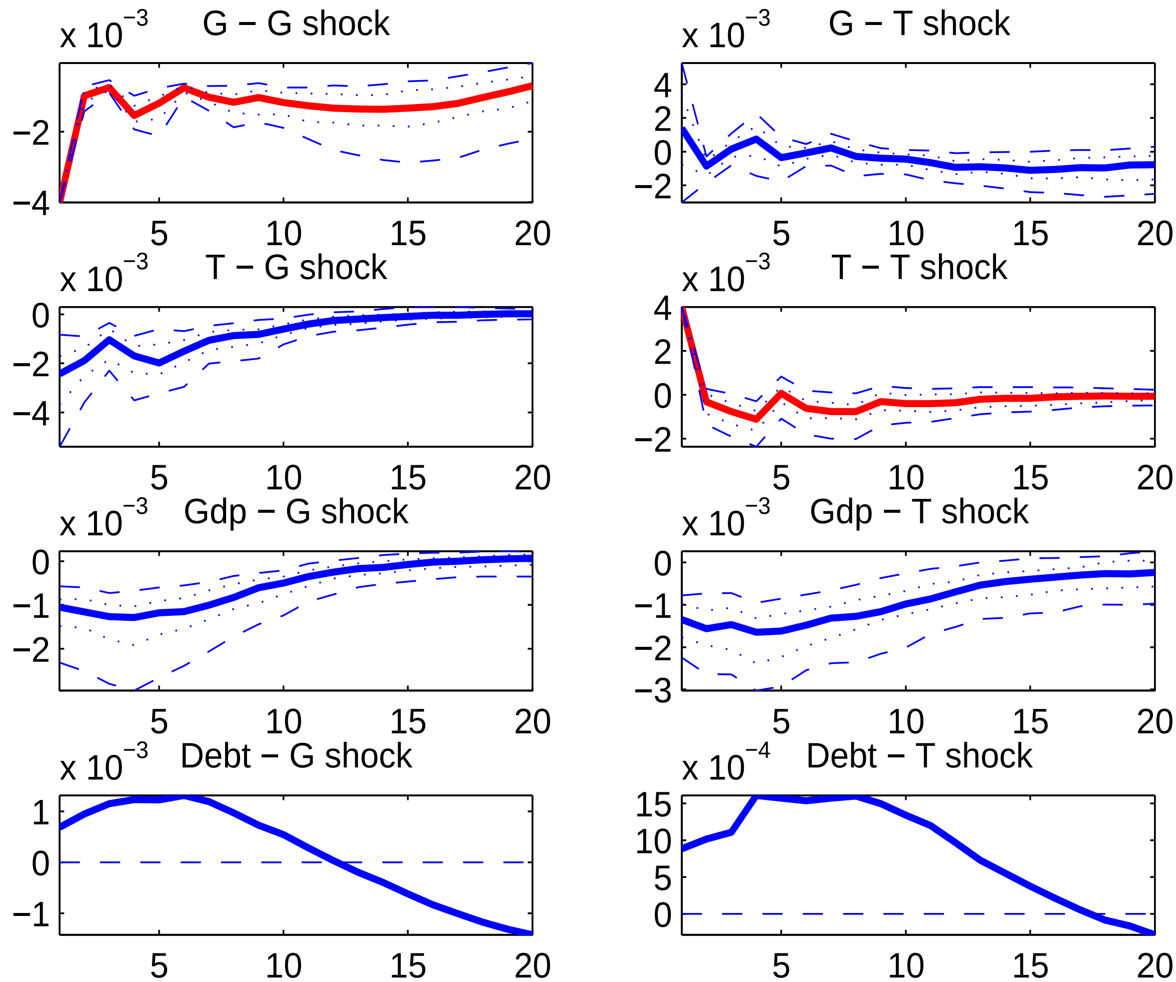

Figure 7 reports the IRFs calculated when the shocks (both spending shock and tax shock) are a 0.2 times as big as in the baseline scenario.(i.e the shocks are 0.2 standard deviations)

Figure 8. Poor economic conditions

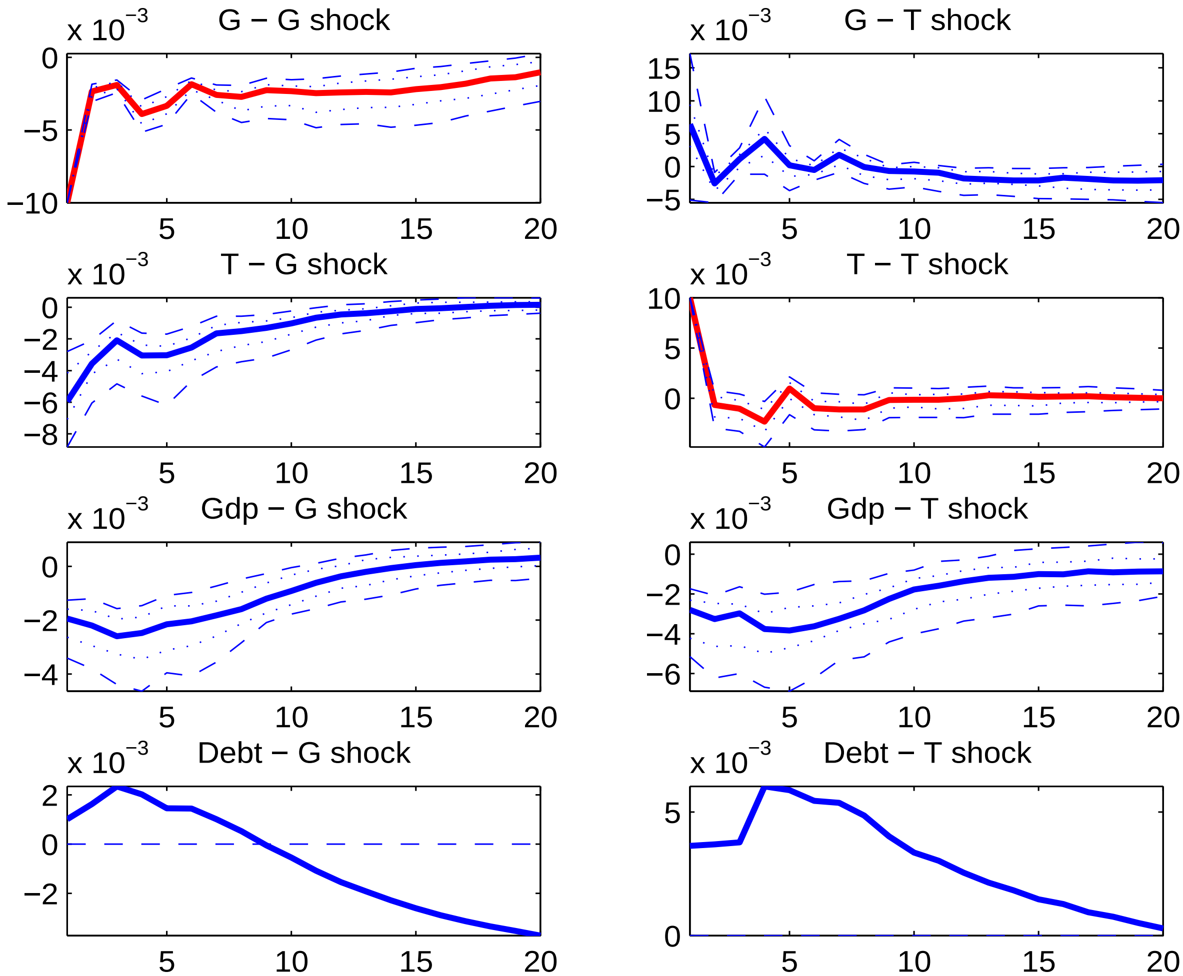

Figure 8 reports IRFs calculated with initial conditions representing poor economic conditions. This means low GDP, high spending, low tax revenues, high interest rate, high inflation and high debt-to-GDP ratio.

Figure 9. Good economic conditions

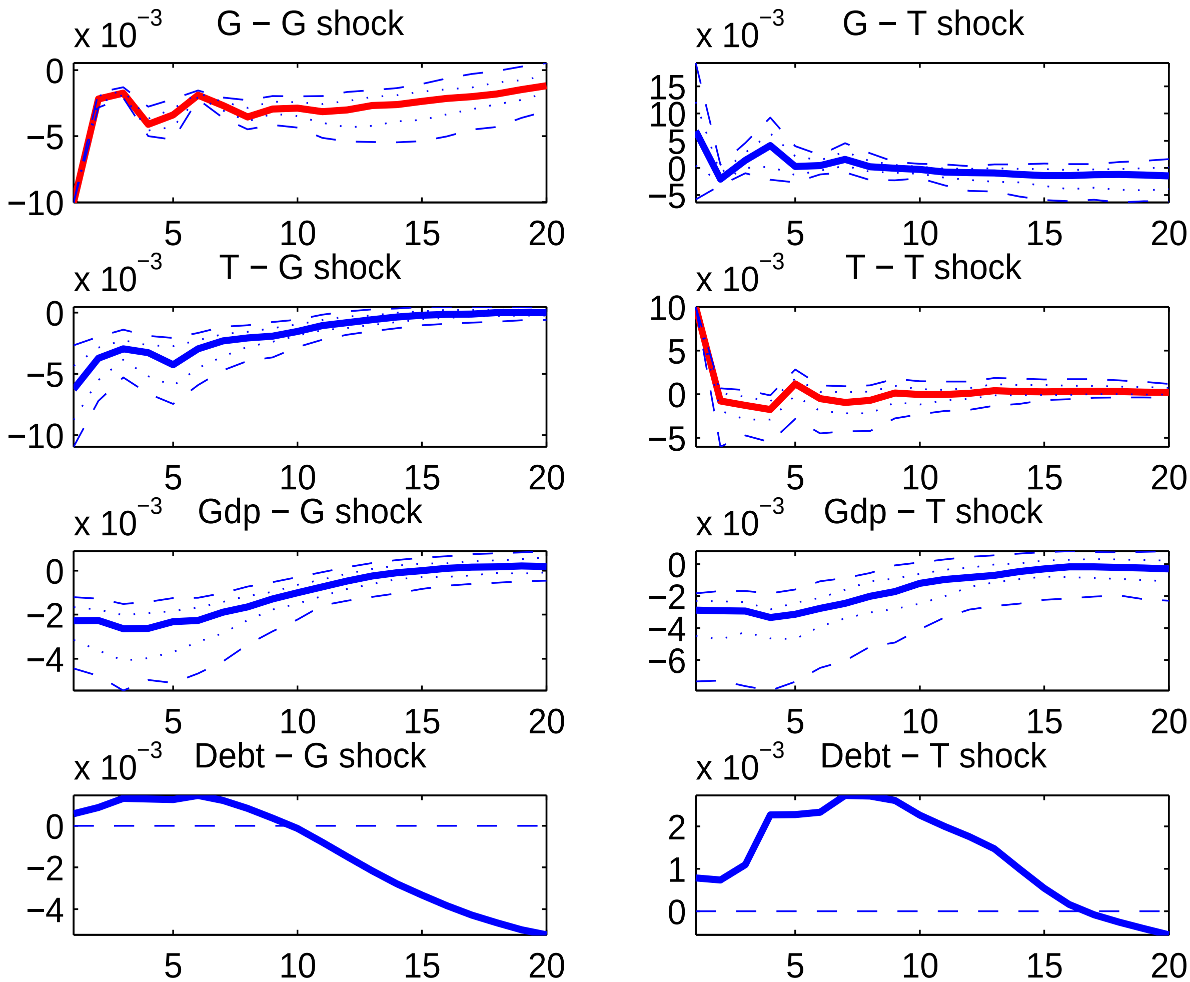

Figure 9 reports the IRFs calculated with initial conditions representing good economic conditions. This means high GDP, low spending, high tax revenues, low interest rate, low inflation and low debt-to-GDP ratio.

Figure 10. High initial debt

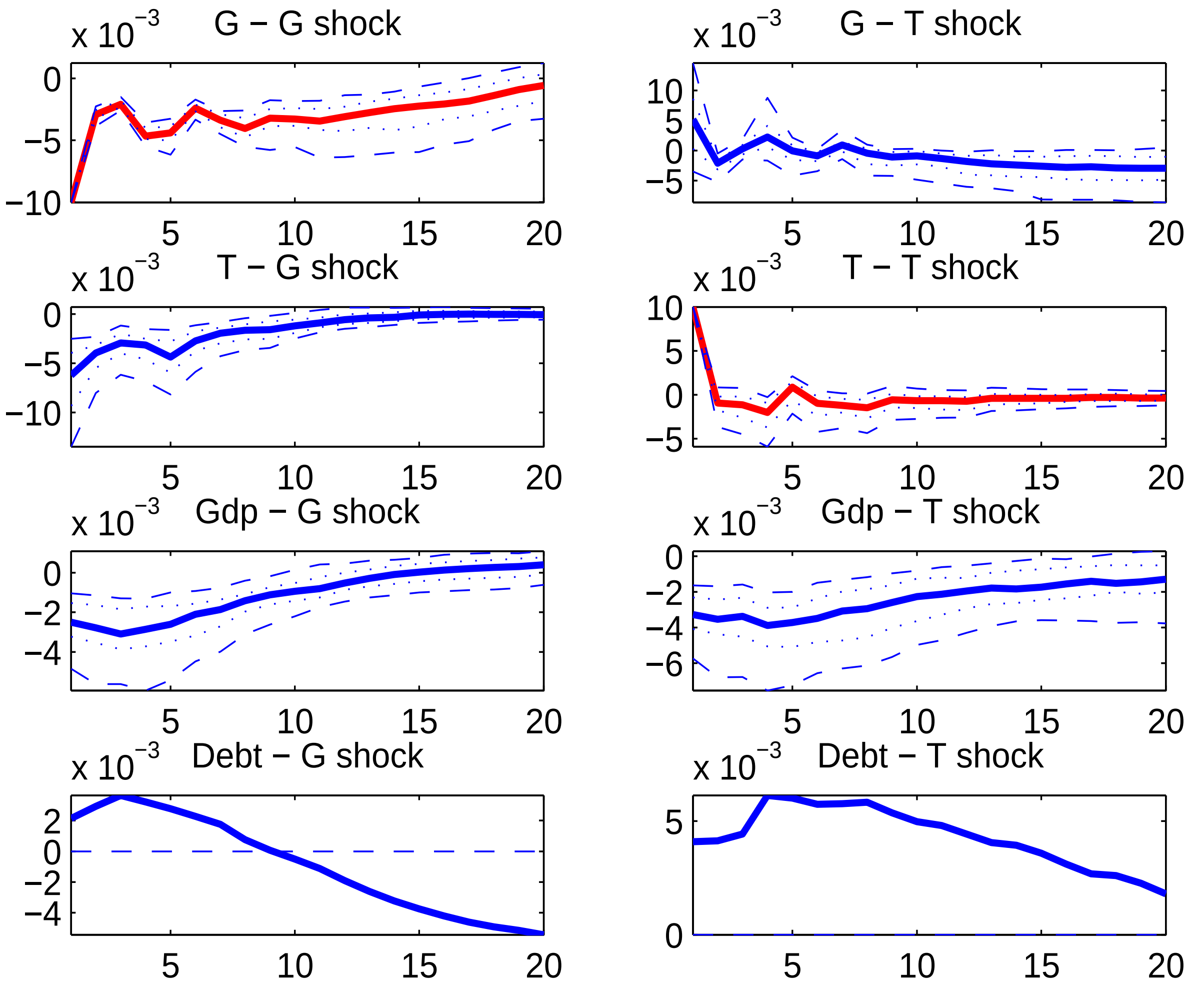

Figure 10 reports the IRFs calculated when initial debt-to-GDP is 50% higher than the baseline. All the other initial conditions are the same as in the baseline scenario.

Figure 11. Low initial debt

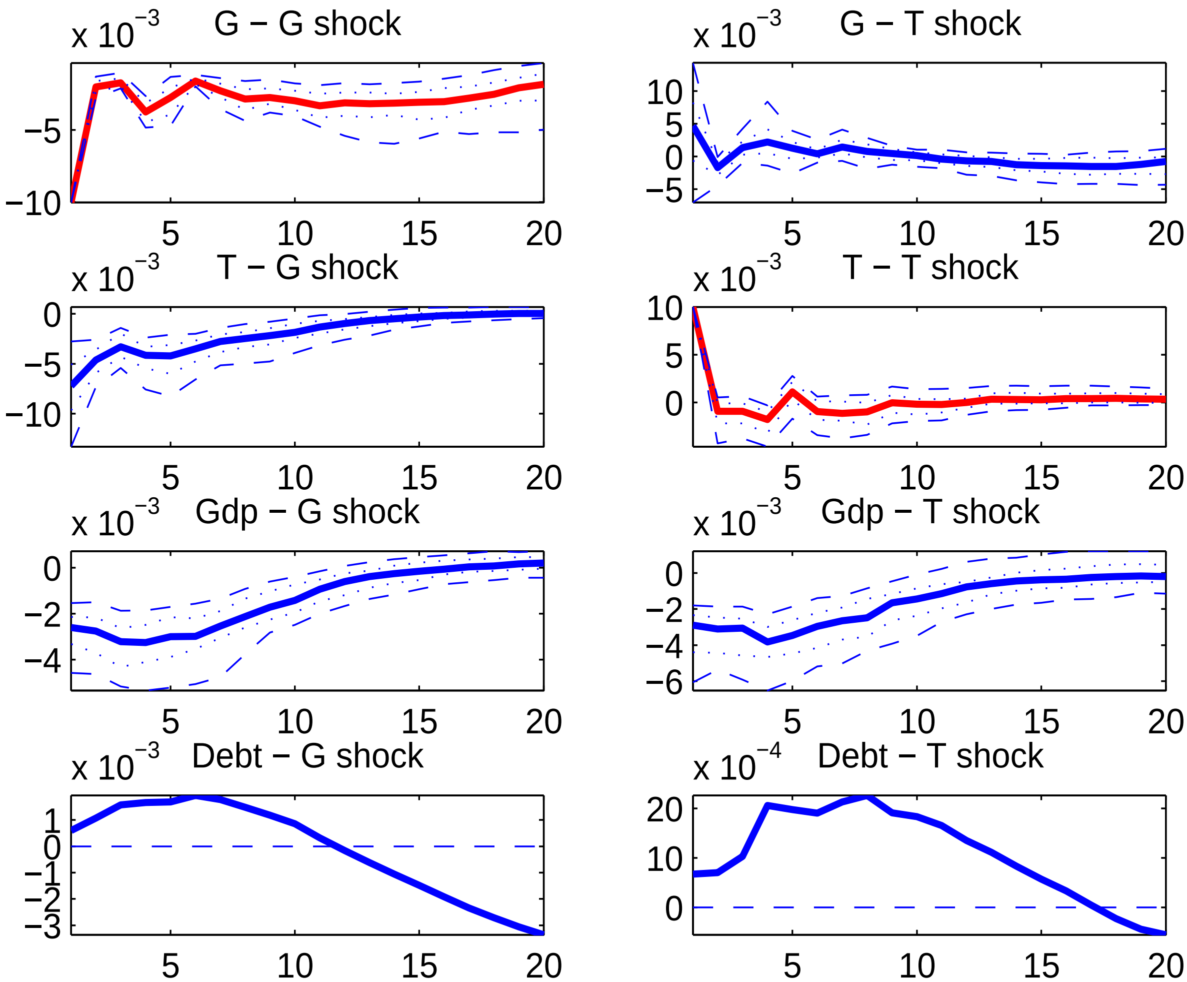

Figure 11 reports the IRFs calculated when initial debt-to-GDP is 50% lower than the baseline. All the other initial conditions are the same as in the baseline scenario.

Figure 12. Implicit interest rate and market interest rate

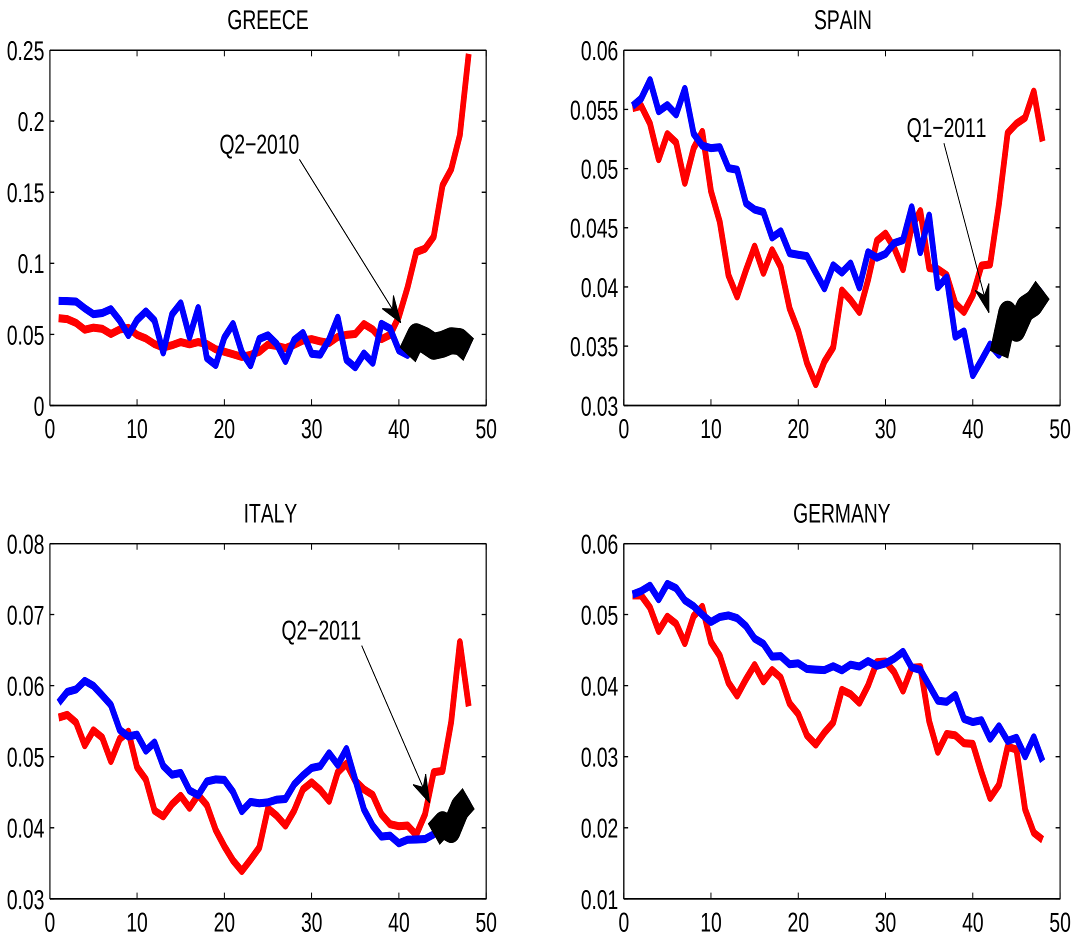

Figure 12 reports the implicit interest rate (blue line) and market interest rate (red line). The dotted points represent quarters in which the country is considered fiscally stressed

Figure 13. G shock: FS and NFS countries

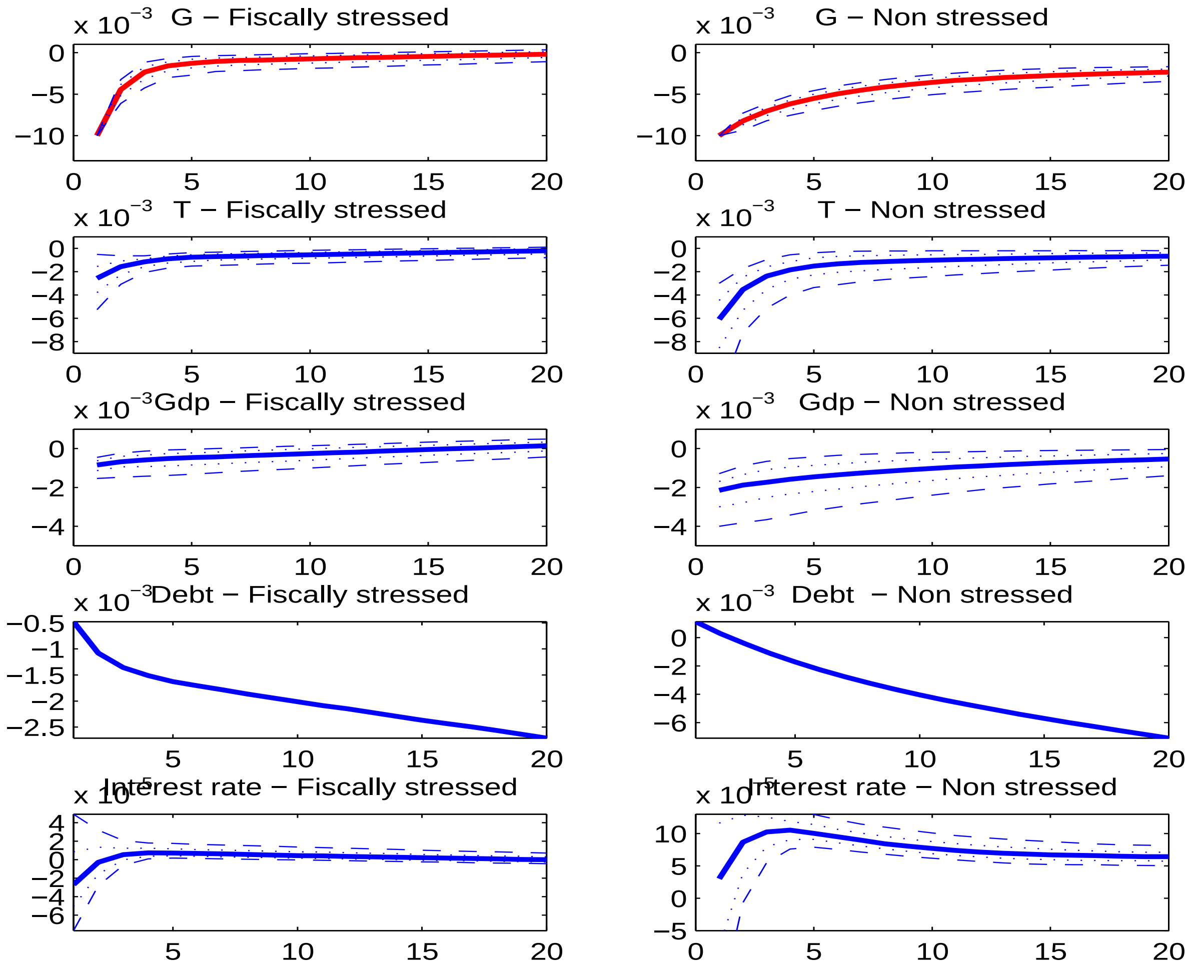

Figure 13 reports the IRFs to a spending shock for the fiscally stressed (FS) countries (left panels) and non-fiscally stressed (NFS) countries (right panels)

Figure 14. T shock: FS and NFS countries

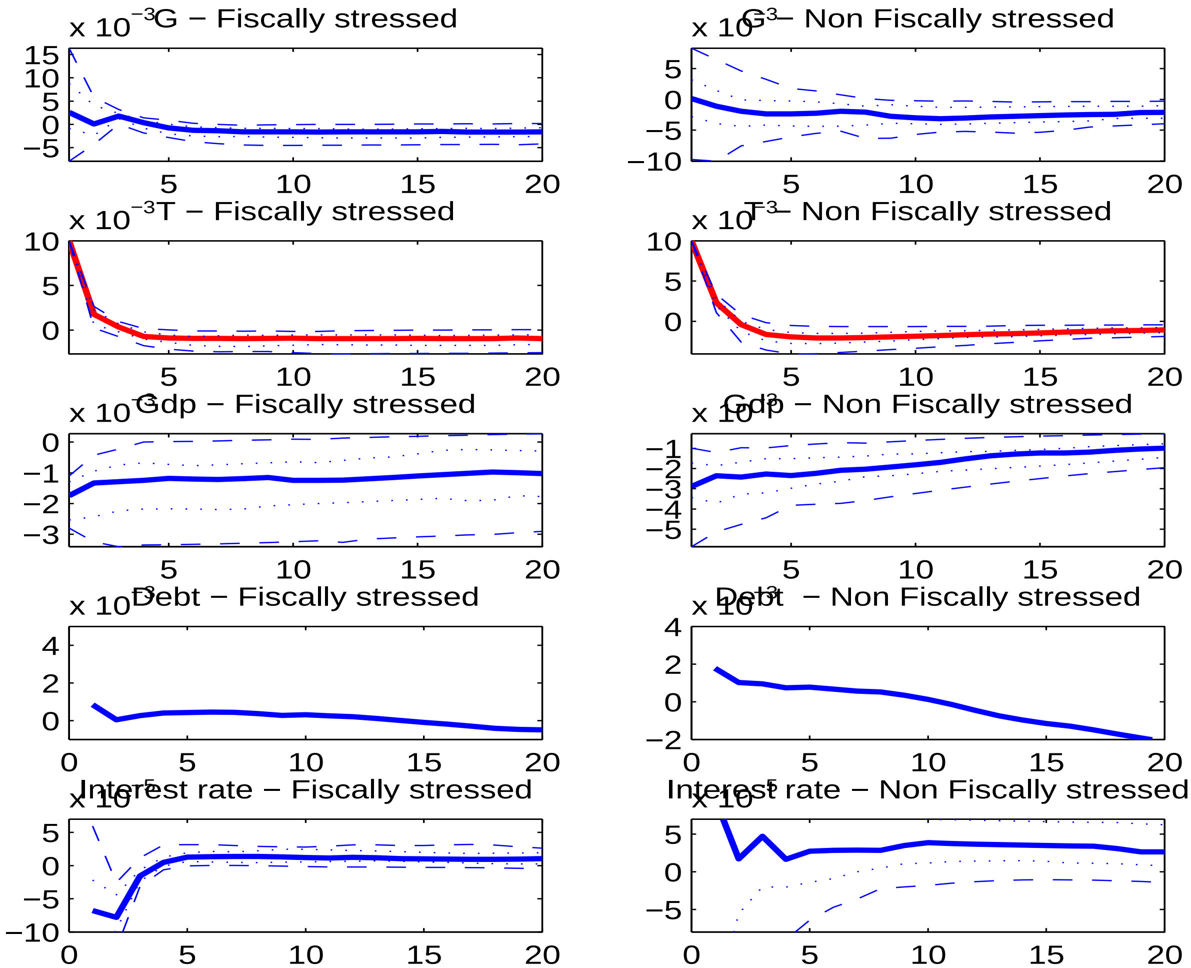

Figure 14 reports the IRFs to a tax shock for the fiscally stressed (FS) countries (left panels) and non-fiscally stressed (NFS) countries (right panels)

Figure 15. G shock: vulnerable countries vs non-vulnerable (whole sample)

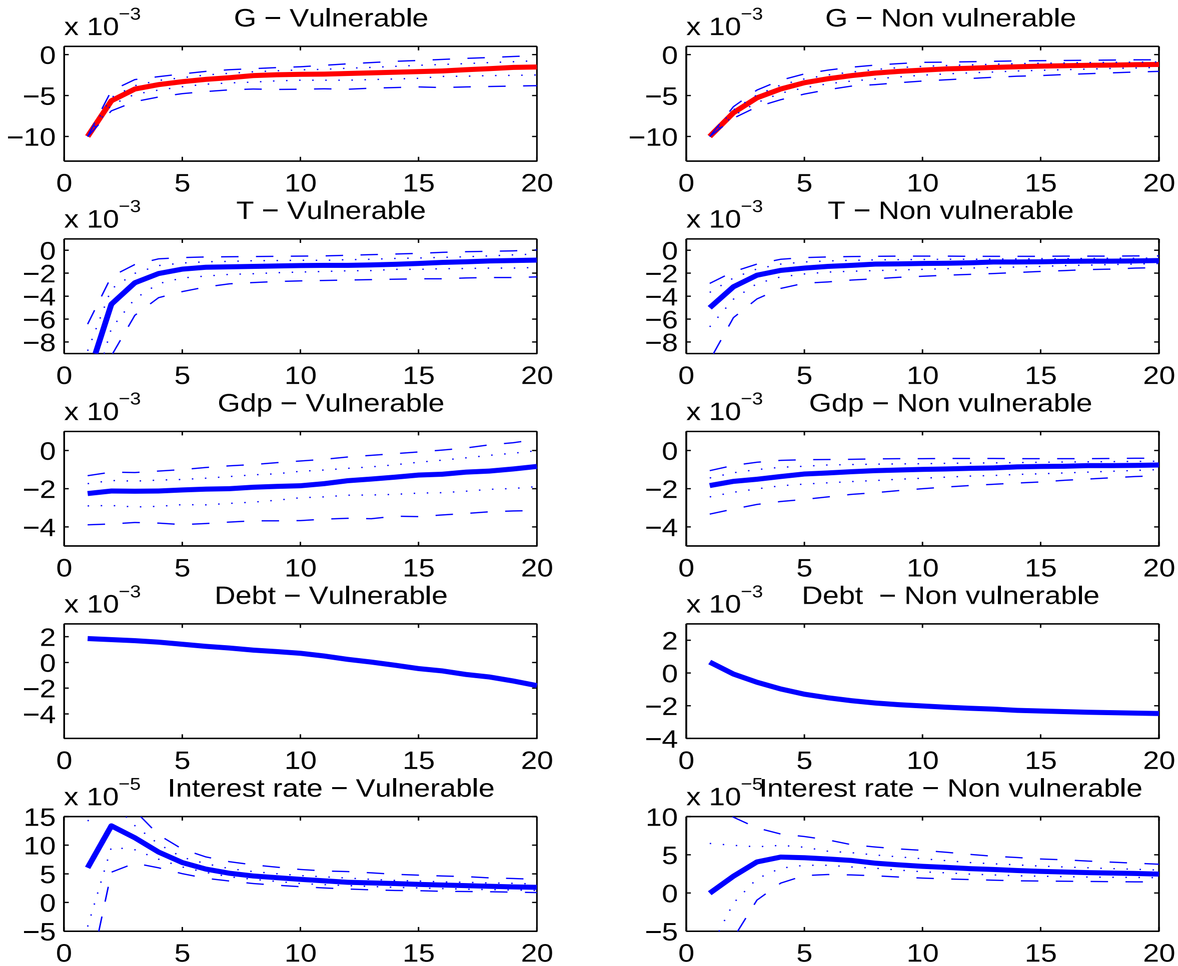

Figure 15 reports the IRFs to a spending shock for the vulnerable countries (left panels) and non-vulnerable countries (right panels)

Figure 16. T shock: vulnerable and non-vulnerable countries (whole sample)

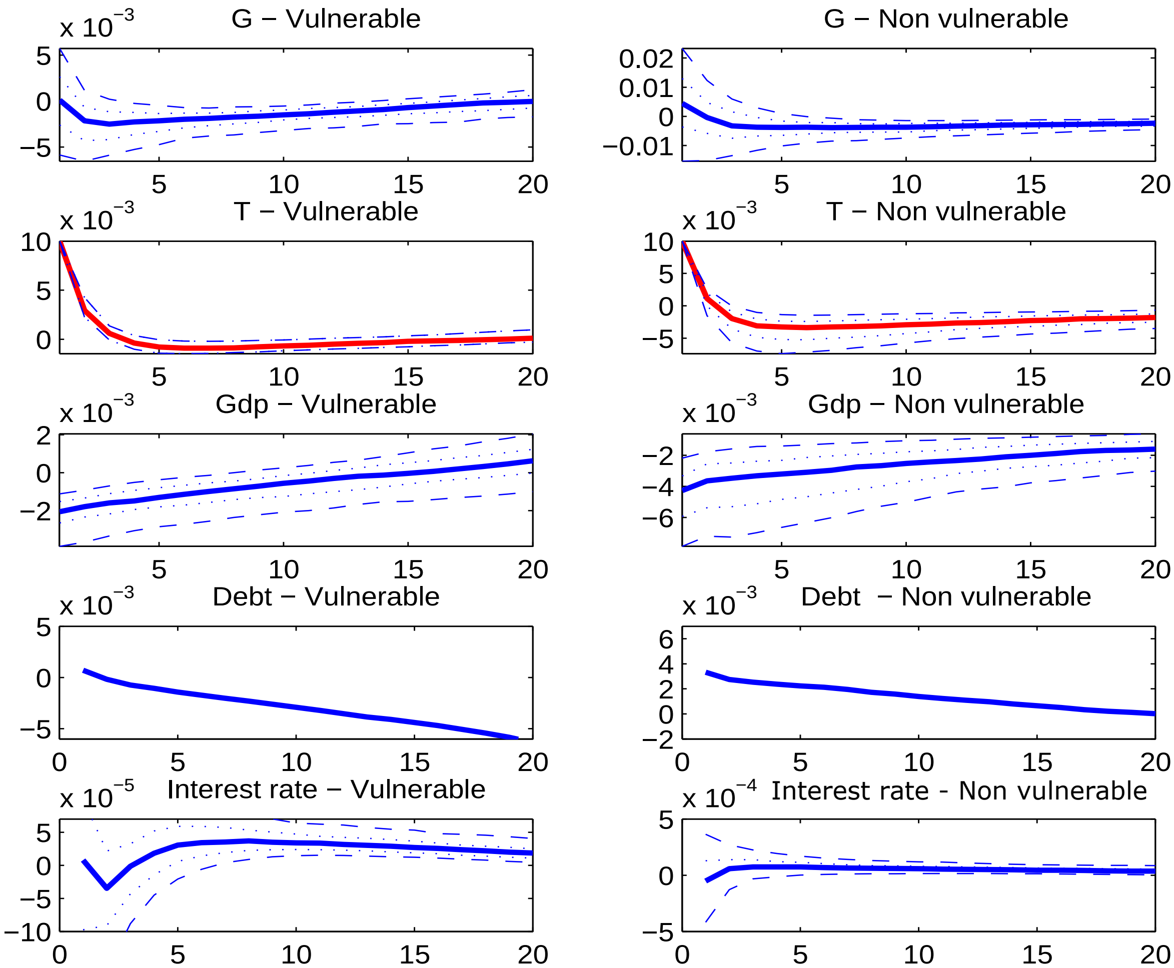

Figure 16 reports the IRFs to a tax shock for the vulnerable countries (left panels) and non-vulnerable countries (right panels)

Figure 17. Baseline: 1 lag

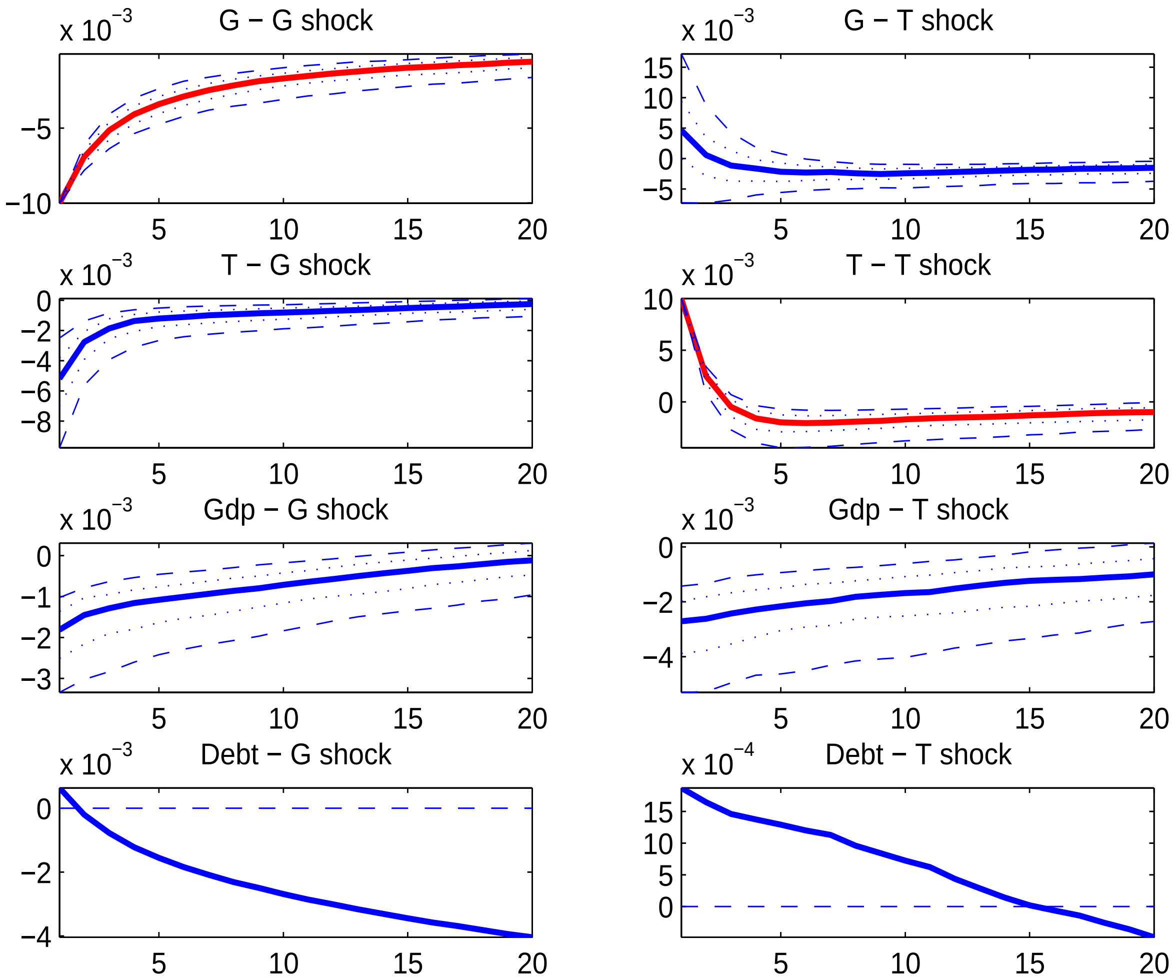

Figure 17 reports the IRFs for the baseline scenario, calculated using 1 lag. G shock on the left. T shock on the right

Figure 18. Baseline: 2 lags

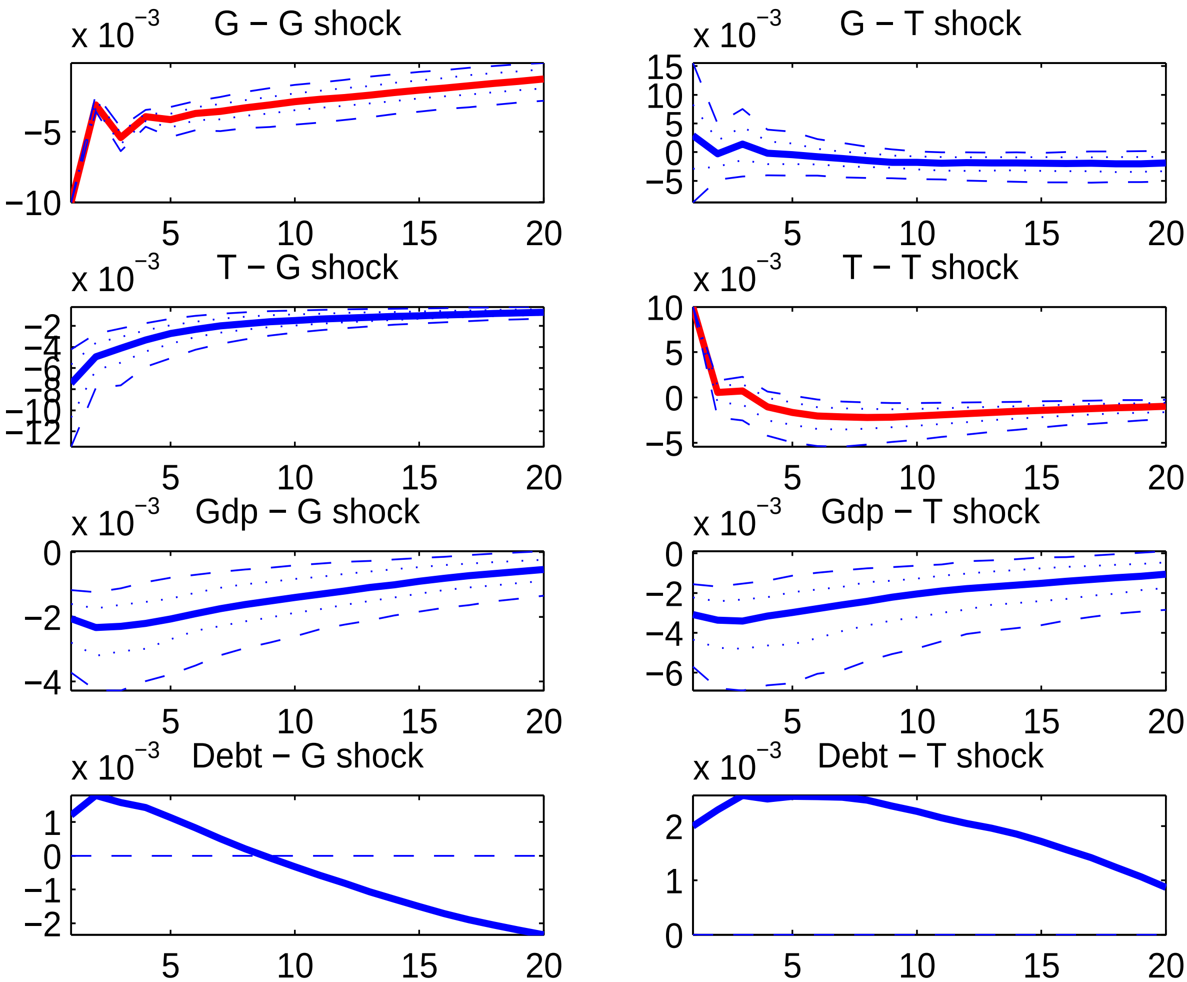

Figure 18 reports the IRFs for the baseline scenario with 2 lags. G shock on the left. T shock on the right

Figure 19. Mean Group Estimator

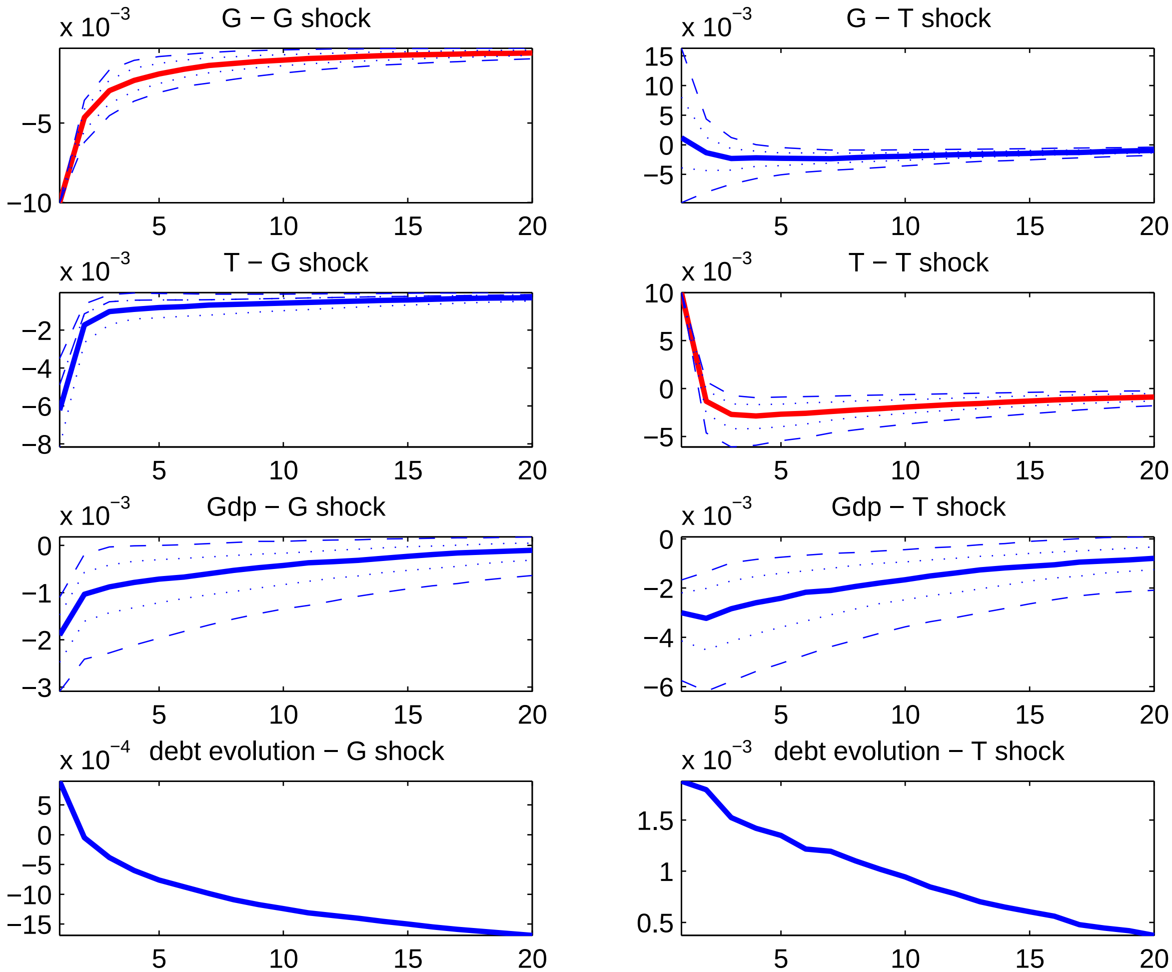

Figure 19 reports the IRFs when the PVAR is estimated using the Mean Group estimator

Figure 20. Baseline 2000-2007

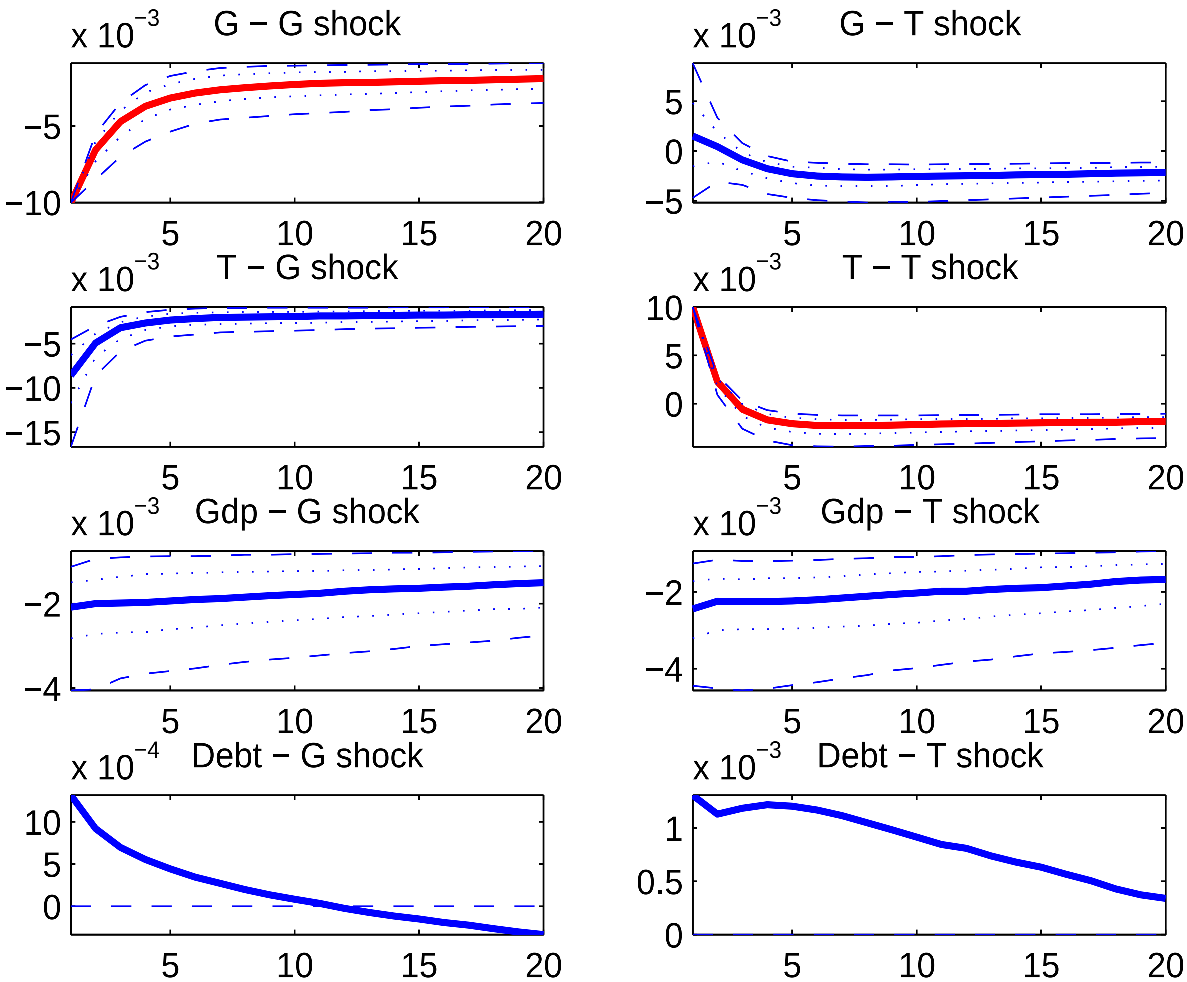

Figure 20 reports the IRFs when the model is estimated over the sample 2000-2007

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