Spillover of fiscal shocks in the euro area

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Abstract

We study the spillovers of fiscal shocks in the Euro area, identify the channels of transmission, and measure the domestic and international multipliers. The domestic transmission of expenditure shocks in the Euro periphery is heterogenous and the output effects depend on the reaction of imports. Debt and long term interest rates responses may make fiscal austerity self-defeating. Core countries may benefit from fiscal contractions in the periphery and gains are larger if the measures are coordinated. Idiosyncrasies are reduced after 2008, but the redistribution effect from the periphery to the core becomes larger. Fiscal retrenchments requiring deficit surpluses have larger international effects.
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1 Introduction

The crisis of 2008 has brought fiscal policy back in the spotlight of academic and policy discussions (see, inter alia, Hall, 2009; Woodford, 2011; Christiano, et al. , 2011; Canova and Pappa, 2011; Auerbach and Gorodnichenko, 2012; IMF, 2012). The crisis has also shown how interconnected the world is, with US shocks rapidly spreading across borders and producing sizable international effects. The recent sovereign debt difficulties in the Euro area have also indicated that fiscal expansions when a crisis in progress and the fiscal position is deteriorating may be dangerous and this perception has led to unprecedented fiscal austerity in the region. Because of the virulence of the Euro area debt crisis, academic economists and policy makers are very much interested in understand both the impact of fiscal policy measures and the international repercussions of coordinated consolidation policies in an environment where public debt is globally growing, the vulnerability of the financial and the banking system still high, and the growth outlook poor.

The recent academic literature offers some guidance in the analysis: by now, it is well understood that the effects of fiscal policy on output, debt and sovereign spreads, may depend on a number of important state variables (see Iltzeski et al., 2012 or Corsetti et al., 2012), on the time when the consolidation measures take place, i.e. recessions vs. expansions (see Auerbach and Gorodnichenko, 2012), on whether the public anticipates the measures (see Ramey, 2011), on what monetary policy does (see Canova and Pappa, 2011) and on the implementation details of the measures (see e.g. Corsetti et. al. 2011).

The renewed policy debate on the magnitude of the fiscal multiplier (e.g. IMF, 2012; Blanchard and Leigh, 2103; Mertens and Ravn 2012) and the impact that this magnitude has on debt sustainaibility, sovereign spreads and the growth costs of fiscal retrenchment (e.g. Cherid and Hasanov, 2012; Attinasi et al., 2012) however calls for a fresh look at the issue of the effects of fiscal contractions taking into account the level of debt, the domestic financial conditions and those of the main economic partners,

the expectations of the private agents about the short terms effects of the programs.

This paper provides evidence in this direction by studying the transmission of fiscal shocks in the Euro area. The scope of the exercise is descriptive: we wish to contribute to the ongoing debate with new evidence whose expected (and desired) impact is high on the policymaking agenda. The focus on the region is motivated by a number of observations. On the one hand, following the crisis of 2008, fiscal finances and country risk premia were most affected in the area, an important fiscal stimulus was enacted in 2009 and strongly reversed in the next few years. On the other, contractionary measures were primarily taken in the periphery of the Euro area but, given the common monetary policy, spillovers to other regions are a-priori expected to be important.

We addresses a number of questions which should help researchers understand the short and medium term consequences of the current measures. What are the domestic effects of expenditure contractions designed to improve the primary deficit position of country and the perceived sustainability of its debt? Is it possible that such contractions generate virtuous output effects? What are the short and medium run effects on the debt and long term interest rates? How large are the international output multipliers? What are the channels of cross-country transmission? Are the effects of coordinated expenditure contractions different than the sum of effects induced by individual country contractions? What happens if expenditure cuts are combined with tax increases to improve the deficit? How has the crises changed the pattern of transmission and the magnitude of the output multipliers?

To answer these questions, we use a structural panel VAR model of the type developed in Canova and Ciccarelli (2009), where real, trade, financial and fiscal variables are jointly considered for four peripheral (Greece, Italy, Spain and Portugal) and three core (Germany, France and Netherlands) countries in the area. The methodology allows us to simultaneously consider a number of domestic and international channels of transmission in a framework that takes into account macroeconomic, monetary policy and financial linkages; has a number of advantages over competitors (e.g.

Factor models, GVARs, spatial models) which a-priori restrict the nature of cross country interdependences; and permits the construction of historical indicators of the fiscal stance, both for the area and for each of the countries, and discuss their time evolution.

Contractionary expenditure shocks in the periphery of the Euro have heterogeneous domestic effects. For example, the short run output effects could be negative, insignificant or positive. The key to understand the sign and the magnitude of the output effect is the dynamics of the trade balance. When the trade balance responds positively and the effect is large, output effects are positive; otherwise, they are insignificant or negative. Interestingly, and contrary to the common wisdom, large trade balance responses do not occur via improved terms of trade and increased exports. Instead, following the contraction of government expenditure there is a large fall in imports, both because absolute demand falls and because local consumers substitute domestic for foreign produced goods. The short term effect on total debt and long term interest rates are also heterogeneous and in some cases perverse - both debt and long term interest rates increase. In general, the signalling effects that contractionary expenditure measures generate in financial markets are quite limited.

The international spillover effects are also quite heterogenous and depend both on the (periphery) country where the expenditure contraction takes place and on the (core) country whose response is considered. In general, they are sizable even before 2008, and trade effects are important, while capital movements appear to be limited. Prior to 2008 however fiscal policy externalities are minor: a simultaneous effort to improve the fiscal balance in the periphery results in output effects in the core which are not much larger than the largest output effect originated by a contractionary shocks in a peripheral country.

Heterogeneities in the domestic transmission are reduced and the magnitude of the international spillovers changes after 2008. In general, the virtuous domestic effects of contractionary expenditure shocks tend to disappear, dragging all periphery countries in the same recessionary spiral. Core countries seem to benefit from this situation

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and positive output effects become stronger, making the contractionary shock quite redistributive in the region. Finally, shocks designed to reduce budget deficit in the periphery have much larger domestic and international effects than shocks which contract expenditure only, making the regional redistribution an important issue of discussion.

The rest of paper is organized as follows. The next section provides some theoretical considerations about the effects of fiscal shocks. Section 3 describes the empirical model and section 4 the data. Section 5 presents the results, section 6 concludes.

2   Some theoretical considerations

The domestic propagation of expenditure shocks is well understood in the literature and depends on wealth effect on labor supply and demand effect on the real interest rate. In general equilibrium models, and other things being equal, a cut in government expenditure makes private agents richer and, under standard preference specifications, leads to lower labor supply and to an output decline. Moreover, a cut in government expenditure, if financed by a reduction in the outstanding amount of real bonds, decreases their supply and increases their price. Thus, the real interest rate declines and this generally expands the private components of aggregate demand.

How these two effects are translated in changes in output, hours worked, real wages, real rates, consumption, investment depends on the model used, on whether the impulse is permanent or transitory, on which component of public expenditure is changed (see e.g. Pappa, 2009, and Pappa, et al., 2013) and on the way it is financed, on what monetary policy does (see Canova and Pappa, 2011, Christiano et al., 2011), on whether the consumers are optimizers or not (see Gali et al., 2007), on financial imperfections (Corsetti, et al., 2010) and on the state of the economy (see Auerbach and Gorodnichenko, 2012). Additional complex non linear effects are possible and, depending on the specification, the debt to GDP ratio, the extent of the current sovereign risk and perceptions of the sustainability of government debt, the financial

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constraints existing in the economy may matter for the results. The magnitude of the effects may also be affected by whether shocks are anticipated or not, the maturity composition of the debt, and the cost of refinancing.

A strand of literature has also emphasized the so-called "expansionary effects of fiscal contractions". In this literature a cut in government expenditure may reduce the need for larger, more disruptive fiscal adjustments in the future. Thus, by stimulating the confidence of households and investors, fiscal consolidations could boost consumption and investment even in the short run (see e.g. Giavazzi and Pagano, 1990, Alesina et al., 2002).

Recently, Corsetti et al. 2011, have emphasized an additional channel that may be important when spending changes are expected to be reversed in the future. Private expenditure depends on the level of long term interest rates. Since these rates reflect the entire path of current and future anticipated short term rates, they are driven by producer price inflation and the resulting feedbacks in the policy rates. Anticipations of spending reversals lead agents to foresee low domestic inflation and, with a standard Taylor rule for monetary policy, low future short term interest rates. Other things equal, these anticipations drive long term interest rates down and may cause a domestic expansion of aggregate demand, which is larger, the sooner the expected reversal is phased-in.

The international spillovers of fiscal contractions usually come via trade and financial channels. A cut in government consumption expenditure at home is likely to reduce imports - because private and public demand for foreign goods will be reduced and because there may be a switch from foreign produced to domestically produced goods. The reduction in imports may be combined with an increase in exports if the real exchange rate depreciates. For example, if the cut in expenditure is accompanied by a reduction in real wages, international competitiveness may be boosted and exports may rise. Thus, net export is likely to increase after a fiscal contraction. In a two country monetary union, such a change will reduce demand in the foreign country and, other things being equal, will imply positive international comovements

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of outputs and interest rates.

The Corsetti et al. effect has important implications also in open economies. When the exchange rate is flexible, and monetary policy moderately concerned with inflation, expected changes in future short term interest rates affect domestic long term interest rates. Thus, domestic aggregate demand and output positively comove and the decrease in absorption generally leading to a twin surplus dynamics (budget surplus and trade surplus). However, the real exchange rate generally appreciate when expenditure is cut. Thus, imports fall and, under standard parameterizations, export will fall also. The fall in imports lead to a decrease in foreign production, lower marginal costs and thus lower inflation on impact. When monetary policy is run independently, foreign short term rates fall, but long term rates increase, thus generating positive comovements across countries in output, consumption and investments. These dynamics are not contradictory: in fact, the currency of the country implementing the fiscal contraction appreciates and, ceteris paribus, this would imply competitive gains abroad, but the effects of these gains on the level of activity are generally overridden by the contractionary effects produced by increases in long term rates. In other words, the level of foreign activity is endogenously determined not only by trade considerations, but also by the dynamics of long term interest rates at home and abroad.

When (uncoordinated) fiscal contractions take place in an environment where monetary policy is run with unconventional measures typical arguments suggesting that coordinated fiscal actions avoid free riders problems may not be effective. These arguments typically assume that domestic fiscal contractions induce negative effects for foreign output and employment via decrease demand for imports as the country's real exchange rate appreciates. A coordinated contraction, can internalize this effect, balancing out demand leakages and preventing unwelcome exchange rate fluctuations. However, when expenditure contractions are in part rebalanced by future expenditure increases, the real exchange rate depreciates, and the main international comovements are driven by the dynamics of long term interest rates and these tend to comove.

Thus, it is not "unfair" competition that induce comovements but the fact that trade surpluses may result even when exchange rate movements may seem perverse.

The combined effect of expenditure cuts and tax increases to induce a positive budget surplus is likely to exacerbate the described domestic effects previously described, with the domestic components of aggregate demand falling by a larger amount. If taxes equally fall on imported and exported goods no major changes in the trade balance should occur. However, in case only one of the two is taxed, the trade balance may be affected. The international effects depends on the available linkages: the trade channel is likely to be dominant also in this case. Financial flows may also induce temporary deviations from interest rate parity (assuming a fixed exchange rate or a monetary union) affecting demand abroad - the magnitude of this effect may depend on whether the sovereign risk premium increases or not. (TO BE CONTINUED).

3   The empirical model

In the analysis, we employ a large-scale panel VAR model of the form:

$$y_{it} = D_i(L)Y_{t-1} + F_i(L)W_t + e_{it} \tag{1}$$

where $i = 1, ..., N$ stands for countries, $t = 1, ..., T$ for time, and L is the lag operator; y_{it} is a $G \times 1$ vector for each i and $Y_t = (y'_{1t}, \dots y'_{Nt})'$; $D_{i,j}$ are $G \times NG$ matrices for each lag $j = 1, \dots, p$, $F_{i,j}$ are $G \times M$ matrices each lag $j = 1, \dots, q$; W_t is a $M \times 1$ vector of common exogenous variables, $e_{it} \sim N(0, \Sigma_i)$ is a $G \times 1$ vector of disturbances. No constant is included in (1) since since the variables we use are all deseasonalized, demeaned and standardized.

Models of this type have been extensively used to study the structure of cyclical fluctuations, the contribution of local vs. external shocks to business cycles, the time variations in the transmission of shocks and other issues of interest to macroeconomists and policymakers (see e.g. Canova et al., 2007, and Canova and Ciccarelli, 2012, among others). Two important features make the model particularly suited for

studies like our which tries to studies the transmission of fiscal shocks in the Euro area. First, both the instantaneous and the lagged dynamics of the model are allowed to be unit specific. Thus, the size of the shocks and their propagation is potentially heterogeneous. While it is common to assume cross country homogeneity and thus pool cross sectional information when studying the effects of fiscal policy (see Leigh et al. (2013), for a recent example), heterogeneity biases of the type discussed in Pesaran and Smith (1996), may be present and distort economic inference. Allowing for heterogeneous transmission may be very relevant in the Euro area since institutional and cultural differences may make the same shocks have different effects in different countries. Second, whenever the $NG \times NG$ matrix $D(L) = [D_1(L), \ldots, D_N(L)]'$, is not block diagonal for some L, cross-unit lagged interdependencies matter. Thus, dynamic feedback across countries are possible and this greatly expands the type of interactions the empirical model can account for. Both features add realism and avoid important specification errors (see Canova and Ciccarelli, 2013, for a discussion), but greatly increase the number of parameters to be estimated. To see the problem rewrite (1) in regression format as:

$$Y_t = Z_t \delta + E_t \quad E_t \sim N(0, \Omega) \tag{2}$$

where $Z_t = I_{NG} \otimes X_t'$; $X_t' = (Y_{t-1}', \ Y_{t-2}', \ldots, Y_{t-p}', W_{t-1}', \ldots, W_{t-q}')$, $\delta = (\delta_1', \ldots, \delta_N')'$ and δ_i are $Gk \times 1$ vectors containing, stacked, the G rows of the matrix D_i and F_i, while Y_t and E_t are $NG \times 1$ vectors of endogenous variables and of random disturbances, $k = NGp + Mq$ and Ω is, in general, a full matrix. If the model features 10 countries, 5 variables, 2 lags and no predetermined variables, δ is 5000×1 vector and Ω has $(NG \times (NG - 1))/2 = 1125$ free parameters. Thus, the sheer dimensionality of the problem prevents any meaningful unconstrained estimation of the free parameters of the model.

We make two types of assumptions to decrease the dimensionality of the parameter space. First, we specify $\Omega = P_1 \otimes P_2$, where P_1 is $N \times N$ and P_2 is $G \times G$. This structure is convenient since it imposes some symmetry in the contemporaneous transmission

of structural shocks within a country. Second, we assume that the vector δ is a function of a lower dimensional vector θ. Let

$$\delta = \Xi\theta + u \qquad\qquad u \sim N(0, \Omega \otimes V) \qquad\qquad (3)$$

where Ξ is a matrix of zeros and ones, $dim(\theta) << dim(\delta)$, and u is a vector of disturbances capturing unmodelled features in the coefficient vector δ. As suggested by Del Negro and Schorfheide (2010), (3) looks like a shrinkage prior, much in the same spirit as the standard Litterman prior imposed on VARs. The main difference is that while the latter is designed for forecasting purposes, our setup captures the panel nature of the available data. For those who prefer a classical approach, (3) is a factor model on the coefficients of the panel VAR. In this case, factoring δ as in (3) is advantageous since it reduces the problem of estimating NGk coefficients to the one of estimating a reduced number of factors characterizing them. In fact, substituting (3) into (2) one obtains

$$Y_t = \sum_{j=1}^{r} \mathcal{Z}_{jt}\theta_j + v_t \qquad\qquad (4)$$

where $\mathcal{Z}_{jt} = Z_t\Xi_j$ and $v_t = E_t + Z_t u_t$. Thus, (3) transforms an overparametrized panel VAR into a parsimonious SUR model, where the regressors are averages of certain right-hand side VAR variables and θ become the parameters of interest and the residuals have a particular heteroskedastic structure.

The approach we use to deal with the dimensionality problem is different from the strategy used in global VARs, where a factor capturing international spillovers it tagged on to country specific VARs. As discussed in Canova and Ciccarelli, 2013 global VARs imply proportionality restrictions on the dynamic spillovers across all countries, while (4) reparametrize the original panel VAR model so as to make it estimable, without imposing restrictions on international spillovers.

It should also be clear that our reparametrization strategy is also preferable using a collection of VARs or bilateral VARs. On the one hand, the random pooling of cross sectional information in (3) helps to get more accurate estimates of the parameters

and to reduce standard errors. On the other hand, if the momentum that the shocks induce across units is the result of a complicated structure of lagged interdependencies, it would instead emerge as "common shocks" in the two alternative frameworks.

In the specification, we use $\Xi\theta = \Xi_1\theta_1 + \Xi_2\theta_2 + \Xi_3\theta_3 + \Xi_4\theta_4$, where Ξ_j are loading matrices of dimensions $NGk \times N$, $NGk \times G$, $NGk \times M$, $NGk \times p$ respectively; θ_j are mutually orthogonal factors capturing, respectively, movements in the coefficient vector which are country-specific; movements which are variable-specific; movements which are specific to exogenous variables, movements which are specific to the lags. Since exogenous variables are capture effect that are common to all variables of the system, θ_3 can be also interpreted as a global factor.

The model has time invariant parameters and the VAR errors have fixed volatilities. Since the recent literature is keen on estimating models where both the VAR parameters and the volatilities are time varying (see e.g. Faccini et al. 2012, Benati and Lubik 2013), a few words of explanations for our choices are needed. First, as it is clear from (4), the estimated model does have an heteroskedastic error term, but time variations in the covariance matrix of the v_t are produced by the lags of the endogenous variables rather than an exogenous independent process. Second, while it is common to specify a parametric law of motion for the evolution of the VAR coefficients, we will take a nonparametric approach. That is, to evaluate the extent of time variations, we will estimate the model on a fixed window of data and roll through the sample. This procedure is very much akin to the one employed by Canova (2009) to estimate time variations in DSGE models and allows direct comparison of the results of fully structural and semi-structural approaches. A non-parametric setup is preferable because estimation of the model is, computationally, much less demanding. Finally, notice that the setup allows, in principle, to take into account time variations in the mean and the variance of the observables when standardizing. Because the sample is relatively short and because of the variables we consider in the VAR, these "real time" standardizations seem to add nothing to our exercises.

Details on the estimation of the model are provided in the appendix. For the cur-

rent versions of the model, fiscal shocks are identified using a Choleski decomposition of the matrix P_2 with government expenditure running first. This is equivalent to the approach used by Blanchard and Perotti (2002) for a closed economy VAR. In future versions of the paper we plan to examine other identification schemes which require sign restrictions on the contemporaneous responses of expenditure, revenues and deficits.

Multipliers are computed as in Auerbach and Gorodnichenko (2012): the short run multipliers are obtained dividing the sum of the output responses by the sum of expenditure responses for horizon zero and one (so that they measure the average over two quarters); the medium run ones are obtained summing up the responses of output and dividing by the sum of the government expenditure responses over twelve quarters, from horizon zero to horizon 11.

3.1   An indicator of the fiscal stance

The reparametrization that (4) produces is useful to decompose the dynamics of the endogenous variables into its components. In fact, the factor structure for δ conveniently we assumed allows us to measure the relative importance of common, unit, or variable specific influences for fluctuations in Y_t. For example, $CLI_t = \mathcal{Z}_{1t}\theta_1$ plays the role of an (vector) of $N \times 1$ of unit specific indicators, while $CLI_t = \mathcal{Z}_{2t}\theta_2$ plays the role of a $G \times 1$ vector of variable specific indicators. Given our interest in providing an historical measure of the fiscal stance, we construct a regional fiscal stance indicator as $RFI_{jt} = \sum_{i=1}^{N} \mathcal{Z}_{1it}\theta_{1i} + \mathcal{Z}_{2jt}\theta_{2j}$, where $\mathcal{Z}_{2jt}\theta_{2j}$ captures either the deficit or the debt component indicators, and track its behavior over time. Similarly, an indicator of the fiscal stance in country i is $NFI_{jit} = \mathcal{Z}_{1it}\theta_{1i} + \mathcal{Z}_{2jt}\theta_{2j}$. Note that in both cases we net out the effects due to exogenous variables. Thus, our measures integrate out effects due to global business cycles and focus only on regional and national specific fluctuations. Furthermore, since the variables are demeaned and standardized, our indicators measure deviations from the standardized mean value in the sample. Hence, their interpretation is simple:when the indicator is positive,

the stance will be loose relative to the average of the sample, while when they are negative the stance is tight relative to the average of the sample.

4   The data

In our exercises we restrict attention to 7 countries in the Euro area, which cover about 87 percent of the area wide GDP (and trade). Four are from the "periphery" (Greece, Italy, Spain and Portugal) and three from the "core" (France, Germany and the Netherlands). For each country there are eight endogenous variables: real government consumption expenditure, total government revenues, total gross government debt, real gross domestic product, real total private consumption, real total fixed investment, the capital accounts, and an interest rate on 10 years government securities. The predetermined variables, common to all countries, are: the US treasury bill rate, the US gross domestic product, the US consumer price index, the Euro area short term interest rate, the Euro area gross domestic product, and the Euro area consumer price index and the forecasts of government expenditure made by the OECD. These variables should capture real, monetary and price effects in the US and the EU, which are responsible for the common movements present in the domestic variables of the seven countries, and potential anticipatory effects. All the data comes from Datastream, except for the capital account series, which are from the IMF, and private and government consumption, fixed investments in Portugal and the government expenditure forecasts which come from the OECD database. The sample goes from 1990:1 to 2012:4.

We use standardized, demeaned year-on-year growth rates of these variables. We need to standardize the variables to make sure that our equal weighting scheme implicit in the choice of Ξ makes sense. We take year-on-year growth rates since some series display important seasonal patterns despite being officially deseasonalized. Interest rates are in year-on-year changes.

Before we present the results, a few comments on the choice of variables are in

order. First, since the model uses government consumption expenditure and total revenues, the deficit series we construct is not comparable with the deficit series typically employed in the literature or reported in the press. However, it can be used to construct an upper bound for the measure of fiscal stance, since when a deficit is recorded in our case, total revenues are not even sufficient to cover current consumption expenditures thus leaving the burden to finance transfers, expenditure for investments, etc. to debt. Second, the dynamics of the debt do not necessarily correspond to the dynamics of the deficit measure because of the above mentioned discrepancy and because the debt has different maturities and the rollover occurs at different times.

5 The results

We divide the presentation of the results in seven subsections, each focusing on a particular themes. First, we present indicators of the fiscal stance we construct and comment on their dynamics. Second, we discuss how expenditure growth shocks domestically spread in the peripheral Euro area countries. Third, we compute the domestic and international output growth multipliers in the short and in the medium run. Fourth, we discuss the channels of international transmission. Fifth, we examine whether a contractionary expenditure growth shock coordinated in the periphery leads to dynamics which are different from those obtained in the idiosyncratic case. Sixth, we compare baseline multipliers with those obtained when expenditure shocks are combined with tax increase to insure that the deficit shirks. Finally, we compare the dynamics that contractionary expenditure growth shocks generate before and after the recent crisis.

5.1 Indicators of the fiscal stance

To start with, we examine the time profile of our indicators of the fiscal stance. We present two types of indicators, one which reflects the debt situation and one

which reflects the deficit situation. Figure 1 reports the time path for the aggregate indicators; figures 2 and 3 present the time path for the country specific indicators.

The dynamics displayed in figure 1 agree with the conventional wisdom. For example, debt control was loose (the indicator is above the zero line) at the beginning of the sample and efforts were made to tighten debt control before the Maastricht Treaty was implemented in 1993. The process was reversed in the middle of the 1990s and a period of very loose debt control followed. Since 1996 there has been a persistent attempt to decrease the debt level in the area. This has resulted in a tight debt stance which lasted until 2002. Since then, the debt started increasing again and the indicator turned loose in the middle of the 2000's. Since 2008 the indicator rapidly moved from tight to loose and reached a level which was higher than the one experienced in the mid-1990s. In the last two years, the rapid increase was reversed but by 2012 the level of debt is still considerably above the historical average.

The indicator based on the deficit also shows dynamics which agree with the conventional wisdom. It was positive in the early 1990s, when almost all countries run a deficit; it turned negative before the creation of the Euro, and again positive in the early 2000s. From 2003 to 2008 the deficit declined persistently, primarily because of the large increase in revenues, and turned massively positive in 2009 and 2010. In these two years, the demeaned standardized growth rate of current government expenditure (excluding transfers and excluding expenditures for investment purposes) exceeded the demeaned standardized growth rate of total revenues by 2.5 percentage points, a number which is unprecedented in the sample. The probability that such an event occurs, given the historical sample, is less than one percent. In the last two years of the sample, because of the large cut in expenditures, the indicator turns negative and at the end of the sample is 1.7 points below its average level. This is a very large adjustment and nothing of this kind has been observed over the sample. In comparison, the adjustments performed prior to the Euro changeover where roughly one-third in size In fact, the probability of observing such an abrupt change in such a short time is less than 1 percent.

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The national indicators display patterns which are qualitatively similar to the aggregate indicators and only level differences are observed. This is because the estimated country specific component is small relative to the estimated variable specific component and the dynamics of the latter dominate. Interestingly, the deficit stance in Germany appears to be looser than in other countries: in fact, the indicator is on the positive side much more often than on the negative side. While this is primarily due to the fact that revenues fluctuate much less in Germany than in other countries, making swings in the deficit measure smaller than elsewhere, it is interesting to notice that the country that most supports fiscal conservatism seems to apply it less often than other countries.

5.2 The domestic response to contractionary expenditure shocks in the periphery

Figure 4 reports the domestic responses of (the level of) government consumption expenditure, real GDP, real consumption, real investment, and real net exports and figure 5 the responses of the debt, of the long term interest rate and of the capital account balance to a one percent decline in the standardized growth rate of government consumption expenditure in the pre-crisis sample (1990-2007).

Overall, the cross-country heterogeneities are pervasive. For example, contractions of government expenditure may have temporary recessionary output effects (Greece), persistent recessionary output effects (Portugal), insignificant output effects (Spain) or temporary expansionary output effects (Italy). In the medium term heterogeneous seem to wash out somewhat: Italy, Spain and Portugal output responses are significantly below the initial steady state, while Greek output response is insignificant. Two seem to be the reasons for these patterns. First, the reduction in government expenditure growth is temporary in Greece and much more persistent in the other three countries. Second, the dynamics of net export seem to drive somewhat the dynamics of output. For example, net export strongly increases in Italy and the instantaneous increase is larger than the instantaneous decline in government consumption expen-

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diture; it moderately increases in Spain and Portugal but the increase is not enough to compensate for the initial fall in government expenditure. Notice that the dynamics of consumption and investment are very much country specific (consumption declines and investment increases in Greece; they both decline in Italy; consumption temporarily increases and investment is insignificant in Portugal; consumption responses are insignificant, but investment increases in Spain), and that there are countries in which private aggregate demand falls (Italy) and countries where private aggregate demand increases (Spain and Portugal). Interestingly, in the increase in net export experienced by three of the four countries is obtained because of a large fall in imports, presumably because both less imports are consumed by the government and domestic consumers switch from foreign to domestically produced goods, and a very moderate increase in export. This is because the effect of expenditure cuts on the real exchange rate is generally small and insignificant. Thus, there is very little evidence, at least in the sample under consideration, that contractionary expenditure measures help to reestablish the international competitiveness of a the periphery - presumably via a reduction of real wages and the costs of production. The main message of table 4 seems to be that if the cut in government consumption growth is accompanied by a larger reduction in imports growth, it may have temporarily virtuous output effects. However, these virtuous effects are temporary as domestic aggregate demand comove considerably with government expenditure.

Figure 5 indicates that temporary reductions in the growth rate of government consumption expenditure do not necessarily make the long term interest rate fall. In fact, if we exclude Spain, where the effect in insignificant at all horizons, the cut increases long term rates, temporarily in Italy and Portugal, and persistently in Greece. Thus, the idea that a more conservative management of the fiscal balance may lead markets to decrease the cost of government financing is not supported by the data. Financial markets do not necessarily see in a cut convincing evidence that the government is genuinely interested in reducing the deficit. For Greece this is obvious, since the cut in expenditure growth is reversed two quarters after the initial

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impulse. For Italy and Portugal, markets seem to wait to see if the cut is persistent and sizable before reversing the initial increase in long term rates.

In addition, cuts in the growth rate of government expenditure do not necessarily trigger reductions in the outstanding debt level. For example, in Italy debt keeps on growing, while in Spain debt responses are insignificant. To understand the pattern one should remember that there are two effects driving debt dynamics. On the one hand, because output falls, revenue also fall making deficits grow in some countries (see e.g. Spain and Portugal). On the other hand, since long term interest rates tend to increase, the cost of financing generally increase. One should be careful with this second effect because the debt has different maturities and it is not rolled over every period, making the interest costs not necessarily change one to one with the changes in the long term rates, but at least in the sample under consideration but seem to drive the debt in the same direction. Interestingly, the medium term responses of the debt in Italy reproduce quite well the medium term responses of government consumption expenditure, suggesting that interest payments may be important in the short run but they are not crucial in generating the observe debt dynamics in the medium run.

Finally, note that the dynamics of the capital account balance are also very heterogeneous. Temporary reductions of the growth rate of government consumption expenditure generate persistence capital outflows in Greece and Italy, temporary capital inflows in Portugal and medium run outflows in Spain. In all cases, the observed changes are of an order of magnitude smaller than those in net export. Two lessons thus emerge from figure 5: the effects on interest rates and on debt may not be the expected ones, unless the contraction is perceived to be credible; the trade channel is more important than the financial channel to understand the domestic effects of fiscal policy shocks in the periphery of the Euro area.

5.3 Multipliers

What is the size of the domestic output multiplier? Do the contractionary expenditure shocks spillovers to other countries? Is international transmission fast or does it take

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some time? The existing literature does not agree on the size of domestic multiplier but cross country evidence (see Spilimbergo et al., 2009) suggests an average value of 0.5, with most country values above zero but below the mean. For Europe, the values are slightly larger (the range is 0.5-1.0) (see Gechert and Will, 2012, or Andres and Domenech, 2012) primarily because alternative fiscal instruments and estimation method are considered. No evidence we are aware of exists for international multipliers.

In theory, the size of the multiplier depends on a number of factors. For example, it has been pointed out that financial frictions, nominal and real rigidities, monetary policy stance, the exchange rate regime; the degree of openness and the credibility of measure (Iltezky, et al., 2012, Corsetti et al. ,2012, etc.) matter. Thus, average measures are not very informative and it is important to condition on time (and on the state) to evaluate the domestic and international effects of fiscal policy. We do this in table 1 where we report the output growth multipliers produced by expenditure growth shocks in the short run (2 periods) and in the medium run (12 periods) for the pre-2008 sample.

The multipliers we obtain are generally positive but their size is small (below 0.5). When the point estimate is larger, the standard error is also larger making the hypothesis of zero multiplier hard to reject. International short term multipliers are overall significant, suggesting that even before 2008 instantaneous spillovers are statistically relevant. Moreover, international multipliers in the periphery exceed in absolute value domestic multipliers (compare e.g. Greek and Italian multipliers to Greek expenditure growth shocks, or Portugal and Spain multipliers in response to Portuguese expenditure growth shocks) and in the core countries the multiplier effects are large (compare, e.g., the French multipliers to Greek or Portuguese expenditure growth shocks, the German multipliers to Italian, Spanish or Portuguese expenditure growth shocks, or the Netherlands multipliers to Greek or Italian expenditure growth shocks). Hence, the economic significance of the spillovers is far from negligible.

The sign of the international multipliers is not uniform and contractionary expen-

diture shocks in Italy produce short run expansionary output effects in all countries but Spain; contractionary expenditure shocks in Greece produce expansionary output effects in France and Germany; but contractionary expenditure shocks in Portugal and Spain lead to temporary output growth contractions both in France and Germany. The somewhat puzzling sign of these multipliers is not due to the local dynamics of government expenditure: in fact, while government expenditure is positively correlated across countries, the responses of government expenditure in France or Germany to expenditure cuts in the periphery is insignificant. Hence, fiscal contractions in the periphery have important redistribution effects. We will try to understand what generates them in the next subsection.

The same tendencies are present in the medium run - the exception here is Greece since expenditure growth shocks generate insignificant effects in all countries. Two are the differences between the short and the medium run: multipliers are generally smaller in the medium run; the international expansionary effects produced are more subdued for Italy and disappear for Greece in the medium run. In general, the effects of government expenditure cuts seem to dissipate fast and, for this sample, that regional redistributive effects are present only in the short run.

5.4 Channels of international transmission

What are the channels of international transmission of fiscal shocks? What happens to the spreads between long term rates? Since international spillovers appear to be relevant, it is worth examining what channel accounts for the international transmission we unveiled. Given, the evidence so far collected, we expect the trade channel to be important. However, one should remember that while within Euro area trade accounts for most of the movements in the trade balance in the countries we consider, capital account changes need not reflect movements from the Euro area only. Thus, while it is possible that domestic capital inflows and outflows are small, these may be consistent with large capital outflows toward the core countries. In figures 6-9, we present the responses of the capital account, of the trade balance and of the spread

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between the long terms interest rates of the countries where the contractionary expenditure growth shock occurs and the domestic long terms interest rate in France, Germany and the Netherlands.

Although there is substantial heterogeneity in the responses, the trade channel seems important, while the capital flows channel is relevant in a few notable cases. Take, for example, the case of Italy government expenditure growth cuts. The responses of net export in France, Germany are positive and significant, while the responses of net export in the Netherlands are negative and significant, at least in the short run. Consistent with this pattern the output multiplier in France and Germany was positive and the one in the Netherlands is negative. Notice that net export is increasing in France and Germany, because import slightly declines and export greatly increases, and this increase seems to be equally split within and outside the Euro area.

There are also important capital movements in these three countries: while France temporarily benefits and the Netherlands persistently benefits from capital inflows following the expenditure cut in Italy, Germany capital account seems to be less responsive in the short run while capital outflows appear in the medium run. Perhaps surprisingly, the pattern mirrors pretty much what current account pattern in Italy. In general, the dynamics of capital flows in response to government expenditure have country specific characteristics which may have to do with factors that are not controlled for in the analysis.

The dynamic response of the spreads is also interesting, and suggests the presence of very strong dual features. Again, considering a contractionary fiscal shock in Italy, which is the major country in the periphery, the spread with German and Dutch long term interest rates increases, due to the fact that both Italian long term interest rates increase and German and Dutch interest rates fall. However, while the spread with German long term rates is persistently above zero for up to four year, the one with the Netherlands follows pretty much the dynamics of Italian long term rates. Hence, the initial "flight to quality" that seems to characterize Dutch long term government

bonds is reversed as soon as Italian long term rates start to fall. French long term rates, on the other hand, instantaneously jump up so that the spread with Italian long term rates is insignificant over the first two quarters. After that, the spread becomes negative - French long term rates decrease less than the Italian rates. Thus, there is an initial "contagion" effect on French long term rates and the return to the "normal situation" is much slower in France than in Italy. The presence of these patterns is remarkable because the period we consider does not include the recent crisis period.

In sum, international transmission occurs both via trade and via capital movements. Trade patterns are surprising in some countries and capital movements are quite heterogeneous in size and timing. The effects on spreads are very much country specific, but overall, there is evidence that both contagion effects and "flight to quality" were present, even in the pre-crisis sample.

5.5 Common shocks

The current fiscal consolidation did not involve only one country but it almost simultaneously occurred in the four peripheral countries we consider. The question to investigate is whether the international effect that are produced are simply the sum of the effects due to each of the national contractionary shock or whether there are externalities, which make international effects larger or different. Such a comparison will be impossible to undertake if using country specific VARs. Our setup, instead, is particularly suited for the exercise. The last column of table 1 reports the output multipliers that are generated in the short and in the medium run when the contraction is common.

Second round effects appear to be minor in the short run. For example, the output growth multipliers in France, Germany and the Netherlands are similar to the largest multipliers reported with single country shocks, while in the peripheral countries the median multiplier is somewhat smaller than the domestic multiplier we previously discussed and for Italy the expansionary effects of fiscal contractions disappear. In the medium run, the effects are more mixed. In some countries, the multiplier is larger

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(Greece or Italy), but in others it is smaller and insignificant (Germany). Interestingly, France seems to benefit most from the coordinated expenditure growth cut, both in the short and in the medium run, while the Netherlands is the country which suffer most, both in the short and the medium run.

Overall, there do not seem to be economically important externalities in the period prior to 2007. We can think of two reasons for why this is not the case. First, coordinated fiscal contractions when they occurred, were quickly reversed. Thus, the combined effects of the measures could be underestimated. Second, apart from the beginning of the 1990s, and perhaps the end of the 1990s, there are few episodes of coordinated fiscal contractions in the sample. The large standard errors we obtain on the medium term multipliers reflects the fact that the information about these events is probably limited.

5.6   Expenditure cuts combined with revenue increases

Table 2 present short and medium term multipliers when expenditure cuts are combined with revenue increases. Thus, contrary to table 1, the multipliers we present are consistent with reductions of government deficits.

There are al least three features of the table that stand out. First, multipliers are much larger, both domestically and internationally, than when only expenditure is cut and there are many more instances where we can not reject the hypothesis that the multiplier is unity. Second, the "virtuous" effect that expenditure cuts have in the short run in Italy remain, but now also medium terms multipliers are negative. Thus, an increase in current taxes leads agents to believe that future taxes will be decreased and this make the gains more persistent. Third, deficit reducing policies in Spain have virtuous consequences, both domestically and in the periphery of the area. While the effects are not strong, they seem to be quite persistent and the pattern is present both in short and medium term. Fourth, coordinated deficit reducing shocks in the periphery seem now to generate multipliers that are larger than those produced by idiosyncratic shocks. Thus, externalities seem to kick in when a

mix of instruments is employed to reduce the size of the deficit. Finally, as it can be seen from the last three rows of each panel in the table, Germany and the Netherlands seem to benefit both in the short and in the medium run from such measures and the multipliers in these countries are often significant and at times large. Hence, regional redistributive effects is considerably larger in this case and certain core countries benefit substantially from the austerity measures in the periphery.

5.7 Has crisis changed the transmission?

The sample we have considered so far stops at 2007. Thus, the dynamics we present are those one should expect to occur after a consolidation measure in somewhat tranquil times. We know that after that date comovements across countries, both in Euro area (see Canova and Ciccarelli, 2012) and around the world (see Imbs, 2011) have dramatically increased. A relevant question is thus whether the recent financial crisis has altered both the stylized facts and the pattern of transmission of fiscal shocks we have previously described.

To measure time variations in the transmission of shocks is now common to use time varying coefficients (TVC) structural VARs. While it is possible to use a structural version of the TVC panel VAR employing some standard assumption to describe the law of motion of the coefficients and of the variances (see e.g. Canova and Ciccarelli, 2009), we do not follow this route since it is computationally demanding. Instead, we examine time variations using a nonparametric approach, similar to the one described in Canova (2009). That is, we estimate the model over rolling different windows of fixed length and trace out how the economy responds to the shocks in different samples. The advantages of such an approach are clear: there is no need to specify the law of motion of the parameters; there is no need to complicate the estimation approach; time variations in the variance of the shocks are possible and may be correlated with the time variations in the parameters. The main disadvantage is that the results may depend on the window used. In future versions of the paper we plan to examine the sensitivity of our results to changes in the window size.

Since the evidence we have presented so far uses 18 years of quarterly data, we move forward the window one year at the time and repeat estimation 6 different times. The last sample starts at 1994 and ends in 2011. We present a subset of the results we obtain in figures 10-13, in table 3 and in figure 14 where we report, respectively, the responses of the domestic variables to shocks, the output multipliers that are generated, and the dynamics of the current account, the spread and the trade balance in France, Germany and the Netherlands for the last sample when the contractionary shock is common to all the periphery.

The crisis seems to have eliminated certain heterogeneities present in the earlier sample. For example, the domestic dynamics of a contractionary expenditure growth in Greece are now similar to those of the other countries and rather than being quickly reversed the expenditure growth contraction is quite persistent. Similarly, the expansionary output effects of fiscal contraction, which were strong in the short run in Italy, now disappears. Spain seems to be the exception, as persistent contractionary expenditure shocks lead to temporary output increases. In all countries the net export effects are still strong and the sign of the responses of output are, once again, generally driven by the magnitude of net export responses since, in addition to government expenditure investment generally falls, while consumption is either unchanged or falls after about one year. Spain is, again, the exception since private consumption increases along with output.

The contraction in government expenditure growth produces now similar effects on the local debt: in the medium run, debt falls and significantly so reflecting the relative large surplus generated with the contractionary measure. While the cross country dynamics of debt are much more similar, there is still heterogeneities in the dynamics of long term rates. Expenditure growth contractions in Greece and Spain make them fall, at least in the medium run; in Italy, long term interest rates remain unchanged and in Portugal they increase. We suspect that these differential patterns have much to do with the dynamics of the capital account balance in each of the countries. In fact, while there are capital outflows in Italy and Spain after the shock,

there is a strong and sustained capital inflow in Portugal.

A very interesting picture obtains when comparing the multipliers we presented in table 1 with those in table 3. Both the magnitude and the significance of the multipliers decreases in this sample, and spillovers from the periphery to the core also seem reduced. For example, short run multipliers generated by expenditure growth shocks in the periphery are smaller in the short run and insignificant (except for Greece) in the medium run. This weakening of the international transmission is counteracted by a much larger effect due to common shocks. As shown in the last column of table 3 international output growth multipliers exceeding one are present and the probability that contractionary fiscal shocks generate expansionary effects both in the short and the medium run increase substantially. The bigger beneficiaries besides Spain seem to be Germany and the Netherlands, who experience increases in GDP growth of the order of three-quarters of a percentage. On the contrary, France suffers and the output growth gains experienced in the first sample are now turned into output growth losses. Thus, our results seem to align well with the strong vocal support in Germany and the Netherlands for joint austerity measures in the periphery often heard in the international press, the persistence of austerity measures in countries like Spain, despite the very high unemployment rate, and the reluctance of France to continue pursuing austerity measures.

The different signs in the multipliers of core countries are easy to explain. While all core countries experience significant capital inflows and Germany and the Netherlands large trade surpluses, both in the short and in the long run, French exports are hurt, probably as a consequence of the fall of domestic consumption in the periphery and of the switch from foreign produced to locally produced goods, and this makes the trade balance persistently fall in France, thus inducing contractionary domestic effects.

In sum, the last five years of the sample have averaged out a number of idiosyncrasies existing in the domestic transmission of contractionary expenditure growth shocks in the periphery of the Euro area, but have also increased the asymmetries in the spillover effects in the core countries. Multipliers are now larger than before

especially when we consider common shocks. As emphasized in Canova and Pappa (2011), this could also be due to the fact that monetary policy has been relatively accommodative in the last few years and that real rates have been close to zero or negative. What is perhaps more surprising is the fact that combined contractionary expenditure measures in the periphery seem to be quite expansionary in some core countries and this is likely to create further political and economic tensions between the periphery of the Euro area, which is contracting, and certain core countries, which are expanding. It may also explain the current stalemate in the policy arena and the bipolar distribution of supports for austerity vs. growth measures.

6 Preliminary conclusions

This paper contributes to the ongoing debate on fiscal policy with new evidence on questions concerning the transmission of fiscal shocks in the euro area and the generated multipliers. In particular, the paper addresses a number of questions which are key to understand the medium term consequences of the current expenditure cuts: (i) What is the international fiscal stance at a point in time? (ii) What is the size of international multipliers relative to domestic ones? (iii) Are the effects of coordinated changes larger than the sum of effects induced by individual changes? (iv) Are deficit reducing measures different than expenditure reducing measures? (v) Are fiscal contractions likely to have larger effects in the recent sample than in the past?

To answer these questions, the paper uses a panel VAR model where real, trade, financial and fiscal variables are jointly considered for a set of periphery (Greece, Italy, Spain and Portugal) and core (Germany, France and Netherlands) countries in the euro area. The methodology is particularly suited to address these questions because it allows to construct indicators of the fiscal stance – both at Euro area and at country level – and to examine their evolution over time in an integrated framework that takes into account macroeconomic, monetary policy and financial linkages across countries.

The main findings of the paper can be summarized as follows. First, the fiscal stance indicators based on deficit and debt show dynamics which agree with the conventional wisdom and can easily be interpreted in the light of the recent economic developments. Second, contractionary expenditure shocks in the periphery of the euro area have heterogeneous domestic effects and the key to understand the sign of the effect is the dynamics of the trade balance that the shocks generate. The short term effect on total debt and long term interest rates are either small or perverse, suggesting that the signalling effects that contractionary expenditure measures generate in financial markets are quite limited. Third, the spillover effects are also very heterogenous and depend both on the (periphery) country where the expenditure contraction is designed and on the (core) country whose response is considered. In general, while trade effects are important, capital movements appear to be limited and the dynamics of sovereign spreads, at time, perverse. Fourth, a contractionary expenditure shock in the periphery produces important international output effects before 2008, suggesting that the international repercussions of fiscal changes where important also before the crisis. Furthermore, a simultaneous effort in the periphery to improve the fiscal balance results in output effects in the core which are not much larger than the largest output effect originated by a contractionary shocks in a peripheral country. Deficit reducing measures generate large multipliers than expenditure reducing measures and important redistributions effects in the area. Finally, as expected, the magnitude of the spillovers changes after 2008. In particular the virtuous effects of contractionary expenditure shocks tend to disappear, dragging all countries in the periphery in the same recessionary spiral.

Country-by-country analysis of the results seems to align well with the strong vocal support in Germany and the Netherlands for joint austerity measures in the periphery often heard in the international press, with the persistence of austerity measures in countries like Spain, despite the very high unemployment rate, and with the reluctance of France to continue pursuing austerity measures. Interestingly, the last five years of the sample have averaged out a number of idiosyncrasies that existed in the domestic

transmission of contractionary expenditure growth shocks in the periphery of the Euro area, but have also increased the asymmetries in the spillover effects in the core countries. Multipliers are now larger than before especially when we consider common shocks, perhaps due to the accommodative monetary policy stance. What is perhaps more surprising is the fact that combined contractionary expenditure measures in the periphery seem to be quite expansionary in some core countries and this is likely to create further political and economic tensions between the periphery of the Euro area, which is contracting, and certain core countries, which are expanding. It may also explain the current stalemate in the policy arena and the bipolar distribution of supports for austerity vs. growth measures.

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Appendix

It is easy to estimate a model like (4). If we stack the t observations the model is

$$Y = \sum_{j=1}^{4} \mathcal{Z}_j \theta_j + v \tag{5}$$

If the factorization in (3) were exact, the error term would be uncorrelated with the regressors and classical OLS could be used to estimate the vector θ and thus the vector δ using (3). Consistency of the estimates would be ensured as T grows. When the factorization in (3) allows for an error, v_t has a particular heteroskedastic covariance matrix which needs to be taken into account in the estimation.

Our approach to estimation is Bayesian, primarily because the sample is small and we are interested in the exact small sample (rather than asymptotic) distribution of the θ_j. To simplify the computation of the posterior distributions, we assume $V = \sigma^2 I$, which makes sense given the fact the variables of the model have similar units. This implies that the error term is $v_t \sim N(0, \sigma_t \Omega)$, where $\sigma_t = (I + \sigma^2 Z_t' Z_t)$. Thus, the unknowns of the model are the vector of factors θ, their scale matrix σ^2, and the blocks of the covariance matrix of the VAR shocks P_1 and P_2.

We assume an independent prior for the three blocks and assume a semi-conjugate structure of the form

$$
\begin{aligned}
\theta &\sim & N(\theta_0, R_0) \\
P_i^{-1} &\sim & W(f, P_{0i}) \\
\sigma^{-2} &\sim & G(0.5, 0.5 s^2),
\end{aligned}
\tag{6}
$$

where i=1,2, $f = N$ if i=1; $f = G$ if i=2; the hyperparameters $(\theta_0, R_0, P_{0i}, s^2)$ are treated as fixed quantities, W stands for Wishart distribution and G for Gamma distribution. We estimate θ_0, R_0 using averages of cross sectional data; P_{02} is estimated using the residuals of the country specific models and P_{01} the residuals of variable specific models, while s^2 is obtained using the average of variance of the residuals of $AR(p)$ regressions of the NG endogenous variables.

To obtain the posterior distribution for $\phi = (\theta, P_i^{-1}, \sigma^{-2})$ we combine the prior with the likelihood of the data, which is proportional to

$$L \propto \left(\prod_t |\sigma_t \Omega|^{-1/2} \right) \exp \left[-\frac{1}{2} \sum_t (Y_t - \mathcal{Z}_t \theta)' (\sigma_t \Omega)^{-1} (Y_t - \mathcal{Z}_t \theta) \right]. \tag{7}$$

Let $Y^T = (Y_1, ..., Y_T)$ denote the available sample. Then $p\left(\phi \mid Y^T\right) = \frac{p(\phi)L\left(Y^T|\phi\right)}{p(Y^T)} \propto$ $p(\phi) L\left(Y^T \mid \phi\right)$ and the posterior distribution for the elements of ϕ, can be obtained by integrating out nuisance elements from $p\left(\phi \mid Y^T\right)$. Once these distributions are found, location and dispersion measures can be easily obtained.

For the model we use, the analytical computation of $p\left(\phi \mid Y^T\right)$ is impossible, because $p\left(Y^T\right)$ requires integration of the joint distribution of (ϕ, Y^T) with respect to ϕ. To draw sequences from the posterior without any need to compute them we use the Gibbs sampling. Each Gibbs sampling cycle requires $p\left(\theta|\Omega^{-1}, \sigma^{-2}, Y^T\right)$, $p\left(P_i^{-1}|\theta, \sigma^{-2}, Y^T\right)$, $p\left(\sigma^{-2}|\Omega^{-1}, \theta, Y^T\right)$, the conditional posterior of each block of unknowns. Given the prior, the first two are very easy to obtain. In fact, it can be shown that

$$
\begin{aligned}
p\left(\theta|\Omega^{-1}, \sigma^{-2}, Y^T\right) &\sim N\left(\theta_1, R_1\right) \\
p\left(P_i^{-1}|\theta, \sigma^{-2}, Y^T\right) &\sim W\left(f_1, Q_{i1}\right)
\end{aligned}
\tag{8}
$$

where

$$
\begin{aligned}
R_1 &= (R_0^{-1} + \sum_t \mathcal{Z}_t(\sigma_t\Omega)^{-1}\mathcal{Z}_t) \\
\theta_1 &= R_1^{-1}(R_0^{-1}\theta_0 + \sum_t \mathcal{Z}_t(\sigma_t\Omega)^{-1}Y_t) \\
f_1 &= N + T \ if i = 1; f_1 = G + T \ if i = 2 \\
Q_{11} &= \sum_{i=1}^{N}(\sum_t(Y_{it} - \sum_j \mathcal{Z}_{jt}\theta_{jt})(\sigma_t)^{-1}(Y_t - \sum_j \mathcal{Z}_{jt}\theta_{jt})') + Q_{10} \\
Q_{21} &= \sum_{g=1}^{G}(\sum_t(Y_{it} - \sum_j \mathcal{Z}_{jt}\theta_{jt})(\sigma_t)^{-1}(Y_t - \sum_j \mathcal{Z}_{jt}\theta_{jt})') + Q_{20}
\end{aligned}
$$

As it is clear from (7), the conditional posterior for σ^{-2} does not have a standard format because of the Jacobian term $|\sigma_t\Omega|$. Thus, to compute it we use a Metropolis step where candidate draws are obtained from $\sigma^{2\dagger} = \sigma^{2i-1} + \nu$, where σ^{2i-1} is the previous draw and ν is distributed as a normal with mean zero and variance λ. The value of λ is selected to have an acceptance rate of the order of 25-35 percent.

Since our system satisfies the regularity conditions set up in Geweke (2000), cycling through the conditional distributions in (8) produces in the limit draws from the joint posterior of these unknowns. From these, the marginal distributions of θ can be computed averaging over draws in the nuisance dimensions. Convergence to the invariant distribution is checked with standard methods. The results we present are

based on the last draw of 500 chains of length 5000 all starting in a small random interval of the last draw of a single (burn-in) chain of 50000 draws.

We summarize the posterior information contained in our sample using impulse responses and multipliers. Given our model structure, impulse responses are computed as the difference between two conditional forecasts, one where an orthogonal shock is set to one in period t and zero otherwise and another where the shock is zero at all t. Formally, let $\mathcal{F}_t^j$ be a conditioning set containing the initial conditions Y^T, draws from the posterior of ϕ, and a value of $\epsilon_j = Hu$, $j = 1, 2, ...$the structural shock of interest. Then, the impulse responses are

$$IR_y^j(t, \tau) = E(y_{t+\tau}|\mathcal{F}_t^1) - E(y_{t+\tau}|\mathcal{F}_t^2) \qquad \tau = 1, 2, \ldots \tag{9}$$
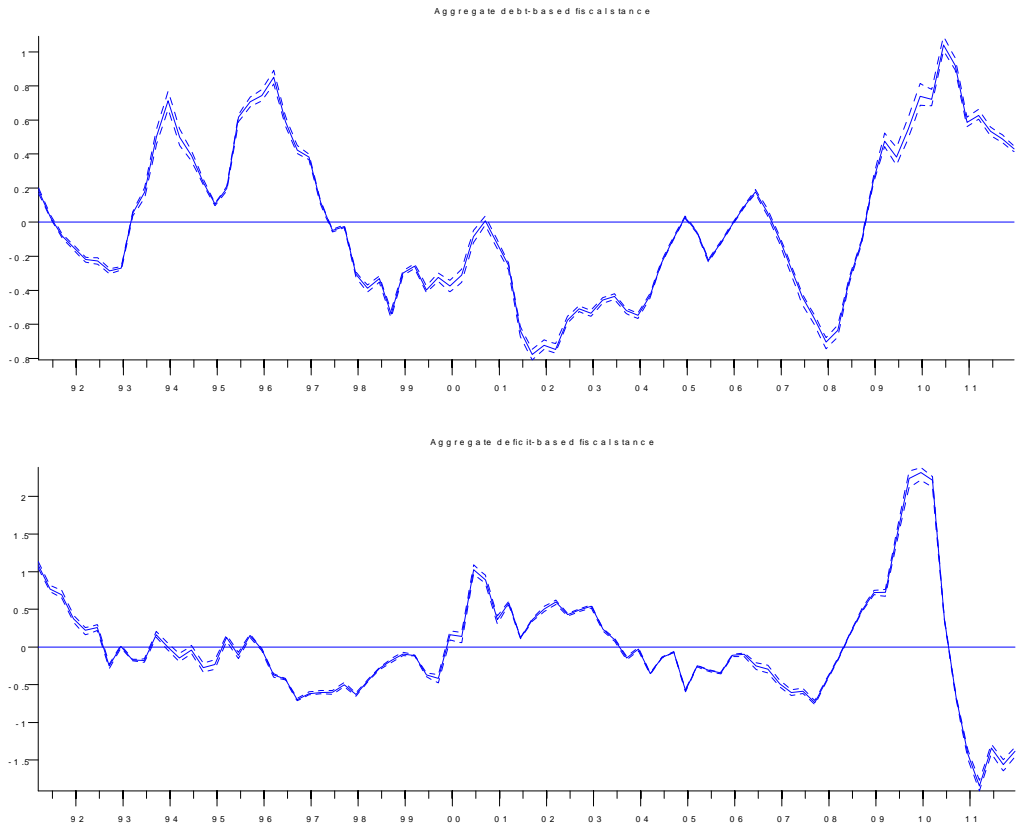
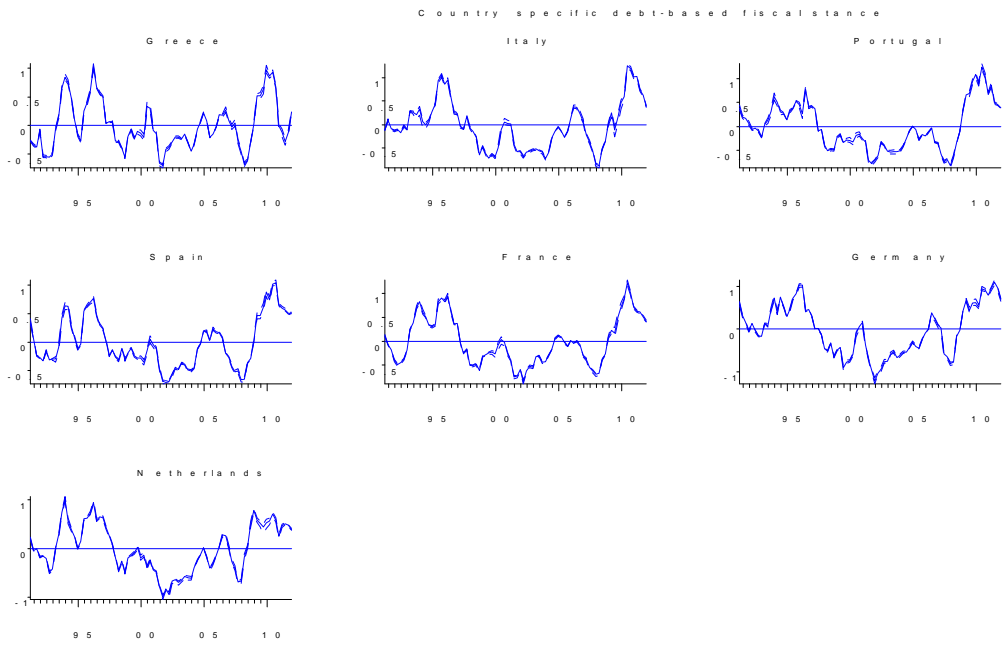Figure 1: Aggregate indicators of the fiscal stance

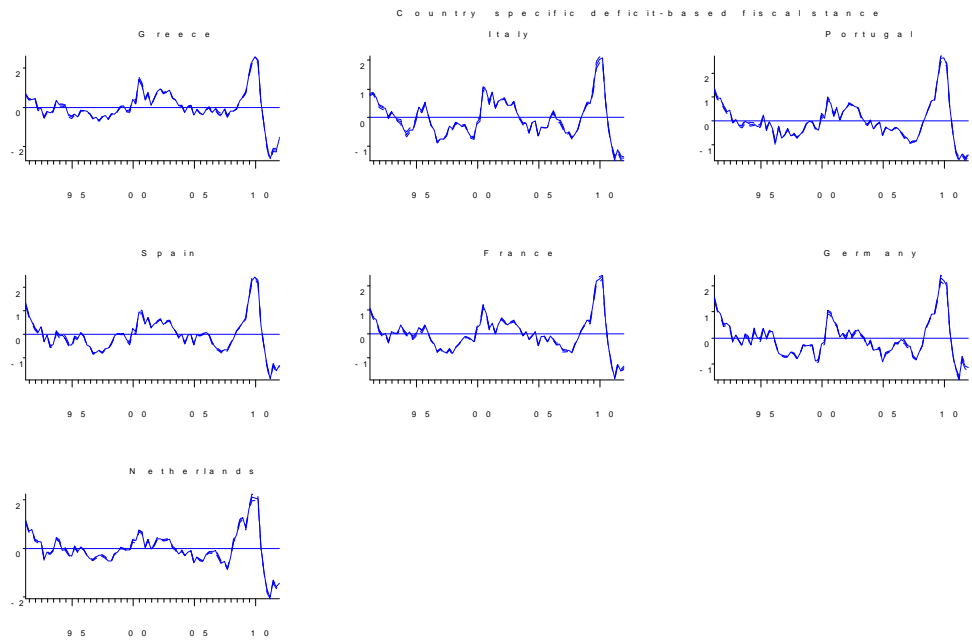Figure 2: Country specific debt based fiscal stance

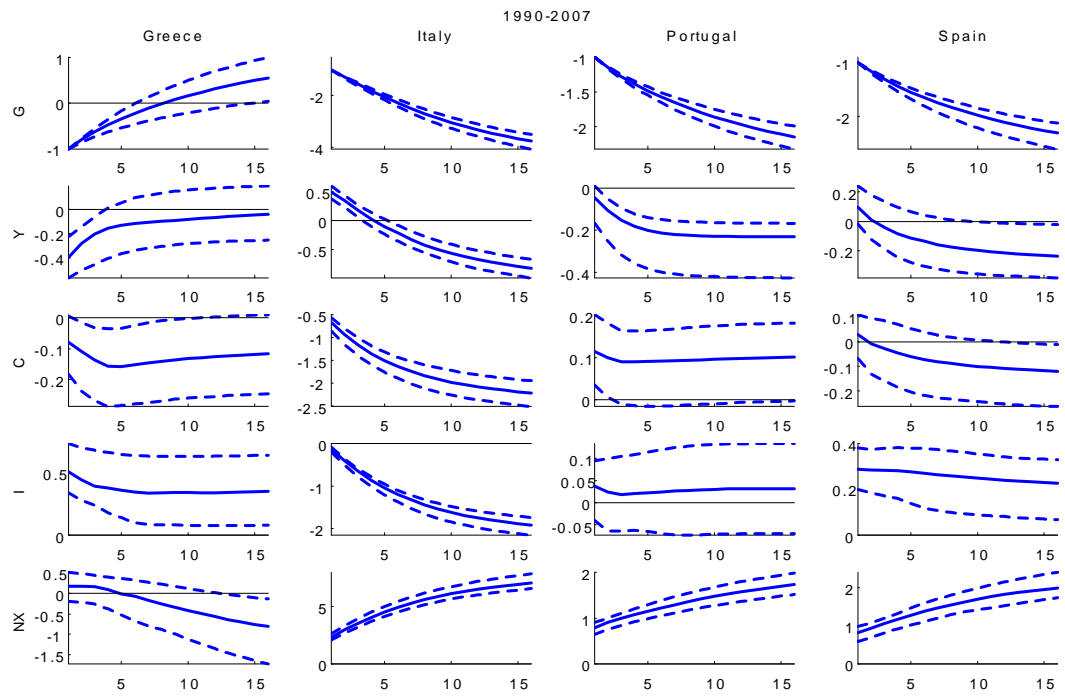Figure 3: Country specific deficit based fiscal stance

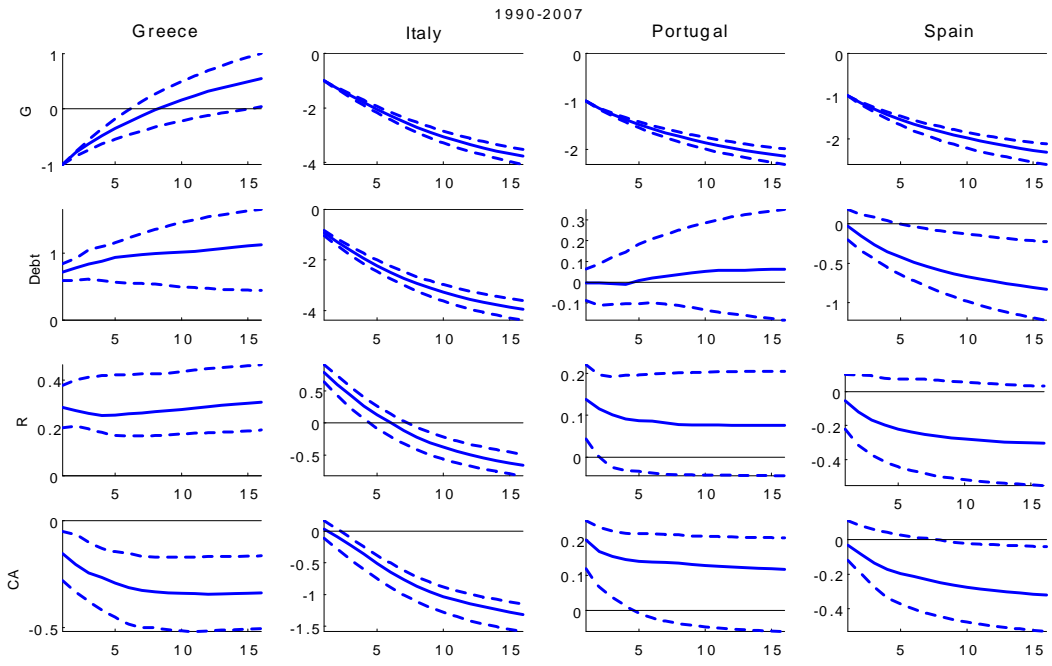Figure 4: Domestic responses to a contractionary expenditure growth shock

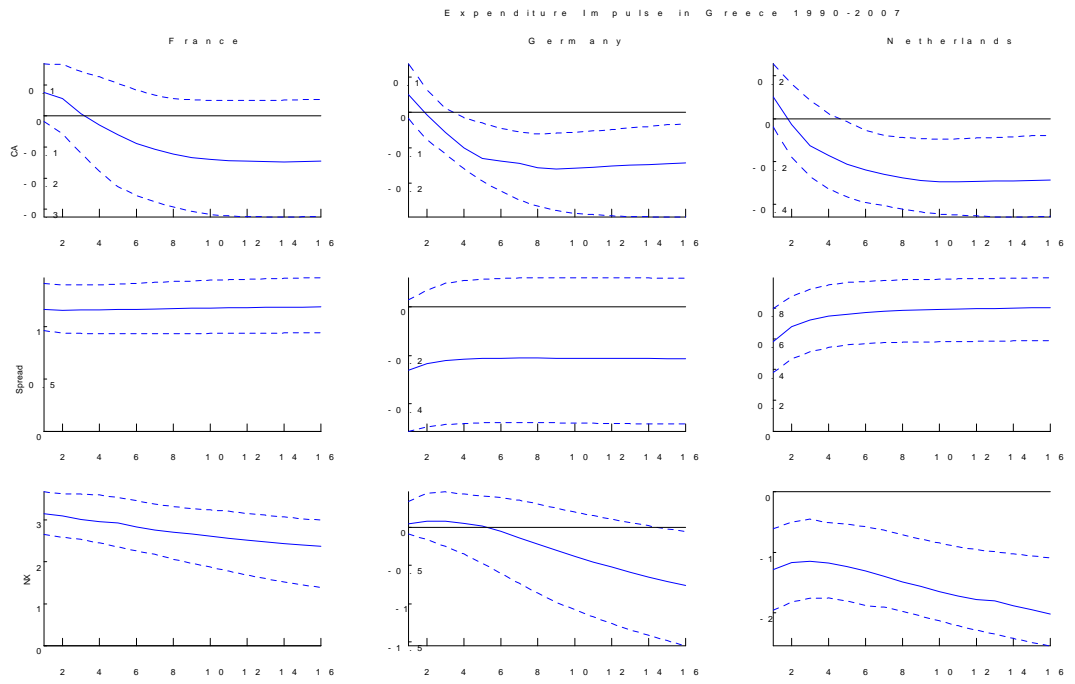Figure 5: Domestic responses to a contractionary expenditure growth shock

Figure 6: International responses to a contractionary expenditure growth shock in Greece
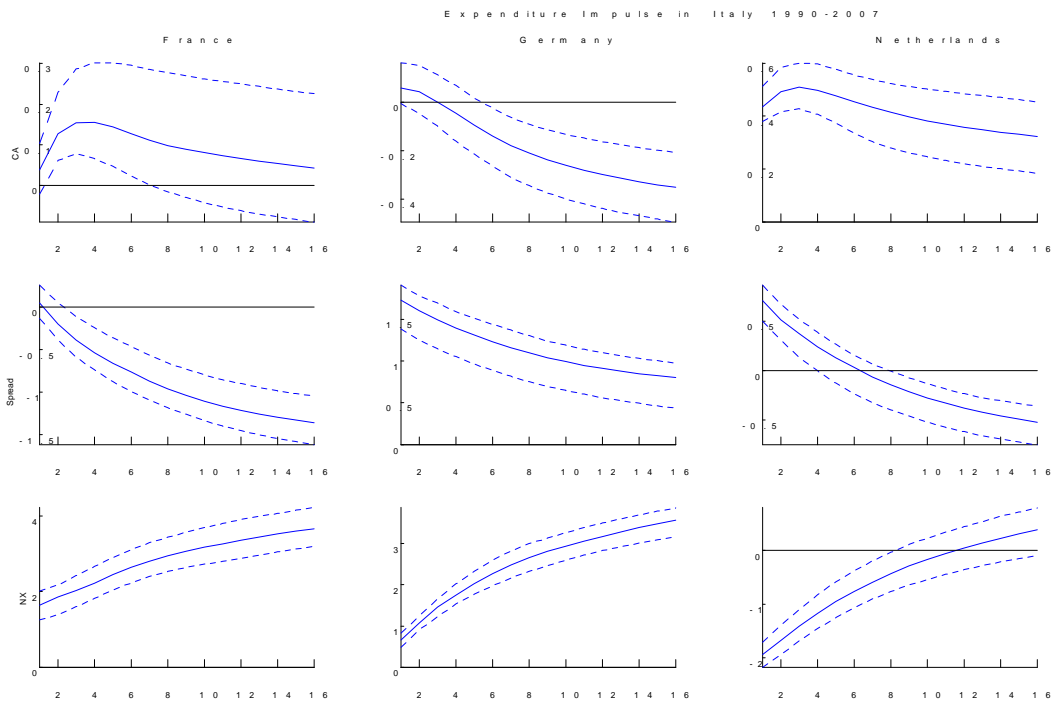
Figure 7: International responses to a contractionary expenditure growth shock in Italy
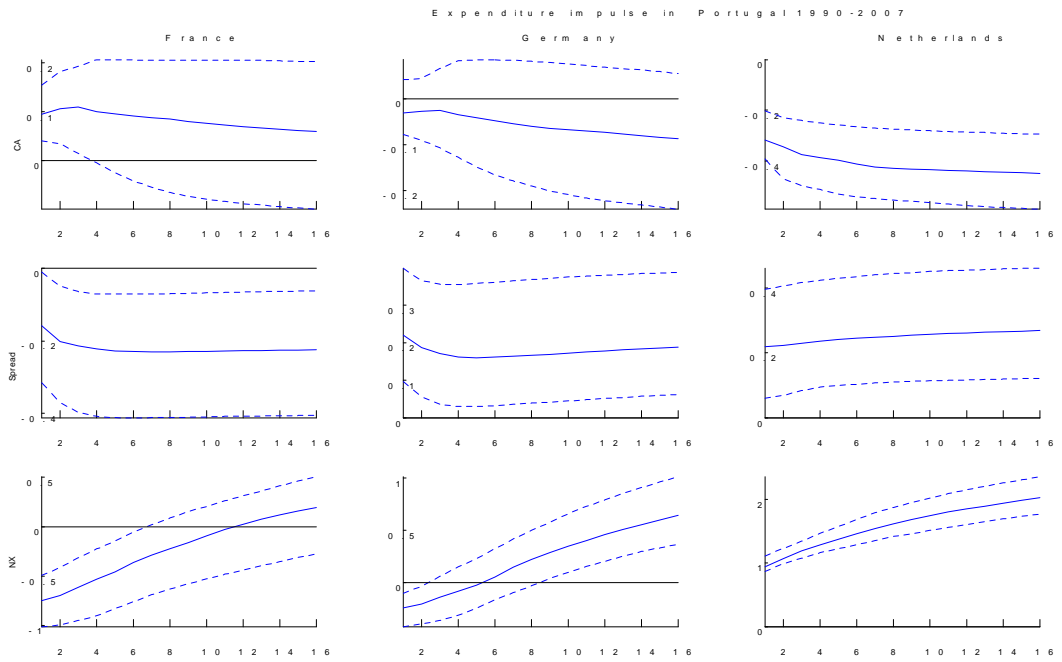
Figure 8: International responses to a contractionary expenditure growth shock in Portugal

Figure 9: International responses to a contractionary expenditure growth shock in Spain

Figure 11: Domestic responses to a contractionary expenditure growth shock in Greece, post 2008

Italy 1994-2011

Government consumption expenditures   Gross government debt   Gross domestic product

Private consumption   Total fixed investment   Capital account

Long-term interest rate   Net exports

Figure 12: Domestic responses to a contractionary expenditure growth shock in Italy, post 2008

Figure 13: Domestic responses to a contractionary expenditure growth shock in Portugal, post 2008

Figure 14: Domestic responses to a contractionary expenditure growth shock in Spain, post 2008

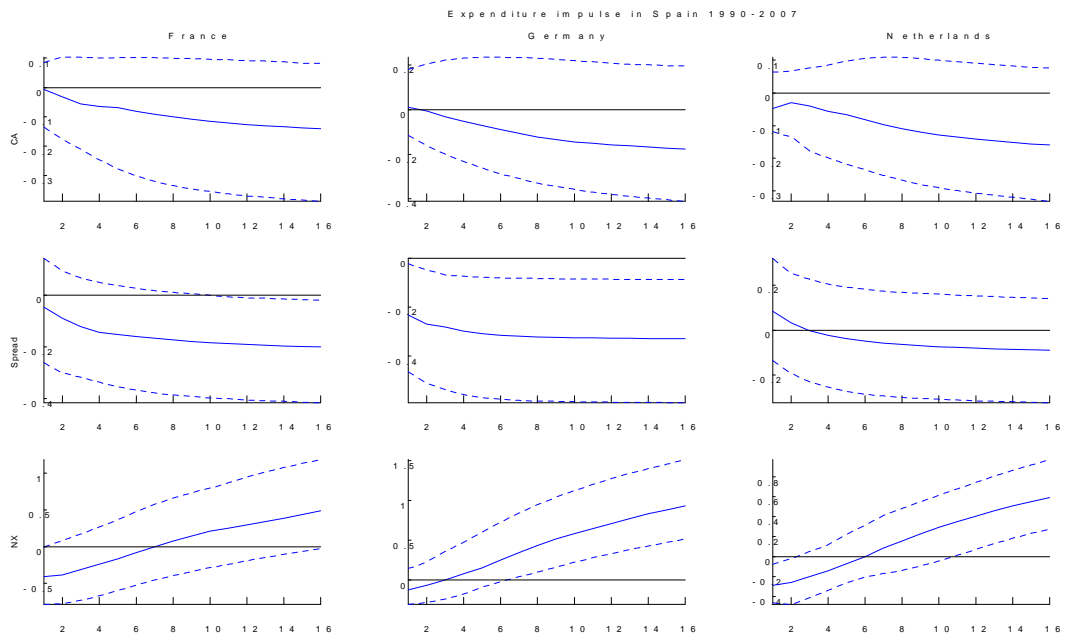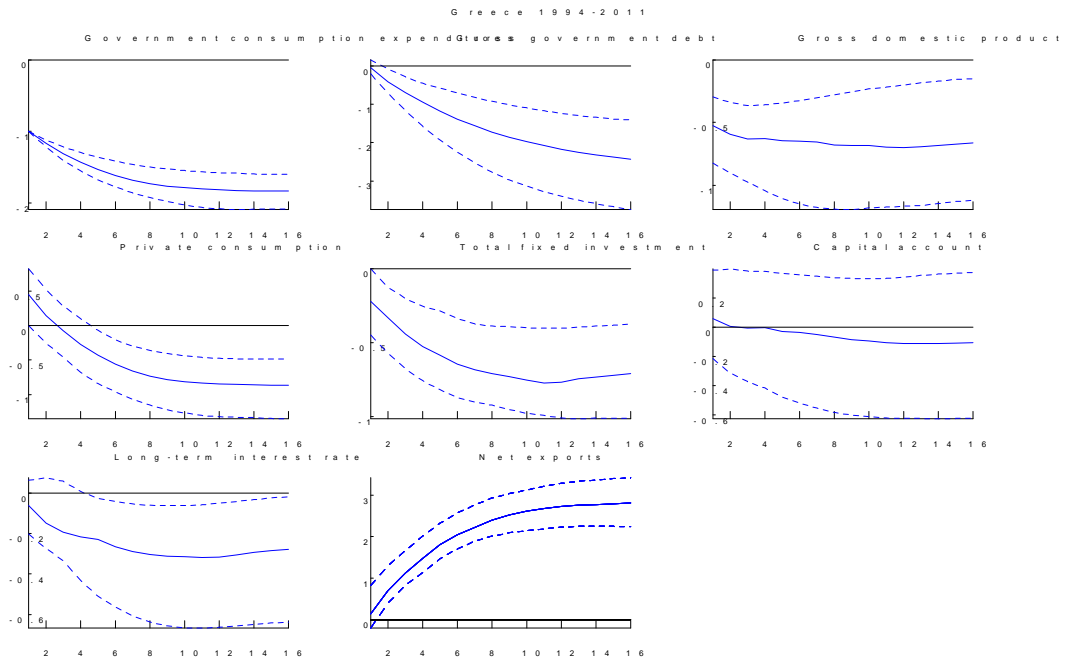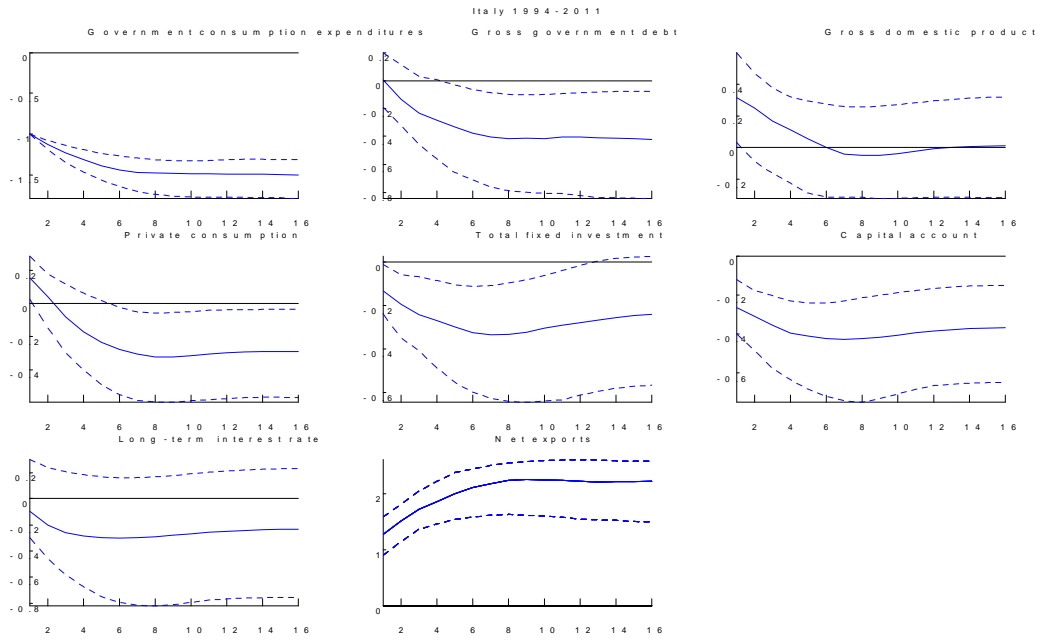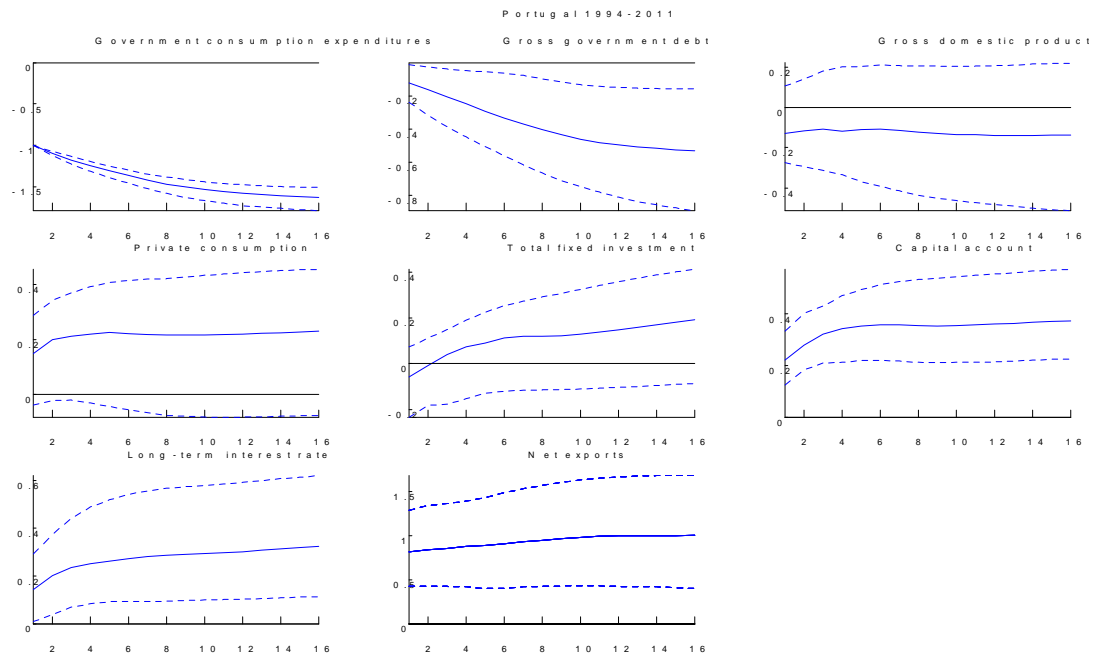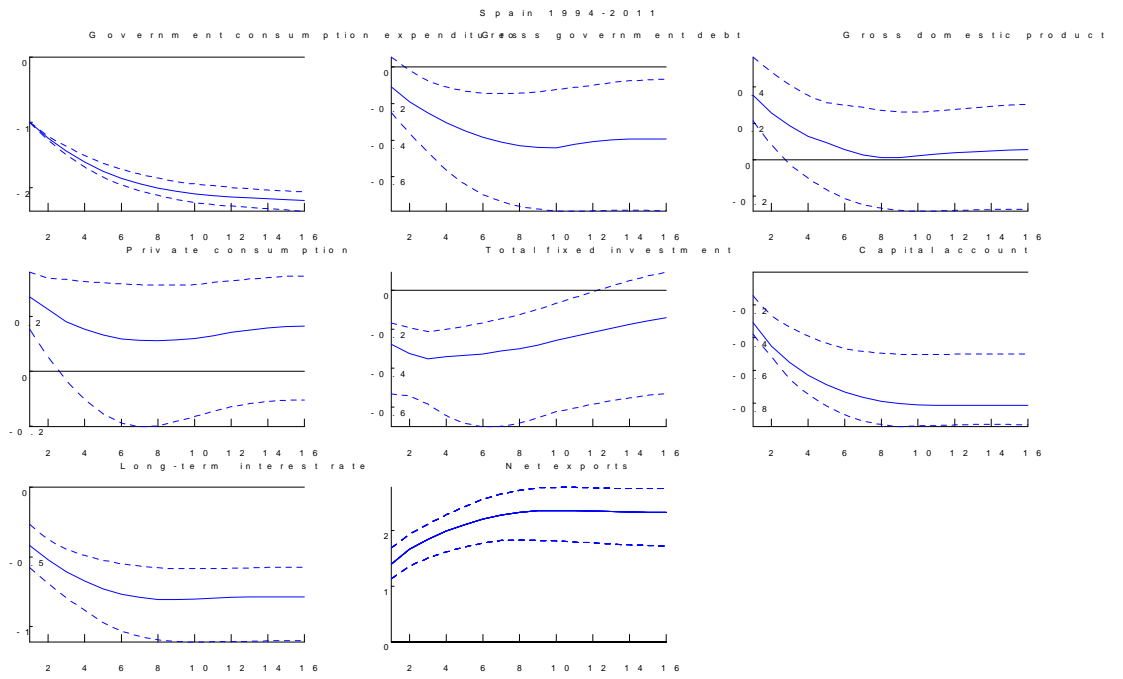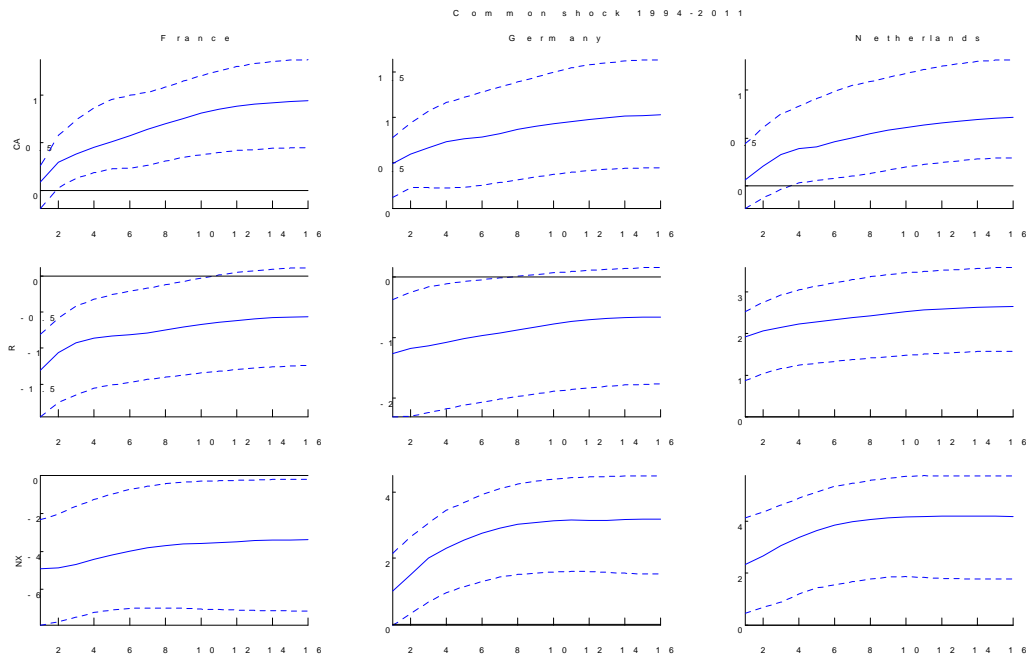Figure 15: International responses to a contractionary expenditure growth shock in the periphery

Short term multipliers					
	Greece	Italy	Portugal	Spain	Common
Greece	0.35	-0.03	0.04	0.03	0.26
	(0.18,0.60)	(-0.05,-0.02)	(0.02,0.05)	(0.01,0.05)	(0.11,0.43)
Italy	0.75	-0.27	0.04	0.03	0.27
	(0.53,0.92)	(-0.33,-0.17)	(0.02,0.05)	(0.01,0.05)	(0.16,0.38)
Portugal	0.36	-0.32	0.09	0.03	0.05
	(0.16,0.60)	(-0.43,-0.21)	(0.04,0.22)	(0.01,0.05)	(-0.19,0.25)
Spain	-0.68	0.24	0.28	-0.01	0.05
	(-0.97,-0.35)	(0.15,0.38)	(0.17,0.38)	(-0.16,0.11)	(-0.21,0.43)
France	-2.57	-0.31	0.32	0.40	-1.18
	(-3.04,-2.13)	(-0.40,-0.21)	(0.22,0.49)	(0.21,0.55)	(-1.62,-0.89)
Germany	-0.44	-0.35	0.18	0.12	-0.34
	(-0.68,-0.22)	(-0.44,-0.29)	(0.11,0.24)	(0.02,0.27)	(-0.51,-0.13)
Netherlands	1.17	0.77	-0.31	-0.06	1.17
	(0.81,1.58)	(0.67,0.87)	(-0.39,-0.19)	(-0.15,0.04)	(0.99,1.38)
Medium term multipliers					
Greece	0.06	0.04	0.09	0.08	0.16
	(-0.71,0.69)	(0.02,0.05)	(0.06,0.11)	(0.05,0.11)	(0.08,0.25)
Italy	-0.41	0.20	0.12	0.13	0.46
	(-1.74,1.12)	(0.16,0.25)	(0.08,0.15)	(0.09,0.17)	(0.35,0.56)
Portugal	-0.30	-0.13	0.11	0.05	0.04
	(-0.97,0.18)	(-0.15,-0.07)	(0.08,0.21)	(0.03,0.09)	(-0.05,0.14)
Spain	1.35	0.23	0.25	0.09	0.24
	(-0.46,3.59)	(0.18,0.29)	(0.17,0.32)	(0.01,0.18)	(0.11,0.43)
France	4.33	-0.12	0.24	0.28	-0.46
	(-5.11,13.63)	(-0.16,-0.07)	(0.17,0.35)	(0.14,0.39)	(-0.64,-0.32)
Germany	0.95	-0.05	0.17	0.15	-0.04
	(-0.67,3.26)	(-0.09,-0.01)	(0.11,0.22)	(0.07,0.26)	(-0.14,0.10)
Netherlands	-1.25	0.33	-0.09	0.01	0.54
	(-5.70,1.92)	(0.28,0.38)	(-0.16,-0.02)	(-0.04,0.10)	(0.43,0.64)

Table 1: Output multipliers, country specific and individual shocks, 1990-2007

Short term multipliers					
	Greece	Italy	Portugal	Spain	Common
Greece	1.32	0.08	-0.04	-0.03	1.26
	(0.95,1.58)	(0.05,0.12)	(-0.09,-0.00)	(-0.07,0.01)	(0.93,1.53)
Italy	0.45	-0.73	-0.04	-0.03	-0.38
	(0.09,0.75)	(-1.01,-0.45)	(-0.09,-0.00)	(-0.07,0.01)	(-0.67,-0.01)
Portugal	0.31	0.76	0.05	-0.03	1.07
	(0.10,0.56)	(0.48,1.09)	(-0.24,0.24)	(-0.07,0.01)	(0.66,1.42)
Spain	-2.03	0.65	-0.35	-0.29	-1.87
	(-2.36,-1.61)	(0.36,0.95)	(-0.59,-0.05)	(-0.68,-0.05)	(-2.57,-1.08)
France	2.04	0.74	0.56	0.31	3.67
	(1.29,3.24)	(0.43,1.10)	(0.17,0.83)	(0.01,0.57)	(2.47,4.55)
Germany	-1.08	0.11	-0.49	-0.30	-1.58
	(-1.40,-0.74)	(-0.10,0.40)	(-0.67,-0.23)	(-0.51,-0.09)	(-1.99,-1.06)
Netherlands	-2.82	-0.31	-0.52	0.08	-3.47
	(-3.46,-2.24)	(-0.72,0.09)	(-0.81,-0.20)	(-0.24,0.31)	(-4.29,-2.51)
Medium term multipliers					
	Greece	Italy	Portugal	Spain	Common
Greece	0.86	0.36	-0.21	-0.02	0.90
	(0.69,1.16)	(0.22,0.47)	(-0.42,-0.02)	(-0.17,0.11)	(0.64,1.27)
Italy	0.01	-0.06	-0.19	-0.04	-0.26
	(-0.26,0.26)	(-0.27,0.10)	(-0.40,-0.01)	(-0.18,0.09)	(-0.55,0.12)
Portugal	-0.13	0.67	-0.07	-0.09	0.32
	(-0.31,0.13)	(0.47,1.04)	(-0.40,0.15)	(-0.22,0.03)	(-0.03,0.73)
Spain	-1.39	0.72	-0.41	-0.07	-1.07
	(-1.73,-1.00)	(0.39,0.97)	(-0.84,-0.16)	(-0.44,0.22)	(-1.61,-0.42)
France	0.87	0.69	0.30	0.11	1.78
	(0.39,1.53)	(0.47,0.97)	(-0.07,0.48)	(-0.09,0.29)	(1.15,2.40)
Germany	-0.82	0.28	-0.54	-0.24	-1.02
	(-1.11,-0.58)	(0.10,0.53)	(-0.74,-0.22)	(-0.45,-0.04)	(-1.39,-0.57)
Netherlands	-1.93	0.01	-0.50	-0.05	-2.18
	(-2.45,-1.57)	(-0.23,0.33)	(-0.85,-0.18)	(-0.27,0.20)	(-2.67,-1.54)

Table 2: Output multipliers, country specific and individual shocks, 1994-2011, Expenditure contraction and revenue increase.

Short term multipliers					
	Greece	Italy	Portugal	Spain	Common
Greece	0.50	0.02	-0.01	0.01	0.50
	(0.30,0.76)	(-0.02,0.07)	(-0.03,0.04)	(-0.03,0.03)	(0.26,0.79)
Italy	-0.00	-0.23	-0.01	0.01	-0.20
	(-0.25,0.30)	(-0.40,0.07)	(-0.03,0.04)	(-0.03,0.03)	(-0.47,0.20)
Portugal	0.56	0.59	0.11	0.01	1.14
	(0.34,0.83)	(0.34,0.85)	(-0.13,0.27)	(-0.03,0.03)	(0.72,1.59)
Spain	-0.99	0.00	-0.22	-0.21	-1.40
	(-1.27,-0.70)	(-0.17,0.29)	(-0.43,-0.01)	(-0.40,-0.07)	(-1.74,-0.79)
France	-0.59	0.04	0.61	0.25	0.55
	(-1.18,0.32)	(-0.37,0.47)	(0.45,0.86)	(0.08,0.55)	(-0.40,1.47)
Germany	-0.37	-0.36	0.06	-0.04	-0.64
	(-0.75,-0.03)	(-0.65,-0.13)	(-0.15,0.24)	(-0.16,0.10)	(-1.17,-0.29)
Netherlands	-0.67	0.27	-0.67	0.07	-0.88
	(-1.21,-0.07)	(-0.05,0.56)	(-0.91,-0.40)	(-0.15,0.26)	(-1.71,-0.13)
Medium term multipliers					
	Greece	Italy	Portugal	Spain	Common
Greece	0.38	0.05	-0.01	0.03	0.42
	(0.11,0.63)	(-0.09,0.26)	(-0.10,0.17)	(-0.07,0.09)	(0.11,0.68)
Italy	-0.36	0.00	0.01	0.02	-0.33
	(-0.63,-0.13)	(-0.22,0.19)	(-0.09,0.17)	(-0.07,0.08)	(-0.46,0.03)
Portugal	0.11	0.44	0.08	0.01	0.44
	(-0.10,0.39)	(0.15,0.75)	(-0.13,0.34)	(-0.10,0.06)	(0.12,0.88)
Spain	-0.79	0.16	-0.22	-0.02	-0.74
	(-1.03,-0.44)	(-0.09,0.49)	(-0.41,0.01)	(-0.13,0.12)	(-1.03,-0.23)
France	-0.55	0.05	0.48	0.16	0.10
	(-0.95,0.01)	(-0.30,0.32)	(0.25,0.67)	(-0.04,0.34)	(-0.60,0.66)
Germany	-0.43	-0.24	0.06	-0.04	-0.61
	(-0.77,-0.13)	(-0.57,0.00)	(-0.10,0.28)	(-0.15,0.11)	(-0.86,-0.21)
Netherlands	-0.72	0.22	-0.41	0.02	-0.76
	(-1.10,-0.20)	(-0.08,0.50)	(-0.65,-0.23)	(-0.10,0.19)	(-1.24,-0.17)

Table 3: Output multipliers, country specific and individual shocks, 1994-2011