Budget Deficit Spillover Effects in the Euro Area*

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Abstract

We estimate spillover effects of a fiscal shock in one member country in the euro area on key variables of the rest of the members, using a Global Vector Autoregression (GVAR) model. Depending on the pair of countries, the results mostly suggest positive, but in some cases negative, spillover effects of a budget deficit shock on outputs of other members. Overall, the bilateral effects resulting from budget deficit shocks are not highly significant. However, in the case of an area-wide budget deficit shock – expressed as a weighted average of the budget deficit shocks across all countries – the impact of the fiscal shock on outputs of all member economies is positive. This finding indicates the importance of coordinated fiscal actions in the euro area. The results of this study are robust to different identification strategies.

Keywords: Fiscal Policy, Cross-border Spillover, Open Economy Macroeconomics, Trade Balance, European Integration, Global VAR

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1 Introduction

A central issue in economics and economic policy guidance is the effects of a change in fiscal policy on the domestic economy. In a highly integrated world, domestic fiscal actions can also affect foreign economies. Domestic effects of a fiscal shift and the associated cross-border externalities are particularly pronounced in the context of a currency union where the exchange rate between member countries is fixed. In this study, we estimate domestic and spillover effects of a fiscal shock in a member country in the euro area. Specifically, we build upon the multi-country global vector autoregression (GVAR) approach developed by Pesaran et al. (2004) as follows:

- Estimate an augmented country-specific VAR model for every economy in the euro 12 area. Country-specific VAR models are augmented with foreign variables.

- Estimate the spillover effects of a domestic budget balance shock on the members of the the euro area by consistently combining all country-specific VAR models in one multi-country model and treating all variables as endogenous. We compute generalised and structural impulse response functions.

Arguments against the available empirical results from VAR estimates of the effects of fiscal shocks are reappraised in detail in Perotti (2007). There is an ongoing debate on the identification of a structural fiscal shock that captures only discretionary fiscal actions. However, in the context of cross-border externalities, fiscal spillovers resulting from a (large) budget deficit in one country would occur whether the cause is only discretion or a combination of discretion, automatic responses, and other effects. Therefore, we primarily rely on identifying generalised impulse response functions. These impulse responses, although broadly interpretable, are informative and capture overall spillover effects. Furthermore, we also identify a structural budget deficit shock, using the recursive identification approach (Cholesky decomposition) and Blanchard and Perotti's expectation augmented approach (2002). Further, as argued in Favero and Giavazzi (2007) and Chung and Leeper (2007), the results of studies that do not take account of the government budget constraint are biased. We consider this by introducing the equation of debt dynamics in country-specific VAR models.

According to our results, overall, our estimates suggest positive fiscal spillover effects between several countries. There are some exceptions, though. The magnitudes of the effects vary across countries. For example, output in the Netherlands seems to be particularly positively affected by a German or a Belgian shock (border countries), but to a less extent by a budget deficit shock in Greece or Portugal. The spillover impacts of a shock to the budget deficit in Germany on output of the other euro area members are rather small and insignificant. Notable exceptions of affected countries are the Netherlands and Luxembourg. For instance, a 1-percent shock to the German budget deficit increases the Dutch output by 0.20 percent on impact. However, we are mainly interested in assessing the qualitative fiscal spillover effects.

A central finding of our analysis is with regard to the area-wide budget deficit shock. This shock is expressed as a weighted average of the budget deficit shocks across the euro area countries, allowing for inter-linkages between these economies. The dynamics of output – for example in Germany – following the area-wide shock is visibly positive in comparison with the effects of a domestic fiscal shock. In essence, in terms of the magnitude of the shock, the area-wide shock is not necessarily larger than the domestic shock. One may think of the euro-wide shock as a shock that has the magnitude of a domestic shock, but to which each country contributes only a fraction depending on the size of the country. Hence, our finding indicates the importance of coordinated fiscal actions.

The documented findings in this study are linked to several results of VAR studies addressing the impacts of a fiscal shock mainly on the domestic economy. The majority of these studies are particularly interested in the U.S. economy or selected G7 economies; for example, Blanchard and Perotti (2002), Pappa (2009), and Perotti (2005). Existing empirical studies on fiscal policy externalities in the euro area typically concentrate on one spillover channel, ignoring others. For instance, Beetsma et al. (2006) consider fiscal spillover effects thorough trade and, in contrast to our integrated approach, proceed in two steps. First, they obtain estimates on the effects of a fiscal shock on output, using a European panel VAR. Second, they impose homogeneity restrictions – that is, the magnitude of the response of output in all included countries is identical – and plug the panel VAR estimates into a trade-gravity type of model. The results of Beetsma et al. (2006) suggest, for example, that a 1-percent increase in German public spending boosts foreign income by 0.15 percent. Faini (2006) employs a single-equation panel approach to estimate the spillover effects through the interest rate channel and finds that a 1-percent decrease in the primary surplus of a member country raises the interest rate of a typical member by 41 basis points.[1]

This study proceeds as follows. Section 2 provides a brief theoretical background of fiscal spillover effects. Section 3 presents our empirical methodology of modelling fiscal policy externalities in the GVAR framework and interprets the fiscal shocks. Section 4 describes the data and our empirical specifications. Section 5 displays our main findings and the robustness analysis based on various identification strategies and specifications. Finally, section 6 concludes.

2 Theoretical Background

There are three main spillover channels of an expansionary fiscal policy in one member country into the rest of the currency union, as can be demonstrated in a multi-country Mundell-Flemming model with a fixed exchange rate peg between members and perfect capital mobility. (1) Positive spillover effects through trade: A fiscal expansion stimulates domestic activities, pressuring the exchange rate to appreciate and the domestic interest rate to increase. In a currency union, however, the exchange rate between members is fixed and the interest rate is ultimately determined at the union level. Hence, domestic money under circulation increases, further stimulating domestic output. The increase in domestic output leads to an increase in imports, boosting the income of the trading partners. (2) Negative spillover effects through eventually affecting the union interest rate: The initial increase in the domestic interest rate following the fiscal expansion attracts capital flows into the domestic economy out of the rest of the union and elsewhere,

[1] While the above mentioned studies focus on fiscal policy externalities in the EU, Arin and Koray (2009) consider the transmission of fiscal shocks from the U.S. to Canada. They find a negative effect of U.S. government spending shocks on Canadian output.

putting upward pressure on the interest rates of the members of the rest of the union. The final equilibrium of the union-wide interest rate may be at a higher level than before the shock. This interest rate channel may have a contractionary effect on foreign and domestic output. (3) Spillover effects through the real exchange rate: The euro is floating with respect to the rest of the world. If the fiscal expansion in a (large) member economy causes an appreciation of the real exchange rate of the euro, as the Mundell-Flemming model predicts, the expansionary effects will be dampened due to worsening trade balances.

Although the transmission mechanism of an expansionary fiscal shock differs in micro-founded dynamic stochastic general equilibrium (DSGE) models, the standard DSGE model agrees with the Keynesian predications of the positive response of output and the appreciation to the real exchange rate. Contrary to the Keynesian predictions, however, consumption decreases in a standard DSGE model. The forward-looking consumer in a DSGE setup is aware of the increase in the present value of household tax liabilities (negative wealth effect) due to the fiscal expansion. Monacelli and Perotti (2010) stress that consumption increases *and* the real exchange rate *depreciates* following an expansionary fiscal shock.[2] Several recent theoretical DSGE studies focus on fiscal shock spillovers within an international setup or specifically in a currency union. Corsetti et al. (2010) show in a two-country DSGE model that financing a current fiscal stimulus plan with a combination of an increase in medium-run taxes and a decreases in medium-run government spending ("spending reversal") enhances positive cross-border fiscal spillovers. Cwik and Wieland (2009) perform simulation exercises using various versions of a structural DSGE model estimated and calibrated for the euro area. They find no support for positive spillover effects of an increase in government spending. Cooper et al. (2009)

[2] The debate on the reaction of consumption and other variables has stimulated a number of studies to modify a standard DSGE model in order to account for the empirically found increase in consumption and depreciation of the real exchange rate. This is accomplished, for example, by allowing for habit persistence at the good level as in Raven et al. (2007), or for future government spending to decrease in reaction to the stock of public debt as in Corsetti et al. (2009). Some models explain the increase in consumption by incorporating non-Ricardian households, as suggested in Mankiw (2000) and Galí et al. (2007). Some empirical studies do not support the positive response of consumption. Hebous (2010) provides a survey of the theoretical and empirical literature on the dynamics of key variables following a fiscal shock.

show in a multi-region overlapping generations model that isolation from fiscal spillovers is not possible.[3] Overall, economic theory provides reasoning to expect positive and negative spillover effects. Empirical evidence is required to clarify the final effect on output and other key variables.

3 Fiscal Policy Externalities in a GVAR Framework

3.1 The GVAR Approach

The GVAR provides an unprecedented coherent approach to estimate spillover effects of a domestic fiscal shock on foreign variables by treating all domestic and foreign variables as endogenous. Strictly, while the terminology "global" VAR is due to the fact that Pesaran et al. (2004) include most countries in the world, our GVAR is indeed a "euro area" VAR that models interdependences across the euro area members.[4] We derive in four steps a system in which the variables of all 12 members of the euro area are combined as follows.[5]

Step 1: Estimate an augmented country-specific VAR model:

$$Y_{i,t} = \alpha_{i,0} + \alpha_{i,1}t + \Phi_i Y_{i,t-1} + \Lambda_{i,0} Y^*_{i,t} + \Lambda_{i,1} Y^*_{i,t-1} + \boldsymbol{\epsilon}_{i,t} \qquad (1)$$

where $Y_{i,t}$ is a $k_i \times 1$ vector of domestic variables. The subscript $i = 1, 2, \ldots, N$ is a country index while $t = 1, \ldots, T$ denotes time. $Y^*_{i,t}$ is a $k^*_i \times 1$ vector of foreign variables. The residual $\boldsymbol{\epsilon}_{i,t}$ is independently and identically distributed with a zero mean and a variance-covariance matrix Σ_i. A foreign variable of country i is computed as a weighted average of its values for the rest of the members. We allow the weights to

[3] Several theoretical studies on fiscal policy in a currency union focus on the interaction between optimal fiscal and monetary policy rules; Ferreo (2009) and Galí and Monacelli (2008).

[4] Pesaran et al. (2004) use the GVAR to examine the effects of global risks on a bank's loan portfolio.

[5] Without loss of generality, in this section, we illustrate the GVAR model by considering one lag. This can be easily generalised to the case of multiple lags.

differ across variables.[6] In a standard country-specific VAR model, foreign variables are discarded; that is, the matrices of coefficients $\Lambda_{i,0}$ and $\Lambda_{i,1}$ are set equal to zero. To study interdependence across countries, one may estimate a large VAR model that includes variables of all countries in the vector Y. In such a model, all variables, domestic and foreign, are treated as endogenous. However, due to the large number of variables, and hence of coefficients to be estimated, and the relatively small number of observations, estimating such a large VAR model is intractable. The GVAR offers an alternative approach by treating foreign variables as weakly exogenous in the country-specific VAR model.

Thus, step 1 allows us to obtain estimates for the matrices $\alpha_{i,0}$, $\alpha_{i,1}$, Φ_i, $\Lambda_{i,0}$, $\Lambda_{i,1}$ and the variance-covariance matrix Σ_i.

Step 2: Transform the model as follows:

$$\underbrace{(I, -\Lambda_{i,0})}_{:=A_i} \underbrace{\begin{pmatrix} Y_{i,t} \\ Y^*_{i,t} \end{pmatrix}}_{:=Z_{i,t}} = \alpha_{i,0} + \alpha_{i,1} t + \underbrace{(\Phi_i, -\Lambda_{i,1})}_{:=B_i} \underbrace{\begin{pmatrix} Y_{i,t-1} \\ Y^*_{i,t-1} \end{pmatrix}}_{:=Z_{i,t-1}} + \boldsymbol{\epsilon}_{i,t} \tag{2}$$

to obtain the matrices: A_i, B_i, $Z_{i,t}$, and $Z_{i,t-1}$.

Step 3: Rearrange the terms to express $Z_{i,t}$ in terms of Y_t:

$$Z_{i,t} = W_i Y_t \tag{3}$$

The matrix W_i is $(k_i + k_i^*) \times k$, where $k = \sum_{i=1}^{N} k_i$. The elements of the matrix W_i are zeros, ones, and the weights used in computing the foreign variables. The matrix W_i links country-specific variables with all foreign variables in the system. The crucial aspect of equation (3) is that there is no subscript i attached to Y_t, that is, variables of all countries in our system are stacked in Y_t.

Step 4: Plug equation (3) into (2) and rearrange to derive:

[6] Section 4 describes the weights in details.

$$A_i W_i Y_t = \alpha_{i,0} + \alpha_{i,1} t + B_i W_i Y_{t-1} + \boldsymbol{\epsilon}_{i,t} \tag{4}$$

which yields the "global" solution:

$$G Y_t = \alpha_0 + \alpha_1 t + H Y_{t-1} + \boldsymbol{\epsilon}_t \tag{5}$$

where: $$\alpha_0 = \begin{pmatrix} \alpha_{1,0} \\ \alpha_{2,0} \\ . \\ . \\ . \\ \alpha_{12,0} \end{pmatrix}, \alpha_1 = \begin{pmatrix} \alpha_{1,1} \\ \alpha_{2,1} \\ . \\ . \\ . \\ \alpha_{12,1} \end{pmatrix}, G = \begin{pmatrix} A_1 W_1 \\ A_2 W_2 \\ . \\ . \\ . \\ A_{12} W_{12} \end{pmatrix},$$

$$H = \begin{pmatrix} B_1 W_1 \\ B_2 W_2 \\ . \\ . \\ . \\ B_{12} W_{12} \end{pmatrix}, \epsilon_t = \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \\ . \\ . \\ . \\ \epsilon_{12,t} \end{pmatrix},$$

and $cov(\epsilon_t) = \Sigma$.

Equation (5) combines all variables in one system, enabling us to examine the effects of a shock to one domestic variable in country i on other domestic variables of country i and variables of country j.

3.2 Interpretation of the Fiscal Shock

As in a standard VAR analysis, the impulse response functions (IRFs) summarise the dynamics of the variables following a shock to the system. While reduced form shocks can be broadly interpreted, structural shocks can be directly linked to policy recommendations. Therefore, existing VAR studies endeavour to disentangle the effects of the structural (discretionary) fiscal shock from other effects. Broadly, the identification of a structural fiscal shock can be achieved either by imposing short-run and long-run restrictions or by means of the sign restriction approach. However, as scrutinised in Perotti (2007) and surveyed in Hebous (2010), the appropriate identification of the structural fiscal shock is debatable. For our purpose, we are particularly interested in the sign of the spillover effect, which is per se subject to different theoretical predictions. This makes the implementation of the sign restriction approach not uncontroversial. In the case of relying on exclusion restrictions, the identification of the structural shock requires imposing $\sum_{i=1}^{N} k_i(k_i-1)$ restrictions that entail several assumptions. Moreover, recovering a structural shock depends on the ordering of the countries in the system. Strictly, there is no theoretical background to guide the order of the countries.

Hence, our strategy is to first rely on generalised impulse response functions (GIRFs). These shocks contain not only the discretionary component of fiscal policy, but also other automatic responses. Still, these shocks are informative, and are invariant to the ordering of the variables in the system (Pesaran and Shin; 1998). The spillover effects of a budget deficit in one member country on the rest of the union would occur independently of the factors behind the deficit, whether discretionary actions or not. Pesaran et al. (2004) show that the GIRF to a one-standard error shock to the jth equation corresponding to the lth variable in country i at time t on expected values of Y at time $t+h$ can be computed as:

$$\psi_{j,l}(h) = \frac{1}{\sqrt{\sigma_{ii,ll}}}(G^{-1}H)^h G^{-1}\Sigma s_j, \; h = 0, 1, \ldots \tag{6}$$

where s is a selction vetor that has 1 as its jth element and zeros otherwise.[7]

Further, we attempt to identify a structural fiscal shock. Let $u_{1,t} = \Upsilon_1 \epsilon_{i,t}$ be the (Cholesky) structural shock in country 1, where Υ_1 is a $k_1 \times k_1$ matrix. Then, $\mathbf{u}_t = \Upsilon^1 \boldsymbol{\epsilon}_t$. Dees et al. (2007) show that the impulse response function in this case is given by:

[7] This is valid for the case of including VAR(1) models. See Pesaran and Shin (1998) for a generalisation.

$$\psi_{j,l}(h) = \frac{1}{\sqrt{\sigma^{1}_{ii,ll}}}(G^{-1}H)^{h}G^{-1}(\Upsilon^{1})^{-1}\tilde{\Sigma}s_{j}, \;\; h = 0, 1, \ldots \tag{7}$$

where

$$\Upsilon^{1} = \begin{pmatrix} \Upsilon_{1} & 0 & 0 & 0 \\ 0 & I_{k_2} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & I_{k_N} \end{pmatrix} \tag{8}$$

and $\tilde{\Sigma}$ is the variance-covariance matrix of the shocks $\mathbf{u}_t$; $cov(\mathbf{u}_t) = \tilde{\Sigma}$.

In our analysis, we recover structural shocks for France and Germany by means of the recursive ordering (Cholesky factoring) originally proposed by Sims (1980). We order the variables in the system in line with studies such as Corsetti and Müller (2006) and Kim and Roubini (2008).[8]

In addition to the country-level budget deficit shocks mentioned above, we examine impulse responses following a shock to the budget deficit in all euro area countries. This area-wide shock (or so-called "global shock") is recovered as a weighted average of the variable-specific shocks across all countries. The weights in the area-wide shock are calculated as the ratio of the GDP of a member country to the total GDP of the euro area.[9]

4 Data and Empirical Specification

Our benchmark specification is a VAR(1) model with a 7-dimensional $Y_{i,t} = (x_{i,t} \; bb_{i,t} \; c_{i,t} \; r_{i,t} \; reer_{i,t} \; nx_{i,t} \; d_{i,t})$, where x is real output per capita, bb is the ratio of primary budget balance to GDP, c is real consumption per capita, r is the real interest rate, $reer$

8 Caldara and Kamps (2008) compare the findings obtained form the recursive formulation with those obtained from other identification approaches proposed in the literature such as the sign restriction approach and the narrative approach.

9 See Dees et al. (2007) for a detailed derivation of the global shock.

is the real effective exchange rate (an increase in $reer$ indicates an appreciation), nx is the ratio of net exports to GDP (trade balance), and d is the ratio of public debt to GDP.[10] All level variables are expressed in natural logarithm. Due to the limited length of the time series, we are restricted to estimate the individual models with only one lag in both domestic and foreign variables. The individual models are then combined to get the GVAR solution of equation (5). Most time series in our analysis are obtained from the OECD Economic Outlook database. The frequency of the data is quarterly, spanning over the period 1979-2009. Our baseline model consists of 12 euro area countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, and Spain.[11]

We compute a foreign variable as a weighted average of its values for the rest of the members as follows:

$$y^*_{i,t} = \sum_{j=1}^{12} w^y_{ij} y_{i,t},$$

Bilateral flows of trade and capital are important determinants of cross-country linkages. We use two different weighting series to construct foreign variables. In the case of real variables, that is, x, bb, and c, the weights are computed based on the trade share of country j in total trade of country i (trade weights). In the case of financial variables, $r^*_{i,t}$ and $d^*_{i,t}$, we use the share of capital flows from country j to country i in total capital inflows into country i (capital weights). The weights are zero for $i = j$. Trade and capital weights are computed as average values over the period 1980-2007 and 2001-2007, respectively.[12] There is no $reer^*$, since the $reer$ is already computed using the worldwide bilateral trade shares as described in the data appendix. Also, to avoid double counting there is no $nx^*_{i,t}$. The source for the bilateral trade data is the International Monetary

[10] Data on debt for Greece, Ireland, Luxembourg, Portugal, and Spain are either not available or the series are short. Therefore, for these countries the country-specific VAR model is 6-dimensional.

[11] The data appendix describes in detail the construction of the variables and documents the sources of the data. Some time series are not available for all countries.

[12] Data on bilateral capital portfolio flows are not available before 2001.

Fund Direction of Trade Statistics. Table (1) displays the bilateral average trade and capital weights for the countries in our sample. Germany is the most important trade partner for all euro area countries. For example, the share of trade with Germany in French total trade is 19.1 percent. However, trade with France accounts only for about 9.8 percent of total German trade. Data on capital weights are taken from the Coordinated Portfolio Investment Survey (CPIS) database of the International Monetary Fund. The figures of capital weights show, for example, that 11.1 percent of total French capital inflows are from the Netherlands.

As shown in table (2), most of the variables are integrated of order one. Tests for cointegration, however, give mixed results. In this case, Enders (2003) and Hamilton (1994) recommend estimating a VAR in terms of levels of variables. This is because a vector error correction model (VECM) might impose invalid restrictions on the coefficients if the assumed cointegrating relations are wrong. A VAR in first differences, however, might be misspecified if variables are actually cointegrated. Estimating a VAR in levels therefore can serve as a good compromise.

Table 1

Bilateral Trade and Capital Shares in the Euro Area

	AUT	BEL	FIN	FRA	GER	GRC	IRL	ITA	LUX	NLD	PRT	ESP
Trade Weights in the Euro Area, averages 1980-2007												
Austria	0	0.009	0.006	0.041	0.385	0.004	0.003	0.086	0.002	0.031	0.003	0.014
Belgium	0.005	0	0.003	0.085	0.095	0.002	0.014	0.027	0.013	0.084	0.003	0.017
Finland	0.012	0.012	0	0.044	0.140	0.004	0.006	0.033	0.001	0.045	0.005	0.016
France	0.009	0.040	0.005	0	0.191	0.005	0.009	0.103	0.007	0.054	0.011	0.060
Germany	0.048	0.026	0.009	0.098	0	0.007	0.007	0.079	0.004	0.090	0.008	0.029
Greece	0.011	0.031	0.008	0.069	0.170	0	0.006	0.128	0.003	0.053	0.003	0.025
Ireland	0.005	0.035	0.006	0.061	0.102	0.003	0	0.033	0.001	0.042	0.003	0.020
Italy	0.023	0.015	0.005	0.126	0.168	0.011	0.005	0	0.003	0.037	0.007	0.039
Luxembourg	0.014	0.262	0.006	0.171	0.277	0.003	0.005	0.049	0	0.056	0.007	0.028
Netherlands	0.010	0.056	0.008	0.080	0.225	0.005	0.010	0.050	0.003	0	0.007	0.022
Portugal	0.010	0.017	0.008	0.127	0.155	0.002	0.005	0.066	0.002	0.043	0	0.174
Spain	0.009	0.016	0.005	0.165	0.142	0.004	0.007	0.084	0.002	0.038	0.042	0
Capital Weights in the Euro Area, averages 2001-2007												
	AUT	BEL	FIN	FRA	GER	GRC	IRL	ITA	LUX	NLD	PRT	ESP
Austria	0	0.0172	0.010	0.066	0.259	0.027	0.032	0.057	0.057	0.074	0.006	0.027
Belgium	0.014	0	0.009	0.134	0.099	0.026	0.027	0.128	0.192	0.097	0.014	0.049
Finland	0.020	0.020	0	0.124	0.129	0.010	0.040	0.054	0.054	0.075	0.006	0.053
France	0.016	0.035	0.013	0	0.121	0.019	0.036	0.121	0.045	0.111	0.018	0.079
Germany	0.039	0.015	0.016	0.097	0	0.019	0.041	0.096	0.151	0.098	0.013	0.077
Greece	0.022	0.003	0.002	0.060	0.079	0	0.013	0.034	0.088	0.035	0.007	0.010
Ireland	0.008	0.009	0.006	0.055	0.078	0.007	0	0.075	0.019	0.036	0.012	0.039
Italy	0.009	0.011	0.005	0.096	0.119	0.013	0.045	0	0.248	0.079	0.007	0.024
Luxembourg	0.014	0.029	0.009	0.084	0.152	0.008	0.021	0.070	0	0.057	0.005	0.034
Netherlands	0.016	0.029	0.009	0.093	0.160	0.014	0.017	0.077	0.029	0	0.005	0.044
Portugal	0.009	0.019	0.004	0.113	0.128	0.010	0.083	0.053	0.071	0.074	0	0.074
Spain	0.006	0.019	0.006	0.127	0.137	0.005	0.027	0.124	0.067	0.100	0.012	0

Notes: These numbers are computed by the authors. An entry presents the share of trade of the column country in total trade of the row country. The data on trade weights are obtained from the Direction of Trade Statistics of the IMF. Data on capital weights are taken from the CPIS database of the IMF.

Table 2
Unit Root Tests

	Unit root tests (levels)											
	FIN	AUT	FRA	NLD	BEL	GER	IRL	PRT	ESP	ITA	GRC	LUX
bb	-1.728	-2.765	-1.785	-2.952	-2.056	-3.607	-1.602	-2.888	-1.916	-2.026	-1.839	-2.255
x	-1.091	-1.363	-1.817	-0.560	-1.370	-1.094	-1.074	-1.444	-1.984	-2.314	0.293	-2.030
c	-4.660	-2.406	-5.318	-0.681	-1.952	-2.368	-3.932	-3.705	-2.861	-3.790	-2.462	-0.800
r	-2.451	-1.351	-1.122	-1.343	-2.606	-3.605	-2.049	-3.345	-1.619	-3.702	-2.597	-2.393
$reer$	-1.675	-2.122	-3.507	-2.801	-3.295	-2.591	-1.249	-1.096	-1.389	-2.148	-0.533	-1.540
nx	-1.448	-1.210	-1.427	-2.996	-2.322	-2.321	-2.610	-3.281	-1.282	-2.490	-2.283	-1.786
d	-1.952	-1.797	-0.268	-1.388	-1.807	-0.183	-	-	-	-1.290	-	-
$rb*$	-2.588	-3.118	-2.105	-2.399	-2.295	-2.194	-2.160	-1.573	-2.146	-2.415	-2.062	-1.962
$x*$	-1.392	-1.367	-1.588	-1.478	-1.294	-1.818	-1.483	-1.615	-1.512	-1.367	-1.664	-1.460
$c*$	-3.905	-3.330	-3.972	-4.016	-4.310	-1.511	-4.303	-4.577	-5.863	-4.532	-4.387	-3.960
$r*$	-2.246	-2.468	-2.273	-2.618	-1.036	-1.027	-2.601	-1.333	-1.139	-1.484	-1.224	-2.679
	Unit root tests (first differences)											
	FIN	AUT	FRA	NLD	BEL	GER	IRL	PRT	ESP	ITA	GRC	LUX
bb	-7.529	-7.519	-6.312	-7.517	-2.304	-7.507	-3.181	-7.520	-2.744	-6.581	-6.554	-7.523
x	-3.596	-6.725	-5.273	-5.817	-3.974	-6.984	-4.723	-5.168	-5.006	-5.815	-4.329	-5.999
c	-4.447	-7.452	-2.417	-4.005	-3.564	-8.700	-4.077	-1.473	-3.516	-3.015	-2.107	-7.006
r	-6.950	-5.807	-8.731	-11.134	-6.190	-6.953	-9.187	-7.863	-8.208	-6.904	-5.389	-6.480
$reer$	-6.404	-5.728	-7.111	-5.298	-4.964	-6.078	-7.241	-3.893	-5.534	-6.698	-7.308	-4.653
nx	-11.689	-8.397	-8.211	-7.843	-7.878	-8.320	-7.833	-4.844	-8.171	-7.933	-3.827	-9.614
d	-2.181	-2.891	-2.593	-3.644	-2.497	-3.564	-	-	-	-3.464	-	-
$rb*$	-7.517	-7.517	-7.517	-7.517	-7.521	-3.291	-7.518	-7.526	-7.519	-7.523	-7.517	-6.256
$x*$	-4.905	-5.814	-4.589	-4.967	-4.257	-3.803	-4.455	-4.115	-4.154	-4.791	-4.577	-4.311
$c*$	-4.628	-7.764	-4.105	-6.666	-3.723	-3.021	-4.048	-3.299	-3.423	-4.491	-3.907	-4.143
$r*$	-7.414	-7.054	-7.272	-7.064	-8.891	-8.634	-7.392	-7.524	-7.476	-9.138	-8.726	-7.493

Note: Standard Dickey-Fuller tests are computed for all variables. If the absolute value of an entry is greater than 2.89 (Dickey-Fuller test statistic), a unit-root is rejected at the 5% significance level. The optimal number of lagged differences is determined by BIC.

5 Empirical Results

5.1 Bilateral Effects of a Shock to Output

Some early studies consider macroeconomic disturbances and the pattern of correlation between business cycles in the euro area. For example, Cheung and Westermann (1999) find evidence for non-synchronised common business cycles of Germany and Austria. Bayoumi and Eichengreen (1992) find that the underlying shocks are significantly more idiosyncratic across EC countries than across the U.S. Our framework enables us to ask a very similar and direct question: What are the effects of a positive output shock of a member country on output of the other member countries? The upper left panel of figure (1) presents the Impulse Response Functions (IRFs) of outputs of the euro area members to a 1-percent error positive shock to output of Germany. As second example of a large economy, the lower left panel of figure (1) plots the dynamics of output following a shock to the French output. The right panels of figure (1) present two examples of small economies: Greece and Luxembourg. These panels suggest two main findings. First, the own-impulse response of output for all countries shows the largest effect. Second, the IRFs show a clear difference in reactions to the different shocks. In particular, as expected, the effects on output resulting from the German or French output shock are larger than those resulting from a shock to output of a smaller economy such as Greece.

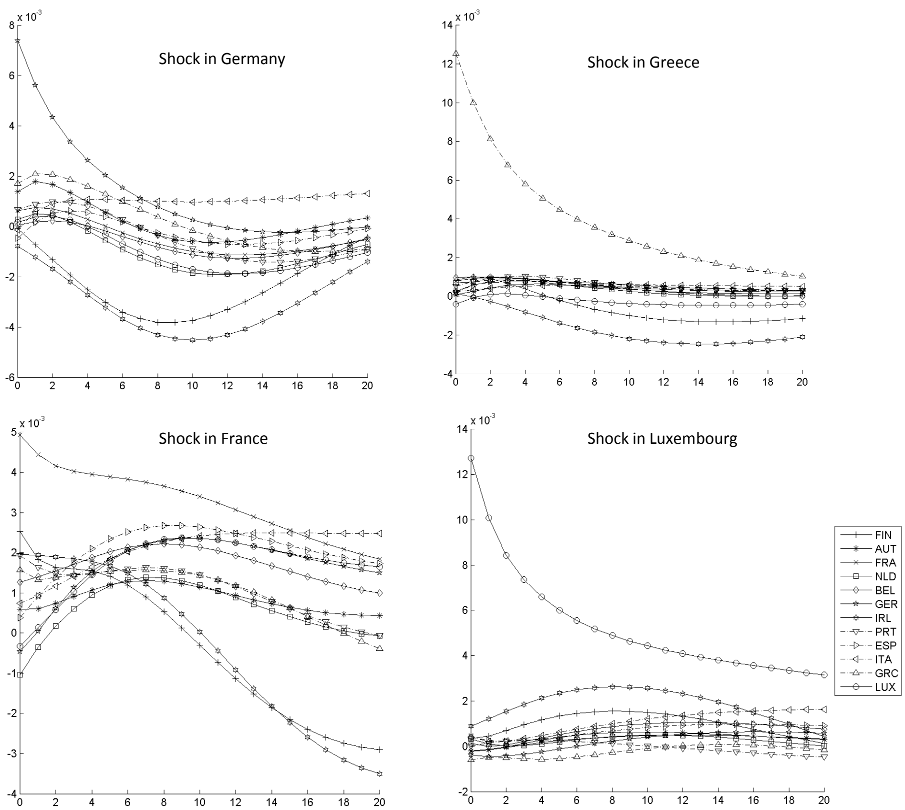
5.2 Bilateral Effects of a Shock to the Budget Deficit

5.2.1 The Response of Output

Figures (2) and (3) display the generalised impulse response of output of a member country in the euro area to a 1-percent shock to the budget deficit ratio of Germany and France, respectively. These IRFs show the sign and size of the effects over a time horizon of 20 quarters. The horizontal axes depict the time horizon, whereas the vertical axes depict the percentage change in output resulting from a 1-percent shock to the budget balance. The dashed lines are 90 percent bootstrap error bounds. The domestic effect and cross-border spillover effects seem to be smaller in the case of Germany. The

Figure 1

Impulse Responses of Output in the Euro Area to Output Shock in Selected Members



hump-shaped response of output is more apparent following the shock to the French budget deficit. Further, the spillover effects exhibit some degree of synchronisation across countries. The peak response of output is reached in 4 to 8 quarters in most members.

Table (3) shows detailed estimated bilateral budget deficit spillover effects in the euro area. In general, the estimates suggest positive fiscal spillover effects between several pairs of countries. The magnitudes of the effects vary across countries, though. For example, the Austrian output seems to be particularly positively affected by a French or an Italian shock (border countries), but to a less extent by a German or a Spanish shock. For instance, a 1-percent shock to the French budget deficit increases Austrian output by 0.23 percent. The spillover impacts of a shock to the budget balance in Germany on output of the other euro area members are rather small. Notable exceptions are the Netherlands and Luxembourg. However, overall, the bilateral effects resulting from budget deficit shocks are not highly significant.

The diagonal elements in table (3) document the own-response of output to a domestic budget balance shock. The own-response of output is also of interest in that only few available results concentrate on a single European country. For example, de Castro and de Cos (2008) provide results for Spain, while Giordano et al. (2007) provide estimates for Italy. According to our results, the highest impact of a domestic budget balance shock is reported for Finland, followed by Greece and Spain, respectively. In the case of France for instance, a 1-percent increase in the French budget deficit increases French output on impact by 0.15 percent. The impact of the shock in Germany is very small and negative. Perotti (2005) documents a negative impact of a government spending structural shock on German output. The effect of a shock to the budget balance on domestic output after 4 quarters is the highest for France, followed by Spain and Ireland, in that order. Again, however, the impulse responses are often not significant. The ultimate aim of our analysis is rather to shed light on the qualitative responses and the shapes of the fiscal spillover effects obtained by the GVAR techniques.

5.2.2 The Response of Consumption, Net Export, Interest Rate and Real Exchange Rate

Thus far, the discussion has focused on the reaction of output as a summary measure. What about the reactions of the other variables? Table (4) summarises the dynamics of the variables in our system by reporting the impacts (one-quarter response) and the cumulative 4-quarter domestic effects on all variables in our system resulting from a one-standard error shock to the budget deficit ratio of Germany or France. The previous subsection has reported positive effects of a shock to the French budget balance on the output of several euro area members. Table (4) suggests that a French budget balance shock increases French consumption, on impact and after 4 quarters, and worsens the French trade balance. In turn, the trade balances of Germany, Austria, Finland, and Greece improve, indicating positive spillover effects though trade. However, the impact of a domestic fiscal shock on consumption in Germany is negative. Theoretically, the response of consumption is model-dependent and is linked to the share of Ricardian consumers in the economy. Estimates for the euro area vary. Coenen and Straub (2005) estimate this share to be about 20 percent, whereas Forni et al. (2009) estimate this share to be about 35 percent.

The real interest rate channel seems to play a crucial role in the cross-border transmission mechanism of the French budget balance shock to outputs of some countries. In particular, the real interest rate decreases in Italy, Portugal, and the Netherlands in response to a French budget balance shock. The appendix report the dynamics of net exports and the real interest rate in the euro area after a shock to the German and French budget balance. The domestic real effective exchange rate depreciates in reaction to a domestic budget deficit shock in France or Germany; see figures in the appendix. The depreciation of the real effective exchange rate is coupled with a worsening trade balance. This finding confirms the results of Monacelli and Perotti (2010) on a structural shock to U.S. government spending, and extends the interpretation by showing that the generalised IRFs yield similar dynamics for the real effective exchange rate and net exports following a domestic budget balance shock.

Figure 2

The Response of Output to a Shock to the German Budget Balance

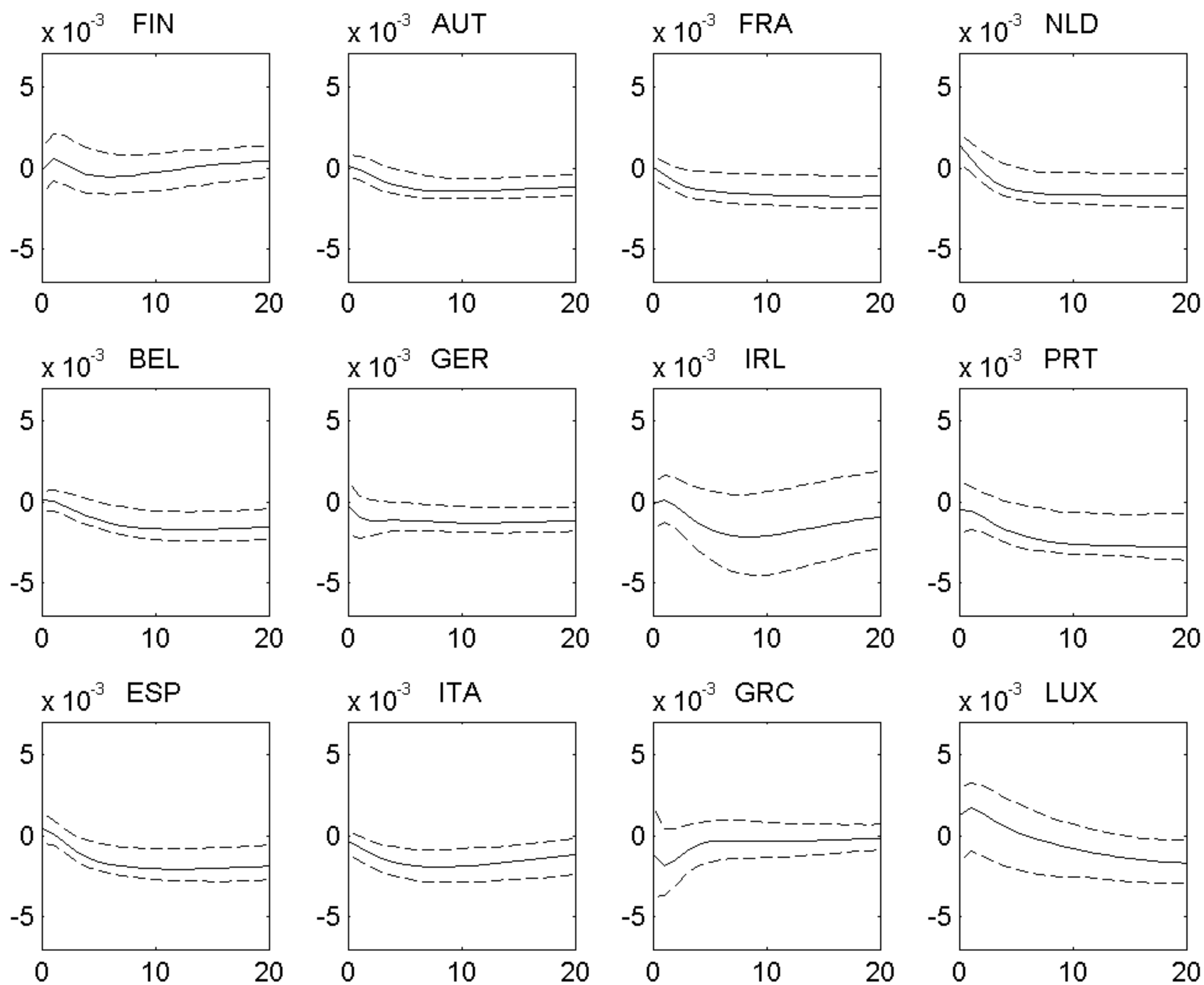


Figure 3
The Response of Output to a Shock to the French Budget Balance

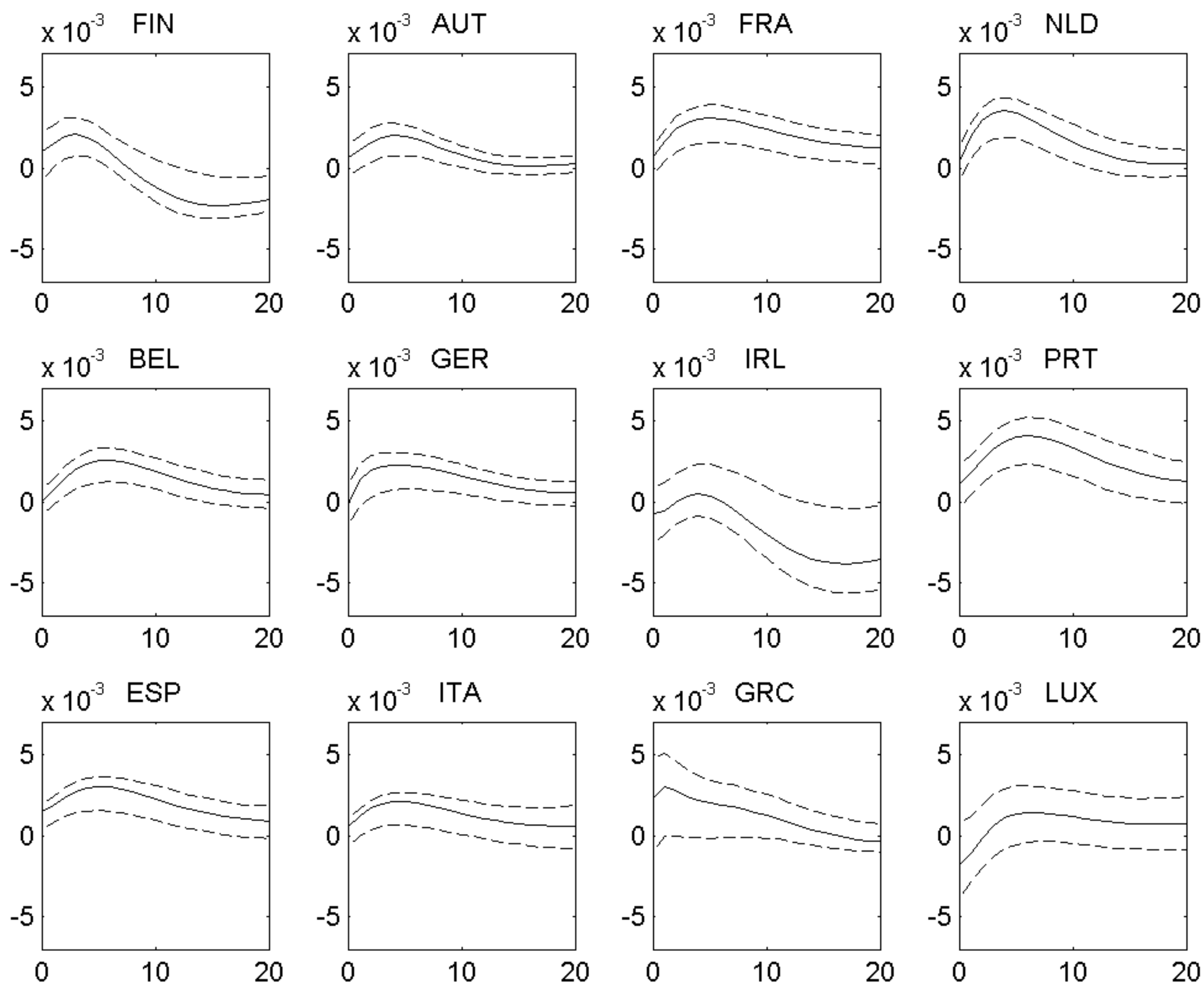


Table 3

Estimated Bilateral Responses of Output to a 1 Percent Shock the Budget Balance

	Bilateral initial response (impact) of y to a 1% bb shock											
	Response in											
Shock in:	FIN	AUT	FRA	NLD	BEL	Ger	IRL	PRT	ESP	ITA	GRC	LUX
FIN	0.142	-0.054	-0.019	0.058	-0.009	0.080	0.009	-0.017	0.028	0.010	0.280	0.153
AUT	0.173	-0.024	0.043	-0.096	0.019	0.125	0.413	-0.125	0.039	0.115	0.549	-0.238
FRA	0.284	0.186	0.184	0.091	-0.007	-0.025	-0.222	0.300	0.431	0.147	0.662	-0.540
NLD	-0.051	-0.034	-0.083	-0.057	-0.087	0.101	-0.362	-0.025	-0.137	0.073	-0.261	-0.127
BEL	0.235	-0.002	0.025	0.191	0.052	-0.091	0.241	0.155	0.077	-0.059	0.175	-0.106
GER	-0.026	0.016	0.008	0.203	0.013	-0.036	-0.023	-0.075	0.065	-0.050	-0.161	0.172
IRL	-0.062	-0.027	0.039	-0.049	0.036	-0.133	0.026	-0.039	0.044	-0.075	-0.303	0.198
PRT	0.085	0.106	0.037	-0.024	0.120	0.160	0.079	0.020	-0.109	-0.041	0.042	0.017
ESP	0.188	0.055	0.088	-0.042	0.083	-0.103	0.200	-0.053	0.190	0.136	0.059	-0.055
ITA	0.056	0.162	0.067	-0.022	0.134	-0.066	0.320	0.057	-0.073	-0.029	0.270	0.190
GRC	-0.132	0.032	-0.065	-0.007	-0.055	0.063	-0.154	-0.097	-0.071	-0.104	-0.216	0.103
LUX	-0.067	-0.018	0.016	-0.034	-0.111	0.054	0.070	0.023	0.126	0.064	0.161	0.051

	Bilateral response of y to a 1% bb shock after four quarters											
	Response in											
Shock in:	FIN	AUT	FRA	NLD	BEL	GER	IRL	PRT	ESP	ITA	GRC	LUX
FIN	0.287	0.084	0.122	0.170	0.125	0.164	0.217	0.117	0.125	0.128	0.254	0.181
AUT	0.257	0.067	0.218	0.226	0.177	0.213	0.356	0.188	0.242	0.206	0.375	0.010
FRA	0.604	0.547	0.808	0.982	0.574	0.629	0.103	0.933	0.788	0.565	0.700	0.171
NLD	0.008	-0.017	-0.073	-0.044	-0.023	-0.056	-0.213	0.005	-0.080	0.062	-0.181	0.116
BEL	0.227	0.167	0.141	0.263	0.143	0.071	0.364	0.283	0.156	0.002	0.012	0.039
GER	-0.017	-0.110	-0.161	-0.112	-0.081	-0.163	-0.112	-0.184	-0.136	-0.200	-0.132	0.135
IRL	0.137	0.124	0.181	0.163	0.148	0.073	0.586	0.103	0.141	0.045	-0.146	0.259
PRT	-0.004	0.005	-0.029	-0.083	0.016	0.049	-0.105	-0.137	-0.064	-0.066	0.005	-0.015
ESP	0.339	0.254	0.376	0.409	0.339	0.280	0.553	0.314	0.399	0.303	0.094	0.251
ITA	0.156	0.221	0.070	0.160	0.157	0.032	0.468	0.103	0.089	-0.075	-0.064	0.094
GRC	-0.029	0.099	0.049	0.203	0.057	0.122	-0.082	0.030	0.064	0.045	-0.289	0.147
LUX	0.006	0.117	0.128	0.131	0.013	0.181	0.124	0.187	0.156	0.089	0.119	-0.349

Numbers reported are estimates from the GVAR with one lag. The table shows point estimates of initial responses and responses after four quarters of different variables to a 1% shock to the budget balance in the row country.

Table 4

The Effects of Budget Balance Shocks in Germany and France

	1% shock to bb in Germany											
Response of	*output*		*consumption*		*interest rate*		*reer*		*net exports*		*debt*	
After (quart.)	0	4	0	4	0	4	0	4	0	4	0	4
FIN	-0.026	-0.017	-0.144	-0.115	0.019	-0.061	-0.207	0.204	-0.215	-0.005	-0.094	0.172
AUT	0.016	-0.110	0.058	-0.287	-0.043	-0.133	-0.263	0.144	-0.098	-0.144	-0.200	0.411
FRA	0.008	-0.161	-0.100	-0.236	-0.106	-0.019	-0.227	0.029	-0.057	0.001	0.370	0.552
NLD	0.203	-0.112	0.133	0.040	0.149	0.076	-0.468	0.226	-0.041	-0.105	0.356	0.595
BEL	0.013	-0.081	-0.037	-0.125	-0.170	-0.091	-0.272	-0.251	-0.173	0.040	0.227	0.668
GER	-0.036	-0.163	-0.773	-0.582	0.014	0.024	-0.457	0.323	-0.036	-0.068	-0.311	-0.060
IRL	-0.023	-0.112	-0.018	-0.265	-0.015	0.076	-0.256	0.115	-0.040	0.152	-	-
PRT	-0.075	-0.184	0.068	-0.154	-0.197	-0.098	-0.193	-0.086	-0.015	0.127	-	-
ESP	0.065	-0.136	0.127	-0.082	-0.084	-0.057	0.320	0.145	0.006	0.038	-	-
ITA	-0.050	-0.200	0.157	0.034	-0.110	-0.120	0.439	0.689	-0.121	-0.041	0.077	0.042
GRC	-0.161	-0.132	0.033	0.012	-0.019	-0.292	0.032	-0.068	0.029	0.029	-	-
LUX	0.172	0.135	-0.399	-0.229	-0.321	-0.059	-0.250	0.048	0.471	0.104	-	-

	1% shock to bb in France											
Response of	*output*		*consumption*		*interest rate*		*reer*		*net exports*		*debt*	
After (quart.)	0	4	0	4	0	4	0	4	0	4	0	4
FIN	0.284	0.604	0.543	0.456	0.628	0.942	0.096	-1.028	0.384	0.076	-2.489	-2.044
AUT	0.186	0.547	0.243	0.530	0.325	0.449	0.142	-0.496	0.132	0.212	-0.126	-0.923
FRA	0.184	0.808	0.634	0.971	0.108	0.135	0.468	-0.338	-0.225	-0.282	-1.168	-2.220
NLD	0.091	0.982	0.534	0.647	-0.199	0.009	0.489	-1.000	-0.020	0.074	-2.604	-2.514
BEL	-0.007	0.574	0.126	0.726	0.246	0.473	0.655	0.189	-0.060	-0.206	-2.791	-3.083
GER	-0.025	0.629	-0.264	0.364	0.051	0.300	0.257	-1.120	0.629	0.436	-0.503	-0.999
IRL	-0.222	0.103	0.579	1.205	-0.167	-0.286	0.785	-0.080	-0.337	-0.470	-	-
PRT	0.300	0.933	0.139	0.663	0.124	0.160	-0.509	-0.549	-0.076	-0.441	-	-
ESP	0.431	0.788	0.306	0.871	0.336	0.432	-0.714	-0.615	-0.183	-0.278	-	-
ITA	0.147	0.565	0.084	0.737	0.091	-0.022	-0.056	-0.109	0.088	-0.298	-1.491	-1.722
GRC	0.662	0.700	3.113	0.880	1.378	1.283	-0.465	-0.477	0.220	0.039	-	-
LUX	-0.540	0.171	0.708	1.524	0.432	0.858	0.392	-0.323	-0.846	-0.579	-	-

Numbers reported are estimates from the GVAR with one lag. The table shows point estimates of initial responses and responses after four quarters of different variables to a 1% shock to the budget balance in Germany (the upper panel) and France (the lower panel).

5.3 The Effects of a Euro Area-Wide Shock

The previous sections have examined the effects of a fiscal shock in one member country. We can also study the effects of a euro area-wide ("global") shock. Following Dees et al. (2007), this area-wide shock is derived as a weighted average of the country-specific budget balance shock across all countries and can be interpreted as a common shock to the euro area. Some studies, such as Pappa (2009), employ aggregate figures of the euro area to estimate the effects of a fiscal shock. Aggregate numbers, while useful, remain silent concerning the economic interdependences of the euro area economies. Beetsma et al. (2006) uses a European panel VAR model. Panel estimates are based on the homogeneity assumption that output of all included countries in the panel response in the same manner to a fiscal expansion. In contrast, one aspect of our area-wide shock is that it is directly derived from the interdependences across the euro area countries, allowing the response of output to differ across countries.

Figure (4) presents the response of output of a member country in the euro area to an area-wide budget shock. The IRFs show a visible positive hump-shaped significant effect on outputs. For example, the impact and dynamics of output in Germany following the area-wide shock is clearly positive in comparison with the case of the domestic German shock. In essence, in terms of magnitude, the area-wide shock is not necessarily larger than the domestic shock. One may think of the euro-wide shock as a shock that has the magnitude of a domestic shock, but to which each country contributes only a fraction depending on the size of the country. Thus, our finding may indicate the importance of coordinated fiscal actions at the level of the euro area, in line with the predictions of the DSGE model of Corsetti et al. (2010).

Figure 4
The Response of Output to an Area-Wide Budget Balance Shock

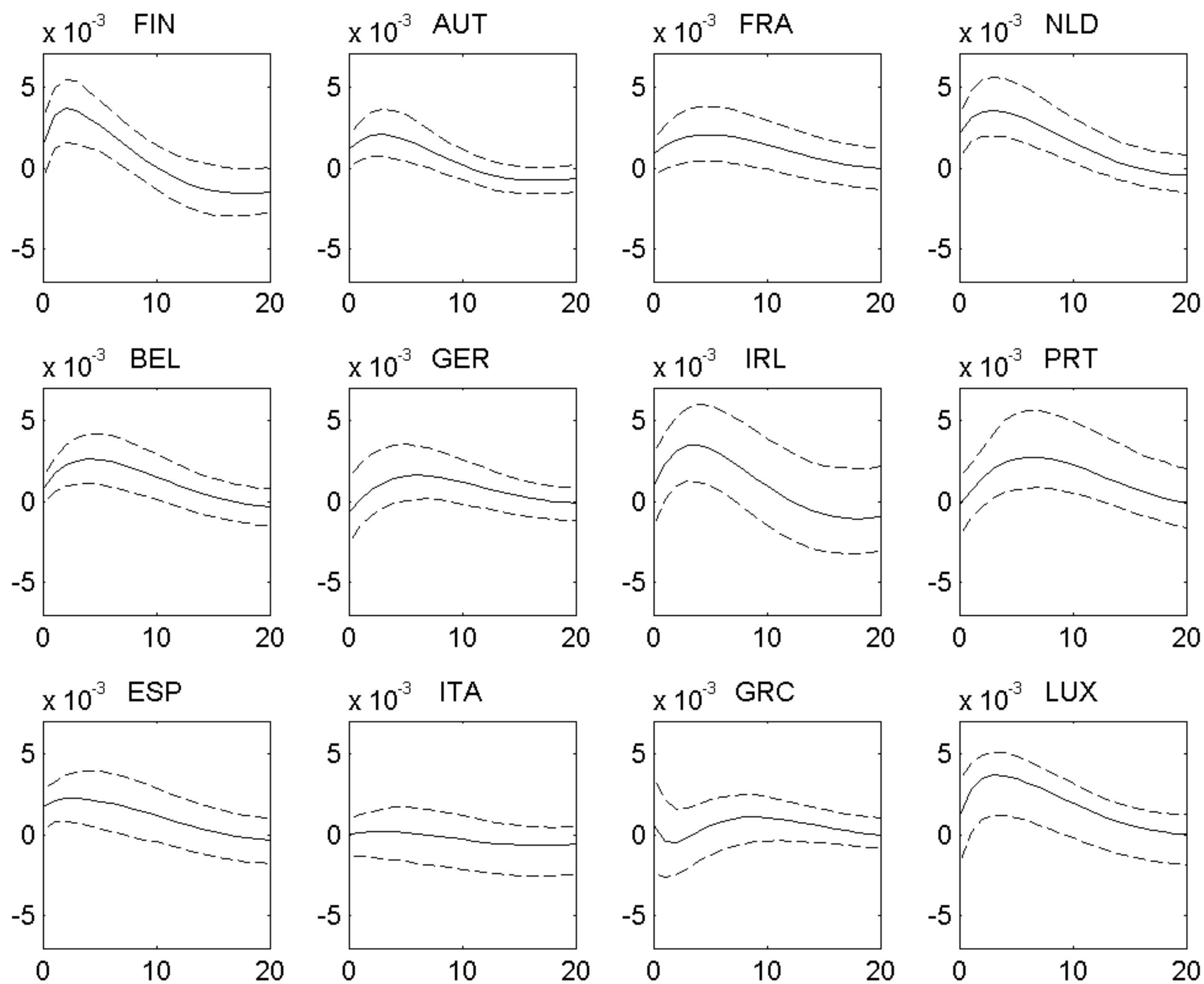
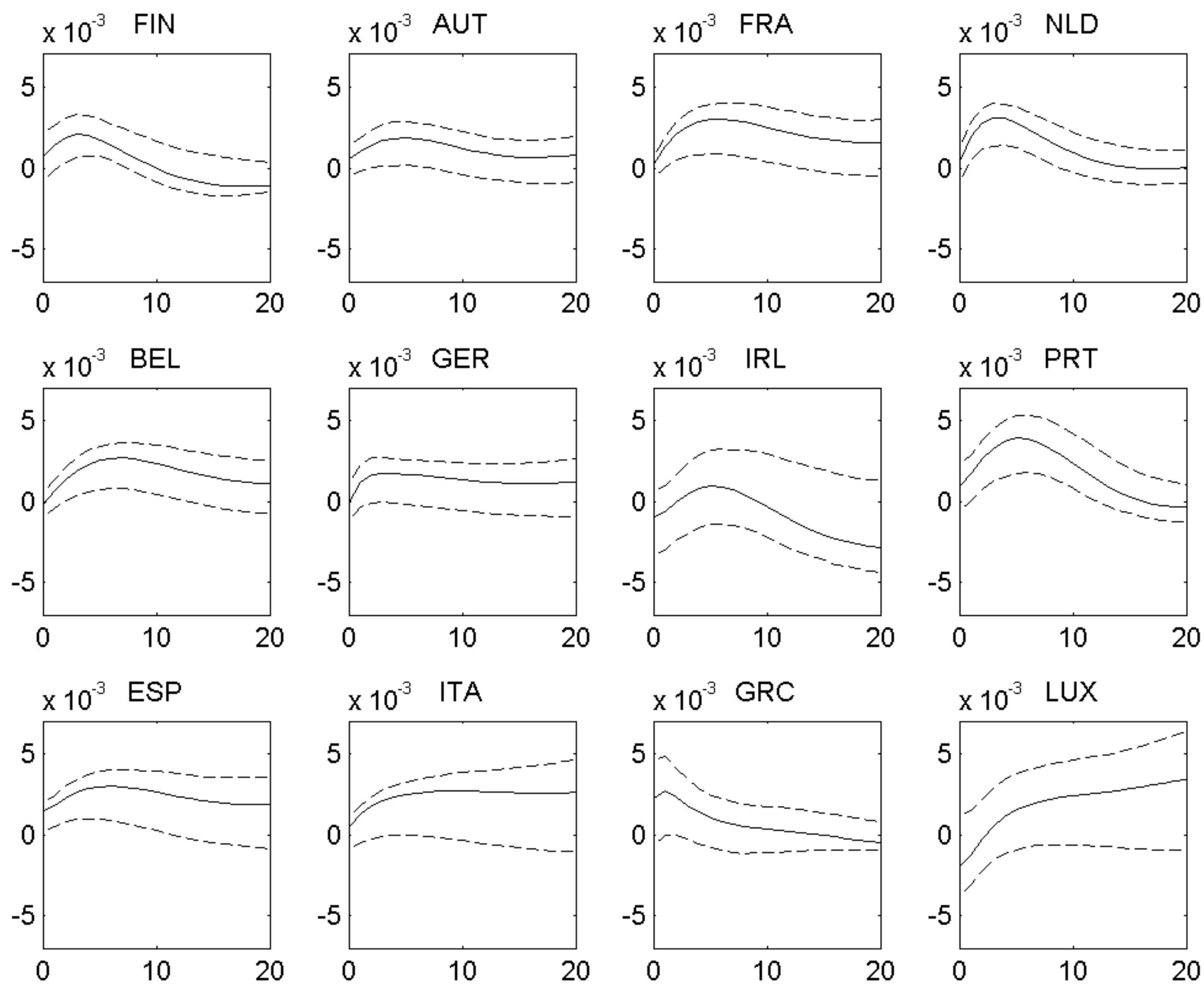


Figure 5
The Response of Output to a French Structural Budget Balance Shock



6 Robustness

6.1 Recursive (Cholesky) Identification

To check the robustness of our results, we examine the effects of a structural fiscal shock as captured by the recursive approach described in equation (7). We order the variables in the model in line with several studies in the literature such as Corsetti and Müller (2006) and Kim and Roubini (2008). Specifically, the country-specific ordering is $Y_{i,t} = (\ x_{i,t}\ bb_{i,t}\ c_{i,t}\ nx_{i,t}\ r_{i,t}\ reer_{i,t}\ d_{i,t})$. Ordering the budget balance bb as the second variable after output in $Y_{i,t}$ implies that the budget balance can respond to changes of output within a quarter but does not respond to changes in the rest of the variables within a quarter.[13] The results are independent of the ordering of the countries. For example, figure (5) displays the impulse response functions of output of member countries following a budget deficit shock in France. The results are similar to those obtained from the generalised impulse response functions.[14]

6.2 Blanchard-Perotti Identification, Anticipation, and Government Spending Shocks

Thus far, this study has considered unanticipated fiscal shocks in a GAVR framework. Fiscal actions can be anticipated due to the implementation lag, i.e., the time until the change in fiscal policy is indeed implemented. In this subsection, we introduce anticipated shocks in an extended VAR model. Following Blanchard and Perotti (2002) and Tenhofen and Wolff (2010), we model anticipated fiscal shocks by allowing agents to know the domestic fiscal shock one period in advance.[15] We permit output to depend not only on

[13] The identification approach of Blanchard and Perotti (2002) yields similar results. This is also found in Caldara and Kamps (2008).

[14] See figure 13 in the appendix for the case of Germany

[15] Both studies consider the U.S. economy, but Blanchard and Perotti (2002) model the effects of anticipated government spending shocks on output, whereas Tenhofen and Wolff (2010) apply this strategy to consumption.

contemporaneous and lagged values of the variables in the system, but also on expected fiscal variables at time $t+1$. Tenhofen and Wolff (2010) analyse in detail the expectation-augmented identification strategy and the estimation procedure.

Let g denotes government spending per capita, and tx denotes total tax revenues per capita (both in log). Our specification to estimate the effects of an anticipated government spending shock in country i ("home country") on output of country j ("foreign country") is: $Y_{i,j,t} = (x_{i,t},\, x_{j,t},\, g_{i,t},\, tx_{i,t})$, where the equations for g and tx are augmented with $E_t[g_{i,t+1}]$ and $E_t[tx_{i,t+1}]$, respectively. The identification of Blanchard and Perotti requires exogenously imposed values of elasticities of government spending and taxes to output. We obtain these elasticities from Girouard and André (2005).

On average, 38-percent of Austrian trade is with Germany (table 1), that is Germany is the most important trading partner for Austria. France is not a dominant trading partner to any other euro area member. Consequently, we present estimation results for a model including Germany (home country) and Austria (foreign country). Figure (6) shows the results. Output increases in Germany in the first six quarters. This is in line with the results of Blanchard and Perotti (2002). As in the case of unanticipated shocks, the spillover effect of anticipated government spending shock in Germany on Austrian output is dampened. There are other studies that consider the effects of anticipated fiscal actions: Perotti (2005) studies how the announced OECD forecasts of government spending and GDP growth affect the estimates of VAR models. The results of Perotti (2005) do not suggest that the VAR innovations are predictable. Mertens and Ravn (2010) find that anticipation does not explain a positive response of consumption following an expansionary fiscal shock.

6.3 Testing Weak Exogeneity of Foreign Variables

The assumption of weak exogeneity of foreign variables is fulfilled when the cross-section correlation between the idiosyncratic shocks of the member countries is low; that is as $N \to \infty$, $\mathrm{cov}(Y^*_{i,t}, \epsilon_{i,t}) \longrightarrow 0$. The inclusion of foreign variables in country-specific VAR models is expected to reduce the cross-sectional correlation of the variables in the GVAR system, since foreign variables can capture common factors. As a simple diagnostic test

Figure 6

The Effects of an Anticipated Government Spending Shock in Germany on Outputs of Germany and Austria

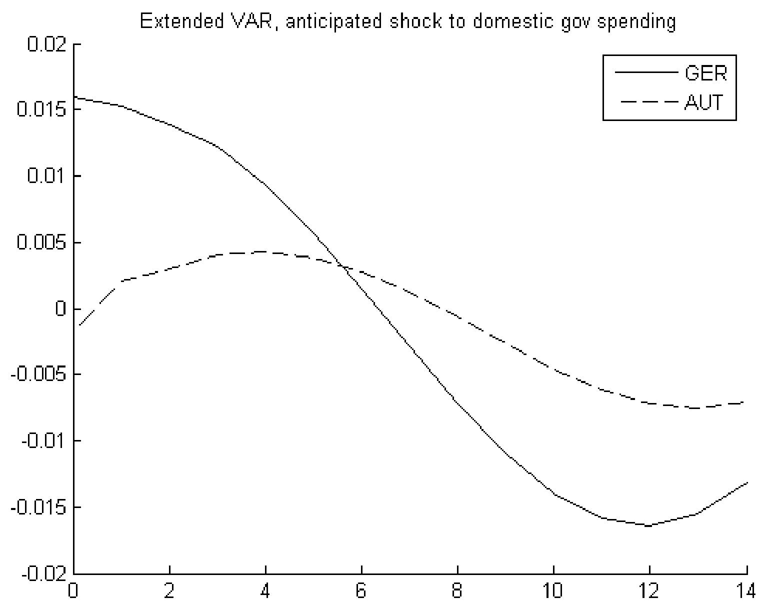


Table 5
Average Pair-Wise Cross-Sectional Correlation of the variables and Idiosyncratic Shocks

	bb	*x*	*c*	*r*	*reer*	*nx*	*d*
Finland	0.0201	0.0158	0.0293	0.0309	0.0386	0.0433	0.0711
Austria	0.0408	0.0014	0.0151	0.0383	0.0914	0.0346	0.0485
France	0.0441	0.0076	0.0139	0.0462	0.1471	0.0516	0.0486
Netherlands	0.0119	0.0060	0.0296	0.0518	0.1346	0.0382	0.0815
Belgium	0.0182	0.0087	0.0108	0.0298	0.1374	0.0578	0.0722
Germany	0.0085	-0.0026	-0.0179	0.0512	0.1145	0.0328	0.0411
Ireland	0.0199	0.0085	0.0329	0.5158	0.1081	0.0000	-
Portugal	0.0171	0.0109	-0.0015	0.0474	0.0147	0.0451	-
Spain	0.0370	0.0101	0.0038	0.0444	0.0660	0.0508	-
Italy	0.0180	0.0072	0.0096	0.0271	0.0795	0.0417	0.0724
Greece	0.0292	0.0124	0.0060	0.0558	-0.0196	0.0074	-
Luxemburg	0.0582	0.0091	0.0353	-0.0173	0.0556	0.0361	-

Note: VAR residuals correspond to country-specific VAR models with foreign variables.

of weak exogeneity of foreign variables, Dees et al. (2007) propose to calculate average pair-wise cross-section correlation of the variables in the model with the residuals. Table (5) presents these figures. Average cross-section correlations are rather small. Most variables in all countries have an average correlation with idiosyncratic shocks between 2 percent and 5 percent. The only exception is the real effective exchange rate, which shows, in some countries such as Belgium and Germany, a modest degree of correlation of around 11 percent and reaches a maximum correlation of 51 percent in Ireland. This suggests that augmenting country-specific VAR models with foreign variables moderates the degree of correlations across the fiscal shocks of the euro area members.

7 Conclusion

This study contributes to the literature on the effects of budget deficits by (1) estimating the domestic effects of a fiscal shock on key variables for the economies in the euro area, (2) estimating spillover effects in one member country on the rest of the euro area by applying a multi-country VAR framework, the GVAR, to the analysis of fiscal policy. According to our results, the highest impact of a domestic budget deficit shock is reported for Spain, followed by France and Finland. A 1-percent increase in the French budget deficit increases French output on impact by 0.18 percent. The impact of a deficit shock in Germany is very small, negative, and insignificant. Overall, the results mostly suggest positive, but in some cases negative, spillover effects of a budget deficit shock on outputs of other members. The magnitudes of the effects vary across countries, though. For example, output in the Netherlands seems to be particularly positively affected by a German or a Belgian shock (border countries), but to a less extent by a budget deficit shock in Greece or Portugal. The spillover impacts of a shock to the budget deficit in Germany on the output of the other euro area members are rather small. Notable exceptions of affected countries are the Netherlands and Luxembourg. However, overall, the bilateral effects resulting from budget deficit shocks are not highly significant. Concerning an area-wide budget deficit shock, the impact and dynamics of output following the area-wide shock, for example in Germany, is clearly positive in comparison with the negative impact of the domestic German shock. This may indicate the importance of coordinated fiscal actions.

Finally, our results indicate heterogeneity in the response of domestic variables across the euro-area members to a fiscal shock. The source of this heterogeneity, for example the share of Ricardian consumers in each member country or the degree of participation in the asset market, is an important area of further research.

8 Appendix

8.1 Description of the Data

All data, except for the $reer$ and the weights in the GVAR, are obtained from the OECD Economic Outlook. bb is the ratio of government balance to GDP; (NLGXQ/100). GDP is the gross domestic product in market prices, value in €. y is the natural logarithm of the real GDP volume per capita. Per capita variables are calculated by dividing the series under consideration by the total labour force. Real variables are computed by filtering the series under consideration by the GDP deflator inflation rate. The GDP deflator is the ratio of GDP to GDPV, where GDPV is the gross domestic product volume. c is the natural logarithm of private consumption per capita, where private consumption is the series CPV. r is the real long-run interest rate, where the interest rate series is (IRL). $reer$ is the natural logarithm of the real exchange rate. Specifically, $reer$ is calculated as geometric weighted averages of bilateral exchange rates adjusted by relative consumer prices. The weights are derived from manufacturing trade flows and capture direct bilateral trade and third market competition. These series and a detailed discretion are available online at the Bank for International Settlement; www.bis.org. nx is the ratio of net export to GDP. The series of net export is computed as exports of goods and services (XGS, value in €) minus imports of goods and services (MGS, value in €). The resulting series is filtered by GDP. Debt (d) is the ratio of government gross financial liabilities to GDP; GGFLQ/100. In the case of Germany, figures for the period before 1991 correspond to West Germany. We use quarterly series. In case quarterly data are not available, we use interpolated annual data. The trade weights in the GVAR are obtained from the Direction of Trade Statistics of the International Monetary Fund and are computed as average values over the period 1980-2007. Data on capital weights in the GVAR are taken from the Coordinated Portfolio Investment Survey (CPIS) database of the International Monetary Fund and are computed as average values over the period 2001-2007.

8.2 The Response of Various Variables to a Fiscal Shock

Figure 7
The Response of Net Exports to a Shock to the German Budget Balance

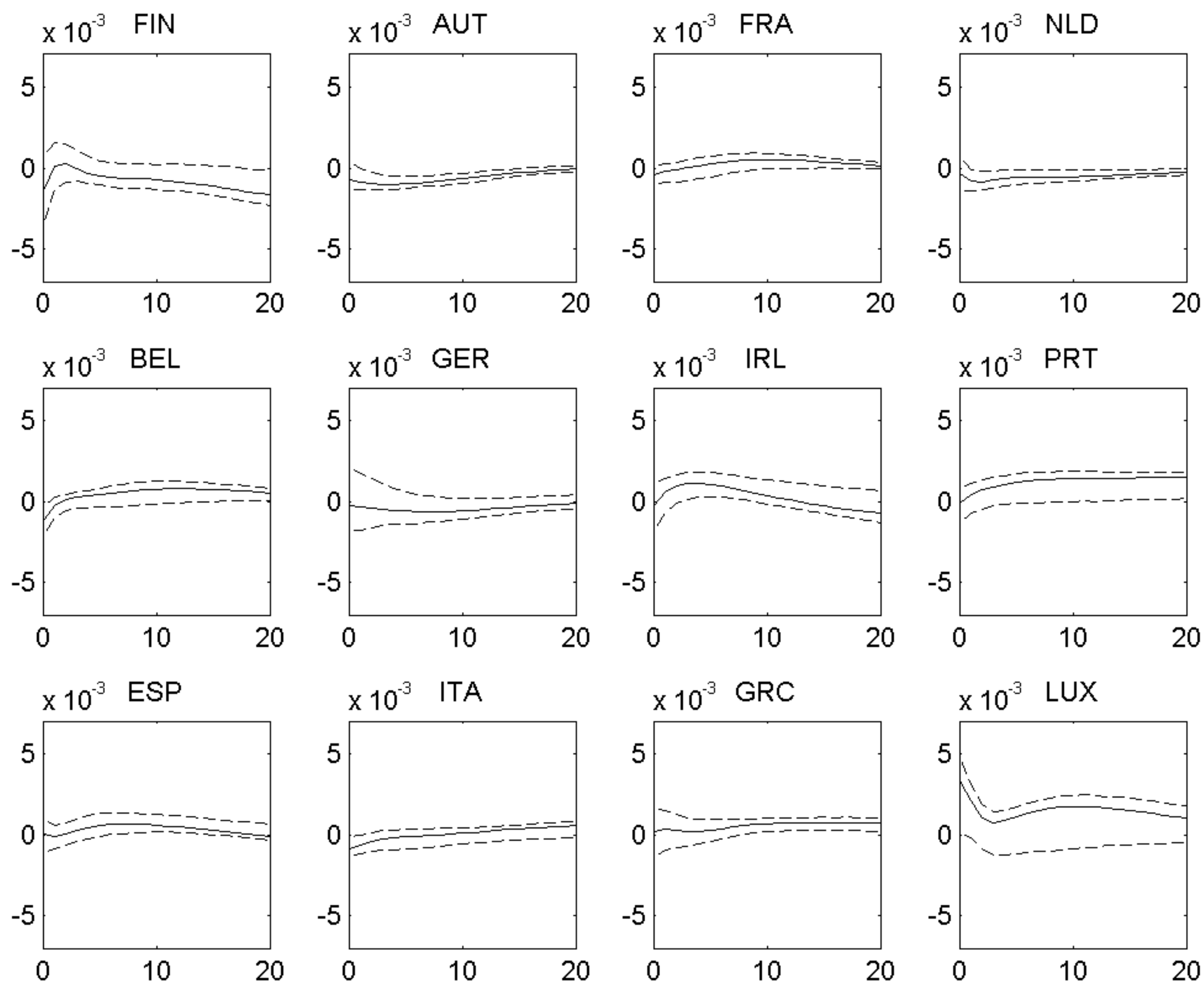


Figure 8
The Response of Net Exports to a Shock to the French Budget Balance

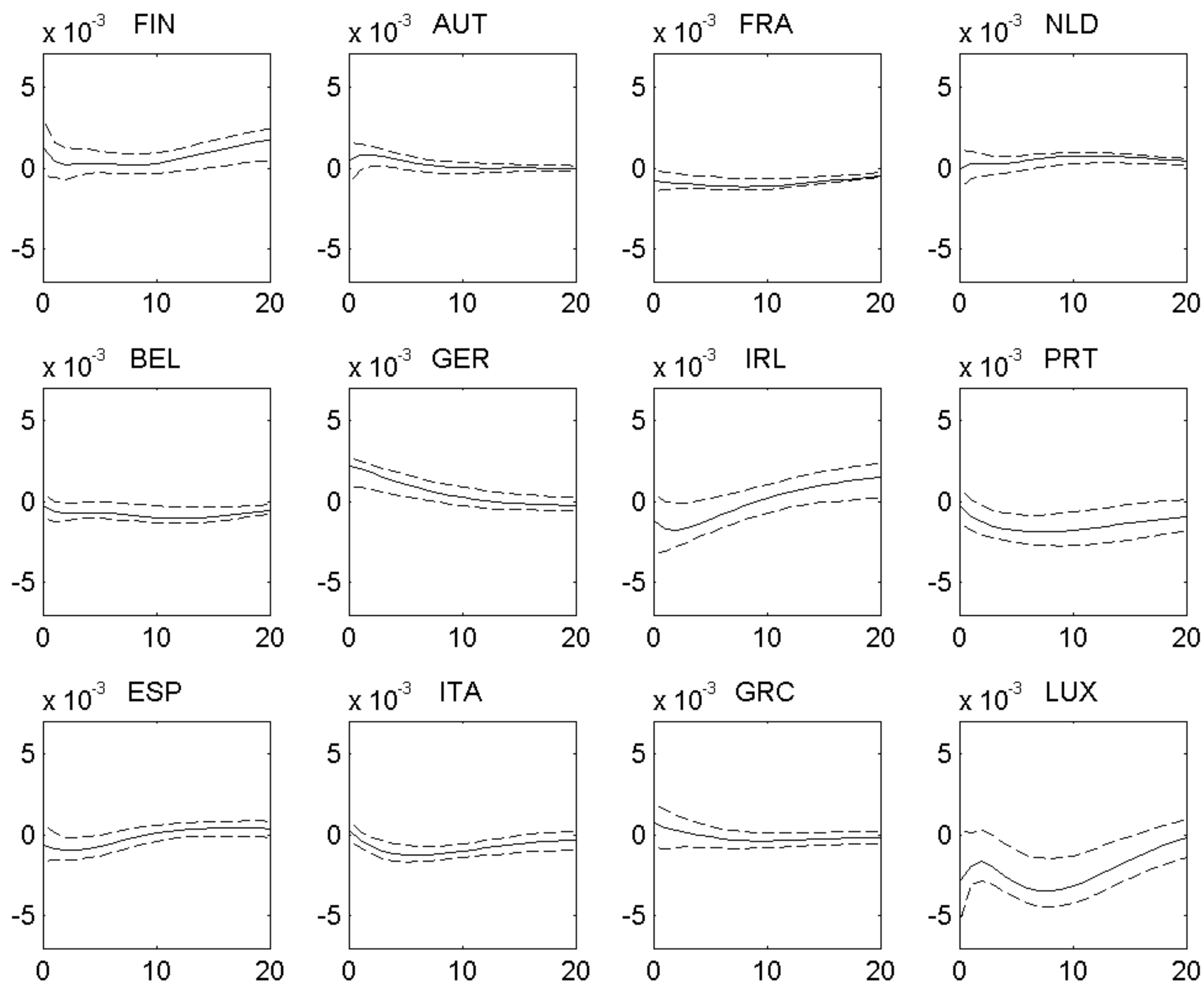


Figure 9
The Response of the Interest Rate to a Shock to the German Budget Balance

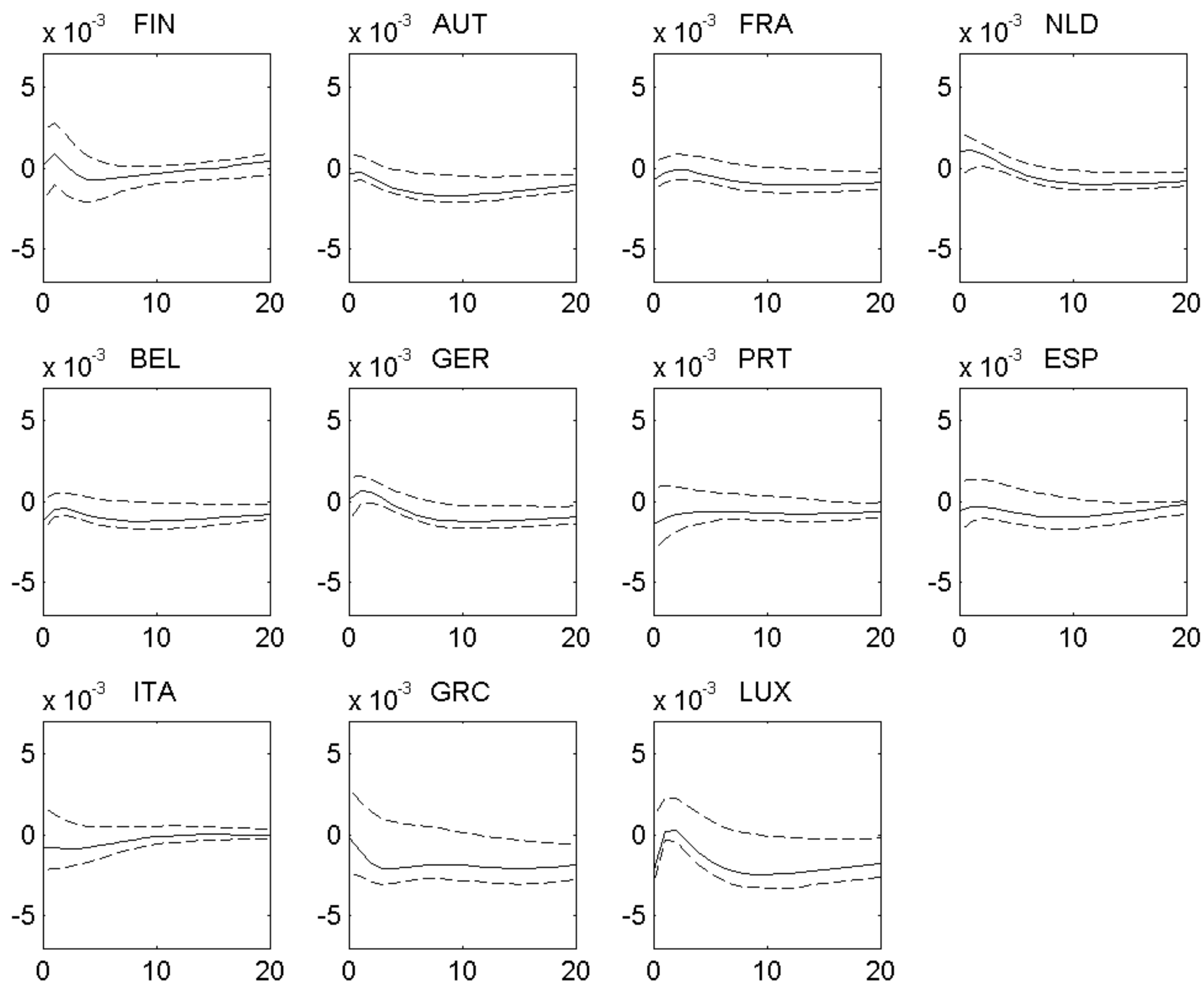


Figure 10
The Response of the Interest Rate to a Shock to the French Budget Balance

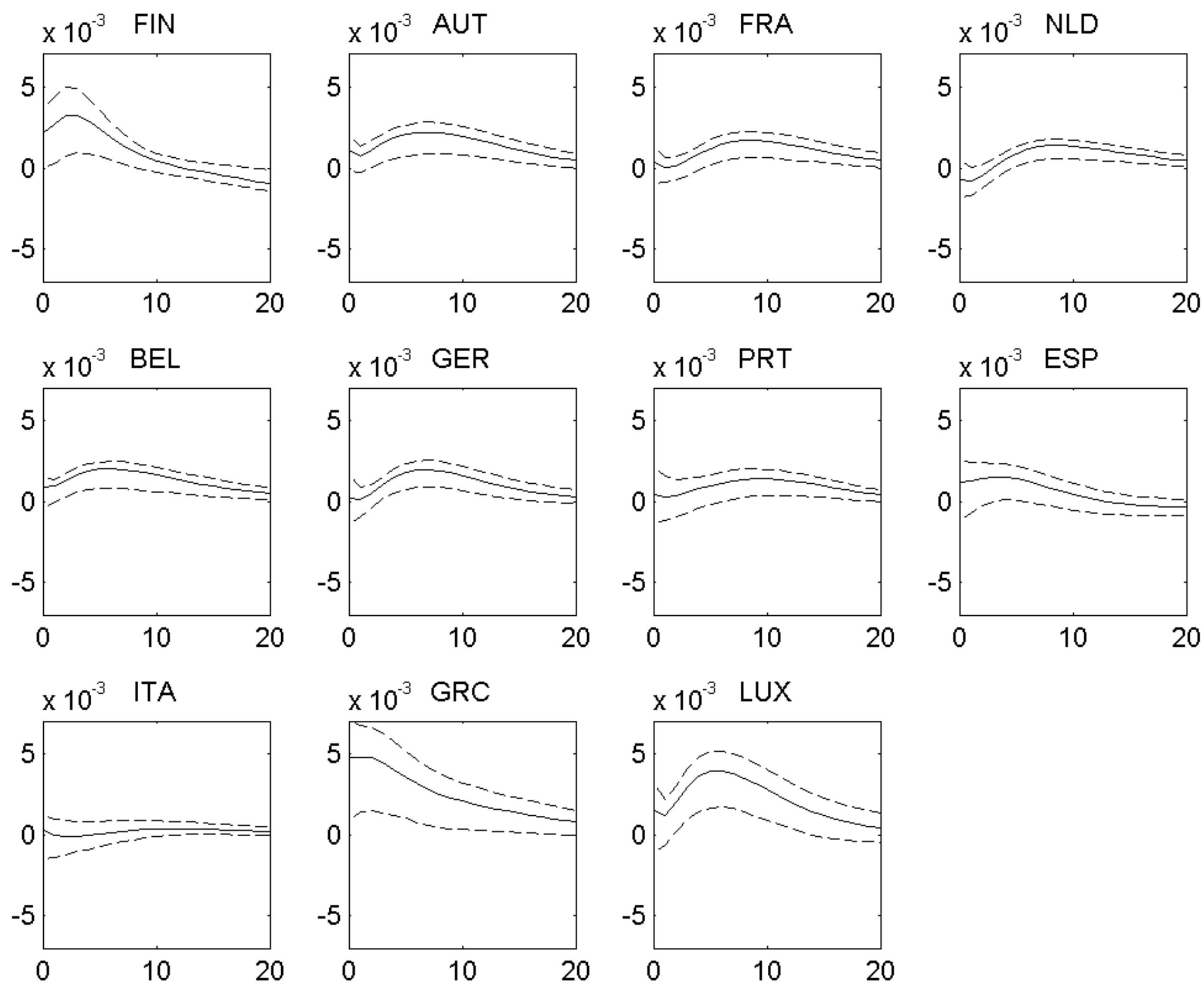


Figure 11
The Response of the reer to a Shock to the German Budget Balance

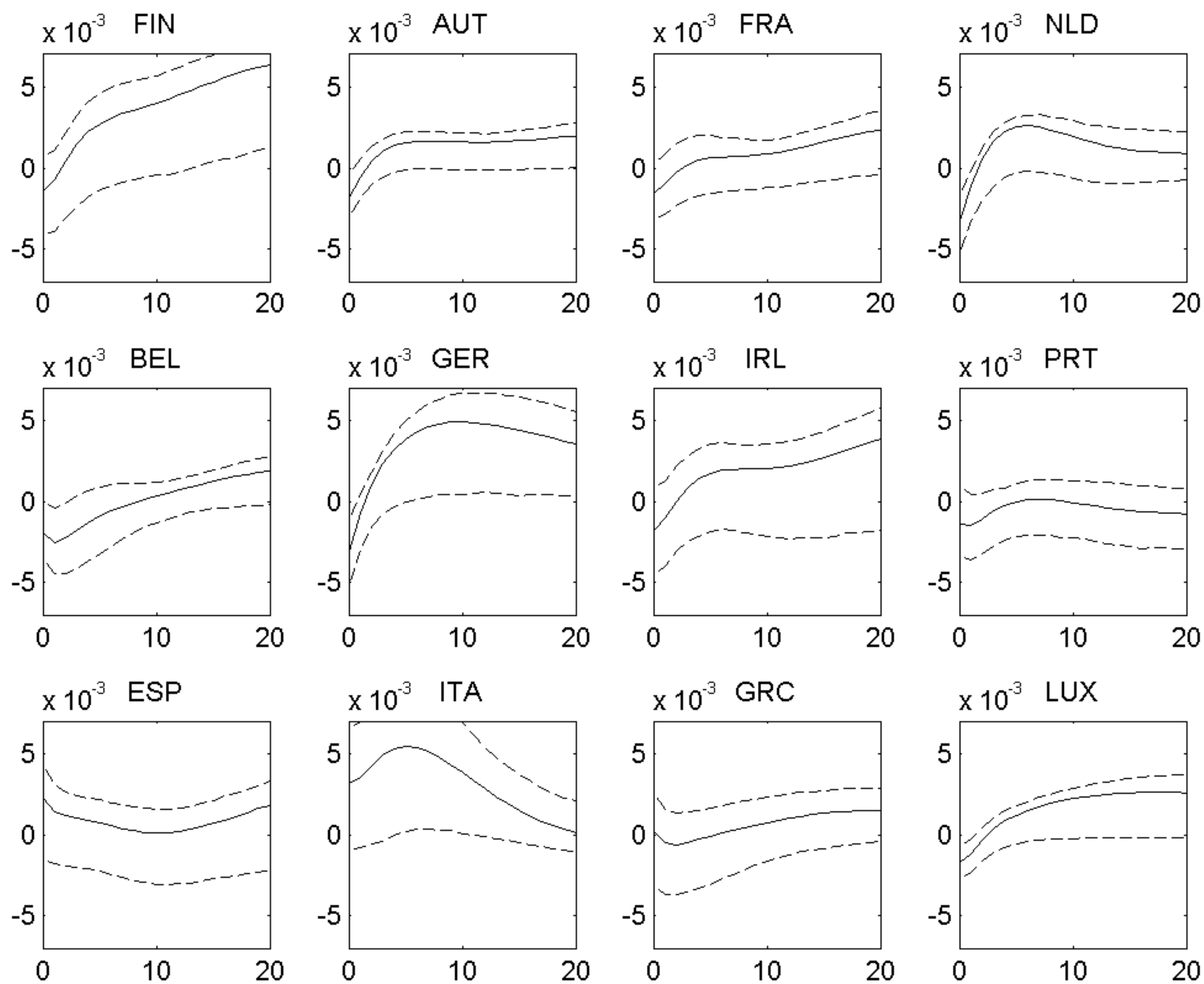


Figure 12

The Response of the reer to a Shock to the French Budget Balance

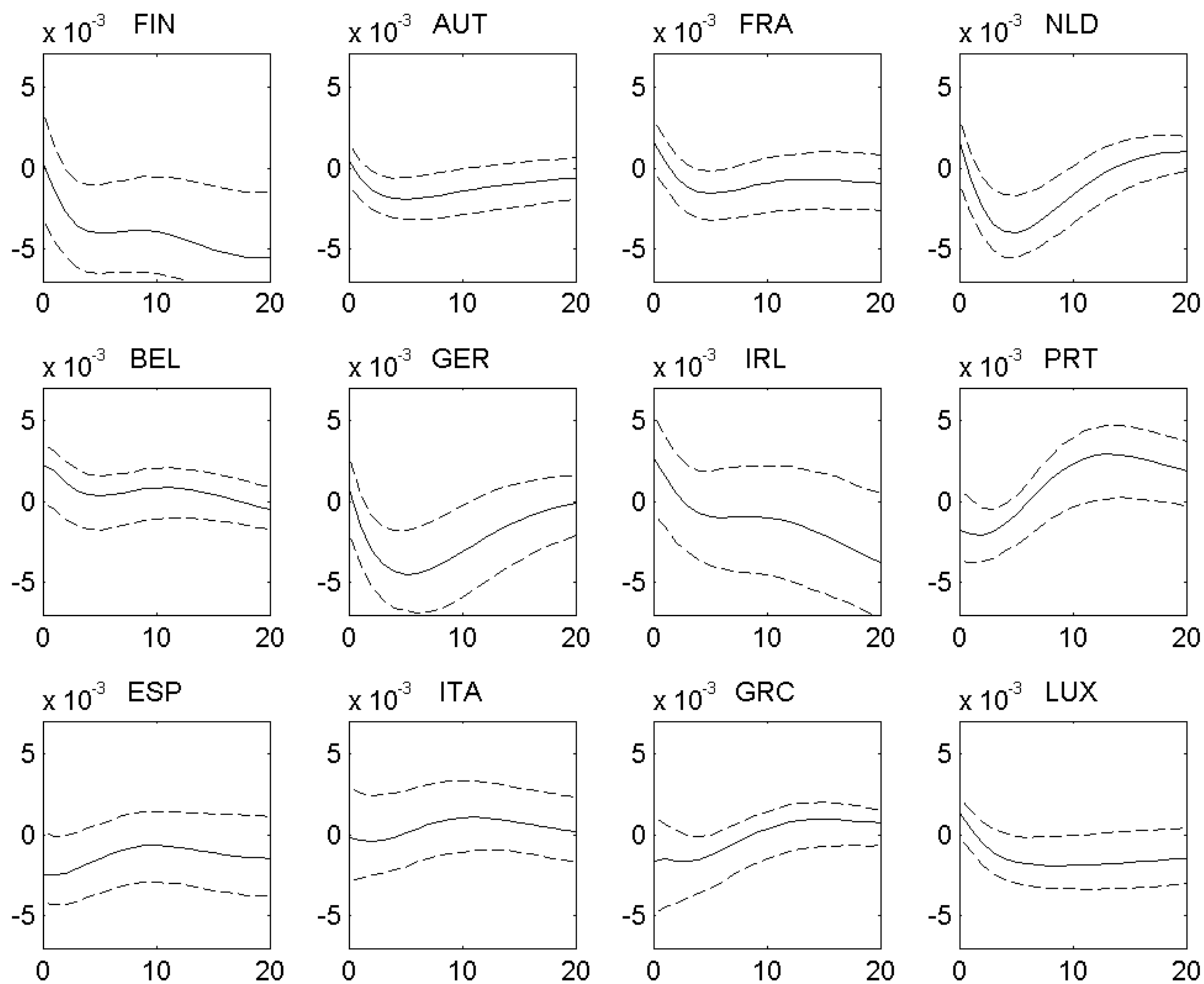
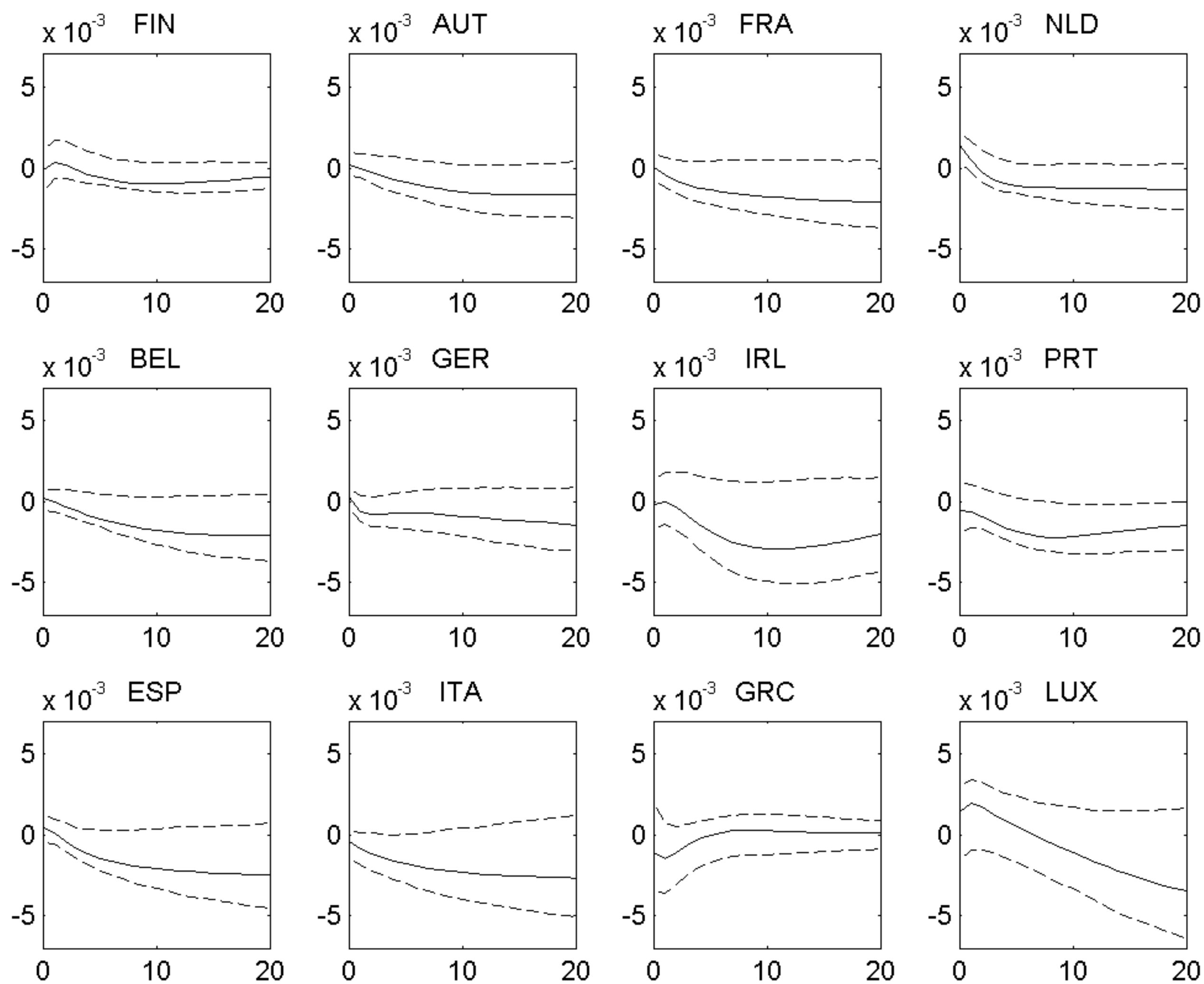


Figure 13
The Response of Output to a German Structural Budget Balance Shock



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