Fiscal Spillovers and Monetary Policy Transmission in the Euro Area

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Abstract

In this paper I set up a New-Keynesian model for each of the eleven original member countries of the Euro area and tie them together with the GVAR methodology of trade weights to obtain a fully structural multi-country model for the whole currency union. Each country is estimated with Bayesian methods on the same observable variables and with the same priors. Spillovers are negative if countries increase their government spending or their labor tax rate and positive after a consumption tax rate increase. The monetary transmission upon a shock to the common Taylor rule yields heterogeneous effects on output and inflation. This transmission would become more homogeneous if all countries followed the same fiscal rules. Stabilization Policy dictates for the central bank to target inflation as aggressively as possible and for the fiscal branch to react heavily to deviations of debt from its steady state.

JEL codes: E52, E58, E62, F41, F42, C11, C22

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1 Introduction

The key to understanding the current challenges in the euro area is the specific construction of Economic and Monetary Union. The coexistence of an achieved monetary union - the single currency, the single monetary policy and the Eurosystem with the ECB at its helm- and of a largely decentralised economic pillar. Indeed, Member States are responsible for their fiscal and economic policies, but are called to treat them as a matter of common concern. (Jean-Claude Trichet (28th of June, 2011), "Revitalising the European Dream: A Corporate View")

The recent debt crisis in Europe has revitalized the debate about the interaction between monetary policy conducted at the ECB and the independent fiscal policies at government level. The fact that Greece and other southern European countries with overwhelming debt have no currency on their own and can therefore not devaluate is at the root of the problem of the ongoing crisis situation and poses a major challenge for the union. Hence an analysis of this particular interaction is important to understand the current problem and help to solve a recurrent one in the future. In this paper I put the Euro area and all its original member countries centerstage and analyze the interaction of their different fiscal policies and the one monetary policy. Especially the monetary transmission in the single member countries and the fiscal spillovers between those countries are examined.

In recent years primarily at big institutions multi-country models have been established to improve policy analysis and advice by using more data and to make forecasting more reliable. Examples herefore are the models by Gomes *et al.* (2010) and Dieppe *et al.* (2011) at the ECB and by Bayoumi (2004) at the IMF. Until now questions unique to currency unions have been mostly analyzed in two country DSGE models. Duarte and Wolman (2008) for instance examine inflation differentials and Rabanal (2009) houseprice spillovers whereas fiscal policy and fiscal consolidation is taken up for example by Forni *et al.* (2010) and Stähler and Thomas (2011). Fiscal policy topics were also at the heart of the papers by Rabanal and Aspachs-Bracons (2011) and Breuss and Rabitsch (2008).

In this study I try to embrace the multicountry literature with the currency union framework by establishing a structural DSGE model for the eleven original member countries of the Euro Area and tying them together to arrive at a multi-country model for a currency union [1]. The advantage of this approach is that the number of countries does not hinge on practical

[1] As there are no nominal exchange rates among the countries and just one monetary policy one can also call

restrictions as in normal DSGE models where a three country model is already becoming highly untractable. This model for the Euro Area is developed to study both fiscal and monetary policy and their interaction.

In the past many different strings have evolved in the literature concerning these two policies and their interaction. Fiscal analysis has until recently very often been empirical and dealt with the multiplier determination in a closed economy, starting with Blanchard and Perotti (2002). Work on fiscal spillover analysis in open economies has equally been reduced form most of the time as for example in Beetsma *et al.* (2006). Lately this topic was increasingly dealt with also in structural models as for example in Cwik and Wieland (2009) and Corsetti *et al.* (2009).

Monetary transmission of the ECB on its member countries has been heatedly discussed at the very beginning of the establishment of the Eurozone with data on the pre-monetary union situation (for example in Ehrmann (2000) and McAdam and Morgan (2001)). Those studies were mostly empirical and neglected a fiscal side that could interfere with monetary transmission.

One of the strands of literature that examine the interaction of both policies started with Leeper (1991) who has looked at so called active and passive policies of both authorities and identified areas of (in-)determinacy. This field of the fiscal theory of the price level has become a very debated one with Chung *et al.* (2007) and Buiter (2002) as active participants. With respect to monetary and fiscal policy in a monetary union the concept of free riding at the disadvantage of others and how one common monetary policy could react to this was taken up by Gali and Perotti (2003) and Uhlig (2002).

In order to build the complete model I first set up an open New Keynesian model for each of the eleven original member countries. Each economy consists of households, firms, a retailer and a fiscal authority. Monetary policy is determined at the union wide level.

The data for the estimation part is given by the key macroeconomic variables output, inflation, government expenditure, debt, consumption and labor tax rates and the common euro area short term interest rate going back to the beginning of the single monetary policy in 1999Q1 and lasting until 2009Q4. The first step of the estimation methodology is detrending the data by the means of a Global Vector Error Correction Model (GVECM) in order to account for possible cointegration within and between the countries.

this a multiregions model. Henceforth, I nevertheless stick to the term multi-country model as fiscal policies are still decided on individual country levels.

Subsequently I estimate the model with Bayesian methods with the same priors for each country. After the estimation of the parameters the model is written in system based form and the single countries are tied together with their respective trade weights. This is the approach which is based on the GVAR methodology, developed by Pesaran *et al.* (2004). The global, recursive solution is finally obtained by solving the rational expectations model with the algorithm by Binder and Pesaran (1995).
The results are exclusively built on the dynamic analysis of this global solution. Fiscal Spillovers in the forms of output and inflation to other countries are throughout negative if government expenditure is increasing in a member country. Monetary transmission is very heterogeneous across countries in terms of inflation and GDP. It would become more homogenous at least in terms of the reaction of output, however if fiscal policies would be equal in all countries. In terms of stabilization policy the monetary authority response to a expansive government spending shock is contingent on the size of the economy executing such a shock. If a big country increases government spending the best response would be to target inflation as aggressively as possible and output only moderately. The opposite holds true if a small country raises government spending. The paper is organized as follows: in section 2 I present the open economy New-Keynesian model. Section 3 is explaining the data and its detrending as well as the Bayesian estimation of the model. The derivation of the final global model is shown in section 4. All results of the dynamic analysis are discussed in section 5. Section 6 concludes.

2 Model

The model I set up is a simple open economy model. The model is structured in discrete time and features an infinite horizon. The agents in the open economy are households and entrepreneurs that are infinitely lived and retailers that contribute the nominal friction to the model. I assume perfect risk-sharing i.e. complete financial markets within the currency union. The number of frictions is kept at a minimum. In addition to that there is a fiscal authority that is country specific and a monetary authority that is supranational. That is, the interest rate r_t is not countryspecific which is also indicated by the missing subscript i that will denote country i with $i = 1 : 11$.

2.1 Households

Most of the household's equations and definitions are standard in the open economy literature. Households in country i maximize their expected lifetime utility which consists of consumption and labor and is given by

$$E_0 \sum \beta_i^t U\left(C_t^i, L_t^i\right). \tag{1}$$

The parameter β_i denotes as usual the degree of impatience. As shown later in the calibration and estimation section, β is assumed to be the same in all countries. The period utility of households in country i looks like the following

$$U(C, L) \equiv \frac{\epsilon_{i,t}^P (C_{i,t} - h_i C_{i,t-1})^{1-\sigma_i}}{1-\sigma_i} - \frac{L_{i,t}^{1+\phi_i}}{1+\phi_i} \tag{2}$$

with σ_i being the parameter for intertemporal elasticity of substitution and ϕ_i as the parameter governing the disutility of labor. $\epsilon_{i,t}^P$ denotes a preference shock that hits households consumption in country i at period t. The lifetime utility function is maximized under the series of budget constraints which are given by

$$\int_0^1 P_{i,t}(j) C_{i,t}(j)(1+\tau_{i,t}^C) + R_t B_{i,t} \leq B_{t-1,i} + (1-\tau_{i,t}^L) W_{i,t} L_{i,t} + Pr_{i,t}$$

where $B_{i,t}$ is a one-period deposit of the home country denominated in the currency of the union, $W_{i,t}$ is the wage and $Pr_{i,t}$ denotes the profits the household gets from the retailers. Consumption and labor are subject to distortionary taxation, $\tau_{i,t}^C$ and $\tau_{i,t}^L$ respectively. Aggregate consumption in the economy i is given by the composite consumption index.

$$C_{i,t} \equiv \frac{(C_{i,t}^H)^{(1-\lambda)} (C_{i,t}^*)^{\lambda}}{(1-\lambda)^{(1-\lambda)} \lambda^{\lambda}} \tag{3}$$

Both consumption of goods j produced at home $C_{i,t}^H$ and abroad $C_{i,t}^*$ (in the whole union) are given by the CES functions

$$C_{i,t}^H \equiv \left(\int_0^1 C_{i,t}^H(j)^{\frac{(\epsilon-1)}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}} \tag{4}$$

and for the imported goods

$$C^*_{i,t} \equiv exp \sum_{k=1}^{11} \int c^*_{i,t} \tag{5}$$

respectively. Here $c^i_{f,t}$ is written as the log of consumption of the imported goods bundle of a special country ($k \neq i$). Symmetrically it must also hold for every other country in the union

$$C^F_{i,t} \equiv \left(\int_0^1 C^F_{i,t}(j)^{\frac{(\epsilon-1)}{\epsilon}} dj \right)^{\frac{(\epsilon)}{\epsilon-1}} \tag{6}$$

The second function denotes the imported goods of country i from the rest of the union. $(1 - \lambda_i)$ is a parameter that is bounded between 0 and 1 and is commonly referred to as the openness parameter. More precisely it is the weight that is attached to consumption of domestically produced and foreign produced goods respectively. Of course this parameter, as any other parameter, is different for every country i in the monetary union. The consumer price index in country i is given as

$$P_{i,t} \equiv (P^H_{i,t})^{\lambda} (P^*_{i,t})^{1-\lambda} \tag{7}$$

with $P^H_{i,t}$ as the price level index of domestically produced goods, i.e. the producer price index price index. $P^*_{i,t}$ is the price index in the rest of the countries. The usual demand functions depend on the price of the good j with respect to the aggregate price in the economy. The exponent $-\epsilon$ is responsible for the demand function to be downward sloping. Therefore consumption demand for good j in country i is written like this:

$$C^H_{i,t}(j) = \left(\frac{P_{i,t}(j)}{P_{i,t}} \right)^{-\epsilon} C^H_{i,t} \tag{8}$$

The demand for goods j produced abroad (imported goods) in country i is given by the demand of consumption of foreign goods $C^*_{i,t}(j)$

$$C^*_{i,t}(j) = \left(\frac{P^*_{i,t}(j)}{P^*_{i,t}} \right)^{-\epsilon} C^*_{i,t}. \tag{9}$$

Finally government demand for good j takes the same form:

$$G_{i,t}(j) = \left(\frac{P_{i,t}(j)}{P_{i,t}} \right)^{-\epsilon} G_{i,t} \tag{10}$$

Note that government expenditure is only directed to internally produced goods. There is no demand schedule of government that hinges on imported goods. This is an assumption that facilitates aggregation later on. Furthermore for the spillover analysis this clear cut assumption is useful as a government expenditure shock only stimulates the domestic economy and only through this can it spillover to the foreign economies. If I loosened up this assumption the economies would be even more heavily intertwined and results would be not as precise to analyze. The price level indices are assumed to follow the well-known rule.

$$P_{i,t} \equiv \left(\int_0^1 P_{i,t}(j)^{(1-\epsilon)} dj \right)^{\frac{1}{(1-\epsilon)}} \tag{11}$$

Due to the fact that the law of one price is assumed to hold I can write the foreign produced goods' price level index in

$$P^*_{i,t} \equiv \left(\int_0^1 P^*_{i,t}(j)^{(1-\epsilon)} dj \right)^{\frac{1}{(1-\epsilon)}} \tag{12}$$

After using the definitions above and combining them in the familiar way the budget constraint can then finally be written in the aggregate form.

$$P_{i,t}C_{i,t}(1+\tau^C_{i,t}) + R_t B_{i,t} \leq B_{i,t-1} + W_{i,t}L_{i,t}(1-\tau^L_{i,t}) + Pr_{i,t}$$

As all countries i are members of one currency union, there are no exchange rates to consider. Terms of trade, however, exist and are defined in the following way. The bilateral terms of trade between the home country i and any foreign country k ($k \neq i$) are given by

$$T_{i,t} \equiv \frac{P^k_{i,t}}{P^H_{i,t}}$$

i.e. the price level of goods produced in country k expressed in country i's price level. The effective terms of trade for country i are then obtained by aggregating over the ten other countries:

$$T_{i,t} = \frac{P^*_{i,t}}{P^H_{i,t}} = exp \sum_{k=2}^{11} (p^*_{i,t} - p^H_{i,}) = exp \sum_{k=1}^{11} t_{i,t}$$

where small letters denote as before the log of the respective variable. (here: $t_{i,t} \equiv logT_{i,t}$). By the same token also the PPI price index and consumer price price index are related in the following way:

$$P_{i,t} = P_{i,t}^{H}(T_{i,t})^{(1-\lambda)}$$

This equation can be expressed in logs like this:

$$p_{i,t} = p_{i,t}^{H} + (1-\lambda)t_{i,t}$$

or in first difference:

$$\pi_{i,t} = \pi_{i,t}^{H} + (1-\lambda)\Delta t_{i,t} \tag{13}$$

Under the assumption of perfectly tradable securities over all countries[2], i.e a complete market across the whole monetary union the marginal utility of the households has to be the same in all countries k ($k \in 1:11, k \neq i$), which equals the real exchange rate between countries.

$$Q_{i,t} = \nu_i \frac{(C_{i,t} - h_i C_{i,t-1})^{-\sigma_i} \epsilon_{i,t}^{P}}{(C_{i,t}^{*} - h_i^{*} C_{i,t-1}^{*}) \epsilon_{i,t}^{P,*}} \tag{14}$$

According to Pytlarczyk (2005) ν_i denotes a constant that summarizes the initial conditions and is assumed to be the same for all countries. More precisely I set it to one for all countries without loss of generality. The real interest rate are related to the terms of trade by the following relationship (in log-linear terms).

$$q_{i,t} = (\lambda_i + \lambda_i^{*} - 1)t_{i,t} \tag{15}$$

Finally, for the purpose of simplicity and according to Rabanal (2009) I log-linearize around a equilibrated current account for all countries.

2.2 Firms

Firms in each country i produce by using a certain level of technology $A_{i,t}$ and labor $L_{i,t}$ that is supplied by the households. There is no capital involved in this economy. The production

[2] This assumption is made to keep the number of frictions at bay and have the same nominal interest rate across countries. Once fiscal policy (and monetary policy, too) is examined it is convenient to exclude this friction as it would complicate the analysis.

function of firm j is then equal to:

$$Y_{i,t}(j) = A_{i,t} L_{i,t}(j)$$

with $Y_{i,t}(j)$ as the output of firm j. The real marginal costs are in this case simply given by the real wage

$$MC_{i,t} = \frac{W_{i,t}}{A_{i,t} P_{i,t}}.$$

In terms of price setting I assume that retailers set their prices according to the Calvo (1983) mechanism, i.e. each period the fraction $(1 - \theta_i)$ of all firms are able to reset their prices optimally. Furthermore I allow that firms that cannot reoptimize their prices in period t index their prices to the lagged inflation rate. This is congruent with e.g. Smets and Wouters (2003) and Christiano *et al.* (2005). Those firms that are not able to reoptimize their prices in period t set them according to the following rule:

$$P_{i,t} = \tilde{\pi}_{i,t} P_{i,t-1} \tag{16}$$

with $\tilde{\pi}_{i,t}$ given by the following formulation[3]:

$$\tilde{\pi}_{i,t} = \pi_{i,t-1}^{\varpi_i} \pi_{i,t}^{1-\varpi_i} \tag{17}$$

Profits of firm j (in nominal terms) are then equal to

$$\Pi_{i,t}(j) = (P_{i,t}(j) - MC_{i,t}) \left(\frac{P_{i,t}(j)}{P_{i,t}} \right) Y_{i,t}(j) \tag{18}$$

The first order conditions are standard and can be found in the appendix.

2.3 Monetary and fiscal rules

The government is divided up into a monetary authority and a fiscal authority. Both institutions follow certain policy rules whereas monetary policy is not determined within the country but at the monetary union level. The union wide central bank sets the common interest rate according to the widely used "Taylor" rule, originally proposed in Taylor (1993).

[3] Christiano *et al.* (2007) use a similar formulation where contemporaneous inflation is substituted by an inflation target

Here the monetary response is delivered with respect to a certain country specific output gap and inflation gap only to the extent of the GDP weight of the respective economy[4]. In addition to that the interest rate depends also on its lagged value to make sure that the sluggishness of interest rate setting is captured in the data as is suggested by Clarida *et al.* (1999). In log-linearized form the interest rate rule for the whole euro area takes the following form:

$$\tilde{r}_t = \rho_r \tilde{r}_{t-1} + \rho_\pi \bar{\tilde{\pi}}_t + \rho_y \bar{\tilde{y}}_t + \epsilon_{t,R} \tag{19}$$

The fiscal side is decided separately in the eleven different countries. I assume that the tax rate rules on consumption and labor look the same. As in Leeper *et al.* (2010) those rules depend positively on current deviations of output from its steady state. This can be thought of as an automatic stabilizer framework, as government expenditures increase to boost economic output if GDP is below its steady state. In order to guarantee stability and determinacy the tax rate rules are also reacting to the past deviation of public debt from its steady state. As with the monetary policy rule, also both tax rate rules include an autoregressive term to capture the persistence of tax rates in general. The log-linearized form of both tax rates looks like this:

$$\tau^S_{i,t} = \rho_{\tau^S} \tau^S_{i,t-1} + \rho_{\tau^S,y} \tilde{y}_{i,t} + \rho_{\tau^S,b} \tilde{b}_{i,t-1} + \epsilon^{\tau^S}_{i,t} \tag{20}$$

with $S = C, L$ where C denotes the consumption tax rate and L the labor tax rate. The last rule that the fiscal authority has at its disposal is the government expenditure rule that also includes a lagged term and the countercyclical response to output deviation and debt deviation from their respective steady state values. It is given by

$$\tilde{g}_{i,t} = \rho_g \tilde{g}_{i,t-1} - \rho_{g,y} \tilde{y}_{i,t} - \rho_{g,b} \tilde{b}_{i,t-1} + \epsilon^G_{i,t} \tag{21}$$

The budget of the governments does not have to be equilibrated and therefore the budget constraint allows for the accumulation of debt:

$$B_{i,t} = \frac{B_{i,t-1} R_{t-1}}{\pi_{i,t}} + G_{i,t} - T_{i,t} \tag{22}$$

with $T_{i,t} = \tau^C_{i,t} C_{i,t} + \tau^L_{i,t} w_{i,t} L_{i,t}$. It should be noted that those fiscal rules are ad hoc and not optimal as the ones that were derived in Schmitt-Grohe and Uribe (2007), but their form

[4] The GDP weights used are taken from the year 2008, averaging over the whole sample size would not make a sizeable difference; note that inflation $\bar{\tilde{\pi}}_t$ and output $\bar{\tilde{y}}_t$ are written as averages of deviations

seems to become increasingly popular in the recent literature as for example in Leeper *et al.* (2010).

2.4 Market clearing

The following condition secures that the market for good j in country i clears if good j is consumed by households either in the home country or abroad (the other ten countries) or by the local government:

$$y_{i,t}(j) = c_{i,t}(j) + \sum_{k=2}^{11} c^*_{i,t}(j) + g_{i,t}(j) \tag{23}$$

where the second element of the right-hand side indicates that good j can be imported from any of the 10 other economies in the currency union.

2.5 Foreign Economy

As in Adolfson *et al.* (2007) and Forni and Pisani (2010) the foreign economy is displayed by a reduced form VAR model. The selected lag length is chosen to be one as the number of time series observations on which the VAR together with the whole structural model of the endogenous home country is estimated is very small. The VAR consists of three variables, foreign inflation $\pi^*_{i,t}$, foreign output $y^*_{i,t}$ and foreign consumption $c^*_{i,t}$. The first is treated to be observables whereas the latter two are unobservable and treated as e.g. technology or marginal costs etc. in the structural home model. All three depend on their own lag and also on the other variables' lag as well as on the lag of the interest rate. If this was not assumed the model would be indeterminate as both the Taylor principle would not be satisfied by the relative small weight for most countries of the central bank on home inflation[5] and at the same time debt is stabilized by the tax rates rules and government expenditure rule. According to Leeper and Davig (2011) this would be a passive monetary and a passive fiscal policy that yields indeterminate model dynamics. So the assumption that foreign variables do depend on the union wide interest rate or its lag is crucial . The reduced form approach

[5] Also in the case of Germany as the largest country in the Euro Area the weight would be 0.29 multiplied with the coefficient of the central bank on inflation 1.56 the Taylor principle the coefficient being bigger than one would not be satisfied.

with attaching the foreign economy exogenously on the home economy in this scenario stems also from the whole GVAR literature. In the reduced form GVAR each VARX is estimated separately for each country whereas all the other countries are treated as weakly exogenous. Only afterwards, upon stacking the countries together and finding the global solution do all countries react to all the others also endogenously. The same method applies here with the structural approach. The set of first order conditions and all log-linearized equations of the model can be found in the appendix.

3 Estimation

In this section I describe the data that is used for the Bayesian Estimation. Furthermore I apply a special way of detrending the observable variables along the lines of Dees *et al.* (2009). Lastly the estimation step is explained in detail.

3.1 Data

Altogether I use eight variables in the GVAR. All of them have a quarterly frequency and start at the beginning of the introduction of the Euro, at the first quarter of 1999. The sample ranges until the fourth quarter of 2009 which yields 44 time observations. I am aware that the sample length is not very big and shortcomings in the results may also be attributed to the lack of data observations. The reason why I do not want to go further back is because I want to concentrate only on the Euro zone and its common monetary policy which exists only since then. The cross section encompasses the eleven original members of the Euro area[6]. Six of the eight variables are country specific and two are common to all countries. The common variables are the short term interest rate and the oil price. The short term interest rate is taken from the Area Wide Model (AWM) database of the ECB. The oil price, originally expressed in dollars is divided by the bilateral exchange rate to the Euro and stems from the same source [7]. The other six variables are real GDP, inflation,

[6]These are: Austria, Belgium, Germany, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain

[7]The oil price is added as further common factor as this is the case in most of the GVAR studies so far. Confer for example Pesaran *et al.* (2004) and Dees *et al.* (2009). Furthermore also in structural open economy models the oil price is considered as major input factor and modeled explicitly, see de Walque *et al.* (2005)

real government expenditure, real government debt, the consumption tax rate and the labor tax rate. The first three are taken from the OECD quarterly database, whereas the last three stem from Eurostat. Inflation is calculated as growth rates from country specific CPI indices. Real GDP is derived by taking nominal GDP, that is seasonally adjusted, for every country and dividing it by the CPI index of the respective country. Government expenditure is derived in the same way. For this series the seasonal adjustment is performed by EViews with the X12 program and the additive option. The two tax rates are treated in the same way. Government debt only exists at a yearly frequency. Budget deficits and surpluses, however, also at a quarterly frequency. So I deflate both with the CPI index of the respective country, perform the seasonal adjustment with the X12 program of Eviews and interpolate debt with the Chow-Lin method using the budget deficit as the reference variable. As is common in GVAR studies I take the logs of all variables (instead of inflation the log of the price index) and perform a unit root test for all variables that I use in this estimation. As expected and common (for example in Pesaran *et al.* (2004)) the log of the price level is I(2) in most of the countries. Therefore the first difference of this series is taken what is also in line with the variable in the DSGE model. All other variables remain in logs and are not differenced. With respect to trade data (imports and exports of a country with respect to all other countries) I use the database of Eurostat.

3.2 Deviations from Steady State

There are different methods of obtaining the deviations of steady states in a multi dimensional time series. As Dees *et al.* (2010) show there are three predominant ones. Either one assumes (or actually proves) that the time series are not integrated and in this case also not cointegrated both within and between countries, then one can regress each time series on an intercept term and a trend and the corresponding residuals are the deviations for every time t.

The next possibility is to use the Hodrick-Prescott filter for each of the time series. If dealing with quarterly data as in the present context a smoothing parameter (λ) of 1600 is chosen as is common in the literature. Dees *et al.* (2010) perform their calculation of the deviation from steady states with this device and actually show that for the forward looking components in the New Keynesian model the estimated parameters using the Hodrick-Prescott filtered deviations are understated compared to the last and most appropriate alternative: the Global Vector Error Correction Model (GVECM)[8].

Using this method the cointegration relations both within and between the countries are properly accounted for. Furthermore it can be shown that this method is equivalent to a multivariate Beveridge-Nelson Decomposition (see also Garrat *et al.* (2006) and Arino and Newbold (1998)). In this set up with eleven countries I find that there are altogether 45 cointegration relations and to deal with this fact appropriately I opt for the GVECM approach to derive the deviations from steady state. The two first alternatives would not take into account that some of those variables have common european trends. In order to do so I perform a GVECM (explained in detail below in the appendix section ?) with the six endogenous variables (GDP, government expenditure, inflation, debt and the two tax rates) and the two weakly exogenous variables (the short term interest rate and the oil price). Given the global solution I finally calculate the infinite horizon forecasts. These values are taken as my steady state values and deducted from the actual observations. Let the actual observations of the eleven countries be given by $x_t = (x'_{1,t}, x'_{2,t}, ..., x'_{11,t})$, then the deviations of the steady states are calculated as follows:

$$\tilde{x}_t = x_t - x_t^P \tag{24}$$

The permanent component x_t^P is further decomposed into a deterministic and a stochastic component:$x_t^P = x_{d,t}^P + x_{s,t}^P$ where the deterministic component is given by $x_{d,t}^P = \mu + gt$, an intercept term and the trend. The stochastic component $x_{s,t}^P$ is then defined as the long-horizon forecast (without the permanent-deterministic component):

$$x_{s,t}^P = \lim_{h\to\infty} E_t(x_{t+h} - x_{d,t+h}^P) = \lim_{h\to\infty} E_t[x_{t+h} - \mu - g(t+h)] \tag{25}$$

For a detailed explanation see also the paper by Dees *et al.* (2010).

3.3 Calibration

A big number of parameters and steady state values must be calibrated before taking the model to the data and estimating the remaining not easily inferable ones. In order to obtain the trade weights that are used to link the countries with each other (both in the reduced

[8] For a general critique of the Hodrick-Prescott Filter when using non-stationary series refer to Cecioni and Neri (2011)

form approach to get the deviations from steady state and also later in linking the structural economies see 4.1) I take the trading data (imports and exports) of Eurostat of all countries with respect to each other and divide the trade amount of country i with respect to country j by the full trade amount of country i. The trade matrix that is finally used is displayed in appendix section 8.4. What is striking in this matrix is the fact that Germany is the predominant trading partner of most of the other countries resulting in relatively high values for most economies linked to Germany. Trade data is also used in order to calibrate the openness parameter λ_i for all countries. It is one minus the imported consumption goods over total consumption in the respective economy. It ranges from 0.1 in the case of big economies as Germany and France to 0.45 in Luxembourg. The opposite λ_i^* holds for the exported share of goods over total Euro Area consumption. It is for most countries close to one. The impatience parameter β_i is uniformly set to 0.99, so as to secure a steady state short term interest rate of 4% in annualized terms. Lastly the steady state ratios of debt to GDP and consumption are imputed along with steady state rates for labor taxes and consumption taxes. For the latter I simply use the average of the quarterly time series of direct taxation and indirect taxation of which VAT from the ESA. For the ratios I assume that the average is not a valid point and retreat to the respective division of the last observation at the end of my sample [9].

3.4 Bayesian Estimation of Each Country

With the obtained deviations from the steady states and the completed linearized model (see appendix section ?), the next step is the estimation. Also in terms of estimations there are several possibilities at hand. Dees *et al.* (2010) opted for the instrumental variables approach where each equation in every country is estimated separately. The Taylor rule and the exchange rate equation were estimated by OLS whereas the Phillips-curve and the IS-curve due to the terms containing expectations were estimated with instrumental variables. In both cases the instrumental variables of both inflation and GDP were their lagged terms. In this approach, however, one loses the interactions within the system that a DSGE-model represents. This DSGE model features a fully blown up fiscal sector and altogether thirteen variables, so equation by equation estimation is impossible with the number of observables

[9] Luxembourg had no debt but a slight surplus, so in order to guarantee determinacy of the model I took the average in this case

I have. So due to the linear set up I use the Kalman Filter to relate the observables to the variables in the model that are unobserved. This approach leaves room for two different procedures. The first would be to estimate each country with the Maximum likelihood estimation. This method, however, requires good knowledge of the parameter values and the concept is situated near to actual calibration. The second option is Bayesian estimation of the DSGE model what is generally preferred as we have some prior knowledge about the parameters to estimate. As I am estimating all country DSGE models separately it is essential that the priors and the shapes are the same for every country. In order to obtain the coefficients in the Taylor rule I estimate the euro area on GDP weighted averages beforehand and include them as calibrated parameters when I estimate each country separately. The estimation itself is carried out in the way An and Schorfheide (2006) propose in their work. One advantage of deriving the deviations of steady state values as I did, there is no need to implement any measurement equations as the variables are exactly in the form they are needed in the estimation. With respect to priors of the deep parameters (habit, elasticity of substitution etc.) I rely heavily on previous studies of estimated DSGE-models and take the same for each of the countries. Along with Lubik and Schorfheide (2005) I take the prior for habit of consumption h_i to be 0.3 and the parameters in the utility function of both consumption (σ_i)and labor (ϕ_i) are taken from Smets and Wouters (2007) to be 2. The same holds true for the Calvo parameter θ_i and the inflation indexation parameter ϖ_i being chosen to be 0.75. For the overall Euro area estimation beforehand the Euro area-wide parameters are chosen in exactly the same way. The priors for the Taylor rule are also chosen to be uniformly distributed between zero and one and for the autoregressive parameter and the responses to inflation deviations and output deviations 1.5 and 0.5 respectively, the values that Taylor (1993) proposed in his seminal work. The response parameters in the fiscal rules with respect to output and debt are all chosen to follow a γ distribution and have a prior mean of 0.25 with respect to output and debt. The autoregressive parameters for technology, the fiscal rules and the exogenous foreign variables are assumed to follow a β distribution and a prior mean of 0.8. The shocks follow an inverted γ distribution and have (except for $\epsilon^{c*}_{i,t}$ and $\epsilon^{\pi*}_{i,t}$) a mean of 0.1 with a standard deviation of two. I estimate the various country models with Dynare 4.2 and use the simplex based optimization routine. The scaling parameter for the Metropolis-Hastings algorithm is set in a way that the acceptance ratio is between 0.2 and 0.3. Altogether I use five chains with 250000 replications each for each country and check that the Brook-Gelman convergence diagnostics is satisfied. In the end I obtain the estimated values of the deep parameters which are (together with the priors, and the prior shape) shown in four tables in appendix C.3. Although most results are standard and very similar across countries a few results stand out. The Calvo Parameter θ is in most countries very high, a result that is also found in many studies estimating the Phillips curve for the euro area over the last time as for example in Cwik (2010). Then the coefficients on consumption and labor are somewhat high throughout, which is in part driven by the relatively loose prior. The coefficients in the fiscal rules are among the most important parameters to be estimated and all of them are well identified (due to the inclusion of the tax rates and government spending) and smaller than the original priors. The divergence across countries, however, is big enough so that the counterfactual analysis of monetary transmission with equal fiscal rules is meaningful. The habit parameter is not in all countries well identified and significantly away from its prior because consumption as the time series that relates to it is missing. The remaining ones are well behaved as can be seen for the case of Germany in C.4 in the Appendix where both the prior and the posterior distribution is plotted. In addition I also included the parameters of the VAR for the reduced form foreign country. Those parameters will not be used later on in building the global model, so their relevance is limited.

4 Solution

4.1 Stacking according to GVAR Methodology

After having estimated the parameters the model can be cast in its structural form:

$$A_{i,0}x_{i,t} = A_{i,1}x_{i,t-1} + A_{i,2}E_t(x_{i,t+1}) + A_{i,3}x^*_{i,t} + A_{i,4}x^*_{i,t-1} + G_i u_{i,t}$$

where the content of each matrix is shown in the Appendix. Then as before in the deviations from steady state case we use the same method and stack the country matrices one below the other: Therefore I construct a trade weighting matrices for all countries W_i. The purpose of each one is to relate its own endogenous variables to the two weakly exogenous foreign variables inflation and consumption. Furthermore the matrix $z_{i,t} = (x^{'}_{it}, x^{*'}_{it})'$ is defined which yields the expression for every country:

$$A_{i,z0}z_{i,t} = A_{i,z1}z_{i,t-1} + A_{i,z2}E_t(z_{i,t+1}) + G_i w_{i,t}$$

with $A_{i,z0} = (A_{i,0}, -A_{i,3})$, $A_{i,z1} = (A_{i,1}, A_{i,4})$ and $A_{i,z2} = (A_{i2}, 0(K, K^*))$ Now I relate the vector $z_{i,t}$ to the overall vector of all endogenous variables x_t with $z_{i,t} = W_i x_t$ and stack the 11 countries below each other to obtain the global solution:

$$A_0 x_t = A_1 x_{t-1} + A_2 E_t(x_{t+1}) + G u_t$$

with $A_j = \begin{pmatrix} A_{1,zj}W_1 \\ A_{2,zj}W_2 \\ \cdots \\ A_{11,zj}W_{11} \end{pmatrix}$

and w_t as the stacked exogenous innovations over all countries: $u_t = \begin{pmatrix} u_{1,t} \\ u_{2,t} \\ \cdots \\ u_{11,t} \end{pmatrix}$. Until then only the endogenous variables of each country are considered and related with the foreign countries. In order to incorporate the interest rate all matrices are enlarged by 1 row and 1 column. The coefficients of the interest rate rule are entered in the last row and the response of consumption in the Euler equation to the last column of A_0. The response of the lagged interest rate on debt is put in the last column of A_1 as well as the coefficient in the interest rate rule on the lagged interest rate. The error terms of the individual countries are not related to each other via trade weights, their interaction comes in the next step when I invert A_0 and yield the global solution:

$$x_t = A x_{t-1} + B E_t(x_{t+1}) + \Gamma u_t$$

This procedure is following the standard GVAR methodology, applied here to the structural form of the model which is comparable to Dees *et al.* (2010).

4.2 Solution to Rational Expectations Model

Finally I have arrived at the multivariate form of the equation:

$$x_t = A x_{t-1} + B E_t(x_{t+1}) + \Gamma u_t$$

with A and B being matrices of the size 133×133 ($N \cdot K + 1 \times N \cdot K + 1$) and Γ is a matrix of 133×56. In order to obtain the global solution and be able to perform dynamic analysis one has to solve the rational expectation model and formulate the multivariate equation in the following form.

$$x_t = \Phi x_{t-1} + \Gamma u_t.$$

There are different ways of solving such a rational expectations system. Many of these rely on the division of predetermined variables and other endogenous variables Blanchard and Kahn (1980),Sims (2001) or putting the state variables first Klein (2000). So these approaches are not implementable in this model as the global solution is ordered by countries. So I rely in the following on the solution algorithm of Binder and Pesaran (1995) and Binder and Pesaran (1997) which is more general and overcomes the above stated problem. Furthermore it is flexible enough to allow for highly singular matrices as is the case here. Moreover this solution method was also used in Dees *et al.* (2010). According to this mechanism Φ is the solution to the quadratic matrix equation: $B\Phi^2 - \Phi + A = 0$. That quadratic matrix equation is solved by a backward-substitution procedure where an initial guess Φ_0 is iterated until convergence of $\Phi_z = (I_k - B\Phi_{z-1})^{-1}A$ is achieved. The convergence criterion in this paper is ($\|\Phi_z - \Phi_{z-1}\|_{max} \leq 10^{-7}$), where z indicates the iteration step.

5 Results

The order of the results will be the following. Firstly, the fiscal spillovers both after a government spending shock and after an exogenous increase to the tax rate rules is presented. Secondly, it is examined how key variables as output, inflation and debt respond to an exogenous increase in the interest rate. As a counterfactual example I analyze how monetary transmission would change if fiscal rules were homogenous across countries. Lastly ad-hoc loss functions both for the fiscal and the monetary branch are established and used for stabilization policy. All Figures are shown in the Appendix and the analysis of the impulse responses is always based on a one standard deviation shock.

5.1 Fiscal Spillovers

After a transitory, positive shock to government spending the multiplier in the respective country is positive as well as inflation. As a result the common interest rate is rising which leads to a dampening of foreign demand. This interest rate channel therefore decreases output and inflation in the other countries. On the other hand domestic households substitute the more expensive home made products for cheaper foreign ones and increase their imports from the ten other countries. This phenomenon is called the trade channel. As can be seen in Figure 1 the spillovers from Germany to all the other countries are negative on impact. So the interest rate channel is dominating the trade channel. The reason is that the interest rate channel relates to the whole consumption bundle of all countries while the trade channel only influences the imports of Germany which are relatively small compared to the aggregate consumption bundle (in the case of Germany roughly 11%). After the first periods one observes an overshooting that is much more pronounced in the big economies or the countries with heavy trade linkages to Germany. Inflation in those countries is reacting less strongly but mostly in the same manner. The effect of the interest rate increase cools off quickly as the central bank only reacts to inflation (which is not increasing by much) and to output according to the GDP weight of the respective country. So once the interest rate is back to zero the trade channel is still operative and therefore output in the other countries is stimulated. Figures 2 and 4 depict the same positive shock to two other big countries, Italy and Spain, while Figure 3 plots the response in the other countries to an expansionary government spending shock to Portugal as an example for a small country. These results are fairly similar, the output multiplier is positive and on impact the interest rate channel dominates while after some periods in many cases the output of the biggest trading partners switches sign and becomes and stays positive. In terms of quantitative analysis the output multipliers for the countries shown here are all around 1 and 1.5%. The magnitude of the spillovers depends then on the economy that is executing a fiscal expansion. In the case of Germany the response of output in Italy is climbing to 0.1% after the minor dip at the beginning. The output reaction of the other countries is somewhat smaller. This depends not only on the magnitude of the exporting country and the trade weight but also on the coefficient of the household with which it internalizes the interest rate change in the Euler equation. For the case of a positive shock to the consumption tax rate I only present two different countries. Once again as an example for a big economy Germany and as an example for a small one, Portugal, Figures 5 and 6 respectively. Both economies react in the same way and also the transmission process to the other economies is very similar. The rest of the euro zone benefits from the first period and the output spillover remains positive throughout. Also here the interest rate channel is at work and evidently it is dominating the trade channel the whole time. Finally I repeat the same exercise with the same countries if the labor tax rule is increased (see Figures 7 and 8). The responses are qualitatively very similar to the government expenditure shock with negative spillovers throughout at least in the beginning and in the case of big countries as Italy or France relatively fast overshooting and positive spillovers. The big difference is, however, that the quantitative responses are much smaller. If spillovers after government expenditure shocks accounted up to 0.1% of GDP, in the case of a labor tax increase the spillovers would be at the order of 0.0001% for GDP of the respective country. Nevertheless, this has to be brought into perspective of the way the tax rate rules have been modelled. Those are not defined in percentages but also in deviations of steady states. So translating the response back to a one percent increase of the tax rate in levels, also the responses would be more sizeable. The same quantitative analysis also holds for the consumption tax rate before.

5.2 Monetary Transmission

The monetary transmission across countries in the euro area has been widely discussed. Here it is examined with a complete multi-country model for the whole euro area complementing the mostly empirical studies beforehand. The included variables that are responding to a contractionary monetary shock are inflation, output, consumption as well as debt. The objective is to determine whether there are asymmetries in the transmission mechanism and if yes how big they are. Figure 9 suggests that the reaction of inflation and output upon a positive monetary policy shock is highly diverse with the least response in Portugal and the most in Germany in the case of output. The way the interest rate shock transmits itself into the economy is through the Euler equation with the key coefficients of habit and the CES utility parameter of consumption. From there on households and firms base all their decisions on the impact on current and future consumption. Given that the structure is of course the same for all countries, but the parameters differing a lot the current result is not surprising. In addition to that, however, another layer is added in this set up to obtain such heterogeneous results. The feedback mechanism from the other countries and second round effects of imports have to be considered, too. Therefore the different results can be explained, above all because consumption across countries seems to react very similarly across countries. In a counterfactual example I am interested in whether monetary transmission is becoming more homogeneous if the fiscal rules all follow the same coefficients (without loss of generality I take the coefficients of Germany for all other countries). This is the closest one can get in this model to study the effects of a "common" fiscal policy. In Figure 10 one observes that output at least is becoming more alike across countries whereas inflation still reacts differently. It is important to note that all fiscal rules react towards deviations of output from its steady state. Once the reaction towards it is standardized (and with very similar responses to consumption) output starts behaving very homogeneous. Inflation, however, is not captured by the fiscal rules and is still a function of all different parameters that have not been harmonized. So it is not surprising that this response is still differing a lot across countries.

5.3 Stabilization Policy

The last aspect of policy interaction that I analyze is how one branch of government should react if the other executes an expansionary shock. In the case of stabilization for monetary policy I assume that the central bank cares about the GDP weighted average of inflation deviations and output deviations across countries. The loss function looks like this:

$$L = 0.8\bar{\bar{\pi}}_t{}^2 + 0.2\bar{\bar{y}}_t{}^2$$

The coefficients are used quite arbitrarily, but also varying them a bit does not change the results decisively [10]. The loss function of the central bank puts relatively more weight on inflation and only little weight on output . Here only a positive shock to government in two different countries is analyzed but the general principle holds for all countries respectively. The monetary authority should react differently according to where the shock originates. If a big country as Germany (see Figure 11) executes a government expenditure shock the optimal reaction according to the loss function is to put relatively little weight on output, i.e. choosing

[10] It is not referred to optimal policy and welfare as the loss function that I use is ad-hoc and not taken from the utility function of the households.

a coefficient on output in the Taylor rule of approximately 0.2 and reacting to inflation as aggressively as possible. In the current example I let the possible coefficients range from 0 to 1 in the case of output and from 1 to 3 for inflation, therefore satisfying the Taylor principle. For France the reaction would be very similar with an output coefficient of 0.1 on output and a very high coefficient on inflation. The case is very different if the government spending shock originates in a small country. As an example Figure 12 is depicting the loss function after a fiscal shock in Netherlands. Here the reaction to inflation seems not to matter much but output should be targeted very aggressively with an ultimate coefficient of 1. The reason for the different reactions is that in the case of a small economy executing an expansionary fiscal shock the inflation reactions (however small they may be) are canceling out each other and only the positive output multiplier is left to react to.

If monetary policy shocks the interest rate negatively fiscal policy could react with three different devices in this model. In this section I restrict the analysis to choosing the coefficients on debt and output deviations in the government expenditure rule. The loss function is once again ad hoc and assumed to take the form:

$$L = 0.5\bar{\bar{b}}_t^{\,2} + 0.5\bar{\bar{y}}_t^{\,2}$$

This is a rather stark assumption that government includes deviations of debt in its loss function, but given the current debt crisis and the stabilization principle of the Maastricht treaty, all the euro area countries should. In this exercise I propose an equal weight of output and debt in the loss function. Figure 13 shows that the optimal reaction of fiscal policy (which is an average of all countries fiscal policies) is to respond both to output and debt very aggressively. This stems from the fact that debt is reacting very strongly to monetary policy given just a little weight in the loss function the reaction to this variable has to be very high. In terms of output, after a negative monetary policy shock output rises, so in order to stabilize the economy the fiscal branch must react to output with a high coefficient to try to offset this increase in GDP.

6 Conclusion

This paper adds to the existing literature along two important dimensions. First of all a true structural multi-regions model for the whole Euro Area is established. Secondly, fiscal spillovers between countries can be shown as well as monetary-fiscal interactions at the Euro area level. As key macroeconomic time series have been used to estimate the model for each country I am able to draw conclusions on how the economies behave after a certain shock and use the model for policy analysis or advice. Fiscal spillovers tend to be negative as the interest rate channel dominates the trade channel. Monetary transmission is rather heterogeneous across countries and the optimal stabilization policy calls for a strong reaction towards output and debt on the fiscal side. The response of the central bank should be contingent on the size of the economy that shocks government spending. Most of the equations are micro founded by the optimizing behavior of the various agents in the economy. Others, however, like the fiscal rules are somewhat ad hoc and lack both a microeconomic and an econometrical foundation such as the widely recognized Taylor Rule as a monetary policy rule. In this area further research is certainly desirable. The linking of the countries is also crucial in this modeling setup. Here I decided to use static trade weights whereas time-varying trade weights or the inclusion of financial weights could have mirrored reality better. Tying together countries in this setup is essential and to improve on it leaves ample room for future research. Other aspects that future papers could tackle is business cycle convergence via a common technology or improving on the use of the model for each country, eg. using a relatively large macro-workhorse model such as Smets and Wouters (2003) or Bernanke *et al.* (1999).

References

Adolfson, M., Laseen, S., Linde, J., and Villani, M. (2007). Bayesian estimation of an open economy DSGE model with incomplete pass-through. *Journal of International Economics*, **72**(2), 481–511.

An, S. and Schorfheide, F. (2006). Bayesian Analysis of DSGE Models. *Working Paper No.06-5; Federal Reserve Band of Philadelphia*, **13**.

Arino, M. A. and Newbold, P. (1998). Computation of the Beveridge-Nelson decomposition for multivariate economic time series. *Economic letters*, **61**, 37–42.

Bayoumi, T. (2004). GEM: A New International Macroeconomic Model. *Occasional Paper 239*.

Beetsma, R., Giuliodori, M., and Klaasen, F. (2006). Trade spill-overs of fiscal policy in the European Union: a panel analysis. *Economic policy*, **21**, 639–687.

Bernanke, B., Gertler, M., and Gilchrist, S. (1999). *The financial accelerator in a quantitative business cycle framework*, volume 1, chapter 21, pages 1341–1393. Handbook of Macroeconomics.

Binder, M. and Pesaran, M. (1995). *Multivariate rational expectations models and macroeconomic modelling: A review and some new results*, volume 1, chapter 21, pages 655–673. Handbook of Applied Econometrics.

Binder, M. and Pesaran, M. (1997). Multivariate linear rational expectations models: characterization of the nature of the solutions and their fully recursive computation. *Econometric Theory*, **13**, 877–888.

Blanchard, O. and Kahn, C. (1980). The solution of Linear Difference Models under Rational Expectations. *Econometrica*, **48**(1), 305–311.

Blanchard, O. and Perotti, R. (2002). An Empirical Characterization Of The Dynamic Effects Of Changes In Government Spending And Taxes On Output. *The Quarterly Journal of Economics*, **117**(4), 1329–1368.

Breuss, F. and Rabitsch, K. (2008). An Estimated Two Country DSGE Model of Austria and the Euro Area. FIW Working Paper series 017, FIW.

Buiter, W. H. (2002). The Fiscal Theory Of The Price Level: A Critique. *Economic Journal*, **112**(481), 459–480.

Calvo, G. (1983). Staggered Prices in a Utility Maximizing Framework. *Journal of Monetary Economics*, **12**, 383–398.

Cecioni, M. and Neri, S. (2011). The monetary transmission mechanism in the euro area: has it changed and why? Temi di discussione (Economic working papers) 808, Bank of Italy, Economic Research Department.

Christiano, L., Eichenbaum, M., and Evans, C. L. (2005). Nominal Rigidities and the Dynamic Effects of a shock to Monetary Policy. *Journal of Political Economy*, **113**(1), 1–45.

Christiano, L., Motto, R., and Rostagno, M. (2007). Shocks, Structures or Monetary Policies? The Euro Area and US after 2001. *ECB Working Paper Series*, **No. 774**.

Chung, H., Davig, T., and Leeper, E. M. (2007). Monetary and Fiscal Policy Switching. *Journal of Money, Credit and Banking*, **39**(4), 809–842.

Clarida, R., Gali, J., and Gertler, M. (1999). The science of Monetary Policy: A new-Keynesian Perspective. *Journal of economic Literature*, **37**, 1661–1707.

Corsetti, G., Meier, A., and J.Mueller, G. (2009). Cross-Border Spillovers from Fiscal Stimulus. *Mimeo*.

Cwik, T. (2010). Fiscal consolidation using the example of Germany. *Mimeo*.

Cwik, T. and Wieland, V. (2009). Keynesian Government Spending Multipliers and Spillovers in the Euro Area. *Mimeo*.

de Walque, G., Smets, F., and Wouters, R. (2005). An Estimated Two-Country DSGE Model for the Euro Area and the US Economy. *mimeo*.

Dees, S., Pesaran, M., Smith, L., and P.Smith, R. (2009). Identification of new Keynesian Phillips curves from a global perspective. *Journal of Money, Credit and Banking*, **41**, 1481–1502.

Dees, S., Pesaran, M., Smith, L., and P.Smith, R. (2010). Supply, Demand and Monetary Policy Shocks in a Multi-Country New Keynesian Model. *CESifo Working Paper No. 3081*.

Dieppe, A., Pandiella, A. G., and Willman, A. (2011). The ECB's New Multi-Country Model for the euro area: NMCM - simulated with rational expectations. Working Paper Series 1315, European Central Bank.

Duarte, M. and Wolman, A. L. (2008). Fiscal policy and regional inflation in a currency union. *Journal of International Economics*, **74**(2), 384–401.

Ehrmann, M. (2000). Comparing Monetary Policy Transmission across European Countries. *Weltwirtschaftliches Archiv*, **136**, 58–83.

Forni, L. and Pisani, M. (2010). Fiscal policy in open economy: estimates for the euro ara. Working paper series, IMF.

Forni, L., Gerali, A., and Pisani, M. (2010). The macroeconomics of fiscal consolidations in euro area countries. *Journal of Economic Dynamics and Control*, **34**(9), 1791–1812.

Gali, J. and Perotti, R. (2003). Fiscal Policy and Monetary Integration in Europe. *Economic Policy*, **18**, 534–572.

Garrat, A., Robertson, D., and Wright, S. (2006). Permanent vs.transitory components and economic fundamentals. *Journal of Applied Econometrics*, **21**, 521–542.

Gomes, S., Jacquinot, P., and Pisani, M. (2010). The EAGLE. A model for policy analysis of macroeconomic interdependence in the Euro area. Working Paper Series 1195, European Central Bank.

Klein, P. (2000). Using the Generalized Schur Form to Solve a Multivariate Linear Expectations Model. *Journal of Economic Dynamics and Control*, **24**, 405–423.

Leeper, E. M. (1991). Equilibria under 'active' and 'passive' monetary and fiscal policies. *Journal of Monetary Economics*, **27**(1), 129–147.

Leeper, E. M. and Davig, T. (2011). Monetary-Fiscal policy interactions and fiscal stimulus. *European Economic Review*, **55**, 211–227.

Leeper, E. M., Plante, M., and Traum, N. (2010). Dynamics of fiscal financing in the United States. *Journal of Econometrics*, **156**, 304–321.

Lubik, T. and Schorfheide, F. (2005). *A Bayesian Look at the New Open Economy Macroeconomics*, volume 20, pages 314–382. NBER Macroeconomics Annual.

McAdam, P. and Morgan, J. (2001). The Monetary Transmission Mechanism at the Euro-Area Level:Issues and Results Using Structural Macroeconomic Models. *ECB Working Paper No.93*.

Pesaran, M., Schuermann, T., and M.Weiner, S. (2004). Modelling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model. *Journal of Business and Economic Statistics*, **22**(10), 129–162.

Pytlarczyk, E. (2005). An estimated DSGE model for the German economy within the euro area. Discussion Paper Series 1: Economic Studies 2005,33, Deutsche Bundesbank, Research Centre.

Rabanal, P. (2009). Inflation Differentials between Spain and the EMU: A DSGE Perspective. *Journal of Money, Credit and Banking*, **41**(6), 1141–1166.

Rabanal, P. and Aspachs-Bracons, O. (2011). The Effects of Housing Prices and Monetary Policy in a Currency Union. Imf working papers, International Monetary Fund.

Schmitt-Grohe, S. and Uribe, M. (2007). Optimal simple and implementable monetary and fiscal rules. *Journal of monetary Economics*, **54**, 1702–1725.

Sims, C. A. (2001). Solving Linear Rational Expectations Models. *Computational Economics*, **20**, 949–968.

Smets, F. and Wouters, R. (2003). An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area. *Journal of the European Economic Association*, **1**(5), 1123–1175.

Smets, F. and Wouters, R. (2007). Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach. *American Economic Review*, **97**(3), 586–606.

Stähler, N. and Thomas, C. (2011). FiMod - a DSGE model for fiscal policy simulations. Discussion Paper Series 1: Economic Studies 2011,06, Deutsche Bundesbank, Research Centre.

Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, **39**(1), 195–214.

Uhlig, H. (2002). One money, but many fiscal policies in europe: What are the consequences? CEPR Discussion Papers 3296, C.E.P.R. Discussion Papers.

Appendix

A Model Equations

A.1 FOCs and Equilibrium Conditions of the model

FOC HH wrt. C:

$$\epsilon_{i,t}^{C}(C_{i,t} - h_i C_{i,t-1})^{-\sigma_i} = (1+\tau_{i,t}^{C})\lambda_{i,t}$$

FOC HH wrt. L:

$$L_{i,t}^{\phi_i} = \lambda_{i,t}(1-\tau_{i,t}^{L})w_{i,t}$$

FOC HH wrt. B:

$$\lambda_{i,t} = \lambda_{i,t+1}\beta R_t$$

FOC of Firm wrt. L:

$$W_{i,t} = \frac{MC_{i,t}Y_{i,t}}{L_{i,t}} \tag{26}$$

FOC of Retailer wrt. P:

$$E_{i,t}\sum_{l=0}^{\infty}\beta_i^l\theta_i^l\varepsilon_{i,t+l}y_{i,t+l}^{j}\left(\frac{\tilde{p}_{i,t}^{j}}{P_{i,t}}\left(\frac{P_{i,t-1+l}/P_{i,t-1}}{P_{i,t+1}/P_{i,t}}\right)^{\varpi_i} - (1+\varepsilon_{p,i,t+l})MC_{i,t+l}\right) = 0 \tag{27}$$

with $\lambda_{i,t}$ as the shadow price for the budget constraint of the household in country i.

A.2 The Linearized System

Euler-equation of Country i:

$$\begin{aligned}
\tilde{c}_{i,t} &= \frac{h_i}{1+h_i}\tilde{c}_{i,t-1} - \frac{1-h_i}{(1+h_i)\sigma_i}\left(\frac{\tau_{i,c}^{ss}}{1+\tau_{i,c}^{ss}}\right)\tau_{i,t}^{C} + \frac{1-h_i}{(1+h_i)\sigma_i}\left(\frac{\tau_{i,c}^{ss}}{1+\tau_{i,c}^{ss}}\right)\tau_{i,t+1}^{C} \\
&+ \frac{1}{1-h_i}\tilde{c}_{i,t+1} - \frac{1-h_i}{(1+h_i)\sigma_i}(\tilde{r}_t - \tilde{\pi}_{i,t+1}) + \frac{1-h_i}{(1+h_i)\sigma_i}(\epsilon_{i,t}^{P} - \epsilon_{i,t+1}^{P})
\end{aligned}$$

Intratemporal condition of HH in Country i:

$$(1+\phi_i)\tilde{l}_{i,t} + \left(\frac{\tau_{i,c}^{ss}}{1+\tau_{i,c}^{ss}}\right)\tau_{i,t}^{C} = \tilde{mc}_{i,t} + \tilde{y}_{i,t} - \left(\frac{\tau_{i,l}^{ss}}{1-\tau_{i,l}^{ss}}\right)\tau_{i,t}^{L} - \frac{\sigma_i}{1-h_i}\tilde{c}_{i,t} + \frac{\sigma_i h_i}{1-h_i}\tilde{c}_{i,t-1}$$

PC-equation of Country i:

$$\tilde{\pi}_{i,t}^{H} = \frac{\beta}{1+\varpi_i\beta}\tilde{\pi}_{i,t+1}^{H} + \frac{\varpi}{1+\varpi_i\beta}\tilde{\pi}_{i,t-1}^{H} + \frac{1}{1+\varpi_i\beta}\frac{(1-\theta_i\beta)(1-\theta_i)}{\theta_i}(\tilde{mc}_{i,t} + (1-\lambda_i)t_{i,t}) + \epsilon_{i,t}^{PC}$$

Production Function of Country i:

$$\tilde{y}_{i,t} = \tilde{a}_{i,t} + \tilde{l}_{i,t}$$

Government Expenditure Rule:

$$\tilde{g}_{i,t} = \rho_g \tilde{g}_{i,t-1} - \rho_{g,y}\tilde{y}_{i,t} - \rho_{g,b}\tilde{b}_{i,t-1} + \epsilon_t^{G} \tag{28}$$

Consumption Tax Rate Rule:

$$\tau_{i,t}^{C} = \rho_{\tau^C}\tau_{i,t-1}^{C} + \rho_{\tau^C,y}\tilde{y}_{i,t} + \rho_{\tau^C,b}\tilde{b}_{i,t-1} + \epsilon_t^{\tau^C} \tag{29}$$

Labor Tax Rate Rule:

$$\tau_{i,t}^{L} = \rho_{\tau^L}\tau_{i,t-1}^{L} + \rho_{\tau^L,y}\tilde{y}_{i,t} + \rho_{\tau^L,b}\tilde{b}_{i,t-1} + \epsilon_t^{\tau^L} \tag{30}$$

Taylor Rule of ECB:

$$\tilde{r}_t = \rho_r \tilde{r}_{t-1} + \rho_\pi(\omega_i\tilde{\pi}_{i,t} + (1-\omega_i)\tilde{\tilde{\pi}}_{i,t}^{*}) + \rho_y(\omega_i\tilde{y}_{i,t} + (1-\omega_i)\tilde{\tilde{y}}_{i,t}^{*}) + \epsilon_{t,R} \tag{31}$$

Government Budget Constraint:

$$\tilde{b}_{i,t} + \tau_{i,L}^{SS}\frac{Y_i^{ss}}{B_i^{ss}}(\tilde{\tau}_{i,t}^{L}\tilde{mc}_{i,t} + \tilde{y}_{i,t}) + \tau_{i,C}^{SS}\frac{C_i^{ss}}{B_i^{ss}}(\tau_{i,t}^{C} + c_{i,t}) = \frac{1}{\beta}(\tilde{b}_{i,t-1} + \tilde{r}_t) + \frac{G_i^{ss}}{B_i^{ss}}\tilde{g}_{i,t} \tag{32}$$

Aggregate Resource Constraint:

$$\tilde{y}_{i,t} = \left(1 - \frac{G_i^{ss}}{Y_i^{ss}}\right)\left(\lambda_i((1-\lambda_i)\tilde{t}_{i,t} + \tilde{c}_{i,t}) + \frac{1-\omega_i}{\omega_i}(1-\lambda_i^{*})(\lambda_i^{*}\tilde{t}_{i,t} + \tilde{c}_{i,t}^{*})\right) + \frac{G_i^{ss}}{Y_i^{ss}}\tilde{g}_{i,t} \tag{33}$$

Risk Sharing Condition:

$$\tilde{t} = \frac{1}{\lambda_i + \lambda_i^* - 1}\left(-\frac{\sigma_i^*}{1-h_i^*}(\tilde{c}_{i,t}^* - h_i^*\tilde{c}_{i,t-1}^*) + \frac{\sigma_i}{1-h_i}(\tilde{c}_{i,t} - h_i\tilde{c}_{i,t-1}) + \epsilon_{i,t}^P - \epsilon_{i,t}^{P,*}\right) \tag{34}$$

Connection of CPI with PPI :

$$\tilde{\pi}_{i,t} = \lambda_i\tilde{\pi}_{i,t} + (1-\lambda_i)\tilde{\pi}_{i,t}^* \tag{35}$$

B The Global Vector Error Correction Model (GVECM)

The estimation of the GVECM is actually a $VECMX^*$ for every country i according to the equation:

$$\Delta x_{i,t} = c_{i,0} - \alpha_i \beta_i' \left[\left(x_{i,t}', x_{i,t}^{*,'}, d_t' \right)' - \gamma_i (t-1) \right] + \Upsilon_{i,0} \Delta d_t + \Lambda_{i,0} \Delta x_{i,t}^* + \Upsilon_{i,1} \Delta d_{t-1} + \Phi_i \Delta z_{i,t-1} + u_t \tag{36}$$

where $z_{i,t} = (x_{i,t}', x_{i,t}^{*'})'$, $x_{i,t} = (Y_{i,t}, G_{i,t}, \pi_{i,t}, B_{i,t})'$, $x_{i,t}^* = (Y_{i,t}^*, G_{i,t}^*, \pi_{i,t}^*, B_{i,t}^*)'$, $d_t = (R_t, Poil_t)'$. The foreign GDP for country i is for example given by $Y_{i,t}^* = \sum_{j=0}^{N} w_{ij} Y_{j,t}$ as a trade weighted average of all foreign economies' GDP. Due to data limitations I use one lag for the endogenous variable, one for the weakly exogenous foreign variable and one for the global factor. I estimate each $VECMX^*$ with the reduced rank Maximum likelihood procedure and find the cointegration rank with the trace test. The amount of cointegrating relations for each country is given by:

Countries	AT	BE	GE	FI	FR	IR	IT	LU	NL	PT	ES
Coint. Relations	4	4	4	4	4	4	4	4	3	5	5

Then, I transfer the coefficient matrices back to the level form in order to do the stacking of the matrices and the dynamic analysis afterwards. For the stacking we define:

$$z_{it} = \begin{pmatrix} x_{it} \\ x_{it}^* \end{pmatrix}$$

and get

$$A_i z_{it} = a_{i0} + a_{i1} t + B_i z_{i,t-1} + u_{it}$$

for every country i: With the trade matrix W_i generated for every country I get: $z_{it} = W_i X_t$ and finally get the global solution

$$GX_t = a_0 + a_1 t + HX_{t-1} + u_t$$

with $G = \begin{pmatrix} A_1 W_1 \\ A_2 W_2 \\ ... \\ A_N W_N \end{pmatrix}$ and $H = \begin{pmatrix} B_1 W_1 \\ B_2 W_2 \\ ... \\ B_N W_N \end{pmatrix}$

To finally get the reduced form global solution I invert the matrix G and obtain:

$$X_t = F X_{t-1} + \epsilon_t$$

The matrix F is 66×66 matrix and contains $21 (= 66 - 45)$ eigenvalues of exactly one[11]. With this global solution I then can perform the forecast to obtain the steady state values and the respective deviations from steady state.

[11]This is the amount of total variables minus the amount of all cointegration relations summed up over all countries

C Parameters

C.1 Structural Model matrices

The structural model for each country i has the following form:

$$A_{i,0}x_{i,t} = A_{i,1}x_{i,t-1} + A_{i,2}E_t(x_{i,t+1}) + A_{i,3}x^*_{i,t} + A_{i,4}x^*_{i,t-1}$$

with: $x'_{i,t} = \begin{pmatrix} c_{i,t} & mc_{i,t} & y_{i,t} & \pi^H_{i,t} & b_{i,t} & t_{i,t} & \pi_{i,t} & \tau^C_{i,t} & \tau^L_{i,t} & g_{i,t} & l_{i,t} & a_{i,t} \end{pmatrix}$

$$A_{i,1} = \begin{pmatrix}
\frac{h}{1+h} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-\frac{\sigma h}{1-h} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \frac{\varpi}{1+\varpi\beta} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{1}{\beta} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-\frac{1}{\lambda+\lambda^*-1}\frac{\sigma h}{1-h} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \rho_{\tau^C,b} & 0 & 0 & \rho_{\tau_C} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \rho_{\tau^L,b} & 0 & 0 & 0 & \rho_{\tau_L} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -\rho_{g,b} & 0 & 0 & 0 & 0 & \rho_G & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho_a
\end{pmatrix}$$

$$A_{i,2} = \begin{pmatrix}
\frac{1}{1+h} & 0 & 0 & 0 & 0 & 0 & \frac{1-h}{\sigma(1+h)} & \frac{1-h}{\sigma(1+h)}\frac{\tau_C^{ss}}{1+\tau_C^{ss}} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \frac{\beta}{1+\beta\varpi} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}$$

$$A_{i,3} = \begin{pmatrix}
0 & 0 \\
0 & 0 \\
(1-\frac{G^{ss}}{Y^{ss}})\frac{1-\omega}{\omega}(1-\lambda^*) & 0 \\
0 & 0 \\
0 & 0 \\
-\frac{1}{\lambda+\lambda^*-1}\frac{\sigma^*}{1-h^*} & 0 \\
0 & (1-\lambda) \\
0 & 0 \\
0 & 0 \\
0 & 0 \\
0 & 0 \\
0 & 0
\end{pmatrix}
A_{i,4} = \begin{pmatrix}
0 & 0 \\
0 & 0 \\
0 & 0 \\
0 & 0 \\
0 & 0 \\
\frac{1}{\lambda+\lambda^*-1}\frac{\sigma^* h^*}{1-h^*} & 0 \\
0 & (1-\lambda)*\rho_{\pi^*} \\
0 & 0 \\
0 & 0 \\
0 & 0 \\
0 & 0 \\
0 & 0
\end{pmatrix}$$

$$A_{i,0} = \begin{pmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{\tau_C^{ss}}{1+\tau_C^{ss}}\frac{1-h}{\sigma(1+h)} & 0 & 0 & 0 & 0 \\
\frac{-\sigma}{1-h} & 1 & 1 & 0 & 0 & 0 & 0 & \frac{-\tau_C^{ss}}{1+\tau_C^{ss}} & \frac{-\tau_L^{ss}}{1-\tau_L^{ss}} & 0 & -(1+\phi) & 0 \\
-\left(1-\frac{G^{ss}}{Y^{ss}}\right)\lambda & 0 & 1 & 0 & 0 & -\left(1-\frac{G^{ss}}{Y^{ss}}\right)\left(\lambda(1-\lambda)+\frac{(1-\omega)(1-\lambda^*)\lambda^*}{\omega}\right) & 0 & 0 & 0 & -\frac{G^{ss}}{Y^{ss}} & 0 & 0 \\
0 & -\frac{1}{1+\varpi\beta}\frac{(1-\theta\beta)(1-\theta)}{\theta} & 0 & 1 & 0 & -\frac{1}{1+\varpi\beta}\frac{(1-\theta\beta)(1-\theta)}{\theta}(1-\omega) & 0 & 0 & 0 & 0 & 0 & 0 \\
\frac{C^{ss}}{B^{ss}}\tau_C^{ss} & \frac{Y^{ss}}{B^{ss}}\tau_L^{ss} & \frac{Y^{ss}}{B^{ss}}\tau_L^{ss} & 0 & 1 & 0 & 0 & \frac{C^{ss}}{B^{ss}}\tau_C^{ss} & \frac{Y^{ss}}{B^{ss}}\tau_L^{ss} & -\frac{G^{ss}}{B^{ss}} & 0 & 0 \\
-\frac{1}{\lambda+\lambda^*-1}\frac{\sigma}{1-h} & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -\lambda & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -\rho_{\tau^C,y} & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & -\rho_{\tau^L,y} & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & \rho_{\tau^G,y} & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{pmatrix}$$

C.2 Calibrated Parameters

Description	Parameter	AT	BE	GE	FI	FR	IR	IT	LU	NL	PO	ES
impatience	β	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
openness	λ	0.738	0.547	0. 876	0.895	0.865	0.914	0.895	0.586	0.775	0.769	0.861
openness *	λ^*	0.988	0.963	0.917	0.995	0.954	0.990	0.969	0.997	0.952	0.994	0.977
Labor tax ss	τ_L^{SS}	0.1346	0.1654	0.1091	0.1812	0.1142	0.1214	0.1418	0.1403	0.1139	0.0892	0.1066
Cons. tax ss	τ_C^{SS}	0.1460	0.1276	0.1276	0.1348	0.1514	0.1263	0.1427	0.1266	0.1217	0.1378	0.1119
Gov. over GDP ss	$\frac{G^{ss}}{Y^{ss}}$	0.187	0.226	0.188	0.197	0.228	0.162	0.195	0.153	0.235	0.201	0.185
GDP over debt ss	$\frac{Y^{ss}}{B^{ss}}$	1.66	1.125	1.500	5.498	1.514	4.689	0.845	21.210	1.781	1.536	2.00
Lagged IR	ρ_r	0.8514	0.8514	0.8514	0.8514	0.8514	0.8514	0.8514	0.8514	0.8514	0.8514	0.8514
Coeff. on inflation	ρ_π	1.5432	1.5432	1.5432	1.5432	1.5432	1.5432	1.5432	1.5432	1.5432	1.5432	1.5432
Coeff. on output	ρ_y	0.0957	0.0957	0.0957	0.0957	0.0957	0.0957	0.0957	0.0957	0.0957	0.0957	0.0957
GDP weight	ω	0.03	0.037	0.289	0.017	0.205	0.015	0.190	0.003	0.062	0.024	0.123

Calculated Trade Matrix:

Countries	AT	BE	GE	FI	FR	IR	IT	LU	NL	PO	ES
AT	0.0000	0.0343	0.6552	0.0106	0.0676	0.0064	0.1338	0.0031	0.0540	0.0051	0.0300
BE	0.0130	0.0000	0.2979	0.0097	0.2456	0.0448	0.0748	0.0228	0.2384	0.0101	0.0429
GE	0.1178	0.1417	0.0000	0.0223	0.2224	0.0229	0.1531	0.0110	0.2044	0.0190	0.0855
FI	0.0336	0.0823	0.3964	0.0000	0.1133	0.0229	0.1096	0.0027	0.1657	0.0141	0.0594
FR	0.0180	0.1735	0.3301	0.0094	0.0000	0.0199	0.1636	0.0109	0.1036	0.0222	0.1487
IR	0.0132	0.2482	0.2620	0.0147	0.1550	0.0000	0.0930	0.0021	0.1220	0.0177	0.0720
IT	0.0547	0.0805	0.3480	0.0140	0.2504	0.0184	0.0000	0.0054	0.0926	0.0160	0.1198
LU	0.0153	0.2968	0.3009	0.0041	0.2014	0.0048	0.0649	0.0000	0.0667	0.0143	0.0308
NL	0.0197	0.2296	0.4144	0.0188	0.1418	0.0216	0.0828	0.0049	0.0000	0.0132	0.0532
PO	0.0101	0.0519	0.2083	0.0087	0.1652	0.0170	0.0780	0.0054	0.0703	0.0000	0.3852
ES	0.0161	0.0607	0.2547	0.0100	0.2986	0.0185	0.1567	0.0034	0.0782	0.1032	0.0000

C.3 Estimation Results

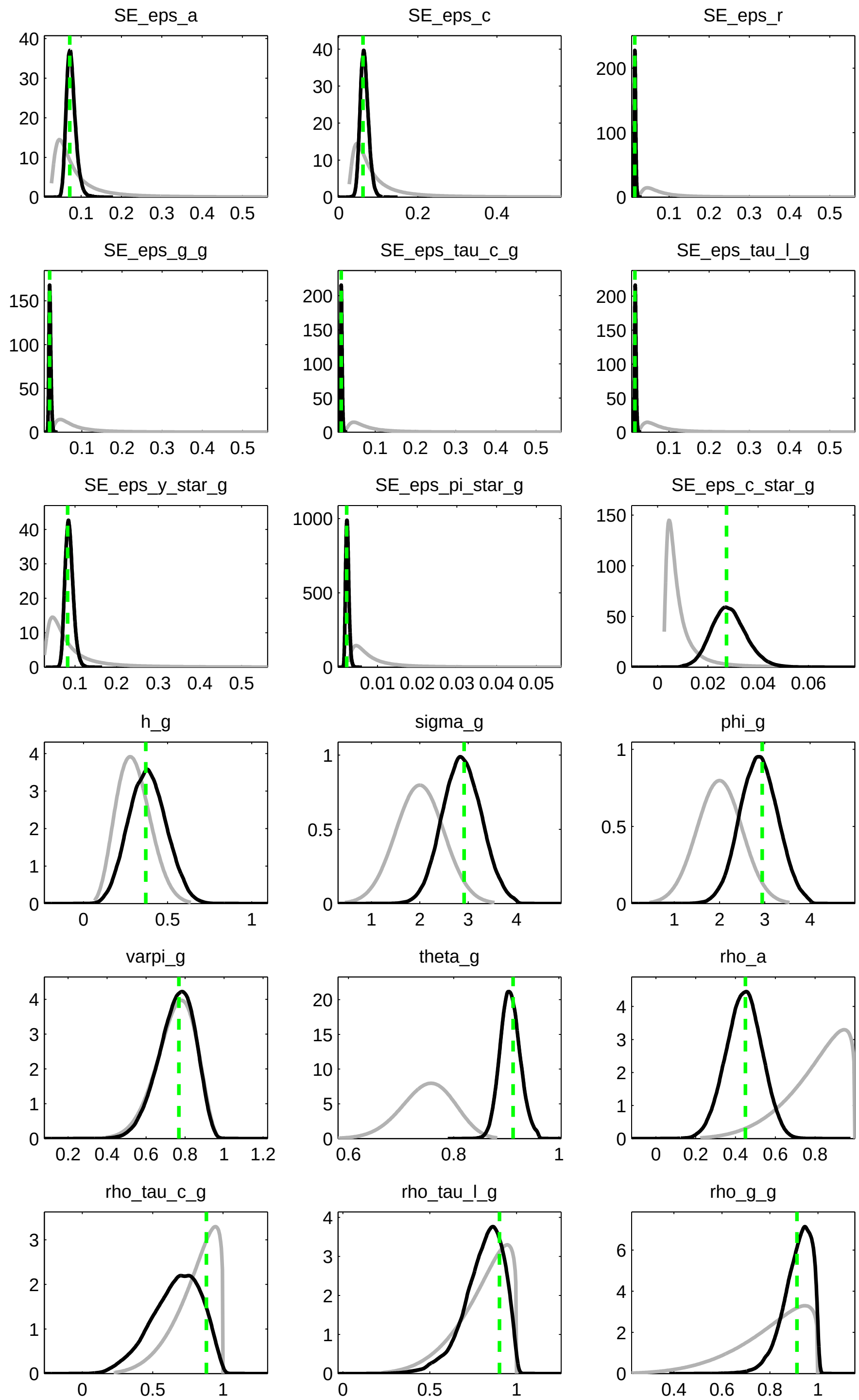
Description	Parameters	Prior Means	Prior Shape	Prior SD	Austria		Belgium	
					Post. Mean	std.dev	Post. Mean	std.dev.
habit	h	0.3	normal	0.1	0.3239	0.1106	0.3033	0.1052
CES utility consumption	σ	3.00	normal	0.5	2.8738	0.4115	2.4243	0.4358
CES utility labor	ϕ	2.00	normal	0.5	3.2902	0.3977	3.4458	0.406
inflation indexation	ϖ	0.75	normal	0.1	0.6871	0.122	0.7372	0.1074
Calvo Parameter	θ	0.75	normal	0.05	0.7754	0.0308	0.7577	0.0274
AR parameter technology	ρ_a	0.5	beta	0.15	0.6933	0.0657	0.5097	0.1001
AR parameter cons. Tax rule	ρ_{τ^C}	0.8	uniform	0.15	0.756	0.0905	0.7139	0.1051
AR parameter labor tax rule	ρ_{τ^L}	0.8	uniform	0.15	0.5424	0.1781	0.6168	0.1064
AR parameter gov. Exp. Rule	ρ_g	0.8	uniform	0.15	0.8604	0.0766	0.8242	0.0703
AR parameter foreign output	ρ_{y^*}	0.5	beta	0.15	0.7213	0.0926	0.81	0.0543
VAR output-IntRate	$\rho_{y,r}$	0.5	beta	0.15	0.6019	0.1373	0.6167	0.1393
AR parameter foreign inflation	ρ_{c^*}	0.5	beta	0.15	0.4856	0.1731	0.4908	0.1733
VAR Inflation-IntRate	$\rho_{\pi,r}$	0.5	beta	0.15	0.7079	0.122	0.7111	0.1176
AR parameter foreign consumption	ρ_{π^*}	0.5	beta	0.15	0.8552	0.0531	0.8937	0.0392
VAR Cons.-Intrate	$\rho_{c,r}$	0.5	beta	0.15	0.3023	0.1243	0.1855	0.0712
VAR Inflation-Output	$\rho_{\pi,y}$	0.5	beta	0.15	0.1373	0.0521	0.2843	0.0944
VAR Inflation-Consumption	$\rho_{\pi,c}$	0.5	beta	0.15	0.2642	0.0544	0.5027	0.1756
VAR output-inflation	$\rho_{y,\pi}$	0.5	beta	0.15	0.4988	0.1755	0.0279	0.0103
VAR output-consumption	$\rho_{y,c}$	0.5	beta	0.15	0.1856	0.0535	0.4016	0.0802
VAR Cons.-Output	$\rho_{c,y}$	0.5	beta	0.15	0.4271	0.1433	0.4966	0.1756
VAR Cons.-Inflation	$\rho_{c,\pi}$	0.5	beta	0.15	0.5011	0.1756	0.0553	0.0147
coeff. On B cons. Tax rule	$\rho_{\tau^C,b}$	0.25	normal	0.05	0.2012	0.0371	0.2442	0.0398
coeff. On B labor tax rule	$\rho_{\tau^L,b}$	0.25	normal	0.05	0.1845	0.0349	0.2358	0.0398
coeff. On B in gov. Exp. Rule	$\rho_{g,b}$	0.25	normal	0.05	0.2278	0.0425	0.2875	0.0526
coeff. On Y cons. Tax rule	$\rho_{\tau^C,y}$	0.25	normal	0.05	0.1548	0.0283	0.1989	0.0321
coeff. On Y labor tax rule	$\rho_{\tau^L,y}$	0.25	normal	0.05	0.1715	0.0302	0.2045	0.0333
coeff. On Y in gov. Exp. Rule	$\rho_{g,y}$	0.25	normal	0.05	0.1638	0.0313	0.1805	0.0343
std.error technology	σ_{ϵ_a}	0.1	inv.gamma	2.00	0.0426	0.0054	0.0618	0.0079
std.error preference	σ_{ϵ_p}	0.1	inv.gamma	2.00	0.028	0.0047	0.0314	0.0045
std.error interest rate	σ_{ϵ_r}	0.1	inv.gamma	2.00	0.0409	0.0061	0.0262	0.0042
std.error gov. Exp.	σ_{ϵ_g}	0.1	inv.gamma	2.00	0.0204	0.0022	0.0223	0.0023
std.error cons. Tax	$\sigma_{\epsilon_{\tau^C}}$	0.1	inv.gamma	2.00	0.016	0.0017	0.0139	0.0014
std.error labor tax	$\sigma_{\epsilon_{\tau^L}}$	0.1	inv.gamma	2.00	0.0159	0.0017	0.0152	0.0016
std.error foreign output	$\sigma_{\epsilon^*_Y}$	0.1	inv.gamma	2.00	0.0149	0.0015	0.0446	0.0046
std.error foreign inflation	$\sigma_{\epsilon^*_C}$	0.01	inv.gamma	0.2	0.0013	0.0002	0.0014	0.0002
std.error foreign consumption	$\sigma_{\epsilon_{\pi^*}}$	0.01	inv.gamma	0.2	0.0276	0.0059	0.0161	0.0027

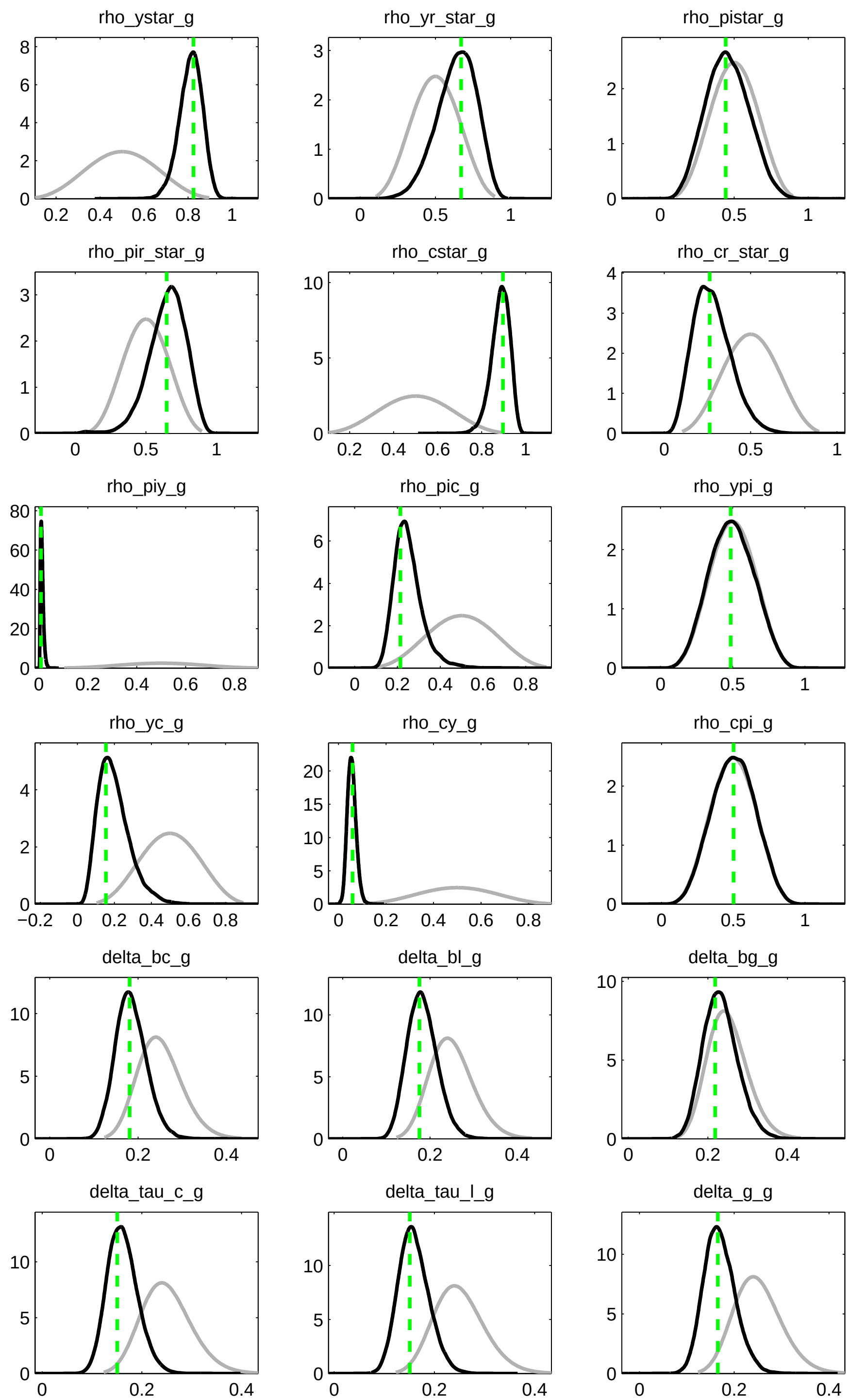
Description	Parameters	Prior Means	Prior Shape	Prior SD	Germany		Finland		France	
					Post. Mean	std.dev.	Post. Mean	std.dev.	Post. Mean	std.dev.
habit	h	0.3	normal	0.1	0.3801	0.1203	0.3766	0.1119	0.3900	0.1161
CES utility consumption	σ	3.00	normal	0.5	2.8704	0.4087	2.8495	0.4189	2.9247	0.3983
CES utility labor	ϕ	2.00	normal	0.5	2.8628	0.4248	2.8037	0.3981	2.9078	0.4297
inflation indexation	ϖ	0.75	normal	0.1	0.7536	0.0982	0.7550	0.1031	0.7040	0.1161
Calvo Parameter	θ	0.75	normal	0.05	0.9071	0.0196	0.6572	0.0359	0.9027	0.0164
AR parameter technology	ρ_a	0.5	beta	0.15	0.441	0.0895	0.7789	0.0466	0.4109	0.0867
AR parameter cons. Tax rule	ρ_{τ^C}	0.8	uniform	0.15	0.6636	0.1116	0.8147	0.0942	0.8348	0.1104
AR parameter labor tax rule	ρ_{τ^L}	0.8	uniform	0.15	0.8067	0.0777	0.6223	0.1514	0.7801	0.1184
AR parameter gov. Exp. Rule	ρ_g	0.8	uniform	0.15	0.9114	0.0563	0.8247	0.1003	0.9419	0.0528
AR parameter foreign output	ρ_{y^*}	0.5	beta	0.15	0.811	0.0496	0.6193	0.1365	0.8368	0.0503
VAR output-IntRate	$\rho_{y,r}$	0.5	beta	0.15	0.6379	0.1392	0.5850	0.1406	0.6680	0.1255
AR parameter foreign inflation	ρ_{c^*}	0.5	beta	0.15	0.4542	0.1603	0.4892	0.1745	0.4574	0.1623
VAR Inflation-IntRate	$\rho_{\pi,r}$	0.5	beta	0.15	0.6484	0.1453	0.6917	0.1203	0.6531	0.1463
AR parameter foreign consumption	ρ_{π^*}	0.5	beta	0.15	0.8844	0.0396	0.8858	0.0526	0.9088	0.0311
VAR Cons.-Intrate	$\rho_{c,r}$	0.5	beta	0.15	0.278	0.1139	0.2319	0.1268	0.2587	0.1044
VAR Inflation-Output	$\rho_{\pi,y}$	0.5	beta	0.15	0.013	0.0049	0.2961	0.1161	0.0214	0.0084
VAR Inflation-Consumption	$\rho_{\pi,c}$	0.5	beta	0.15	0.2501	0.0539	0.2730	0.0509	0.2008	0.0456
VAR output-inflation	$\rho_{y,\pi}$	0.5	beta	0.15	0.4925	0.1751	0.5004	0.1755	0.4893	0.1753
VAR output-consumption	$\rho_{y,c}$	0.5	beta	0.15	0.1978	0.0707	0.2029	0.0509	0.1343	0.0462
VAR Cons.-Output	$\rho_{c,y}$	0.5	beta	0.15	0.0556	0.0183	0.5409	0.1742	0.1303	0.0361
VAR Cons.-Inflation	$\rho_{c,\pi}$	0.5	beta	0.15	0.5013	0.1738	0.4943	0.1755	0.5022	0.1756
coeff. On B cons. Tax rule	$\rho_{\tau^C,b}$	0.25	normal	0.05	0.1838	0.034	0.2020	0.0341	0.1286	0.0236
coeff. On B labor tax rule	$\rho_{\tau^L,b}$	0.25	normal	0.05	0.1821	0.0333	0.2141	0.0368	0.1205	0.0228
coeff. On B in gov. Exp. Rule	$\rho_{g,b}$	0.25	normal	0.05	0.2316	0.0404	0.2597	0.0459	0.1787	0.0337
coeff. On Y cons. Tax rule	$\rho_{\tau^C,y}$	0.25	normal	0.05	0.1611	0.0283	0.1441	0.0246	0.1484	0.0277
coeff. On Y labor tax rule	$\rho_{\tau^L,y}$	0.25	normal	0.05	0.1588	0.0287	0.1653	0.0283	0.1539	0.0289
coeff. On Y in gov. Exp. Rule	$\rho_{g,y}$	0.25	normal	0.05	0.1688	0.0328	0.1821	0.0341	0.1691	0.0348
std.error technology	σ_{ϵ_a}	0.1	inv.gamma	2.00	0.0753	0.0109	0.0474	0.0052	0.0887	0.0126
std.error preference	σ_{ϵ_p}	0.1	inv.gamma	2.00	0.0648	0.0097	0.0425	0.0068	0.061	0.0098
std.error interest rate	σ_{ϵ_r}	0.1	inv.gamma	2.00	0.0155	0.0016	0.0349	0.0069	0.0157	0.0017
std.error gov. Exp.	σ_{ϵ_g}	0.1	inv.gamma	2.00	0.0208	0.0022	0.0313	0.0032	0.0267	0.003
std.error cons. Tax	$\sigma_{\epsilon_{\tau^C}}$	0.1	inv.gamma	2.00	0.0157	0.0017	0.0159	0.0017	0.0187	0.0022
std.error labor tax	$\sigma_{\epsilon_{\tau^L}}$	0.1	inv.gamma	2.00	0.0165	0.0018	0.02	0.0021	0.019	0.0022
std.error foreign output	$\sigma_{\epsilon^*_Y}$	0.1	inv.gamma	2.00	0.0864	0.0088	0.0136	0.0013	0.0497	0.005
std.error foreign inflation	$\sigma_{\epsilon^*_C}$	0.01	inv.gamma	0.2	0.0024	0.0004	0.0013	0.0002	0.002	0.0003
std.error foreign consumption	$\sigma_{\epsilon_{\pi^*}}$	0.01	inv.gamma	0.2	0.0284	0.0064	0.0229	0.0074	0.0289	0.0058

Description	Parameters	Prior Means	Prior Shape	Prior SD	Ireland		Italy		Luxembourg	
					Post. Mean	std.dev.	Post. Mean	std.dev.	Post. Mean	std.dev.
habit	h	0.3	normal	0.1	0.3451	0.1096	0.42	0.1297	0.319	0.1071
CES utility consumption	σ	3.00	normal	0.5	2.2584	0.4537	3.0047	0.4027	2.2629	0.4497
CES utility labor	ϕ	2.00	normal	0.5	3.0642	0.4817	3.0598	0.434	3.2521	0.4531
inflation indexation	ϖ	0.75	normal	0.1	0.7088	0.1124	0.6349	0.118	0.7122	0.119
Calvo Parameter	θ	0.75	normal	0.05	0.7934	0.0247	0.9159	0.0103	0.6765	0.0428
AR parameter technology	ρ_a	0.5	beta	0.15	0.4102	0.1216	0.3256	0.089	0.4368	0.1187
AR parameter cons. Tax rule	ρ_{τ^C}	0.8	uniform	0.15	0.8214	0.0821	0.8212	0.0652	0.8051	0.0687
AR parameter labor tax rule	ρ_{τ^L}	0.8	uniform	0.15	0.7389	0.0941	0.4279	0.1515	0.6082	0.0822
AR parameter gov. Exp. Rule	ρ_g	0.8	uniform	0.15	0.817	0.0698	0.913	0.0475	0.9214	0.0617
AR parameter foreign output	ρ_{y^*}	0.5	beta	0.15	0.6793	0.1139	0.8025	0.0634	0.5536	0.1609
VAR output-IntRate	$\rho_{y,r}$	0.5	beta	0.15	0.5702	0.143	0.6672	0.1227	0.5432	0.1379
AR parameter foreign inflation	ρ_{c^*}	0.5	beta	0.15	0.498	0.1744	0.498	0.1739	0.4947	0.1754
VAR Inflation-IntRate	$\rho_{\pi,r}$	0.5	beta	0.15	0.7014	0.1193	0.5601	0.2162	0.636	0.1286
AR parameter foreign consumption	ρ_{π^*}	0.5	beta	0.15	0.9542	0.0165	0.9133	0.03	0.9491	0.0191
VAR Cons.-Intrate	$\rho_{c,r}$	0.5	beta	0.15	0.0853	0.0359	0.2908	0.1161	0.0639	0.0265
VAR Inflation-Output	$\rho_{\pi,y}$	0.5	beta	0.15	0.0954	0.0148	0.0431	0.0188	0.3283	0.1239
VAR Inflation-Consumption	$\rho_{\pi,c}$	0.5	beta	0.15	0.1141	0.0165	0.1503	0.0468	0.5049	0.1241
VAR output-inflation	$\rho_{y,\pi}$	0.5	beta	0.15	0.2146	0.0334	0.51	0.1751	0.5022	0.1755
VAR output-consumption	$\rho_{y,c}$	0.5	beta	0.15	0.1463	0.0235	0.1193	0.0389	0.3911	0.1259
VAR Cons.-Output	$\rho_{c,y}$	0.5	beta	0.15	0.1739	0.0258	0.1921	0.0729	0.5735	0.146
VAR Cons.-Inflation	$\rho_{c,\pi}$	0.5	beta	0.15	0.19	0.0366	0.5093	0.1755	0.5001	0.1755
coeff. On B cons. Tax rule	$\rho_{\tau^C,b}$	0.25	normal	0.05	0.1872	0.0688	0.1699	0.0311	0.1311	0.019
coeff. On B labor tax rule	$\rho_{\tau^L,b}$	0.25	normal	0.05	0.3713	0.1152	0.1743	0.0317	0.1304	0.018
coeff. On B in gov. Exp. Rule	$\rho_{g,b}$	0.25	normal	0.05	0.5029	0.1756	0.2427	0.043	0.0903	0.0155
coeff. On Y cons. Tax rule	$\rho_{\tau^C,y}$	0.25	normal	0.05	0.275	0.1056	0.1631	0.0301	0.1969	0.037
coeff. On Y labor tax rule	$\rho_{\tau^L,y}$	0.25	normal	0.05	0.474	0.1516	0.1901	0.0342	0.2033	0.0377
coeff. On Y in gov. Exp. Rule	$\rho_{g,y}$	0.25	normal	0.05	0.5008	0.1757	0.1912	0.0374	0.1849	0.037
std.error technology	σ_{ϵ_a}	0.1	inv.gamma	2.00	0.152	0.0193	0.1002	0.0144	0.0947	0.0114
std.error preference	σ_{ϵ_p}	0.1	inv.gamma	2.00	0.0951	0.0115	0.0731	0.0111	0.0434	0.0061
std.error interest rate	σ_{ϵ_r}	0.1	inv.gamma	2.00	0.0372	0.0078	0.0145	0.0014	0.0635	0.0164
std.error gov. Exp.	σ_{ϵ_g}	0.1	inv.gamma	2.00	0.0656	0.0069	0.0321	0.0033	0.0626	0.0077
std.error cons. Tax	$\sigma_{\epsilon_{\tau^C}}$	0.1	inv.gamma	2.00	0.0206	0.0026	0.0172	0.0019	0.0622	0.0097
std.error labor tax	$\sigma_{\epsilon_{\tau^L}}$	0.1	inv.gamma	2.00	0.0237	0.0027	0.017	0.0018	0.0689	0.01
std.error foreign output	$\sigma_{\epsilon^*_Y}$	0.1	inv.gamma	2.00	0.0138	0.0014	0.0319	0.0033	0.0132	0.0013
std.error foreign inflation	$\sigma_{\epsilon^*_C}$	0.01	inv.gamma	0.2	0.0013	0.0002	0.0016	0.0002	0.0013	0.0002
std.error foreign consumption	$\sigma_{\epsilon_{\pi^*}}$	0.01	inv.gamma	0.2	0.0114	0.003	0.0325	0.0069	0.0073	0.0017

Description	Parameters	Prior Means	Prior Shape	Prior SD	Netherlands		Portugal		Spain	
					Post. Mean	std.dev.	Post. Mean	std.dev.	Post. Mean	std.dev.
habit	h	0.3	normal	0.1	0.3238	0.1094	0.4129	0.1144	0.3676	0.1144
CES utility consumption	σ	3.00	normal	0.5	2.5845	0.4205	2.7169	0.4095	2.5832	0.4071
CES utility labor	ϕ	2.00	normal	0.5	3.3556	0.4101	3.2302	0.4403	2.6656	0.4539
inflation indexation	ϖ	0.75	normal	0.1	0.7186	0.1125	0.4091	0.0734	0.5994	0.131
Calvo Parameter	θ	0.75	normal	0.05	0.8401	0.0193	0.8992	0.0154	0.9166	0.0109
AR parameter technology	ρ_a	0.5	beta	0.15	0.4549	0.0937	0.1336	0.0506	0.3182	0.1041
AR parameter cons. Tax rule	ρ_{τ^C}	0.8	uniform	0.15	0.6018	0.2146	0.5969	0.1683	0.8352	0.0921
AR parameter labor tax rule	ρ_{τ^L}	0.8	uniform	0.15	0.5452	0.1962	0.5119	0.1782	0.6802	0.2283
AR parameter gov. Exp. Rule	ρ_g	0.8	uniform	0.15	0.8317	0.0833	0.8701	0.0701	0.855	0.064
AR parameter foreign output	ρ_{y^*}	0.5	beta	0.15	0.8223	0.0539	0.7991	0.0397	0.8367	0.0637
VAR output-IntRate	$\rho_{y,r}$	0.5	beta	0.15	0.6413	0.1306	0.6067	0.1298	0.6301	0.1289
AR parameter foreign inflation	ρ_{c^*}	0.5	beta	0.15	0.4671	0.1725	0.4966	0.1755	0.5087	0.1719
VAR Inflation-IntRate	$\rho_{\pi,r}$	0.5	beta	0.15	0.6971	0.1265	0.7278	0.1166	0.7031	0.1225
AR parameter foreign consumption	ρ_{π^*}	0.5	beta	0.15	0.8965	0.0371	0.9456	0.0186	0.9414	0.0205
VAR Cons.-Intrate	$\rho_{c,r}$	0.5	beta	0.15	0.2219	0.0833	0.1216	0.0427	0.1904	0.0865
VAR Inflation-Output	$\rho_{\pi,y}$	0.5	beta	0.15	0.0442	0.0161	0.1019	0.0327	0.502	0.1744
VAR Inflation-Consumption	$\rho_{\pi,c}$	0.5	beta	0.15	0.3099	0.0651	0.3239	0.0839	0.1309	0.0396
VAR output-inflation	$\rho_{y,\pi}$	0.5	beta	0.15	0.5001	0.1755	0.508	0.1752	0.198	0.0432
VAR output-consumption	$\rho_{y,c}$	0.5	beta	0.15	0.202	0.0659	0.2081	0.0634	0.0791	0.0277
VAR Cons.-Output	$\rho_{c,y}$	0.5	beta	0.15	0.1386	0.0311	0.4629	0.0958	0.504	0.1753
VAR Cons.-Inflation	$\rho_{c,\pi}$	0.5	beta	0.15	0.4937	0.1754	0.5046	0.1755	0.3922	0.1392
coeff. On B cons. Tax rule	$\rho_{\tau^C,b}$	0.25	normal	0.05	0.1918	0.0314	0.0797	0.0147	0.1364	0.0205
coeff. On B labor tax rule	$\rho_{\tau^L,b}$	0.25	normal	0.05	0.186	0.0316	0.0844	0.0155	0.1323	0.0249
coeff. On B in gov. Exp. Rule	$\rho_{g,b}$	0.25	normal	0.05	0.2631	0.0471	0.1041	0.0197	0.2414	0.0398
coeff. On Y cons. Tax rule	$\rho_{\tau^C,y}$	0.25	normal	0.05	0.1885	0.0301	0.1602	0.031	0.1733	0.027
coeff. On Y labor tax rule	$\rho_{\tau^L,y}$	0.25	normal	0.05	0.1931	0.0314	0.1694	0.0325	0.2012	0.0322
coeff. On Y in gov. Exp. Rule	$\rho_{g,y}$	0.25	normal	0.05	0.1934	0.0375	0.1752	0.0342	0.2017	0.0393
std.error technology	σ_{ϵ_a}	0.1	inv.gamma	2.00	0.0663	0.0087	0.2338	0.0329	0.151	0.0218
std.error preference	σ_{ϵ_p}	0.1	inv.gamma	2.00	0.0363	0.005	0.0683	0.0089	0.0986	0.0155
std.error interest rate	σ_{ϵ_r}	0.1	inv.gamma	2.00	0.0169	0.0017	0.0851	0.0188	0.0142	0.0014
std.error gov. Exp.	σ_{ϵ_g}	0.1	inv.gamma	2.00	0.0337	0.0035	0.0306	0.0038	0.052	0.0053
std.error cons. Tax	$\sigma_{\epsilon_{\tau^C}}$	0.1	inv.gamma	2.00	0.0149	0.0016	0.022	0.0028	0.0179	0.002
std.error labor tax	$\sigma_{\epsilon_{\tau^L}}$	0.1	inv.gamma	2.00	0.0163	0.0018	0.0236	0.003	0.0205	0.0023
std.error foreign output	$\sigma_{\epsilon^*_Y}$	0.1	inv.gamma	2.00	0.0326	0.0033	0.0149	0.0017	0.0226	0.0023
std.error foreign inflation	$\sigma_{\epsilon^*_C}$	0.01	inv.gamma	0.2	0.0014	0.0002	0.0013	0.0002	0.0015	0.0002
std.error foreign consumption	$\sigma_{\epsilon_{\pi^*}}$	0.01	inv.gamma	0.2	0.0211	0.0035	0.0144	0.0027	0.0245	0.0065

C.4 Prior and Posterior Shapes

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rho_cpi_g
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delta_tau_l_g
delta_g_g

D Figures

D.1 Fiscal Spillovers

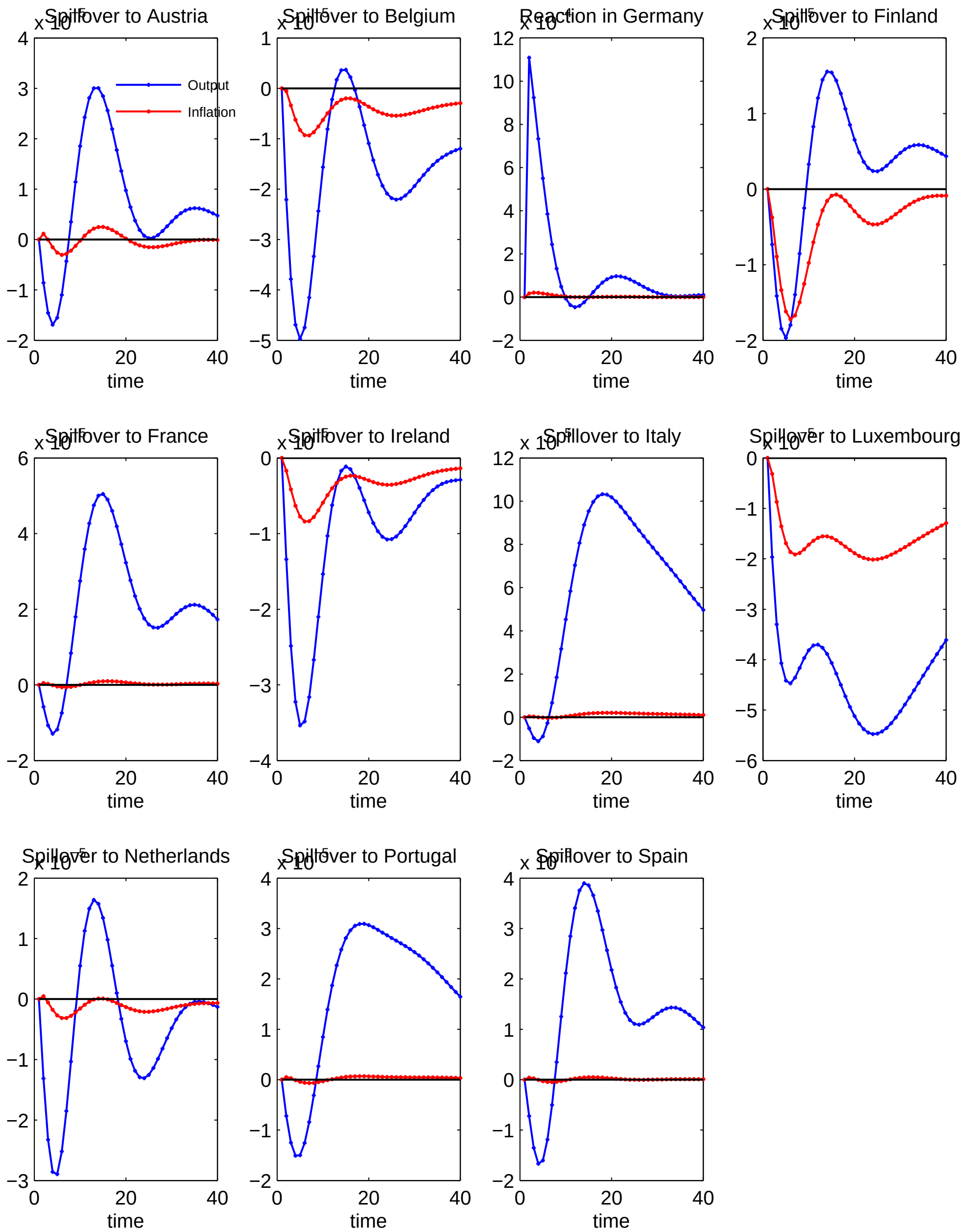

Figure 1: Fiscal Spillovers from Germany after a positive gov. expenditure shock

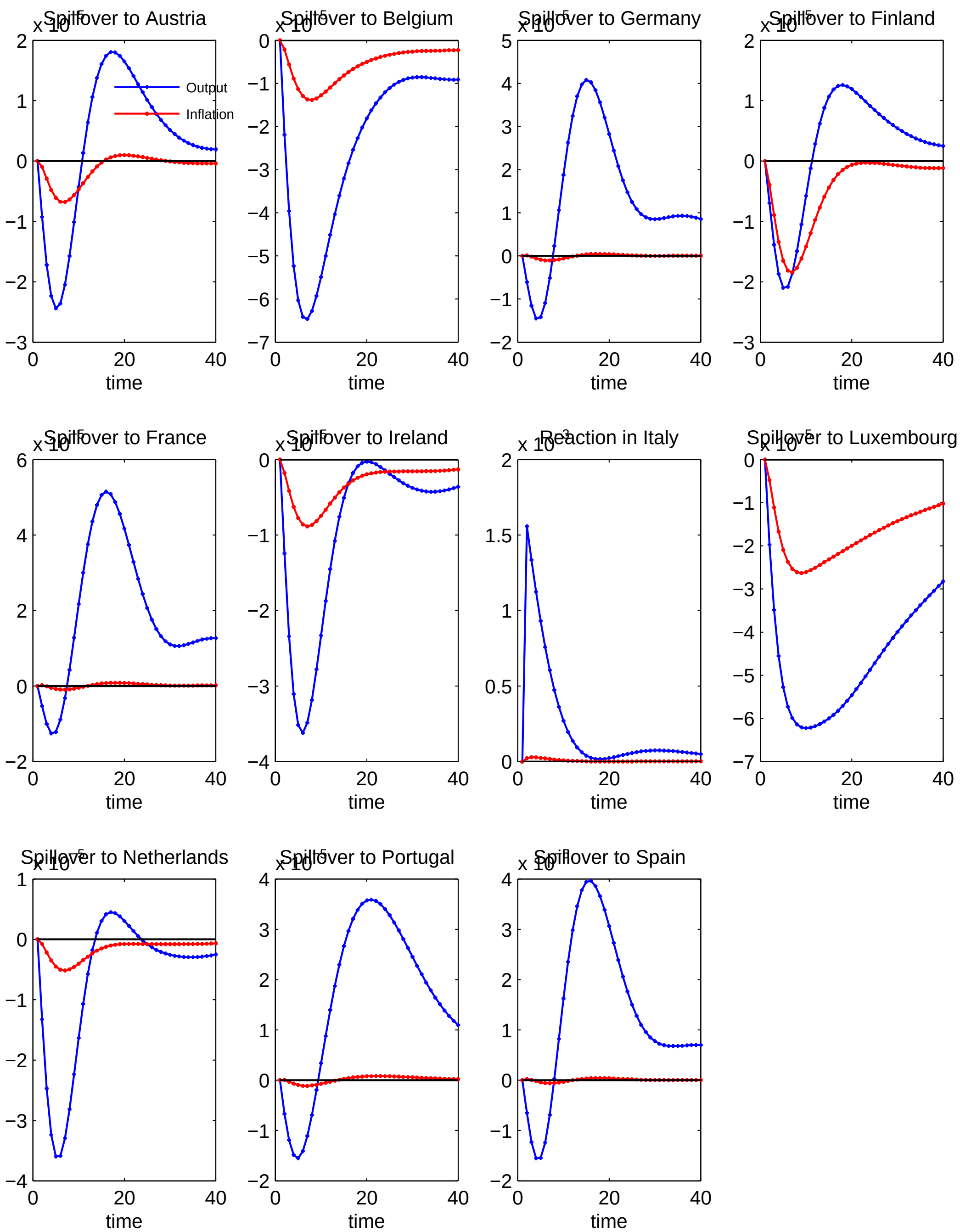

Figure 2: Fiscal Spillovers from Italy after a positive gov. expenditure shock

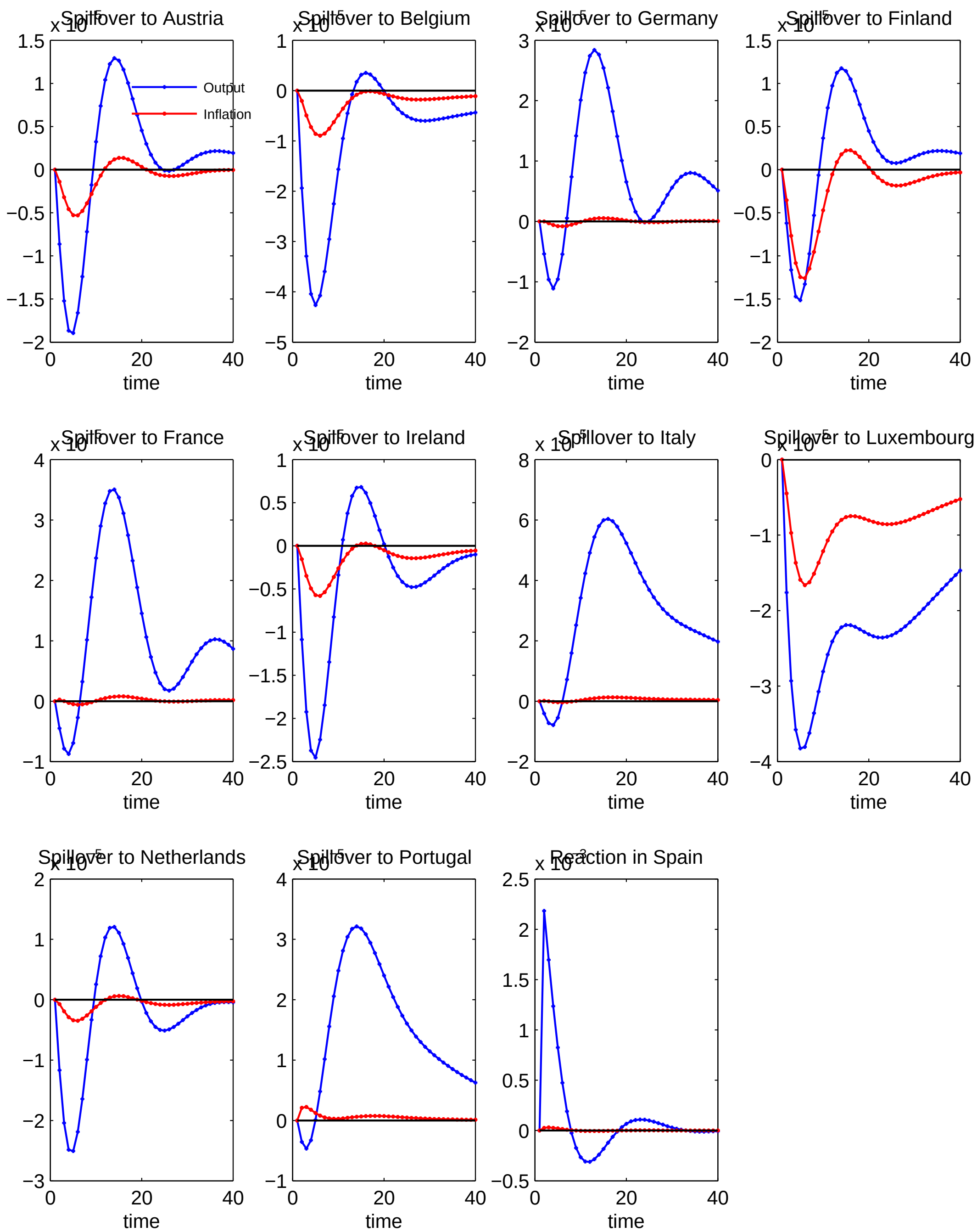

Figure 3: Fiscal Spillovers from Spain after a positive gov. expenditure shock

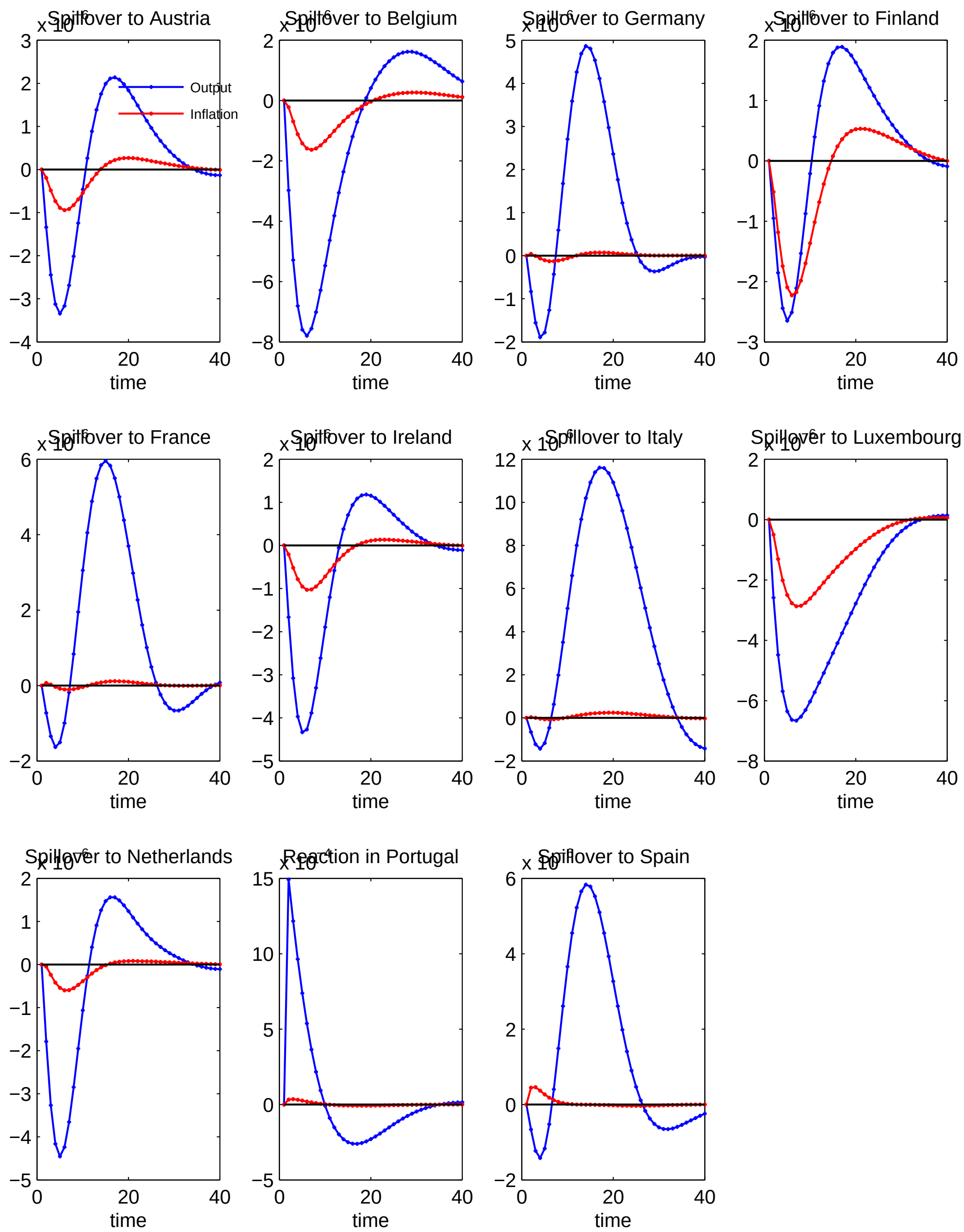

Figure 4: Fiscal Spillovers from Portugal after a positive gov. expenditure shock

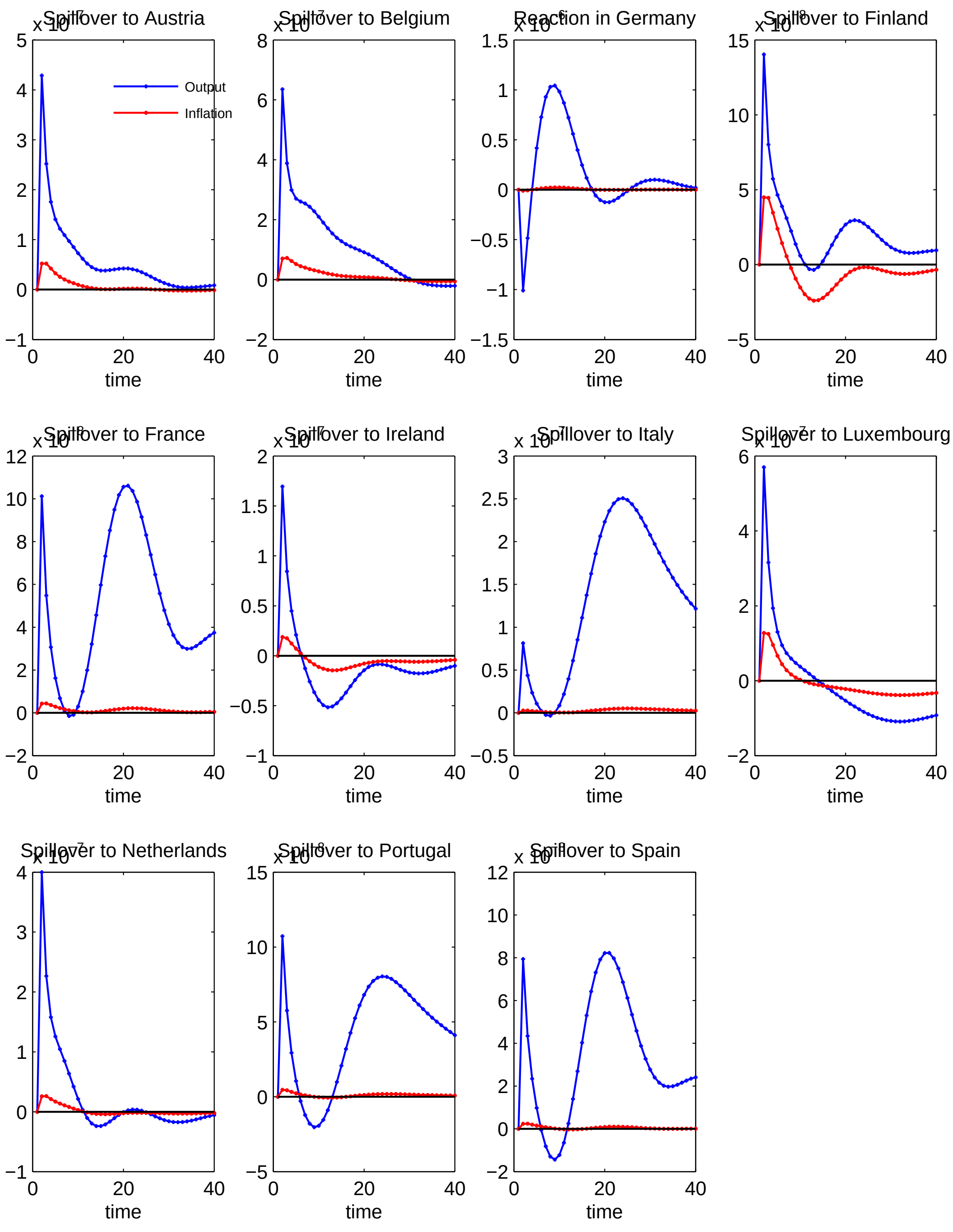

Figure 5: Fiscal Spillovers from Germany after a positive consumption tax rate

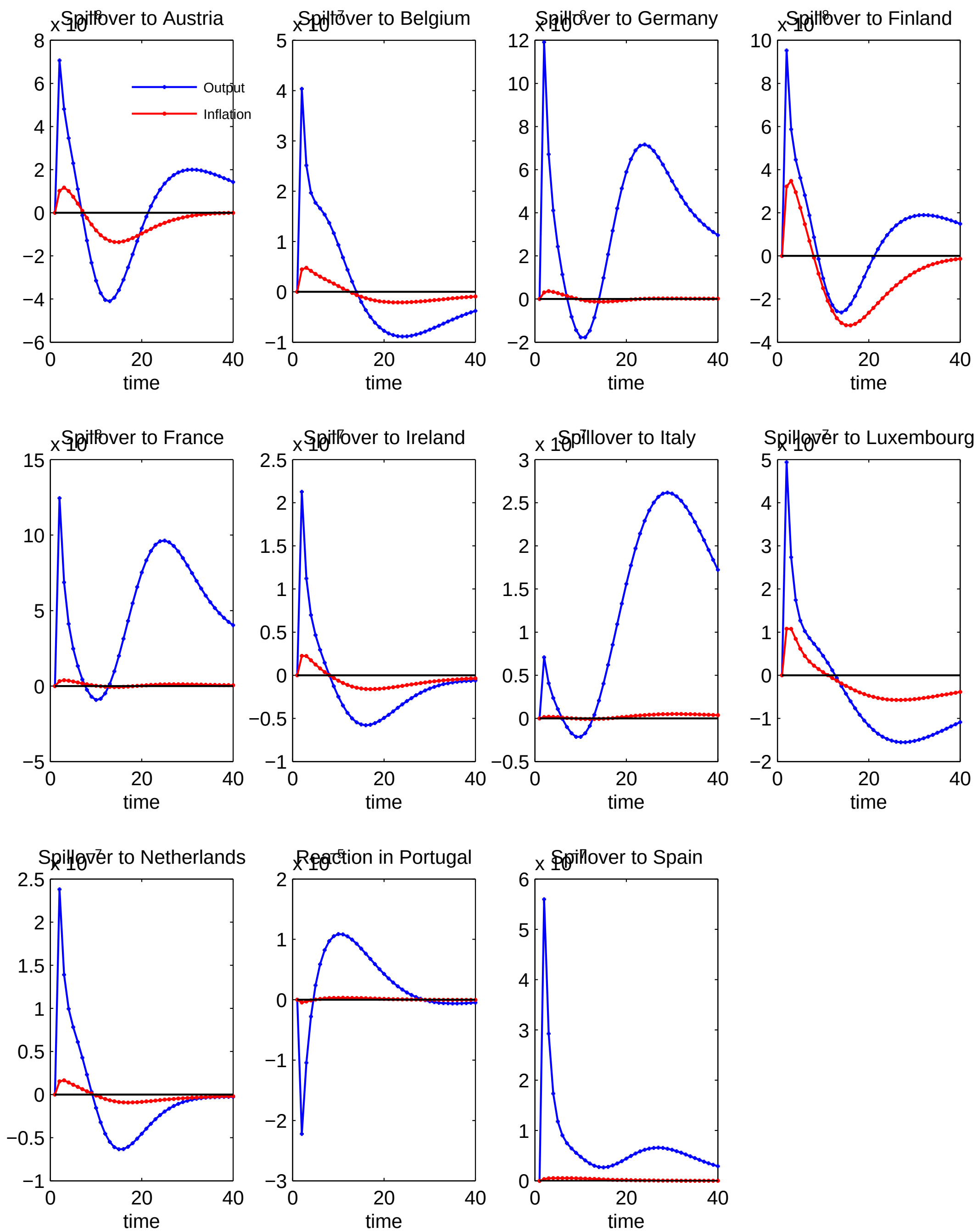

Figure 6: Fiscal Spillovers from Portugal after a positive consumption tax rate

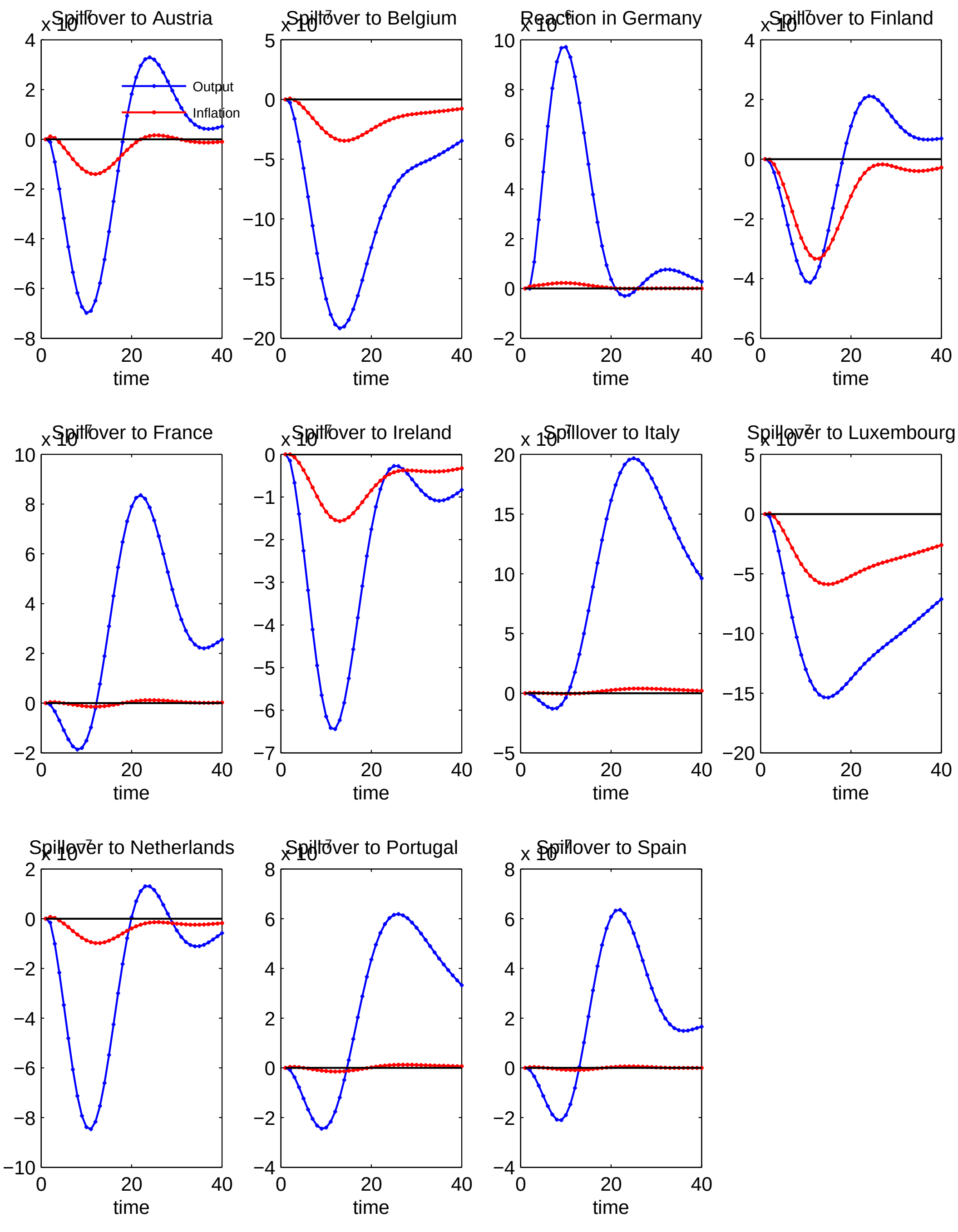

Figure 7: Fiscal Spillovers from Germany after a positive labor tax rate

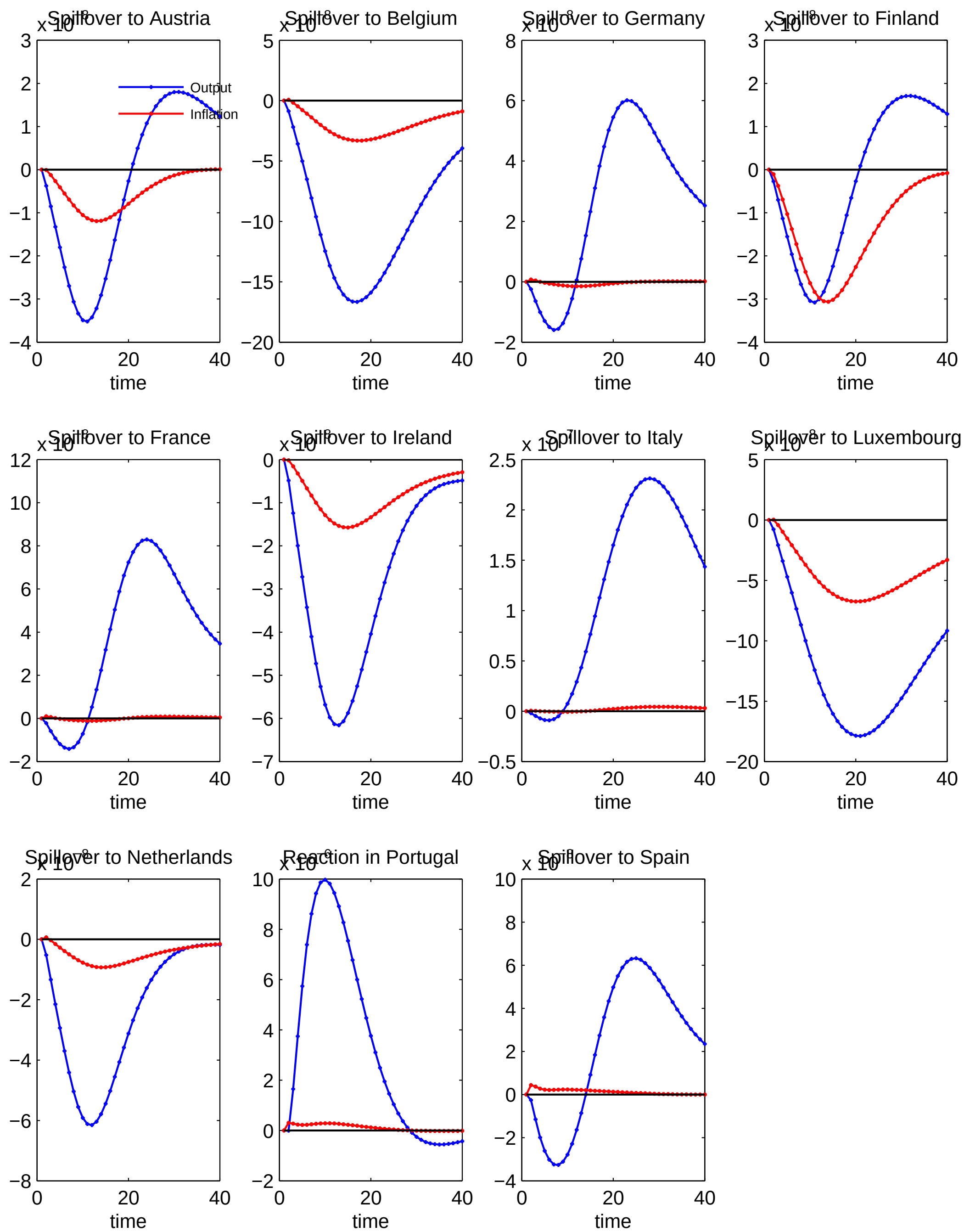

Figure 8: Fiscal Spillovers from Portugal after a positive labor tax rate

D.2 Monetary Policy Transmission

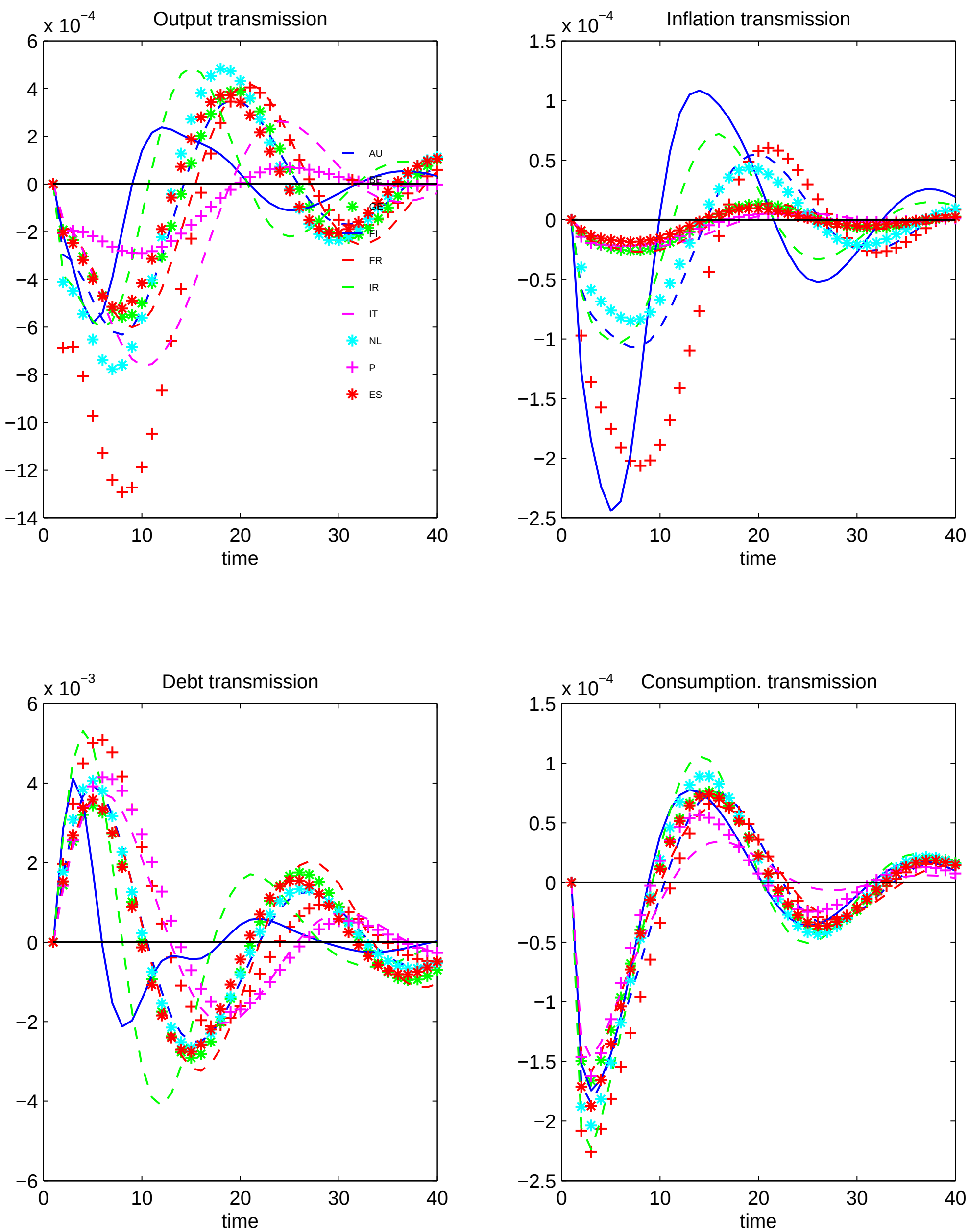

Figure 9: Monetary Transmission for all countries; Baseline Case

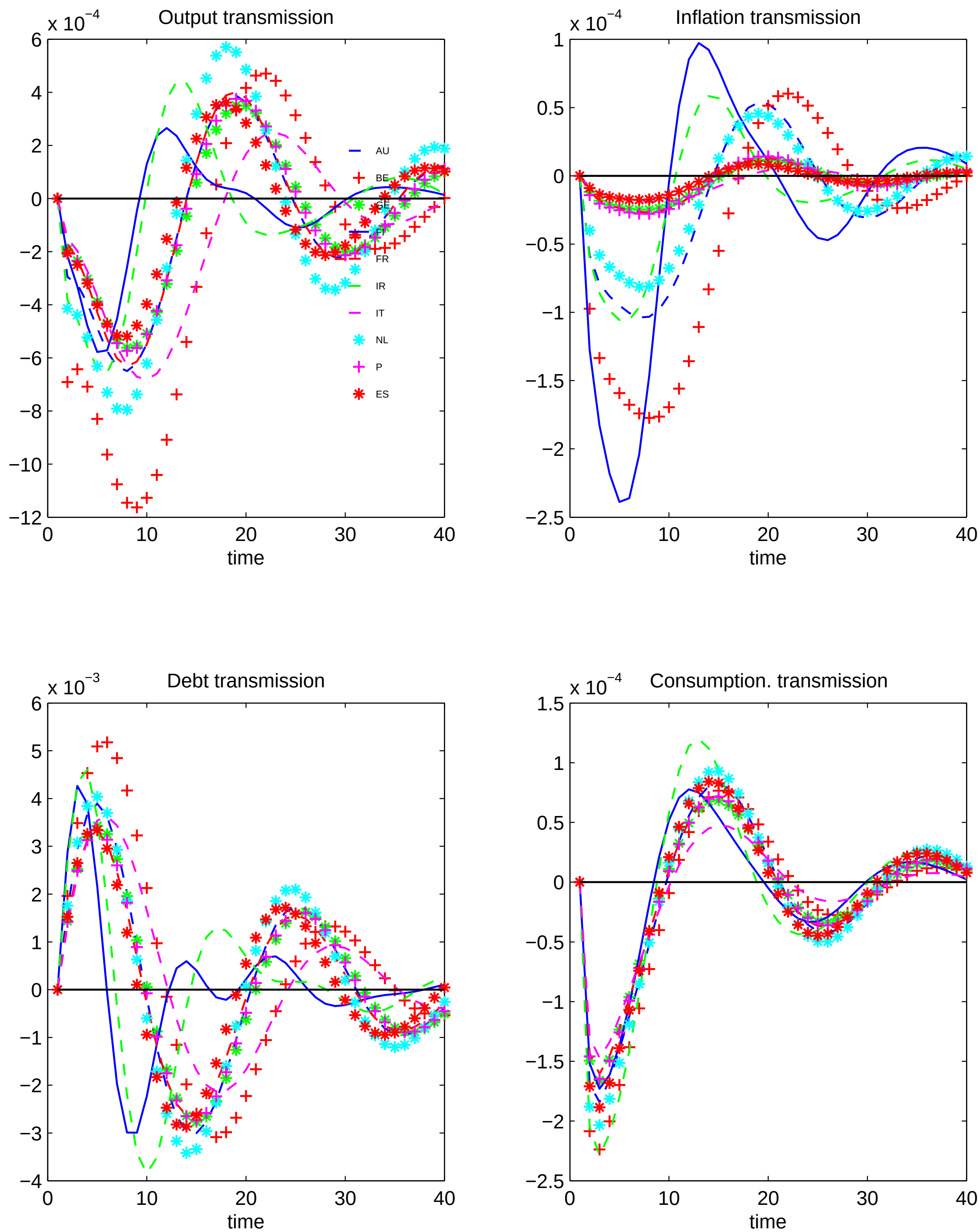

Figure 10: Monetary Transmission for all countries; Counterfactual with the same fiscal coefficients

D.3 Stabilization Policy of the Monetary Authority

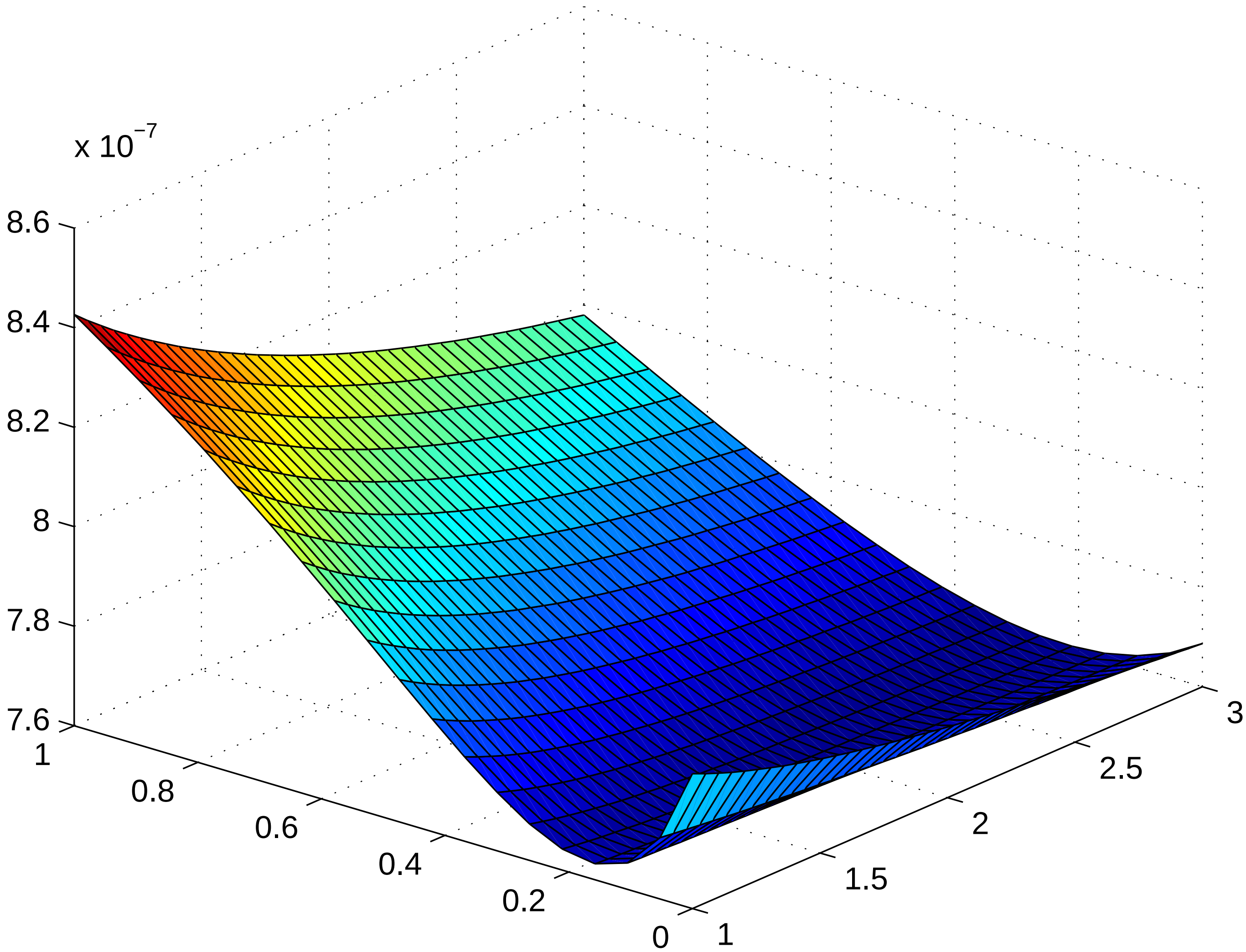

Figure 11: Stabilization Policy through the monetary authority after a gov. expenditure shock in Germany

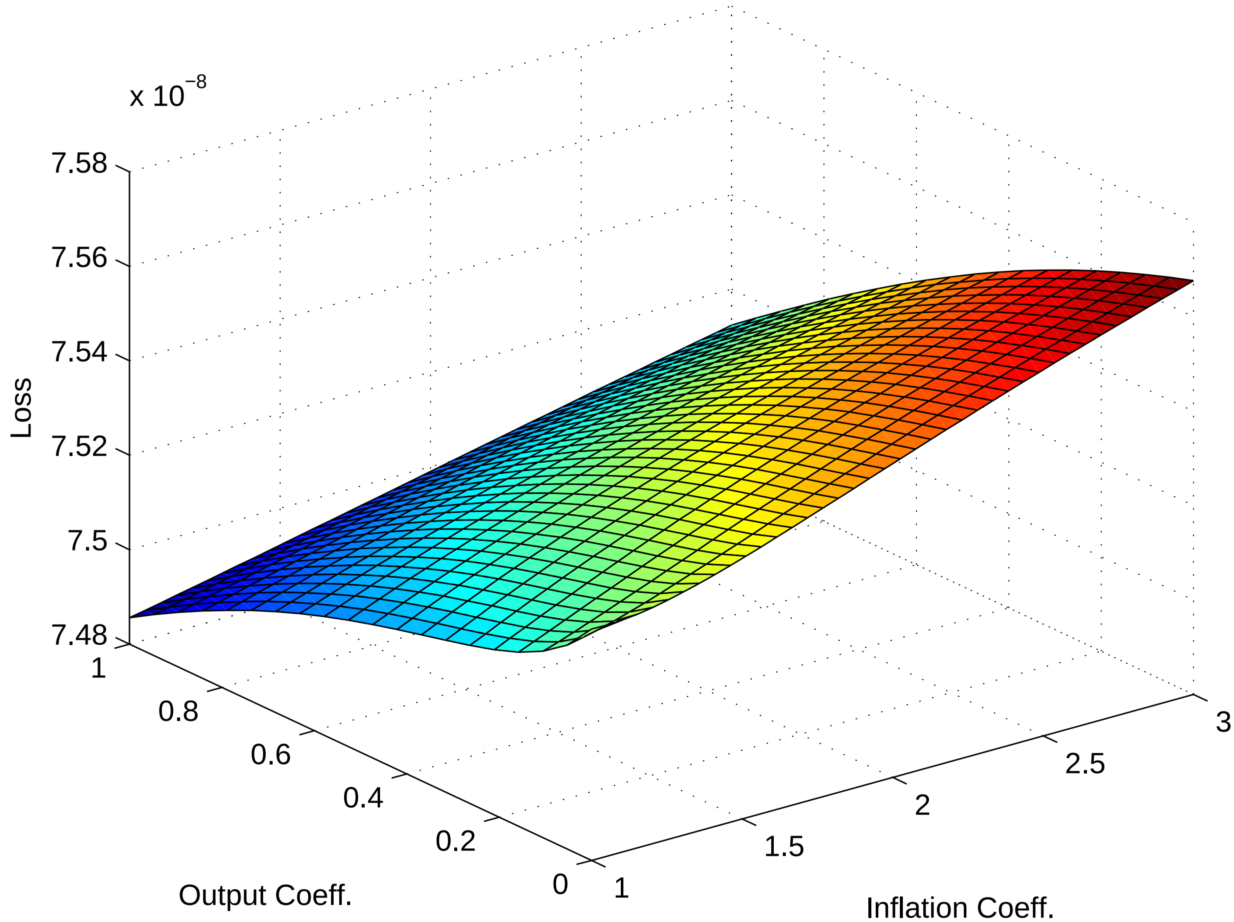

Figure 12: Stabilization Policy through the monetary authority after a gov. expenditure shock in Netherlands

D.5 Stabilization Policy of the Fiscal Authority

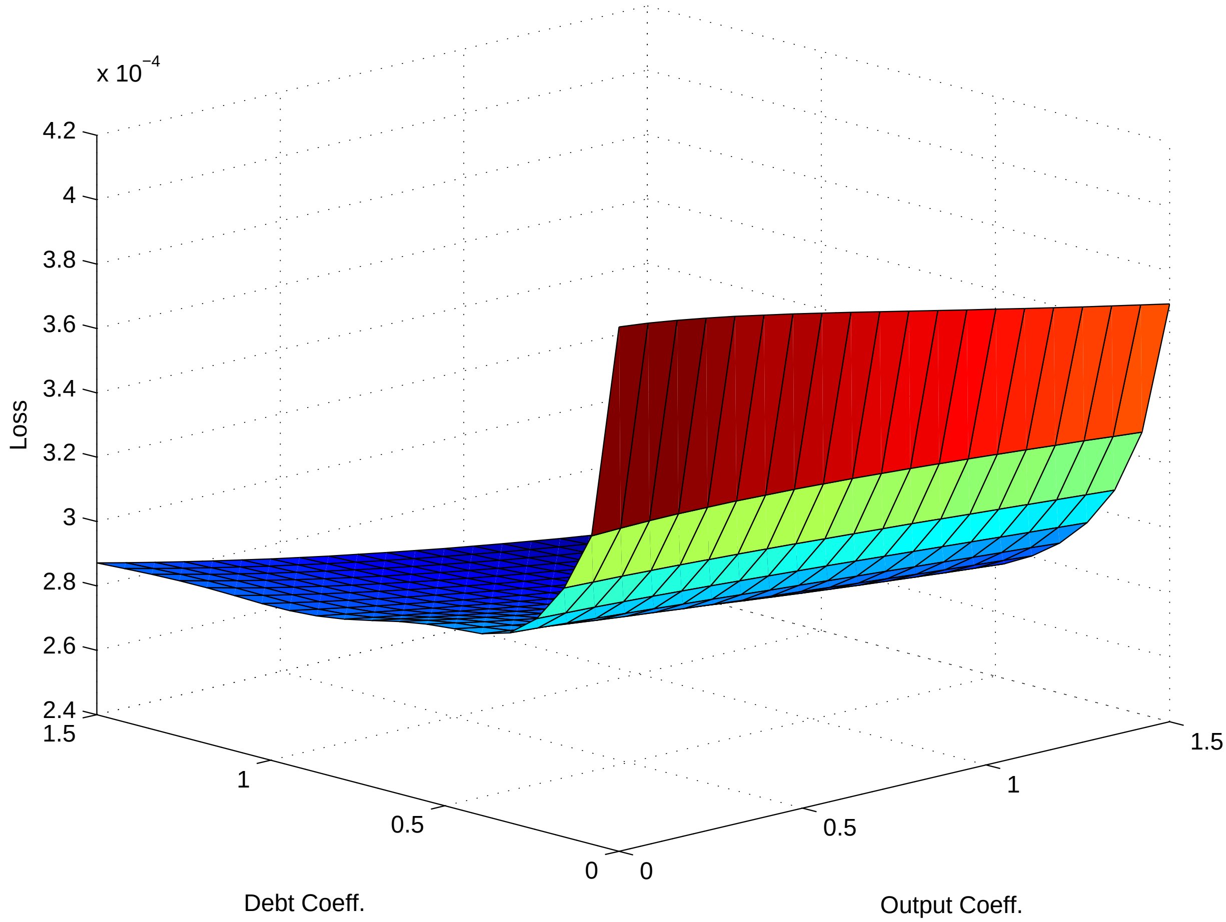

Figure 13: Stabilization Policy through the fiscal authorities after a contractionary monetary policy shock