Fiscal multipliers in the euro area: the role of coordination

Lorenzo Forni (International Monetary Fund)

Massimiliano Pisani (Bank of Italy)*

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Abstract

We quantitatively assess the effectiveness of cross-country coordinated temporary (two-year) fiscal measures in the euro area by simulating a two-region currency union DSGE model. To capture the role of size and openness heterogeneity across regions, we calibrate one region to Germany and, alternatively, to Belgium (we calibrate the other region to the rest of the euro area). Our results are as follows. First, in each region the output multipliers associated with a coordinated public spending-based stimulus are equal to around one per cent (0.6 per cent) in the first (second) year, the multipliers associated with a coordinated tax-based stimulus to around 0.2-0.3 per cent per year. Second, coordination increases the effectiveness of fiscal measures only in sufficiently open countries, such as Belgium, as higher exports more than compensate for the negative effect on output induced by the higher monetary policy rate (driven by higher economic activity in the euro area). Third, the effectiveness of fiscal coordination is higher when monetary policy is accommodative, in particular in the case of public spending (the related multiplier is 1.4 on average over the two years).

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*Corresponding author: Lorenzo Forni. E-mail: lforni@imf.org. Fiscal Affairs Department, International Monetary Fund, 700 19th Street, NW Washington, DC, 20431, US. Tel: +1 (202) 623 76 27. Massimiliano Pisani. E-mail: massimiliano.pisani@bancaditalia.it. Research Department, Banca d'Italia. Via Nazionale 91, 00184 Rome, Italy. Tel: +39 06 4792 3452. Usual disclaimers hold. This project benefited from discussions with Paolo Angelini and Stefano Siviero.

1 Introduction

The world financial crisis and recession have led to unprecedented worldwide economic policy activism raising issues about the domestic and spillover effects as well as the coordination of those policies. In particular, the crisis has spurred a renewed interest in the effectiveness of discretionary fiscal policy to stimulate the economy, as demand in several countries remained weak even if the stance of monetary policy was extremely loose. Empirical results on the macroeconomic effects of discretionary fiscal measures are mixed. Typically VAR analyses find relatively large fiscal multipliers (Perotti, 2007; Mountford and Uhlig, 2005). To the opposite, analyses based on event studies (Ramey, 2008) find negligible multipliers. The rather broad range of empirical results implicitly suggest that a proper assessment of fiscal policy effectiveness should control for many dimensions. The type of intervention (i.e. tax- vs public expenditure-based intervention), how it is financed, how long it is expected to last, the interaction with the monetary policy, the degree of trade openness of the country are just some of the many features that can affect the macroeconomic impact of fiscal measures.

In the attempt to control for all these elements, many international institutions and central banks exploit dynamic general equilibrium models. Just to give some examples, Freedman et al. (2009) simulate the impact of different fiscal stimulus policies using the IMF's Global Integrated Monetary and Fiscal (GIMF) model. Similarly, Roeger and in't Veld (2009) use a version of the European Commission Quest III model. Finally the OECD (2009) presents simulations based on a standard new-Keynesian DSGE model. These contributions analyze the effects of temporary deficit-financed fiscal stimuli lasting one or two years, assuming a return of the debt level to its long term value after the end of the stimulus. Also, they analyze scenarios where the monetary stance is accommodative by assuming that the policy rate is held constant during the implementation of the fiscal stimulus.

In this paper we contribute to the debate by quantitatively assessing the effectiveness of cross-country coordinated temporary fiscal stimuli in the euro area. Building on the New Area Wide Model (Coenen et al. 2008) and IMF Global Economy Model (Pesenti 2008), we develop a two-region monetary union DSGE model. Monetary policy has a nontrivial stabilization role because there are sticky prices and wages. Public spending can be financed by raising public

debt or taxes and it can have Keynesian effects because of the presence of "non Ricardian households", that in each period consume all the available income. Moreover, there are lump-sum and distortionary taxes. Last but not least, there are real and nominal frictions (habit formation in consumption, investment adjustment costs, price and wage indexation) commonly used in estimated macroeconomic models to get prolonged and hump-shaped responses of quantities and prices to main shocks.

The model allows us to consider two important aspects for the effectiveness of fiscal coordination. First, the euro area countries have heterogenous sizes and trade openness. It is hence likely that, because of differences in trade leakages, the same fiscal measures have different effects in different countries. For this reason, we calibrate the model alternatively to Germany and Belgium.[1] Second, the monetary policy is managed at euro area level, it reacts to euro area-wide macroeconomic variables and its stance, more or less accommodative, does affect the macroeconomic effects of the stimulus

We simulate the effects of four different temporary (two-year) fiscal measures (increases in public purchases, reductions in labor income taxes, reductions in capital income and consumption taxes) under alternative assumptions for cross-country fiscal coordination and the euro area-wide monetary policy. All stimuli do not face delay in implementation, they are perfectly anticipated and, as such, credible. As said, we calibrate one region to Germany and, alternatively, to Belgium. The other region is calibrated to the rest of the euro area.

Our results are the following ones.

First, under fiscal coordination, in each region the output multiplier associated with public spending is one per cent (0.6 per cent) in the first (second) year. Multipliers associated with lower tax rates are lower than one (around 0.2-0.3 per cent).

Second, cross-regional fiscal coordination increases the size of regional multipliers if the region is sufficiently open. This is the case of Belgium, but not the case of Germany. The output multiplier associated with unilateral increases in German public purchases is around one (0.6) in the first (second) year, while the multiplier associated with unilateral reduction in German taxes

[1] Beetsma et al. (2008) provide some evidence on the relevance of trade leakages for the macroeconomic impact of fiscal shocks. Focusing on a panel of European Union countries, they show that the trade leakage can be sizeable. They estimate that an increase in public expenditures of 1 percent of (gross domestic product (GDP from now on) leads to a deterioration of the trade balance between 0.5 and 1 percent of GDP in the first year.

is between 0.1 and 0.3 percent, depending on the specific tax reduction. As such, multipliers associated with unilateral (German) measures are similar to those associated with coordinated stimuli. For Belgium, the multipliers associated with unilateral stimuli are half the size of corresponding German ones, as trade leakages are higher. So, Belgian multipliers almost double when the stimuli are coordinated across regions. Two opposite forces drive the result. On the one hand, the higher aggregate demand in the rest of the euro area, that has a stronger impact on the more open economy. On the other hand, the monetary policy, that increases the policy rate reacting to the higher level of activity and inflation in the monetary union during the euro area-wide stimulus. In other terms, in the case of Belgium, trade leakages are sufficiently high to more than compensate for the increase in the policy rate. In the case of Germany, they are not.

Third, the effectiveness of fiscal coordination can be, to some extent, higher when monetary policy has an accommodative stance. This is true in particular for multipliers associated with public spending, that become higher than one (1.6 and 1.3 in the first and second year, respectively). To the opposite, multipliers associated with tax reductions continue to be lower than one (around 0.3-0.6 percent).

Fourth, results are robust to alternative values of the share of non-Ricardian households and asymmetry in the implemented coordinated fiscal stimulus (for example, the German or Belgium region increases public spending and the rest of the euro area reduces taxes or vice versa).

Overall, results suggest that fiscal coordination in the euro area is particularly effective in the case of public spending-based stimulus. For sufficiently small open economies, such as Belgium, coordination widely augments the size of multipliers. In the case of countries less open to intra-euro area trade, such as Germany, public-spending coordination is effective only if the monetary policy is accommodative.

The values of our fiscal multipliers are in line with those provided by Coenen et al. (2010), that simulate DSGE models developed by staff of, among the others, ECB, IMF, European Commission and OECD. Differently from ours, those models do not consider the monetary union dimension and hence the role of intra-euro area trade leakages and common (currency union-wide) monetary policy. As in our case, their results suggest a higher short term impact

of stimuli based on public demand components (government consumption and investment) than those based on tax cuts. Moreover, an accommodative monetary policy can increase to some extent the size of the corresponding fiscal multipliers.

The paper is organized as follows. Section 2 provides a discussion of the setup and calibration of the model. Section 3 presents the main results. Section 4 concludes.

2 Model setup

The basic structure of the model is akin to the International Monetary Fund's Global Economy Model (GEM) and the European Central Bank's New Area Wide Model (NAWM).[2] We split the euro area in two regions, Home and rest of the euro area.

For the production side, we assume that in each region there are firms producing final non-tradable goods under perfect competition. The goods are used for consumption and investment purposes by households and public sector. They are produced combining tradable and nontradable intermediate goods. Intermediate goods are produced under the monopolistic competition regime. So each firm in the sector is able to set the price for the variety it produces, taking into account of the demand and price adjustment costs (that allow to introduce price stickiness, as in Rotemberg 1982). In particular, firms producing tradable goods are able to discriminate between domestic and exporting market (hence they set two region-specific prices). Intermediate goods are produced by combining labor and capital supplied by domestic households.

For households, we assume there are two types, that differ with respect to their ability to access financial markets. "Ricardian" households accumulate capital (they rent it to domestic firms) and a riskless nominal bond traded at euro area level (so cross-region financial markets are incomplete). "Non-Ricardian" households do not have access to financial markets. They do not smooth consumption over time but in each period consume the available wage income. Both households supply labor to domestic firms. The model allows for monopolistic competition in the labor market. So each household is able to set its wage, taking into account of the labor demand from domestic firms and wages adjustment costs (nominal wages are sticky, as they are

[2]For a description of the GEM and NAWM see respectively Pesenti (2008) and Coenen et al. (2008). A detailed description of our model is reported in the Appendix.

subject to adjust costs la Rotemberg 1982).

Monetary and fiscal authorities behave according to feedback rules. A standard Taylor rule holds for the monetary policy. The monetary policy rate reacts to monetary union-wide consumer price index (CPI from now on) inflation rate and output growth. It is set in an inertial way, to capture the gradualism in the conduct of monetary policy. Fiscal policy is conducted at the regional level. On the expenditure side, we distinguish between spending on public purchases, investment, public employment and transfers to families. On the revenue side, we distinguish between lump-sum and distortionary (on labor income, capital income and consumption) taxation.[3] So the Ricardian equivalence does not hold because of distortionary taxes and non-Ricardian households. The fiscal sector is closed by a fiscal rule, that stabilizes the public debt by appropriately changing lump-sum transfers.

Finally, the model matches the persistence and hump-shaped responses usually found in the data thanks to standard real and nominal frictions (habit formation in consumption, adjustment costs on investment changes, adjustment costs on nominal prices and wages, wage and price indexation to a weighted average of previous period's sector-specific inflation and current region-specific CPI inflation).

In the following sections we describe the fiscal policy setup, the monetary policy rule and the households' optimization problem for the Home region. Similar equations (not reported) hold in the Foreign region (rest of the euro area). Subsequently, we discuss the calibration.

2.1 Fiscal policy

Fiscal policy is set at the regional level. The government budget constraint is:

$$\frac{B^g_{t+1}}{R_t} - B^g_t = (1+\tau^c_t)P_t C^g_t + P_{I,t} I^g_t + W_t L^g_t + Tr_t - T_t \tag{1}$$

where $B^g_t \geq 0$ is nominal public debt. It is a one-period risk-free nominal bond issued in the euro area-wide market that pays a gross nominal interest rate R_t controlled by the monetary authority of the currency union. The variable C^g_t represents government purchases, $W_t L^g_t$ is

[3]For a model having similar fiscal features, see Forni et al. (2010) and Forni et al. (2009).

the wage bill paid to public employee, Tr_t are the lump-sum transfers to Ricardian households. We assume that C_t^g has the same composition as private consumption. As such, C_t^g (1) is a final nontradable bundle of nontradable, domestic and imported tradable intermediate goods and (2) is pre-multiplied by the private consumption price index P_t. For expenditure in public employment, we assume that in each region there is only one labor market (as such, firms and public sector pay the same wages). The variable I_t^g represent public sector's investment. We assume it has the same composition as private investment. As the composition of I_t^g is different from that of consumption, it is pre-multiplied by the price index $P_{I,t}$.[4] Moreover, we assume per capita transfers are equal across all Ricardian households.

Total government revenues T_t are given by the following accounting identity:

$$T_t \equiv \tau_t^{\ell} W_t L_t + \tau_t^c \left(P_t C_t + P_t C_t^g\right) + \tau_t^k \left(R_t^k K_{t-1} + \Pi_t^P\right) \tag{2}$$

where the τs are tax rates on labor income (τ_t^{ℓ}), capital income (τ_t^k) and consumption (τ_t^c), L_t is amount of hours worked in the economy (equal to the sum of labor employed by firms and the public sector), R_t^k is the rental rate of existing physical capital stock K_{t-1} held by households and Π_t^P stands for dividends from households' ownership of domestic firms.

We assume that the government follows a fiscal rule defined on lump-sum transfers (as a percent of domestic GDP), tr, to bring the public debt (as a percent of domestic GDP), $b > 0$, in line with its long run (steady-state) target b^{ss}. Following Coenen et al. (2008), we specify it as:

$$\frac{tr_t}{tr^{ss}} = \left(\frac{b_t^g}{b^{g,ss}}\right)^{\phi_1} \tag{3}$$

where ϕ_1 is lower than zero.

[4] For public employment and public investment, we assume they do not have any supply-side effect, consistently with the temporary short-run dimension of our simulations.

2.2 Monetary policy

The monetary authority controls the (gross) short-term rate according to a Taylor rule. Following Coenen et al. (2008), we specify it as:

$$R_t^4 = \left(R_{t-1}^4\right)^{\rho_R} \left(\pi_{MU,t-4}\right)^{(1-\rho_R)\rho_\pi} \left(\frac{GDP_{MU,t}}{GDP_{MU,t-1}}\right)^{\rho_{GDP}} \tag{4}$$

The parameter ρ_R $(0 < \rho_R < 1)$ captures inertia in interest rate setting, while parameters ρ_π and ρ_{GDP} are respectively the weights of currency union's (yearly) CPI inflation rate $(\pi_{MU,t-4})$ and GDP $(GDP_{MU,t})$. The CPI inflation rate is a geometric average of (gross) CPI inflation rates in the Home and Foreign country (respectively π_t^C and π_t^{C*}, with $\pi_t^C \equiv P_t/P_{t-1}$ and $\pi_t^{C*} \equiv P_t^*/P_{t-1}^*$). Each weight is equal to the correspondent country size (respectively s and $1-s$):[5]

$$\pi_{MU,t} \equiv \left(\pi_t^C\right)^s \left(\pi_t^{C*}\right)^{1-s} \tag{5}$$

The union-wide GDP is the sum of the Home and Foreign GDPs (respectively GDP_t and GDP_t^*):

$$GDP_{MU,t} \equiv GDP_t + GDP_t^* \tag{6}$$

Given the presence of public employment, and consistently with common practice in the national accounts statistics, we include the public expenditure for wages in the definition of regional GDP. So we have, in the case of Home GDP:

$$GDP_t \equiv P_t C_t + P_t C_t^g + + W_t L_t^g + P_t^I I_t + P_t^I I_t^g + P_t^X X_t - P_t^M M_t \tag{7}$$

where P_t^X and P_t^M are prices of export (X) and import (M), respectively.

[5] Consistently with Coenen et al. (2008), we assume monetary policy does react to the CPI inflation net of changes in the consumption tax rate.

2.3 Ricardian households

Home Ricardian households are indexed by $i \in [0; \omega s]$, with $0 \leq \omega \leq 1$.[6] Households' preferences are additively separable in consumption and labor effort. Households receive utility from consuming and disutility from working L_t hours. The expected value of household i lifetime utility is given by:

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \left[\frac{\left(C_t(i) - \kappa C_t\right)^{1-\sigma}}{(1-\sigma)} - \frac{1}{\tau} L_t(i)^{\tau} \right] \right\} \tag{8}$$

where E_0 denotes the expectation conditional on information set at date 0, β is the discount factor ($0 < \beta < 1$), $1/\sigma$ is the elasticity of intertemporal substitution ($\sigma > 0$), κ ($0 \leq \kappa \leq 1$) is (external) habit formation and $1/(\tau - 1)$ is the labor Frisch elasticity ($\tau > 0$).

The budget constraint of the household i is:

$$\begin{aligned} \frac{B_t(i)}{(1+R_t)\,\mu_t} - B_{t-1}(i) \quad \leq \quad & (1-\tau_t^k)\left(\Pi_t^P(i) + R_t^K K_{t-1}(i)\right) + \\ & + (1-\tau_t^{\ell}) W_t(i) L_t(i) - (1+\tau_t^c) P_t C_t(i) - P_t^I I_t(i) \\ & + Tr_t(i) - AC_t^W(i) \end{aligned} \tag{9}$$

It holds a one-period risk-free bond, B_t, denominated in the currency of the monetary union. The short-term nominal rate R_t is paid at the beginning of period t and is known at time t. It is directly controlled by the currency union's monetary authority. A financial friction μ_t is introduced to guarantee that the aggregate net asset position of the Home households follows a stationary process and the economy converges to a well defined steady state.[7] We assume that bonds issued by households and government can be traded internationally in the same market. Ricardian households own all domestic firms and there is no international trade in claims on firms'

[6] The population of the monetary union is normalized to one. The parameter s is the size of the Home population. It is also equal to the number of firms in each Home sector (nontradable final good, tradable and nontradable intermediate goods). Similar assumptions hold for the size $(1-s)$ of the rest of the euro area. The continuum of non-Ricardian households in the Home region is distributed over the interval $(\omega s; s]$. In the rest of the euro area, the continuum of Ricardian households is distributed over the interval $(s, s + (1-s)\,\omega^*]$. The continuum of non-Ricardian households over the interval $(s + (1-s)\,\omega^*, 1]$.

[7] Revenue from financial intermediation are rebated in a lump-sum way to Ricardian households in the rest of euro area. See Benigno (2009). We assume that the cost has the following functional form:

$$\mu_t \equiv \phi_{B1} \frac{\exp(\phi_{B2}\left[B_t/GDP_t - b^{ss}\right]) - 1}{\exp(\phi_{B2}\left[B_t/GDP_t - b^{ss}\right]) + 1}, 0 \leq \phi_{b1} \leq 1, \phi_{b2} > 0 \tag{10}$$

where b^{ss} is the long-run net asset position of Home households.

profits. The variable Π_t^P includes profits accruing to the household. We assume that profits are equally shared across Home Ricardian households. The variable I_t is the investment bundle in physical capital. The household accumulates physical capital K_t and rents it to domestic firms at the nominal rate R_t^k. The law of motion of capital accumulation is:

$$K_t(i) = (1-\delta) K_{t-1}(i) + \left(1 - AC_t^I(i)\right) I_t(i) \tag{11}$$

where δ $(0 < \delta < 1)$is the depreciation rate. The adjustment cost on investment AC_t^I is:

$$AC_t^I(i) = \frac{\phi_I}{2}\left(\frac{I_t(i)}{I_{t-1}(i)} - \delta\right)^2,\ \phi_I > 0 \tag{12}$$

Finally, Home households act as wage setters in a monopolistic competitive labor market. Each household i set its nominal wage taking into account of labor demand by domestic firms and public sector and adjustment costs AC_t^W on the nominal wage $W_t(i)$:

$$AC_t^W(i) = \frac{\kappa_W}{2}\left(\frac{W_t(i)/W_{t-1}(i)}{\left(\pi_t^W\right)^{\alpha_W}\left(\pi_t^C\right)^{1-\alpha_W}} - 1\right)^2 W_t L_t,\ \kappa_W > 0, 0 \leq \alpha_W \leq 1 \tag{13}$$

The costs are proportional to wage bill of the overall economy, $W_t L_t$. There is a weighted-indexation mechanism to previous period wage (gross) inflation ($\pi_t^W \equiv W_t/W_{t-1}$) and to current period domestic (gross) CPI inflation (π_t^C).

2.4 Non-Ricardian households

Home non-Ricardian households are indexed by $i' \in [\omega s; s]$. Non-Ricardian are modeled in various ways in the literature, leading to different responses of their consumption to changes in their current disposable income. We follow Campbell and Mankiw (1989) and Galí et al. (2004, 2007) and assume that in each period they consume their after-tax disposable income. That is, the budget constraint of the generic non-Ricardian household i' is:

$$(1+\tau_t^c)P_tC_t\left(i'\right) \quad = \quad (1-\tau_t^\ell)W_t\left(i'\right)L_t\left(i'\right) \tag{14}$$

We assume non-Ricardian households' wage and hours are the same as those of Ricardian households. We also assume that tax rates on labor income and consumption are the same for both types of households. We stress that this way of modeling of non-Ricardian households does not necessarily imply a positive response of total private consumption to government expenditure shocks. The response will depend, among other things, on the value of the share of non-Ricardian households in the population.[8]

2.5 Calibration

We calibrate the model at quarterly frequency to Germany (Home economy) and the rest of the euro area (Foreign economy). Alternatively, we also calibrate the model to Belgium (Home) and the (corresponding) rest of the euro area region. Comparing results for the two countries allows us to assess the role of size and trade openness.[9] We set some parameter values to get steady-state ratios consistent with 2008 national account data. For remaining parameters we resort to previous studies and estimates available in the literature.[10] In particular, for parameters affecting the dynamics we calibrate the model to get euro-area wide responses to monetary and government expenditure shocks in line with the ECB NAWM Model (Christoffel et al. 2009 and Coenen et al. 2008).

We report in Table 1 parameters related to preferences and technology. Parameters with a "$*$" are related to the rest of the euro area region. We set the discount factor β to 0.9926, so

[8] Other contributions assume that non-Ricardian households cannot participate in capital markets, but they can still smooth consumption by adjusting their holding of money (see for example Coenen et al. 2008).

[9] Compared to the German case, results do not greatly change when we calibrate the Home economy to France or Italy, as the countries are rather similar in terms of size, great ratios and intra-euro area trade openness. Germany, France and Italy have similar levels of private consumption (about 60% of GDP), private investment (20%) and public consumption (20%). Their sizes and degree of openness are also relatively similar (German GDP is about 30% of euro area GDP, French and Italian GDP about 20%; bilateral Germany-rest of the euro area export and import are about 20% of German GDP, while bilateral France- and Italy-rest of the euro area export and import are about 15% of the corresponding GDP). We do not report results for France and Italy to save on space. They are available from the authors upon request.

[10] See Coenen et al. (2008), Forni et al. (2010a, 2010b), Forni et al. (2009), Gomes et al. (2010).

that the steady state real interest rate is equal to 3 per cent on an annual basis. We set the value for the intertemporal elasticity of substitution, $1/\sigma$, to 1; the Frisch labor elasticity,$1/(\tau - 1)$ to 0.5; habit formation, κ, to 0.8; the depreciation rate of capital δ to 0.025.

For the production functions of tradables, we set the elasticity of substitution between labor and capital to 0.9 and the bias towards capital to 0.7. For the production functions of nontradables, we set the elasticity to 0.90 and the bias towards capital to 0.68.

In the final consumption and investment goods we set the elasticity of substitution between domestic and imported tradable to 1.5, while the elasticity of substitution between tradables and nontradables to 0.5. We set the bias for the composite tradable to 0.55 and the bias for the domestically produced tradables to match the Germany-rest of the euro area import and export to GDP ratios (see Table 5). We set the size of the Home population, n, to 0.25 (we normalize the population of the euro area to 1).

In Table 2 we report gross markups in the tradable, nontradable and labor markets. We assume markups are higher in the nontradable and labor markets. We obtain these figures by calibrating the sector-specific elasticities of substitution between varieties.[11]

We show in Table 3 parameters that regulate the dynamics. We set adjustment costs on investment change to 4.5. As previously said, we set nominal wage and price quadratic adjustment costs as well as indexation parameters in such a way to get responses of the main macroeconomic variables to a monetary policy shock similar to those reported by Christoffel et al. (2009) and Coenen et al. (2008). The two parameters regulating the adjustment cost paid by the Home households on their net financial position are set to 0.00055, to minimize the impact of the cost on the Ricardian households' responses.[12]

We report parametrization of systematic feedback rule followed by the fiscal and monetary authorities in Table 4. In the fiscal policy rule (3) we set $\phi_1 = 0.1$, a value that is sufficiently low to allow to reach the public debt target gradually over time. The central bank of the euro area

[11] For an analysis of the macroeconomic effects of different markup levels in a model similar to the one used in this paper, see Forni et al. (2010).

[12] Higher values of the cost introduce an asymmetry between Home households' and Foreign households' responses as Home households tend to smooth consumption by changing physical capital rather than the costly bonds. Overall, results do no greatly change in correspondence of alternative value of those parameters. To simplify the interpretation of results and transmission mechanism of the shocks, we prefer to set the costs to a rather low value.

targets the contemporaneous euro area wide consumer price inflation (we set the corresponding parameter to 2.0) and the output growth (we set the parameter to 0.1).[13] We assume that the interest rate decisions are taken in an inertial way. As such, the previous-period value of the policy rate enters the rule with a weight equal to 0.86.

We show in Table 5 the model-based and actual steady-state great ratios and tax rates under our baseline calibration. Private consumption, investment, bilateral imports and exports match the data rather well. We assume a zero steady state net foreign asset position for the Home economy. This implies that - in steady state - the *net* financial position of the Home private sector equals the level of the Home public debt.

As for fiscal policy variables, we perfectly match public consumption and investment(as a ratio to GDP) as they are exogenous. For other items, as the public wage bill, we calibrate the hours worked in the public sector-to-total hours worked ratio to replicate the actual data. As the wage rate is endogenous, however, we don't match exactly the corresponding expenditure component. Similarly, we perfectly match the steady-state interest rate and public debt(as a ratio to GDP), but we do not perfectly match the interest rate payments on public debt. We compute transfers as a residual from the government budget constraint. We calibrate tax rates using effective average tax rates estimates for 2007 taken from Eurostat (2008). We set the tax rate on wage income τ^{ℓ} to 46, the tax rate on capital income τ^{k} to 33, the tax rate on consumption τ^{c} to 18. We calibrate the public debt-to-yearly GDP ratio to 60 per cent.

We also calibrate the model to Belgium. Compared to Germany, Belgium is smaller (5 vs 25 percent of euro area GDP) and more open (imports from the rest of the euro area, as a ratio to GDP, are equal to 53 and 22 percent in the case of Belgium and Germany, respectively). To match these variables, we appropriately change the size of the regions, the home bias and weight of tradables in the consumption and investment bundles. We do not change other parameters, as Belgium and Germany do no greatly differ along other dimensions.[14]

To assess the dynamic implications of the chosen calibration, we report in Figures 1 and 2 the effects on the Home (Germany) and rest of the euro area regions of two standard shocks.

[13]The euro area-wide consumer price inflation rate and GDP are weighted (by the regional size) geometric average of the corresponding regional variables.

[14]See Forni et al. (2010) for the Belgium calibration. To save on space, we do not report it.

In Figure 1 we show the impact of a 1 percentage point increase in the (annualized) policy rate. The dynamics is rather standard and in line with results reported in Christoffel et al. (2009) and Gomes et al. (2010). Note in particular that the decrease in output is twice as large as that in the annualized CPI inflation rate, consistently with the high degree of nominal rigidities in the euro area. The impact is rather symmetric across the two regions.

In Figure 2 we show the impact of a simultaneous increase in Home and rest of the euro area public spending. The size of each shock is equal to 1 percent of domestic GDP and the public spending follows a standard AR(1) process with persistence coefficient equal to 0.90. On the impact period, the fiscal multiplier is slightly higher than one, after the first period it decreases. Households' consumption slightly increases on impact, because of the positive income effect on non-Ricardian households that more than compensates for the negative wealth effect on Ricardian households. The deficit-to-GDP ratio increases, because of the higher spending for purchases and interest payment on public debt. The interest rate increases, as the currency union's monetary authority faces higher inflation and economic activity. Also in this case results are in line with those by Coenen et al. (2008) and Gomes et al. (2010).

3 Results

We consider four temporary (two year) fiscal measures: increase in public consumption; cut in labor income, capital income and consumption tax rate. The increase in public consumption is achieved via an increase in purchases of goods and services.[15] The cut in labor (capital) income tax consists in a reduction in the average tax rate on labor (capital) income. Finally, we consider a reduction in consumption taxes.

For each fiscal measure, we assume that in the baseline scenarios the measure is implemented unilaterally by the Home government only and the common monetary policy follows the Taylor rule (we name these scenarios "Home fiscal stimulus"). We consider three alternative scenarios:

[15] An increase in public investment would have effects similar to those of an increase in public consumption as long as they have about the same import content. It will increase domestic demand with little effect on the supply side, given the temporary nature of the stimulus. The effect on the stock of public capital, and therefore on the productivity of the economy, would be limited. As such, we do not report results for public investment measures (they are available upon request). Similarly, we assume that public expenditure on employment is not changed over time.

(1) the fiscal measure is implemented unilaterally by the Home government only and the common monetary policy is accommodative (the policy rate is held constant at the baseline level during the stimulus; thereafter, the monetary authority resumes to follow the Taylor rule); (2) the same fiscal measure is implemented simultaneously in both the Home and Foreign region (the case of coordination); (3) the same fiscal measure is implemented simultaneously in both Home and Foreign region and the monetary policy is accommodative. In all scenarios each measure has a size equal to 1% of pre-stimulus domestic GDP. All stimuli last for two years. We also assume that each measure is financed entirely with public debt and that three years after the beginning of the implementation lump-sum transfers are reduced to gradually bring the public debt back to the long-run (steady-state) target.

All scenarios run under perfect foresight. So there is no uncertainty and fiscal and monetary decisions (in periods different from the initial one) are perfectly anticipated by households. Moreover, we assume there is no delay in the implementation of fiscal policy decisions. In what follows, we initially report results when measures are implemented unilaterally by the Home region and the monetary policy is standard or, alternatively, is accommodative. Reported results for the case of unilateral stimuli would help to assess those obtained when the corresponding measures are coordinated (reported in section 3.2).

3.1 Home fiscal measures

For each fiscal measure, Tables 6 to 9 report the first and second year average impact on selected variables for both the Home economy (calibrated to Germany) and the euro area.[16] Column (1) reports the domestic (see top panel in each Table) and spillover (see bottom panel) effects of a fiscal stimulus implemented by the Home fiscal authority when the monetary policy authority follows the Taylor rule. Public expenditure (Table 6) has the highest impact on Home GDP. The corresponding multiplier has a value equal to 1.0 and 0.6 in the first and second year after the stimulus, respectively. The output multipliers associated with cut in labor income tax (Table

[16] All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and (primary and overall) public deficit-to-GDP ratios, which are reported as percentage-point deviations. Inflation rates, terms of trade and real exchange rate are reported net of changes in the consumption tax rate. The primary deficit is the public deficit net of interest payments on public debt.

7) and consumption tax (Table 9) are equal to around 0.3 in each year. Finally, the output multiplier associated with lower capital income tax (Table 8) is rather low (0.1)

The relatively high value of output multiplier associated with public spending is a standard result, as public spending has a direct effect on Home GDP. In this case, households' consumption is essentially at the baseline level, investment decreases as households' savings finance the increase in public debt, hours worked increase to augment production.

Tax-based measures have more muted effects on GDP. The lower wage income tax rate stimulates employment (leisure becomes relatively expensive) and non-Ricardian households' available income. Both effects stimulate consumption. Similarly, the cut in capital income tax rate stimulates the investment component of GDP. The overall increase in productive factors, and hence output, is not very strong, as the increase in the capital stock is gradual. Finally, the lower consumption tax rate stimulates higher consumption, that slowly increases over time (in the second year the consumption and output multipliers are higher than the corresponding values in the first year).

Home consumer price inflation is rather stable across the considered scenarios. The highest increase is obtained under the public spending-based stimulus (0.2 percentage points in each year). Similarly, the Home real interest is stable. In the case of public spending-based stimulus, the Home real interest rate slight decreases during the first and second year. The decrease is an implication of the monetary union dimension. The monetary authority sets the (common) nominal interest rate reacting to the currency union-wide variables. The relatively low weight of the Home country implies a negligible increase in the policy rate in correspondence of higher Home inflation and real activity. As such, the Home real interest rate decreases, partially counterbalancing the negative impact of higher public spending on households' demand. As said, however, the decrease in the Home real interest rate is rather muted, as Home inflation does not strongly react to the stimuli. The reason is that the degree of price stickiness is calibrated to be a rather high value in the euro area, consistently with empirical evidence (see Christoffel et al. 2009).

For the open economy dimension, trade leakages imply that the stimulus induces a decrease in Home net export. Higher Home aggregate demand has a direct positive impact on imports.

Export decrease, in particular in the case of higher Home public spending and lower consumption taxes. The reason is the increase in the Home goods' relative prices (the Home real exchange rate and terms of trade respectively appreciate and improve), due to the bias of Home demand towards domestic goods.[17] As a consequence the currency union's demand shifts towards the Foreign good. As shown in section 3.3, trade leakages are much stronger for a more open economy such as Belgium, implying for output multipliers much lower values than the corresponding German ones.

Trade volumes and movements in international relative prices have a modest impact on the Foreign economy. Foreign production is roughly constant at the baseline level or decreases. Even if Home imports increase, Foreign households reduce investment in physical capital and consumption to finance the higher Home public debt. Quantitatively, the impact on Foreign output is rather small.

For the euro area GDP, it increases by around 0.3 (0.2) percent in the first (second) year in the case of higher Home public spending and by roughly 0.1 percent in the case of lower Home tax measures.

Overall, Home output multipliers are lower than one. This is true in particular for multipliers associated with reductions in taxes. The Home output multipliers associated with increase in public purchases is higher and around one in the first year, it is lower than one in the second year.[18]

3.1.1 Accommodative monetary policy

To assess the extent to which an *accommodative* monetary policy can increase the magnitude of the Home fiscal multipliers, Column (2) in Tables 6-9 reports the impact of each Home fiscal measure when the monetary policy authority holds the policy rate constant at baseline level during

[17] The impact of the shocks on international relative prices is generally rather muted, as the degree of price stickiness is rather high and similar across euro area regions. Moreover, differently from a standard open economy model with country-specific currency, in a currency area the nominal exchange rate between the two regions is constant by definition. So the real exchange rate cannot jump instantaneously for a given shock, as it would otherwise do in a standard two-country model (in the short run, with sticky prices, the real exchange rate would closely track the nominal exchange rate). The Home real exchange rate is defined as the Foreign-to-Home consumer price index ratio. The Home terms of trade as the Home import-to-Home export price ratio.

[18] We do not report results for unilateral stimuli implemented in the rest of the euro area, as they are similar to those obtained in the case of coordination. The relatively large size of the rest of the euro area region and its relatively wide home bias imply that spillovers from the Home region are not particularly large.

the two-year fiscal stimulus and, subsequently, resumes to follow the Taylor rule. Effectiveness of discretionary fiscal measures depends upon two factors. First, the constant policy rate should limit the decrease in Home exports. The latter should be driven by higher Foreign demand, as Foreign households anticipate that the policy (and real interest) rate will be higher in the future once the monetary authority resumes to follow the standard Taylor rule. Second, the Home real interest rate should be lower than in the case of Taylor-rule based monetary policy, stimulating Home consumption and investment. Results show that, compared to the case of standard monetary policy, the increase in Home output multipliers is rather muted. The Home GDP increases by slightly more (less) than 0.1 extra percentage points per year under a public spending- (tax-) based stimulus. The impact is slightly stronger in the case of the public spending-based stimulus than in the cases of tax-based stimuli as in the first case both Home and Foreign inflation rates increase relatively more thanks to the larger increase in the euro area aggregate demand. However, as said, the increase in the Home multipliers is muted, as the region-specific real interest rates do not widely decrease. The reason is that inflation reaction is rather small, as nominal price rigidities in the euro area are rather high.

3.2 The role of fiscal coordination

The column (3) in Tables 6-9 report results when the same fiscal measure is implemented in both the Home and rest of the euro area regions. The monetary authority follows the standard rule. Compared to the case of Home-based public spending stimulus (column 1), the Home GDP increases (decreases) by less that 0.1 extra percentage points during the first (second) year when the increase in public spending is coordinated. When the reduction in (the same type of) tax rate is coordinated, the Home output gains less than 0.1 extra percentage point per year compared to the corresponding unilateral Home reduction. In the case of a coordinated reduction in consumption tax rates, the Home multiplier is lower than in the case of an isolated Home consumption tax reduction. The results clearly show that gains from fiscal coordination are not extremely high in the case of Germany. The reason is that trade leakage are not sufficiently high to more than compensate for the reduction in domestic households' aggregate demand. The latter is induced by the increase in nominal and real interest rates, as the monetary authority

tries to stabilize euro area inflation and activity, that are now pushed up by the euro area-wide fiscal stimulus. Specifically, in the first year the reduction in the Home real interest rate is rather similar to that obtained under the Home-based stimulus. In the second year the Home real interest rate is higher. As shown in the next section, an accommodative stance of monetary policy is necessary to amplify the effectiveness of fiscal coordination on the German economy. Alternatively, trade leakages should be higher, as in the case of Belgium (as shown in section 3.3).

In the rest of the euro area generally households' consumption increases (the exception is the stimulus based on public spending), while investment in physical capital is roughly constant at the baseline level or decreases (it increases in the case of a stimulus based on lower capital income tax rate). Foreign households work more and use savings to finance the rising public debt. The multiplier associated with higher public spending in the rest of the euro area is equal to 1.0 and 0.6 percent respectively in the first and second year. Remaining (tax) multipliers are much lower than one. Overall, Foreign multipliers have values in line with Home counterparts. Two forces determine the value of Foreign multipliers. On the one hand, the monetary authority rises relatively more the policy rate in correspondence of the coordinated fiscal stimulus, as the inflation rate and economic activity in the currency area increase. The higher monetary policy rate and the associated increase in Foreign real interest rate dampen the expansionary effects of the coordinated stimulus on Foreign variables. On the other hand, the Foreign economy is a relatively closed economy (the home bias is relatively high), implying that the Foreign stimulus is relatively more effective than the Home stimulus.

In the case of coordinated public spending-based stimulus, the overall euro area GDP increases by 1.0 and 0.6 percent in the first and second year, respectively. For other coordinated stimuli, the increase in euro area output is lower (0.3, 0.2, 0.1 for reductions in, respectively, labor income, consumption and capital income tax rate). In all cases the obtained values are three times as big as the corresponding values in the case of Home fiscal stimulus.

Overall, output multipliers are lower than one. Only the first-year multiplier associated with higher public spending is around one.

3.2.1 Accommodative monetary policy

We now consider (column 4 in Tables 6-9) the case of an *accommodative* monetary policy, meaning that the policy rate is held constant at the baseline (steady state) level during the implementation of the coordinated fiscal stimulus (two years). Subsequently, the monetary authority resumes to follow the Taylor rule.

Compared to the scenarios of fiscal coordination under standard monetary policy (column 3), the yearly Home output multipliers increase by 0.6 extra percentage points (in the case of coordinated public spending stimulus), by 0.1 in the case if capital and labor income tax-based stimuli and by 0.3 in the case of consumption tax-based stimulus. The sources of the gains are the higher Home and Foreign aggregate demand, driven by the lower Home and Foreign real interest rates. The gains are stronger in the case of higher public spending (as this type of stimulus directly affects aggregate demand) and lower consumption tax rate (as consumption is a large share of overall GDP). As such, the impact on Home and Foreign inflation rates is larger and the Home and Foreign real interest rates decrease to a larger extent. This implies a stronger amplifying effect on the fiscal stimulus.

Compared to the scenarios of fiscal coordination under standard monetary policy, the increase in Foreign multipliers is similar to the increase in the corresponding Home multipliers (0.6 and 0.1-0.3 percentage points for public spending- and tax-based stimuli, respectively). As for the Home region, the Foreign economy benefits from the reduction in the real interest rate due to the accommodative monetary policy stance.

After a public spending stimulus the increase in euro area GDP would be equal to 1.6 and 1.2 percentage points in the first and second year, respectively. The increase in GDP is lower and equal to 0.5 per year in the case of labor income and consumption tax reductions, to 0.3 in the case of lower capital income taxes.

The simulations suggest that output multipliers continue to be lower than one also when monetary policy is accommodative. The only exception is the multiplier associated with public purchases, that becomes higher than one but not extremely so (its two year average is 1.5).

Overall, results do suggest that, for a country such as Germany, coordination is particularly effective in the case of public spending and accommodative monetary policy. Otherwise, German

economic performance does not greatly change compared to the case of unilateral measures. Results are different for a smaller and more open region such as Belgium, as shown in the next section.

3.3 The role of trade openness: the case of Belgium

Tables 10-13 show the macroeconomic effects of the different fiscal measures implemented in the Belgium economy. It is worth to note the following points. First, multipliers associated with the isolated Belgian fiscal stimulus are lower than the corresponding German values (it can be seen by comparing column 1 in Tables 6-9 and Tables 10-13). The multiplier associated with higher public spending is lower than 0.5, multipliers associated with lower taxes are lower than 0.2. The reason is the trade leakage, which is higher for Belgium than for Germany. Second, accommodative monetary policy does not enhance multipliers in the case of unilateral stimulus, as it can be seen by comparing columns 1 and 2 in each Table. The reason is that Belgium is very small. As such, under standard (Taylor rule-based) monetary policy, the monetary stance is not affected by Belgian economic performance and the policy rate does not move at all when the Belgian stimulus is implemented apart. Third, Belgium greatly benefits from fiscal coordination. As in the case of Germany when the stimulus is coordinated, monetary policy augments the policy rate (limiting the increase in euro area aggregate demand). However, differently from Germany, Belgian output relies relatively more on foreign demand, as the Belgium's degree of openness is much higher than that of Germany. As such, Belgian output increases following the increase in rest of euro area aggregate demand, notwithstanding the increase in the real interest rate. The magnitude of Belgian output multipliers becomes similar to that of German ones. Similar considerations hold when the fiscal coordination is implement jointly with accommodative monetary policy. As for Germany, benefits, in terms of multipliers' size, are stronger in the case of accommodative monetary policy that stimulates demand in the rest of the euro area. Also in this case, the magnitude of Belgian multipliers becomes similar becomes similar to that of the corresponding German ones. Output multiplier associated with public spending is higher than one (1.6 in the first year, 1.2 in the second). Multipliers associated with reduction in tax rates continue to be lower than one.

Overall, results do suggest that fiscal coordination benefits the fiscal multipliers of smaller and more open economies, such as Belgium (the same argument, and, likely, similar results hold for countries in the euro area having size and trade openness similar to those of Belgium). Moreover, the monetary policy stance enhances the size of multipliers when the stimulus is coordinated. As for Germany, the size of the multiplier associated with public spending is larger than one, while the size of tax multipliers is much lower than one.

3.4 Sensitivity analysis

We perform the following sensitivity analysis. First, we assess the role of share of non-Ricardian households, by simulating coordinated and symmetric measures when the share is set to 0.45 instead of 0.30 (benchmark) in each region. Second, we assess the macroeconomic effects of an increase in public spending in the Home country, coupled with alternative tax measures in the Foreign country. Finally, we refer to the opposite combination and consider alternative Home fiscal stimuli in correspondence of a public spending-based Foreign stimulus. To save on space, we report results for Germany only.[19]

3.4.1 Share of non-Ricardian households

Table 14 reports results obtained when increasing the share of non-Ricardian households from 0.3 to 0.45 in both Home and Foreign region (the corresponding parameters are ω and ω^*, respectively). We consider only the case of higher public spending, as the latter measure should benefit relatively more than tax measures from the higher share. Higher public spending, in fact, directly affects aggregate demand and, hence, production. Firms meet higher production needs by increase employment and wages. As such, a higher share of non-Ricardian households (who benefit from higher labor income) implies a higher positive income effect of expansionary fiscal measures on households' aggregate consumption. The latter increases to a bigger extent, fueling

[19] We have also increased the elasticity of substitution between domestic and imported tradable goods, from 1.5 to 3.0. A higher value of the elasticity of intratemporal substitution between domestic and imported good means that households are more willing to substitute across the two goods for a given change in relative prices. However, results (not reported, but available upon request from the authors) show that the size of the additional effect on fiscal multipliers is relatively small. Differently from a standard open economy model, there is no a nominal exchange rate that immediately and widely jumps. Moreover, the fiscal shock is rather symmetric, so there is less scope for changes in international relative prices. As such, the fluctuations in relative prices are small and result are robust to changes in the value of the intratemporal elasticity of substitution.

labor, consumption and output.[20] Quantitatively, results do not greatly change compared to the corresponding benchmark scenarios (Tables 6), as consumption increases by partially subtracting resources to investment. The largest difference is for fiscal coordination when the monetary policy is accommodative, as the Home multiplier increases by 0.15 percentage points in the first year (to 1.8 percent) and 0.10 in the second (to 1.4), because of the larger increase in consumption.

Overall, results seem to be robust to changes in the share of non-Ricardian households, as the levels of multipliers, in particular those obtained under coordination, do not greatly change across the correspondent scenarios.

3.4.2 Cross-country asymmetric measures

In the above analysis we assume that both regions simultaneously implement the same fiscal measure. We now turn to the case in which the two regions jointly enact a coordinated fiscal stimulus relying on different measures. We assume that the monetary policy follows the standard Taylor rule.

Table 15 shows the macroeconomic effects of an increase in public spending in the Home country, coupled with a reduction in, alternatively, labor income, capital income and consumption tax rates in the Foreign country. Compared to the case of symmetric (public expenditure-based) stimulus (column 1), the Home multiplier associated with public spending does not greatly change. It slightly decreases in the first year as exports increase less. In the second year, it slightly increases in the case of lower foreign labor and capital income tax rates, as the economy benefits from a lower increase in the monetary policy rate (as the monetary authority faces a lower increase in euro area aggregate demand in the case of rest of the euro area tax-based stimuli).

Table 16 refers to the opposite combination. We consider alternative Home (public spending, labor income, capital income and consumption tax-based) stimuli in correspondence of a public spending-based Foreign stimulus. Compared to the corresponding Home tax-based measures when the coordinated stimulus is symmetric (column 3 in Tables 7-9), the output multipliers

[20] In the case of fiscal coordination and standard monetary policy, the multipliers associated whit public spending and labor income tax increase respectively by roughly 0.1 and 0.2 percentage points per year, while the other multipliers (associated with capital income and consumption tax) increase to a lower extent. Results are available upon request.

are in general lower. However differences are not large. Two opposite forces drive the results. Spillovers on the Home economy from the rest of the euro area are now stronger, as foreign public spending favors the increase in Home exports. However, it also induces the monetary policy to increase the policy rate, with depressing effects on Home aggregate consumption and investment. Overall, multipliers associated with lower tax rates are still lower than one.

4 Concluding remarks

This paper analyzes the benefits of coordination of temporary fiscal stimuli in the euro area. Overall, results suggest that fiscal coordination in the euro area is particularly effective in the case of public spending-based stimulus. For sufficiently small open economies, such as Belgium, coordination widely augments the size of multipliers. In the case of countries less open to intra-euro area trade, such as Germany, public-spending coordination is effective only if the monetary policy is accommodative.

Many factors could affect our results. First, we do not consider regional sovereign risk premia, that could increase following the widening in public debt, depressing, if transmitted to other financial markets, households' aggregate demand. Second, the model does not allow for trade leakages related to extra-euro area trade. The relevance of the two factors depends on the considered country. They should matter relatively more for those countries having higher public debt and a high share of extra-euro area trade. However, they also depend on the monetary policy stance and the fiscal strategy pursued in the long run. An accommodative monetary policy could limit the extra-euro area trade leakages, as the euro would not appreciate in nominal terms against other currencies.[21] The fiscal policy strategy pursued in the medium and long run could, if credibly oriented towards fiscal stability and consolidation, limit the short-run increase in sovereign risk premia and, in some cases, even amplify, to some extent, short-run multipliers.[22] Moreover, coordination of the medium run strategies could further augment their credibility, limiting the increase in the risk premium. We leave all these issues for future research.

[21] See Forni and Pisani (2010).
[22] See Corsetti et al. (2009).

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Appendix

In this Appendix we report a description of the model, excluding the fiscal policy and the the households' optimization problem that are reported in the main text.[23]

A The setup

There are two regions, Home and Foreign, having different sizes and sharing the monetary authority. In each region there are households and firms. Each household consumes a public good and a final composite good sold by domestic firms and composed by nontradable, domestic and imported tradable intermediate goods. Households have access to financial markets and smooth consumption by trading a short-term nominal riskless bond. They also own domestic firms and capital stock, which is rent to domestic firms in a perfectly competitive market. Households supply differentiated labor services to domestic firms and act as wage setters in monopolistically competitive markets by charging a markup over their marginal rate of substitution.

On the production side, there are perfectly competitive firms that produce the final goods and monopolistic firms that produce the intermediate goods. The three final goods (a private consumption, a private investment and a public consumption good) are produced combining all available intermediate goods in a constant-elasticity-of-substitution matter. Tradable and nontradable intermediate goods are produced combining capital and labor. Tradable intermediate goods are split in domestically-consumed and export goods. Because intermediate goods are differentiated, firms have market power and restrict output to create excess profits. We assume that Home and Foreign regions are segmented markets and the law of one price for tradables does not hold. Hence, each firm producing a tradable good sets two prices, one for the domestic market and the other for the export market. Since the firm faces the same marginal costs regardless of the scale of production in each market, the different price-setting problems are independent of each other.

To capture the empirical persistence of the aggregate data and generate realistic dynamics, we include adjustment costs on real and nominal variables, ensuring that, in response to a shock,

[23] The Appendix is inspired by Pesenti (2008) and Coenen et al. (2008)

consumption and production do not immediately jump but have a smooth and hump-shaped response. On the real side, quadratic costs prolong the adjustment of the capital stock, esternal habit formation the adjustment of consumption. On the nominal side, quadratic cost make wage and prices sticky. Moreover, we assume that prices and wages are indexed to a weighted average of previous period sector-specific inflation and current CPI inflation.

B The model

In what follows we illustrate the Home economy. The structure of the Foreign economy is similar and to save on space we do not report it.

B.1 Final consumption and investment goods

There is continuum of symmetric Home firms producing Home final nontradable consumption under perfect competition. Each firm producing the consumption good is indexed by $x \in (0, s]$, where the parameter $0 < s < 1$ is a measure of country size. Foreign firms producing the Foreign final consumption goods are indexed by by $x^* \in (s, 1]$ (the size of the monetary union is normalized to 1). The CES production technology used by firm x is:

$$A_t(x) \equiv \left(\begin{array}{c} a_T^{\frac{1}{\phi_A}} \left(a_H^{\frac{1}{\rho_A}} Q_{HA,t}(x)^{\frac{\rho_A - 1}{\rho_A}} + (1 - a_H)^{\frac{1}{\rho_A}} Q_{FA,t}(x)^{\frac{\rho_A - 1}{\rho_A}} \right)^{\frac{\rho_A}{\rho_A - 1} \frac{\phi_A - 1}{\phi_A}} \\ + (1 - a_T)^{\frac{1}{\phi_A}} Q_{NA,t}(x)^{\frac{\phi_A - 1}{\phi_A}} \end{array} \right)^{\frac{\phi_A}{\phi_A - 1}} \tag{15}$$

where Q_{HA}, Q_{FA} and Q_{NA} are bundles of respectively Home tradable, Foreign tradable and Home nontradable intermediate goods, $\rho_A > 0$ is the elasticity of substitution between tradables and $\phi_A > 0$ is the elasticity of substitution between tradable and nontradable goods. The parameter a_H $(0 < a_H < 1)$ is the weight of domestic tradable, a_T $(0 < a_T < 1)$ the weight of tradable goods.

The production of investment good is similar. There are symmetric Home firms under perfect competition indexed by $y \in (0, s]$, and symmetric Foreign firms by $y^* \in (s, 1]$. Output of Home

firm y is:

$$E_t(y) \equiv \left(\begin{array}{c} v_T^{\frac{1}{\phi_E}} \left(v_H^{\frac{1}{\rho_E}} Q_{HE,t}(y)^{\frac{\rho_E-1}{\rho_E}} + (1-v_H)^{\frac{1}{\rho_E}} Q_{FE,t}(y)^{\frac{\rho_E-1}{\rho_E}} \right)^{\frac{\rho_E}{\rho_E-1}\frac{\phi_E-1}{\phi_E}} \\ + (1-v_T)^{\frac{1}{\phi_E}} Q_{NE,t}(y)^{\frac{\phi_E-1}{\phi_E}} \end{array} \right)^{\frac{\phi_E}{\phi_E-1}} \tag{16}$$

Finally, we assume that public expenditure C^g has the same composition as that of private consumption.

B.2 Intermediate goods

Demand Bundles used to produce the final consumption goods are CES indexes of differentiated intermediate goods, each produced by a single firm under conditions of monopolistic competition:

$$Q_{HA}(x) \equiv \left[\left(\frac{1}{s} \right)^{\theta_T} \int_0^s Q_A(h,x)^{\frac{\theta_T-1}{\theta_T}} dh \right]^{\frac{\theta_T}{\theta_T-1}} \tag{17}$$

$$Q_{FA}(x^*) \equiv \left[\left(\frac{1}{1-s} \right)^{\theta_T} \int_s^1 Q_A(f,x)^{\frac{\theta_T-1}{\theta_T}} df \right]^{\frac{\theta_T}{\theta_T-1}} \tag{18}$$

$$Q_{NA}(x) \equiv \left[\left(\frac{1}{s} \right)^{\theta_N} \int_0^s Q_A(n,x)^{\frac{\theta_N-1}{\theta_N}} dn \right]^{\frac{\theta_N}{\theta_T-1}} \tag{19}$$

where firms in the Home tradable and nontradable intermediate sectors and in the Foreign intermediate tradable sector are respectively indexed by $h \in (0,s)$, $n \in (0,s)$, $f \in (s,1]$. Parameters θ_T, $\theta_N > 1$ are respectively the elasticity of substitution between brands in the tradable and nontradable sector. The prices of the nontradable intermediate goods are denoted $p(n)$. Each firm x takes these prices as given when minimizing production costs of the final good. The resulting demand for nontradable intermediate input n is:

$$Q_{A,t}(n,x) = \left(\frac{1}{s} \right) \left(\frac{P_t(n)}{P_{N,t}} \right)^{-\theta_N} Q_{NA,t}(x) \tag{20}$$

where $P_{N,t}$ is the cost-minimizing price of one basket of local intermediates:

$$P_{N,t} = \left[\int_0^s P_t(n)^{1-\theta_N} dn\right]^{\frac{1}{1-\theta_N}} \tag{21}$$

We can derive $Q_A(h,x)$, $Q_A(f,x)$, $C_A^g(h,x)$, $C_A^g(f,x)$, P_H and P_F in a similar way. Firms y producing the final investment goods have similar demand curves. Aggregating over x and y, it can be shown that total demand for intermediate nontradable good n is:

$$\begin{aligned} & \int_0^s Q_{A,t}(n,x)\,dx + \int_0^s Q_{E,t}(n,y)\,dy + \int_0^s C_t^g(n,x)\,dx \\ = \quad & \left(\frac{P_t(n)}{P_{N,t}}\right)^{-\theta_N}\left(Q_{NA,t} + Q_{NE,t} + C_{N,t}^g\right) \end{aligned} \tag{22}$$

where C_N^g is nontradable component of the public sector consumption. Home demands for Home and Foreign tradable intermediate goods can be derived in a similar way.

Supply The supply of each Home nontradable intermediate good n is denoted by $N^S(n)$:

$$N_t^S(n) = \left((1-\alpha_{KN})^{\frac{1}{\xi_N}} L_{N,t}(n)^{\frac{\xi_N-1}{\xi_N}} + \alpha_{KN}^{\frac{1}{\xi_N}} K_{N,t}(n)^{\frac{\xi_N-1}{\xi_N}}\right)^{\frac{\xi_N}{\xi_N-1}} \tag{23}$$

Firm n uses labor $L_{N,t}^p(n)$ and households' capital $K_{N,t}(n)$. The production function has a constant elasticity of substitution $\xi_N > 0$ and capital weight equal to $0 < \alpha_{KN} < 1$. Firm takes the prices of labor and capital. Denoting W_t the nominal wage index and R_t^K the nominal rental price of capital, cost minimization implies:

$$L_{N,t}^p(n) = (1-\alpha_{KN})\left(\frac{W_t}{MC_{N,t}(n)}\right)^{-\xi_N} N_t^S(n) \tag{24}$$

$$K_{N,t}(n) = \alpha_{KN}\left(\frac{R_t^K}{MC_{N,t}(n)}\right)^{-\xi_N} N_t^S(n) \tag{25}$$

where $MC_{N,t}(n)$ is the nominal marginal cost. The productions of each Home tradable intermediate good, $T^S(h)$, is similarly characterized.

Price setting in the intermediate sector Consider now profit maximization in the Home country's nontradable intermediate sector. Each firm n sets the price $p_t(n)$ by maximizing the present discounted value of profits subject to demand constraint (22) and the quadratic adjustment costs:

$$AC_{N,t}^{p}(n) \equiv \frac{\kappa_N^p}{2}\left(\frac{P_t(n)/P_{t-1}(n)}{\left(\pi_{t-1}^{N}\right)^{\alpha_N}\left(\pi_t^{C}\right)^{1-\alpha_N}}-1\right)^2 Q_{N,t} \quad \kappa_N^p \geq 0 \tag{26}$$

paid in unit of sector-specific product $Q_{N,t}$ and where κ_N^p measures the degree of price stickiness. The parameter α_N $(0 < \alpha_N < 1)$ measures the degree of indexation to previous sector-specific (gross) inflation and the domestic (region-specific) consumer price inflation. The resulting first-order condition, expressed in terms of domestic consumption, is:

$$p_t(n) = \frac{\theta_N}{\theta_N - 1} mc_t(n) - \frac{A_t(n)}{\theta_N - 1} \tag{27}$$

where $mc_t(n)$ is the real marginal cost and $A(n)$ contains terms related to the presence of price adjustment costs:

$$\begin{aligned} A_t(n) \approx\ & \kappa_N^p \frac{P_t(n)/P_{t-1}(n)}{\left(\pi_{t-1}^{N}\right)^{\alpha_N}\left(\pi_t^{C}\right)^{1-\alpha_N}}\left(\frac{P_t(n)/P_{t-1}(n)}{\left(\pi_{t-1}^{N}\right)^{\alpha_N}\left(\pi_t^{C}\right)^{1-\alpha_N}}-1\right) \\ & -\beta\kappa_N^p \frac{P_{t+1}(n)/P_t(n)}{\left(\pi_t^{N}\right)^{\alpha_N}\left(\pi_{t+1}^{C}\right)^{1-\alpha_N}}\left(\frac{P_{t+1}(n)/P_t(n)}{\left(\pi_t^{N}\right)^{\alpha_N}\left(\pi_{t+1}^{C}\right)^{1-\alpha_N}}-1\right)\frac{Q_{N,t+1}}{Q_{N,t}} \end{aligned} \tag{28}$$

The above equations clarify the link between imperfect competition and nominal rigidities. As emphasized by Pesenti (2008), when the elasticity of substitution θ_N is very large and hence the competition in the sector is high, prices closely follow marginal costs, even though adjustment costs are large. To the contrary, it may be optimal to maintain stable prices and accommodate changes in demand through supply adjustments when the average markup over marginal costs is relatively high. If prices were flexible, optimal pricing would collapse to the standard pricing rule of constant markup over marginal costs (expressed in units of domestic consumption):

$$p_t(n) = \frac{\theta_N}{\theta_N - 1} mc_{N,t}(n) \tag{29}$$

Firms operating in the intermediate tradable sector solve a similar problem. We assume that there is market segmentation. Hence the firm producing the brand h chooses $p_t(h)$ in the Home market and $p_t^*(h)$ in the Foreign market as to maximize the expected flow of profits (in terms of domestic consumption units):

$$E_t \sum_{\tau=t}^{\infty} \Lambda_{t,\tau} \left[p_\tau(h) y_\tau(h) + p_\tau^*(h) y_\tau^*(h) - mc_{H,\tau}(h) \left(y_\tau(h) + y_\tau^*(h) \right) \right] \tag{30}$$

subject to quadratic price adjustment costs similar to those considered for nontradables and standard demand constraints. The term E_t denotes the expectation operator conditional on the information set at time t, $\Lambda_{t,\tau}$ is the appropriate discount rate (in equilibrium it is equal to the Ricardian households' stochastic discount rate) and $mc_{H,t}(h)$ is the real marginal cost. The first order conditions with respect to $p_t(h)$ and $p_t^*(h)$ are:

$$p_t(h) = \frac{\theta_T}{\theta_T - 1} mc_t(h) - \frac{A_t(h)}{\theta_T - 1} \tag{31}$$

$$p_t^*(h) = \frac{\theta_T^*}{\theta_T - 1} mc_t(h) - \frac{A_t^*(h)}{\theta_T - 1} \tag{32}$$

where θ_T^* is the elasticity of substitution of tradable intermediate goods in the Foreign country, while $A(h)$ and $A^*(h)$ involve terms related to the presence of price adjustment costs:

$$\begin{aligned} A_t(h) \approx\ & \kappa_H^p \frac{P_t(h)/P_{t-1}(h)}{\left(\pi_{t-1}^H\right)^{\alpha_H} \left(\pi_t^C\right)^{1-\alpha_H}} \left(\frac{P_t(h)/P_{t-1}(h)}{\left(\pi_{t-1}^H\right)^{\alpha_H} \left(\pi_t^C\right)^{1-\alpha_H}} - 1 \right) \\ & - \beta \kappa_H^p \frac{P_{t+1}(h)/P_t(h)}{\left(\pi_t^H\right)^{\alpha_H} \left(\pi_{t+1}^C\right)^{1-\alpha_H}} \left(\frac{P_{t+1}(h)/P_t(h)}{\left(\pi_t^H\right)^{\alpha_H} \left(\pi_{t+1}^C\right)^{1-\alpha_H}} - 1 \right) \frac{Q_{H,t+1}}{Q_{H,t}} \end{aligned} \tag{33}$$

$$\begin{aligned} A_t^*(h) \approx\ & {\theta_T}^* - 1 + {\kappa_H^p}^* \frac{P_t^*(h)/P_{t-1}^*(h)}{\left(\pi_{t-1}^{H*}\right)^{\alpha_H^*} \left(\pi_t^{C*}\right)^{1-\alpha_H^*}} \left(\frac{P_t^*(h)/P_{t-1}^*(h)}{\left(\pi_{t-1}^{H*}\right)^{\alpha_H^*} \left(\pi_t^{C*}\right)^{1-\alpha_H^*}} - 1 \right) \\ & - \beta {\kappa_H^p}^* \frac{P_{t+1}^*(h)/P_t^*(h)}{\left(\pi_t^{H*}\right)^{\alpha_H^*} \left(\pi_{t+1}^{C*}\right)^{1-\alpha_H^*}} \left(\frac{P_{t+1}^*(h)/P_t^*(h)}{\left(\pi_t^{H*}\right)^{\alpha_H^*} \left(\pi_{t+1}^{C*}\right)^{1-\alpha_H^*}} - 1 \right) \frac{Q_{H,t+1}^*}{Q_{H,t}^*} \end{aligned} \tag{34}$$

where $\kappa_H^p > 0$ ($\kappa_H^{p\,*} > 0$) measure the degree of nominal rigidity in the Home (Foreign) country. If nominal rigidities in the (domestic) export market are relatively large, the degree of inertia of Home goods prices in the (Home) Foreign market will be high. If prices were flexible ($\kappa_H^p = \kappa_H^{p\,*}$) and $\theta_T = \theta_T^*$, then optimal price setting would be consistent with the cross-border law of one price:

$$p_t(h) = \frac{\theta_T}{\theta_T - 1} mc_t(h) = p_t^*(h) \tag{35}$$

Labor Market In the case of firms in the nontradable intermediate sector, the labor input $L_N(n)$ is a CES combination of differentiated labor inputs supplied by domestic agents and defined over a continuum of mass equal to the country size ($j \in [0, s]$):[24]

$$L_{N,t}(n) = \left(\frac{1}{s}\right)^{\frac{1}{\psi}} \left[\int_0^s L_t(n,j)^{\frac{\psi-1}{\psi}} dj\right]^{\frac{\psi}{\psi-1}} \tag{36}$$

where $L(n,j)$ is the demand of the labor input of type j by the producer of good n and $\psi > 1$ is the elasticity of substitution among labor inputs. Cost minimization implies:

$$L_t^p(n,j) = \left(\frac{1}{s}\right)\left(\frac{W_t(j)}{W_t}\right)^{-\psi} L_{N,t}^p(j), \tag{37}$$

where $W(j)$ is the nominal wage of labor input j and the wage index W is:

$$W_t = \left[\left(\frac{1}{s}\right)\int_0^s W_t(h)^{1-\psi} dj\right]^{\frac{1}{1-\psi}}. \tag{38}$$

Similar equations hold for firms producing intermediate tradable goods. Each household is the monopolistic supplier of a labor input j and sets the nominal wage facing a downward-sloping demand, obtained by aggregating demand across Home firms. The wage adjustment is sluggish because of quadratic costs paid in terms of the total wage bill:

$$AC_t^W(j) = \frac{\kappa_W}{2}\left(\frac{W_t(j)/W_{t-1}(j)}{\left(\pi_t^W\right)^{\alpha_W}\left(\pi_t^C\right)^{1-\alpha_W}} - 1\right)^2 W_t L_t,\ \kappa_W > 0, (0 < \alpha_W < 1) \tag{39}$$

[24] In per capita terms non-Ricardian households supply the same amount of labor as Ricardian households. As such, to make notation simple, we do not distinguish between Ricardian and non-Ricardian in the labor market.

where the parameter $\kappa_W > 0$ measures the degree of nominal wage rigidity and L is the total amount of labor in the Home economy.

C Market Clearing

The model is closed by imposing the following resource constraints and market clearing conditions. The resource constraint for Home nontradable final consumption good is:

$$\int_0^s A_t(x)\,dx \geq \int_0^{s\omega} C_t(i)\,di + \int_{s\omega}^s C_t(i')\,di' + C_t^g \tag{40}$$

The resource constraint for Home nontradable final investment good is:

$$\int_0^s E_t(x)\,dx \geq \int_0^{s\omega} I_t(i)\,di + I_t^g \tag{41}$$

The resource constraint for good n is

$$N_t^S(n) \geq \int_0^s Q_t(n,x)\,dx \tag{42}$$

The Home tradable h can be used by Home firms or imported by Foreign firms:

$$T_t^S(h) \geq \int_0^s Q_t(h,x)\,dx + \int_s^1 Q_t(h,x^*)\,dx^* \tag{43}$$

The market clearing conditions for labor and capital are respectively:

$$\int_0^s L_t(j)\,dj \geq \int_0^s L_t(n)\,dn + \int_0^s L_t(h)\,dh + L_t^g \tag{44}$$

$$\int_0^{s\omega} K_{t-1}(i)\,di \geq \int_0^s K_t(n)\,dn + \int_0^s K_t(h)\,dh \tag{45}$$

The bond market clearing condition is:

$$\int_0^{s\omega} B_t(i)\,di + \int_s^{s+(1-s)\omega^*} B_t(i^*)\,di^* + B_t^g + B_t^{g,*} = 0 \tag{46}$$

Table 1. Parametrization of Home and Rest of the Euro Area

Parameter	Home	Rest of the euro area
Rate of time preference $\left(1/\beta^4-1\right)*100, \left(1/(\beta^*)^4-1\right)*100$	3.00	3.00
Intertemporal elasticity of substitution $1/\sigma, 1/\sigma^*$	1.00	1.00
Habit persistence in consumption κ, κ^*	0.80	0.80
Frisch elasticity of labor $1/\left(\tau-1\right), 1/\left(\tau^*-1\right)$	0.50	0.50
Depreciation rate of (private and public) capital δ, δ^*	0.025	0.025
Tradable Intermediate Goods		
El. of substitution btw factors of production ξ_T, ξ_T^*	0.90	0.90
Bias towards capital $\alpha_{KT}, \alpha_{KT}^*$	0.70	0.70
Nontradable Intermediate Goods		
El. of substitution btw factors of production ξ_N, ξ_N^*	0.90	0.90
Bias towards private capital $\alpha_{KN}, \alpha_{KN}^*$	0.68	0.68
Final consumption goods		
Substitution btw domestic and imported tradables ϕ_A, ϕ_A^*	1.50	1.50
Bias towards domestic tradables a_H, a_F^*	0.77	0.10
Substitution between tradables and nontradables ρ_A	0.50	0.50
Bias towards tradable goods a_T, a_T^*	0.55	0.55
Final investment goods		
Substitution btw domestic and imported tradables ϕ_E	1.50	1.50
Bias towards domestic tradables υ_H, υ_F^*	0.62	0.10
Substitution btw tradables and nontradables ρ	0.50	0.50
Bias towards tradable goods υ_T, υ_T^*	0.55	0.55
Size n and $(1-n)$	0.25	0.75

Table 2. Gross Markups

	Markups (Implied elasticities of substitution)		
	Tradables	Nontradables	Labor
Home	1.2 (θ_T=6.0)	1.3 (θ_N=4.3)	1.3 (ψ=4.3)
Rest of the euro area	1.2 (θ_T^*=6.0)	1.3 (θ_N^*=4.3)	1.3 (ψ^*=4.3)

Note: between brackets, the elasticity of substitution btw brands/labor varieties consistent with markup

Table 3. Real and Nominal Adjustment Costs

Parameter ("*" refers to rest of the euro area)	Home	Rest of the euro area
Real Adjustment Costs		
Investment ϕ_I, ϕ_I^*	4.50	4.50
Households' financial net position parameter ϕ_{b1}	0.00055	-
Households' financial net position parameter ϕ_{b2}	0.00055	-
Nominal Adjustment Costs		
Wages κ_W, κ_W^*	700	700
Price of nontradables κ_N, κ_N^*	900	900
Domestic price of tradables κ_H, k_F^*	900	900
Price of imported tradables κ_F, κ_H^*	900	900
Price Indexation α_T,α_T^*,α_N,α_N^*	0.75	0.75
Wage Indexation α_W,α_W^*	0.50	0.50

Table 4. Fiscal and Monetary Policy Rules

Parameter	Home	Rest of the euro area	euro area
Regional fiscal policy rule			
Deviation of public debt from target ϕ_1, ϕ_1^*	0.1	0.1	-
Common monetary policy rule			
Lagged interest rate at $t-1$ ρ_i	-	-	0.86
Inflation ρ_Π	-	-	2.00
GDP growth ρ_{GDP}	-	-	0.10

Table 5. Great Ratios and Tax Rates (Base-Case Parameters)

	Home	Rest of the euro area
Macro variables		
Private consumption C	61	60
Private Investment I	20	22
Imports	22	5
Net Foreign Asset Position	0	0
Fiscal variables		
Public expenditure		
Public consumption C^g	10	10
Wage bill WL^g	5.8	5.6
Public investment I^g	2	2
Interest payment	2.2	2.2
Tax rates		
Labor income	46	46
Capital income	33	33
consumption	18	18
Debt (ratio to annual GDP)	60	60

Note: For macroeconomic variables: national account data (2008 values). For fiscal variables: AMECO database for expenditure data (2008 values); Eurostat (2008) for tax rates. Macro and fiscal variables are expressed as a ratio to GDP, tax rates in percent.

Table 6. Alternative public spending-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.96	0.63	1.09	0.77	1.02	0.59	1.64	1.26
Consumption	0.10	-0.09	0.20	0.03	0.01	-0.25	0.47	0.31
Investment	-0.33	-1.20	-0.05	-0.94	-0.76	-1.82	0.55	-0.62
Export(volumes)	-0.17	-0.40	-0.03	-0.25	1.02	0.55	1.69	1.25
Import(volumes)	1.12	0.86	1.28	1.02	0.84	0.32	1.58	1.07
Labor	1.83	1.25	2.08	1.50	1.97	1.27	3.14	2.39
Terms of Tr.(+=deterior.)	-0.08	-0.16	-0.09	-0.16	-0.01	-0.02	-0.01	-0.02
Real.Exc.Rate(+=depr.)	-0.08	-0.25	-0.08	-0.25	-0.01	-0.02	0.00	-0.02
Inflation(annualized)	0.16	0.16	0.21	0.24	0.20	0.21	0.43	0.55
Real.Int.Rate(annualized)	-0.17	-0.08	-0.26	-0.20	-0.12	0.07	-0.54	-0.50
Pub.Def.(%gdp)	1.00	1.06	0.98	1.02	1.05	1.17	0.94	0.98
Prim.Pub.Def.(%gdp)	1.00	1.01	0.99	1.00	1.00	1.03	0.96	0.98
REA								
GDP	0.02	-0.01	0.16	0.14	0.97	0.55	1.61	1.22
Consumption	-0.02	-0.05	0.08	0.07	0.00	-0.25	0.46	0.30
Investment	-0.13	-0.19	0.16	0.08	-0.77	-1.78	0.53	-0.60
Labor	0.05	0.01	0.31	0.25	1.88	1.18	3.08	2.31
Inflation(annualized)	0.02	0.02	0.06	0.09	0.19	0.19	0.42	0.54
Real.Int.Rate(annualized)	0.01	0.04	-0.08	-0.08	-0.10	0.08	-0.53	-0.48
Pub.Def.(%gdp)	0.02	0.02	0.03	0.03	1.05	1.17	0.94	0.98
Prim.Pub.Def.(%gdp)	0.00	-0.01	0.03	0.03	1.00	1.03	0.96	0.98
EA								
GDP	0.27	0.16	0.41	0.31	0.98	0.56	1.62	1.23
Nom.Int.Rate(annualized)	0.03	0.05	0.00	0.00	0.13	0.23	0.00	0.00
Inflation(annualized)	0.05	0.05	0.10	0.13	0.19	0.20	0.42	0.54

Note: Home=Germany; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 7. Alternative labor tax-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.27	0.27	0.30	0.30	0.34	0.33	0.47	0.47
Consumption	0.45	0.43	0.47	0.46	0.46	0.45	0.56	0.57
Investment	0.02	0.03	0.08	0.10	0.04	0.06	0.32	0.31
Export(volumes)	0.00	0.02	0.04	0.06	0.35	0.34	0.49	0.49
Import(volumes)	0.29	0.27	0.33	0.31	0.32	0.31	0.47	0.47
Labor	0.52	0.51	0.58	0.57	0.65	0.62	0.89	0.86
Terms of Tr.(+=deterior.)	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00
Real.Exc.Rate(+=depr.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inflation(annualized)	0.01	-0.01	0.02	0.01	0.04	0.03	0.08	0.10
Real.Int.Rate(annualized)	0.00	0.03	-0.02	0.00	0.00	0.04	-0.10	-0.08
Pub.Def.(%gdp)	0.96	0.99	0.95	0.98	0.97	1.01	0.94	0.97
Prim.Pub.Def.(%gdp)	0.95	0.95	0.95	0.95	0.95	0.95	0.94	0.94
REA								
GDP	0.02	0.02	0.05	0.05	0.33	0.32	0.46	0.46
Consumption	0.00	0.00	0.03	0.03	0.46	0.45	0.56	0.56
Investment	0.00	0.00	0.07	0.06	0.04	0.06	0.32	0.31
Labor	0.04	0.03	0.10	0.09	0.63	0.61	0.88	0.85
Inflation(annualized)	0.01	0.01	0.02	0.03	0.03	0.02	0.08	0.10
Real.Int.Rate(annualized)	0.00	0.00	-0.02	-0.02	0.00	0.04	-0.10	-0.08
Pub.Def.(%gdp)	0.01	0.01	0.01	0.01	0.97	1.01	0.94	0.97
Prim.Pub.Def.(%gdp)	0.00	0.00	0.01	0.01	0.95	0.95	0.94	0.94
EA								
GDP	0.09	0.08	0.12	0.12	0.33	0.32	0.47	0.47
Nom.Int.Rate(annualized)	0.01	0.01	0.00	0.00	0.04	0.05	0.00	0.00
Inflation(annualized)	0.01	0.00	0.02	0.02	0.03	0.02	0.08	0.10

Note: Home=Germany; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 8. Alternative capital tax-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.12	0.11	0.14	0.14	0.15	0.13	0.26	0.25
Consumption	0.02	0.01	0.04	0.03	0.02	0.01	0.10	0.11
Investment	0.61	0.60	0.66	0.65	0.59	0.57	0.83	0.80
Export(volumes)	-0.01	-0.01	0.02	0.02	0.16	0.14	0.28	0.27
Import(volumes)	0.22	0.20	0.24	0.23	0.21	0.19	0.34	0.33
Labor	0.21	0.13	0.25	0.18	0.26	0.17	0.47	0.38
Terms of Tr.(+=deterior.)	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Real.Exc.Rate(+=depr.)	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00
Inflation(annualized)	0.02	0.01	0.02	0.02	0.03	0.04	0.07	0.10
Real.Int.Rate(annualized)	-0.01	0.01	-0.03	-0.02	-0.02	0.01	-0.09	-0.09
Pub.Def.(%gdp)	1.01	1.05	1.01	1.04	1.01	1.07	1.00	1.03
Prim.Pub.Def.(%gdp)	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
REA								
GDP	0.01	0.01	0.04	0.03	0.16	0.14	0.27	0.26
Consumption	0.00	0.00	0.02	0.02	0.02	0.01	0.11	0.11
Investment	-0.01	-0.02	0.04	0.03	0.59	0.55	0.83	0.77
Labor	0.02	0.01	0.07	0.06	0.28	0.19	0.49	0.39
Inflation(annualized)	0.01	0.01	0.01	0.02	0.03	0.04	0.07	0.10
Real.Int.Rate(annualized)	0.00	0.00	-0.02	-0.02	-0.02	0.01	-0.09	-0.09
Pub.Def.(%gdp)	0.00	0.01	0.01	0.01	1.01	1.07	0.99	1.03
Prim.Pub.Def.(%gdp)	0.00	0.00	0.01	0.01	1.00	1.00	0.99	0.99
EA								
GDP	0.04	0.03	0.06	0.06	0.15	0.13	0.27	0.26
Nom.Int.Rate(annualized)	0.01	0.01	0.00	0.00	0.02	0.04	0.00	0.00
Inflation(annualized)	0.01	0.01	0.02	0.02	0.03	0.04	0.07	0.10

Note: Home=Germany; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 9. Alternative consumption tax-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.30	0.36	0.37	0.43	0.25	0.29	0.55	0.62
Consumption	0.56	0.86	0.61	0.92	0.47	0.72	0.69	1.00
Investment	-0.07	-0.55	0.07	-0.42	-0.39	-1.04	0.26	-0.42
Export(volumes)	-0.11	-0.28	-0.04	-0.20	0.24	0.26	0.56	0.61
Import(volumes)	0.39	0.54	0.47	0.62	0.18	0.14	0.54	0.52
Labor	0.57	0.70	0.69	0.82	0.49	0.62	1.05	1.17
Terms of Tr.(+=deterior.)	-0.05	-0.12	-0.05	-0.12	0.00	-0.01	0.00	-0.01
Real.Exc.Rate(+=depr.)	-0.04	-0.15	-0.04	-0.15	0.00	-0.01	0.00	-0.01
Inflation(annualized)	0.08	0.12	0.10	0.15	0.08	0.12	0.19	0.30
Real.Int.Rate(annualized)	-0.09	-0.08	-0.13	-0.14	-0.07	-0.01	-0.25	-0.28
Pub.Def.(%gdp)	0.80	0.80	0.80	0.78	0.82	0.86	0.78	0.77
Prim.Pub.Def.(%gdp)	0.80	0.77	0.79	0.76	0.81	0.78	0.78	0.75
REA								
GDP	-0.01	-0.02	0.05	0.05	0.23	0.26	0.54	0.60
Consumption	-0.02	-0.04	0.02	0.02	0.47	0.72	0.69	1.00
Investment	-0.09	-0.15	0.05	-0.02	-0.41	-1.03	0.24	-0.43
Labor	-0.02	-0.02	0.11	0.10	0.45	0.57	1.03	1.13
Inflation(annualized)	0.00	0.01	0.03	0.04	0.08	0.11	0.19	0.29
Real.Int.Rate(annualized)	0.00	0.02	-0.04	-0.04	-0.06	0.00	-0.25	-0.28
Pub.Def.(%gdp)	0.00	0.01	0.01	0.01	0.83	0.86	0.78	0.77
Prim.Pub.Def.(%gdp)	0.00	0.00	0.01	0.01	0.81	0.78	0.78	0.75
EA								
GDP	0.07	0.08	0.14	0.15	0.24	0.27	0.54	0.60
Nom.Int.Rate(annualized)	0.01	0.02	0.00	0.00	0.04	0.11	0.00	0.00
Inflation(annualized)	0.02	0.03	0.05	0.07	0.08	0.12	0.19	0.29

Note: Home=Germany; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 10. Alternative public spending-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.46	0.34	0.47	0.35	1.01	0.57	1.62	1.20
Consumption	0.04	-0.03	0.05	-0.02	0.02	-0.26	0.47	0.27
Investment	-0.03	-0.30	-0.01	-0.29	-0.82	-1.92	0.40	-0.92
Export(volumes)	-0.07	-0.17	-0.06	-0.16	1.02	0.54	1.68	1.22
Import(volumes)	1.11	1.01	1.12	1.02	0.95	0.43	1.63	1.10
Labor	0.87	0.65	0.89	0.67	2.03	1.27	3.21	2.36
Terms of Tr.(+=deterior.)	-0.04	-0.09	-0.04	-0.09	-0.01	-0.01	-0.01	-0.01
Real.Exc.Rate(+=depr.)	-0.02	-0.06	-0.02	-0.06	-0.01	-0.04	-0.02	-0.07
Inflation(annualized)	0.04	0.04	0.05	0.05	0.22	0.21	0.46	0.58
Real.Int.Rate(annualized)	-0.05	-0.03	-0.06	-0.04	-0.14	0.07	-0.58	-0.51
Pub.Def.(%gdp)	1.00	1.04	1.00	1.04	1.04	1.17	0.93	0.98
Prim.Pub.Def.(%gdp)	1.00	1.01	1.00	1.01	1.00	1.02	0.95	0.97
REA								
GDP	0.02	0.01	0.03	0.02	0.98	0.56	1.61	1.22
Consumption	0.00	0.00	0.01	0.00	0.00	-0.25	0.46	0.30
Investment	-0.02	-0.04	0.00	-0.02	-0.77	-1.79	0.52	-0.62
Labor	0.03	0.02	0.05	0.03	1.90	1.20	3.08	2.32
Inflation(annualized)	0.00	0.00	0.01	0.01	0.19	0.20	0.42	0.54
Real.Int.Rate(annualized)	0.00	0.00	-0.01	-0.01	-0.11	0.08	-0.53	-0.48
Pub.Def.(%gdp)	0.00	0.00	0.00	0.00	1.05	1.17	0.94	0.98
Prim.Pub.Def.(%gdp)	0.00	0.00	0.01	0.00	1.00	1.02	0.96	0.98
EA								
GDP	0.03	0.02	0.04	0.03	0.98	0.56	1.61	1.22
Nom.Int.Rate(annualized)	0.00	0.00	0.00	0.00	0.13	0.23	0.00	0.00
Inflation(annualized)	0.01	0.01	0.01	0.01	0.20	0.20	0.42	0.54

Note: Home=Belgium; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 11. Alternative labor tax-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.14	0.18	0.14	0.18	0.34	0.32	0.47	0.45
Consumption	0.43	0.42	0.43	0.42	0.47	0.45	0.57	0.57
Investment	0.02	0.09	0.03	0.09	0.03	0.02	0.29	0.24
Export(volumes)	0.02	0.06	0.02	0.07	0.35	0.33	0.49	0.47
Import(volumes)	0.28	0.27	0.28	0.28	0.34	0.32	0.48	0.46
Labor	0.27	0.34	0.28	0.34	0.67	0.63	0.91	0.86
Terms of Tr.(+=deterior.)	0.01	0.04	0.01	0.04	0.00	0.00	0.00	0.00
Real.Exc.Rate(+=depr.)	0.00	0.02	0.00	0.02	0.00	-0.01	-0.01	-0.02
Inflation(annualized)	-0.01	-0.02	-0.01	-0.02	0.04	0.03	0.09	0.10
Real.Int.Rate(annualized)	0.01	0.02	0.01	0.02	-0.01	0.03	-0.11	-0.09
Pub.Def.(%gdp)	0.96	0.99	0.96	0.98	0.97	1.01	0.94	0.97
Prim.Pub.Def.(%gdp)	0.95	0.95	0.95	0.95	0.95	0.95	0.94	0.94
REA								
GDP	0.00	0.00	0.01	0.01	0.33	0.32	0.46	0.46
Consumption	0.00	0.00	0.00	0.00	0.46	0.45	0.56	0.56
Investment	0.00	-0.01	0.01	0.00	0.04	0.06	0.31	0.31
Labor	0.01	0.00	0.02	0.01	0.64	0.61	0.88	0.85
Inflation(annualized)	0.00	0.00	0.00	0.00	0.03	0.02	0.08	0.09
Real.Int.Rate(annualized)	0.00	0.00	0.00	0.00	0.00	0.04	-0.10	-0.08
Pub.Def.(%gdp)	0.00	0.00	0.00	0.00	0.97	1.01	0.94	0.97
Prim.Pub.Def.(%gdp)	0.00	0.00	0.00	0.00	0.95	0.95	0.94	0.94
EA								
GDP	0.01	0.01	0.01	0.01	0.33	0.32	0.46	0.46
Nom.Int.Rate(annualized)	0.00	0.00	0.00	0.00	0.04	0.05	0.00	0.00
Inflation(annualized)	0.00	0.00	0.00	0.00	0.03	0.02	0.08	0.09

Note: Home=Belgium; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 12. Alternative capital tax-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.05	0.07	0.06	0.07	0.14	0.12	0.25	0.24
Consumption	0.01	0.00	0.01	0.01	0.02	0.00	0.10	0.10
Investment	0.65	0.72	0.65	0.72	0.58	0.54	0.80	0.72
Export(volumes)	0.00	0.02	0.00	0.02	0.16	0.14	0.28	0.26
Import(volumes)	0.18	0.19	0.18	0.19	0.18	0.16	0.30	0.28
Labor	0.09	0.05	0.09	0.05	0.27	0.17	0.47	0.37
Terms of Tr.(+=deterior.)	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00
Real.Exc.Rate(+=depr.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
Inflation(annualized)	0.00	-0.01	0.00	0.00	0.04	0.04	0.08	0.10
Real.Int.Rate(annualized)	0.00	0.01	0.00	0.01	-0.02	0.01	-0.10	-0.09
Pub.Def.(%gdp)	1.02	1.05	1.02	1.05	1.01	1.07	0.99	1.03
Prim.Pub.Def.(%gdp)	1.01	1.01	1.01	1.01	1.00	1.00	0.99	0.99
REA								
GDP	0.00	0.00	0.00	0.00	0.15	0.13	0.26	0.25
Consumption	0.00	0.00	0.00	0.00	0.02	0.01	0.10	0.11
Investment	0.00	-0.01	0.00	0.00	0.59	0.56	0.82	0.78
Labor	0.00	0.00	0.01	0.01	0.28	0.18	0.48	0.38
Inflation(annualized)	0.00	0.00	0.00	0.00	0.03	0.04	0.07	0.10
Real.Int.Rate(annualized)	0.00	0.00	0.00	0.00	-0.02	0.01	-0.09	-0.09
Pub.Def.(%gdp)	0.00	0.00	0.00	0.00	1.01	1.07	1.00	1.03
Prim.Pub.Def.(%gdp)	0.00	0.00	0.00	0.00	1.00	1.00	0.99	0.99
EA								
GDP	0.00	0.00	0.01	0.00	0.15	0.13	0.26	0.25
Nom.Int.Rate(annualized)	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.00
Inflation(annualized)	0.00	0.00	0.00	0.00	0.03	0.04	0.07	0.10

Note: Home=Belgium; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 13. Alternative consumption tax-based stimuli

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	0.14	0.19	0.15	0.19	0.25	0.28	0.54	0.59
Consumption	0.56	0.92	0.57	0.92	0.48	0.74	0.70	1.00
Investment	0.05	-0.07	0.06	-0.06	-0.41	-1.09	0.19	-0.57
Export(volumes)	-0.04	-0.11	-0.03	-0.10	0.24	0.26	0.56	0.60
Import(volumes)	0.39	0.60	0.39	0.61	0.22	0.20	0.55	0.54
Labor	0.27	0.35	0.28	0.36	0.50	0.62	1.06	1.16
Terms of Tr.(+=deterior.)	-0.02	-0.06	-0.02	-0.06	0.00	-0.01	0.00	-0.01
Real.Exc.Rate(+=depr.)	-0.01	-0.04	-0.01	-0.04	-0.01	-0.02	-0.01	-0.03
Inflation(annualized)	0.02	0.03	0.02	0.03	0.09	0.13	0.20	0.31
Real.Int.Rate(annualized)	-0.03	-0.03	-0.03	-0.03	-0.07	-0.01	-0.27	-0.29
Pub.Def.(%gdp)	0.80	0.79	0.80	0.79	0.82	0.85	0.78	0.76
Prim.Pub.Def.(%gdp)	0.80	0.76	0.80	0.76	0.80	0.77	0.78	0.75
REA								
GDP	0.00	0.00	0.01	0.01	0.24	0.27	0.54	0.60
Consumption	0.00	0.00	0.00	0.00	0.47	0.72	0.69	1.00
Investment	-0.01	-0.03	0.00	-0.02	-0.40	-1.03	0.23	-0.44
Labor	0.01	0.01	0.02	0.02	0.46	0.58	1.02	1.13
Inflation(annualized)	0.00	0.00	0.00	0.01	0.08	0.12	0.19	0.29
Real.Int.Rate(annualized)	0.00	0.00	0.00	0.00	-0.06	0.00	-0.24	-0.27
Pub.Def.(%gdp)	0.00	0.00	0.00	0.00	0.82	0.86	0.78	0.77
Prim.Pub.Def.(%gdp)	0.00	0.00	0.00	0.00	0.81	0.78	0.78	0.75
EA								
GDP	0.01	0.01	0.01	0.01	0.24	0.27	0.54	0.60
Nom.Int.Rate(annualized)	0.00	0.00	0.00	0.00	0.04	0.11	0.00	0.00
Inflation(annualized)	0.00	0.00	0.00	0.01	0.08	0.12	0.19	0.29

Note: Home=Belgium; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 14. Sensitivity. Fiscal coordination (ω and ω^* set to 0.45)

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	1.01	0.66	1.17	0.82	1.09	0.63	1.80	1.36
Consumption	0.20	-0.02	0.32	0.12	0.13	-0.17	0.67	0.47
Investment	-0.36	-1.27	-0.05	-0.99	-0.80	-1.91	0.59	-0.66
Export(volumes)	-0.18	-0.42	-0.01	-0.25	1.10	0.58	1.86	1.35
Import(volumes)	1.19	0.90	1.37	1.08	0.91	0.35	1.74	1.17
Labor	1.93	1.30	2.21	1.57	2.11	1.33	3.43	2.57
Terms of Tr.(+=deterior.)	-0.09	-0.16	-0.09	-0.16	-0.01	-0.02	-0.01	-0.02
Real.Exc.Rate(+=depr.)	-0.08	-0.26	-0.08	-0.26	-0.01	-0.02	0.00	-0.02
Inflation(annualized)	0.17	0.17	0.22	0.25	0.22	0.22	0.46	0.60
Real.Int.Rate(annualized)	-0.18	-0.08	-0.28	-0.21	-0.12	0.08	-0.59	-0.53
Pub.Def.(%gdp)	0.99	1.05	0.96	1.01	1.03	1.16	0.90	0.95
Prim.Pub.Def.(%gdp)	0.98	1.00	0.97	0.99	0.99	1.01	0.93	0.95
REA								
GDP	0.03	-0.01	0.18	0.16	1.04	0.58	1.76	1.32
Consumption	-0.02	-0.05	0.10	0.09	0.11	-0.19	0.66	0.45
Investment	-0.13	-0.19	0.17	0.08	-0.81	-1.86	0.57	-0.65
Labor	0.07	0.01	0.35	0.28	2.00	1.24	3.35	2.49
Inflation(annualized)	0.02	0.02	0.07	0.10	0.20	0.20	0.45	0.59
Real.Int.Rate(annualized)	0.01	0.04	-0.09	-0.09	-0.11	0.09	-0.58	-0.52
Pub.Def.(%gdp)	0.02	0.02	0.03	0.03	1.04	1.17	0.91	0.95
Prim.Pub.Def.(%gdp)	0.00	-0.01	0.03	0.04	0.99	1.01	0.93	0.95
EA								
GDP	0.29	0.17	0.44	0.33	1.05	0.59	1.77	1.33
Nom.Int.Rate(annualized)	0.03	0.05	0.00	0.00	0.14	0.24	0.00	0.00
Inflation(annualized)	0.06	0.06	0.11	0.14	0.21	0.21	0.46	0.59

Note: Home=Germany; REA=rest of euro area; EA=euro area. Columns (1) Home fiscal stimulus; (2) Home fiscal stimulus and accommodative monetary policy; (3) Coordinated fiscal stimulus; (4) Coordinated fiscal stimulus and accommodative monetary policy. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 15. Home public spending-based stimulus and alternative Foreign measures

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	1.02	0.59	1.02	0.69	0.98	0.65	0.91	0.56
Consumption	0.01	-0.25	0.12	-0.07	0.10	-0.09	0.01	-0.22
Investment	-0.76	-1.82	-0.30	-1.18	-0.34	-1.23	-0.65	-1.69
Export(volumes)	1.02	0.55	0.17	-0.09	0.00	-0.25	0.18	0.13
Import(volumes)	0.84	0.32	1.14	0.90	1.11	0.84	0.91	0.46
Labor	1.97	1.27	1.96	1.37	1.88	1.30	1.74	1.17
Terms of Tr.(+=deterior.)	-0.01	-0.02	-0.09	-0.18	-0.08	-0.16	-0.04	-0.05
Real.Exc.Rate(+=depr.)	-0.01	-0.02	-0.08	-0.26	-0.07	-0.23	-0.04	-0.11
Inflation(annualized)	0.20	0.21	0.19	0.20	0.18	0.19	0.16	0.17
Real.Int.Rate(annualized)	-0.12	0.07	-0.17	-0.07	-0.17	-0.07	-0.14	0.00
Pub.Def.(%gdp)	1.05	1.17	1.01	1.08	1.01	1.08	1.02	1.12
Prim.Pub.Def.(%gdp)	1.00	1.03	0.99	1.01	1.00	1.01	1.00	1.02
REA								
GDP	0.97	0.55	0.34	0.30	0.17	0.12	0.27	0.27
Consumption	0.00	-0.25	0.43	0.39	0.00	-0.04	0.47	0.71
Investment	-0.77	-1.78	-0.08	-0.12	0.47	0.39	-0.44	-1.07
Labor	1.88	1.18	0.65	0.59	0.31	0.18	0.52	0.59
Inflation(annualized)	0.19	0.19	0.04	0.03	0.04	0.04	0.09	0.12
Real.Int.Rate(annualized)	-0.10	0.08	0.01	0.07	-0.01	0.05	-0.05	0.02
Pub.Def.(%gdp)	1.05	1.17	0.98	1.03	1.03	1.09	0.83	0.87
Prim.Pub.Def.(%gdp)	1.00	1.03	0.95	0.95	1.00	1.01	0.81	0.78
EA								
GDP	0.98	0.56	0.52	0.40	0.38	0.26	0.44	0.35
Nom.Int.Rate(annualized)	0.13	0.23	0.06	0.09	0.05	0.08	0.06	0.14
Inflation(annualized)	0.19	0.20	0.08	0.07	0.08	0.08	0.11	0.14

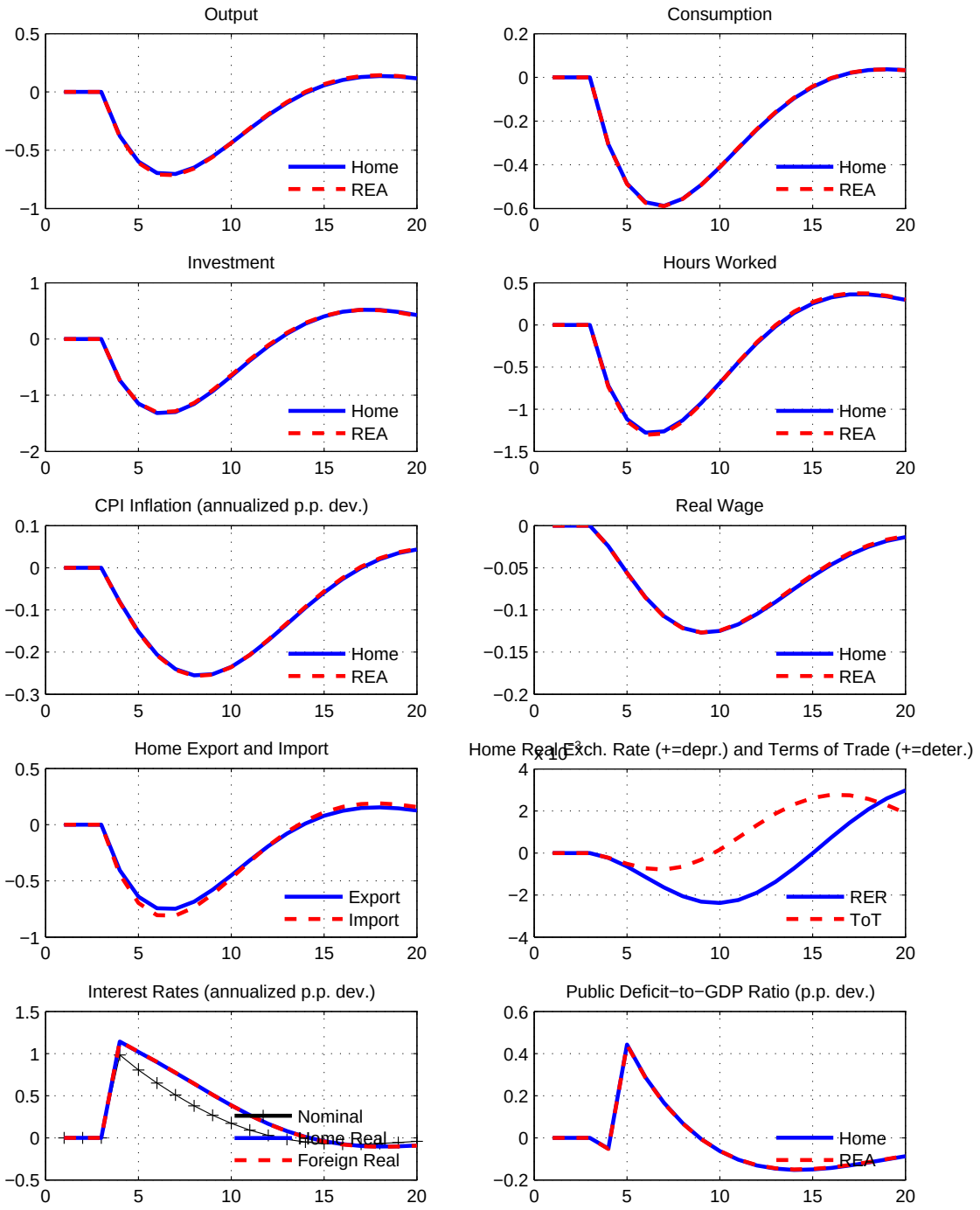
Note: Home=Germany; REA=rest of euro area; EA=euro area. Columns (1) Increase in Foreign public spending; (2) Reduction of Foreign labor income tax; (3) Reduction of Foreign capital income tax; (4) Reduction of Foreign consumption tax. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Table 16. Home alternative measures and Foreign public spending-based stimulus

	1		2		3		4	
	2009	2010	2009	2010	2009	2010	2009	2010
Home								
GDP	1.02	0.59	0.33	0.24	0.18	0.08	0.36	0.33
Consumption	0.01	-0.25	0.36	0.27	-0.07	-0.15	0.47	0.70
Investment	-0.76	-1.82	-0.41	-0.58	0.18	-0.02	-0.49	-1.16
Export(volumes)	1.02	0.55	1.20	0.98	1.19	0.95	1.08	0.68
Import(volumes)	0.84	0.32	0.02	-0.26	-0.06	-0.33	0.12	0.01
Labor	1.97	1.27	0.66	0.53	0.35	0.15	0.72	0.71
Terms of Tr.(+=deterior.)	-0.01	-0.02	0.08	0.17	0.08	0.15	0.03	0.02
Real.Exc.Rate(+=depr.)	-0.01	-0.02	0.07	0.23	0.07	0.22	0.03	0.08
Inflation(annualized)	0.20	0.21	0.05	0.03	0.06	0.05	0.12	0.16
Real.Int.Rate(annualized)	-0.12	0.07	0.05	0.17	0.04	0.15	-0.04	0.06
Pub.Def.(%gdp)	1.05	1.17	1.01	1.10	1.06	1.16	0.85	0.91
Prim.Pub.Def.(%gdp)	1.00	1.03	0.96	0.96	1.01	1.02	0.81	0.78
REA								
GDP	0.97	0.55	0.96	0.57	0.96	0.57	0.93	0.54
Consumption	0.00	-0.25	0.03	-0.20	0.02	-0.21	0.00	-0.25
Investment	-0.77	-1.78	-0.64	-1.59	-0.65	-1.61	-0.74	-1.74
Labor	1.88	1.18	1.86	1.20	1.85	1.19	1.81	1.15
Inflation(annualized)	0.19	0.19	0.18	0.19	0.18	0.19	0.18	0.18
Real.Int.Rate(annualized)	-0.10	0.08	-0.11	0.05	-0.12	0.05	-0.11	0.06
Pub.Def.(%gdp)	1.05	1.17	1.04	1.15	1.04	1.15	1.04	1.16
Prim.Pub.Def.(%gdp)	1.00	1.03	1.00	1.02	1.00	1.02	1.00	1.02
EA								
GDP	0.98	0.56	0.80	0.49	0.75	0.44	0.78	0.48
Nom.Int.Rate(annualized)	0.13	0.23	0.11	0.19	0.11	0.19	0.11	0.20
Inflation(annualized)	0.19	0.20	0.15	0.15	0.15	0.15	0.16	0.18

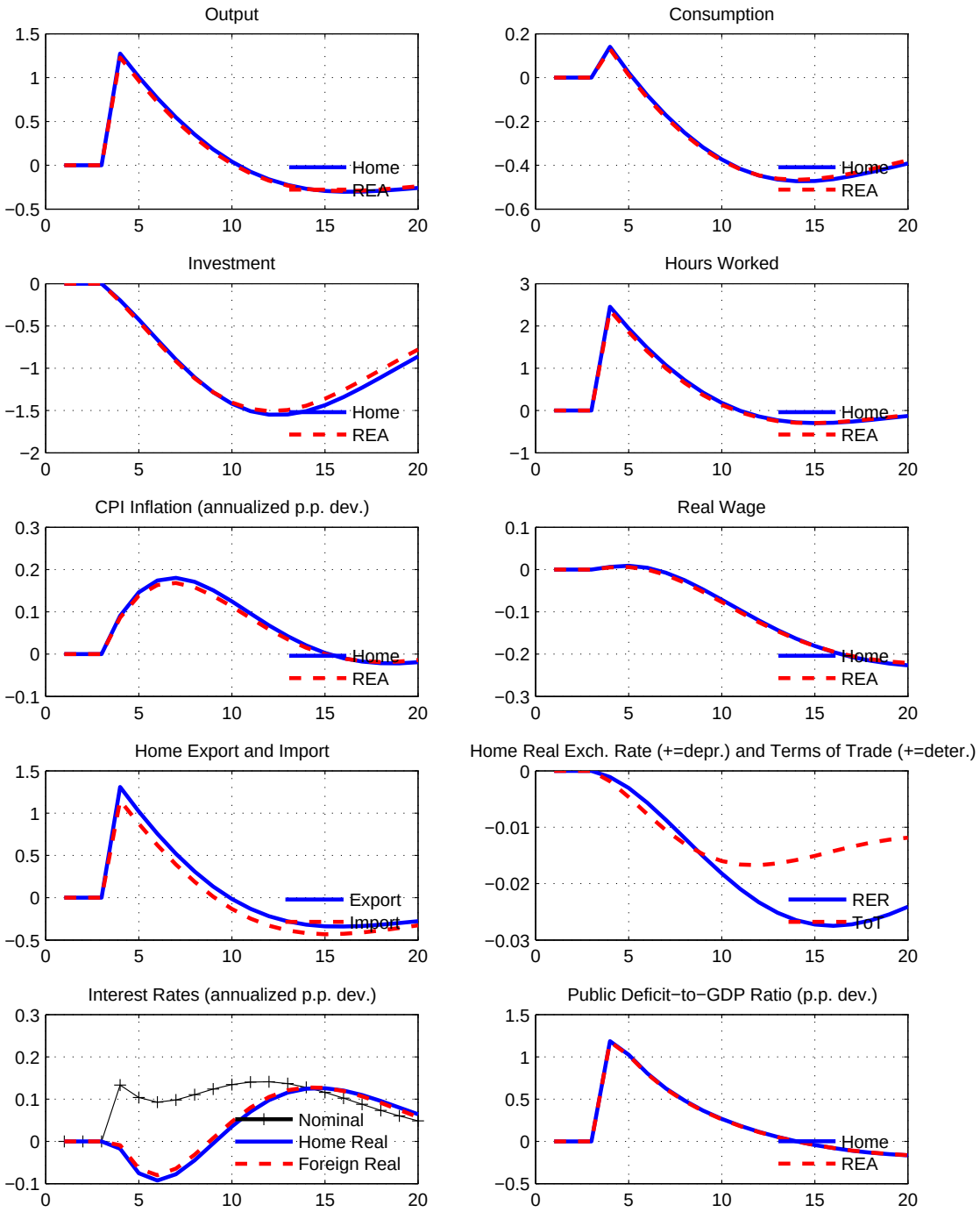
Note: Home=Germany; REA=rest of euro area; EA=euro area. Columns (1) Increase in Home public spending; (2) Reduction of Home labor income tax; (3) Reduction of Home capital income tax; (4) Reduction of Home consumption tax. All variables are reported as percent deviation from the steady state, except for inflation and interest rates which are reported as annualised percentage-point deviations and public deficit-to-GDP ratios which are reported as percentage-point deviations.

Fig. 1 Euro area monetary policy shock



Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline, except for inflation and interest rates (annualized percentage-point deviations), and the trade balance-to-GDP ratio (percentage-point deviations). GDP and its components are reported in real terms.

Fig. 2 Euro area-wide public spending shock



Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline, except for inflation and interest rates (annualized percentage-point deviations), and the trade balance-to-GDP ratio (percentage-point deviations). GDP and its components are reported in real terms.