

# The effectiveness of fiscal policy in the Euro area: the role of coordination

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## Abstract

This paper uses a medium-scale two-region DSGE model of a monetary union calibrated to the Euro area to quantify the change in fiscal multipliers associated with a coordinated fiscal action. It shows that under the presumption that monetary policy reacts to macroeconomic deviations according to historical evidence, fiscal coordination can increase GDP multipliers in the first year by about 20-30% for a wide range of fiscal measures. With accommodative monetary policy (constant nominal interest rate), GDP multipliers can almost double when coordination is assumed. Differences in size, openness and debt levels among the main Euro area economies all impact modestly on the results.

We address also the issue of whether Euro area GDP would benefit more from measures distributed across Euro area countries than from concentrated ones. Our results suggest that - for a given size of the stimulus - Euro area GDP increase is approximately the same for both concentrated and distributed measures.

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# 1 Introduction

The current global crisis has spurred a renewed interest in the use of countercyclical discretionary fiscal policy. However, there is some uncertainty on the size of fiscal multipliers and therefore on the effectiveness of countercyclical discretionary fiscal policy. Academic conferences are still characterized by vivid debates between proponents of new-keynesian models and those more on the neoclassical side. Empirical estimates have not helped to settle the issue. Typically VAR analyses tend to support the new-keynesian view that fiscal multipliers can be significant (Perotti, 2007; Mountford and Uhlig, 2005), while event studies (Ramey, 2008) are more for negligible multipliers and therefore bring support to the neoclassical side. These estimates have been made mainly on US data, as fiscal data for other countries are scarce.

Part of the uncertainty is due to the fact that the effectiveness of fiscal policy depends on a variety of elements: on the type of intervention (i.e. on the expenditure or revenue side), on how it is financed, on how long it is expected to last, on the interaction with the monetary policy, on the degree of openness to trade of the country, and so on. General equilibrium models are well suited to capture all these elements; many international institutions and central banks have recently produced analysis of fiscal stimulus based on such models.

Freedman, Kumhof, Laxton and Lee (2009) of the IMF have simulated the impact of different fiscal stimulus policies using the IMF's Global Integrated Monetary and Fiscal Model. Roeger and in't Veld (2009) of the European Commission have used a version of the DG-ECFIN Quest III model (a two area DSGE that describes the EU and rest of the world) with liquidity constrained agents to simulate the fiscal multipliers of government consumption changes and labor income tax cuts. The OECD (2009) too has presented simulations based on a standard new-keynesian DSGE model. All those works examined the effects of temporary deficit-financed fiscal stimuli (generally over one or two years), assuming a return of the debt level to its long term value after the stimulus. In this way the negative wealth effect on infinite horizon agents is minimized. Also, scenarios where the monetary stance is extremely accommodative (assuming no change in the nominal interest rate following the fiscal stimulus) were usually presented. Overall the results of these exercises tend to suggest a higher impact of stimuli concentrated on public demand components (government consumption and investment) than those focused on tax cuts.

The focus of this paper is on the role of coordination for the effectiveness of fiscal measures. A coordinated package could contribute to increase the fiscal multipliers reducing the leak through the trade channel (increases in import and decreases in export would in fact limit the effect on domestic GDP). Focusing on a panel of European Union countries, Beetsma,

Giuliodori and Klaassen (2008) show that this leak can be relevant. They estimate that an increase in public expenditures of 1% of GDP leads to a deterioration of the trade balance of between 0.5 and 1% of GDP in the first year.

This paper contributes to the ongoing debate by quantitatively assessing the gains (or losses) from a coordinated fiscal action at Euro area level. To that purpose, we use a two-region monetary union DSGE model relatively rich in terms of fiscal features. Although the model is in line with previous papers on similar topic (see for example Coenen, McAdam and Straub, 2008), we introduce some innovations with respect to previous contributions. We consider a more detailed description of the fiscal side and we are the first ones to cast it in an open economy general equilibrium model of a monetary union. This allows us to quantitatively assess the macroeconomic and welfare effects of different fiscal consolidation scenarios for the Euro area countries. We simulate the effects of four different temporary fiscal measures (increases in public consumption, reductions in labor income taxes, reductions in capital income taxes and incentives to private consumption) and compare the results for coordinated vs. uncoordinated actions. Our results would approximately hold (with switched sign) if we consider - instead of a positive stimulus - a withdraw of the fiscal impulse.

Our results show that Euro area countries would benefit from coordinating their fiscal stimulus action (and loose from exiting simultaneously from the fiscal stimulus packages). The reason is that each country would record an increase (decrease) in exported quantities that would compensate the increase (decrease) in import which would follow the stimulus, while movements in relative prices would be limited. Assuming the monetary policy to react to area-wide development, the increase in the GDP fiscal multiplier from coordination is in the order of 20-30% across a wide range of fiscal measures. Under a scenario with coordination and accommodative monetary policy, GDP fiscal multipliers could almost double with respect to the uncoordinated case. Moreover, we address also the issue of whether Euro area GDP would benefit more from fiscal measures distributed across all Euro area countries or from concentrated action in one or few countries. Our results suggest that - for a given size of the stimulus - Euro area GDP increase is approximately the same for both concentrated and distributed measures.

The paper is organized as follows. Section 2 provides a discussion of the setup of the model and of the baseline calibration. Section 3 and 4 present the main results and Section 5 concludes.

## 2 Model and calibration

The basic structure of the model is akin to the Global Economy Model (GEM) developed at the IMF.<sup>1</sup> We split the Euro area in two regions, Home and rest of the Euro area. Each region produces tradable and nontradable intermediate goods as well as final nontradable goods. The latter are used only for domestic (public and private) consumption and investment. Households can be Ricardian or liquidity-constrained (35% of the population size in either country). The former accumulate capital (which is rent to domestic firms) and a riskless nominal bond traded at euro area level between private agents and the public sector. Liquidity-constrained households consume the available income in each period. Both agents supply labor to domestic firms. The model allows for monopolistic competition in the goods and labor markets. To match the persistence and hump-shaped responses usually found in the data, the model includes standard real (habits in consumption and adjustment costs on investment changes) and nominal frictions (adjustment costs on nominal prices and wages and indexation to previous period inflation).

Fiscal and monetary authority behaviors are driven by standard feedback rules. Fiscal policy is conducted at the regional level. A standard Taylor rule, that reacts to area-wide inflation rates and output growth, holds for the monetary policy. The fiscal rule calls for an increase in labor income tax rates whenever the debt level is above target and for a larger increase whenever the dynamics of the debt is not converging. The Ricardian equivalence does not hold because of distortionary taxes (on labor income, capital income and consumption) and liquidity constrained agents (in each period they consume all the available income). On the expenditure side, we distinguish between spending on final goods and services produced by the private sector, public employment, transfer to families. The model takes fully into account expectations on the government inter-temporal budget constraint, thanks to the presence of public debt. Hence the model is able to incorporate all the main elements that should affect the effectiveness of fiscal stimuli at the macro level. Overall the model translates into an open economy settings all the features, especially the ones regarding the fiscal side, presented in Forni, Monteforte, Sessa (2009).

The transmission mechanism of fiscal spillovers is based on the trade channel (related to changes in net exports, terms of trade and real exchange rate) and the interest rate channel (the regional real interest rate depends upon the common area-wide nominal interest rate and the expected region-specific inflation rate).

As for calibration, we calibrate the Home region to replicate Germany.

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<sup>1</sup>See Pesenti (2008). A detailed description of our model is reported in the Appendix. For previous applications along the same lines, see Forni, Gerali and Pisani (2008).

In fact there would be not significant differences in the results had we picked another large Euro area country, as France or Italy.<sup>2</sup> Germany, France and Italy share similar levels of private consumption (about 55% of GDP), private investment (20%) and public consumption (20%). Their sizes (Germany being about 30% of Euro area GDP, France and Italy about 20% each) and degree of openness (Germany having intra-euro area export and import of about 20% of GDP, while France and Italy about 15%) are also relatively similar.<sup>3</sup> Finally, we assume a debt level of 65% of GDP (France is at about the same level, while Italy at 104%) and labor, capital and consumption taxes at, respectively, 39%, 21% and 20%.<sup>4</sup>

In the following section we describe in detail the fiscal policy setup and the households problem. We then discuss in some detail the calibration. In the Appendix we laid down the rest of the model.

## 2.1 Fiscal policy

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

$$\left[ \frac{B_{t+1}^g}{R_t} - B_t^g \right] = (1 + \tau_t^c) P_t C_t^g + W_t L_t^g + Tr_t - T_t \quad (1)$$

where  $B_t^g \geq 0$  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

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<sup>2</sup>We performed sensitivity analysis with respect to the baseline calibration. According to the obtained results, differences in size, openness and debt levels among the three main economies all impact modestly on the results. The degree of intra-euro area openness tend to affect fiscal multipliers in case of uncoordinated stimulus: for example we estimate that the first year GDP multiplier of an increase in government consumption decreases by 15% for a 5 percentage point increase in openness (measured as the ratio of export to GDP). On the other hand, the degree of openness affects very modestly the multipliers in case of coordinated measures, as the stimulus does not create disequilibrium in the trade balance. Therefore, and rather obviously, countries relatively more open to trade, instead of resisting fiscal measures, should call for a coordinated action as they are the ones who would benefit the most from it.

<sup>3</sup>As we consider a two-region model of the monetary union, we ignore the effects of the stimulus on the extra-euro trade balance. Although this omission holds for both the cases of coordinated and uncoordinated stimulus, and therefore should not greatly affect the differences between these two cases, it certainly affects the absolute size of the fiscal multipliers. Our educated guess is that including extra-area trade would reduce multipliers by about 30%.

<sup>4</sup>We abstract from considerations related to country risk premium. Fiscal measures taken by a single country could in fact bring about an increase in the risk premium (as for example in a high debt country like Italy), while coordinated action could have a significantly smaller effect. However, it can be argued that in particularly adverse times a fiscal stimulus adopted by a single country can sustain production and avoid very negative scenarios in which public debt to GDP ratios rise steeply due to a sharp contraction in activity, therefore limiting the negative effect on the premium.

variable  $C_t^g$  represents government purchases of goods and services,  $W_t L_t^g$  is compensation for public employees ( $W_t$  is the nominal wage,  $L_t^g$  is the total number of hours worked in the public sector),  $Tr_t$  are lump-sum transfers to households. We assume that  $C_t^g$  has the same composition as private consumption. Hence it is pre-multiplied by the private consumption price index  $P_t$ . Total government revenues  $T_t$  are given by the following identity:

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

where the  $\tau$ s are tax rates on labor income ( $\tau_t^\ell$ ), capital income ( $\tau_t^k$ ) and consumption ( $\tau_t^c$ ),  $L_t$  is total amount of hours worked (in the public sector,  $L_t^g$ , and in the private sector,  $L_t^p$ , that is  $L_t = L_t^p + L_t^g$ ),  $R_t^k$  is the rental rate of existing physical capital stock  $K_{t-1}$  and  $\Pi_t^P$  stands for dividends from ownership of domestic monopolistic firms.

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 GDP:

$$GDP_t = C_t + p_t^I I_t + C_t^g + p_t^{EXP} EXP_t - p_t^{IMP} IMP_t + w_t L_t^g \quad (3)$$

where  $p_t^I$ ,  $p_t^{EXP}$ ,  $p_t^{IMP}$ ,  $w_t$  are prices of respectively investment, export and import and wage expressed in units of the domestic consumption bundle.

We assume that the government uses a fiscal rule defined on lump-sum transfers to bring the public debt as a percent of domestic GDP,  $b > 0$ , in line with its target  $b^*$ :

$$\frac{Tr_t}{Tr_{t-1}} = \left(\frac{b_t}{b^*}\right)^{\phi_1} \left(\frac{b_t}{b_{t-1}}\right)^{\phi_2} \quad (4)$$

where  $\phi_1$  and  $\phi_2$  are lower than zero when the rule is defined on an expenditure item calling for a reduction in transfers whenever the debt level is above target and for a larger reduction whenever the dynamics of the debt is not converging.

## 2.2 Households

In each country there is a continuum of symmetric households. Home households are indexed by  $j \in [0; s]$  and Foreign households by  $j^* \in (s; 1]$ .<sup>5</sup> Households' preferences are additively separable in consumption and labor effort.

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<sup>5</sup>The population of the monetary union is normalized to one. The parameter  $s$  is the size of the Home population, which is also equal to the number of firms in each Home sector (final nontradable, intermediate tradable and intermediate nontradable). Similar assumptions holds for  $1 - s$  in the rest of the euro area.

Households receive utility from consuming and disutility from working  $L_t$  hours. The expected value of household  $j$  lifetime utility is given by:

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

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

The budget constraint of agent  $j$  is:

$$\begin{aligned} \frac{B_t(j)}{(1+R_t)\mu_t} - B_{t-1}(j) &\leq (1-\tau_t^k)(\Pi_t^P(j) + R_t^K K_{t-1}(j)) + \\ &+(1-\tau_t^\ell)W_t(j)L_t(j) - (1+\tau_t^e)P_t C_t(j) - P_t^I I_t(j) \\ &+Tr_t(j) - AC_t^W(j) \end{aligned}$$

Home agents hold a one-period risk-free bond,  $B_t$ , denominated in the currency of the monetary union. The short-term nominal rates  $R_t$  is paid at the beginning of period  $t$  and is known at time  $t$ . It is directly controlled by the monetary authority. A financial friction  $\mu_t$  is introduced to guarantee that net asset positions follow a stationary process and the economy converge to a steady state.<sup>6</sup> We assume that government and private bonds can be traded internationally in the same market. Households own all domestic firms and there is no international trade in claims on firms' profits. The variable  $\Pi_t^P$  includes profits accruing to the Home household. We assume that profits are equally shared across households. The variable  $I_t$  is investment bundle in physical capital and  $P_t^I$  the related price index, which is different from the price index of consumption because the two bundles have different composition.<sup>7</sup> Home agents accumulate physical capital  $K_t$  and rent it to domestic firms at the nominal rate  $R_t^k$ . The law of motion of capital accumulation is:

$$K_t(j) = (1-\delta)K_{t-1}(j) + (1-AC_t^I(j))I_t(j)$$

where  $\delta$  is the depreciation rate. Adjustment cost on investment  $AC_t^I$  is :

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

Finally, Home households act as wage setters in a monopolistic competitive labor market. Each household  $j$  set her nominal wages taking into account of labor demand and adjustment costs  $AC_t^W$  on the nominal wage  $W_t(j)$ :

$$AC_t^W(j) = \frac{\kappa_W}{2} \left( \frac{W_t(j)}{W_{t-1}(j)} - 1 \right)^2 W_t L_t, \quad \kappa_W > 0$$

<sup>6</sup>Revenue from financial intermediation are rebated in a lump-sum way to agents in the rest of euro area. See Benigno (2009).

<sup>7</sup>See the Appendix for more details.

The costs are proportional to the per-capita wage bill of the overall economy,  $W_t L_t$ . Similar relations hold in the Foreign country, with the exception of the intermediation frictions in the financial market.

### 2.3 Calibration

The model is calibrated at a quarterly frequency. We set some parameter values so that steady-state ratios are consistent with 2008 national account data. For remaining parameters we resort to previous studies and estimates available in the literature.<sup>8</sup> Table 1 contains parameters related to preferences and technology. Parameters with a “\*” are related to the rest of the euro area region. We assume that discount rates and elasticities of substitution have the same value across the two regions. The discount factor  $\beta$  is set to 0.9875, so that the steady state real interest rate is equal to 5 per cent on an annual basis. The value for the intertemporal elasticity of substitution,  $1/\sigma$ , is 1. The Frisch labor elasticity is set to 2. The depreciation rate of capital  $\delta$  is set to 0.025.

In the production functions of tradables the elasticity of substitution between labor and capital is set respectively to 0.85 for Germany and 0.9 for the rest of the euro area. In the German production function of nontradables the elasticity is set to 0.79, for the rest of the euro area to 0.95. The bias towards private capital is set to 0.75 in the German tradable sector, and to 0.7 for the rest of the euro area. The bias is set to 0.7 in the nontradable sector of each region.

In the final consumption and investment goods the elasticity of substitution between domestic and imported tradable is set to 1.5, while the elasticity of substitution between tradables and nontradables to 0.5. The bias for the composite tradable is set to 0.55 for Germany and to 0.5 for the rest of the area. The biases for the domestically produced tradables and for composite tradable goods are set to match the Germany-rest of the euro area import and export to GDP ratios. The population size of Germany,  $n$ , is set to 0.3 and we normalize the population of the euro area to 1.

Table 2 reports 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.<sup>9</sup>

Table 3 contains parameters that regulate the dynamics. Adjustment costs on investment change are set to 3.5. Nominal wage and price quadratic adjustment costs are set in such a way to get an average frequency of price

<sup>8</sup> Among others, see Forni, Gerali and Pisani (2009) and Forni, Monteforte and Sessa (2009).

<sup>9</sup> For an analysis of the macroeconomic effects of different degree of markups in a model similar to the one used in this paper, see Forni, Gerali and Pisani (2009).

adjustment roughly equal to 10 quarters and of wage adjustment equal to 6 quarters. Overall, we have calibrated the model such to have responses - after monetary and government expenditure shocks - of GDP, private consumption, CPI inflation and wage inflation broadly similar to the ones reported in the New Area Wide Model of the ECB (see Christoffel, Coenen and Warne, 2009) The two parameters regulating the adjustment cost paid by the Home households on their net financial position are set to 0.01.

Parametrization of systematic feedback rule followed by the fiscal and monetary authorities are reported in Table 4. In the fiscal policy rule (4) we set  $\phi_1 = 0.5$ ,  $\phi_2 = 5$  and  $\phi_3 = 5$  for Germany and rest of the euro area. The chosen values allow reaching the public debt target in more or less ten years in all the simulations. The central bank of the euro area targets the contemporaneous euro area wide consumer price inflation (the corresponding parameter is set to 1.7) and the output growth (the parameter is set to 0.4).<sup>10</sup> Interest rate is set in an inertial way and hence its previous-period value enters the rule with a weight equal to 0.9.

Table 5 reports 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 German economy. This implies that - in steady state - the *net* financial position of the German private sector equals the level of the German public debt.<sup>11</sup>

As for fiscal policy variables, it must be noted that some expenditure items (as purchases  $C^g$  as a ratio to GDP) are perfectly matched as they are exogenous. For other items, as the public wage bill and the interest expenditure, we calibrate the share of public employees over the total number of employees and the level of public debt-to-annual GDP ratio to replicate the actual data. As the wage and interest rates are endogenous, however, we don't match exactly the corresponding expenditure components. Tax rates are calibrated using effective average tax rates estimates for 2007 taken from Eurostat (2008). The tax rate on wage income  $\tau^\ell$  is set to 39 per cent in Germany and to 34 in the rest of the euro area. The tax rate on capital income  $\tau^k$  respectively to 21 and 23, while the tax rate on consumption  $\tau^c$  to 20 and 22. The public debt-to-yearly GDP ratio is calibrated to 65 per cent for Germany and to 60 for the rest of the euro area.

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<sup>10</sup>The euro area-wide consumer price inflation rate and GDP are weighted (by the regional size) geometric average of the corresponding regional variables.

<sup>11</sup>The zero net foreign asset assumption holds in both the initial and final steady state, but not along the transition. We have done robustness analysis assuming steady state German net financial position different from zero in the initial steady state and a value different from zero in the final steady state. Results, available from the authors upon request, are not greatly affected. This is to be expected. Because we have a monetary union framework, we don't have a flexible nominal exchange rate that induces "valuation effects" on the financial position through its fluctuations.

### 3 The role of coordination: the home country point of view

We now discuss the results of our simulations. We consider four fiscal measures: increases in public consumption; cut in labor income taxes; cut in capital income taxes; incentives for private consumption.<sup>12</sup> In the baseline scenario we assume that the fiscal stimulus package is implemented only in the Home economy. Specifically,

- The ex-ante size of each measure amounts, each year, to 1% of pre-stimulus (nominal) GDP; it is temporary and lasts two years.
- Each measure is initially financed entirely with debt; three years after the beginning of the implementation, lump-sum taxes are increased to bring the debt level back to steady state in the course of the following five years.

#### 3.1 Coordination on symmetric measures

For each fiscal measure, Tables 1 to 4 report the first and second year average impact on selected variables for both the Home economy and the Euro area in the case of a stimulus which is uncoordinated or coordinated across Euro area countries. When the stimulus is coordinated, both countries enact the same type of measure, by the same proportional amount (the case in which countries implement different types of measures is considered below). For each scenario we consider two alternatives, depending on the reaction of monetary policy: i) monetary policy reacts to the macroeconomic developments according to a Taylor rule; ii) monetary policy is accommodative. The accommodative monetary policy scenario assumes that nominal rates remain unchanged for the first four quarters after the start of the fiscal stimulus and resume reacting to the macroeconomy thereafter.

The absolute size of the (first year) fiscal multipliers in the *uncoordinated case* is close to (but smaller than) 1 only for increases in public consumption (it is similar in the case of public investment); it is significantly less than

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<sup>12</sup>Increase in public consumption is achieved via an increase in purchases of goods and services by the public administration. An increase in infrastructure investment would have very similar *short run* effects (in fact we consider scenarios where the stimulus lasts for two years) as an increase in public consumption (at least as long as they have about the same import content). It will increase domestic demand with little effect on the supply side, for two reasons: i) infrastructures take time to build; ii) their initial effect on the infrastructure level, and therefore on the productivity of the economy, would be limited. Therefore we do not report results for public investment measures (they are available upon request).

Regarding the other implemented measures, labor income tax cut is simply a reduction in the average tax rate on labor income, while capital income tax cut in the average tax rate on capital income; consumption incentives are obtained reducing consumption taxes.

1 for tax cuts. Given that the stimuli are assumed to be temporary, the discounted value of future tax increases needed to re-balance the budget is relatively small, hence resulting in a small negative income effect. The initial increase in the public deficit is close to 1% of pre-stimulus GDP, with some differences across measures, which mainly depend on the different response of wage income, whose increase is more pronounced in the case of labor income tax cut and consumption incentives.

We now consider the coordinated case, where the rest of the Euro area too spends 1% of its GDP. *Coordination* in fiscal action would bring an extra kick to the first year Home GDP of about 30% for increases in public consumption and labor income tax cuts, and about 20% for incentives to private consumption and cuts in capital income taxes. The benefits of coordination stem from a rise in exports, which is stronger when public consumption is raised, as this directly raises demand. Relative prices do not change significantly.

Finally, when the coordinated fiscal stimulus is accompanied by an *accommodative monetary policy* (unchanged nominal rates for the first year), fiscal multipliers are greatly enhanced. The fall in the real interest rate is between zero and 1%, depending on the fiscal measure considered. Coordinating fiscal policy does have a significant effect on inflation in the case of measures stimulating public or private consumption and investment (while cuts in labor income taxes do not significantly increase inflation). As a result the real interest rate falls, hence favoring increases in consumption, investment and GDP. The different monetary stance significantly impact on the comparison between coordinated and uncoordinated measures in almost all cases (with the exception of labor taxes-based measures), increasing the size of the multipliers in the case of coordination by 30 to 60%.

### 3.2 Coordination on asymmetric measures

In the above analysis the economies in the area are assumed to implement the same fiscal measures. We now turn to the case in which the two economies jointly enact fiscal stimulus, but they rely on different measures.

Table 5 shows the macroeconomic effects of an increase in public spending in the Home country, coupled with a reduction in taxes in the other countries. Table 6 refers to the opposite combination. The results suggest that the Home GDP increases slightly more if the rest of the area stimulates internal demand through public expenditures than via tax cuts, as the former has a higher multiplier and therefore results in a larger increase in Home export. However, the differences are in general within the decimal range.

## 4 The impact of coordination on euro area GDP

Up to here we have taken the point of view of the Home country and analyzed how much domestic fiscal multipliers can be enhanced by the coordination of the fiscal stimuli. But how about the area as a whole? For a given size of the stimulus, would the area GDP benefit more if the fiscal measures are concentrated in a single country or if, instead, they are spread among all area members?

Table 7 tries to address this issue. With reference to a public expenditure expansion, it shows that measures concentrated in the Home economy lead to a approximately the same effect on the area real GDP than distributed ones: Euro area nominal GDP in the first year would grow by 1.2 and 2.0, respectively, with normal and with accommodative monetary policy, when the measures are concentrated in the Home country, and by 1.0 and 1.7 when the measures are distributed (using GDP weights) between Home and the rest of the area. Therefore there are limited differences on the area GDP between the two cases.

Differences in Euro area GDP multipliers between concentrated and distributed measures relate to three effects. The first two, both favouring a higher euro area GDP response in the case of concentrated stimulus, are the interest rate channel and the relative price channel (change in real exchange rate and terms of trade). The real interest channel leads to a lower real interest rate in the case of concentrated stimulus, as domestic inflation increases more. The relative price channel works through a higher appreciation - when the stimulus is concentrated - of Home country terms of trade and real exchange rates, leading to a substantial increase in import and decrease in export. This leads to a substantial spillover effect (the rest of the area GDP grows by 0.4% in the first year without any direct fiscal stimulus). The last channel is related to the wealth effect due to government spending: as the higher negative effect in the case of concentrated stimulus tend to reduce private consumption with respect to the distributed case.

On these results we have performed robustness exercises and found that two parameters are particularly important. First is the size of the Home country. The real interest rate and the relative prices tend to move more the smaller is the Home country, therefore the difference between the concentrated and the distributed case tend to diminish as the two areas become of similar size. Bringing the argument to the limit, when the two areas are completely symmetric, there is no difference between the two cases. A second important parameter is the home bias in consumption. When we increase it (in both areas) the two mechanisms we have described earlier (the real interest rate effect and the relative price affect) are enhanced, leading to a stronger GDP effect in the Home country; the response of the rest of the Euro area GDP does not change much however, as the stronger GDP

effect in the Home country is compensated by the higher home bias, therefore Home import do not change significantly. Overall, the effect on Euro area GDP tend to increase, although mildly, as we increase the home bias.

## 5 Concluding remarks

This paper shows that there are significant benefits from coordinating fiscal stimulus at the Euro area level (and significant costs from exiting simultaneously from the fiscal stimulus packages). The effect for each country works mainly through the increase in exported quantities, while movements in imports and relative prices would be limited. The rise in GDP fiscal multipliers from coordination is about 30% for fiscal measures that expand public or private consumption, or decrease labor income taxes; it is smaller for cuts in capital income taxes. Under a scenario with accommodative monetary policy, GDP fiscal multipliers could almost double with respect to the uncoordinated case. We have addressed also the issue of whether Euro area GDP would benefit more from measures distributed across the area countries than from concentrated ones. Our results suggest that - for a given size of the stimulus - Euro area GDP increase is approximately the same for both concentrated and distributed measures and therefore is the total amount of the stimulus that matters more than how it is distributed among the member countries.

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## Appendix

In this Appendix we report a detailed description of the model, excluding the fiscal policy part and the description of the Households optimization problem that are reported in the main text.

### A The setup

There are two regions, Italy and rest of the euro area, having different sizes and sharing the currency and the central bank. In each region there are households and firms. Each household consumes a final composite good made of non-tradable, domestic tradable and imported intermediate goods from the rest of the area. Households have access to financial markets and smooth consumption by trading a risk-free one-period nominal 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 non-tradable intermediate goods are produced combining capital and labor in the same way. 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 Italy and the rest of the euro area 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, consumption and production do not immediately jump to a new long-term equilibrium. On the real side, quadratic costs prolong the adjustment of the capital stock. On the nominal side, quadratic cost make wage and prices sticky.

Imperfect competition in product and labor markets is reflected in markups over marginal costs. The elasticity of substitution between products of different firms determines the market power of each profit-maximizing firm. The setup in the labor market is similar. Each worker offers a differentiated

kind of labor services that is an imperfect substitute for services offered by other workers. The lower the degree of substitutability, for example because of skill differences or anti-competitive regulation, the higher is the markup and the lower employment in terms of hours. Hence, markups are modeled by a single parameter.

## A The model

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

### A Final consumption and investment goods

There is continuum of symmetric Home firms producing Home final non-tradable 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  $x^* \in (s, 1]$  (the size of the monetary union is normalized to 1). The CES production technology used by firm  $x$  is:

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

where  $Q_{HA}$ ,  $Q_{FA}$  and  $Q_{NA}$  are bundles of respectively Home tradable, Foreign tradable and Home non-tradable intermediate goods,  $\rho > 0$  is the elasticity of substitution between tradables and  $\phi > 0$  is the elasticity of substitution between tradable and non-tradable 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:

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

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

## B Intermediate goods

### B.1 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:

$$Q_{HA}(x) \equiv \left[ \left( \frac{1}{s} \right)^{\theta_T} \int_0^s Q(h, x)^{\frac{\theta_T-1}{\theta_T}} dh \right]^{\frac{\theta_T}{\theta_T-1}} \quad (5)$$

$$Q_{FA}(x^*) \equiv \left[ \left( \frac{1}{1-s} \right)^{\theta_T} \int_s^1 Q(f, x)^{\frac{\theta_T-1}{\theta_T}} df \right]^{\frac{\theta_T}{\theta_T-1}} \quad (6)$$

$$Q_{NA}(x) \equiv \left[ \left( \frac{1}{s} \right)^{\theta_N} \int_0^s Q(n, x)^{\frac{\theta_N-1}{\theta_N}} dn \right]^{\frac{\theta_N}{\theta_N-1}} \quad (7)$$

where firms in the Home tradable and non-tradable 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  $\theta_T, \theta_N > 1$  are respectively the elasticity of substitution between brands in the tradable and non-tradable sector. The prices of the non-tradable 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 non-tradable intermediate input  $n$  is:

$$Q_{A,t}(n, x) = \left( \frac{1}{s} \right) \left( \frac{P_t(n)}{P_{N,t}} \right)^{-\theta_N} Q_{NA,t}(x) \quad (8)$$

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

$$P_{N,t} = \left[ \int_0^s P_t(n)^{1-\theta_N} dn \right]^{\frac{1}{1-\theta_N}} \quad (9)$$

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 non-tradable good  $n$  is:

$$\int_0^s Q_{A,t}(n, x) dx + \int_0^s Q_{E,t}(n, y) dy + \int_0^s C_t^g(n, x) dx \quad (10)$$

$$= \left( \frac{P_t(n)}{P_{N,t}} \right)^{-\theta_N} \left( Q_{NA,t} + Q_{NE,t} + C_{N,t}^g \right) \quad (11)$$

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

## B.2 Supply

The supply of each Home non-tradable intermediate good  $n$  is denoted by  $N_t^S(n)$ :

$$N_t^S(n) = \left( (1 - \alpha_N)^{\frac{1}{\xi_N}} L_{N,t}(n)^{\frac{\xi_N - 1}{\xi_N}} + \alpha^{\frac{1}{\xi_N}} K_{N,t}(n)^{\frac{\xi_N - 1}{\xi_N}} \right)^{\frac{\xi_N}{\xi_N - 1}} \quad (12)$$

Firm  $n$  uses labor  $L_{N,t}^p(n)$  and capital  $K_{N,t}(n)$  with constant elasticity of input substitution  $\xi_N > 0$  and capital weight  $0 < \alpha_N < 1$ . Firms producing intermediate goods take the prices of labor inputs and capital as given. Denoting  $W_t$  the nominal wage index and  $R_t^K$  the nominal rental price of capital, cost minimization implies:

$$L_{N,t}^p(n) = (1 - \alpha_N) \left( \frac{W_t}{MC_{N,t}(n)} \right)^{-\xi_N} N_t^S(n) \quad (13)$$

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

where  $MC_{N,t}(n)$  is the nominal marginal cost:

$$MC_{N,t}(n) = \left( (1 - \alpha) W_t^{1 - \xi_N} + \alpha (R_t^K)^{1 - \xi_N} \right)^{\frac{1}{1 - \xi_N}} \quad (14)$$

The productions of each Home tradable good,  $T^S(h)$ , is similarly characterized.

## B.3 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 (10) and the quadratic adjustment costs:

$$AC_{N,t}^p(n) \equiv \frac{\kappa_N^p}{2} \left( \frac{P_t(n)}{P_{t-1}(n)} - 1 \right)^2 Q_{N,t} \quad \kappa_N^p \geq 0$$

paid in unit of sectorial product  $Q_{N,t}$  and where  $\kappa_N^p$  measures the degree of price stickiness. The resulting first-order condition, expressed in terms of domestic consumption, is:

$$p_t(n) = \frac{\theta_N}{\theta_N - 1} m_{c_t}(n) - \frac{A_t(n)}{\theta_N - 1} \quad (15)$$

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

$$A_t(n) \approx \kappa_N^p \frac{P_t(n)}{P_{t-1}(n)} \left( \frac{P_t(n)}{P_{t-1}(n)} - 1 \right) \quad (16)$$

$$-\beta \kappa_N^p \frac{P_{t+1}(n)}{P_t(n)} \left( \frac{P_{t+1}(n)}{P_t(n)} - 1 \right) \frac{Q_{N,t+1}}{Q_{N,t}} \quad (17)$$

The above equations clarify the link between imperfect competition and nominal rigidities. As emphasized by Bayoumi et al.(2004), when the elasticity of substitution  $\theta_N$  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):

$$p_t(n) = \frac{\theta_N}{\theta_N - 1} mc_{N,t}(n) \quad (18)$$

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):

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

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 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:

$$p_t(h) = \frac{\theta_T}{\theta_T - 1} mc_t(h) - \frac{A_t(h)}{\theta_T - 1} \quad (19)$$

$$p_t^*(h) = \frac{\theta_T^*}{\theta_T - 1} mc_t(h) - \frac{A_t^*(h)}{\theta_T - 1} \quad (20)$$

where  $\theta_T^*$  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:

$$A_t(h) \approx \kappa_H^p \frac{P_t(h)}{P_{t-1}(h)} \left( \frac{P_t(h)}{P_{t-1}(h)} - 1 \right) \quad (21)$$

$$-\beta \kappa_H^p \frac{P_{t+1}(h)}{P_t(h)} \left( \frac{P_{t+1}(h)}{P_t(h)} - 1 \right) \frac{Q_{H,t+1}}{Q_{H,t}} \quad (22)$$

$$A_t^*(h) \approx \theta_T^* - 1 + \kappa_H^{p^*} \frac{P_t^*(h)}{P_{t-1}^*(h)} \left( \frac{P_t^*(h)}{P_{t-1}^*(h)} - 1 \right) \quad (23)$$

$$-\beta \kappa_H^{p^*} \frac{P_{t+1}^*(h)}{P_t^*(h)} \left( \frac{P_{t+1}^*(h)}{P_t^*(h)} - 1 \right) \frac{Q_{H,t+1}^*}{Q_{H,t}^*} \quad (24)$$

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 highly relevant (that is, if it is relatively large), the degree of inertia of Home goods prices in the 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:

$$p_t(h) = \frac{\theta_T}{\theta_T - 1} mc_t(h) = p_t^*(h) \quad (25)$$

#### B.4 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 ( $j \in [0, s]$ ):

$$L_{N,t}(n) \equiv \left( \frac{1}{s} \right)^{\frac{1}{\psi}} \left[ \int_0^s L_t(n, j)^{\frac{\psi-1}{\psi}} dj \right]^{\frac{\psi}{\psi-1}} \quad (26)$$

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:

$$L_t^p(n, j) = \left( \frac{1}{s} \right) \left( \frac{W_t(j)}{W_t} \right)^{-\psi} L_{N,t}^p(j), \quad (27)$$

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

$$W_t = \left[ \left( \frac{1}{s} \right) \int_0^s W_t(h)^{1-\psi} dj \right]^{\frac{1}{1-\psi}}. \quad (28)$$

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:

$$AC_t^W = \frac{\kappa_W}{2} \left( \frac{W_t}{W_{t-1}} - 1 \right)^2 W_t L_t \quad (29)$$

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.

## B Monetary Policy

The monetary authority controls the short-term rate according to a Taylor rule of the form:

$$\left( \frac{1+i_t}{1+i} \right) = \left( \frac{1+i_t}{1+i} \right)^{\rho_i} (\Pi_{MU,t})^{(1-\rho_i)\rho_\pi} \left( \frac{GDP_{MU,t}}{GDP_{MU,t-1}} \right)^{(1-\rho_i)\rho_{GDP}} \quad (30)$$

The parameter  $\rho_i$  ( $0 < \rho_i < 1$ ) captures inertia in interest rate setting, while parameters  $\rho_\pi$  and  $\rho_{GDP}$  are respectively the weights of currency union's CPI inflation rate  $\Pi_{MU,t}$  and GDP  $GDP_{MU,t}$ . The CPI inflation rate is a geometric average of CPI inflation rates in the Home and Foreign country (respectively  $\Pi_t$  and  $\Pi_t^*$ ) with weights equal to the correspondent country size:

$$\Pi_{MU,t} \equiv (\Pi_t)^s (\Pi_t^*)^{1-s} \quad (31)$$

The union-wide GDP is the sum of the Home and Foreign GDPs (respectively  $GDP_t$  and  $GDP_t^*$ ), both evaluated at the steady state prices:

$$GDP_{MU,t} \equiv GDP_t + rer * GDP_t^* \quad (32)$$

where  $rer$  is the Home real exchange rate, defined as the ratio of rest of the euro area to Home consumer prices.

## 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:

$$\int_0^s A_t(x) dx \geq \int_0^s C_t(j) dj + C_t^g \quad (33)$$

The resource constraint for Home nontradable final investment good is:

$$\int_0^s E_t(x) dx \geq \int_0^s I_t(j) dj \quad (34)$$

The resource constraint for good  $n$  is

$$N_t^S(n) \geq \int_0^s Q_t(n, x) dx \quad (35)$$

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

$$T_t^S(h) \geq \int_0^s Q_t(h, x) dx + \int_s^1 Q_t(h, x^*) dx^* \quad (36)$$

The resource constraints for factor market are:

$$\int_0^s L_t(j) dj \geq \int_0^s L_t(n) dn + \int_0^s L_t(h) dh + L_t^g \quad (37)$$

$$\int_0^s K_{t-1}(j) dj \geq \int_0^s K_t(n) dn + \int_0^s K_t(h) dh \quad (38)$$

The bond market clearing condition is:

$$\int_0^s B_t(j) dj + \int_s^1 B_t(j^*) dj^* + B_t^g + B_t^{g,*} = 0 \quad (39)$$

## D The equilibrium

We find a symmetric equilibrium of the model. In each country there is a representative agent and four representative sectorial firms (in the intermediate tradable sector, intermediate nontradable sector, consumption production sector and investment production sector). The equilibrium is a sequence of allocations and prices such that, given initial conditions and the sequence of exogenous shocks, each private agent and firm satisfy the correspondent first order conditions, the private and public sector budget constraints and market clearing conditions for goods, labor, capital and bond holdings.

**Table 1.** Parametrization of Germany and the Rest of the Euro Area  
(Base-Case Parameters)

Parameter	Germany	Rest of the euro area
Rate of time preference $(1/\beta^4 - 1) * 100$	5.00	5.00
Intertemporal elasticity of substitution $1/\sigma$	1.00	1.00
Frisch elasticity of labor $1/(\tau - 1)$	2.00	2.00
Depreciation rate of (private and public) capital $\delta, \delta^*$	0.025	0.025
Tradable Intermediate Goods		
El. of substitution btw factors of production $\xi_T, \xi_T^*$	0.85	0.90
Bias towards capital $\alpha_T, \alpha_T^*$	0.75	0.70
Nontradable Intermediate Goods		
El. of substitution btw factors of production $\xi_N, \xi_N^*$	0.79	0.95
Bias towards capital $\alpha_N$	0.70	0.70
Final consumption goods		
Substitution btw domestic and imported tradables $\phi_A, \phi_A^*$	1.50	1.50
Bias towards domestic tradables $a_H, a_F^*$	0.60	0.70
Substitution between tradables and nontradables $\rho_A$	0.50	0.50
Bias towards tradable goods $a_T, a_T^*$	0.55	0.50
Final investment goods		
Substitution btw domestic and imported tradables $\phi_E$	1.50	1.50
Bias towards domestic tradables $v_H, v_F^*$	0.30	0.70
Substitution btw tradables and nontradables $\rho$	0.50	0.50
Bias towards tradable goods $v_T, v_T^*$	0.55	0.50
Size $n$ and $(1 - n)$	0.30	0.70

**Table 2.** Gross Markups

	Markups (Implied Elasticities of Substitution)		
	Tradables	Non-tradables	Wages
Germany	1.2 ( $\theta_T=6.0$ )	1.3 ( $\theta_N=4.3$ )	1.3 ( $\psi=4.3$ )
Belgium	1.2 ( $\theta_T=6.0$ )	1.3 ( $\theta_N=4.3$ )	1.3 ( $\psi=4.3$ )
Rest of the euro area	1.2 ( $\theta_T^*=6.0$ )	1.2 ( $\theta_N^*=4.3$ )	1.2 ( $\psi^*=4.3$ )

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

**Table 3.** Real and Nominal Adjustment Costs (Base-Case Parameters)

Parameter (“*” refers to rest of the euro area)	Germany	Rest of the euro area
Real Adjustment Costs		
Investment $\phi_I, \phi_I^*$	3.50	3.50
Households’ financial net position parameter $\phi_{b1}$	0.01	-
Households’ financial net position parameter $\phi_{b2}$	0.01	-
Nominal Adjustment Costs		
Wages $\kappa_W, \kappa_W^*$	150	150
Price of nontradables $\kappa_N, \kappa_N^*$	500	500
Domestic price of tradables $\kappa_H, \kappa_F^*$	500	500
Price of imported tradables $\kappa_F, \kappa_H^*$	500	500

**Table 4.** Fiscal and Monetary Policy Rules

Parameter	Germany	Rest of the euro area	Euro Area
Regional fiscal policy rule			
Deviation of public debt from target $\phi_1, \phi_1^*$	$\pm 0.5$	$\pm 0.5$	-
Public deficit $\phi_2, \phi_2^*$	$\pm 5.0$	$\pm 5.0$	-
GDP growth $\phi_3, \phi_3^*$	$\pm 5.0$	$\pm 5.0$	-
Common monetary policy rule			
Lagged interest rate at $t - 1$ $\rho_i$	-	-	0.9
Inflation $\rho_\Pi$	-	-	1.7
GDP growth $\rho_{GDP}$	-	-	0.4

**Table 5.** Great Ratios and tax rates  
(Base-Case Parameters)

	Germany		Rest of the euro area	
	data	model	data	model
MACRO VARIABLES				
Private consumption $C$	55	56	57	56
Private Investment $I$	20	20	22	21
Export	20	20	-	-
Imports	17	20	-	-
Net Foreign Asset Position	0	0	-	-
FISCAL VARIABLES				
Public purchases $C^g$	11	11	10	10
Transfer to households $Tr$	17	11	16	12
Wage bill $WL^g$	7	11	10	11
Public Investment $I^g$	2	2	3	3
Interests	3	3	3	3.0
Debt (ratio to annual GDP)	65	65	60	60
Tax Rates				
on wage	39	39	34	34
on rental rate of capital	21	21	23	23
on price of consumption	20	20	22	22

Data sources: National Account data for macroeconomic variables (2008 values).  
For fiscal variables: expenditure data (2008 values) are from AMECO database. Tax  
rates (in percent) are taken from Eurostat (2008). Macro and fiscal variables are  
expressed as a ratio to GDP.

**Table 1 – Increases in public consumption (1% of GDP), effects under different scenarios**  
(First and second year average effects, % deviation from baseline)

	<i>Uncoordinated</i>				<i>Coordinated</i>			
	<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>		<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
<b>Home</b>								
Real GDP	0.9	0.7	1.2	0.9	1.2	0.8	1.8	1.3
Consumption	0.0	0.0	0.2	0.2	0.1	0.0	0.5	0.4
Investment	0.6	0.3	1.0	0.4	0.5	0.0	1.4	0.1
Export(volumes)	-0.3	-0.8	0.2	-0.3	0.7	-0.2	1.8	1.0
Import(volumes)	1.4	1.5	1.7	1.6	1.4	1.3	2.0	1.5
Hours	1.7	1.2	2.3	1.7	2.3	1.5	3.5	2.5
Terms_of_Tr(+=deterior.)	-0.2	-0.5	-0.1	-0.4	-0.1	-0.3	-0.1	-0.2
Real.Exc.Rate(+=depr.)	-0.1	-0.2	-0.1	-0.2	0.0	-0.1	0.0	0.0
Inflation(annualized)	0.3	0.2	0.5	0.5	0.4	0.4	0.8	1.0
Real.Int.Rate(annualized)	-0.3	0.0	-0.6	-0.4	-0.4	0.0	-1.0	-0.9
Pub.Def.(%gdp)	1.0	1.1	0.9	1.0	1.0	1.2	0.8	0.9
Prim.Pub.Def.(%gdp)	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9
<b>Rest of the Euro Area</b>								
Real GDP	0.2	0.1	0.6	0.4	0.8	0.4	1.7	1.2
Consumption	0.0	-0.1	0.3	0.3	-0.3	-0.5	0.4	0.3
Investment	-0.5	-1.1	0.6	-0.2	-1.2	-2.8	1.0	-1.1
Labor	0.3	0.2	1.1	0.8	1.7	1.1	3.4	2.3
Inflation(annualized)	0.1	0.1	0.4	0.4	0.3	0.3	0.8	1.0
Real.Int.Rate(annualized)	-0.1	0.0	-0.5	-0.4	-0.3	0.1	-1.1	-0.8
Pub.Def.(%gdp)	0.1	0.1	0.4	0.3	1.0	1.2	0.8	0.9
Prim.Pub.Def.(%gdp)	0.1	0.0	0.4	0.3	1.0	1.0	0.9	0.9
<b>Euro area</b>								
Real GDP	0.5	0.3	0.8	0.6	1.0	0.6	1.7	1.2
Nom.Int.Rate(annualized)	0.0	0.1	0.0	0.0	0.1	0.3	0.0	0.0
Inflation(annualized)	0.2	0.2	0.4	0.5	0.4	0.3	0.8	1.0

**Table 2 – Cut in labor income taxes (1% of GDP), effects under different scenarios**  
(First and second year average effects, % deviation from baseline)

	<i>Uncoordinated</i>				<i>Coordinated</i>			
	<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>		<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
<b>Home</b>								
Real GDP	0.6	0.8	0.7	0.9	0.8	1.0	0.8	1.0
Consumption	0.7	0.8	0.8	0.9	0.8	0.9	0.9	1.0
Investment	1.3	2.4	1.5	2.4	1.5	2.8	1.6	2.8
Export(volumes)	0.1	0.2	0.3	0.4	0.6	0.6	0.7	0.7
Import(volumes)	0.9	1.1	0.9	1.1	1.1	1.6	1.1	1.6
Hours	1.1	1.4	1.3	1.6	1.4	1.7	1.6	1.7
Terms_of_Tr(+=deterior.)	0.0	0.2	0.0	0.2	-0.1	-0.1	0.0	-0.1
Real.Exc.Rate(+=depr.)	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0
Inflation(annualized)	0.0	-0.1	0.1	0.0	0.1	0.0	0.1	0.0
Real.Int.Rate(annualized)	0.0	0.2	-0.1	0.0	-0.1	0.1	-0.1	0.0
Pub.Def.(%gdp)	0.9	0.9	0.9	0.8	0.9	0.9	0.8	0.8
Prim.Pub.Def.(%gdp)	0.9	0.8	0.9	0.8	0.9	0.8	0.9	0.8
<b>Rest of the Euro Area</b>								
Real GDP	0.2	0.1	0.3	0.2	0.6	0.8	0.7	0.9
Consumption	0.1	0.0	0.2	0.2	0.7	0.7	0.7	0.8
Investment	0.0	-0.3	0.3	0.0	0.6	1.1	0.8	1.3
Labor	0.3	0.3	0.6	0.5	1.3	1.6	1.4	1.7
Inflation(annualized)	0.1	0.1	0.2	0.2	0.1	0.0	0.1	0.0
Real.Int.Rate(annualized)	-0.1	0.0	-0.2	-0.2	0.0	0.1	-0.1	0.0
Pub.Def.(%gdp)	0.1	0.1	0.2	0.2	0.9	0.9	0.9	0.8
Prim.Pub.Def.(%gdp)	0.1	0.1	0.2	0.2	0.9	0.8	0.9	0.8
<b>Euro area</b>								
Real GDP	0.3	0.4	0.5	0.5	0.7	0.9	0.8	0.9
Nom.Int.Rate(annualized)	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Inflation(annualized)	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0

**Table 3 – Cut in capital income taxes (1% of GDP), effects under different scenarios**  
(First and second year average effects, % deviation from baseline)

	<i>Uncoordinated</i>				<i>Coordinated</i>			
	<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>		<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
<b>Home</b>								
Real GDP	0.4	0.4	0.6	0.6	0.4	0.5	0.7	0.7
Consumption	0.3	0.4	0.4	0.5	0.3	0.4	0.4	0.5
Investment	2.0	2.5	2.3	2.5	2.0	2.5	2.4	2.5
Export(volumes)	-0.1	-0.4	0.2	0.0	0.1	-0.2	0.6	0.3
Import(volumes)	0.9	1.2	1.0	1.2	0.9	1.2	1.1	1.2
Hours	0.7	0.5	1.0	0.8	0.8	0.6	1.3	1.0
Terms_of_Tr(+=deterior.)	-0.1	-0.2	-0.1	-0.1	-0.1	-0.2	0.0	-0.1
Real.Exc.Rate(+=depr.)	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0
Inflation(annualized)	0.1	0.2	0.3	0.3	0.2	0.2	0.3	0.4
Real.Int.Rate(annualized)	-0.2	0.0	-0.3	-0.3	-0.2	0.0	-0.5	-0.4
Pub.Def.(%gdp)	1.0	1.1	0.9	1.0	1.0	1.1	0.9	1.0
Prim.Pub.Def.(%gdp)	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0
<b>Rest of the Euro Area</b>								
Real GDP	0.1	0.1	0.4	0.3	0.3	0.2	0.6	0.5
Consumption	0.0	-0.1	0.2	0.2	0.0	-0.1	0.3	0.3
Investment	-0.3	-0.7	0.4	-0.2	0.5	0.0	1.5	0.8
Labor	0.2	0.2	0.7	0.5	0.5	0.3	1.2	0.8
Inflation(annualized)	0.1	0.1	0.2	0.3	0.1	0.1	0.3	0.4
Real.Int.Rate(annualized)	-0.1	0.0	-0.3	-0.3	-0.1	0.0	-0.4	-0.4
Pub.Def.(%gdp)	0.1	0.1	0.3	0.2	1.0	1.1	0.9	1.0
Prim.Pub.Def.(%gdp)	0.1	0.0	0.3	0.2	1.0	1.0	0.9	1.0
<b>Euro area</b>								
Real GDP	0.2	0.2	0.4	0.4	0.3	0.3	0.6	0.6
Nom.Int.Rate(annualized)	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Inflation(annualized)	0.1	0.1	0.2	0.3	0.1	0.2	0.3	0.4

**Table 4 – Incentives for private consumption (1% of GDP), effects under different scenarios**  
(First and second year average effects, % deviation from baseline)

	<i>Uncoordinated</i>				<i>Coordinated</i>			
	<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>		<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
<b>Home</b>								
Real GDP	0.4	0.5	0.6	0.6	0.5	0.5	0.8	0.8
Consumption	0.7	1.0	0.8	1.2	0.7	1.0	0.9	1.3
Investment	0.6	0.5	0.9	0.6	0.6	0.3	1.2	0.4
Export(volumes)	-0.2	-0.5	0.1	-0.2	0.2	-0.1	0.8	0.6
Import(volumes)	0.7	1.0	0.8	1.1	0.7	0.9	1.0	1.0
Hours	0.7	0.8	1.1	1.0	0.9	1.0	1.6	1.5
Terms_of_Tr(+=deterior.)	-0.1	-0.3	-0.1	-0.2	-0.1	-0.2	0.0	-0.1
Real.Exc.Rate(+=depr.)	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	0.0
Inflation(annualized)	0.1	0.2	0.3	0.3	0.2	0.3	0.4	0.6
Real.Int.Rate(annualized)	-0.2	-0.1	-0.3	-0.3	-0.2	-0.1	-0.6	-0.6
Pub.Def.(%gdp)	0.8	0.8	0.7	0.7	0.8	0.9	0.7	0.7
Prim.Pub.Def.(%gdp)	0.8	0.7	0.8	0.7	0.8	0.7	0.7	0.7
<b>Rest of the Euro Area</b>								
Real GDP	0.1	0.0	0.3	0.3	0.3	0.3	0.8	0.7
Consumption	0.0	-0.1	0.2	0.2	0.5	0.7	0.9	1.2
Investment	-0.3	-0.7	0.3	-0.2	-0.6	-1.7	0.7	-0.6
Labor	0.1	0.1	0.6	0.5	0.6	0.7	1.5	1.4
Inflation(annualized)	0.1	0.1	0.2	0.3	0.2	0.2	0.4	0.6
Real.Int.Rate(annualized)	-0.1	0.0	-0.3	-0.3	-0.2	0.0	-0.6	-0.5
Pub.Def.(%gdp)	0.1	0.1	0.2	0.2	0.8	0.9	0.7	0.7
Prim.Pub.Def.(%gdp)	0.0	0.0	0.2	0.2	0.8	0.7	0.7	0.7
<b>Euro area</b>								
Real GDP	0.2	0.2	0.4	0.4	0.4	0.4	0.8	0.8
Nom.Int.Rate(annualized)	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0
Inflation(annualized)	0.1	0.1	0.2	0.3	0.2	0.2	0.4	0.6

**Table 5 – Coordinated asymmetric measures, overall 1% of Euro area GDP: Home = Increase in public consumption**

(First and second year average effects, % deviation from baseline)

	<i>Rest of Euro area = Increase in public consumption</i>		<i>Rest of Euro area = Cut in labor income taxes</i>		<i>Rest of Euro area = Cut in capital income taxes</i>		<i>Rest of Euro area = Incentives for private consumption</i>	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
<b>Home</b>								
Real GDP	1.2	0.8	1.1	0.8	1.0	0.7	1.0	0.8
Consumption	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Investment	0.5	0.0	0.8	0.7	0.6	0.3	0.5	0.1
Export(volumes)	0.7	-0.2	0.2	-0.4	-0.1	-0.7	0.1	-0.4
Import(volumes)	1.4	1.3	1.6	2.0	1.4	1.5	1.4	1.4
Hours	2.3	1.5	2.1	1.5	1.9	1.3	1.9	1.4
Terms_of_Tr(+=deterior.)	-0.1	-0.3	-0.2	-0.8	-0.2	-0.5	-0.1	-0.4
Real.Exc.Rate(+=depr.)	0.0	-0.1	-0.1	-0.4	-0.1	-0.2	-0.1	-0.2
Inflation(annualized)	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3
Real.Int.Rate(annualized)	-0.4	0.0	-0.3	-0.1	-0.3	0.0	-0.4	0.0
Pub.Def.(%gdp)	1.0	1.2	1.0	1.1	1.0	1.1	1.0	1.1
Prim.Pub.Def.(%gdp)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
<b>Rest of the Euro Area</b>								
Real GDP	0.8	0.4	0.6	0.8	0.3	0.2	0.4	0.3
Consumption	-0.3	-0.5	0.6	0.5	0.0	-0.1	0.5	0.7
Investment	-1.2	-2.8	0.1	0.3	0.3	-0.4	-0.8	-2.0
Labor	1.7	1.1	1.3	1.5	0.6	0.4	0.8	0.8
Inflation(annualized)	0.3	0.3	0.1	0.0	0.2	0.2	0.2	0.3
Real.Int.Rate(annualized)	-0.3	0.1	-0.1	0.2	-0.2	0.1	-0.2	0.0
Pub.Def.(%gdp)	1.0	1.2	0.9	0.9	1.0	1.2	0.8	0.9
Prim.Pub.Def.(%gdp)	1.0	1.0	0.9	0.8	1.0	1.0	0.8	0.7
<b>Euro area</b>								
Real GDP	1.0	0.6	0.8	0.8	0.6	0.4	0.6	0.5
Nom.Int.Rate(annualized)	0.1	0.3	0.0	0.1	0.1	0.2	0.1	0.2
Inflation(annualized)	0.4	0.3	0.2	0.1	0.2	0.2	0.2	0.3

**Table 6 – Coordinated asymmetric measures, overall 1% of Euro area GDP: Rest of the Euro area = Increase in public consumption**  
(First and second year average effects, % deviation from baseline)

	<i>Home = Increase in public consumption</i>		<i>Home = Cut in labor income taxes</i>		<i>Home = Cut in capital income taxes</i>		<i>Home = Incentives for private consumption</i>	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
<b>Home</b>								
Real GDP	1.2	0.8	0.8	1.0	0.6	0.6	0.6	0.6
Consumption	0.1	0.0	0.8	0.9	0.3	0.4	0.7	1.1
Investment	0.5	0.0	1.2	2.1	1.9	2.2	0.5	0.2
Export(volumes)	0.7	-0.2	1.1	0.9	0.9	0.3	0.8	0.2
Import(volumes)	1.4	1.3	0.8	0.9	0.8	1.0	0.7	0.8
Hours	2.3	1.5	1.6	1.7	1.2	0.8	1.2	1.1
Terms_of_Tr(+=deterior.)	-0.1	-0.3	0.1	0.3	0.0	-0.1	0.0	-0.2
Real.Exc.Rate(+=depr.)	0.0	-0.1	0.1	0.2	0.0	0.0	0.0	0.0
Inflation(annualized)	0.4	0.4	0.2	0.1	0.3	0.3	0.3	0.3
Real.Int.Rate(annualized)	-0.4	0.0	-0.1	0.2	-0.3	0.0	-0.3	0.0
Pub.Def.(%gdp)	1.0	1.2	0.9	1.0	1.0	1.2	0.8	0.9
Prim.Pub.Def.(%gdp)	1.0	1.0	0.9	0.8	1.0	1.0	0.8	0.7
<b>Rest of the Euro Area</b>								
Real GDP	0.8	0.4	0.8	0.5	0.8	0.4	0.7	0.4
Consumption	-0.3	-0.5	-0.2	-0.4	-0.2	-0.5	-0.3	-0.5
Investment	-1.2	-2.8	-0.8	-2.0	-1.0	-2.5	-1.0	-2.5
Labor	1.7	1.1	1.7	1.1	1.6	1.0	1.5	1.0
Inflation(annualized)	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3
Real.Int.Rate(annualized)	-0.3	0.1	-0.3	0.1	-0.3	0.1	-0.3	0.1
Pub.Def.(%gdp)	1.0	1.2	1.0	1.2	1.0	1.2	1.0	1.2
Prim.Pub.Def.(%gdp)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
<b>Euro area</b>								
Real GDP	1.0	0.6	0.8	0.7	0.7	0.5	0.7	0.5
Nom.Int.Rate(annualized)	0.1	0.3	0.1	0.2	0.1	0.3	0.1	0.3
Inflation(annualized)	0.4	0.3	0.3	0.2	0.3	0.3	0.3	0.3

**Table 7 – Distributed vs. concentrated measures, increase in public consumption, overall 1% of Euro area GDP**

(First and second year average effects, % deviation from baseline)

	Distributed stimulus, overall 1% of Euro area GDP increase in public consumption				Concentrated stimulus in the Home country, 1% of Euro area GDP in public consumption			
	<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>		<i>Normal monetary policy</i>		<i>Accommodative monetary policy</i>	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
<b>Home</b>								
Real GDP	1.2	0.8	1.8	1.3	2.3	1.7	3.0	2.3
Consumption	0.1	0.0	0.5	0.4	0.1	-0.1	0.6	0.4
Investment	0.5	0.0	1.4	0.1	1.3	0.7	2.5	0.8
Export(volumes)	0.7	-0.2	1.8	1.0	-0.7	-2.0	0.6	-0.7
Import(volumes)	1.4	1.3	2.0	1.5	3.5	3.8	4.2	4.0
Hours	2.3	1.5	3.5	2.5	4.4	3.0	5.8	4.2
Terms_of_Tr(+=deterior.)	-0.1	-0.3	-0.1	-0.2	-0.4	-1.1	-0.4	-1.0
Real.Exc.Rate(+=depr.)	0.0	-0.1	0.0	0.0	-0.2	-0.6	-0.1	-0.4
Inflation(annualized)	0.4	0.4	0.8	1.0	0.7	0.6	1.1	1.3
Real.Int.Rate(annualized)	-0.4	0.0	-1.0	-0.9	-0.7	-0.1	-1.4	-1.1
Pub.Def.(%gdp)	1.0	1.2	0.8	0.9	2.4	2.7	2.2	2.4
Prim.Pub.Def.(%gdp)	1.0	1.0	0.9	0.9	2.4	2.4	2.3	2.4
<b>Rest of the Euro Area</b>								
Real GDP	0.8	0.4	1.7	1.2	0.4	0.2	1.4	1.0
Consumption	-0.3	-0.5	0.4	0.3	0.0	-0.3	0.8	0.7
Investment	-1.2	-2.8	1.0	-1.1	-1.2	-2.6	1.4	-0.6
Labor	1.7	1.1	3.4	2.3	0.8	0.6	2.8	2.0
Inflation(annualized)	0.3	0.3	0.8	1.0	0.3	0.3	0.9	1.1
Real.Int.Rate(annualized)	-0.3	0.1	-1.1	-0.8	-0.3	0.1	-1.1	-1.0
Pub.Def.(%gdp)	1.0	1.2	0.8	0.9	0.3	0.2	0.9	0.8
Prim.Pub.Def.(%gdp)	1.0	1.0	0.9	0.9	0.2	0.0	1.0	0.8
<b>Euro area</b>								
Nominal GDP	1.0	0.6	1.7	1.2	1.2	0.8	2.0	1.5
Real GDP	0.1	0.3	0.0	0.0	0.1	0.4	0.0	0.0
Nom.Int.Rate(annualized)	0.4	0.3	0.8	1.0	0.4	0.4	0.9	1.2
Inflation(annualized)	1.2	0.8	1.8	1.3	2.3	1.7	3.0	2.3