The macroeconomics of fiscal consolidations in a Monetary Union: the case of Italy

Lorenzo Forni Andrea Gerali Massimiliano Pisani *

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Abstract

We present a medium scale two-areas dynamic general equilibrium currency-union model to quantitatively assess the macroeconomic and welfare implications of different fiscal consolidation scenarios in one country of the Euro area. We focus on Italy, the country with the highest level of public debt. Differently from similar models, ours is rich in the terms of fiscal features. We assume distortionary taxes (on labor income, capital income and consumption) and welfare-enhancing public expenditure. We distinguish between public spending on final goods and services, public employment and transfers to households. We use Dynare to run alternative simulations under the assumption that the Italian public debt (as a ratio to GDP) is reduced by 10 percentage points in 5 years.

Our main results are as follows. First, fiscal distortions are quantitatively significant. Second, the best fiscal consolidation strategy is to lower tax rates and simultaneously reduce expenditures: long run GDP increases by 5 to 7% and welfare by 4 to 7% of the initial levels, depending on the composition of the adjustment. Third, among expenditures it is preferable to cut purchases of goods and services or public employment rather than transfers. Fourth, the transition is not costly: consumption and investment grow on impact and along the path to the new steady state. Finally, spillovers to the rest of the euro area are expansionary and sizeable both in the long run and along the transition.

*Bank of Italy, Modeling and Forecasting Division. Emails: lorenzo.forni@bancaditalia.it, andrea.gerali@bancaditalia.it, massimiliano.pisani@bancaditalia.it. We received useful suggestions from Francesco Lippi, Alberto Locarno, Fabio Panetta, Morten Ravn, Stefano Siviero, Piero Tommasino, Aleh Tsyvinski, Joseph Zeira and from seminar participants at the Bank of Italy (November 2007), Computing in Economic and Finance annual meeting (Paris, June 2008), Society for Economic Dynamics annual meeting (Boston, July 2008), Italian Society of Public Finance annual meeting (Pavia, September 2008), Einaudi Institute for Economics and Finance (Roma, October 2008) and LUISS University (Roma, October 2008).

1 Introduction

This paper presents a medium scale two-areas dynamic general equilibrium currency-union model to quantitatively assess the macroeconomic and welfare implications of different fiscal consolidation scenarios in one country of the Euro area. We model a single country as part of the Euro area in order to properly take into account the role of the common monetary policy and the spillovers from (and to) the rest of the area. As our focus is quantitative, we calibrate the model to match Italian and the rest of the Euro area variables. We focus on Italy as it is the country with the highest level of public debt.

The basic structure of the model is akin to the Global Economy Model (GEM) developed at the IMF.[1] It allows for monopolistic competition in the goods and labor markets and includes standard real and nominal frictions to match the persistence usually found in the data as well as a feedback rule for the central bank.[2] Differently from other similar models, ours is rich in the terms of fiscal features, that allow to realistically analyze fiscal issues in a general equilibrium context. Fiscal policy is conducted at regional level. In each region we break down the Ricardian equivalence by introducing distortionary taxes on labor income, capital income and consumption, allowing for a realistic treatment of fiscal policy. On the expenditure side, we depart from the simplifying assumption that public expenditures are "pure waste". We carefully distinguish between different uses of public money: spending on final goods and services produced by the private sector, public employment and transfer to families. Decomposing public expenditures in its main components is important, as each one has different macroeconomic implications.[3] In particular, we assume that public spending on private final goods is used as intermediate good and combined with public employment to produce public goods that enter the households' utility function. In this way, a trade-off between the welfare-enhancing public good and the misallocation of (goods and labor) resources induced by its production is introduced in the model.

In this paper we do not present optimal Ramsey policy results, that - as highlighted among others by Juillard and Pelgrin (2007) - suffer from time consistency problems. We focus on consolidation scenarios where the

[1] See Bayoumi (2004) for a non-technical description of the GEM. Several central banks have developed DSGE models for policy analysis. Among the others, the Fed has developed SIGMA (see Erceg et al (2006)), the European Central Bank the New Euro Area Wide Model (see Coenen et al (2007)).

[2] Judd (2002) has shown that market power can substantially change the analysis of optimal tax policy. On this issue see also Jonsson (2007).

[3] Rogerson (2007) argues that "it is essential to explicitly consider how the government spends tax revenues when assessing the effects of tax rates on aggregate hours of market work." For a formal analysis along these lines, see Leeper and Yang (2006).

Italian fiscal authority permanently reduces the public debt-to-annual gross domestic product (GDP from now on) ratio target from 105% to 95% over a five-year horizon. This reduction in the debt target was envisaged in the last Stability Programme of Italy submitted to the European Commission in November 2007. The scenarios differ in terms of tax rates and expenditure items that are changed to reach the target. The model parameters are calibrated to values commonly used in the literature and to replicate the great ratios of Italy and rest of the Euro in 2006. We assume that in the rest of the Euro area lump-sum transfers are tuned in order to leave the public debt to GDP ratio unchanged.

The simulations are run under perfect-foresight and assuming that the only shocks perturbing the economy are the Italian fiscal ones. We use Dynare to compute steady states and simulate the transition from one steady state to the other. One advantage of using Dynare is that it solves the full non-linear model. As argued by Aruoba, Fernandez-Villaverde and Rubio-Ramirez (2006), non linear solutions achieve higher accuracy. We abstract from considerations related to lack of credibility, uncertainty, the use of fiscal instrument to stabilize business cycle and to coordination issues between Italian and rest of the euro area fiscal policy makers.

Along the transition nominal and real rigidities contribute, jointly with the gradual implementation of fiscal measures, to prolong the adjustment of the economy towards the new long run equilibrium. So we report long run (final steady state) and short-medium run (transition) macroeconomic domestic effects and spillovers to the rest of the euro area. We also provide a measure of the effects on Italian welfare in terms of consumption equivalents. Finally, we perform sensitivity analysis to check for the robustness of results.

Results are as follows. First, we show that fiscal distortions are quantitatively relevant. Compensated (by lump-sum transfers) tax rate cuts have clear welfare-improving implications. To the contrary, compensated increases in expenditures aimed at the provision of public goods have negative welfare effects, because the increase in welfare related to the higher public good is more than compensated by the increase in economic distortions (on private goods and labor supply) associated to its production. Second, and consistently, the best way to accomplish a fiscal consolidation is by lowering tax rates while, at the same time, reducing expenditures by more than would be needed with unchanged tax rates. In particular, a simultaneous reduction in public expenditures and tax rates that achieves the targeted reduction of the public debt has long run steady-state expansionary effects on the Italian GDP and on all its components. The former increases by 5 to 7% of the initial steady state level, depending on the exact composition of the adjustment. Moreover, among expenditures it is preferable to cut purchases of goods and services or public employment rather than transfers to households. Third, spillovers to the rest of the euro area are expansion-

ary and sizeable (long run GDP in the rest of the euro area increases by 2-3%). Finally, on impact and along the transition private consumption and investment grow, while GDP shows an initial negative hump if public purchases (a component of internal demand) or government employment (as GDP includes also the public sector wage bill) are being cut.

Our findings are interesting along several dimensions. We contribute to the debate on the quantitative relevance of macroeconomic effects of fiscal measures. In his Presidential Address to the AEA discussing the "Macroeconomic Priorities", R. Lucas (2003) argues that the welfare gains from supply side fiscal policies would be sizeable and equivalent to increases of about 5 to 15 percent in overall consumption levels. Also Feldstein (2008) discusses "how the effects of taxes on economic behavior are important for revenue estimation, for calculating efficiency effects, and for understanding short-term macroeconomic consequences." Mankiw and Weinzierl (2006) use standard growth models to assess the supply side effects of tax cuts and conclude that "in all models considered, the dynamic response of the economy to tax changes is too large to be ignored". They also show that the results obtained using the standard neoclassic growth model with infinitely lived agents - the framework considered in this paper - are robust to departures, like that of assuming agents with finite horizons or including a share of rule of thumb consumers.[4]

One of the results that we obtain is that there is a wide margin to reduce public expenditures with limited welfare costs. This conclusion supports those obtained by Afonso, Schuknecht and Tanzi (2005), although from a completely different perspective. Their study applies Data Envelope Analysis to assess the "efficiency frontier" of the public sector in the provision of public services and conclude that the same level of public services could be attained with 1/4 less public spending. This result is surprisingly close to what we find.

Our contribution is also related to the empirical literature on the so called non-Keynesian effects of fiscal policy.[5] This literature has considered fiscal consolidations (variously defined) of OECD countries in order to obtain some indications on the characteristics that most likely would lead to successful (i.e. lasting) adjustments. The main conclusion were that (i) adjustments concentrated on the expenditure side of the budget more than on the revenue side and (ii) large adjustments (measured by the reduction in the debt-to-GDP ratio) tend to have more non-Keynesian effects. The main theoretical argument behind these results is that agents are forward looking and therefore any sustainable reduction in public expenditure would

[4]We extend the model to include non Ricardian (or rule-of-thumb) agents in the robustness analysis and confirm the findings of Mankiw and Weinzierl (2006).

[5]See, among the others, Alesina and Perotti (1995, 1997), Giavazzi and Pagano (1990, 1996), McDermott and Wescott (1996), Alesina and Ardagna (1998).

generate a wealth effect (agents foresee less taxes) leading to an increase in consumption, investment and economic activity. This wealth effect could – under certain circumstances (as in cases of very high debt-to-GDP ratio at the beginning of the consolidation phase) – dominate against the (Keynesian) direct depressing effect coming from cuts in public expenditures. Our general equilibrium model formalizes most of these channels and allows weighting them in a sound quantitative manner.

Other papers strongly related to ours are Coenen, McAdam and Straub (2006) and Coenen, Mohr and Straub (2006). In particular, the latter analyzes costs and benefits of fiscal consolidation scenarios in the Euro area, using a less detailed description of fiscal policy that we use. Their results point to significant positive long-run effects on the main macroeconomic variables, mainly when the improvement in the budget position is used to lower distortionary taxes.

The paper is organized as follows. Section 2 provides a discussion of the model, its fiscal features, the calibration and the fiscal consolidation scenarios. Section 3 presents the results for the baseline consolidation scenario (dividing the analysis in steady state comparisons and description of the transition phase) and provides some robustness checks. Section 4 concludes.

2 The Model

2.1 The Setup

There are two regions, Italy and rest of the Euro area, having different sizes and sharing the monetary policy and currency. In each region there are households and firms. Each household consumes a final composite good made of non-tradable and tradable goods, the latter produced both at home and abroad. Households participate in financial markets and smooth consumption by trading a short-term nominal riskless bond. They also own domestic firms and capital stock, which is rented to domestic firms in a perfectly competitive market. All 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 two final goods (private consumption and investment goods) are produced combining all available intermediate goods using a constant-elasticity-of-substitution (CES) production function. Tradable and non tradable intermediate goods are produced combining capital and labor, that are assumed to be mobile across sectors. Tradable intermediate goods are split into domestically-consumed and export goods. Because intermedi-

ate goods are differentiated, firms have market power and restrict output to create excess profits.

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, they make wages and prices sticky.[6]

In the following section we describe in detail the fiscal policy and households part of the model. In the Appendix we laid down the rest of the model.

2.2 Fiscal policy

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

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

where $B_t^g \geq 0$ is nominal public debt (issued in the euro area wide market for riskless bonds and paying a gross nominal interest rate R controlled by the monetary authority of the currency union), C_t^g is government purchases of goods and services, $W_t L_t^g$ is compensation for public employees, Tr_t are transfers to households. We assume that C^g has the same composition as private consumption. Hence it is pre-multiplied by the private consumption price index P. Total government revenues T_t are given by the following identity:

$$T_t \equiv \tau_t^\ell W_t L_t + \tau_t^c \left[P_t C_t + P_t C_t^g\right] + \tau_t^k \left[R_t^k K_t + \Pi_t^P\right] \tag{2}$$

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 total employment (including public employment L_t^g, and private L_t^p; that is $L_t = L_t^p + L_t^g$), R_t^k is the rental rate of physical capital K_t and Π_t^P stands for dividends from ownership of domestic monopolistic firms.

Public employees together with purchases of goods and services (and an exogenously given stock of public building and land, $\overline{BL}_g$) are combined (using a CES production function) to produce public goods Y^g (as health, education, security, justice...):

$$Y_t^g = \left[(1-\gamma_{L^g}-\gamma_{C^g})^{\frac{1}{\alpha_g}} \overline{BL}_g^{\frac{\alpha_g-1}{\alpha_g}} + \gamma_{C^g}^{\frac{1}{\alpha_g}} C_t^{g\,\frac{\alpha_g-1}{\alpha_g}} + \gamma_{L^g}^{\frac{1}{\alpha_g}} L_t^{g\,\frac{\alpha_g-1}{\alpha_g}}\right]^{\frac{\alpha_g}{\alpha_g-1}}$$

[6] See Rotemberg (1982).

where $\alpha_g > 0$ measures the degree of substitutability between the three kinds of input and γ_{Lg}, γ_{Cg} are the weights of government employment and purchases of goods and services, respectively. Both C^g and L^g are exogenously given.

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

$$GDP = C + p^I I + C^g + p^{EXP} EXP - p^{IMP} IMP + wL^g \tag{3}$$

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

We need some fiscal rule able to stabilize the level of debt as a percent of GDP, b. We therefore assume a policy rule that uses a single instrument, among the three tax rates $(\tau_t^\ell, \tau_t^k, \tau_t^c)$ and the three expenditure items (C_t^g, L_t^g, Tr_t) as a share of GDP (in the case of public employment the rule is defined on the *level* of public employment as a share of total employment), in order to bring the debt to the target b^*. In particular we assume the following rule:

$$\frac{i_t}{i_{t-1}} = \left(\frac{b_t}{b^*}\right)^{\phi_1} \left(\frac{b_t}{b_{t-1}}\right)^{\phi_2} \tag{4}$$

where i_t is one of the six fiscal instruments considered, $b > 0$ is the debt-to-GDP ratio. Parameters ϕ_1 and ϕ_2 are lower than zero when the rule is defined on an expenditure item calling for a reduction in expenditures whenever the debt level is above target and for a larger reduction whenever the dynamics of the debt is not converging. To the contrary, they are greater than zero when the rule is on tax rates. Rule (4) is a simple linear rule. However, as Schmitt-Grohe and Uribe (2006) have shown, in a model very similar to ours, that such linear rules can approximate quite well optimal results.

2.3 Households

In each country there is a continuum of symmetric households. Home households are indexed by $j \in [0; s]$ and Foreign households by $j \in (s; 1]$. 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 j lifetime utility is given by:

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

where E_0 denotes the expectation conditional on information set at date 0, β 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 consumption bundle $\widetilde{C}_t(j)$ is given by:

$$\widetilde{C}_t(j) = \left[\omega^{\frac{1}{\theta}} C_t(j)^{\frac{\theta-1}{\theta}} + (1-\omega)^{\frac{1}{\theta}} Y_t^{g\,\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

where $\theta > 0$ measures the degree of substitutability between private (C) and public goods (Y^g) while $0 \leq \omega \leq 1$ is the weight of the private good in the consumption bundle. When $\omega = 1$, the level of the public good does not alter private consumption decisions.

The budget constraint of agent j is:

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

where adjustment cost on wages AC_t^W are:

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

Home agents hold a bond, B, 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 μ_t is introduced to guarantee that net asset positions follow a stationary process and the economy converge to a steady state.[7] Regarding the bond market, we assume that government and private bonds can be traded internationally. Home agents own all Home firms and there is no international trade in claims on firms' profits. The variable $\Pi^P(j)$ includes profits accruing to Home households.

Home agents accumulate physical capital which they rent to Home firms at the nominal rate R^k. The law of motion is:

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

where δ is the depreciation rate. Adjustment cost on investment AC_t^I is given by:

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

Similar relations hold in the Foreign country, with the exception of the intermediation frictions in the financial market.

[7] Revenue from financial intermediation are rebated in a lump-sum way to Foreign agents. See Benigno (2001).

Overall, we believe that, from a macroeconomic perspective, our model is able to take into account the diverse implications of different tax and expenditure items. This is essential in order to better understand the macroeconomic effects of consolidation scenarios that might differ in size and composition.[8]

2.4 Calibration

The model is calibrated at a quarterly frequency. Some parameter values are pinned down by the requirement that steady-state ratios need to be consistent with national accounts data in 2006. For the rest of the parameters we resort to previous studies and estimates available in the literature.[9] Table 1 contains parameters that regulate preferences and technology. Parameters with a "$*$" are related to the rest of the euro area. We assume that discount rates and elasticities of substitution have the same value across the two regions. The discount factor β 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 weight of the private good ω in the utility function is 0.8.[10] The elasticity of substitution between private and public goods, θ, is set at 1.5.[11] The depreciation rate of capital δ is set to 0.025 on a quarterly basis.

In the production functions of tradables the elasticity of substitution between labor and capital is set respectively to 0.85 in Italy and 0.9 in the rest of the area. In the production functions of non-tradables to 0.79 and 0.95. The biases towards private capital is set to 0.75 and 0.7 in the Italian and rest of the area tradable sectors, respectively; to 0.7 for both areas in the non tradable sectors. In the production function of the public sector the elasticity of substitution between inputs (labor, fixed stock of public capital and intermediate goods) α_g is equal to 0.79, the biases towards intermediate goods γ_{Cg} and labor γ_{Lg} are set to 0.15.

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 non tradables to 0.5. The bias for the composite tradeable to 0.55 in Italy and 0.5 in the rest of the area. The biases for the domestically produced and that for the composite

[8] For an earlier work along these lines see Forni, Monteforte and Sessa (2008).

[9] Among others, see Cristadoro, Gerali, Neri e Pisani (2007) and Forni, Monteforte and Sessa (2008).

[10] There is not clear empirical evidence that we can use in the calibration of this parameter. We will check the robustness of our results with respect to our calibrated value in the robustness section 3.4.

[11] In the robustness section we will discuss also the results when the elasticity of substitution is lower (we will assume $\theta = 0.8$). Most contributions assume that private and public consumption are substitutes (Prescott, 2002, assumes they are perfect substitutes).

tradable goods are chosen to match the Italy-Euro area import and export-to-GDP ratios. The population size of Italy, n, is set to 0.2 (we normalize the whole Euro area population to 1).

Table 2 reports gross markups in the tradable, non-tradable and labor markets. They are all set to 1.2. Hence the net markups are set to 20%. We obtain this number by calibrating the sector-specific elasticities of substitution between varieties to 6.[12]

Table 3 contains parameters that regulate the dynamics. Adjustment costs on investment change are set to 1. Both nominal wage and price quadratic adjustment costs are set to 60, which corresponds to an average frequency of wage and price adjustment roughly equal to 4 quarters. The two parameters regulating the adjustment cost paid by the Italian private agents on their net financial position are set to 0.01. The cost is introduced to make the model stationary.

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 $\phi_1 = \phi_2 = \pm 1.5$ for both Italy and rest of the area. The chosen values allow reach the public debt target in more or less eight years in all the simulations. Their sign is positive when the fiscal instrument in the rule is a tax rate, it is negative when the instrument is a public expenditure. 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).[13] 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, bilateral imports and exports match the data rather well, while private investment in Italy is somehow underestimated. On top of that, consistently with available data, we assume a zero steady state net foreign asset position for the Italian economy: this implies that - in steady state - the *net* financial position of the Italian private sector equals the level of the Italian public debt. This assumption holds in both the initial and final steady state (but not along the transition).[14]

[12]For an analysis of the macroeconomic effects of different degree of murkups in a model similar to the one used in this paper, see Forni, Gerali and Pisani (2008).

[13]The Euro Area-wide consumer price inflation rate is a weighted (by sizes of the two regions) geometric average of regional inflation rates.

[14]We have done robustness analysis assuming steady state Italian 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. Differently from a standard open economy model, we don't have a nominal exchange rate that induce "valuation effects" on the finacial position through its fluctuations.

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 quantities (i.e. the share of public employees over the total number of employees and the level of public debt to GDP) to replicate the actual data; as the wage and interest rates are endogenous, however, we don't match exactly the corresponding expenditure components. Regarding revenues, the model produces steady state values higher than actual data. In the case of Italy the overestimation is evenly distributed across labor and capital income taxes, while for the rest of the euro area the model produces a strong overestimation of capital income tax revenues. As our focus is on the Italian economy, mismatch concerning euro area revenues does not alter our conclusions. Tax rates are calibrated using effective average tax rates estimates for 2006 taken from Eurostat (2007). The tax rate on wage income τ^ℓ is set to 43.1 per cent in Italy and to 38.7 in the rest of the Euro area. The tax rate on physical capital income τ^k to 29.0 and 30.1, while the tax rate on consumption τ^c to 16.9 in Italy and to 19.2 in the rest of the euro area. The public debt-to-yearly GDP ratio is calibrated to 105 for Italy and to 60.7 for the rest of the euro area.

2.5 Consolidation scenarios

We consider scenarios where the target level of debt to GDP ratio falls by 10 percentage points over five years, from 105% to 95%. This reduction in the debt target was envisaged in the last Stability Programme of Italy submitted to the European Commission in November 2007.[15]

We consider fully credible and fully anticipated reduction in the debt target b^* and run perfect-foresight simulations. We first compare steady states before and after the consolidation and then study the adjustment path of endogenous variables towards the new steady state level.

We use Dynare for all simulations, including the computation of steady states and transition dynamics of the model in its non linear form.

[15] As already mentioned, we do not present Ramsey optimal policy results. This mainly for two reasons. First, optimal Ramsey policy results suffer from time consistency problems. Second, they are difficult to implement in a high debt country like Italy. In fact, if lump-sum taxes/transfers are allowed, then distortionary taxes should be set to zero and all revenues necessary to finance the public good should be levied through lump-sum taxes. If lump-sum taxes are ruled out, transfers can be diminished (with respect to the steady state level) in order to reduce the debt level, eventually bringing it to a negative value (public assets). The public sector could then finance the public good provision out of interest revenues coming for the government assets.

3 Results

In what follows we simulate the model to quantitatively assess the effects of alternative fiscal consolidation strategies on the Italian economy. We initially show the relevance of distortions induced by taxes and public expenditures. Then we show the long run (steady-sate) and dynamic (transitional) impact of the alternative fiscal consolidations. The overall message that comes out from the simulations is that reductions of fiscal distortions have sizeable expansionary effects on the Italian economy and positive effects on Italian welfare. In particular, fiscal consolidations based on simultaneous reductions of tax rates and expenditures have the strongest effects in both long and short run.

3.1 How important are tax and expenditure distortions?

To show the quantitative relevance of tax and expenditure distortions, that is how much we can improve welfare if we reduce them, we simulate effects of introducing compensated changes in the level of distortionary taxation and government expenditures. These exercises also help in understanding the transmission mechanism of the model and the results of the consolidation scenarios, reported in the next section. The reductions in *tax distortions* are achieved via reductions in tax rates compensated by reductions in lump-sum transfers. The reduction in *expenditure distortions* is obtained reducing C^g and L^g while at the same time increasing transfers. As for tax rates, also expenditures are distortive as they change the optimal allocations of private agents (through both the wealth effect and the public goods in the utility function); in fact, based on our calibration, the reduction in non-lump-sum expenditures (compensated by changes in lump-sum transfers) is welfare improving. For simplicity, in this section we restrict our attention to steady state comparisons.

Table 6 shows the percentage changes with respect to the initial steady state levels for the main macroeconomic variables, in Italy and in the rest of the euro area. We report also the percent change in welfare between initial and final steady state. The measure is expressed in terms of consumption equivalents, that is the constant percentage change in consumption level ($\widetilde{C}$) that would deliver the same utility as the one achieved in the scenario under consideration. The measure does not take into account the welfare effects during the transition, that are illustrated in the next section.

The first three columns of the Table show the long-run effects of reducing transfers to households (Tr) by 1 per cent of GDP and exactly compensating this expenditure reduction with tax rates reductions (either on labor income, capital income or consumption) as to leave the level of debt as a ratio to GDP unchanged. Since transfers are in the model equivalent to a negative lump

sum tax, this procedure delivers a reduction in tax rates leaving unchanged the total amount of net taxes (that is taxes minus transfers, as a percentage of GDP) that agents have to pay.

The Table shows that this compensated reduction in tax rates produces an increase in welfare between 0.5 and 1.2 per cent. The reduction in labor income tax rates induces a decrease in real wages (w) while at the same time a substantial increase in after-tax real wages ($(1-\tau^{\ell})w$), employment and consumption. The increase in employment brings about also an increase in investment. Similarly, the cut in consumption taxes leads to a reduction in real wages and to an increase in employment; but at the same time it favors consumption over investment and therefore limits capital accumulation. In sum, a cut in this tax rate leads to a limited increase in employment, investment, output and welfare. Also, cuts to consumption taxes apply to both domestically produced and imported goods, while cuts to labor income or capital income taxes reduce the cost of production only of domestically produced goods. In the case of a compensated reduction in the capital income tax rate, the increase in investment drives up output, while consumption is subdued as the reduction in capital income taxes makes it relatively more costly.[16]

As the welfare and efficiency gains related to cuts in consumption taxes tend to be smaller than those due to cuts in labor and capital income rates, the analysis in the rest of the paper will focus on those two latter rates. It must be kept in mind, however, that consumption taxes are still in the model (although fixed) and contribute to the calibration of steady state values.

The last two columns of the Table show the effects of reducing *expenditure distortions*. This is achieved by increasing lump-sum transfers by 1 per cent of GDP while at the same time reducing by the same amount government purchases (column 4) or public employment (column 5). As the increase in transfers corresponds to a reduction in net taxes, without reductions in tax rates, the move achieves a reduction in the overall level of taxation without changing tax rates. On the one hand, welfare improves due to the positive income effect; on the other, the reduction in the provision of the public good has a negative effect on welfare. Overall, in both column 4 and 5 the welfare gains are positive, although tend to be smaller than the ones of the first three columns. GDP decreases, mainly due to the reduction in its public component (both purchases of goods and services or the public wage bill are part of GDP; see equation 3).

Up to this point we have analyzed the gains in implementing compen-

[16]The size of the welfare gains are rather robust to alternative calibrations. In particular, we have done some robustness check with respect to the parameters of the production function (as the elasticity of substitution between labor and capital) and utility function (as the intertemporal elasticity of substitution and the level of the disutility of the working effort) and there are not substantial changes in the results.

sated tax rates and expenditure cuts. We now assess the trade-off existing when the reduction in tax rates is achieved at the cost of productive public expenditures. That is when the cut in taxes is compensated not through lump-sum transfers, but via reduction in purchases C^g or public employment L^g that are used to produce the public good. In this case there will be a level of tax cuts above which welfare decreases. In figure 1 we report the welfare level for different combinations of labor and capital income taxes, while setting all other parameters at their baseline values. The picture plots the welfare level assuming that the reduction in tax revenues is compensated by cuts in one of the three expenditure items (purchases C^g, public employment L^g and transfers Tr) in order to leave the debt level unchanged. The point in the figure labelled *initial steady state* has a welfare level normalized to 1; in the initial steady state $\tau^\ell = 0.431$ and $\tau^k = 0.29$. The picture shows that reducing one or both rates increases the welfare level, regardless of the expenditure item that is being reduced. Welfare increases almost linearly when the reduction in tax rates is compensated by cuts in transfers, as the change simply reduces tax distortions. When the expenditure reduction is concentrated on C^g, the welfare increases up to a maximum of about 3%. At the maximum τ^ℓ is at about 29% and τ^k at about 23%. This implies a cut in the former of about 14 points and in the latter of 6 points. When it is concentrated on L^g, welfare goes up to about 2% (with τ^ℓ at 29% and τ^k at 25%). In both cases total expenditure in Italy would decrease by about 1/4, roughly the same number that Afonso, Schuknecht and Tanzi (2005) find, using a completely different approach. Finally, it is interesting to note, although not straightforward to see from the picture, that the surface is steeper along the τ^ℓ axis than the τ^k one, suggesting the reduction in the former leads to higher welfare gains compared to an equal reduction in the latter.[17]

To sum up, based on our calibration, tax and expenditure distortions seem to be significant. Moreover, there is a wide margin to cut tax rates and productive expenditures while increasing the level of welfare. In particular, our results suggest that welfare would increase for simultaneous cuts in the labor and capital income tax rates up to 14 and 6 percentage points, respectively, compensating the revenue loss by reducing productive public expenditures.

[17] This result depends on the specific calibration that we assume. In particular, the relative rank in terms of welfare of cutting labor versus capital income taxes is heavily affected by the level of the intertemporal elasticity of substitution. For an elasticity equal to 2 (is 1 in our baseline) the steady state welfare gains are almost the same; are higher in the case of capital income taxes for higher values of the elasticity.

3.2 The long-run effects of the fiscal consolidation

We now consider the long run (or steady state) effects of reducing the debt to GDP by 10 percentage points over a five year horizon.

The first two columns of Table 7 - labelled (B, τ^{ℓ}), (B, τ^{k}) - assume that the consolidation is achieved increasing along the transition one tax rate at a time (on labor income and capital income, respectively) following the fiscal rule (4), leaving public expenditure for goods and services (as ratio to GDP) and for employment (as ratio to total employment) unchanged.[18]

In the next three columns of Table 7 - labelled (B, C^{g}), (B, L^{g}) and (B, Tr) - the consolidation is achieved imposing along the transition the fiscal rule defined on one expenditure item at a time (purchases of goods and services, public employment and transfers, respectively), leaving tax rates unchanged. The columns after the fifth consider scenarios where, in order to reduce the debt-to-GDP ratio to the target, tax rates are exogenously reduced by five percentage points and one expenditure item at a time is endogenously reduced through the fiscal rule. By reducing both tax rates by 5 percentage points, total primary expenditures have to be cut by about 4% of GDP, quite a significant amount.[19]

The main mechanism to understand steady-state results is as follows. In the scenarios of tax-based consolidation, tax rates are increased along the transition. Once the debt target is achieved and interest expenditure on public debt is reduced, tax rates can stabilize at a final steady-state level below the initial one. Similarly, in the scenarios of public expenditure-based consolidation, public expenditures are cut along the transition but eventually end up to a final steady-state level above the initial one, substituting for the lower interest outlays. Lastly, reducing both expenditures and taxes along the transition implies that the lower steady-state interest rate payment is divided between lower expenditures and taxes.

Table 7 reports steady state comparisons. The first two columns shows that reducing tax rates induces an increase in output, which is stronger for lower labor income tax rate. In this case, there is a positive reaction in hours worked, that induces higher consumption (households substitute consumption for leisure) and investment (capital is more productive when

[18] Results are only slightly different if we assume that expenditures remain unchanged in real terms, instead of as a percentage of GDP. Since GDP increases for all three tax cuts, fixed expenditures in real term would imply that they would decrease in terms of GDP. Therefore, the positive effects (on the macro variables and on steady state welfare) would be larger. As expenditures, especially in Italy, tend to grow with GDP, we feel more confident with our baseline assumption.

[19] We could have considered larger tax cuts (as we know from the previous section that they might lead to higher welfare gains). These, however, would have implied reductions in total primary expenditures larger than 4% of GDP, an amount difficult to achieve in the horizon that we consider for the transition.

employment is higher). In the case of lower capital income tax, investment strongly increases while the increase in consumption and employment is relatively low.

Columns 3-5 show the effects of higher steady state public expenditure for goods, employment and lump-sum transfers. The latter have zero effect, given that the net financial asset position of the Italian economy (equal to the sum of private and public sector asset positions) is equal in both the initial and final steady state and change in transfers do not affect households' first order conditions. In the other two cases, output increases by the same amount, albeit for different reasons. Higher public expenditure for goods and services induces a decrease in private demand for consumption and an increase in supply driven by employment and capital (higher investment). Higher public expenditure for employment induce an increase in the wage component of output (see equation 3), while private demand decreases.

Columns 6-8 report the results (as in columns 3-5) assuming a reduction in labor income taxes equal to 5 percentage points. Output increases less when public consumption and employment are reduced, because the latter directly affect the GDP. To the contrary, private consumption, investment and employment increase more, as more resources are made available for private (households and firms) demand.

A similar picture emerges from columns 9-11. Similarly to the previous scenarios, in the new steady state both capital income taxes and public expenditures are reduced. Also in this case, the lower increase in GDP and the higher increase in private demand components (investment in particular) is associated to the C^g and L^g scenarios.

A similar ranking and logic apply when both taxes are simultaneously reduced (columns 12-14). There are expansionary effects on the economic activity, that are roughly equal to the sum of effects obtained when tax reductions are implemented separately.

All tax-based reforms have positive effects on the steady state welfare, which increases with respect to the initial one. The biggest effect is obtained when all taxes and expenditures are reduced. This means that utility provided by the public good is more than compensated by the distortions associated to taxation, public employment and purchases. Consistently with this statement, the steady state welfare deteriorates in the scenarios reported in columns 4 and 5, when tax rates are not changed and public expenditures increase in the steady state.

Finally, spillovers to the rest of the euro area are relatively small compared to domestic effects, but not dramatically so. They are generally positive, given that the expansionary effects of reforms on the Italian supply side imply higher Italian imports and cheaper Italian goods for all households in the area. Consistently, the Italian terms of trade, defined as the price of

Italian imports to the price of Italian exports (both expressed in terms of Italian consumption units), deteriorate.

The overall message is that fiscal consolidation strategies that allow to reduce taxes and public expenditures in the steady state have expansionary effects on the Italian production side and hence on the Italian economic activity and welfare.

3.3 Transition dynamics

In the previous section we have seen that the reduction in Italian public debt (as a ratio to GDP) can induce a significant long run steady-state increase in the economy activity and welfare gains when steady state expenditures and revenues are reduced at the same time. In this section we analyze the related transition from the initial steady state to the final one. After a permanent fiscal shock, the economy does not jump immediately from one steady state to the other, because the presence of nominal and real rigidities (nominal sticky prices and wages, adjustment costs on investment) slows the adjustment process. In the following we will restrict our attention to the scenarios where - over an horizon of five years - the target level of the debt to GDP decrease by 10 percentage points and both labor and capital income tax rates are being cut by 5 percentage points. As shown in the previous section, this policy strategy induces the higher increase in the long-run steady state welfare (columns 12-14 in Table 7). As usual, we consider three scenarios. The first (*scenario* C^g) corresponds to the case where the public expenditure for intermediate goods is decreased. In the second (*scenario* L^g), the expenditure for public employment is cut. Finally, the *scenario* Tr is characterized by a reduction in lump-sum transfer to households. Each expenditure item is adjusted according to the fiscal rule (4).

Figure 2 shows the path of the main fiscal variables and of GDP; figure 3 of the other main macroeconomic variables. In the three scenarios there is an initial decrease in the public debt-to-GDP ratio more or less pronounced. The reason is the strong expansionary effects of tax rate reduction on GDP on impact. In the scenario C^g the increase in GDP is so strong that debt undershoot the target, inducing an increase in public expenditure through the fiscal rule. In the other two scenarios, the undershooting is less strong. After the impact periods, as the GDP slows, the debt-to-GDP ratio increases, overshooting the target. As a consequence, the fiscal rule imposes a strong and persistent reduction in the public expenditure, that drives down the debt-to-GDP ratio starting from the 12th quarter. The convergence process ends around quarter 30th, when the actual debt-to-GDP ratio assumes a value very close to the target. After, there is a slight undershoot of the target, that characterize the adjustment until the new steady state is

reached.

What drives GDP in the various scenarios? In the scenario C^g there is a strong increase in consumption on impact, driven by the reduction in Italian real interest rate (not reported). The latter decreases because the increase in Italian inflation is not compensated by an increase in the euro-area wide nominal interest rate. As employment increases and the supply of goods expands on one hand and the public expenditure decreases on the other, the inflation rate decreases and consumption slows. In the medium run consumption persistently increases, as tax distortions and public expenditures are reduced. Investment initially decreases, to make room for consumption and because it is convenient to accumulate capital in the future, when tax distortions are lower. In the other two scenarios consumption does not increase on impact, as the cut in transfers or the public wage bill reduces households disposable income and therefore moderates initially the increase in private consumption. Also the effect on the real interest rate and on the rental rate of capital is smaller.

Overall GDP might remain below steady state for few quarters, but private consumption and investment would not record any contraction.

The described macroeconomic paths have a positive effect on the Italian welfare. Table 8 reports the results. The welfare is measured in terms of consumption equivalents, that is the constant change, x, in initial steady state (ss) consumption that induces the same discounted flow of utility as the actual one, that is:

$$x \quad s.t. \quad \sum_{i=1}^{\infty} \beta^i U\left(xC_{ss}, L_{ss}\right) = \sum_{i=1}^{\infty} \beta^i U\left(C_i, L_i\right)$$

According to our results, reform based on simultaneous reductions in tax rates and public expenditures on employment and purchases of goods and services produce the highest increase in welfare, due to the strongest wealth effect associated to the reduction in distortion in the allocation of private resources.

Overall, the response of the main macro variables to the fiscal consolidation shows that there would not be any significantly negative effect on the Italian economy during the transition.

3.4 Robustness

We performed robustness checks on three important aspects of the model. First, with respect to the elasticity of labor supply, which drives the response of employment to tax cuts. Second, with respect to the role of the public good in the utility function, changing its weight (ω) and its degree of complementarity/substitutability with the private one (θ). Third, we introduce non Ricardian (or rule-of-thumb) agents, i.e. agents that do not participate

in the financial markets and consume their current (labor plus government transfers) net income. The latter two robustness exercises are meant to increase the negative welfare effects of cutting expenditures and see whether, for realistic alternative calibration of these parameters, our main results (in particular, that the positive effects due to tax cuts more than compensate the negative effects coming from expenditures cuts) can be overturned.

The first three columns of Table 9 report our baseline scenario (same as in the last three columns of Table 7). The columns from forth to sixth assume $\tau = 3$, thus a Frisch labor elasticity of 0.5 (instead of 2 as in the baseline scenario), a rather extreme value given that most estimated DSGE models place this elasticity in a range between 1 and 2. Results are somehow expected: employment increases by less, leading to a lower increase in investment, consumption and output.

The columns (7)-(9) replicate the baseline scenario assuming $\omega = 0.5$ (instead of 0.8), thus giving a weight equal to one half to the public good in the consumption bundle. In this case we observe a drop in the welfare gains of the fiscal consolidation, consistently with the fact that it requires cuts in expenditures. The drop is higher especially for cuts to public employment and purchases, as these expenditure items affect directly the production of the public good, while is much more limited for cuts to transfers. It must be noted, in any case, that welfare gains remain in general positive and significant. As for the effects on the macro variables, since public and private goods are substitutes (in the baseline we assume $\theta = 1.5$), the drop in the public good leads to a slightly higher increase in private consumption.

In the next three columns, (10)-(12), we assume that public and private goods are complements ($\theta = 0.8$). This implies that reductions in purchases or public employment (that reduce the provision of the public good) decrease the marginal utility of private consumption. No surprise therefore that in this scenario private consumption increases by less, although moderately.

Finally we evaluate the robustness of our results with respect to the introduction of a share of non Ricardian agents (NR), λ, equal to 35 per cent. Non Ricardian agents are assumed to consume their current disposable income, that is:

$$(1 + \tau_t^c) P_t C_t^{NR}(j) = (1 - \tau_t^\ell) W_t(j) L_t^{NR}(j) + Tr_t(j)$$

The results are shown in columns (13)-(15) and are only slightly different from the baseline. This is in line with the finding of Mankiw and Weinzierl (2006), among others. The reason is that non Ricardian agents do not smooth consumption and therefore do not contribute to pin down the steady state level of the capital stock. Moreover since, for simplicity, we assume that non Ricardians supply the same quantity of hours as Ricardian agents, they do not contribute to the choice of employment either.

Overall these robustness checks broadly confirm our baseline results. In particular in all cases we obtain that reductions in the debt to GDP ratio obtained via a concomitant reduction in expenditures and revenues is welfare improving. In general, the consequences of the different assumptions on the parameter values that we have considered are rather limited, both on the macroeconomic variables and on the welfare levels.

4 Concluding remarks

We have simulated a DSGE model – calibrated to replicate the main Italian and euro area macroeconomic and fiscal policy aggregates – to analyze the macroeconomic and welfare effects of alternative fiscal consolidation strategies in Italy. We have presented the effects of a permanent reduction of the Italian public debt to GDP ratio of 10 percentage points achieved over five years. We have shown that a significant debt to GDP reduction obtained via reducing both expenditure and taxes can be welfare improving. The order of magnitude of these welfare gains is comparable with those suggested by Lucas (2003) .

Our simulations have highlighted a series of other results. A simultaneous reduction in public expenditures and tax rates that achieves the targeted reduction of the public debt has long run steady-state expansionary effects on the Italian GDP and on all its component. The former increases by 5% to 7% of the initial steady state level, depending on the exact composition of the adjustment. Moreover, among expenditures it is preferable to cut purchases of goods and services or public employment rather than transfers to households. The spillovers to the rest of the euro area are expansionary and sizeable (long run GDP in the rest of the euro area would increase by 2-3%). Finally, on impact and along the transition private consumption and investment grow, while GDP shows an initial mild negative hump if public purchases (a component of internal demand) or government employment (as GDP includes also the public sector wage bill) are being cut. These conclusions seem to be robust to alternative calibrations.

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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 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 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 by $x^* \in (s, 1]$ (the size of the monetary union is normalized to 1). The CES production technology used by firm x is:

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

where Q_H, Q_F and Q_N 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 $(0 < a_T < 1)$ is 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:

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

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:

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

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

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

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 θ_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:

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

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

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

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:

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

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

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 $N^S(n)$:

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

Firm n uses labor $L_N(n)$ and capital $K_N(n)$ 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 the nominal wage index and R^K the nominal rental price of capital, cost minimization implies:

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

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

where MC_N is the nominal marginal cost:

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

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 κ_N^p measures the degree of price stickiness. The resulting first-order condition, expressed in terms of domestic consumption, is:

$$p_t(n) = \frac{\theta_N}{\theta_N - 1} mc_t(n) - \frac{A_t(n)}{\theta_N - 1} \tag{15}$$

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

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

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

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

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

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):

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

subject to quadratic price adjustment costs similar to those considered for non-tradables 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 $mc_H(h)$ is the marginal cost. The first order conditions with respect to $p_t(h)$ and $p_t^*(h)$ are:

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

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

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:

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

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

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

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

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 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:

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

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 ($j \in [0, s]$):

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

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:

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

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

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

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:

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

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:

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

The parameter ρ_i $(0 < \rho_i < 1)$ captures inertia in interest rate setting, while parameters ρ_π and ρ_{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 Π_t and Π_t^*) with weights equal to the correspondent country size:

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

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:

$$GDP_{MU,t} \equiv GDP_t + GDP_t^* \tag{32}$$

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:

$$\int_0^s A_t\left(x\right) dx \geq \int_0^s C_t\left(j\right) dj + C_t^g \tag{33}$$

The resource constraint for Home nontradable final investment good is:

$$\int_0^s E_t\left(x\right) dx \geq \int_0^s I_t\left(j\right) dj \tag{34}$$

The resource constraint for good n is

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

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

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

The resource constraints for factor market are:

$$\int_0^s L_t(j)\,dj \geq \int_0^s L_t^p(n)\,dn + \int_0^s L_t^p(h)\,dh + L_t^g \tag{37}$$

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

The bond market clearing condition is:

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

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 Italy and the rest of the Euro Area
(Base-Case Parameters)

Parameter	Italy	Rest of the Euro Area
Rate of time preference $\left(1/\beta^4 - 1\right) * 100$	5.0	5.0
Intertemporal elasticity of substitution $1/\sigma$	1.0	1.0
Frisch elasticity of labor $1/\left(\tau - 1\right)$	2.0	2.0
Depreciation rate of (private and public) capital δ, δ^*	0.025	0.025
Substitution between private and public goods in cons. bundle θ	1.5	1.5
Bias towards private goods in cons. bundle ω	0.8	0.8
Tradable Intermediate Goods		
Substitution between factors of production ξ_T, ξ_T^*	0.85	0.9
Bias towards capital α_T, α_T^*	0.75	0.7
Non tradable Intermediate Goods		
Substitution between factors of production ξ_N, ξ_N^*	0.79	0.95
Bias towards capital α_N	0.70	0.70
Production function of the public good		
Substitution between factors of production α_g	0.79	0.79
Bias towards intermediate goods $\gamma_{C^g}, \gamma_{C^g}^*$	0.15	0.15
Bias towards public employment $\gamma_{L^g}, \gamma_{L^g}^*$	0.15	0.15
Final consumption goods		
Substitution between domestic and imported goods ϕ_A, ϕ_A^*	1.5	1.5
Bias towards domestic tradable goods a_H, a_F^*	0.3	0.7
Substitution between domestic tradables and non tradables ρ_A, ρ_A^*	0.5	0.5
Bias towards tradable goods a_T, a_T^*	0.55	0.5
Final investment goods		
Substitution between domestic and imported goods ϕ_E, ϕ_E^*	1.5	1.5
Bias towards domestic tradable goods υ_H, υ_F^*	0.3	0.7
Substitution between domestic tradables and non tradables ρ_E, ρ_E^*	0.50	0.50
Bias towards tradable goods υ_T, υ_T^*	0.55	0.50
Size n and $(1 - n)$	0.20	0.80

Table 2. Gross Markups

	Markups and Elasticities of Substitution		
	Tradables	Non-tradables	Wages
Italy	1.2 (θ_T=6)	1.2 (θ_N=6)	1.2 (ψ=6)
Rest of the euro area	1.2 (θ_T^*=6)	1.2 (θ_N^*=6)	1.2 (ψ^*=6)

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

Parameter ("*" refers to rest of the Euro area)	Italy	Rest of the Euro Area
Real Adjustment Costs		
Investment ϕ_I, ϕ_I^*	1.00	1.00
Households' financial net position $\phi_{b1,}\phi_{b2}$	0.01, 0.01	-
Nominal Adjustment Costs		
Wages κ_W, κ_W^*	60	60
Price of domestically-produced tradables κ_H, k_F^*	60	60
Price of non tradables κ_N, κ_N^*	60	60
Price of imported intermediate goods κ_F, κ_H^*	60	60

Table 4. Fiscal and Monetary Policy Rules

Parameter	IT	RoEA	EA
Fiscal policy rule			
ϕ_1, ϕ_1^*	± 1.5	± 1.5	-
ϕ_2, ϕ_2^*	± 1.5	± 1.5	-
Common monetary policy rule	-	-	
Lagged interest rate at t-1 ρ_i	-	-	0.9
Inflation ρ_{Π}	-	-	1.7
GDP growth ρ_{GDP}	-	-	0.4

Table 5. Great Ratios and tax rates

(Base-Case Parameters)

	Italy		Rest of the Euro Area	
	data	model	data	model
MACRO VARIABLES				
Private consumption C	59.7	56.8	57.1	59.5
Private Investment I	20.7	14.2	21.1	19.8
Export	25.8	23.6	-	-
Imports	25.9	23.6	-	-
Net Foreign Asset Position	0.0	0.0	-	-
FISCAL VARIABLES				
Public purchases C^g	9.3	9.3	10.3	10.3
Transfer to households Tr	17.1	16.7	16.1	18.3
Wage bill WL^g	11.0	11.9	10.1	10.1
Primary total expenditures	39.7	40.2	39.1	41.3
Interests	4.6	5.3	2.5	3.0
Total expenditures	44.3	45.6	41.6	44.3
Labor income revenues	20.4	23.1	20.8	15.6
Capital income revenues	10.1	13.0	8.6	17.3
Consumption revenues	10.1	9.6	10.7	11.4
Sum of the above revenues	40.6	45.7	40.1	44.3
Debt(ratio to annual GDP)		105.0		60.0
Tax Rates				
on wage	43.1	43.1	38.7	38.7
on rental rate of capital	29.0	29.0	30.1	30.1
on price of consumption	16.9	16.9	19.2	19.2

Data sources: National Account data for the macroeconomic variables (2006 values). For the fiscal variables: expenditure figures are from AMECO database for 2006 (Bank of Italy 2007); revenues data are from Eurostat (2007) and refer to 2005. Macro and fiscal variables are expressed as a ratio to GDP. Tax rates in percent.

Table 6. Steady state comparisons: reduction in tax and expenditure distortions (% changes)

	Tax distortions (1% of GDP)			Expenditure distortions (1% of GDP)	
	$[Tr, \tau^{\ell}]$	$[Tr, \tau^{k}]$	$[Tr, \tau^{c}]$	$[Tr, C^{g}]$	$[Tr, L^{g}]$
	(1)	(2)	(3)	(4)	(5)
Italy					
GDP	1.8	1.7	0.7	-0.6	-0.6
Private consumption (C)	2.3	1.1	0.9	0.8	0.7
Public good (Y_g)	0.2	0.2	0.1	-1.5	-3.4
Investment	2.5	4.6	0.9	-0.8	0.5
Export	0.3	0.3	0.1	-0.1	0.1
Import	3.1	2.8	1.1	-1.0	0.6
Hours worked (L)	2.4	0.5	0.9	-0.8	-1.3
Real wage (w)	-1.0	1.4	-0.4	0.3	-0.2
After-tax real wage ($(1-\tau^{\ell})w$)	3.4	1.4	-0.4	0.3	-0.2
Terms of trade	2.0	1.8	0.7	-0.6	0.4
Welfare	1.2	0.8	0.5	0.7	0.4
Rest of the Euro area					
GDP	0.6	0.6	0.2	-0.2	0.1
Private Consumption (C^{*})	0.6	0.6	0.2	-0.2	0.1

Table 7. Steady state comparisons (% changes)

	No change in expenditures		No change in tax rates			Reduction in labor tax rate			Reduction in capital tax rate			Reduction in both tax rates		
	$[B,\tau^{\ell}]$	$[B,\tau_k]$	$[B,C^g]$	$[B,L^g]$	$[B,Tr]$	$[B,C^g]$	$[B,L^g]$	$[B,Tr]$	$[B,C^g]$	$[B,L^g]$	$[B,Tr]$	$[B,C^g]$	$[B,L^g]$	$[B,Tr]$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Italy														
GDP	1.1	1.0	0.4	0.4	0.0	2.8	2.7	3.6	2.7	2.6	3.6	5.2	5.1	7.4
Private consumption (C)	1.4	0.7	-0.5	-0.4	0.0	5.8	5.5	4.6	3.7	3.5	2.4	10.2	9.6	7.1
Public good (Y_g)	0.1	0.1	0.8	1.9	0.0	-1.7	-4.5	0.5	-2.0	-5.0	0.5	-5.5	-12.9	0.9
Investment	1.5	2.7	0.5	-0.3	0.0	3.7	5.6	4.9	8.6	10.8	10.0	12.2	17.4	15.3
Export	0.2	0.2	0.1	0.0	0.0	0.4	0.6	0.6	0.4	0.7	0.6	0.8	1.3	1.1
Import	1.8	1.6	0.6	-0.3	0.0	4.6	6.9	6.0	4.4	7.0	6.0	8.6	14.9	12.4
Hours worked (L)	1.4	0.3	0.5	0.8	0.0	3.6	2.8	4.7	0.0	-1.0	1.2	3.1	1.1	5.9
Real wage (w)	-0.6	0.8	-0.2	0.1	0.0	-1.5	-2.2	-1.9	3.4	2.5	2.9	2.1	0.1	1.0
After-tax real wage ($(1-\tau^{\ell})w$)	2.0	0.8	-0.2	0.1	0.0	7.2	6.4	6.7	3.4	2.5	2.9	11.0	8.9	9.8
Terms of trade	1.2	1.1	0.4	-0.2	0.0	3.0	4.4	3.9	2.8	4.5	3.9	5.5	9.4	7.9
Welfare	0.7	0.5	-0.4	-0.3	0.0	3.4	2.9	2.4	2.8	2.3	1.7	6.5	5.3	4.1
Rest of the Euro area														
GDP	0.4	0.3	0.1	-0.1	0.0	1.0	1.4	1.2	0.9	1.4	1.2	1.8	3.0	2.5
Private Consumption (C^*)	0.4	0.4	0.1	-0.1	0.0	1.0	1.4	1.3	0.9	1.5	1.3	1.8	3.0	2.5

Table 8. Welfare along the transition (% changes)

No change in expenditures	$[B, \tau^{\ell}]$	-0.2
	$[B, \tau^{k}]$	0.0
No change in tax rates	$[B, C^{g}]$	-0.1
	$[B, L^{g}]$	-0.1
	$[B, Tr]$	0.0
Reduction in labor tax rate	$[B, C^{g}]$	2.8
	$[B, L^{g}]$	2.0
	$[B, Tr]$	1.5
Reduction in capital tax rate	$[B, C^{g}]$	2.0
	$[B, L^{g}]$	1.3
	$[B, Tr]$	0.7
Reduction in both tax rates	$[B, C^{g}]$	4.7
	$[B, L^{g}]$	3.1
	$[B, Tr]$	2.2

Table 9. Robustness, steady state comparisons (% changes)

	Baseline			$\tau = 3$			$\omega = 0.5$			$\theta = 0.8$			$\lambda = 0.35$		
	$[B, C^g]$	$[B, L^g]$	$[B, Tr]$	$[B, C^g]$	$[B, L^g]$	$[B, Tr]$	$[B, C^g]$	$[B, L^g]$	$[B, Tr]$	$[B, C^g]$	$[B, L^g]$	$[B, Tr]$	$[B, C^g]$	$[B, L^g]$	$[B, Tr]$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Italy															
GDP	5.2	5.1	7.4	4.0	5.0	5.3	5.6	5.6	7.5	4.3	3.8	7.0	5.3	4.8	7.1
Private consumption (C)	10.2	9.6	7.1	8.7	9.1	4.2	10.8	10.2	7.4	9.4	8.3	6.7	10.4	9.4	6.8
Public good (Y_g)	-5.5	-12.9	0.9	-5.6	-23.3	0.6	-5.3	-10.1	1.0	-5.9	-12.7	0.9	-5.4	-11.3	0.9
Non Ricardian consumption (C^{NR})													11.6	8.2	4.9
Investment	12.2	17.4	15.3	10.4	17.0	12.1	12.9	18.1	15.7	11.0	15.9	14.9	12.4	17.2	15.0
Export	0.8	1.3	1.1	0.6	1.2	0.7	1.0	1.6	1.3	0.6	1.0	0.9	0.8	1.3	1.1
Import	8.6	14.9	12.4	6.6	14.4	8.5	9.4	15.6	12.7	7.2	13.1	11.9	8.9	14.5	12.0
Hours worked (L)	3.1	1.1	5.9	1.7	0.7	3.3	3.6	1.7	5.9	2.0	-0.5	5.5	3.2	0.8	5.5
Real wage (w)	2.1	0.1	1.0	2.7	0.2	2.1	1.9	-0.1	0.9	2.5	0.5	1.0	2.0	0.2	1.1
After-tax real wage ($(1-\tau^{\ell})w$)	11.0	8.9	9.8	11.7	9.1	11.1	10.8	8.7	9.8	11.5	9.4	9.9	11.0	9.0	9.9
Terms of trade	5.5	9.4	7.9	4.3	9.0	5.5	6.0	9.8	8.0	4.7	8.5	7.7	5.7	9.2	7.7
Welfare: steady state	6.5	5.3	4.1	6.0	3.8	2.7	4.2	2.5	3.6	5.0	3.1	3.7	6.6	6.0	4.8
Welfare: with transition	4.7	3.1	2.2	4.5	1.4	1.2	2.6	0.6	2.0	3.3	1.0	2.0	4.8	3.8	2.9
Rest of the Euro area															
GDP	1.8	3.0	2.5	1.3	2.8	1.7	2.0	3.3	2.7	1.4	2.5	2.2	1.8	2.9	2.4
Private Consumption (C^*)	1.8	3.0	2.5	1.3	2.8	1.7	2.0	3.4	2.8	1.4	2.5	2.3	1.8	3.0	2.5

Figure 1. Welfare (% deviation from steady state), compensating the tax cuts with different expenditure items

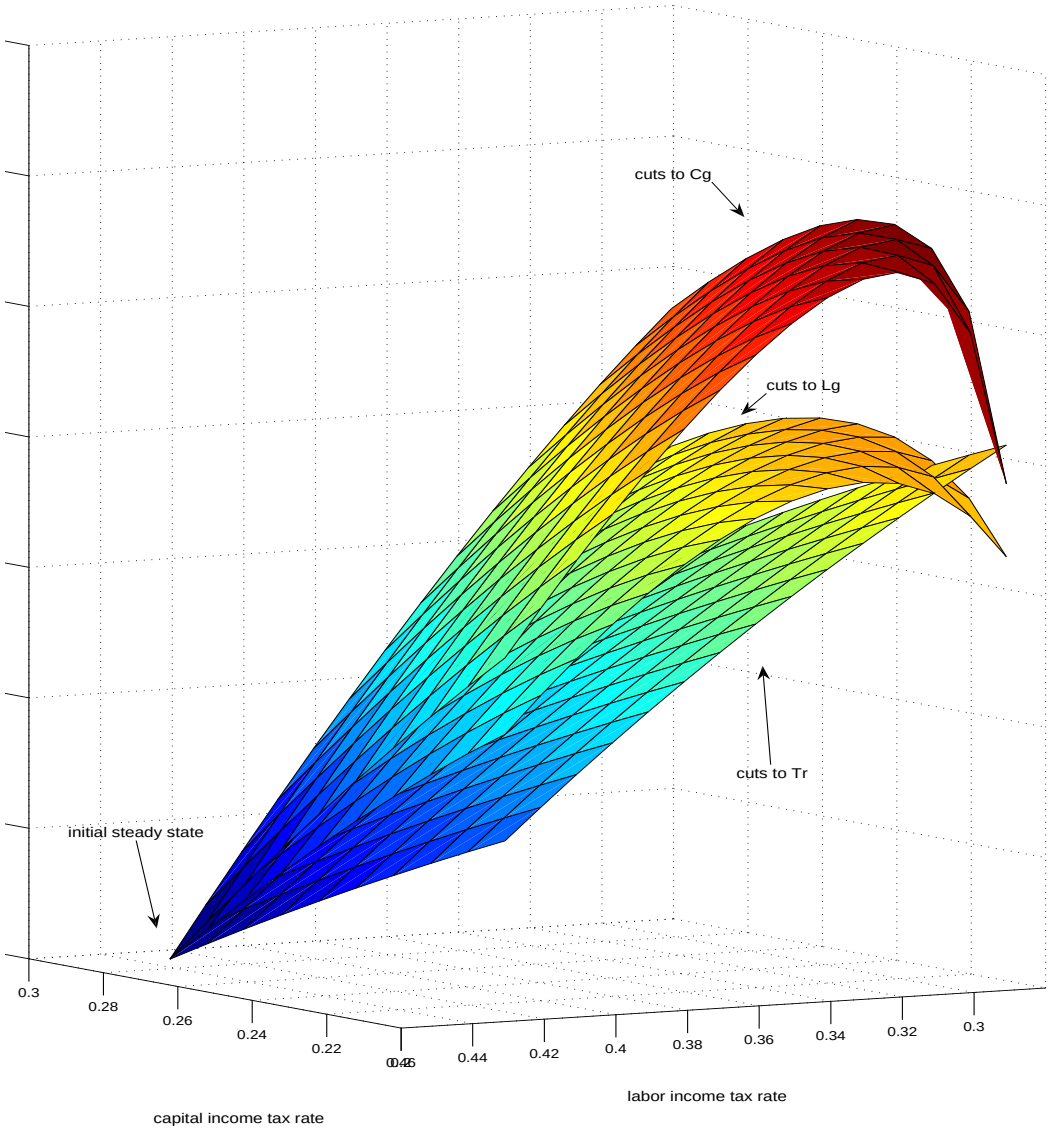

Figure 2. Baseline scenario: fiscal variables

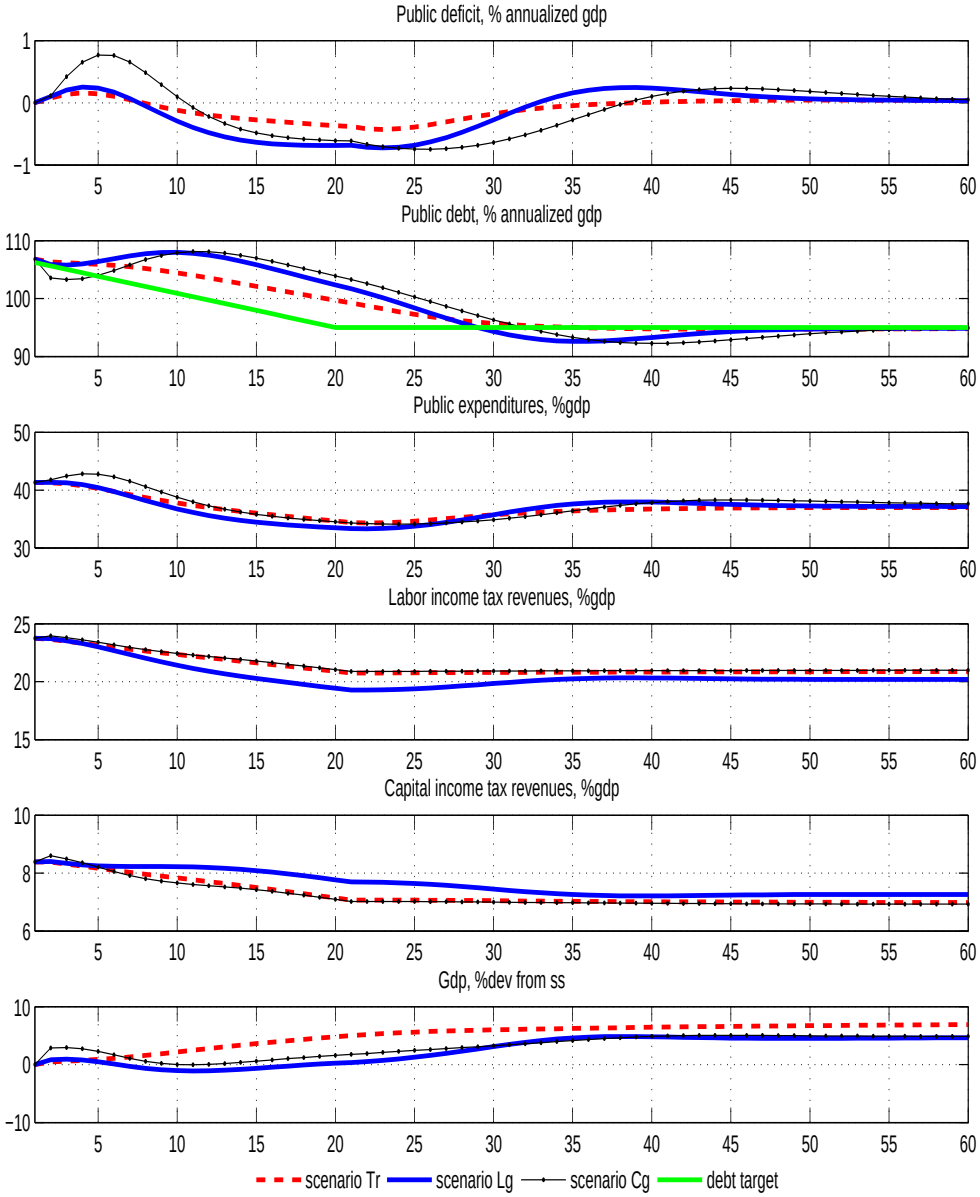

Figure 3. Baseline scenario: macroeconomic variables