Fiscal Consolidation in a Small Euro-Area Economy*

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This article focuses on macroeconomic impacts and welfare effects of a fiscal consolidation process in a small euro-area economy. Fiscal consolidation is defined as a permanent decline in the ratio of public debt to GDP. The analysis is based on PESSOA, a New Keynesian general equilibrium model with non-Ricardian agents. The results suggest that a reduction in public expenditure leads in the long run to sizable increases in output and tends to improve welfare, specifically because it allows for a sustainable decrease in the labor income tax rate. However, output and consumption decline in the short run, and current generations are likely to experience welfare losses. This situation might well provide a rationale for the frequent lack of political will to move in this direction. The results are robust to alternative paths for fiscal consolidation.

JEL Codes: E62, F41, H63.

1. Introduction

The Great Recession triggered massive fiscal stimulus in many economies. The injection of public funds in troubled financial institutions assumed a crucial role in bringing systemic risk under control, against a background characterized by tight financing conditions around the globe. Public debt levels increased substantially in many developed economies, including some in the euro area, raising

*We are indebted to Michael Kumhof and Douglas Laxton. This article would not exist without their inspiration and contribution. We would also like to thank the two anonymous referees for their comments and suggestions, as well as the participants in the Working Group on Econometric Modelling of the Eurosystem for the valuable discussions.

sustainability concerns and bringing debt sustainability and fiscal consolidation to center stage in the policy debate.

The international financial and economic crisis also highlighted the heterogenous nature of euro-area economies. Indeed, countries revealing larger structural fragilities, specifically larger fiscal imbalances or asset-price bubbles, found themselves singled out in international wholesale credit markets, with resultant severe impact on domestic financing conditions and on economic activity. In this context, ensuring debt sustainability, evaluating the benefits of fiscal consolidation in the long run, and creating conditions for a successful consolidation process became a focus for the economic literature (Barrios, Langedijk, and Pench 2010; Mulas-Granados, Baldacci, and Gupta 2010; Rother, Schuknecht, and Stark 2010).

This article focuses on the impacts on economic activity, demand conditions, and welfare during a period of fiscal consolidation in a small euro-area economy. Fiscal consolidation is defined as a permanent decline in the ratio of public debt to GDP. The analysis is based on PESSOA, a New Keynesian general equilibrium model with non-Ricardian agents. The results suggest that a reduction in public expenditure leads to sizable output increases in the long run and is likely to be welfare improving. This outcome is obtained after an a priori evaluation of the main transmission channels of alternative fiscal instruments (transfers to households, government consumption, and taxes on wage income and consumption). More precisely, a benchmark fiscal consolidation strategy was set out, based on expenditure cuts (government consumption and transfers to households), where the tax burden on wage income adjusts endogenously. The robustness of the results is evaluated for alternative paces of fiscal tightening.

This article adds to the existing literature on expansionary fiscal consolidations. Kumhof et al. (2011) acknowledge that an important driving force behind the long-run gains in worldwide fiscal consolidation is that the increase in the world savings rate creates room for a drop in real interest rates and this boosts economic activity. The results documented in this article show that the long-run gains are preserved in the case of a small open economy (SOE) without independent monetary policy and with no influence in world real interest rates. This case is of paramount importance for Southern European economies currently under stress in sovereign debt markets.

The results of this article are subject to some caveats. Firstly, the model is silent on the interaction between fiscal consolidation and financing conditions. This is particularly relevant against an international environment shaped by sovereign debt crises. Moreover, the model assumes perfect credibility of fiscal policy, while the impact of alternative consolidation strategies on financing prospects may also depend on credibility issues. Secondly, the model does not account for income inequality, which plays a key role in fiscal policy strategies and may also interact with financial stability. Some recent literature suggests that income inequality may have played a part in triggering the financial crisis (Kumhof and Rancière 2010; Kumhof et al. 2012), though some empirical evidence suggests that this may not represent a general relationship (Bordo and Meissner 2012).

The structure of the article is as follows. The model is presented in section 2. Section 3 addresses the costs and benefits of fiscal consolidation, including alternative paces of fiscal tightening. Section 4 concludes and draws some policy implications.

2. A Model for a Small Euro-Area Economy

This section briefly presents PESSOA, the New Keynesian dynamic general equilibrium model behind the analysis of the macroeconomic impacts of a fiscal consolidation process.[1] The model features an SOE integrated in a fully fledged monetary union (MU)—in this case, the euro area. We assume from the outset that the rest of the MU is immune to domestic shocks. Hence, developments in foreign interest rates are orthogonal to domestic developments as in Adolfson et al. (2007) and domestic interest rates can only deviate from the MU reference rate by a risk premium. Contrary to most general equilibrium models in the literature on SOEs, PESSOA has intrinsic non-Ricardian features based on the International Monetary Fund's (IMF's) Global Integrated Monetary and Fiscal model (Kumhof et al. 2010): (i) finitely lived households in line with the stochastic finite lifetime framework (Yaari 1965; Blanchard 1985; Buiter 1988; Weil 1989); (ii) distortionary taxation on household

[1] A more detailed description of the model can be found in Almeida, Castro, and Félix (2010).

consumption, labor, and capital income; and (iii) hand-to-mouth households (Galí, López-Salido, and Vallés 2007).

It is well known that breaking the Ricardian equivalence is important to generate realistic private consumption responses to government expenditure shocks (Blanchard 1985; Galí, López-Salido, and Vallés 2007). The stochastic finite lifetime framework may generate sizable wealth effects from public debt issuance, which are absent in the workhorse infinitely lived agent framework (Frenkel and Razin 1996; Kumhof and Laxton 2009b). In the Blanchard-Yaari-Buiter-Weil world, households strongly prefer debt issuance to tax financing of government expenditure, since future generations will bear some of the tax burden (Buiter 1988). In addition, this framework allows for the endogenous determination of the net foreign asset position of the economy, since finite lifetimes limit the amount of assets/debt that a household can accumulate (Harrison et al. 2005). This represents an appealing feature for the simulation of permanent fiscal shocks, since it generates a positive correlation between public debt and the net foreign debt position.[2] The link between fiscal consolidation and the current account balance has been assessed in IMF (2011).

Since PESSOA is designed for an SOE integrated in an MU, the economy's adjustment mechanism to domestic shocks is rather different from the standard SOE model. The dynamic stability of the model is ensured by an active role of the real exchange rate, which has sizable impacts on competitiveness, trade, and, thus, on the net foreign asset/debt position of the economy. In a context in which foreign prices are independent of domestic shocks, it is the real exchange rate that pins down the domestic price level.

Finally, the monopolistic structure in labor and product markets yields market power to both workers and firms. This, in combination with a number of nominal rigidities that imply staggered wage and price inflation adjustment, creates room for an active macroeconomic stabilization policy. On the real side, external habit formation in

[2]On the contrary, in the infinitely lived agents model, the steady-state net foreign asset position is pinned down exogenously (Schmitt-Grohe and Uribe 2003), implying that changes in steady-state public debt are fully offset by changes in private savings and are, by assumption, uncorrelated with the net foreign debt.

private consumption and quadratic adjustment costs on investment and on the import content of final demand are featured.

2.1 Households

Households evolve according to the overlapping-generations scheme first proposed in Blanchard (1985). All households are subject to stochastic finite lifetimes, facing an equal constant instant probability of death $1-\theta$.[3] The overall size of the population, N, is constant, implying that in each period $N(1-\theta)$ households die and the same number are born. Two types of households coexist: asset holders (type $\mathcal{A}$) that smooth out their consumption over their lifetime by trading in assets, and hand-to-mouth households à la Galí, López-Salido, and Vallés (2007) (type $\mathcal{B}$) that do not trade assets and consume all their income in each and every period. The share of type $\mathcal{B}$ households is constant at ψ, implying that in each period there exist $N(1-\psi)$ asset holders and $N\psi$ hand-to-mouth households.

A representative household of type $H \in \{\mathcal{A}, \mathcal{B}\}$ with age a derives utility from consumption, $C^H_{a,t}$, and leisure, $1 - L^H_{a,t}$, according to a constant relative risk aversion (CRRA) utility function.[4] Expected lifetime utility is given by

$$E_t \sum_{s=0}^{\infty} (\beta\theta)^s \frac{1}{1-\gamma} \left[\left(\frac{C^H_{a+s,t+s}}{Hab^H_{a+s,t+s}} \right)^{\eta^H} (1 - L^H_{a+s,t+s})^{1-\eta^H} \right]^{1-\gamma}, \quad (1)$$

where E_t is the expectation operator, $0 \leq \beta \leq 1$ stands for the standard time discount factor, $\gamma > 0$ is the coefficient of risk aversion, and $0 \leq \eta^H \leq 1$ is a distribution parameter. Hab^H_t stands for external habits, defined in terms of per capita consumption $[C^{\mathcal{A}}_{t-1}/(N(1-\psi))]^v$ and $[C^{\mathcal{B}}_{t-1}/(N\psi)]^v$ for type $\mathcal{A}$ and $\mathcal{B}$ households, respectively, with parameter $0 \leq v \leq 1$ controlling for the

[3] Probability $1-\theta$ can also be interpreted as a probability of "economic death" or a degree of "myopia" (Blanchard 1985; Frenkel and Razin 1996; Harrison et al. 2005; Bayoumi and Sgherri 2006).

[4] $L^H_{a,t}$ stands for hours worked as a percentage of households' full time endowment.

degree of habit persistence.[5] Note that government consumption is not included in equation (1) and therefore does not contribute directly to household utility, as in Kumhof et al. (2011), which is acknowledged to be an extreme case.

Type $\mathcal{A}$ households trade in both domestic ($B_{a,t}$) and foreign government bonds ($B^*_{a,t}$), which yield gross nominal interest rates i_t and i^*_t, respectively. Interest is assumed to be disbursed at the beginning of period $t+1$. Type $\mathcal{A}$ households earn labor income at a wage rate, W_t, adjusted by the household's age-specific productivity level, $\Phi_a = k\chi^a$ (k is a scaling factor and $0 \leq \chi \leq 1$ is the labor productivity rate of decay), roughly mimicking a life-cycle income profile. In addition, asset holders receive dividends from firms and labor unions, $D^{\mathcal{A}}_{a,t}(x)$. Finally, households pay consumption and labor income taxes ($\tau_{C,t}$ and $\tau_{L,t}$ are the respective average tax rates) and receive transfers from both the government ($TRG^{\mathcal{A}}_t$) and abroad ($TRX^{\mathcal{A}}_t$).

The asset holders' optimization problem consists in setting the path of consumption, labor, and domestic and foreign asset holdings, which maximizes (1) subject to the following budget constraint:

$$\begin{aligned} P_t C^{\mathcal{A}}_{a,t} + B_{a,t} + B^*_{a,t} \leq \frac{1}{\theta}\left[i_{t-1}B_{a-1,t-1} + i^*_{t-1}\Psi_t B^*_{a-1,t-1}\right] \\ + W_t \Phi_a L^{\mathcal{A}}_{a,t}(1-\tau_{L,t}) \\ + \sum_{\substack{x=\mathcal{N},\mathcal{T},\mathcal{C},\\ \mathcal{G},\mathcal{I},\mathcal{X},\mathcal{U}}} D^{\mathcal{A}}_{a,t}(x) + TRG^{\mathcal{A}}_t + TRX^{\mathcal{A}}_t, \quad (2) \end{aligned}$$

where $P_t = (1+\tau_{C,t})P^C_t$ is the after-tax price of the final consumption good and is taken as the numeraire price, while P^C_t is the before-tax price.

Type $\mathcal{A}$ households are not indifferent as to financing government expenditure with tax levies or debt issuance (i.e., future taxes). Non-Ricardian behavior (namely, finite lifetimes amplified by the life-cycle income profile) imply that asset holders strongly prefer debt financing, since they take part of the government bond holdings as

[5]Aggregation across generations is feasible only under multiplicative habits. However, it is recognized that this formulation generates lower consumption persistence than additive habits.

net wealth. Indeed, in the case of debt financing, current generations purchase a share of the newly issued debt that exceeds the present discounted value of corresponding future tax liabilities, since future taxes will be charged largely on yet-to-be born generations. Hence, part of the debt held by current generations can be used to finance private consumption expenditure during their lifetime, instead of being used to face future tax liabilities. These effects are magnified by the above-mentioned life-cycle income profile, which implies that the further apart in time taxes are levied, the lower the labor income tax payments of current generations. In this framework, households tend to be more shortsighted than in infinitely lived agents models.

The lack of access to asset markets by type $\mathcal{B}$ households is an additional source of non-Ricardian behavior. The objective function of these households is also given by the utility function (1), though they cannot smooth consumption by trading in assets, being instead constrained to consume at most, in each period, their current income (that is, the after-tax wage income plus all transfers from both the government and abroad). The optimization problem is to maximize (1) subject to the following budget constraint:

$$P_t C^{\mathcal{B}}_{a,t} \leq W_t \Phi_a L^{\mathcal{B}}_{a,t}(1-\tau_{L,t}) + D^{\mathcal{B}}_{a,t}(\mathcal{U}) + TRG^{\mathcal{B}}_t + TRX^{\mathcal{B}}_t. \quad (3)$$

The households' maximization problem delivers a condition for each type of household that yields their optimal consumption-labor allocation and a consumption function that depends on current income in the case of hand-to-mouth households (which represents all their wealth in each period) and on human and financial wealth in the case of asset holders. Human wealth corresponds to the present discounted value of labor and dividend income accruing in the future, while financial wealth corresponds to current domestic and foreign asset holdings. In the case of asset holders, an interest rate parity condition resulting from portfolio optimization defines the equilibrium in the bonds market. This implies that domestic interest rates depart from foreign interest rates by a risk premium, Ψ_t, which is modeled as an exogenous process.

2.2 Unions

There is a continuum of labor unions in the economy $h \in [0,1]$. Unions transform homogenous labor services into differentiated

varieties, $U_t(h)$. Labor varieties are bundled and then sold to manufacturers at an aggregate wage, V_t, higher than the households' wage, W_t. Labor differentiation yields market power, which is used by labor unions to charge a markup, reflecting limited substitutability among labor varieties in the bundle purchased by manufacturer $j, U_t(j)$.

Each manufacturer demands a specific labor bundle. Aggregating across manufacturers, the demand for labor variety h is given by

$$U_t(h) = \left(\frac{V_t(h)}{V_t}\right)^{-\sigma_{U,t}} U_t, \tag{4}$$

where $V_t(h)$ represents the variety h wage and $0 \leq \sigma_{U,t} \leq \infty$ the elasticity of substitution across labor varieties determining the wage markup in the steady state.

Wage adjustments are costly, with abrupt changes in $V_t(h)$ being more costly than smooth adjustments. It is assumed that labor unions incur quadratic wage adjustment costs, $\Gamma_t^{\mathcal{U}}(h)$, as in Ireland (2001) and Laxton and Pesenti (2003).[6]

Labor union h solves the following dividend-maximization problem:

$$\max_{V_t(h)} E_t \sum_{s=0}^{\infty} \tilde{R}_{t,s} D_{t+s}^{\mathcal{U}}(h) \tag{5}$$

with

$$\tilde{R}_{t,s} = \prod_{l=1}^{s} \frac{\theta}{i_{t+l-1}} \text{ for } s > 0 (1 \text{ for } s = 0)$$

subject to labor demand (4) and quadratic adjustment costs $\Gamma_t^{\mathcal{U}}(h)$. $\tilde{R}_{t,s}$ stands for the subjective nominal discount factor and i_t is the nominal interest rate. Labor unions are owned by households and managed under the preferences of finitely lived agents. Therefore, the subjective discount factor in the maximization problem of labor unions and firms incorporates the survival rate θ.

[6]More specifically, quadratic adjustment costs are specified as $\Gamma_t^{\mathcal{U}}(h) = \frac{\phi_{\mathcal{U}}}{2} T_t U_t (\frac{V_t(h)/V_{t-1}(h)}{V_{t-1}/V_{t-2}} - 1)^2$, where T_t is labor-augmenting technical progress. A number of real and nominal variables are subject to this type of costs in PESSOA and follow similar formulations.

Period t dividends, $D_t^{\mathcal{U}}(h)$, are defined as

$$D_t^{\mathcal{U}}(h) = (1 - \tau_{L,t}) \left[(V_t(h) - W_t) U_t(h) - P_t \Gamma_t^{\mathcal{U}}(h) \right]. \tag{6}$$

2.3 Firms

Two types of firms are featured: manufacturers and distributors. Manufacturers produce differentiated tradable ($\mathcal{T}$) and non-tradable ($\mathcal{N}$) intermediate goods, using a constant elasticity of substitution (CES) technology. Manufacturers hire labor from unions and manage a capital stock by purchasing new capital from the distributor who produces investment goods. In turn, distributors combine domestic intermediate goods (both tradable and non-tradable) with imports to produce differentiated final goods that fulfill final demand.

2.3.1 Manufacturers

For each type of intermediate good $J \in \{\mathcal{T}, \mathcal{N}\}$, there is a continuum of manufacturers $j \in [0, 1]$. Each manufacturer produces a variety, $Z_t^J(j)$, combining capital, $K_t^J(j)$, and labor, $U_t^J(j)$, through a CES production function with labor-augmenting technology, which is the source of real growth in the model. Manufacturers sell variety j at a price $P_t^J(j)$, which corresponds to a markup over marginal costs, reflecting the market power yielded by the limited substitutability between intermediate goods varieties.

Capital accumulation by manufacturer j follows a standard accumulation condition, $K_{t+1}^J(j) = (1 - \delta^J) K_t^J(j) + I_t^J(j)$, where $I_t^J(j)$ stands for the new capital goods purchased in period t that will start operating in $t + 1$, and $0 \leq \delta^J \leq 1$ is the constant depreciation rate of type J firms.

To obtain smooth responses to shocks, capital and labor services are subject to quadratic real adjustment costs ($\Gamma_t^{\mathcal{I}J}(j)$ and $\Gamma_t^{\mathcal{U}J}(j)$, respectively). Furthermore, realistic inflation persistence in the intermediate goods price is ensured by quadratic inflation adjustment costs, $\Gamma_t^{PJ}(j)$, as in Rotemberg (1982).

In this framework, each distributor sets the demand for variety j of the intermediate good that is cost minimizing. Aggregating across distributors, the demand for variety j is given by

$$Z_t^J(j) = \left(\frac{P_t^J(j)}{P_t^J} \right)^{-\sigma_{J,t}} Z_t^J, \tag{7}$$

where $P_t^J(j)$ represents the variety j price and $0 \leq \sigma_{J,t} \leq \infty$ the elasticity of substitution between type J good varieties.

Manufacturer j solves the following dividend-maximization problem:

$$\max_{P_t^J(j), I_t^J(j), U_t^J(j), K_{t+1}^J(j)} \quad E_t \sum_{s=0}^{\infty} \tilde{R}_{t,s} D_{t+s}^J(j) \tag{8}$$

subject to the constraints imposed by the CES technology, capital accumulation condition, quadratic adjustment costs, and the demand curve (7).

Period t dividends, $D_t^J(j)$, are defined as

$$\begin{aligned} D_t^J(j) = (1 - \tau_{K,t}) & \\ & \times \left[P_t^J(j) Z_t^J(j) - (1 + \tau_{SP,t}) V_t U_t^J(j) - \text{ adj. \& fixed costs}\right] \\ & - P_t^{\mathcal{I}} I_t^J(j) + \tau_{K,t} P_t^{\mathcal{I}} q_t^J \delta^J K_t^J(j). \end{aligned}$$

Dividends before corporate income tax correspond to sales revenues, $P_t^J(j) Z_t^J(j)$, net of labor costs, $(1 + \tau_{SP,t}) V_t U_t^J(j)$ (where $\tau_{SP,t}$ is firms' payroll tax rate), adjustment and fixed costs,[7] and investment spending, $P_t^{\mathcal{I}} I_t^J(j)$. The expression $\tau_{K,t} P_t^{\mathcal{I}} q_t^J \delta^J K_t^J(j)$ accounts for the corporate income tax rebate of capital depreciation, where $\tau_{K,t}$ is the corporate income tax rate and q_t^J stands for Tobin's Q, which is the shadow price of a unit of installed capital in terms of new capital goods. It should be noted that corporate income tax is charged on net operational profits, implying that, in contrast with investment spending, capital depreciation is tax rebatable.

2.3.2 Distributors

There is a continuum of distributors $f \in [0, 1]$ producing each type of final good $F \in \{\mathcal{C}, \mathcal{G}, \mathcal{I}, \mathcal{X}\}$. Each type of final good is demanded by a unique type of customer: consumer goods ($\mathcal{C}$) are demanded by households, new capital goods ($\mathcal{I}$) are demanded by manufacturers, government consumption goods ($\mathcal{G}$) are demanded by the

[7] A real fixed-cost term is used to ensure that economic profits arising from monopolistic competition are largely depleted in the steady state and, therefore, no firm enters or leaves the market. The fixed-cost term is defined as a constant share of nominal output, ensuring that it does not vanish along the inflationary balanced growth path of the economy.

public sector, and export goods ($\mathcal{X}$) are demanded by foreign customers. Each distributor sells its good variety f at price $P_t^F(f)$, which is set as a markup over marginal costs (reflecting the imperfect substitutability across each type of final goods).

Each distributor uses a two-stage CES production technology. In the first stage, distributor f uses a CES technology to obtain an assembled good, $Y_t^{\mathcal{A}F}(f)$, through the combination of domestic tradable goods, $Z_t^{\mathcal{T}F}(f)$, with imported goods, $M_t^F(f)$. To change the import content of the assembled good, the distributor incurs quadratic real adjustment costs $\Gamma_t^{AF}(f)$. In the second stage, the distributor combines the assembled good with domestic non-tradable goods, $Z_t^{\mathcal{N}F}(f)$, using also a CES technology, to produce the variety f of the final good, $Y_t^F(f)$.[8]

As with manufacturers, distributors also face quadratic inflation adjustment costs, $\Gamma_t^{PF}(f)$, which generate realistic inflation dynamics.

In this framework, each customer sets the demand for variety f of the final good that is cost minimizing. Aggregating across customers, the demand for variety f is given by

$$Y_t^F(f) = \left(\frac{P_t^F(j)}{P_t^F}\right)^{-\sigma_{F,t}} Y_t^F, \tag{9}$$

where $0 \leq \sigma_{F,t} \leq \infty$ is the elasticity of substitution between varieties of the type F good.

Each final goods producer f solves the following dividend-maximization problem:

$$\max_{P_t^F(f), Z_t^{\mathcal{T}F}(f), Z_t^{\mathcal{N}F}(f), M_t^F(f)} E_t \sum_{s=0}^{\infty} \tilde{R}_{t,s} D_{t+s}^F(f) \tag{10}$$

subject to the constraints imposed by the CES technology, adjustment costs, and demand curve (9). Period t dividends, $D_t^F(j)$, are defined as

$$\begin{aligned} D_t^F(f) = (1-\tau_{K,t}) \big[& P_t^F(f) Y_t^F(f) - P_t^{\mathcal{T}} Z_t^{\mathcal{T}F}(f) \\ & - P_t^{\mathcal{N}} Z_t^{\mathcal{N}F}(f) - P_t^* M_t^F(f) - \text{ adj. \& fixed costs} \big]. \end{aligned}$$

[8] The production technology can be formalized as a sector-specific nested CES production function, $Y_t^F(f) = CES_2\{CES_1[Z_t^{\mathcal{T}F}(f), M_t^F(f)], Z_t^{\mathcal{N}F}(f)\}$.

Dividends before corporate income tax correspond to sales, $P_t^F(f)Y_t^F(f)$, net of input costs, $P_t^{\mathcal{T}}Z_t^{\mathcal{T}F}(f) + P_t^{\mathcal{N}}Z_t^{\mathcal{N}F}(f) + P_t^* M_t^F(f)$, and adjustment and fixed costs. Finally, P_t^* is the price of imported goods set by foreign suppliers.

Finally, it should be mentioned that public capital stock, resulting from the accumulation of public investment, is not explicitly modeled and therefore plays no role in the production function of firms. The model is therefore silent on the role played by some public policies, such as the development of infrastructures that are used by the private sector. Nevertheless, it should also be noted that many projects are developed by private firms in the context of public-private partnerships and public concessions.

2.4 The Government

The fiscal block of the model is detailed enough to allow for the assessment of macroeconomic impacts of alternative fiscal policy strategies. The government finances expenditure through tax levies and manages a public debt stock.

The government consumes a specific final good, $P_t^{\mathcal{G}}G_t$ ($P_t^{\mathcal{G}}$ is the price charged by distributors for the government consumption good) and performs lump-sum transfers to households, TRG_t. In addition, the government pays debt interest outlays, $(i_{t-1} - 1)B_{t-1}$, to asset holders.

Government spending is financed by taxes on households' labor income and consumption, on manufacturers' payroll, and on corporate income.[9] Note that the average tax rates that have an impact on wage income are the labor income tax paid by employees, $\tau_{L,t}$, and the payroll taxes paid by employers, $\tau_{SP,t}$. Taken together, they represent what will henceforth be called the "tax burden on wage income."

The government issues one-period bonds, paying interest outlays at the beginning of period t on the stock held from $t-1$. Is is assumed that all government debt is held by domestic asset holders (i.e., full home bias is assumed). However, these households can borrow in

[9]The possibility of government expenditures being partly financed by transfers from the rest of the MU is also considered, but it does not play an active role in this article.

international debt markets to buy domestic government bonds.[10] The issuance of public debt allows for the postponement of the tax levies required to finance expenditure in each period, implying that the public-sector account does not need to be balanced in each and every period. This has a non-trivial impact on household decisions, since part of the public debt is taken as net wealth by asset holders.

To ensure that public debt follows a non-explosive path, a fiscal policy rule is introduced, with the imposition that the ratio of public debt to GDP, B_t/GDP_t, and the ratio of fiscal balance to GDP, SG_t/GDP_t, converge to predetermined (target) steady-state levels. The fiscal rule implies that at least one fiscal instrument adjusts endogenously. In line with Kumhof and Laxton (2009a), the following rule is considered:

$$\left(\frac{SG}{GDP}\right)_t = \left(\frac{SG}{GDP}\right)_t^{target} + d_1\left(\frac{RV_t - RV_t^{ss}}{GDP_t^{ss}}\right) + d_2\left(\frac{B_t}{GDP_t^{ss}} - \left(\frac{B}{GDP}\right)_t^{target}\right), \tag{11}$$

where RV_t^{ss} is the structural overall tax revenue (i.e., the tax revenue that is collected when tax bases stand at their steady-state levels), and GDP_t and GDP_t^{ss} are the observed and the steady-state GDP levels. The response to business-cycle fluctuations and the speed of convergence to the public debt target depend on parameters d_1 and d_2, respectively. Parameter d_1 controls for the response to the tax revenue gap and parameter d_2 controls for the government (in)tolerance to deviations from the debt target. In the steady state, both the tax revenue gap and the debt gap are zero.

At this point, the fiscal instrument that becomes endogenous remains to be defined. A common option relies on the use of the labor income tax rate as the endogenous fiscal policy instrument (Kilponen and Ripatti 2005; Kumhof and Laxton 2007; Kumhof et al. 2010). Nevertheless, other possibilities are available in PESSOA, among them using one of the remaining taxes, lump-sum transfers

[10] In an environment without financial frictions, the assumption of full home bias in public debt holding is likely to be neutral. The absence of financial frictions is an acknowledged fragility of the model.

to households, government consumption, or a combination of these instruments.

Finally, a word of caution is needed. Although the above-mentioned fiscal block is suited to implement several fiscal simulations, the model remains a simplification of reality. As already mentioned, government consumption and investment are assumed not to generate any externalities and, therefore, do not affect the marginal utility of consumption and leisure or firms' productivity level. The only tangible impact of government consumption is on the demand conditions for a specific final good, which is particularly intensive in non-tradable intermediate goods and has a low import content. The model is thus silent on other roles played by the government—in particular, as a large-scale employer and investor—or on the externalities associated with alternative fiscal policies. Note also that the model does not feature unemployment benefits explicitly, since the labor market is not explicitly modeled.

2.5 The Rest of the World

In PESSOA, the rest of the world (RoW) corresponds to the rest of the euro area. Without loss of generality, the nominal effective exchange rate is irrevocably set to unity.

As for trade flows, the demand for imports by domestic distributors results from the cost-minimization problem presented in section 2.3 and reflects final demand conditions and competitiveness. Domestic exports are essentially determined by the foreign distributors' imports demand. Foreign distributors are assumed to be identical to domestic ones, and therefore their demand for domestic economy exports results from their cost-minimization problem subject to a CES technology. The representative foreign distributor produces a final good variety, $Y_t^*(f^*)$, by assembling domestic economy exports (i.e., foreign economy imports), $X_t(f^*)$, and intermediate goods produced by foreign manufacturers, $Z_t^*(f^*)$.

Aggregating across foreign final goods producers and export good varieties, the demand for domestic exports is given by

$$X_t = \alpha^* \left(\frac{P_t^X}{P_t^*} \right)^{-\xi^*} Y_t^*, \tag{12}$$

where P_t^X is the aggregate export price charged by domestic distributors, P_t^* is the price of the foreign good, and Y_t^* is foreign output level. Parameter α^*, the CES quasi-share, is of key importance in determining the steady-state export market share. In turn, ξ^* is the elasticity of substitution between home exports and foreign goods.

Equation (12) is fundamental to render the model dynamically stable. In particular, a large real exchange rate elasticity of exports is required. The model operates like a fixed nominal exchange rate model under perfect credibility, in which domestic price levels are pinned down by the external constraint that uniquely sets the real exchange rate in the steady state.[11] Like the remaining foreign variables, both P_t^* and Y_t^* are assumed to be independent of domestic developments.

Regarding financial flows, the SOE approach relies on the assumption that changes in the domestic economy net foreign asset position have negligible impacts on euro-area aggregates and on policy decisions.

2.6 Market Clearing Conditions and GDP Definition

The model is closed by a set of conditions imposing market clearing for each and every period for labor, intermediate, and final goods. In a frictionless international financial environment, the modeling of financial flows becomes trivial and is fully determined by national saving decisions at the prevailing interest rate and by the following market clearing condition where changes in net foreign asset holdings must be identical to the current account balance:

$$B_t^* - i_{t-1}^* \Psi B_{t-1}^* = P_t^X X_t - P_t^* M_t + TRX_t. \tag{13}$$

Nominal GDP is defined as

$$GDP_t = P_t C_t + P_t^G G_t + P_t^I I_t + P_t^X X_t - P_t^* M_t. \tag{14}$$

Real GDP is aggregated by the Fisher formula.

[11] In the standard SOE model, monetary policy is actively managed and the adjustment of the real interest rate supplements the real exchange rate in rendering the model dynamically stable. In an SOE in an MU, the absence of monetary policy implies that real interest rate dynamics tend to amplify business-cycle fluctuations.

2.7 Calibration

PESSOA was calibrated to fit the Portuguese economy, using actual data and additional information from studies on the Portuguese and euro-area economies. The model parameters are presented in detail in the appendix.

There is a relatively large set of parameters and assumptions behind the model, and from these it is worth mentioning that the steady-state real GDP growth was assumed to be identical in the entire MU, ensuring the existence of a balanced growth path. The labor-augmenting productivity annual growth was set to 2 percent, which is consistent with the available estimates for the potential output growth in the euro area (Musso and Westermann 2005; Proietti and Musso 2007). This figure also seemed reasonable for Portugal (Almeida and Félix 2006).

Regarding inflation, the steady state was solved under the assumption that foreign inflation stands at 2 percent per year. The euro-area nominal interest rate in the steady state was set to 4.5 percent (Coenen, McAdam, and Straub 2007).

The parameters related to the Blanchard-Yaari households' behavior—specifically, the instant probability of death and the decay in productivity over the lifetime—were calibrated as in Kumhof et al. (2010). The elasticities of substitution in the production functions of manufacturers and distributors, the parameters governing wage and price markups, adjustment costs, and the fiscal rule parameters also follow Coenen, McAdam, and Straub (2007), Kumhof et al. (2010), and estimates for Portugal, whenever available.

2.8 Welfare Analysis

The utility function presented in equation (1) can also be used to conduct welfare analysis of alternative policy actions. This analysis can be seen as a metric stressing the role of consumption and leisure in households' utility, instead of simply focusing on output.

Some key issues arise in the computation of welfare in an overlapping-generations model with asset holders and rule-of-thumb households. Firstly, the impact of policy changes on welfare differs across current generations. Following Ganelli (2005) and Kumhof, Laxton, and Leigh (2010), consumption and leisure of households of

type $H \in \{\mathcal{A}, \mathcal{B}\}$ with age a in the utility function (1) is replaced by the corresponding average per capita values across all generations. Secondly, the impact of policy changes on welfare also differs between current and future generations. In an overlapping-generations framework, the discount rate (henceforth defined as Υ) determines the weight attached to current versus future generations in the overall welfare assessment. The higher the Υ, the larger the relative weight of current in comparison with future generations and the higher the weight attached to the transitional dynamics. Hence, the choice of Υ is not a straightforward matter and a variety of rates have been used in the literature. Ramsey (1928) and Stern (2007) advocate that all generations should be treated identically and therefore the future should not be discounted at all, which is tantamount to assessing welfare in the initial and in the final steady state and to attaching a negligible weight to the welfare implication in the transitional dynamics (this is assessed by setting, respectively, $\Upsilon = 0.0$ percent and $\Upsilon = 0.1$ percent in table 2). In turn, Kaplow (2007) advocates the optimality of using the market rate of return to capital ($\Upsilon = 2.8$ percent), while Marini and Scaramozzino (2000) favor a discount rate identical to productivity growth ($\Upsilon = 2.0$ percent). Besides the previous rates, it is also considered the households' discount rate ($\Upsilon = 6.8$ percent), which accounts for the finitely lived nature of households.

The welfare impacts are expressed in consumption good units using the compensating variation of consumption, that is, the percentage increase in the initial steady-state consumption that yields the same welfare as the policy change, while keeping the amount of leisure at the initial steady-state level. The aggregate value is obtained as a weighted average of compensating consumption variations of type $\mathcal{A}$ and $\mathcal{B}$ households, using their respective weights, $1 - \psi$ and ψ. A recent application using this type of household can be found in Kumhof et al. (2011).

Finally, it should be acknowledged that welfare analysis is conditioned by the working assumptions that government consumption does not directly affect households' utility or have any impact on factor productivity. Thus, any fiscal consolidation based on government consumption is perceived as less welfare harming than otherwise. A key issue in this context is whether this type of good is valued separably or not in the utility function. If government consumption enters

the utility function in a non-separable fashion, it affects the marginal rate of substitution between consumption and leisure. If this type of good enters in a separable fashion, the utility level is affected, as in Kumhof, Laxton, and Leigh (2010), but the households' decisions remain unchanged. The absence of these effects implies that the welfare impacts, arising from cuts in government consumption, should best be seen as upper-limit estimates. In turn, if the reduction in this type of government spending is achieved through higher efficiency in the provision of goods and services actually valued by households or by elimination of spending negligibly valued, then the absence of government consumption in equation (1) is more negligible.

3. The Costs and Benefits of Fiscal Consolidation

This section assesses the macroeconomic effects of a fiscal consolidation process in a small euro-area economy. Fiscal consolidation is defined as a permanent reduction in the public debt ratio and is implemented through an initial fiscal tightening. Over time, debt falls and so do government interest outlays, allowing for a larger primary deficit and creating room either for lower taxes or higher primary expenditure in the final steady state. More precisely, the fiscal consolidation process is implemented through equation (11) and takes the form of a permanent reduction in the fiscal deficit of 1 percent of the initial steady-state GDP. Given the assumptions for nominal interest rates and GDP growth, this leads to a decline in the public debt ratio of around 25 percentage points in the final steady state.

Before discussing the costs and benefits of a specific fiscal consolidation strategy, sub-section 3.1 presents in detail the impact and the main transmission channels for each fiscal instrument (transfers to households, government consumption, tax burden on wage income, and consumption taxes). Based on these results, a benchmark fiscal consolidation package is defined. This package considers mainly expenditure cuts (government consumption and transfers to households), and the fiscal room created by lower interest outlays in the final steady state is used to cut the tax burden on wage income. Sub-section 3.2 presents the macroeconomic impacts of different paces of the consolidation process. More specifically, three

alternative scenarios are considered: a slow consolidation scenario, a medium-pace scenario ("central scenario"), and a fast consolidation scenario.

The simulations presented in sub-sections 3.1 and 3.2 assume perfect foresight and full credibility of the fiscal authority. Therefore, the risk premium on public debt is assumed not to be affected by the chosen consolidation strategy.

3.1 Impact of Alternative Instruments

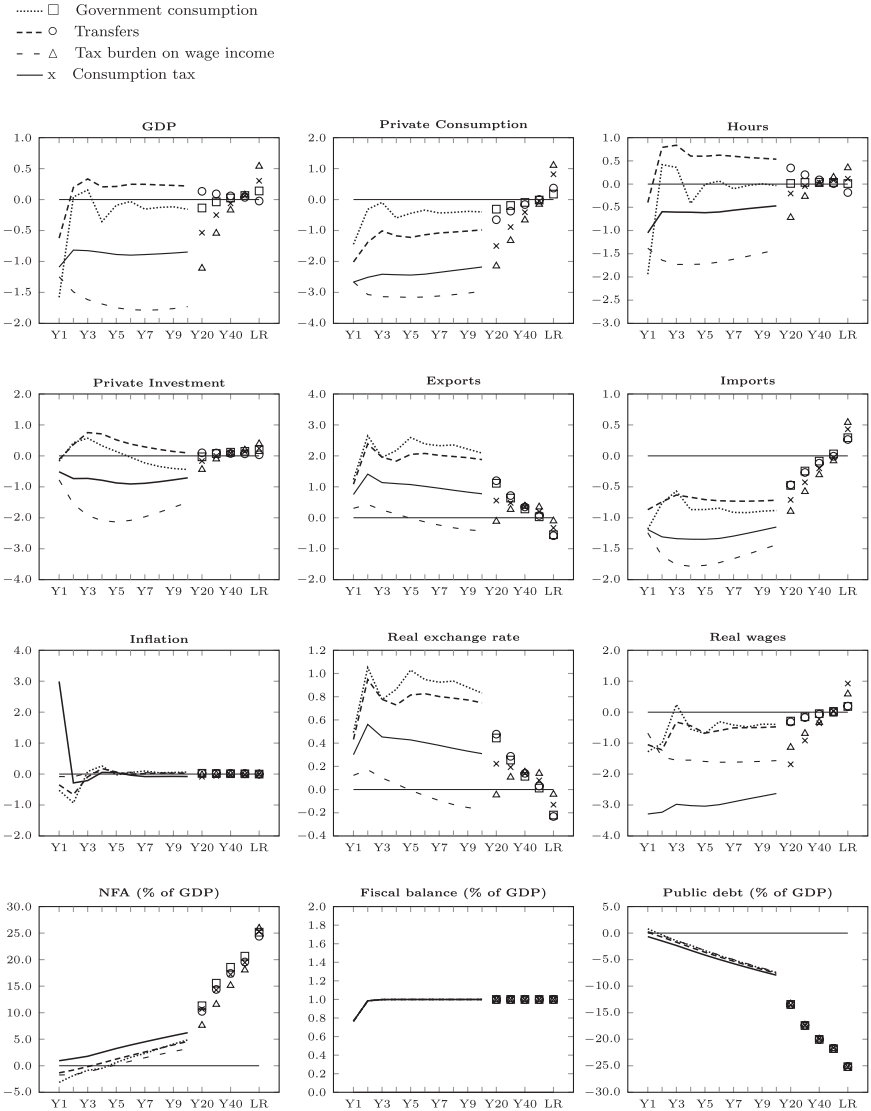
This sub-section investigates the short-, medium-, and long-run impacts of each fiscal instrument—namely transfers to households, government consumption, tax burden on wage income, and the consumption tax—and clarifies the main transmission channels of these instruments.[12]

All policy actions share the objectives of reaching a reduction in the fiscal deficit equal to 1 percent of the initial steady-state GDP (more than 90 percent of the reduction is assumed to be reached after one year) and a decrease in the public debt ratio of around 25 percentage points of GDP in the long run. The fiscal rule parameters in equation (11) are set to zero, implying that the endogenous fiscal instrument adjusts as much as needed to ensure that the fiscal balance matches the new target level in each and every period. This feature implies identical fiscal balances across all instruments and a very slow fiscal consolidation pace. Alternative fiscal consolidation paces will be discussed in the next sub-section.

To design the benchmark fiscal package, three different simulation exercises were implemented. The first simulation assumes that the fiscal instrument used to implement the initial tightening is the same one that is used to take advantage of the fiscal room created by lower interest outlays at longer horizons. Simulation results, in percentage deviations from the initial steady state, are presented in figure 1.

[12]Though lump-sum taxes are not explicitly considered, a cut in transfers can be reinterpreted as an increase in lump-sum taxes. The labor income tax and the firm payroll tax, defined in section 2 as the tax burden on wage income, are adjusted in identical magnitudes in terms of percentage-point changes in their average rates.

Figure 1. Macroeconomic Impacts Using One Fiscal Instrument



Notes: Values are expressed as percentage deviation from steady-state levels. Inflation, NFA, fiscal balance, and public debt deviations are in percentage points. The remaining variables are in percentages. A higher real exchange rate implies depreciation. "LR" refers to a long-run outcome. Note that while the first ten years are shown by lines, longer horizons are represented by markers. In each simulation, there is only one fiscal instrument being used at a time (which implies a unique instrument behind both the initial fiscal tightening and the fiscal rule that ensures a fiscal balance consistent with a stable debt path).

The results suggest that fiscal policy instruments operate through different channels. A fiscal consolidation based on a cut in transfers to households affects macroeconomic outcomes mainly through the impact on households' wealth and on the resulting responses of hours worked and private consumption. A reduction in transfers has significantly negative wealth effects, leading to a drop in consumption and leisure and, thus, to an increase in hours worked.[13] Households with no access to asset markets cut their consumption and simultaneously increase hours worked to partially compensate forgone income. The consumption of asset holders is less affected, reflecting improved dividend prospects and the ability to smooth consumption. Moreover, the upward shift in hours leads to lower real wages and to a decrease in firms' marginal costs, implying a drop in domestic prices and a real exchange rate depreciation.

A fiscal consolidation process based on a cut in government consumption implies a reduction in hours worked. Government consumption is extremely intensive in domestic non-tradable intermediate goods, which, in turn, are significantly labor intensive. As a consequence, real wages decline, as well as households' wealth and, consequently, private consumption. Hence, a cut in government consumption depresses domestic demand, thereby contributing to a decrease in domestic prices and, thus, to international competitiveness gains through a real exchange rate depreciation. The cut in government consumption ends up releasing resources that can be allocated to other sectors—in particular, to the production of tradable goods.

An expenditure-based fiscal tightening implies a reduction in demand pressures, promotes a real exchange rate depreciation, and improves the international competitiveness of domestic firms. The increase in competitiveness stimulates domestic production and factor demand and improves the external account, partly offsetting the recessive impact of fiscal consolidation. In contrast, the fall in expected inflation raises the real interest rate, exacerbating the

[13]In PESSOA, a cut in transfers induces a shift in labor supply. In practice, however, a part of the transfers is received by pensioners who do not actively supply labor. This feature is not captured and may significantly limit labor-supply impacts.

decline in aggregate demand and amplifying the short-run recessive effects of the fiscal consolidation measures.[14]

In turn, the results suggest that a fiscal tightening based on tax increases implies a protracted decline in output, private consumption, and investment to levels below the initial steady state. An increase in the labor income tax (one of the components of the tax burden on wage income) affects the economy mainly through its impact on the marginal rate of substitution between consumption and leisure. Hence, a rise in the labor income tax discourages workers, and this implies a decrease in labor supply. At the same time, an increase in firms' payroll taxes (the second component of the tax burden) leads to an increase in the marginal costs of firms, inducing an increase in capital intensity and a reduction in labor demand. Therefore, a rise in the tax burden on wage income implies a decrease in hours worked and an increase in domestic prices, gradually leading to a real exchange rate appreciation.

The consumption tax increase is less distortionary of the consumption/leisure allocation than the tax burden on wage income. Changes in the consumption tax affect the economy mainly through the price transmission channel, reducing the real value of households' wealth. This induces households to supply more labor in order to limit the impact of the negative wealth effects on consumption, leading to a smaller decline in hours worked than in the case of a higher tax burden on wage income.

In the first year, the most negative effect on output comes from a cut in government consumption, which is a result also obtained in several models (Coenen et al. 2012). From the second year onwards, tax-based policies are likely to involve higher losses in terms of GDP, while consolidation strategies based on transfers and government consumption are less penalizing. In the cases of consumption and investment, this result is valid even in the first year. These results suggest that fiscal consolidations should be initially biased towards spending cuts rather than tax hikes. This conclusion is further analyzed below. Theoretical analysis favoring fiscal consolidation based

[14]In models with autonomous monetary policy, the policy interest rate response plays a key role during the transition period. In this type of model, the contractionary short-term impact of fiscal consolidation is partly offset by a reduction in nominal interest rates in the case when the zero lower bound is not binding.

on spending cuts, following a fiscal stimulus, have been suggested by Corsetti et al. (2010). This policy option also seems appealing in the European context, since taxes are already at high levels in some economies and the recent period has been characterized by a rise in government spending. Expenditure cuts are nevertheless likely to imply reforms that take time to implement. Thus, in the short run, taxes may help to speed up the fiscal consolidation.

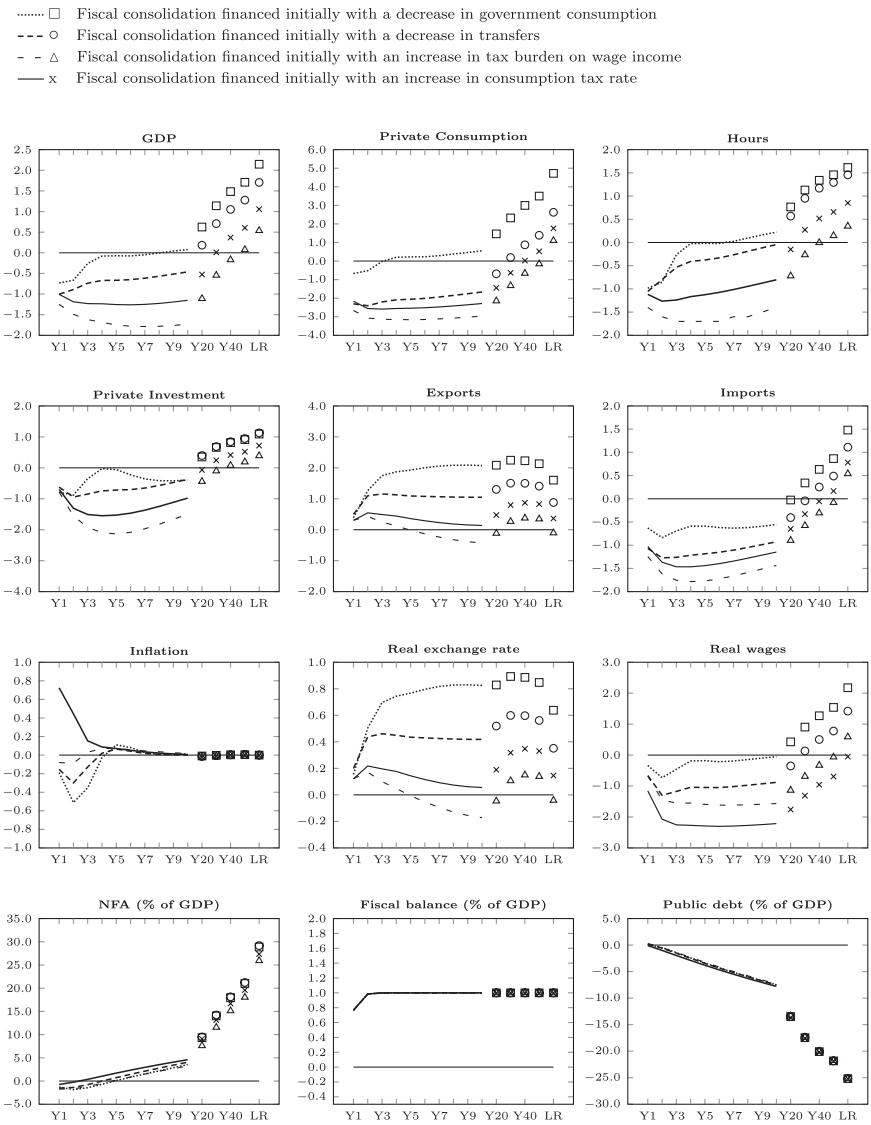
The results in figure 1 also illustrate that each fiscal instrument has different impacts over different time horizons. More specifically, the most adequate instrument in the short run is not necessarily the most effective in boosting economic activity in the long run.

To ensure that the previous finding (fiscal consolidations should be initially biased towards spending cuts) is not conditional on the instrument that adjusts endogenously in the fiscal rule, a second simulation is implemented. As before, the fiscal rule parameters are set to zero and the initial tightening is based on a single instrument at a time. However, the fiscal rule is now based on a unique instrument across all experiments—specifically, the tax burden on wage income, which according to the results presented in figure 1 is the most effective in boosting output in the long run. These taxes are thus the only instrument that adjusts to ensure that the fiscal balance is always on target. The results of the second simulation are presented in figure 2.

The conclusion that an expenditure-based fiscal tightening is preferable to tax increases is confirmed by the results of this simulation. In addition, the outcome suggests that the design of the fiscal package can benefit from the utilization of different instruments at different horizons. In comparison with a strategy in which the tax burden on wage income is used in the fiscal tightening phase, a fiscal consolidation policy initially biased towards government spending cuts is less costly in terms of forgone output (as measured by GDP) and households' consumption.

To design the benchmark fiscal package, the third simulation focuses exclusively on long-run impacts and introduces a welfare analysis of the alternative policy actions. The initial fiscal tightening is based on permanent cuts in government consumption and in transfers to households, each contributing 0.5 percent of initial steady-state GDP, while the fiscal room in the long run is used to either cut taxes or increase spending. The results are summarized in table 1.

Figure 2. Macroeconomic Impacts Using Two Fiscal Instruments



Notes: This figure reports the macroeconomic impacts of using one instrument at a time, but only to implement the initial tightening. The second instrument is always the tax burden on wage income, which is endogenously determined by the fiscal rule. For further information, see the notes presented in figure 1.

Table 1. Long-Run Impacts from the Lower Interest Rate Burden

	Lower Interest Burden Used to:			
	Reduce $\tau_L + \tau_{SP}$	**Reduce τ_C**	**Raise G**	**Raise TRG**
GDP	2.4	1.3	0.5	−0.3
Private Consumption	4.4	3.0	−0.2	0.8
Private Investment	1.5	0.7	0.6	−0.3
Exports	1.7	0.7	−0.5	−0.6
Imports	1.6	1.0	0.4	0.2
Hours	2.1	0.9	0.4	−0.6
Real Wage Rate	2.2	3.9	0.2	0.2
Real Exchange Rate	0.7	0.3	−0.2	−0.3
Welfare Analysis:				
CV in % of Initial SS Consumption	3.1	2.3	−0.5	1.2

Notes: Values are expressed as percentage deviation from steady-state levels. $\tau_L + \tau_{SP}$ represent the tax burden on wage income, τ_C is the consumption tax, G is government consumption, and TRG are lump-sum transfers to all households. "SS" stands for steady state and "CV" for compensating variation. Welfare analysis in this table treats all generations alike, following Ramsey (1928).

The results are in line with the standard view of relative distortionary features of the various fiscal instruments. In the long run, tax cuts have the larger GDP impact. The welfare analysis also points in the same direction. The consumption compensating variation varies between –0.5 percent and 3.1 percent, the latter delivered by the reduction of the tax burden on wage income. This policy option can thus be rationalized in terms of being welfare maximizing.

A fiscal strategy based on higher government consumption in the long run also delivers a positive impact on GDP, whereas an increase in transfers leads to a marginally negative impact. This negative impact is due to the fact that transfers are defined as lump-sum payments to households that may flexibly adjust their labor supply. Therefore, if the fiscal room is used to increase transfers, households reduce their labor supply in view of higher income and the possibility of higher consumption. In this case, the higher level of wages that is required to motivate households to supply enough labor leads

to a loss in competitiveness and to a drop in exports. This negative effect more than offsets the positive impact on consumption in the long run, implying a marginal negative impact on GDP.

3.2 The Benchmark Fiscal Consolidation under Alternative Timings

This sub-section assesses the costs and benefits of the benchmark fiscal consolidation strategy considering alternative paces of consolidation. The simulations are implemented by changing the calibrated fiscal parameters in equation (11) and by allowing the instrument that is endogenously determined by the fiscal rule to react to tax revenue gaps and to public debt deviations from target. In the previous sub-section, fiscal rule parameters were set to zero and this implied a slow and identical consolidation pace across all simulations (see figures 1 and 2). In this sub-section, the rule is calibrated to allow for alternative paces.

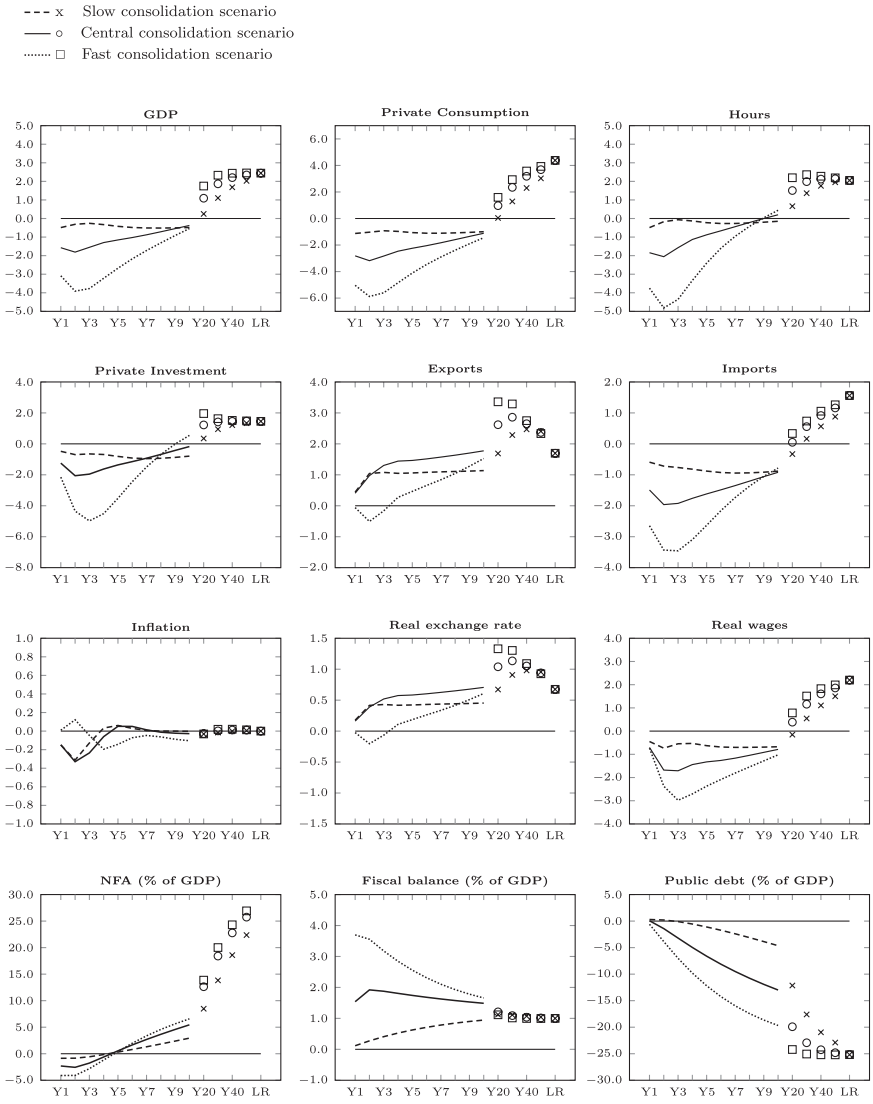
The benchmark fiscal consolidation strategy is defined as a permanent cut in government consumption and in transfers to households, each contributing with 0.5 percent of initial steady-state GDP. These measures are furthermore assumed to be gradually factored in over a period of two years. In the short run, the adjustment to a lower deficit level requires a slight increase in the tax burden, and this speeds up the convergence to a lower public debt level. However, as public debt declines, interest payments shrink and savings are used to reduce the tax burden on wage income, since this instrument is the most distortionary and this reduction enhances the medium- and long-run impacts on GDP and welfare.

This sub-section starts by analyzing the macroeconomic impacts of a fiscal policy that features half of the envisaged decline in the public debt ratio in eight years. This policy is referenced as the "central consolidation scenario" and the results are presented in figure 3.

In the short run, the central scenario implies a fall in real GDP, which reaches a trough in the second year (around 2 percent below the initial steady state) and makes a gradual recovery thereafter.[15]

[15]A sensitivity analysis was conducted in order to assess the impact of changing the parameter that defines the percentage of rule-of-thumb consumers in the results. Simulation results do not depend significantly on this parameter and, therefore, conclusions are robust to alternative calibrations of the parameter ψ in the range of realistic values.

Figure 3. Macroeconomic Impacts of Alternative Fiscal Consolidation Paces



Notes: For further information, see the notes presented in figure 1.

Nevertheless, this scenario leads to a protracted period of below-steady-state real GDP. Private consumption decreases steeply in the short run, due not only to the direct impact of fiscal measures on households' wealth but also to the increase in the real interest rate. Indeed, the return on savings increases, measured in terms of future consumption, implying a further disincentive to current consumption. The negative impact on consumption and investment is partly offset in the short run by more favorable future wealth prospects due to expected lower distortionary taxes. In turn, the short-run decrease in the price level leads to gains in international competitiveness, and this implies both an increase in export market share and a decline in the import content of domestic output. Thus, in the short run, fiscal consolidation leads to an improvement in the ratio of trade balance to GDP.

In the central scenario, the tax burden on wage income declines 3.2 percentage points in the final steady state. Hence, households' after-tax real wage increases, raising the opportunity cost of leisure and thereby leading to an upward shift in labor supply. Simultaneously, firms' payroll tax falls and labor demand increases, leading to a rise in the marginal product of capital and fostering capital accumulation. The increase in households' wealth, due to the increase in wage and capital income prospects, boosts consumption and investment and, consequently, GDP. In the final steady state, GDP is 2.4 percent above the initial steady state.

The fiscal consolidation leads to a permanent improvement in the net foreign asset position. Hence, on the one hand, the income balance improves permanently, since interest rates are held constant by assumption, but on the other hand, imports also increase permanently, due to higher global demand in the long run. Therefore, the above-mentioned improvement in the trade balance, resulting from the real exchange rate depreciation, vanishes gradually, leading to a larger trade deficit than in the initial steady state.

Table 2 presents the impact of the central scenario on households' welfare, considering alternative discount rates. The results show that welfare impacts are conditional on the discount rate Υ. More precisely, the welfare gains are enhanced for lower Υ. In this scenario, the compensating variation of consumption ranges from –0.8 percent to +3.1 percent.

Table 2. Welfare Assessment of Alternative Scenarios

	Discount Rate (Υ)				
	0.0%	**0.1%**	**2.0%**	**2.8%**	**6.8%**
Slow Consolidation	3.1	3.0	0.9	0.5	−0.5
Central Consolidation	3.1	3.0	1.0	0.5	−0.8
Fast Consolidation	3.1	3.0	0.9	0.4	−1.3

Note: Values in percent of initial steady-state consumption. The welfare impacts are expressed in consumption good units using the compensating variation of consumption.

Despite the short-run costs of fiscal consolidation, it can be concluded that a lower ratio of public debt to GDP has positive long-run impacts on economic activity, private consumption, investment, and exports, as shown in Coenen, Mohr, and Straub (2008). It also increases households' welfare and significantly improves the net foreign asset position. The short-term pain and long-run gains of permanent deficit reductions are fully in line with Kumhof et al. (2011). There are, however, some significant qualifications that are worth emphasizing. In particular, figure 3 shows that the main driving forces behind a fiscal consolidation process remain intact even if a particular country does not have an active monetary policy and does not affect worldwide real interest rates.

Figure 3 also illustrates the impact on the main macroeconomic variables of alternative paces of fiscal consolidation. Besides the central fiscal consolidation scenario, there are two additional scenarios that differ on the speed of convergence towards the new public debt target: the "slow consolidation scenario," which ensures that half of the reduction of the public debt ratio is achieved in twenty years, and the "fast consolidation scenario," in which half of the public debt ratio decline is achieved after five years.

A front-loaded fiscal tightening—the fast consolidation scenario—implies a deep recession, with significant losses in output, consumption, and investment, and lower hours worked in the short run. On the other hand, a slow fiscal consolidation scenario, with a longer transition period, implies lower output, consumption, and investment losses and a smaller reduction in hours worked in the short and medium run, but a more protracted period of below initial

steady-state GDP. Moreover, medium-run improvements in the competitiveness of domestic firms are more limited in the last scenario.

Table 2 also presents the welfare costs and benefits for the slow and fast fiscal consolidation scenarios. Results show that for the highest discount rate, the slow consolidation scenario is the strategy that implies smaller welfare losses, and therefore current generations may prefer a more gradual approach, a result that is in line with the literature pointing to the optimality of tax smoothing (Caprioli, Rizza, and Tommasino 2010). As the discount rate decreases, the difference between the alternative fiscal consolidation paces in terms of costs and benefits narrows.

The above results suggest that the slower the fiscal consolidation, the lower is the decrease in output and domestic demand in the short and medium run. However, the slower the consolidation, the longer is the time period to reap its full benefits. Regardless of the fiscal consolidation pace, a protracted time period of below initial steady-state GDP seems warranted. This might well provide a rationale for the frequent lack of political will to move in this direction.

4. Conclusions

A credible fiscal consolidation strategy seems necessary in many euro-area countries. Some economies have been facing a surge in sovereign debt spreads and are now being forced to take immediate and rapid measures to ensure access of the public sector to the sovereign debt markets. In this context, evaluating the costs and benefits of fiscal consolidation and creating the conditions for a successful consolidation process became a topical policy issue.

This article analyzes the impact of alternative fiscal consolidation strategies on the macroeconomic scenario and on welfare, using a dynamic general equilibrium model with non-Ricardian features (PESSOA). Under the assumption of full credibility and unchanged sovereign risk premium, the simulations suggest that fiscal consolidation, in general, implies a trade-off between the short-run costs and the long-run benefits. In the short run, debt reduction is painful, especially for slow-growing economies, since it implies a reduction in economic activity. In contrast, lowering debt and thus reducing interest rate payments on outstanding government debt brings long-run benefits, among them sizable increases of output.

The welfare analysis conducted in the article suggests that the costs and benefits of a credible fiscal consolidation strategy are conditional on the discount rate and therefore on the relative weight attached to current versus future generations. A consolidation strategy is likely to be more welfare improving the larger the weight attached to future generations. This analysis is conditioned by the assumption that government consumption does not directly affect households' utility or factor productivity. Thus, the welfare impacts of government spending cuts should be interpreted as resulting from reforms aimed at increasing government efficiency in the provision of services and/or at eliminating services negligibly valued by households.

Consolidation strategies based on transfers to households and government consumption cuts are relatively less penalizing than tax hikes for real GDP from the second year onwards. In the case of private consumption and investment, this result is valid even in the short run. Moreover, an expenditure-based fiscal tightening brings about a bigger real exchange rate depreciation than tax hikes and improves the international competitiveness of domestic firms. In turn, long-term gains from fiscal consolidation are enhanced if the fiscal room created by lower public interest outlays is used to cut distortionary taxes—in particular, the tax burden on wage income. Well-designed strategies could therefore minimize the costs and enhance the benefits of fiscal consolidation. Nevertheless, a protracted period of below initial steady-state GDP seems warranted and might well provide a rationale for the frequent lack of political will to move in this direction.

Additionally, a front-loaded fiscal consolidation process implies a deeper recession, with significant short-term losses in output, when compared with more gradual strategies. Thus a credible slow fiscal adjustment is more appealing. However, the slower the implementation, the longer is the time period to reap the full benefits of fiscal consolidation. Finally, welfare analysis suggests that, as the discount rate increases, the slow consolidation scenario is likely to become the preferred strategy, as it implies smaller welfare losses. As the weight of current and future generations becomes the same, all strategies deliver welfare gains and the difference between them becomes negligible.

Appendix

Table 3 reports the main parameters of the model and table 4 the steady-state key ratios, including a comparison with actual data, when available.

The calibration of households' parameters is largely based on Fagan, Gaspar, and Pereira (2004), Harrison et al. (2005), and Kumhof and Laxton (2007). Parameters $\eta_{\mathcal{A}}$ and $\eta_{\mathcal{B}}$ were calibrated so as to ensure a unitary elasticity of labor supply to real wage. The coefficient of relative risk aversion was set to calibrate the intertemporal elasticity of substitution to 0.2. The share of liquidity-constrained households was set to 40 percent, broadly in line with the estimates for Portugal presented in Castro (2006).

The steady-state wage markup of labor unions was set at 25 percent. Although relatively high, the tightly regulated Portuguese labor market may even justify a higher number. Nominal wage rigidity was calibrated to ensure that wages adjust to the new equilibrium in six quarters, a value slightly above euro-area estimates published in Coenen, McAdam, and Straub (2007) but still in the range usually found in the literature.

Turning to firms, the depreciation rate was assumed to be identical across manufacturers and was calibrated by taking into account actual data on investment-to-GDP ratio. The elasticity of substitution between capital and labor in the production function was assumed to be unitary and takes into account the actual labor income share. The steady-state price markup of tradable and non-tradable goods was calibrated using OECD product market regulation indicators and the correlation between tradable and non-tradable goods markups and product market regulation indicators found in Høj et al. (2007). The price markup of the non-tradable goods was set at 20 percent, in line with low competition levels in this sector. As for real rigidities, capital adjustment costs were calibrated so as to ensure plausible investment responses. Regarding nominal rigidities, price-growth adjustment costs were calibrated to match average adjustment time spans, in which the adjustment of prices in the non-tradable goods sector is slightly slower than in the tradable goods sector. The elasticity of substitution between domestic tradable goods and imports was assumed to be identical across firms and set above unity (Erceg, Henderson, and Levin 2000; Harrison

Table 3. Main Parameters

	Parameter	Value
Monetary Union Parameters		
Euro-Area Interest Rate (annualized)	i^*	1.05
Euro-Area Labor-Augmenting Prod. Growth (annualized)	g	1.02
Euro-Area Inflation Target (annualized)	π^*	1.02
Euro-Area EoS between Domestic and Imported Goods	ξ^*	2.50
Households and Unions		
Households' Discount Rate (annualized)	β	0.97
Intertemporal Elasticity of Substitution	$\frac{1}{\gamma}$	0.20
Households' Instant Probability of Death (annualized)	$1-\theta$	0.04
Households' Habit Persistence	ν	0.20
Consumption Share—Type $\mathcal{A}$ Households	$\eta_{\mathcal{A}}$	0.74
Consumption Share—Type $\mathcal{B}$ Households	$\eta_{\mathcal{B}}$	0.66
Lifetime Productivity Decline Rate (annualized)	$1-\chi$	0.04
Share of Type $\mathcal{B}$ Households	ψ	0.40
Wage Markup	$\frac{\sigma_U}{\sigma_U-1}$	1.25
Wage Rigidity—Adjustment Cost	ϕv	200
Manufacturers		
Depreciation Rate (annualized)	δ	0.09
EoS between Capital and Labor	ξ_J	0.99
Price Markup—Tradables	$\frac{\sigma_T}{\sigma_T-1}$	1.10
Price Markup—Non-Tradables	$\frac{\sigma_N}{\sigma_N-1}$	1.20
Capital Adjustment Cost	ϕ_{IJ}	10
Labor Adjustment Cost	ϕ_{UJ}	5
Price Adjustment Cost	ϕ_{PJ}	200
Quasi Labor Income Share—Tradables	α_T	0.56
Quasi Labor Income Share—Non-Tradables	α_N	0.60
Distributors		
EoS Domestic Tradable/Imported Good	ξ_{AF}	1.50
EoS Assembled/Non-Tradable Good	ξ_F	0.50
Price Markup (domestic distributors)	$\frac{\sigma_F}{\sigma_F-1}, F \neq X$	1.05
Price Markup (exporters)	$\frac{\sigma_X}{\sigma_X-1}$	1.03
Import Content Adjustment Cost	ϕ_{AF}	2
Price Adjustment Cost	ϕ_{PF}	200

(continued)

Table 3. (Continued)

	Parameter	Value
Government		
Labor Income Tax Rate	τ_L	0.23
Consumption Tax Rate	τ_C	0.31
Capital Income Tax Rate	τ_K	0.17
Firms' Payroll Tax Rate	τ_{SP}	0.19
Debt-to-GDP Ratio (annualized)	$\frac{b}{gdp}$	0.53
Fiscal Stance Parameter	d_1	1.00
Speed Adjustment towards the Target Debt Ratio Parameter	d_2	0.10

Table 4. Steady-State Key Ratios

	Data	Model
Expenditure (as a % of GDP)		
Private Consumption	0.64	0.60
Government Consumption and GFCF	0.23	0.23
Private Investment	0.21	0.21
Exports	0.30	0.29
Imports	0.38	0.33
Labor Income Share (as a % of overall income)	0.58	0.57
Tradable Goods	0.54	0.55
Non-Tradable Goods	0.59	0.59
Capital-Output Ratio (as a % of output)	*NA*	2.34
Tradable Goods	*NA*	2.53
Non-Tradable Goods	*NA*	2.21
Government (as a % of GDP)		
Debt Stock	0.58	0.53
Fiscal Balance	−0.03	−0.02
Overall Revenues	0.42	0.43
Overall Expenditure	0.45	0.45
External Account (as a % of GDP)		
Net Foreign Assets	−0.64	−1.44
Current Account	−0.08	−0.06
Trade Balance	−0.08	−0.04

Note: *NA* stands for non-available data.

et al. 2005; Coenen, McAdam, and Straub 2007; Kumhof et al. 2010), while the combination of assembled goods with non-tradable goods was assumed to feature a low substitutability (Mendoza 2005; Kumhof et al. 2010). These production functions were also calibrated in line with the National Accounts import contents and the non-tradable goods content of each type of final good. The degree of monopolistic competition among distributors was assumed to be lower than among manufacturers, with the steady-state markup being set to 5 percent, except in the case of exporters, where fiercer competition justifies a lower markup. In terms of price stickiness, it was assumed that prices take two quarters to fully adjust for all distributors except exporters, whose prices are assumed to adjust faster. Real rigidities related to the import content adjustment costs were set to ensure a smooth adjustment of import contents to real exchange rate fluctuations.

The steady-state tax rates, as well as transfers from the rest of the MU, government consumption and investment, and government transfers, were calibrated to match actual data. The fiscal policy rule was calibrated to ensure smooth tax adjustments. The target debt was set to 53 percent of GDP, implying a fiscal balance of −2.1 percent in line with the fiscal target set in the European Union.

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