The Unbearable Tightness of Being in a Monetary Union: Fiscal Restrictions and Regional Stability

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The Unbearable Tightness of Being in a Monetary Union: Fiscal Restrictions and Regional Stability

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Abstract

We study how constrained fiscal policy can affect macroeconomic stability and welfare in a two-region model of a monetary union with sticky prices and distortionary taxation. Both government spending and taxes can be used to stabilize regional variables; however, the best welfare outcome is obtained under some tax variability and constant regional inflations. We use a variety of rules to characterize constrained fiscal policy and find that strict fiscal rules coupled with a monetary policy that targets union-wide inflation result in regional inflation stability and the welfare costs of such rules are not as unbearable as one would expect. Fiscal authorities can enhance welfare by targeting the regional output gap, while targeting regional inflation is less successful since inflation stability is guaranteed by the central bank.

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1 Introduction

The creation of a monetary union implies that domestic monetary policy can not be used to respond to region-specific economic disturbances. Interest rates, in fact, can no longer serve to meet regional targets for inflation and output and, for a region wishing to exert influence over its domestic economic conditions, fiscal policy is the only instrument left for maneuver.

The use of fiscal policy as a stabilization tool in a monetary union poses several questions: Can regional fiscal policy affect domestic macroeconomic conditions and how? Are country-members bound by fiscal constraints (as the ones imposed by the Stability and Growth Pact in the EMU) able to offset the effects of shocks to regional variables? Can fiscal constraints be sustainable? What are their welfare consequences? Are there alternative arrangements to fiscal constraints that are welfare improving?

All these questions arise naturally in the European Monetary Union. The fiscal framework exemplified in the Stability and Growth Pact (henceforth SGP) attempts to combine flexibility, for coping with cyclical downturns, with discipline, for deterring negative externalities produced by individual members' irresponsible policies. Since the SGP came into force in 1999, its implementation can be best characterized as mixed. The disappointing fiscal performance in some European countries after 2001 has placed a considerable pressure in the implementation of the Pact. The crisis reached its peak when the ECOFIN decided to put on hold the excessive deficit procedures for France and Germany, in November 2003. The Pact reform confirms that the implied restrictions were too inflexible in light of a changing economic reality and that they represented an impediment to the evolution of the union-wide economy (See, e.g., Blanchard and Giavazzi (2003)). For that reason, the reform of the SGP in September 2005 allows for more flexibility in budgetary rules and puts stronger emphasis on debt and regional idiosyncrasies. Given that the SGP reform is still in the centre of academic debates, it is only natural to question the usefulness of fiscal constraints, in general, and the relation between welfare and macroeconomic stability and the degree of tightness of fiscal policy, in particular.

This paper addresses these questions: It investigates how regional fiscal policy can affect regional inflation and output in a two-region model of a monetary union where agents derive utility from private and public spending, prices are sticky and taxes are distortionary, and analyzes the macroeconomic and welfare properties of different types of fiscal constraints.

In particular, we construct a DSGE model of a monetary union where regional government spending is financed with distortionary (income) taxation and study the dynamics of the economy under alternative fiscal rules when regions are subject to asymmetric productivity shocks.

We first obtain an analytical expression for the welfare criterion that can be used to compare outcomes of different policies and characterize the optimal monetary and fiscal policy problem. In the optimal solution regional inflations are stabilized and government consumption gaps are closed, while taxes vary relatively smoothly. We, then, consider general rules for fiscal policy in the two regions that try to imitate the SGP requirements of the fiscal policy performance and study the welfare and stability properties for different specializations of these rules. We formulate the fiscal policy rules using taxes and/or government spending as instruments. We assume that the fiscal instrument in each region responds simultaneously to changes in the real debt, or deficit, from some target level and/or can be used for regional stabilization purposes.

The tightness of fiscal constraints is not that unbearable in terms of welfare losses. Yet, when we contrast more flexible with rigid fiscal rules we find that the fiscal authorities can improve domestic welfare by targeting the regional output gap, while targeting regional inflation is less effective when the central bank targets union-wide inflation. Our results are robust to the fiscal instrument used and to the fiscal target adopted. We also find that using government spending to consolidate debt might result to instabilities and the welfare losses associated with a government spending rule that targets regional debt are positively related with the usefulness of public expenditure. Finally, our theoretical predictions are consistent with the empirical results for US states in Canova and Pappa (2005) who find that the second moments of macroeconomic variables in states with different budgetary restrictions are economically and statistically similar.

The literature so far has been mostly concentrated in analyzing monetary-fiscal interactions in a monetary union. Most studies highlight that countercyclical fiscal policy may create coordination failures between the central bank and regional fiscal authorities. Dixit and Lambertini (2001, 2003) provide an excellent review of this literature. Others have studied the desirability of fiscal constraints in a monetary union and reach conflicting conclusions. For example, Dixit (2001) shows that the fiscal freedom at regional level might undermine the central bank's objectives and provides arguments in favor of fiscal constraints; Beetsma and Bovenberg (1998) and Beetsma and Uhlig (1999) argue that fiscal constraints improve welfare because they correct the debt bias originating from government myopia; Uhlig (2002) shows that budgetary rules help to avoid the free-riding problems arising from the interaction between many fiscal and one monetary authority in the monetary union, while Chari and Kehoe (1998) and recently Adams and Billi (2004) claim that fiscal constraints are not necessary when the monetary authorities can commit.

In the New Open Economy Macroeconomic Literature (NOEM) Beetsma and Jensen (2004, 2005), Canzoneri et. al. (2005), Ferrero (2005) and Gali and Monacelli (2005) also study optimal monetary and fiscal policy in a currency area. Beetsma and Jensen (2004, 2005) employ different assumptions and techniques to derive an analytical expression for the welfare criterion. Gali and Monacelli (2005) study the problem of optimal monetary and fiscal policy in a currency union composed of small open economies and do not allow for variable distortionary taxation in equilibrium, while Canzoneri et al. (2005) focus on the asymmetric effects of monetary policy for different regions within a monetary union using a different modeling scheme and metric for welfare evaluations. Our study is mostly related to the work of Ferrero (2005). Relative to the latter, we endogenize government spending and allow agents to derive utility from public consumption (as in Gali and Monacelli (2005)) and employ taxes on labor instead of VAT taxes as a tax instrument. Also, we mostly focus on the macroeconomic stability and welfare evaluation of different fiscal rules for a given monetary policy and employ government spending and/or taxes as fiscal instruments for regional stabilization instead of debt.

The rest of the paper is organized as follows: the next section describes the model. Section 3 examines equilibrium dynamics. Section 4 discusses optimal monetary and fiscal policy in our currency area and section 5 studies the performance of different types of rules for regional deficits and debts. Section 6 concludes.

2 The Model

The economy is a monetary union which consists of two regions, home and foreign, each populated by a continuum of identical, infinitely lived agents. The representative household in each region is endowed with one unit of time, and derives utility from consuming a basket of goods produced in both regions. Agents also derive utility from a domestic public good which is provided by the government. There is no migration, so households supply labor to domestic firms only.

Time is discrete. At each $t = 0, 1, \ldots$, supply (productivity) shocks occur. Firms and households make their decisions after observing the shocks. International financial markets are complete. That is, all agents have access to an international financial market, where they can trade a state-contingent nominal bond. The government in each region decides the amount of government expenditure in domestic goods, lump sum taxes and taxes on labor, and the level of debt. Monetary policy is conducted at the union level by a central bank who sets the union-wide interest rate.

2.1 Representative Households

The preferences of households are symmetric across regions, so we present the problem of the representative household in the home region. Utility is characterized by the following function:

$$\mathrm{E}\sum_{t=0}^{\infty}\beta^t[\omega\ln C_t+(1-\omega)\ln G_t-L_t], \tag{2.1}$$

where $0<\beta<1$ is the subjective discount factor, $C_t>0$ denotes private consumption, G_t denotes government consumption that is valued positively by the private households when $\omega<1$, and $L_t\in(0,1)$ denotes hours worked, and E is an expectation operator.

The purchase of consumption goods is financed by after tax labor income, profit income, and lump-sum transfers from the government. The household can purchase nominal risk-free bonds from the domestic and the foreign government and has also access to an international financial market, where state-contingent nominal bonds can be traded. The period-budget constraint facing the household is given by

$$P_tC_t+E_tQ_{t,t+1}D_{t+1}+\overline{B}_{t+1}\geq(1-\tau_t^l)W_tL_t+D_t+(1+R_{t-1})\overline{B}_t+\Pi_t+\tau_t,\quad t=0,1,\ldots, \tag{2.2}$$

where P_t is the price level, D_{t+1} is the holdings of the state-contingent nominal bond that pays one unit of currency in period $t+1$ if a specified state is realized, $Q_{t,t+1}$ is the period-t price of such bonds, $\overline{B}_{t+1}$ is the holdings of the risk-free nominal government bonds in the two regions which yield $(1+R_t)$ in the coming period[1], W_t is the nominal wage rate, τ_t^l, is a tax on labor income, Π_t is the profit income, and τ_t is a lump-sum transfer from the government.

The household maximizes (2.1) subject to (2.2). The supply of labor is, then, determined by:

$$C_t=\omega(1-\tau_t^l)\frac{W_t}{P_t}, \tag{2.3}$$

which states that the marginal rate of substitution between leisure and consumption equals the real after tax consumption wage. The optimal consumption-saving decision is described by

$$E_tQ_{t,t+1}=\beta E_t\frac{C_t}{C_{t+1}}\frac{P_t}{P_{t+1}}, \tag{2.4}$$

so that the intertemporal marginal rate of substitution equals the price of the state contingent bond. The decision regarding the government bonds defines the Euler equation:

$$\frac{1}{C_t}=\beta\mathrm{E}_t\left[\frac{1}{C_{t+1}}\frac{P_t}{P_{t+1}}(1+R_t)\right], \tag{2.5}$$

[1] Although households can hold foreign debt, we do not allow regional governments to do so. Still, regional governments can implicitly finance each other´s deficit by lending to the other region ´s households who have purchased debt issued by them.

The consumption basket consists of domestically produced and imported goods. Denote C_{Ht} the composite of domestically produced goods, and C_{Ft} the composite of goods that are imported. Then, we define:

$$C_t = \bar{\alpha} C_{Ht}^{\alpha} C_{Ft}^{1-\alpha}, \quad \bar{\alpha} = \alpha^{-\alpha}(1-\alpha)^{\alpha-1}. \tag{2.6}$$

Solving the household's expenditure-minimizing problem yields the following demand functions for domestically produced and imported goods:

$$C_{Ht} = \alpha P_t C_t / \bar{P}_{Ht}, \quad C_{Ft} = (1-\alpha) P_t C_t / \overline{P}^*_{Ft}, \tag{2.7}$$

where $\bar{P}_{Ht}$ is the price index of domestically produced goods, and $\overline{P}^*_{Ft}$ is the price index of imported goods, which are related to the home price level P_t by

$$P_t = \bar{P}_{Ht}^{\alpha} \overline{P}_{Ft}^{*1-\alpha}. \tag{2.8}$$

Throughout the analysis, we assume that firms set prices in the sellers' local currency and the law-of-one-price holds, so that the cost of imported goods in the home consumption basket is simply the price charged by foreign exporting firms since the exchange rate is fixed in a monetary union.

2.2 Firms

There is a continuum of firms producing differentiated goods indexed in the interval $[0, 1]$. The production of goods requires labor input, with constant-returns-to-scale (CRS) technologies

$$Y_{Ht}(j) + Y^*_{Ht}(j) + Y^G_{Ht}(j) = A_t L_t(j), \quad j \in [0,1], \tag{2.9}$$

where $Y_{Ht}(j)$ is the output of type-j goods sold in the domestic market; $Y^*_{Ht}(j)$ is the output of type-j goods exported to the foreign market; $Y^G_{Ht}(j)$ is the output of type-j goods sold to the domestic government and A_t is a productivity shock; and L_t is the labor input. The logarithm of the productivity shock follows an AR(1) process, that is,

$$\ln(A_{t+1}) = \rho^A \ln(A_t) + \varepsilon^A_{t+1} \tag{2.10}$$

where ε^A_t is a zero mean, iid normal process with finite variance σ^2_A. Productivity shocks across regions can be correlated with a correlation coefficient, ρ^A_{HF}.

We assume that the goods produced by firms are transformed into final consumption according to

$$C_{Ht} = \left[\int_0^1 Y_{Ht}(j)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}}, \quad C^*_{Ht} = \left[\int_0^1 Y^*_{Ht}(j)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}}, \quad G_t = \left[\int_0^1 Y^G_{Ht}(j)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}} \tag{2.11}$$

where $\theta > 1$, denotes the elasticity of substitution between differentiated products and G_t the composite of domestically produced goods purchased by the government.

The cost-minimizing problem of the final good sector implies demand functions for each type of goods:

$$Y_{Ht}^d(j) = \left[\frac{P_{Ht}(j)}{\bar{P}_{Ht}}\right]^{-\theta} C_{Ht}, \quad Y_{Ht}^{d*}(j) = \left[\frac{P_{Ht}(j)}{\bar{P}_{Ht}}\right]^{-\theta} C_{Ht}^*, \quad Y_{Ht}^{Gd}(j) = \left[\frac{P_{Ht}(j)}{\bar{P}_{Ht}}\right]^{-\theta} G_t, \quad (2.12)$$

where $P_{Ht}(j)$ is the price of type-j good, and $\bar{P}_{Ht} = \left[\int_0^1 P_{Ht}(j)^{1-\theta} dj\right]^{\frac{1}{1-\theta}}$ is the corresponding price index.

Firms are price takers in the input market and monopolistic competitors in the product markets. Following Calvo (1983), at each t each domestic producer is allowed to reset her price with a constant probability, $(1-\gamma)$, independently of the time elapsed since the last adjustment. Producers face domestic (private and public) and foreign demand for their product. Since they do not engage in international price discrimination and the exchange rate is fixed, the real exchange rate is equal to the ratio of foreign to domestic prices: $q_t = P_t^*/P_t$. When a type-j producer receives a signal to change her price, she chooses her new price $P_{Ht}(j)$ so as to maximize her expected present value of profits

$$\mathrm{E}_t \sum_{\tau=t}^{\infty} \gamma^{\tau-t} Q_{t,\tau} [P_{Ht}(j) - MC_t] Y_\tau^d(j), \quad (2.13)$$

where MC_t is the nominal marginal cost, which is identical across firms since all firms face the same input market, and $Y_t^d(j)$ is the demand schedule for type j good described by the sum of demands in (2.12), that is $Y_t^d(j) = Y_{H\tau}^d(j) + Y_{H\tau}^{*d}(j) + Y_{H\tau}^{Gd}(j)$. The cost-minimizing problem of the firm yields the marginal cost function

$$MC_t = W_t/A_t, \quad (2.14)$$

and a conditional labor demand function

$$L_t = \frac{1}{A_t} \int_0^1 Y_t^d(j) dj. \quad (2.15)$$

The solution to the profit-maximizing problem gives the optimal pricing rule

$$P_{Ht}(j) = \mu \frac{\mathrm{E}_t \sum_{\tau=t}^{\infty} \gamma^{\tau-t} Q_{t,\tau} MC_\tau Y_t^d}{\mathrm{E}_t \sum_{\tau=t}^{\infty} \gamma^{\tau-t} Q_{t,\tau} Y_t^d}, \quad (2.16)$$

where $\mu = \theta/(\theta-1)$ measures the steady state markup.

2.3 Regional fiscal variables

The fiscal authority in the home region issues nominal debt, B_t, taxes nominal wage income at the rate τ_t^l and has access to lump sum taxes, τ_t. These revenues finance domestic government

spending, G_t, and interest payments on debt. The government budget constraint in the home region is given by:

$$B_{t+1} \leq (1 + R_t)B_t + G_t - T_t \tag{2.17}$$

where

$$T_t = \tau_t^l W_t L_t + \tau_t \tag{2.18}$$

2.4 Risk Sharing, Market Clearing and Aggregation

Since the state-contingent nominal bond is traded in the international financial market, the foreign household's optimal consumption-saving decision leads to

$$E_t Q_{t,t+1} = \beta E_t \frac{C_t^*}{C_{t+1}^*} \frac{P_t^*}{P_{t+1}^*}. \tag{2.19}$$

By combining this equation with its home region counterpart (2.4) and iterating with respect to t, we obtain a risk-sharing condition

$$\frac{P_t^*}{P_t} = \psi_0 \frac{C_t}{C_t^*}, \tag{2.20}$$

where $\psi_0 = P_0^* C_0^* / P_0 C_0$. The risk-sharing condition links the ratio of foreign to domestic prices (i.e., the real exchange rate) to the marginal rate of substitution between consumption in the two regions, so that all households face identical relative price of consumption goods in the world market.

In equilibrium, state contingent bonds are in zero net supply in the world market, so that $D_t + D_t^* = 0$. Aggregate domestic demand in the home economy is given by:

$$\bar{P}_{Ht} Y_t = P_t C_t + \bar{P}_{Ht} G_{Ht} \tag{2.21}$$

where we have used the demand functions for domestic goods in (2.7) and (2.12) and their foreign counterparts, and the the risk-sharing condition (2.20). Similarly, we can show that aggregate demand in the foreign economy is:

$$\bar{P}_{Ft}^* Y_t^* = P_t^* C_t^* + \bar{P}_{Ft}^* G_{Ft}^*. \tag{2.22}$$

Let $S_t = \bar{P}_{Ft}^* / \bar{P}_{Ht}$ denote the terms of trade. Then, it follows from (2.21) and (2.22), along with (2.20), that the terms of trade is given by:

$$S_t = \left[\frac{Y_t - G_t}{Y_t^* - G_t^*} \right]. \tag{2.23}$$

Equation (2.21) and the price index relation $P_t = \bar{P}_{Ht}^{\alpha} \overline{P}_{Ft}^{*1-\alpha}$ imply that real domestic demand is given by

$$Y_t = C_t S_t^{1-\alpha} + G_t, \tag{2.24}$$

If we do the same for the foreign real domestic demand and use the risk sharing condition we find that aggregate consumption in the home region is given by:

$$C_t = [Y_t - G_t]^{\alpha}[Y_t^* - G_t^*]^{1-\alpha} \tag{2.25}$$

Similar conditions hold for demand and consumption in the foreign region.

From (2.12) and (2.15), the aggregate demand for labor is given by

$$L_t = \int_0^1 L_t(j)dj = \frac{1}{A_t}\int_0^1 Y_t^d(j)dj = \frac{\Delta_{Ht}}{A_t}Y_t, \tag{2.26}$$

where $\Delta_H = \int_0^1 (P_H(j)/\bar{P}_H)^{-\theta_T}dj$ is the domestic price dispersion index.

To fully characterize the equilibrium we need to describe how monetary and fiscal policy in each region is conducted. Our goal is to analyze the welfare and macroeconomic stability properties of different fiscal policy arrangements for a given monetary policy. As a benchmark, we first analyze the optimal regime in which both fiscal authorities and the central bank cooperate. We model such a regime by assuming that a world planner chooses the fiscal instruments in the two regions and the monetary instrument so as to maximize world welfare. Then, we study the welfare and stability properties of alternative fiscal rules for a given monetary policy. We assume that regional governments commit to follow the fiscal rules.

3 Equilibrium Dynamics

The optimizing conditions of households and firms characterize the equilibrium in our two-region economy. We denote $\tilde{x}_t = \hat{x}_t - \hat{x}_t^n$ the deviation of equilibrium variable $\hat{x}_t$ from its flexible price level $\hat{x}_t^n$, and we refer to this variable as the gap. The private sector's optimizing conditions in log-linear form for the home region can be summarized as follows:

$$\pi_{Ht} = \beta \mathrm{E}_t \pi_{H,t+1} + \kappa \widetilde{mc}_t \tag{3.1}$$

$$\widetilde{mc}_t = \frac{1}{\omega}\tilde{y}_t - \frac{1-\omega}{\omega}\widetilde{g}_t - (1-\alpha)\widetilde{s}_t + \frac{\tau^l}{1-\tau^l}\tau_t^l + (1-\alpha)(a_t^* - a_t) \tag{3.2}$$

$$\tilde{y}_t = \mathrm{E}_t\tilde{y}_{t+1} - \omega[r_t - \mathrm{E}_t\pi_{H,t+1}] - (1-\omega)\mathrm{E}_t\Delta\widetilde{g}_{t+1} + \omega\Delta a_t, \tag{3.3}$$

$$\Delta\widetilde{s}_t = \pi_{Ht} - \pi_{Ft}^* - [\Delta a_t - \Delta a_t^*] \tag{3.4}$$

where π_{Ht} denotes the domestic growth rate of prices, $\tilde{y}_t$ denotes the domestic output gap, $\widetilde{g}_t$ the government consumption gap, $\widetilde{s}_t$ the terms of trade gap and τ_t^l, r_t and a_t, a_t^* the log deviations of the tax rate, the nominal interest rate, and the home and foreign productivity shocks from their steady state values, respectively. The constant $\kappa = \frac{(1-\beta\gamma)(1-\gamma)}{\gamma}$ measures the responsiveness of the pricing decisions to variations in the real marginal cost gap, $\widetilde{mc}_t$. The foreign region's optimizing conditions are similar.

Further, the flexible price level of output is given by:

$$Y_t^n = A_t, \tag{3.5}$$

while government and private consumptions under flexible prices are:

$$G_t^n = (1-\omega)A_t, \qquad C_t^n = \omega A_t^{\alpha} A_t^{*1-\alpha} \tag{3.6}$$

Thus, systematic regional expenditure in the flexible price equilibrium should be procyclical responding positively to changes in domestic productivity. On the other hand, domestic consumption, due to risk sharing, should react positively to productivity shocks, independently from their origin.

Also, the flexible price level of the terms of trade is given by:

$$S_t^n = \frac{A_t}{A_t^*} \tag{3.7}$$

That is, an increase in the relative productivity in the home economy tends to lower the relative price of home goods.

Equations (3.1) - (3.4) are crucial for understanding the results we obtain. Equation (3.1) describes the Phillips-curve, relating domestic growth rate of prices to current and future marginal costs. Equation (3.2) has important implications for our results: real marginal costs in the home region can be affected by regional fiscal policy because the latter affects the labor market variables. Taxes on labor income affect real wages and, thus, marginal costs, while increases in government spending affect marginal costs through their impact on demand and, thus, on employment. Moreover, domestic marginal costs are also affected indirectly by foreign fiscal policy since, with trade links, increases in foreign demand affect the terms of trade (terms of trade externality). Also, foreign productivity shocks can affect domestic real marginal costs both directly and indirectly. This is because they affect the equilibrium value of the terms of trade, which, in turn, determines domestic and foreign demand of consumption goods. The importance of the foreign economic conditions, as well as the terms of trade on the domestic growth rate of prices declines as $\alpha \longrightarrow 1$.

Equation (3.3) is derived from log-linearizing the intertemporal Euler equation (2.5) for the home household, with the consumption gap replaced by the output gaps using equation (2.24). Finally, equation (3.4) gives the definition of the terms of trade.

Equations (3.4), (3.1) and (3.2) imply that regional inflation stabilization is not compatible with the terms of trade stabilization. Thus, the flexible price equilibrium cannot be implemented by stabilizing real marginal costs, as in closed economies, or open economies with

flexible exchange rates. This happens since by (3.4) the terms of trade under regional inflation stability will deviate from their flexible price value and the reallocation of resources under flexible prices cannot be achieved. In other words, the constancy of the exchange rate in a currency area makes the implementation of the flexible price equilibrium unfeasible. Thus, the creation of the monetary union is costly (see Pappa (2004)) despite the presence of additional instruments (government spending and taxes) to substitute for the lack of the exchange rate instrument.

To complete the analysis, we present the equation characterizing the dynamics of real debt in the home region in log-linear form:

$$b^{ss}b_{t+1} + b^{ss}\pi_{Ht+1} + b^{ss}(1-\alpha)\Delta\widetilde{s}_{t+1} = \frac{b^{ss}}{\beta}b_t + \frac{1-\beta}{\beta}r_t - \frac{\tau^l}{1-\tau^l}\frac{1+\omega}{\omega}\widetilde{y}_t +$$
$$(1-\omega)\left(1+\frac{\tau^l}{(1-\tau^l)\omega}\right)\widetilde{g}_t - \frac{\tau^l}{(1-\tau^l)^2}\tau_t^l - (1-\alpha)[(1-\omega) - \frac{\tau^l}{1-\tau^l}]\widetilde{s}_t + \phi_t \qquad (3.8)$$

where b^{ss} is the steady state value of debt and ϕ_t is a function of domestic and foreign productivity shocks, $\phi_t = [\alpha\{(1-\omega) - \frac{\tau^l}{1-\tau^l}\} + (1-\alpha)(1-\rho^A)b^{ss}]a_t + (1-\alpha)[1-\omega-(1-\rho^A)b^{ss} - \frac{\tau^l}{1-\tau^l}]a_t^*$. The evolution of debt in the foreign economy is defined by a similar equation.

In order to characterize fully the equilibrium we need to define how monetary and regional fiscal policies are determined.

4 Optimal Monetary and Fiscal Policy

The optimal monetary and fiscal policy problem can be described as the problem of a social planner that maximizes a weighted average of the two regions households utility functions, subject to the aggregate constraints in the two regions, the regional debts evolution and the definition of the terms of trade. The policy problem we analyze is under commitment from the part of the policymaker since, in this setting, the planner has incentives to default from her initial decision when she is given the possibility to reoptimize. In particular, the planner would choose to create high inflation in the period she reoptimizes and keep inflation low thereafter.

We solve for the approximate policy problem. In order to characterize this and compare alternative fiscal policy arrangements we need a welfare metric. A natural welfare criterion in our model is the representative household's expected life-time utility. Following the approach described in Liu and Pappa (2005)[2], we derive an analytical, quadratic expression for the welfare criterion based on second-order approximations to the period utility functions for

[2]The approach of Liu-Pappa (2005) is similar with the approach of Benigno and Woodford (2005) for a closed economy and Ferrero (2005) for an open economy.

the households in the home and the foreign region. We, then, find the allocations under optimal policy by maximizing the quadratic objective subject to the set of log-linear equilibrium conditions.

In order to derive the welfare objective, we first describe the steady state problem of the social planner. We, then, derive the objective through quadratic approximations to the two-regions representative households' utility around that steady state. Finally, we solve the optimal policy problem for small perturbations around the optimal steady state[3].

We solve the steady state problem of the planner in two stages. In the first stage she chooses the steady-state levels of public and private consumption and labor in the two regions to maximize the union's welfare. In the second stage she chooses the level of lump-sum taxes that determine the level of debt in the steady state[4]. Since the population size is equal across countries, we assume that the planner assigns equal weights to each member country's national welfare. The problem of the planner is to maximize $\frac{1}{2}[\omega \ln C + (1-\omega)\ln G - L] + \frac{1}{2}[\omega \ln C^* + (1-\omega)\ln G^* - L^*]$ subject to the national resource constraints (2.25) and imposing $A = A^* = 1$, $Y_j = L_j$ and $Y_j^* = L_j^*$ and $NX = 0$[5]. The first order conditions for the planner's steady-state problem lead to:

$$Y = L = Y^* = L^* = 1 \tag{4.1}$$

$$C = C^* = \omega, \quad G = G^* = (1-\omega). \tag{4.2}$$

The optimal tax rates for the social planner are, then, given by

$$1 - \tau^l = 1 - \tau^{l*} = \mu \tag{4.3}$$

The optimal tax rate is negative. That is, the planner's optimal steady state solution involves a labor subsidy that exactly offsets the steady-state markup distortions. As a result, the steady-state equilibrium allocations for the planner coincide with those under perfect competition and are, hence, Pareto optimal. Finally, given a steady state level of debt to GDP ratio, lump sum taxes are set to satisfy the government budget constraint in the steady state.

[3] The linearization of a model of fiscal policy is always troubling (See Giavazzi et al. (2000)). Fiscal policies have strong non-linear effects and might involve explosive paths for debt without violating the transversality condition. Our approximate equilibrium avoids these problems by requiring solutions for the endogenous variables that deviate little from the optimal steady state. Thus, in the approximate problem strong non-linear effects of fiscal policy are ruled out.

[4] The second stage problem is introduced to guarantee steady state debt to GDP ratios that match their data analogues for Germany and France.

[5] Net exports are given by: $NX_t = P_{Ht}C_{Ht}^* - P_{Ft}^*C_{Ft} = (1-\alpha)P_t^*C_t^*[1 - \frac{P_t}{P_t^*}\frac{C_t}{C_t^*}]$. For net exports to be zero in the steady state, the parameter ψ_0 in the risk sharing condition 2.20 should be set equal to one.

In the appendix, we derive the planner's welfare objective, which is given by

$$W^{Planner} = -\frac{1}{4}\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t L_t^{Planner} + t.i.p. + O\left(\|\xi\|^3\right), \tag{4.4}$$

where the period loss function is:

$$\begin{aligned} L_t^{Planner} &= \theta\kappa^{-1}\pi_{Ht}^2 + \frac{1}{\omega}\tilde{y}_t^2 + \frac{1-\omega}{\omega}\tilde{g}_t^2 + \frac{1}{\omega}\tilde{y}_t^{*2} + \frac{1-\omega}{\omega}\tilde{g}_t^{*2} + \theta\kappa^{*-1}\pi_{Ft}^{*2} + 2\omega(1-\alpha)^2\tilde{s}_t^2 \\ &\quad -2\frac{1-\omega}{\omega}\tilde{y}_t\tilde{g}_t - 2(1-\alpha)\tilde{y}_t\tilde{s}_t + 2(1-\omega)(1-\alpha)\tilde{s}_t\tilde{g}_t \\ &\quad -2\frac{1-\omega}{\omega}\tilde{y}_t^*\tilde{g}_t^* + 2(1-\alpha)\tilde{y}_t^*\tilde{s}_t - 2(1-\omega)(1-\alpha)\tilde{s}_t\tilde{g}_t^* \end{aligned} \tag{4.5}$$

To gain some intuition for the planner's loss function (4.5) we can rewrite it as:

$$L_t^{Planner} = \theta(\kappa^{-1}\pi_{Ht}^2 + \kappa^{*-1}\pi_{Ft}^{*2}) + \omega(\tilde{c}_t^2 + \tilde{c}_t^{*2}) + (1-\omega)(\tilde{g}_t^2 + \tilde{g}_t^{*2}) \tag{4.6}$$

Since the planner chooses subsidy rates to fully offset all markup distortions, the flexible-price equilibrium allocations are Pareto optimal and the planner´s objective reflects her willingness to close all the relative gaps when conducting optimal policy. In order, however, to minimize the private consumption gaps, the planner has to stabilize fluctuations in the terms-of-trade gap and to induce comovements in regional output with the terms of trade and with government consumption that guarantee movements in regional consumption under sticky prices that resemble the dynamics of consumption under flexible prices.

Notice that when the economy is closed, $\alpha = 1$, and agents derive no utility from government consumption, $\omega = 1$, the welfare objective in (4.5) reduces to a similar expression as the one in Benigno and Woodford (2005). On the other hand, for $\alpha < 1$ and $\omega = 1$, the period loss utility in (4.5) becomes similar to the one presented in Ferrero (2005). Also, our welfare criterion is comparable with the one presented in Gali and Monacelli (2005) except that, in our case, the members of the monetary union are two equally large regions and for that reason they can affect the terms of trade in general, while in the latter authors' analysis only unions between small open economies are considered and for that reason the terms of trade does not show in their welfare objective.

The optimal monetary and fiscal policy problem is to choose home and foreign inflation, home and foreign output and government consumption gaps, tax rates[6], next period home and

[6] When lump-sum taxes are available, home and foreign deficits and debts can be zero in equilibrium with no effects for the macroeconomy. Hence, conclusions on the welfare effects of fiscal policy rules will differ depending on the type of taxation assumed. Since the assumption of variable distortionary taxation offers more interesting trade-offs and dynamics, we will focus our analysis in the case of distortionary taxation and assume that lump-sum taxes are kept constant to their steady state values.

foreign debt and the union-wide interest rate to maximize the welfare objective (4.4) subject to the log linearized private sector's optimizing conditions summarized in (3.1)-(3.4), the debt evolution equation (3.8) and their foreign counterparts, as well as constraints on period-zero terms (so as to respect the initial conditions).

The first order conditions of the planner´s solution are described in the Appendix. As it was first documented in Ferrero (2005), the main feature of the optimal policy plan is the unit root behavior of the Lagrange multipliers on debt. This is also inherited by the output, the government consumption and the terms of trade gap, as well as the real value of debt. In the optimal solution some tax smoothing occurs. This is because debt changes permanently to guarantee the sustainability of the intertemporal government budget constraint. Moreover, in the optimal solution inflation is stationary (see also Ferrero (2005)).

Optimal policy is characterized by the solution of the system of equations (3.1)-(3.3), (3.8) and their foreign counterparts, equation (3.4) and the first order conditions of the optimal policy problem. Here we present only the qualitative features of the optimal plan. These will be used as a guide for the intuition of our results in the next section. We abstract from the complete characterization of the optimal solution, given the unit root behavior of most of the variables and its considerable complexity.

We can summarize the qualitative properties of the optimal solution as follows: regional inflation rates and government consumption gaps are completely stabilized, while taxes and debt vary and, as a result, the regional output gaps are non-zero. Given the stabilization of regional inflations, the terms of trade gap is also non-zero and, in turn, private consumptions deviate from their flexible price values as well. Thus, the planner opts for a policy of inflation stabilization using the tax rate as an instrument for smoothing variations in real marginal costs and allows for variations in the private consumption and output gaps[7]. Such policy can be easily rationalized by inspecting the coefficients on inflation and private and public consumption gaps in (4.6): the coefficients for regional inflations are much higher than the coefficients in front of the consumption gaps. This property of the optimal plan is essential to understand the results presented in the next section.

[7] Collard and Dellas (2004) also find that in a closed economy with distortionary taxation the case of perfect price stability, although not optimal, it implies insignificant welfare losses. In different frameworks, Andersen (2000) and Von Hagen and Mundschenk (2002)) show also that the presence of inflation differentials creates incentives for policy competition among regional fiscal authorities and regional inflation stability is an optimal outcome.

5 Constraints on regional debts and deficits.

The previous section has underlined an important feature of our economy: in a monetary union the most advantageous reallocation of resources can be achieved when regional inflations are stabilized. In this section we study what are the effects that alternative constraints on debt and deficit to GDP ratios have on regional stability and welfare. We assume that the central bank follows a monetary policy that targets union-wide inflation, while regional fiscal authorities commit to follow specific fiscal policy rules.

We define union-wide inflation as:

$$\pi_t^u = \frac{1}{2}\pi_t + \frac{1}{2}\pi_t^* = \frac{1}{2}(\pi_{Ht} + \pi_{Ft}^*) \tag{5.1}$$

We model the behavior of the central bank by assuming a Taylor-type of rule for the setting of the union-wide interest rate:

$$r_t = \overline{r} + V_\pi^U \pi_t^u \tag{5.2}$$

where $\overline{r}$ is a constant.

We consider general rules for fiscal policy in the two regions that try to imitate the SGP requirements for fiscal policy performance and study the welfare and stability properties for different specializations of these rules. The government deficit is defined according to the accounting definition of the SGP, as the sum of government spending and interest payments on debt minus tax revenues. That is, $DF_t = R_t B_t + G_t - T_t$.

We formulate the fiscal policy rules using both government spending and income taxes as tools, since both can be used to determine the fiscal stance and can affect marginal costs and output in equilibrium.

$$\tau_t^l = \lambda_{\rho\tau}\tau_{t-1}^l + (1-\lambda_{\rho\tau})\lambda_b(b_t - b^{ss}) + (1-\lambda_{\rho\tau})\lambda_{df}(b_t - df^{ss}) + (1-\lambda_{\rho\tau})\lambda_\pi \pi_{Ht} + (1-\lambda_{\rho\tau})\lambda_y \widetilde{y}_t \tag{5.3}$$

$$\widehat{g}_t = \lambda_{\rho g}\widehat{g}_{t-1} - (1-\lambda_{\rho g})\lambda_b(b_t - b^{ss}) - (1-\lambda_{\rho g})\lambda_{df}(b_t - df^{ss}) - (1-\lambda_{\rho g})\lambda_\pi \pi_{Ht} - (1-\lambda_{\rho g})\lambda_y \widetilde{y}_t \tag{5.4}$$

The two instruments are not allowed to be simultaneously active. When taxes vary according to (5.3), government spending is assumed to be constant and, by the same token, when government spending is used as the fiscal instrument, taxes are assumed to be constant[8].

[8] Assuming some variability in taxes, when government spending is the fiscal instrument, or some variability in government spending when taxes are used as the fiscal instrument, would not change our qualitative results.

We allow for the possibility of tax and government spending smoothing ($0 \leq \lambda_{\rho g}, \lambda_{\rho \tau} \leq 1$). We also allow tax rates and government spending to respond simultaneously to changes in debt and deficit from some target level, as well as to the growth rate of domestic prices and the regional output gap.

The parameters λ_{df}, λ_b determine the speed of adjustment for the tax and government spending rules in (5.3) and (5.4). When λ_{df}, λ_b assume high values, fiscal policy is passive in the sense defined in Leeper (1991) and its role is constrained in generating sufficient tax revenues, or managing government spending to meet the debt/deficit requirements. Instead, when λ_{df}, λ_b assume values close to zero, fiscal policy is active in the sense that it is not constrained by restrictions on the level of debt and deficit and is allowed to engage in regional stabilization policies (when $\lambda_y, \lambda_\pi > 0$). Notice that the government debt evolution and the definition of deficit imply that when regional fiscal policies target deficits they actually control the evolution of debt and vice versa. Thus, when, for example, the fiscal instrument focuses on the stabilization of debt, deficit is also under control. In what follows, we consider rules in which the tax rate and government spending target either debt, or deficit[9].

Thus, the rules defined in (5.3) and (5.4) can incorporate different types of fiscal policy regimes. Von Hagen, Hughess-Hallett and Strautch (2001) have suggested that successful consolidations in industrialized countries involve movements of expenditure as in (5.4). Instead, Leeper (1991) introduces fiscal rules in which taxes respond to debt variability as in (5.3). Our analysis allows to study the effectiveness of the two fiscal policy instruments.

We will analyze the welfare and macroeconomic stability properties of different variants of (5.3) and (5.4). Since our model does not have closed-form solutions under the rules specified in (5.2) and (5.3)-(5.4), we resort to numerical simulations in order to calculate the welfare outcomes of different fiscal policy regimes. For this purpose, we calibrate the parameters in the model using France and Germany to approximate the economies of the two-regions[10]. Our baseline calibration is summarized in Table 1. We take periods to be quarters and set $\beta = 0.99$, so that the steady-state annualized real interest rate is 4 percent. The parameter characterizing the share of imports in consumption $1-\alpha$ is set equal to 0.2. We set also $1-\omega = 0.2$ to capture the average share of government spending in total output in Germany and France. Steady state inflation in both regions and union-wide is zero. The steady state debt to GDP ratio is set to 60 percent, which corresponds roughly to the average value of debt to GDP ratios for France

[9] We have also considered specifications in which the policy is mixed and both λ_{df} and λ_b are positive. The results on the welfare costs of fiscal restrictions are robust.

[10] We believe that assuming symmetry for France and Germany is not an unreasonable assumption, although the two countries are not equally sized.

and Germany between 2000 and 2005[11]. We set $\theta = 10$, so that the steady state markup is 11 percent; and $\gamma = 0.75$, so that price stickiness lasts one year on average. The standard deviation of both productivity shocks is equal to 0.01 and their persistence is set to 0.9. In all the analysis that follows monetary policy will be given and in all the experiments V_π^U is set equal to 3.0. We start our analysis by assuming very strict rules in which deficit and debt should remain constant at their steady state level.

5.1 Strict fiscal rules

The case of constant deficits and debt is obtained from the fiscal rules in (5.3) and (5.4) when λ_b, and/or λ_{df} are very high and $\lambda_{\rho\tau}$, $\lambda_{\rho g}$ are relatively small, while fiscal policy does not use its instruments for stabilization purposes ($\lambda_y = \lambda_\pi = 0$). We consider four different specializations to represent strict fiscal regimes: (a) deficit stabilization through variable taxation, (b) debt stabilization through variable taxation, (c) deficit stabilization through variable government spending and (d) debt stabilization through variable government spending. We present the values for the coefficients in the fiscal policy rules in (5.3) and (5.4) for the four scenaria in the first row of Table 2. The rest of the rows report the welfare losses and the macroeconomic stability properties of the different regimes.

The welfare loss here is measured as the percentage of steady-state consumption equivalence, that is, the percentage increase in steady-state consumption required to keep the households indifferent between living in a world with optimal policy and in one with fiscal constraints.

The presence of strict debt and deficit constraints is costly. However, the losses, although considerable, are not as severe as one would expect. They range between 2.5 % to 3.4% of consumption equivalence. This is of a substantial magnitude but not extremely high, compared to the welfare losses stemming from other distortions in a two-country model, as, for example, the inefficient fluctuations in the relative price of non-traded goods due to price stickiness in Liu and Pappa (2005)[12].

In order to understand the intuition of this result, note that the constancy of debt and deficits does not impede the achievement of an equilibrium where both regional (and, thus, union-wide) inflations are stable. In other words, strict regional debt and deficit constraints together with a union-wide inflation target from the part of the central bank, can implement an equilibrium with regional inflation stability, which is highly important for welfare. This is

[11] Source: Euro Area Statistics (EAS) database of the ECB.

[12] Liu and Pappa (2005) find that the losses for inefficient movements in relative prices of non-traded goods can reach 5% of steady state consumption.

because when government spending and taxes move to balance the budget they do not affect adversely the behavior of real marginal costs.

For example, suppose taxes is the fiscal instrument that targets real debt (i.e., scenario (b)) and a positive productivity shock occurs. From (3.8), a positive productivity shock, other things equal, increases debt. Since in equilibrium taxes are negative, i.e., they subsidize employment, subsidies have to be reduced according to (5.3) so as to keep the debt and deficit constant. These movements in taxation do not affect marginal costs in equilibrium. This is because productivity shocks decrease marginal costs, but on the other hand the reductions in subsidies tend to increase them. Overall, marginal costs remain almost constant in equilibrium and, thus, inflation is stabilized.

However, the movements in taxation and government spending do alter the behavior of the output and consumption gaps. Movements in taxes make output deviate from potential and movements in government spending under constant taxes imply a trade-off between output, government consumption and inflation stabilization in (3.2). Moreover, since the inflation rates in the two regions remain almost constant, the terms of trade cannot adjust to implement the reallocation of consumption under flexible prices. This terms of trade behavior generates non-zero private consumption gaps in the two regions.

The variabilities of these gaps for the four different strict regimes are presented in Table 2. Variances and, thus, welfare are comparable across regimes except for regime (d). In regime (d), where government spending reacts to changes in debt, the trade-offs between output, government consumption gap and inflation stabilization are more severe generating higher output gap and government spending gap variabilities. This, in turn, leads to higher welfare losses.

5.2 Flexibility in fiscal rules

In what follows we study how increasing the flexibility of the fiscal rules affects regional stability and welfare in our two-region currency area. To this end we analyze the macroeconomic stability and welfare properties of the four regimes described in Table 2, when we vary the coefficients on inflation and the output gap in (5.3) and (5.4).

As it has already been highlighted in Leeper (1991) for a closed economy, the interaction between active monetary and fiscal policy might result into instability, i.e., indeterminacy of equilibria. For that reason, in what follows we concentrate in specifications (i.e., parameter value choices) for the policy rules that result to well behaved solutions.

5.2.1 Inflation Stabilization

We first consider more flexible fiscal rules that target the domestic growth rate of prices in each region. To this end we allow λ_π to vary in the interval $(0, 15)$ for tax rules and $(0, 10)$ for government spending rules. The results are presented in Figure 1. The left panel of the figure presents welfare losses as a function of λ_π when the income tax is used as the fiscal instrument in each region to either stabilize real debt (regime (a): continuous line), or deficits (regime (b): circled line). The right panel of the figure plots similarly welfare losses when government spending is used as the fiscal tool.

When fiscal authorities in the two regions target the domestic growth rate of prices more aggressively welfare is improved in almost all cases[13]. This is because stronger regional inflation targeting implies higher regional inflation stability, which is very important for welfare, given the size of the weight of regional inflation in the objective of the planner. However, since most of inflation stabilization is achieved at the central level, the additional gains from inflation stabilization at the regional level are relatively small. Hence, the welfare losses decrease with the size of λ_π but not substantially.

In general, there is more room for welfare improvements when fiscal policy targets real deficit. Observe that the circled lines in Figure 1 are steeper than the continuous lines. Under a tax rule welfare losses are reduced by approximately 30% and under a government spending rule by approximately 10% when the fiscal authorities target deficits, while the corresponding changes when fiscal authorities target debt are minimal. In the case of a tax rule it is easy to understand the reasoning behind this result. Note that in the intercept, when $\lambda_\pi = 0$, a rigid tax rule that consolidates debt is associated with smaller welfare losses than a rigid tax rule that controls deficits. Therefore, there is more scope for fiscal activism in the latter case.

Moreover, when real deficit is targeted, variations in the tax instrument are more effective to control for regional inflation, and, thus, to increase welfare than variations in government spending. Notice that the circled line in the left panel of Figure 1 is steeper than the slope of the circled line in the right panel. This is because varying taxes is less costly in terms of macroeconomic stability than varying government spending. To see this, notice that in (3.2) taxes can vary in response to productivity shocks to stabilize marginal costs without affecting the gaps on output, government consumption and terms of trade. Instead, under constant taxes, when government consumption moves in response to productivity shocks, either

[13] The case of debt stabilization through changes in government spending is always problematic since it often leads to indeterminacy of equilibria. We present it here for completeness, although it cannot serve as a sound fiscal policy rule.

the output, or the terms of trade gap has to change to keep marginal costs constant. This introduces a trade-off that makes government spending a less effective instrument.

5.2.2 Output gap stabilization

Can fiscal policy improve welfare when it targets the regional output gap? The answer is yes and is depicted in the two panels of Figure 2 where we let λ_y vary in the $(0, 3)$ interval. Again, the left panel shows how variations in λ_y change the consumption equivalence losses when the fiscal instrument is income taxation and the right panel plots the case of variable government spending.

The general pattern is very similar to the case of inflation stabilization except that welfare losses decrease with the size of λ_y more substantially. Starting from a deficit targeting regime, with a tax rule, regional output gap stabilization reduces welfare losses from 2.5% to 1.1% of steady state consumption equivalence and with a government spending rule from 2.5% to 2.1%. Strengthening the reaction of regional policy to output gap variations (i.e., increasing λ_y) delivers higher welfare gains relative to strengthening the reaction of regional policy to inflation variations (i.e., increasing λ_π). The reasoning behind this pattern is quite intuitive. Since the central authority targets inflation, regional policy complements the central authority´s policy by focusing on regional output stability.

5.3 What rule to choose?

The preceding analysis advocates that regional stabilization policies can improve welfare. In particular, the adoption of a regional output gap target from the fiscal authorities can improve welfare substantially relative to the case of rigid deficit or debt targeting. On the other hand, the adoption of a domestic growth rate of prices target is not fruitful as a goal for national fiscal authorities in a monetary union when at the same time the central bank targets the union-wide inflation rate.

The objective of the SGP reform that was agreed by the EU states in September 2005 is to enhance the economic relevance of the SGP framework and strengthen credibility and enforcement. Some of the key changes involving the deficit criteria include (a) the presence of differentiated "medium-term objectives" (henceforth, MTO) for every region in the EMU that take into account the economic characteristics and the cyclical position of each country, and (b) differentiated adjustment efforts to the MTO that take into account the regional business cycle position. On the other hand, the reformed Pact prescribes an increasing focus on debt and sustainability. The debt surveillance framework is strengthened by applying the concept of

a government debt ratio that is "sufficiently diminishing and approaching the reference value at a satisfactory pace" in qualitative terms and by also taking into account macroeconomic conditions and debt dynamics[14].

Our results justify the SGP reform: more flexibility should result to welfare gains and macroeconomic stability as long as fiscal authorities engage in domestic stabilization policies. Another important policy implication of our results is that regional fiscal policy should focus on regional output gap stabilization. Thus, our analysis justifies the adoption of differentiated adjustment efforts to the MTO that take into account the regional business cycle position.

Further, our analysis suggests that, when rigid rules are considered necessary and when taxes are used to consolidate debt, it is preferable to adhere to rigid rules for debt rather than rigid budgetary requirements. The opposite when government spending is used to control the debt evolution. This mainly reflects the fact that government spending is an inadequate instrument for controlling debt when government spending enhances private agents utility. When government spending is adjusted to control debt deviations from target it deviates a lot from its natural level. As a result, its gap increases substantially affecting negatively welfare (see Table 2). Thus, whether government spending is an adequate instrument for controlling debt depends on the assumed value of ω. In Figure 3 we plot the welfare losses associated with regime (d) when ω varies in the (0.5, 1) interval. We find that when government spending is not enhancing private utility, i.e., as $\omega \to 1$, adhering to strict government spending rules that consolidate debt is as (if not more) effective as adhering to tax rules. Thus, our results point to the use of government expenditure items that do not enhance private utility as the most effective fiscal instrument for fiscal consolidation and stabilization purposes.

Hence, our results tone well with the change of focus towards debt stabilization in the reformed Pact and the increased flexibility of the deficit criteria. They further suggest the usage of taxes, or government expenditure that excludes government services such as hospitals, schooling etc. as fiscal instruments for the control of regional debt. Furthermore, the tightness of fiscal constraints is not that unbearable in terms of welfare costs. These results are in line with the empirical results of Canova and Pappa (2005) that find that macroeconomic stability is barely affected by the presence of budgetary restrictions in the US states. They reflect the fact that in our model welfare gains arise essentially from inflation stabilization which is under the control of the central bank.

Finally, our results on the importance of price stability from the part of the central bank and fiscal activism from the part of regional policymakers confirm the theoretical results of

[14] We only consider the changes of the SGP that concern the preventive arm of the Pact, since our model cannot address the changes in the corrective arm.

Ferrero (2005) and Canzoneri et. al. (2005) on optimal monetary and fiscal policy. The fact that the gains from fiscal activism are relatively small in our framework reflects mainly the absence of asymmetries across regions and the adoption of different fiscal rules[15].

6 Concluding Remarks and Possible extensions

Our analysis suggests that fiscal policies with clear stabilization objectives and a monetary policy geared to price stability are fundamental for macroeconomic stability and welfare in a monetary union. When political distortions make the presence of strict constraints necessary, rigid constraints on debt are more effective for enhancing welfare than constraints on deficits. This is the case especially when regional authorities can move government expenditure items that do not affect significantly the private households welfare. Our results advocate the reform of the Pact in the EMU and suggest that there is still room for improvements concerning the stabilization tools and objectives of regional fiscal policies.

However, we recognize that the current analysis cannot address all the issues raised in the reform of the SGP. First, in the current analysis we consider a union between two countries with similar economic characteristics, the EMU instead is composed by regions with very different economic structures and we conjecture that examining optimal fiscal policy and fiscal rules in an asymmetric framework will provide further insights for the design of sound fiscal policies in a currency area. Second, fiscal constraints are usually motivated by the presence of a political distortion which is absent in our framework making our analysis biased against the presence of budgetary restrictions. The incorporation of political distortions would enrich the framework for evaluating the desirability of fiscal constraints. Finally, fiscal policy coordination was also taken as given when examining the different fiscal rules and their macroeconomic consequences, while in practice this is not guaranteed and the sustainability of fiscal constraints is still an open issue in Europe. The derivation of welfare objectives for each regional authority in future work will help us analyze the sustainability of fiscal constraints in monetary unions.

[15] Also, Ferrero (2005) and Canzoneri et al. (2005) use different metrics from welfare and absolute values for the losses are not directly comparable.

7 Appendix

7.1 Deriving the Welfare Objective

We derive the welfare objective of a central planner by taking second-order approximations to the representative household's period utility function. A second order approximation to the home household's period utility function is given by:

$$U_t - U_{ss} = \omega \hat{c}_t + (1-\omega)\widehat{g}_t - L\left(\hat{l}_t + \frac{1}{2}\hat{l}_t^2\right) + O\left(\|\xi\|^3\right). \tag{7.1.1}$$

where for a generic variable x_t, $\widehat{x}_t$ characterizes log-deviations from the steady state. The first two components of the approximated utility function are deviations of private and public consumption from steady state, which are related to deviations of output through the aggregate resource constraint (2.25). The second order approximation of this relation is given by

$$\begin{aligned}\omega(\hat{c}_t + \frac{1}{2}\widehat{c}_t^2) &= \alpha[\hat{y}_t + \frac{1}{2}\hat{y}_t^2] - (1-\omega)\alpha[\widehat{g}_t + \frac{1}{2}\widehat{g}_t^2] \\ &\quad +(1-\alpha)[\hat{y}_t^* + \frac{1}{2}\hat{y}_t^{*2}] - (1-\omega)(1-\alpha)[\widehat{g}_t^* + \frac{1}{2}\widehat{g}_t^{*2}]\end{aligned} \tag{7.1.2}$$

The second part of the approximated utility involves second-order approximations to labor. We know that in equilibrium labor is given by: $L_t = \frac{\Delta_{Ht}}{A_t} Y_t$, thus, we can rewrite that in log linear terms as:

$$\hat{l}_t = \widehat{\Delta}_{Ht} + \hat{y}_t + a_t. \tag{7.1.3}$$

A second order approximation of $\widehat{\Delta}_{Ht}$ yields (See, Woodford (2003)) :

$$\sum_{t=0}^{\infty} \beta^t \widehat{\Delta}_{Ht} = \frac{1}{2}\frac{\theta\gamma}{(1-\beta\gamma)(1-\gamma)} \sum_{t=0}^{\infty} \beta^t \pi_{Ht}^2 + t.i.p + O\left(\|\xi\|^3\right) \tag{7.1.4}$$

where *t.i.p.* denotes terms independent of policy, including constant terms and shocks. The above result together with equation (7.1.3) implies that $\hat{l}_t^2 = \hat{y}_t^2 + O\left(\|\xi\|^3\right)$, since a_t is exogenous and $\widehat{\Delta}_{Ht}$ is of second order.

The foreign region's households utility is given by:

$$U_t^* - U_{ss}^* = \omega \hat{c}_t^* + (1-\omega)\widehat{g}_t^* - L^*\left(\hat{l}_t^* + \frac{1}{2}\hat{l}_t^{*2}\right) + O\left(\|\xi\|^3\right). \tag{7.1.5}$$

Again using the foreign aggregate resource constraint we can express foreign consumption as

$$\begin{aligned}\omega(\hat{c}_t^* + \frac{1}{2}\widehat{c}_t^{*2}) &= \alpha[\hat{y}_t^* + \frac{1}{2}\hat{y}_t^{*2}] - (1-\omega)\alpha[\widehat{g}_t^* + \frac{1}{2}\widehat{g}_t^{*2}] \\ &\quad +(1-\alpha)[\hat{y}_t + \frac{1}{2}\hat{y}_t^2] - (1-\omega)(1-\alpha)[\widehat{g}_t + \frac{1}{2}\widehat{g}_t^2]\end{aligned} \tag{7.1.6}$$

Foreign labor can be written as:

$$\hat{l}_t^* = \widehat{\Delta}_{Ft}^* + \hat{y}_t^* + a_t^*. \tag{7.1.7}$$

The results for the square of foreign output and price dispersion abroad are similar as in the home economy.

The social planner, then, constructs his objective by weighting equally the two regions household utilities. That is, the welfare objective of the planner is the sum of (7.1.1) and (7.1.5), where its regions' welfare is weighted by half, given equal population across countries. This implies using (7.1.2) and (7.1.6), together with (7.1.3) and (7.1.7) that the social objective takes the form:

$$\begin{aligned}\frac{1}{2}(U_t+U_t^*) &= -\frac{1}{4}\{\omega(\widetilde{c}_t^2+\widetilde{c}_t^{*2})+(1-\omega)(\widetilde{g}_t^2+\widetilde{g}_t^{*2})\}-\frac{1}{2}\widehat{\Delta}_{Ht}-\frac{1}{2}\widehat{\Delta}_{Ft}^* \\ &= -\frac{1}{4}\left\{\theta(\kappa^{-1}\pi_{Ht}^2+\kappa^{*-1}\pi_{Ft}^{*2})+\omega(\widetilde{c}_t^2+\widetilde{c}_t^{*2})+(1-\omega)(\widetilde{g}_t^2+\widetilde{g}_t^{*2})\right\} \quad (7.1.8)\end{aligned}$$

where the last equality results from using equation (7.1.4).

Finally, to derive the welfare objective in terms of output gap we use the approximation of (2.24) and its foreign counterpart to substitute for the consumption gap in (7.1.8). The resulting expression is equation (4.5) in the text.

7.2 The first order conditions of the optimal policy problem of Section 4 (not for publication)

If we denote with ξ_i,the lagrange multipliers in front of the constraints (3.1)-(3.3) and the debt evolution equation (3.8) and their foreign counterparts, the first order condition with respect to π_{Ht} is given by:

$$\frac{1}{2}\theta k^{-1}\pi_{Ht}+\xi_{1t}-\xi_{1t-1}-\frac{\omega}{\beta}\xi_{3t-1}-\xi_{5t}+\frac{b^{ss}}{\beta}\xi_{6t-1}=0$$

The first order condition with respect to Foreign domestic growth rate of prices:

$$\frac{1}{2}\theta k^{-1}\pi_{Ft}^*+\xi_{2t}-\xi_{2t-1}-\frac{\omega}{\beta}\xi_{4t-1}+\xi_{5t}+\frac{b^{ss}}{\beta}\xi_{7t-1}=0$$

The first order condition with respect to the Home region output gap:

$$\frac{1}{2}[\widetilde{y}_t-(1-\omega)\widetilde{g}_t-(1-\alpha)\omega\widetilde{s}_t]-k\xi_{1t}+\omega\xi_{3t}-\frac{\omega}{\beta}\xi_{3t-1}+\frac{\tau^l}{1-\tau^l}(1+\omega)\xi_{6t}=0$$

The first order condition with respect to the Foreign region output gap:

$$\frac{1}{2}[\widetilde{y}_t^*-(1-\omega)\widetilde{g}_t^*+(1-\alpha)\omega\widetilde{s}_t]-k\xi_{2t}+\omega\xi_{4t}-\frac{\omega}{\beta}\xi_{4t-1}+\frac{\tau^l}{1-\tau^l}(1+\omega)\xi_{7t}=0$$

The first order condition with respect to the Home region consumption gap:

$$-\frac{1}{2}[\widetilde{y}_t - \widetilde{g}_t - (1-\alpha)\omega\widetilde{s}_t] + k\xi_{1t} - \omega\xi_{3t} + \frac{\omega}{\beta}\xi_{3t-1} - \left[\frac{\tau^l}{1-\tau^l} + \omega\right]\xi_{6t} = 0$$

The first order condition with respect to the Foreign region consumption gap:

$$-\frac{1}{2}[\widetilde{y}^*_t - \widetilde{g}^*_t + (1-\alpha)\omega\widetilde{s}_t] + k\xi_{2t} - \omega\xi_{4t} + \frac{\omega}{\beta}\xi_{4t-1} - \left[\frac{\tau^l}{1-\tau^l} + \omega\right]\xi_{7t} = 0$$

The first order condition with respect to the terms of trade gap:

$$\frac{1}{2}[2\omega\widetilde{s}_t - \widetilde{y}_t + (1-\omega)\widetilde{g}_t + \widetilde{y}^*_t - (1-\omega)\widetilde{g}^*_t] + k\xi_{1t} - k\xi_{2t} + \frac{1}{1-\alpha}\xi_{5t} - \frac{\beta}{1-\alpha}E_t\xi_{5t+1}$$
$$+ \left[(1-\omega) - \frac{\tau^l}{1-\tau^l} - b^{SS}\right]\xi_{6t} + \frac{b^{ss}}{\beta}\xi_{6t-1} - \left[(1-\omega) - \frac{\tau^l}{1-\tau^l} - b^{SS}\right]\xi_{7t} - \frac{b^{ss}}{\beta}\xi_{7t-1} = 0$$

The first order condition with respect to the interest rate:

$$\omega(\xi_{3t} + \xi_{4t}) = \frac{1-\beta}{\beta}b^{ss}(\xi_{6t} + \xi_{7t})$$

The first order condition with respect to taxes at Home:

$$\xi_{1t} = \frac{1}{k(1-\tau^l)}\xi_{6t}$$

The first order condition with respect to taxes at Home:

$$\xi_{2t} = \frac{1}{k(1-\tau^l)}\xi_{7t}$$

The first order condition with respect to next period Home debt:

$$\xi_{6t} = E_t\xi_{6t+1}$$

The first order condition with respect to next period Foreign debt:

$$\xi_{7t} = E_t\xi_{7t+1}$$

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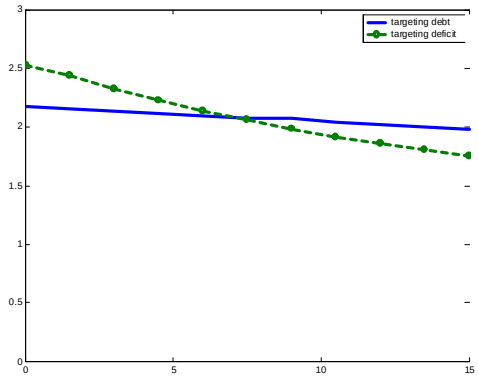
Table 1. Baseline Parameter Calibration

Discounting:	$\beta = 0.99$
Imports share:	$1 - \alpha = 0.2$
Markup:	$\theta = 10$
Price stickiness:	$\gamma = 0.75$
Government consumption as % of GDP:	$\omega = 0.8$
steady state debt to GDP ratio	60%
Standard deviations:	$\sigma_A = 0.01$
Persistence:	$\rho^A = 0.9$
Correlations:	$\rho^A_{HF} = 0$

Table 2. Welfare losses for different fiscal rules

Fiscal Rules	(a) $\overline{df}_t(\tau^l)$	(b) $\overline{b}_t(\tau^l)$	(c) $\overline{df}_t(g)$	(d) $\overline{b}_t(g)$
Coefficients	$\lambda_{\rho\tau}$= 0.1, λ_{df}= 7 λ_b= λ_y = λ_π= 0	$\lambda_{\rho\tau}$= 0.1, λ_b= 7 λ_{df}= λ_y = λ_π= 0	$\lambda_{\rho g}$= 0.1, λ_{df}= 7 λ_b= λ_y = λ_π= 0	$\lambda_{\rho g}$= 0.1, λ_b= 30 λ_{df}= λ_y = λ_π= 0
Welfare loss (%)	**2.53**	**2.18**	**2.52**	**3.40**
$Var(\pi_H)$	0.0003	0.0003	0.0003	0.0003
$Var(\widetilde{y})$	0.0108	0.0140	0.0140	0.0216
$Var(\widetilde{s})$	0.2567	0.2311	0.2352	0.2300
$Var(\widetilde{g})$	0.0527	0.0526	0.0694	0.1544
$Var(\widetilde{c})$	0.0045	0.0033	0.0135	0.0023
$Var(\tau^l)$	0.1040	0.0422	0.0	0.0

Tax instrument



Government spending instrument

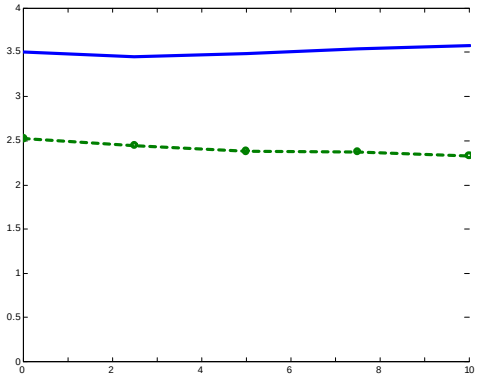
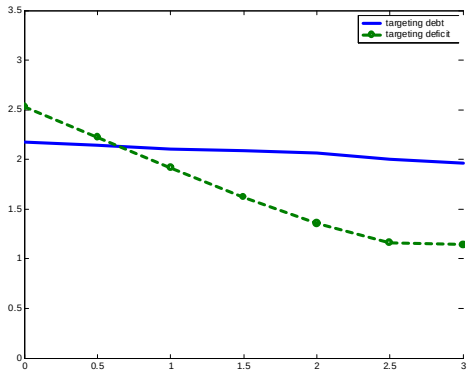


Figure 1: Welfare losses as a function of λ_π

Tax instrument



Government spending instrument

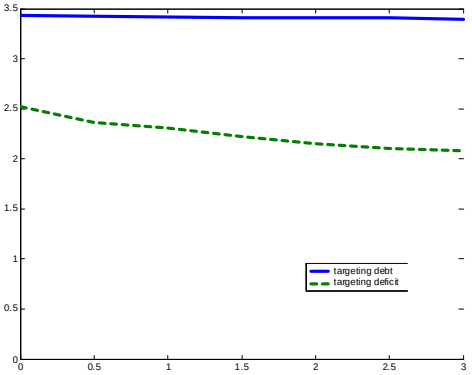


Figure 2: Welfare losses as a function of λ_y

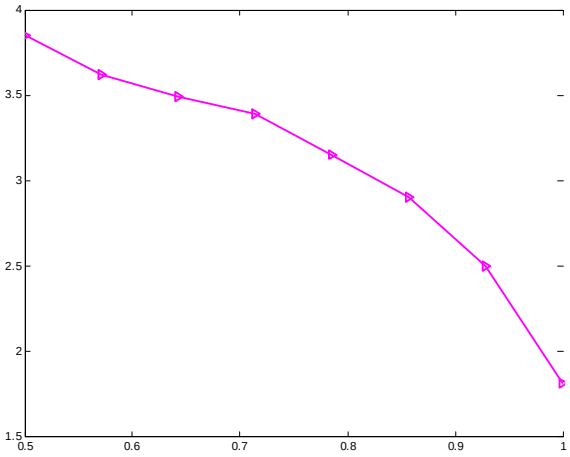


Figure 3: Welfare losses of regime (d) as a function of ω

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