Discretionary Fiscal Policy and Optimal Monetary Policy in a Currency Area*

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Abstract

The paper evaluates the effects of fiscal discretion in a currency area, where a common and independent monetary authority commits to optimally set the union-wide nominal interest rate. National governments implement fiscal policy by choosing government expenditure. The assumption of fiscal policy coordination across countries is retained in order to evaluate the costs exclusively due to discretion, leaving aside the free-riding problems stemming from non-cooperation. In such a context, nominal rigidities potentially generate a stabilization role for fiscal policy, in addition to the one of ensuring efficient provision of public goods. However, it is showed that, under discretion, aggregate fiscal policy stance is inefficiently loose and the volatility of government expenditure is higher than optimal. As an implication, the optimal monetary policy rule involves the targeting of union-wide fiscal stance, on top of inflation and output gap. The result questions the welfare enhancing role of government expenditure, as the proper instrument for stabilizing asymmetric shocks. In fact, discretion entails significant welfare costs, the magnitude depending on the stochastic properties of the shocks and, for plausible parameter values, it is not optimal to use fiscal policy as a stabilization tool.

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1 Introduction

In currency areas, country-specific shocks and nominal rigidities assign fiscal policy a stabilizing role, beyond the efficient provision of public goods. This is because the nominal exchange rate as a shock absorbing device is not available, so that the terms of trade respond inefficiently to shocks. Provided that fiscal policy is optimally set, the central bank can safely disregard national cycles and focus on the stabilization of average inflation and output, union-wide. These results have been recently emphasized by Beetsma and Jensen (2004, 2005) and Galí and Monacelli (2008) under the assumption of cooperation on the part of all policy makers involved. However, Galí and Monacelli (2008) also warn: if governments do not do their part in implementing the optimal policy package, the central bank may have the incentive to deviate from her own plan too.

In this paper we reassess the optimal monetary and fiscal policy mix in currency areas, when governments retain full independence from the monetary authority in setting the fiscal instruments and they are not able to commit to future policy. The interest for the question is motivated by the observation that the tenure of governments is limited in time. In addition, governments' objectives are not as clearly established by statute as for inflation targeting central bankers. Therefore, governments may credibly commit to future policies to a lesser extent than the monetary policy maker. Recent debates about and reforms of the Stability and Growth Pact are an example of such a lack of credibility.

We find that in this context the central bank and the government do not agree on the costs and benefits associated to monetary policy actions. In particular, governments evaluate monetary policy tightening (loosening) as more recessionary (expansionary) than the central bank does, unless she implements a discretionary policy too. This is because governments, choosing sequentially, overlook the benefits of the current monetary policy tightening in terms of past inflation expectations. As a consequence of that, public spending is inefficiently volatile, as it is used by governments to correct the policy stance and to bring it in line with their plan. The result directly follows from the time inconsistency of optimal plans, first emphasized by Kydland and Prescott (1977). Gnocchi (2009) shows in a companion paper that in a one sector closed economy model it is the disagreement on the optimal plan, rather than discretion per se, to give rise to inefficient fluctuations of public spending. Here, we place that mechanism in a currency area model so as to trade-off the welfare improving role of fiscal policy generated by asymmetric shocks against the welfare losses disagreement entails.

Disagreement about optimal policy has interesting implications. First, optimal monetary policy differs from the rule that would be implemented under commitment of all policy makers. In fact, deviations from efficient public goods provision are costly. Hence, the central bank is willing to accept higher volatility of inflation and/or output to give governments the incentive to contain the volatility of government expenditure. The result is reminiscent of Dixit and Lambertini (2003a,b) who point out that fiscal discretion "destroys" monetary commitment. Second, it is welfare improving to constrain governments to efficiently provide public goods, rather than to let them focus on stabilization issues. Alternatively, the paper opens the question of designing suitable institutional arrangements to cope with the problem of discretionary governments.

Throughout the paper, we abstract from the free-riding problems stemming from non-cooperation among fiscal authorities. Then, we only relax the assumption of monetary and fiscal policy coordination, while keeping coordination of governments across countries. For a discussion about the issue of free riding within a currency area see Forlati (2007). She allows for non-cooperation among fiscal authorities, while retaining the assumption of commitment. In that environment also, the central bank deviates from the optimal package described by Beetsma and Jensen (2004, 2005) and Galí and Monacelli (2008) so as to optimally respond to the negative externality governments impose on each other.

We perform our analysis within the framework built by Galí and Monacelli (2008), modified to allow for a policy game where the central bank commits to the optimal plan while fiscal policy is acting under discretion. Following Dixit and Lambertini (2003a) and Adam and Billi (2008a,b), we model strategic interaction as a Stackelberg game. The committed authority, the central bank in our case, is assumed to be the leader, while fiscal policy is the follower. As such, the latter takes the union-wide nominal interest rate as given. The model is solved by backward induction: after solving for the fiscal rule of the government, the central bank determines at time zero her optimal state contingent plan taking into account the fiscal policy reaction function. Note that there is not any leadership structure within each time period: after monetary policy has solved for the optimal plan, the monetary and fiscal instruments are simultaneously set in every period.

Several papers study the optimal monetary and fiscal policy mix, most of them leaving aside coordination problems[1]. In contrast, the issue of strategic interaction between policy makers has received much less attention.

Since the seminal contribution by Sargent and Wallace (1981), Dixit and Lambertini (2001, 2003a,b) first delved into the topic, both in one sector closed economy and currency area models. Our work differs from those contributions in two respects. First, we assume that policy makers are all benevolent, while they only differ in their ability to commit. Second, the desired outcome is not implementable as we allow for the presence of short-run stabilization trade-offs.

Adam and Billi (2008a,b) investigate non-cooperative monetary and fiscal policy games in a one sector closed economy model, featuring steady state distortions. These papers show that appointing a central banker more conservative than society in the spirit of the proposal by Rogoff (1985) improves steady state welfare at the small cost of generating some stabilization biases, arising because of departures from the assumption of benevolent policy makers.

This paper is also related to Debortoli and Nunes (2009, 2008), who study how government expenditure, taxes and debt evolve when successive policymakers

[1]See for example Leeper (1991), Woodford (2001), Schmitt-Grohé and Uribe (2004, 2007), Ferrero (2009), Lambertini (2006) and Leith and Wren-Lewis (2006) together with the authors cited above, Beetsma and Jensen (2004, 2005) and Galí and Monacelli (2008).

have different policy objectives and cannot make credible commitments about their future policies.

2 The Private Sector Equilibrium

The currency union is represented by a continuum of infinitely many countries indexed by i on the unit interval [0,1]. Each country is a small open economy whereas the union as a whole is assumed to be a closed economic system. The members of the currency area have symmetric preferences and are ex-ante identical in terms of technology and market structure, but they are subject to asymmetric shocks. Each economy is populated by infinitely many households and firms interacting on goods, labor and asset markets. Goods markets are imperfectly competitive and prices are set in staggered contracts with random duration. Labor markets are monopolistically competitive and labor mobility across countries is ruled out. Moreover, the wage mark-up is assumed to fluctuate exogenously around its mean value in order to create a meaningful policy trade-off at the union-wide level. Financial markets are complete and the law of one price is assumed to hold.

Monetary policy is in charge to set the union-wide nominal interest rate, while fiscal policy is responsible for choosing government expenditure and taxes. It is assumed for simplicity that the static distortion due to imperfect competition on goods and labor markets is undone by means of subsidies, while lump-sum taxes and transfers are available and they adjust so as to balance the government budget constraint at all times.

It is described next the private sector equilibrium as a function of monetary and fiscal policy.

2.1 Households

Each household $h \in [0,1]$[2] in country i consumes a continuum of private and public goods and sells differentiated labor services to firms. Preferences are described by a utility function defined over private consumption, public expenditure and leisure

$$U_0^i = \sum_{t=0}^{\infty} \beta^t \left((1-\chi) log C_t^i + \chi log G_t^i - \frac{(N_t^i)^{1+\varphi}}{1+\varphi} \right) \tag{2.1}$$

C_t^i is a composite consumption good defined as

$$C_t^i = \frac{(C_{i,t}^i)^{1-\alpha}(C_{F,t}^i)^{\alpha}}{(1-\alpha)^{(1-\alpha)}\alpha^{\alpha}} \tag{2.2}$$

[2] To lighten notation, index h is dropped whenever it is possible to omit it without creating ambiguity. Also, as wages are flexible and identically set across households, equilibrium is symmetric. For further details, we refer to Woodford (2003).

where $C^i_{i,t}$ is a CES aggregator of domestically produced varieties

$$C^i_{i,t} = \left[\int_0^1 C^i_{i,t}(j)^{\frac{\epsilon_p - 1}{\epsilon_p}} dj \right]^{\frac{\epsilon_p}{\epsilon_p - 1}} \tag{2.3}$$

$C^i_{i,t}(j)$ denotes the quantity consumed of variety j produced in country i and ϵ_p is the elasticity of substitution between varieties produced in the same country. $C^i_{F,t}$ is domestic consumption of imported varieties from the other members of the currency area

$$C^i_{F,t} = exp \int_0^1 log C^i_{f,t} df \tag{2.4}$$

and it is in turn a function of an aggregator combining all varieties j produced in each foreign country f

$$C^i_{f,t} = \left[\int_0^1 c^i_{f,t}(j)^{\frac{\epsilon_p - 1}{\epsilon_p}} dj \right]^{\frac{\epsilon_p}{\epsilon_p - 1}} \tag{2.5}$$

The parameter α can be interpreted as a measure either of home bias in private consumption or of opennes towards the rest of country members.[3]

Defining for each country i the aggregate price index of domestically produced goods (i.e. the producer price index) as

$$P^i_t = \left[\int_0^1 P^i_t(j)^{1-\epsilon_p} dj \right]^{\frac{1}{1-\epsilon_p}} \tag{2.6}$$

the union wide price index as

$$P^*_t = exp \int_0^1 log P^f_t df \tag{2.7}$$

and the consumer price index for each country i

$$P^i_{c,t} = (P^i_t)^{1-\alpha} (P^*_t)^{\alpha} \tag{2.8}$$

optimal intra-temporal allocation among varieties implies the following equations[4]

$$C^i_{i,t}(j) = \left(\frac{P^i_t(j)}{P^i_t} \right)^{-\epsilon_p} C^i_{i,t} \tag{2.9}$$

$$P^f_t C^i_{f,t} = P^*_t C^i_{F,t} \tag{2.10}$$

[3]As long as $\alpha < 1$, because of the home bias, countries are consuming different consumption bundles. As a consequence, CPI inflation differentials may arise even if the law of one price is assumed to hold. Were absent the home bias, one would observe producer price inflation differentials only.

[4]Price indexes P^i_t, P^*_t and $P^i_{c,t}$ are defined so that the minimum cost of consumption bundles $C^i_{i,t}$, $C^i_{F,t}$ and C^i_t are respectively $P^i_t C^i_{i,t}$, $P^*_t C^i_{F,t}$, and $P^i_{c,t} C^i_t$. Moreover, $P^i_t C^i_{i,t} + P^*_t C^i_{F,t} = P^i_{c,t} C^i_t$.

$$P_t^i C_{i,t}^i = (1-\alpha) P_{c,t}^i C_t^i \qquad P_t^* C_{F,t}^* = \alpha P_{c,t}^i C_t^i \tag{2.11}$$

Given optimal allocation of expenditure, the period budget constraint can be written as

$$P_{c,t}^i C_t^i + E_t \left\{ Q_{t,t+1} D_{t+1}^i \right\} \leq D_t^i + (1+\tau^w) W_t^i N_t^i + T_t^i \tag{2.12}$$

$W_t^i N_t^i$ is nominal labor income, τ_w^i is a proportional subsidy to labor income and T_t^i are lump-sum taxes. In addition, households hold a portfolio that is including state contingent assets and shares in foreign and domestic firms. D_{t+1}^i denotes the nominal payoff of the portfolio in $t+1$, $Q_{t,t+1}$ is the one-period ahead stochastic discount factor and it is such that $E_t\{Q_{t,t+1}\} R_t^* = 1$, where R_t^* is the risk-free nominal interest rate factor of the currency area.

Labor services offered by households are regarded by firms as imperfect substitutes, where the elasticity of substitution is equal to $\epsilon_w > 1$. As in the standard monopolistic competition set up, total labor demand faced by each household is given by

$$N_t^i(h) = \left[\frac{W_t^i(h)}{W_t^i} \right]^{-\epsilon_w} N_t^i \tag{2.13}$$

where

$$N_t^i = \left[\int_0^1 N_t^i(h)^{\frac{\epsilon_w - 1}{\epsilon_w}} dh \right]^{\frac{\epsilon_w}{\epsilon_w - 1}} \tag{2.14}$$

is the aggregate labor index combining in the Dixit-Stiglitz from the total quantity sold of each variety and

$$W_t^i = \left[\int_0^1 \left(W_t^i(h) \right)^{1-\epsilon_w} dh \right]^{\frac{1}{1-\epsilon_w}} \tag{2.15}$$

Utility maximization subject to the period budget constraints and labor demand yields the standard optimality conditions[5]

$$C_t^i (N_t^i)^{\varphi} = (1-\chi) \frac{W_t^i}{P_{c,t}^i} \tag{2.16}$$

$$\beta \left(\frac{C_t^i}{C_{t+1}^i} \right) \left(\frac{P_{c,t}^i}{P_{c,t+1}^i} \right) = Q_{t,t+1} \tag{2.17}$$

In order to introduce a tension between inflation and output gap stabilization, it is assumed from now on that the wage mark-up fluctuates exogenously around

[5]The wage equation already takes into account that the subsidy to labor income is set so as to offset market power

its mean value[6]. Hence, equation (2.16) is augmented to include a random shock $\mu_t^{w,i}$

$$exp\{\mu_t^{w,i}\} C_t^i (N_t^i)^{\varphi} = (1-\chi)\frac{W_t^i}{P_{c,t}^i} \tag{2.18}$$

After rewriting (2.17) as a conventional Euler equation

$$\beta R_t^* E_t \left\{ \left(\frac{C_t^i}{C_{t+1}^i}\right) \left(\frac{P_{c,t}^i}{P_{c,t+1}^i}\right) \right\} = 1 \tag{2.19}$$

complete financial markets imply the following international risk sharing condition[7]

$$C_t^i = C_t^f (S_{f,t}^i)^{1-\alpha} \tag{2.20}$$

where $S_{f,t}^i$ stands for the bilateral terms of trade between any country i and f and it is defined as

$$S_{f,t}^i = \frac{P_t^f}{P_t^i}$$

so that the effective terms of trade of any country i against the rest of the currency area are

$$\begin{aligned} S_t^i &= \frac{P_t^*}{P_t^i} \qquad (2.21) \\ &= exp \int_0^1 (logP_t^f - logP_t^i)\ df \\ &= exp \int_0^1 logS_{f,t}^i\ df \end{aligned}$$

Note finally that the terms of trade can be related to CPI by

$$P_{c,t}^i = P_t^i (S_t^i)^{\alpha} \tag{2.22}$$

this implying the following relation between CPI and domestic inflation

$$\pi_{c,t}^i = \pi_t^i + \alpha \Delta s_t^i \tag{2.23}$$

2.2 Firms

Each country is populated by a continuum of firms indexed by j on the unit interval $[0,1]$, each producing a variety with a constant return to scale technology

$$Y_t^i(j) = A_t^i N_t^i(j) \tag{2.24}$$

[6]The assumption could be rationalized by any real or nominal friction in the wage contracting process. See also Clarida, Galí and Gertler (1999), Galí (2003) and Woodford (2003)

[7](2.20) holds under the assumption of symmetric initial conditions and initial zero net foreign asset holdings.

with country-specific productivity denoted by A_t^i. Prices are staggered à la Calvo, then in every period firms face a constant probability θ of changing the price. The optimal (log) price charged by firms that are allowed to re-optimize in period t is[8]

$$\overline{p}_t^i = \mu + (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\left\{mc_{t+k}^i + p_{t+k}^i\right\} \tag{2.25}$$

where $\mu = log\frac{\epsilon_p}{\epsilon_p - 1}$ is the log of the optimal mark-up. mc_t stands for the log of the marginal cost and is equal to

$$mc_t^i = -log(1-\tau_p^i) + w_t^i - p_t^i - a_t^i + \mu_t^{w,i} \tag{2.26}$$

and τ_p^i is a proportional production subsidy. Finally, it can be easily shown that the aggregate production function is given by

$$Y_t^i Z_t^i = A_t^i N_t^i \tag{2.27}$$

where Z_t^i is defined as

$$Z_t^i = \int_0^1 \frac{Y_t^i(j)}{Y_t} dj \tag{2.28}$$

and represents a measure of relative price dispersion[9].

2.3 Government Expenditure

Define aggregate government expenditure as

$$G_t^i = \left[\int_0^1 G_t^i(j)^{\frac{\epsilon_p - 1}{\epsilon_p}} dj\right]^{\frac{\epsilon_p}{\epsilon_p - 1}} \tag{2.29}$$

where $G_t^i(j)$ is the quantity of public consumption of variety j. Note that, differently from households, government is assumed to consume only domestically produced goods.[10] Given G_t^i, the government chooses $G_t^i(j)$ so as to minimize expenditure. Hence the following condition has to be satisfied

$$G_t^i(j) = \left(\frac{P_t^i(j)}{P_t^i}\right)^{-\epsilon_p} G_t^i \tag{2.30}$$

[8]To a first order approximation.

[9]It can be proved that $log(Z)$ is a function of the cross sectional variance of relative prices and it is of second order.

[10]The assumption that the government consumes domestically produced goods only is not as strong as it may look like: the empirical evidence in fact is in favor of a considerably higher home bias in public consumption than private consumption.

2.4 Market Clearing

After defining aggregate output as

$$Y_t^i = \left[\int_0^1 Y_t^i(j)^{\frac{\epsilon_p - 1}{\epsilon_p}} dj \right]^{\frac{\epsilon_p}{\epsilon_p - 1}} \tag{2.31}$$

one can show that the clearing of all goods markets, along with conditions for optimal intra-temporal allocation among varieties[11], implies that

$$Y_t^i = A_t^i N_t^i = C_t^i (S_t^i)^{\alpha} + G_t^i \tag{2.32}$$

2.5 The Pareto Optimum

The Pareto efficient equilibrium is determined by solving the problem of a planner who wishes to maximize utility of the union as a whole

$$\int_0^1 U(C_t^i, N_t^i, G_t^i) di \tag{2.33}$$

subject to technology and resource constraints

$$Y_t^i = A_t^i N_t^i \tag{2.34}$$

$$Y_t^i = C_{i,t}^i + \int_0^1 C_{i,t}^f df + G_t^i \tag{2.35}$$

for all $i \in [0, 1]$ The corresponding first order conditions determine the following efficient outcome for country i

$$\overline{N}_t^i = 1; \quad \overline{Y}_t^i = A_t^i; \quad \overline{C}_t^i = (1 - \chi)(1 - \alpha)(A_t^i)^{1-\alpha}(A_t^*)^{\alpha}; \quad \overline{G}_t^i = \chi A_t^i \tag{2.36}$$

Aggregating over i yields the union-wide Pareto optimum

$$\overline{N}_t^* = 1; \qquad \overline{Y}_t^* = A_t^*; \qquad \overline{C}_t^* = (1 - \chi) A_t^*; \qquad \overline{G}_t^* = \chi A_t^* \tag{2.37}$$

The evolution of the terms of trade at an efficient equilibrium has to be

$$\overline{S}_t^i = \left(\frac{\overline{C}_t^i}{\overline{C}_t^*} \right)^{\frac{1}{1-\alpha}} = \frac{A_t^i}{A_t^*} \tag{2.38}$$

[11]For further details see Galí and Monacelli (2008).

2.6 Equilibrium Dynamics

As efficiency will constitute the benchmark for welfare analysis, it is convenient to describe the equilibrium dynamics in terms of deviation from first best outcomes. Let output, government expenditure and fiscal gaps be respectively defined as

$$\tilde{y}_t = y_t - \overline{y}_t; \qquad \tilde{g}_t = g_t - \overline{g}_t; \qquad \tilde{f}_t = \tilde{g}_t - \tilde{y}_t; \tag{2.39}$$

$\tilde{f}_t$ can be interpreted as the percentage deviation from efficiency of government expenditure, as a fraction of GDP[12]. One can show that country i's inflation and output gap are fully described by the following equations (in log deviations from the efficient steady state)

$$\pi_t^i = \beta E_t\{\pi_{t+1}^i\} + \lambda(1+\varphi)\tilde{y}_t^i - \lambda\frac{\chi}{1-\chi}\tilde{f}_t^i + \lambda\mu_t^{w,i} \tag{2.40}$$

$$\Delta\tilde{y}_t^i - \Delta\tilde{y}_t^* = \frac{\chi}{1-\chi}(\Delta\tilde{f}_t^i - \Delta\tilde{f}_t^*) - [(\pi_t^i - \pi_t^*) + (\Delta a_t^i - \Delta a_t^*)] \tag{2.41}$$

as a function of domestic fiscal policy $\{\tilde{f}_t^i\}$, given productivity differentials and the evolution of union-wide inflation and output gap, where the following definitions apply

$$\pi_t^* = \int_0^1 \pi_t^i di \qquad \tilde{y}_t^* = \int_0^1 \tilde{y}_t^i di \qquad \tilde{f}_t^* = \int_0^1 \tilde{f}_t^i di \tag{2.42}$$

and λ is a convolution of deep parameters

$$\lambda = \frac{(1-\theta)(1-\theta\beta)}{\theta}$$

Equation (2.41) is peculiar to the case of a currency area. It relates the evolution of output gap differentials to fiscal gap, inflation and productivity differentials. In particular, note that $\Delta a_t^i - \Delta a_t^*$ is the efficient change in the terms of trade. As in a monetary union the nominal exchange rate cannot adjust so as to keep the terms of trade at their efficient level, price stickiness implies that each country can increase its own output gap relatively to the average, by creating deflation and then pushing the terms of trade above their efficient level. Hence, other things equal, devaluations of the real exchange rate increase domestic output gap through a beggar thy neighbor policy.

Finally, after specifying a monetary policy rule, the equilibrium of the currency area as a whole can be determined using union-wide versions of the standard closed-economy Phillips and IS curves

$$\pi_t^* = \beta E_t\{\pi_{t+1}^*\} + \lambda(1+\varphi)\tilde{y}_t^* - \lambda\frac{\chi}{1-\chi}\tilde{f}_t^* + \lambda\mu_t^{w,*} \tag{2.43}$$

[12] The steady state of the solution to the policy problem coincides with the steady state of the Pareto efficient allocation if the government is allowed to appropriately choose a subsidy to production. This result holds because of two assumptions: lump sum taxes are available; fiscal policy is set cooperatively across countries, so that they don't free ride on each other by manipulating the terms of trade.

$$\tilde{y}_t^* = E_t \tilde{y}_{t+1}^* + \frac{\chi}{1-\chi}\tilde{f}_t^* - \frac{\chi}{1-\chi}E_t \tilde{f}_{t+1}^* - (r_t^* - E_t\{\pi_{t+1}^*\} - rr_t^*) \tag{2.44}$$

where rr_t^* is a function of TFP shocks

$$rr_t^* = \rho + E_t\{\Delta a_{t+1}^*\} \tag{2.45}$$

3 Optimal Monetary Policy under Fiscal Discretion

Monetary and fiscal policy are conducted by two independent authorities, sharing the same objectives. However, only the latter can credibly commit to future policies, while the fiscal policy maker is allowed to re-optimize in every period. Hence, the central bank sets at time zero a state contingent path for the nominal interest rate $\{i_t^*\}_{t=0}^{\infty}$ and the government chooses public spending in each period[13].

As in Dixit and Lambertini (2003a), we model strategic interaction as a Stackelberg game. The committed authority, the central bank in our case, is assumed to be the leader, while fiscal policy is the follower. As such, the government takes as given the union-wide nominal interest rate and market expectations about future variables. In particular, when evaluating the impact of current policy on future variables, fiscal policy makers internalize policy functions mapping current states into future values of endogenous variables[14]. The model is solved by backward induction. We first find the fiscal policy rule, given the nominal interest rate. Then, we determine the optimal state contingent path of the interest rate at time zero, by including the fiscal reaction function among the constraints faced by the central bank.

It is important to emphasize that in each time period government expenditure and the nominal interest rate are set simultaneously, so that the leadership structure concerns the choice of the policy rule rather than the choice of the instruments. Also, we restrict the government to play open loop strategies[15],

[13]It is well known that this is equivalent to let the government choose a state contingent plan $\{g_{t+j}\}_{j=0}^{\infty}$ in every period t from $t = 0$ onwards, but ruling out as an equilibrium whatever plan that is not credible. Also, recall that subsidies are set at the level ensuing efficiency at the steady state and lump-sum taxes adjust to balance the government budget constraint at all times.

[14]To solve the model we use the same method as Clarida et al. (1999) and Beetsma and Jensen (2004, 2005). We conjecture that expectations are linear functions of current states, with some arbitrary coefficients defined to be consistent with the parameters entering the policy functions. The equilibrium concept is the same as the one applied by Klein, Krusell and Rios-Rull (2008) and it requires to rule out Markov-strategies that do not yield differentiable policy functions. Our solution method differs from Klein et al. (2008) only because we follow the linear-quadratic approach. Further discussion is postponed to the Appendix.

[15]Many contributions have analyzed dynamic policy games to tackle the issue of international cooperation. For a discussion and the use of open loop strategies, see Benigno (2002), Benigno and Benigno (2006), Canzoneri and Gray (1985), Canzoneri and Henderson (1992), Clarida, Galí and Gertler (2002), Coenen, Lombardo, Smets and Straub (2008) and Liu and Pappa (2008).

i.e. the whole interest rate path is taken as given. Then, fiscal policy does not internalize that the monetary authority can condition the current play on the past fiscal play. Nevertheless, all players hold rational beliefs at equilibrium. As it has been pointed out by Adam and Billi (2008a,b), this is a self-confirming equilibrium according to the definition by Fudenberg and Levine (1993).

In the remainder of the section, we first define the policy game. Then, we characterize the equilibrium of the currency area as a whole and of the representative country. All derivations are left to the Appendix.[16]

A second order approximation to the sum of utilities of union households around the efficient steady-state yields

$$W = -\frac{1}{2}\sum_{t=0}^{\infty}\beta^t \int_0^1 \left(\frac{\epsilon_p}{\lambda}(\pi_t^i)^2 + (1+\varphi)(\tilde{y}_t^i)^2 + \frac{\chi}{1-\chi}(\tilde{f}_t^i)^2\right) di \tag{3.1}$$

(3.1) is assumed to be the objective function of both policymakers. Nominal rigidities, cost push disturbances and the asymmetry of shocks make it impossible to attain the Pareto efficient allocation.

Definition 3.1 *Discretionary fiscal policy is a set of rules for the fiscal gaps* $\{\tilde{f}_t^i\}_{t=0}^{\infty}$ *for all* $i \in [0,1]$ *maximizing (3.1) subject to (2.40), (2.41), (2.42) and (2.44), given the nominal interest rate and the exogenous stochastic processes.*

Definition 3.2 *Optimal monetary policy under fiscal discretion is defined as the state contingent path for the common interest rate* $\{r_t^*\}$ *maximizing (3.1) subject to (2.40), (2.41), (2.42)* ***and*** *the set of optimal rules* $\{\tilde{f}_t^i\}_{t=0}^{\infty}$ *defined in Definition 3.1.*

It is immediate to prove that inflation, output and fiscal gap in difference from the mean are fully determined by solving the fiscal policy problem. Hence, they are independent of monetary policy. The intuition is straightforward. The central bank does not have enough instruments to choose more than one allocation across i for $\{\pi_t^i\}$, $\{\tilde{y}_t^i\}$ and $\{\tilde{f}_t^i\}$. Two are the implications.

First, monetary policy has no leverage on differentials. In fact, she can only choose a linear combination across countries of inflation, output and fiscal gaps. It will turn out that, as all countries are ex-ante symmetric and equally weighted in the objective function, optimal monetary policy will imply a targeting rule involving average inflation, output and fiscal gaps, union wide.

Second, there is no strategic interaction, and then no policy game, as far as the choice of differentials is concerned. This meaning that equilibrium differentials in this model are the same as in Beetsma and Jensen (2004, 2005), who have already investigated the perfect coordination case under discretion.

[16]The Appendix shows how the full optimization program can be conveniently split into a currency area part and a relative part, completely independent from each other. This is because being countries ex-ante symmetric and of equal size, factoring all variables into averages and differences from the average allows to split all equations into two independent systems. In doing this, we follow Beetsma and Jensen (2004, 2005) by applying Aoki (1981) factorization.

3.1 Union-wide Equilibrium

Optimal monetary policy under fiscal discretion implies

$$\tilde{g}_t^* = -\varphi(\tilde{y}_t^* + \epsilon_p \pi_t^*) \tag{3.2}$$

$$\epsilon_p \pi_t^* + \Delta \tilde{y}_t^* = \chi(1 + \varphi \epsilon_p \lambda)\widetilde{g^*} - \chi \widetilde{g_{t-1}^*} \tag{3.3}$$

the former being the fiscal reaction function and the latter the monetary reaction function. Average inflation, output and fiscal gap are fully characterized by (3.2) and (3.3), together with the union-wide Phillips curve (2.43), given the exogenous stochastic processes. The equilibrium evolution of the currency area as a whole is exactly the same that would be observed in a one sector closed economy sharing preferences and technology of the union's member countries. As pointed out by Gnocchi (2009) a few results stand out.

Result 3.1 *Public spending is always at its efficient level if and only if monetary policy acts discretionally.*

This is immediate as long as we recall that optimal monetary policy under discretion implies $\tilde{y}_t^* + \epsilon_p \pi_t^* = 0$. Discretionary governments evaluate as too recessionary (expansionary) whatever policy tightening (loosening) stabilizing inflation (the output gap) by more than a discretionary central bank would do. In fact, governments overlook the benefits of announcing future lower inflation in terms of current output gap: such announcement is time inconsistent and cannot be implemented unless governments too are endowed with a commitment technology. Therefore, any deviation from a discretionary monetary policy plan generates a disagreement yielding inefficient public spending fluctuations. We follow Galí and Monacelli (2008) and we label $\tilde{g}_t^*$ as neutral (aggregate) fiscal stance.

Result 3.2 *Fiscal discretion loosens the aggregate monetary policy stance.*

This is also immediate by recalling from Galí and Monacelli (2008) that optimal policy under coordination requires $\epsilon_p \pi_t^* + \Delta \tilde{y}_t^* = 0$. In contrast, here monetary policy has to target public spending in deviation from its efficient level: this is the only way to reduce the incentive to over-react on the part of the government. As a consequence of that, a combination of higher inflation and/or a higher output gap, compared to perfect coordination, is tolerated if public spending is inefficiently high.

Result 3.3 *Absent wage mark-up shocks, public spending is always at its efficient level.*

Absent a short-run stabilization trade-off, an allocation with zero average inflation and zero average output and fiscal gaps is feasible and no Pareto improving allocations exist. When the efficient allocation is feasible indeed, time inconsistency is not an issue and there is no disagreement between policy authorities. Hence, public spending is not used for stabilization purposes and the perfect

coordination solution is recovered. This is the case under TFP shocks, as price stickiness is the only distortion. However, were nominal or real wages rigid, the perfect coordination solution could never be implemented.
It is evident that whenever a stabilization trade-off exists, lack of coordination brings about welfare costs, due to inefficiently high variability of government expenditure *and* of inflation and/or output gap. Then, it is not necessarily true in this environment that the discretionary use of fiscal policy is welfare improving: the benefit of addressing asymmetric shocks has to be traded-off against the cost of inefficient aggregate fluctuations.

3.2 Equilibrium in The Representative Country

The solution to the governments' problem yields a policy rule for the representative country[17]

$$\begin{aligned} \varphi\epsilon_p\lambda\pi_t^{di} + (1+\varphi)(d_1 - \lambda\varphi)\tilde{y}_t^{di} + (1+\varphi)d_1\tilde{f}_t^{di} &= \\ \beta E_t\left[\varphi\epsilon_p\lambda\pi_{t+1}^{di} + (1+\varphi)\tilde{y}_{t+1}^{di} + \tilde{f}_{t+1}\right] \end{aligned} \tag{3.4}$$

where

$$\pi_t^{di} = \pi_t^i - \pi_t^* \qquad \tilde{f}_t^{di} = \tilde{f}_t^i - \tilde{f}_t^* \qquad \tilde{y}_t^{di} = \tilde{y}_t^i - \tilde{y}_t^* \tag{3.5}$$

stand for inflation, fiscal and output gap differentials respectively, c_1 is a state space coefficient defined in the appendix and

$$d_1 = 1 + \beta(1 - c_1) + \lambda(1+\varphi) \tag{3.6}$$

It is immediate to see that the rule is entirely forward looking: due to the lack of commitment, the government fails to internalize the effect of policy on past expectations. This implies an additional welfare cost of discretion, that adds up to the ones stemming from inefficient aggregate fluctuations.

4 Welfare Analysis

Recent literature claims that in a currency area fiscal policy enhances welfare through the stabilization of asymmetric shocks. We ask whether the result survives when governments act in a discretionary fashion without coordinating with the central bank. Results suggest that public spending is not the proper instrument to take care of idiosyncratic shocks, as long as the central bank and governments disagree about costs and benefits of monetary policy action. In fact, if welfare gains from fiscal policy are large under commitment and perfect coordination, they are negative under fiscal discretion. In all other cases, gains are close to zero under both regimes. Gains are computed with respect to the case of neutral fiscal policy, where government expenditure is constrained to the efficient provision of public goods.

[17] See the Appendix for all the technical details

4.1 Parametrization

Structural parameters are the same as in Galí and Monacelli (2008) and they are reported in Table 1. φ is set equal to 3, implying a labor supply elasticity of 1/3. The elasticity of substitution among goods and labor types, ϵ_p and ϵ_w are equal to 6, which is consistent with average mark-ups of 20 percent. θ and β are respectively set to 0.75 and 0.99. The steady-state share of government spending in output, $\gamma = \chi$, is parameterized to 0.25, the average of final government consumption for the Euro zone.

Let single country TFP and cost-push shocks be decomposed as the sum of an aggregate and an idiosyncratic component

$$\mu_{t+1}^{w,i} = \mu_{t+1}^{w,*} + \mu_{t+1}^{w,di} \tag{4.1}$$

$$a_{t+1}^{i} = a_{t+1}^{*} + a_{t+1}^{di} \tag{4.2}$$

where $\int_0^1 \mu_{t+1}^{w,di} di = 0$ and $\int_0^1 a_{t+1}^{di} di = 0$. The aggregate and the idiosyncratic components are assumed to be contemporaneously uncorrelated and to follow autoregressive processes

$$\mu_{t+1}^{w,*} = \rho_{u,*}\mu_t^{w,*} + \varepsilon_{t+1,u}^{*} \tag{4.3}$$

$$\mu_{t+1}^{w,di} = \rho_{u,di}\mu_t^{w,di} + \varepsilon_{t+1,u}^{di} \tag{4.4}$$

$$a_{t+1}^{*} = \rho_{a,*}\mu_t^{w,*} + \varepsilon_{t+1,a}^{*} \tag{4.5}$$

$$a_{t+1}^{di} = \rho_{a,di}a_t^{di} + \varepsilon_{t+1,a}^{di} \tag{4.6}$$

$\varepsilon_{t+1,u}^{*}$, $\varepsilon_{t+1,u}^{di}$, $\varepsilon_{t+1,a}^{*}$ and $\varepsilon_{t+1,a}^{di}$ are white noise innovations with zero mean and standard deviations respectively equal to $\sigma_{\varepsilon,u}^{*}$, $\sigma_{\varepsilon,u}^{di}$, $\sigma_{\varepsilon,a}^{*}$ and $\sigma_{\varepsilon,a}^{di}$. This decomposition is consistent with symmetry if and only if $\rho_{a,di} = \rho_{a,*}$, $\rho_{u,di} = \rho_{u,*}$, $\sigma_{\varepsilon,u}^{di} = \sigma_{\varepsilon,u}^{dj}$, $\sigma_{\varepsilon,a}^{di} = \sigma_{\varepsilon,a}^{dj}$ for any i and j in $[0,1]$, $i \neq j$. Hence, after defining $\rho_a = \rho_{a,*}$, $\rho_u = \rho_{u,*}$, $\sigma_{\varepsilon,u}^{d} = \sigma_{\varepsilon,u}^{di}$, $\sigma_{\varepsilon,a}^{d} = \sigma_{\varepsilon,a}^{di}$ single countries processes can be written as

$$a_{t+1}^{i} = \rho_a a_t^{i} + \varepsilon_{t+1,a}^{i}$$

$$\mu_{t+1}^{w,i} = \rho_u \mu_t^{w,i} + \varepsilon_{t+1,u}^{i}$$

where $\varepsilon_{t+1,u}^{i}$ and $\varepsilon_{t+1,a}^{i}$ are white noise innovations with zero mean and standard deviations respectively equal to

$$\sigma_{\varepsilon,u} = \left((\sigma_{\varepsilon,u}^{*})^2 + (\sigma_{\varepsilon,u}^{d})^2\right)^{0.5}$$

and

$$\sigma_{\varepsilon,a} = \left((\sigma_{\varepsilon,a}^{*})^2 + (\sigma_{\varepsilon,a}^{d})^2\right)^{0.5}$$

Note that the decomposition implies that cross-country covariances of TFP and cost-push shocks are such that

$$cov(a_t^i, a_t^j) = var(a_t^*) \quad cov(\mu_t^{w,i}, \mu_t^{w,j}) = var(\mu_t^{w,*})$$

Cross-country correlations, ρ_a^{CS} and ρ_u^{CS}, are equal to 1 if and only if single-country variances are explained by aggregate shocks only. Conversely, cross-country correlations are equal to 0 if and only if single-country variances are explained by idiosyncratic shocks only. It is in the latter case that the active use of fiscal policy is worth the most. The choice of parameters is discussed in each of the following subsections.

4.2 Results: Baseline

To perform welfare analysis we need to choose the values of parameters associated to the stochastic processes. In particular, the parameter space is

$$\Theta = \{\rho_a, \rho_u, \sigma^i_{\varepsilon,a}, \sigma^i_{\varepsilon,u}, \sigma^*_{\varepsilon,a}, \sigma^*_{\varepsilon,u}, \sigma^*_{\varepsilon,d}, \sigma^d_{\varepsilon,u}\}$$

We follow the literature in parameterizing single country TFP shocks. Hence, we set $\rho_a = 0.95$ and $\sigma^i_{\varepsilon,a} = 0.0071$. Then, we use as baseline a parametrization imposing $\rho_u = \rho_a$ and $\rho_a^{CS} = \rho_u^{CS} = \rho^{CS}$. This implies that, given cross-country correlation, all the remaining parameters can be expressed as a function of the standard deviation of the cost-push shock relative to TFP. Defining $RS \equiv \sqrt{\frac{Var(\mu^{w,i})}{Var(a^i)}}$

$$\sigma^*_{\varepsilon,a} = \left(\rho_a^{CS}\right)^{0.5} 0.0071$$

$$\left(\sigma^{di}_{\varepsilon,a}\right)^2 = 0.0071^2 - \left(\sigma^*_{\varepsilon,a}\right)^2$$

$$\sigma^i_{\varepsilon,u} = RS * 0.0071\sqrt{\frac{(1-\rho_u^2)}{(1-\rho_a^2)}}$$

$$\sigma^*_{\varepsilon,u} = \left(\rho_u^{CS}\right)^{0.5} \sigma^i_{\varepsilon,u}$$

$$\left(\sigma^{di}_{\varepsilon,u}\right) = \left(\sigma^i_{\varepsilon,u}\right)^2 - \left(\sigma^*_{\varepsilon,u}\right)^2$$

We compute welfare as a function of cross-country correlation and of RS. All welfare differences across regimes are measured in consumption equivalents, i.e. the percentage variation of steady state consumption under the benchmark policy that is making agents indifferent to the alternative policy regime.

Figure 1 plots the contour sets of the cost generated by discretion, with respect to full commitment. Not surprisingly, discretion entails welfare costs. This is due to two reasons: on one hand, the union-wide fiscal gap is too volatile, making harder the job of the central bank in stabilizing inflation and output gap. On the other hand, discretion leads to sub-optimal fluctuations of inflation, output and fiscal gap differentials. The relative importance of the two components is assessed in Figure 2, displaying the fraction of the total cost due to inefficient union-wide fluctuations. The cost is higher the higher is the cross-country correlation of shocks. When single country fluctuations are entirely due to aggregate shocks, all the differentials are closed. It follows that fiscal policy plays no role in differentials stabilization, but still it overreacts inefficiently to aggregate shocks.

As a consequence, the whole cost of discretion is due to inefficient aggregate fluctuations.

Given the cost stemming from fiscal discretion, it is interesting to ask whether it is sensible to use public spending as an instrument to stabilize national business cycles, rather than confining governments to the role of efficiently providing public goods. To answer this question, we compare welfare under full commitment and under fiscal discretion against the case of neutral fiscal stance.

Figure 3 plots the welfare gain of the full commitment solution. The stabilizing role of fiscal policy generates welfare gains that are decreasing in the cross-country correlation of shocks. This is because the fiscal policy instrument is needed when a significant fraction of fluctuations is explained by idiosyncratic risk.

Figure 4 displays welfare differences between the fiscal discretion regime and the case of neutral fiscal stance. The use of the fiscal instrument to stabilize asymmetric shocks either generates negligible welfare gains or, most of the time, it generates welfare costs. In particular, if welfare gains from fiscal policy are large under commitment and perfect coordination, they are negative under fiscal discretion.

4.3 Results: Sensitivity Analysis

We now alternatively relax the assumption that $\rho_u = \rho_a$ and $\rho_a^{CS} = \rho_u^{CS} = \rho^{CS}$ in order to assess the dependence of our result on the calibration of the shocks.

Figures 5 and 6 show again welfare gains from commitment and discretion respectively where $\rho_u = \rho_a = 0.95$. Welfare is computed as a function of ρ_a^{CS}, ρ_u^{CS} and RS. It is possible to see that, for all possible calibrations, either the gains from full commitment are negligible or whenever gains are higher then 0.05 percent the active discretionary regime is welfare reducing with respect to the neutral fiscal stance.

Figures 7 and 8 show welfare gains from commitment and discretion respectively as a function of ρ_u when $\rho_a^{CS} = \rho_u^{CS} = \rho^{CS}$. The pictures make clear that serial correlation is the crucial parameter driving the results. The higher serial correlation, the wider the region of the parameter space where neutral fiscal stance is better than the discretionary regime. The intuition is that when serial correlation is high, the central bank resolves the trade-off induced by fiscal misbehavior by over-stabilizing output and under-stabilizing inflation. As it is common in the whole sticky price literature, output gap fluctuations are much less costly than inflation fluctuations. As a consequence, the welfare cost of fiscal discretion increases in serial correlation.

We conclude that, as long as cost-push shocks display high serial correlation, the baseline result continues to hold: gains from fiscal policy are either close to zero both under full commitment and fiscal discretion or whenever they are large under full commitment they are negative under fiscal discretion. In this simple model cost-push shocks are the only disturbances creating a trade-off between inflation and output stabilization at the aggregate level. In a model with sticky prices and wages, TFP shocks would always generate a policy trade-off and therefore a disagreement between the central bank and the governments. Hence, discretion would produce inefficiently loose fiscal stance independently of cost-push shocks. Considering that TFP shock autocorrelation is commonly estimated to be around 0.9, it is sensible to claim that for plausible calibrations of the shocks fiscal policy is not the proper instrument to stabilize cross-country differentials.

5 Conclusion

This paper studies the optimal monetary and fiscal policy mix in a currency area, where only the central bank is able to commit to future policies. The contribution of the paper is twofold. First, we show that discretion "weakens" the gains from monetary commitment. In fact, the central bank has to accept deviations from the optimal package so as to contain governments' incentives to overexpand public spending. Moreover, we perform welfare analysis and we find that the costs generated by discretion offset the benefits of using fiscal policy for stabilization purposes. Therefore, fiscal policy is not the proper instrument to take care of asymmetric shocks as long as the central bank and governments disagree about costs and benefits of monetary policy action. The result opens the question of designing a suitable institutional framework coping with the problem of fiscal discretion.

The issue deserves further theoretical and empirical investigation. In particular, some relevant distortions the paper is abstracting from could push welfare results in opposite directions, either strengthening or weakening our argument. In fact, on one hand the introduction of distortionary taxation and debt may worsen the effects of discretionary fiscal policy as emphasized by Leith and Wren-Lewis (2006). In this perspective, our analysis would just provide a lower bound of the costs generated by the lack of commitment on the fiscal side. On the other hand, transaction frictions would reduce the cost of using public spending as a stabilization instrument, relatively to the nominal interest rate. This provides a motive for the use of government expenditure as a union-wide stabilization tool, even under full commitment.

A Appendix: Factorization

Defining country i inflation, output gap and fiscal gap differentials

$$\pi_t^{di} = \pi_t^i - \pi_t^* \qquad \tilde{f}_t^{di} = \tilde{f}_t^i - \tilde{f}_t^* \qquad \tilde{y}_t^{di} = \tilde{y}_t^i - \tilde{y}_t^* \tag{A.1}$$

the welfare function (3.1) and the constraints (2.40), (2.41), (2.42) and (2.44) can be rewritten as

$$W = W^* + W^d \tag{A.2}$$

$$\pi_t^* = \beta E_t\{\pi_{t+1}^*\} + \lambda(1+\varphi)\tilde{y}_t^* - \lambda\frac{\chi}{1-\chi}\tilde{f}_t^* + \lambda\mu_t^{w,*} \tag{A.3}$$

$$\tilde{y}_t^* = E_t\tilde{y}_{t+1}^* + \frac{\chi}{1-\chi}\tilde{f}_t^* - \frac{\chi}{1-\chi}E_t\tilde{f}_{t+1}^* - (r_t^* - E_t\{\pi_{t+1}^*\} - rr_t^*) \tag{A.4}$$

$$\pi_t^{di} = \beta E_t\{\pi_{t+1}^{di}\} + \lambda(1+\varphi)\tilde{y}_t^{di} - \lambda\frac{\chi}{1-\chi}\tilde{f}_t^{di} + \lambda(\mu_t^{w,i} - \mu_t^{w,*}) \tag{A.5}$$

$$\Delta\tilde{y}_t^{di} = \frac{\chi}{1-\chi}\Delta\tilde{f}_t^{di} - [\pi_t^{di} + (\Delta a_t^i - \Delta a_t^*)] \tag{A.6}$$

$$\int_0^1 \pi_t^{di} di = 0 \qquad \int_0^1 \tilde{y}_t^{di} di = 0 \qquad \int_0^1 \tilde{f}_t^{di} di = 0 \tag{A.7}$$

where

$$W^* = -\frac{1}{2}E_0\sum_{t=0}^{\infty}\beta^t\left(\frac{\epsilon_p}{\lambda}(\pi_t^*)^2 + (1+\varphi)(\tilde{y}_t^*)^2 + \frac{\chi}{1-\chi}(\tilde{f}_t^*)^2\right) + tips \tag{A.8}$$

$$W^d = -\frac{1}{2}E_0\sum_{t=0}^{\infty}\beta^t\int_0^1\left(\frac{\epsilon_p}{\lambda}(\pi_t^{di})^2 + (1+\varphi)(\tilde{y}_t^{di})^2 + \frac{\chi}{1-\chi}(\tilde{f}_t^{di})^2\right)di + tips \tag{A.9}$$

Applying (A.1) allows to retrieve the original system.

B Appendix: The Discretionary Fiscal Policy Problem

The currency area problem consists in selecting $\{\tilde{f}_t^*\}_{t=0}^{\infty}$ maximizing (A.8) subject to (A.3) and (A.4), given the union-wide nominal interest rate and the exogenous stochastic processes. Finally, optimization of (A.9) subject to (A.5), (A.6) and (A.7) determines the state-contingent path of fiscal gap differentials $\{\tilde{f}_t^{di}\}_{t=0}^{\infty}$, for all $i \in [0,1]$.

B.1 The Currency Area Problem

First order conditions are the following

$$\frac{\epsilon_p}{\lambda}\pi_t^* + \psi_{\pi,t}^* = 0 \tag{B.1}$$

$$(1+\varphi)\tilde{y}_t^* - \lambda(1+\varphi)\psi_{\pi,t}^* + \psi_{r,t}^* = 0 \tag{B.2}$$

$$\frac{\chi}{1-\chi}\tilde{f}_t^* + \lambda\frac{\chi}{1-\chi}\psi_{\pi,t}^* - \frac{\chi}{1-\chi}\psi_{r,t}^* = 0 \tag{B.3}$$

together with the constraints (A.3) and (A.4), where $\psi_{\pi,t}^*$ and $\psi_{r,t}^*$ are the lagrange multipliers respectively associated to (A.3) and (A.4). The system can be equivalently rewritten as

$$\frac{\epsilon_p}{\lambda}\pi_t^* + \psi_{\pi,t}^* = 0 \tag{B.4}$$

$$(1+\varphi)\tilde{y}_t^* - \lambda(1+\varphi)\psi_{\pi,t}^* + \psi_{r,t}^* = 0 \tag{B.5}$$

$$\tilde{f}_t^* = -\tilde{y}_t^* - \varphi(\tilde{y}_t^* + \epsilon_p\pi_t^*) \tag{B.6}$$

where (B.6) is the fiscal policy rule reported in the text, (3.2), and the first two equations, given the solution that the central bank wants to implement, serve the only purpose to determine lagrange multipliers.

B.2 The Representative Country Problem

To keep the problem as tractable as possible, we substitute out inflation using its definition

$$\pi_t^{di} = p_t^{di} - p_{t-1}^{di} \tag{B.7}$$

and the fact that

$$y_t^{di} = \frac{\chi}{1-\chi}f_t^{di} - \left[p_t^{di} + (a_t^i - a_t^*)\right] \tag{B.8}$$

This allows to reduce the number of endogenous states, by replacing (A.6) with (B.8). The equivalent optimization program features two controls, y_t^{di} and f_t^{di}, and an endogenous state, p_t^{di}. Because of the presence of an endogenous state, expectations cannot be taken as given. Therefore, we conjecture that the private sector forecasts future variables as linear functions of current states for some arbitrary coefficients. At the rational expectation equilibrium, those coefficients are defined to be such to coincide with the true fundamental parameters of the state space representation. It is guessed that

$$p_t^{di} = c_1 p_{t-1}^{di} + c_2(a_t^i - a_t^*) + c_3(\mu_t^i - \mu_t^*) \tag{B.9}$$

Equation (B.8) can be used in the Phillips curve to write f_t^{di} in terms of current and past states only

$$\begin{aligned}\tilde{f}_t^{di} = {} & \frac{1-\chi}{\chi\lambda\varphi}\left[1+\beta(1-c_1)+\lambda(1+\varphi)\right]p_t^{di} - \frac{1-\chi}{\chi\lambda\varphi}p_{t-1}^{di} \\ & + \frac{1-\chi}{\chi\lambda\varphi}\left[\lambda(1+\varphi)-\beta\rho c_2\right](a_t^i - a_t^*) \\ & - \frac{1-\chi}{\chi\lambda\varphi}(\lambda+\beta\rho c_3)(\mu_t^i-\mu_t^*)\end{aligned} \tag{B.10}$$

Plugging (B.10) back into (B.8) yields

$$\begin{aligned}\tilde{y}_t^{di} = &\left\{\frac{1}{\lambda\varphi}\left[1+\beta(1-c_1)+\lambda(1+\varphi)\right]-1\right\}p_t^{di} - \frac{1}{\lambda\varphi}p_{t-1}^{di} \\ &+\left\{\frac{1}{\lambda\varphi}\left[\lambda(1+\varphi)-\beta\rho c_2\right]-1\right\}(a_t^i - a_t^*) \\ &-\frac{1}{\lambda\varphi}(\lambda+\beta\rho c_3)(\mu_t^i-\mu_t^*)\end{aligned} \tag{B.11}$$

All future variables have been expressed as a function of current states, hence the problem can be cast in a conventional recursive form. Being the problem linear-quadratic, equilibrium can be formally stated as follows. Let s_{t-1} be the vector collecting exogenous states. Equilibrium consists of a linear policy function $\mathcal{P}$ and a quadratic value function V such that for any p_{t-1}^{di}, $\mathcal{P}(p_{t-1}^{di})$ solves

$$\max_{p_t}\left\{\mathcal{H}(p_t^{di}, p_{t-1}^{di}, s_t) + \beta E_t V(p_t^{di}, s_{t+1})\right\} \tag{B.12}$$

where

$$\mathcal{H} = -\frac{\varepsilon}{\lambda}(p_t^{di}-p_{t-1}^{di})^2 - (1+\varphi)(\tilde{y}_t^{di})^2 - \frac{\chi}{1-\chi}(\tilde{f}_t^{di})^2 \tag{B.13}$$

$$V(p_{t-1}^{di}, s_t) = \mathcal{H}(\mathcal{P}(p_{t-1}^{di}), p_{t-1}, s_t) + \beta E_t V(\mathcal{P}(p_{t-1}^{di}), s_{t+1}) \tag{B.14}$$

and (B.10)-(B.11) have been used for convenience. The corresponding first order condition is

$$\begin{aligned}&\frac{2\varepsilon}{\lambda}(p_t^{di}-p_{t-1}^{di}) + 2(1+\varphi)\left\{\frac{1}{\lambda\varphi}\left[1+\beta(1-c_1)+\lambda(1+\varphi)\right]-1\right\}\tilde{y}_t^{di} \\ &+\frac{2}{\lambda\varphi}\left[1+\beta(1-c_1)+\lambda(1+\varphi)\right]\tilde{f}_t^{di} + \beta E_t\frac{\partial V}{\partial p_t} = 0\end{aligned} \tag{B.15}$$

It is easy to recover the envelope condition by differentiating the value function with respect to the state

$$\frac{\partial V}{\partial p_{t-1}} = \frac{\partial \mathcal{H}}{\partial p_t^{di}}\frac{\partial \mathcal{P}}{\partial p_{t-1}^{di}} + \frac{\partial \mathcal{H}}{\partial p_{t-1}^{di}} + \beta E_t\frac{\partial V}{\partial p_t^{di}}\frac{\partial \mathcal{P}}{\partial p_{t-1}^{di}}$$

and substituting the first order condition

$$\frac{\partial \mathcal{H}}{\partial p_t^{di}} + \beta E_t\frac{\partial V}{\partial p_t} = 0$$

in order to obtain

$$\frac{\partial V}{\partial p_{t-1}} = \frac{\partial \mathcal{H}}{\partial p_{t-1}^{di}} = -\frac{2\varepsilon}{\lambda}(p_t^{di}-p_{t-1}^{di}) - \frac{2(1+\varphi)}{\lambda\varphi}\tilde{y}_t^{di} - \frac{2}{\lambda\varphi}\tilde{f}_t^{di} \tag{B.16}$$

This proves that, as in standard dynamic programming, derivatives of the unknown policy function vanish from the envelope because of optimality. This is the case, even if in this environment the unknown function $\mathcal{P}$ needs to be differentiated in the first order condition. Updating (B.16) one period ahead and substituting it in (B.15) yields equation (3.4) in the text. It is evident that the representative country's problem is independent of interest rates, then independent of monetary policy.

C Appendix: The Monetary Policy Problem

The central bank has to choose a state contingent path for the union-wide policy outcomes $\left\{\pi_t^*, \tilde{y}_t^*, \tilde{f}_t^*\right\}_{t=0}^{\infty}$ in order to maximize W^* subject to (2.43) and (B.6). The nominal interest rate is chosen ex-post, consistently with the union-wide IS equations. The associated first order conditions are

$$\frac{\epsilon_p}{\lambda}\pi_t^i + \Delta\xi_{\pi,t}^* + \varphi\epsilon_p\xi_{f,t}^* = 0 \tag{C.1}$$

$$(1+\varphi)\tilde{y}_t^* - \lambda(1+\varphi)\xi_{\pi,t}^* + (1+\varphi)\xi_{f,t}^* = 0 \tag{C.2}$$

$$\frac{\chi}{1-\chi}\tilde{f}_t^* + \lambda\frac{\chi}{1-\chi}\xi_{\pi,t}^* + \xi_{f,t}^* = 0 \tag{C.3}$$

where $\xi_{\pi,t}^*$, $\xi_{f,t}^*$ are the lagrange multipliers respectively associated to (2.43) and (B.6). (C.2) and (C.3) allow to express lagrange multipliers as functions of output and fiscal gaps

$$\xi_{\pi,t}^* = \frac{1-\chi}{\lambda}\tilde{y}_t^* - \frac{\chi}{\lambda}\tilde{f}_t^* \tag{C.4}$$

$$\xi_{f,t}^* = -\chi(\tilde{y}_t^* + \tilde{f}_t^*) \tag{C.5}$$

Substituting back into (C.1) yields the monetary policy rule (3.3) in the text.

Table 1: **Baseline Calibration**

Parameter	**Value**
φ	3
$\epsilon_p = \epsilon_w$	6
θ	0.75
β	0.99
$\gamma = \chi$	0.25
ρ_a	0.95
$\sigma_{\varepsilon,a}$	0.0071

Figure 1: **Welfare cost of discretion.** Contour sets of the welfare cost of discretion as a function of cross-country correlation and relative standard deviation. Welfare cost is measured in consumption equivalents, i.e. as the percentage decrease of steady state consumption under full commitment in order to be indifferent to the fiscal discretion regime.

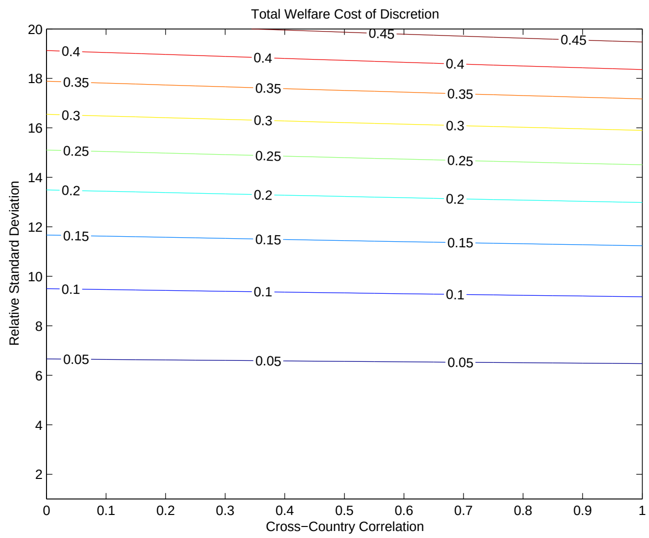


Figure 2: **Welfare cost of discretion: union-wide component.** The graph displays contour sets of the union-wide component as a fraction of the total cost of discretion. The cost is measured in consumption equivalents.

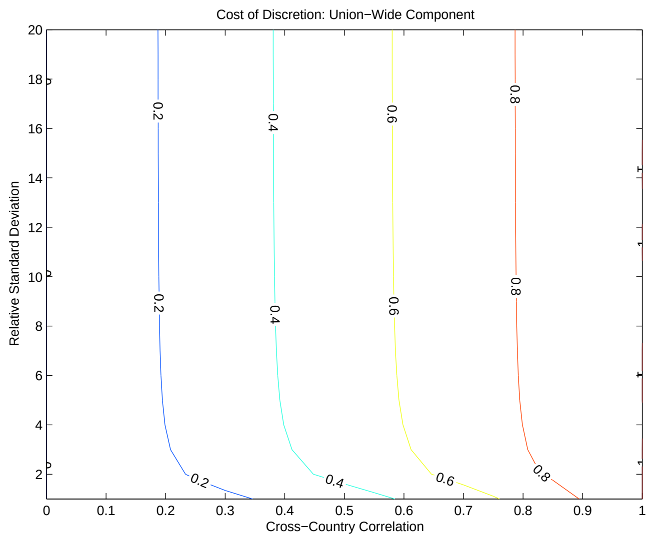


Figure 3: **Welfare gain from committed fiscal policy.** The gain is computed with respect to inactive fiscal policy, i.e. a regime where fiscal policy is constrained to efficient provision of public goods.

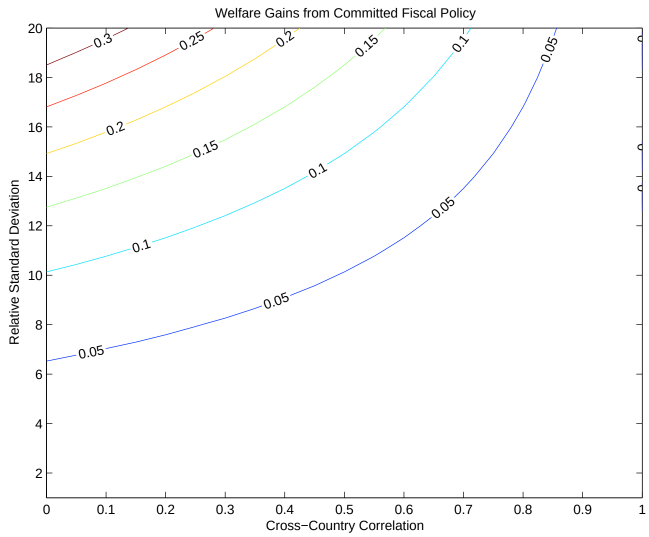


Figure 4: **Welfare gain from discretionary fiscal policy.** The gain is computed with respect to inactive fiscal policy.

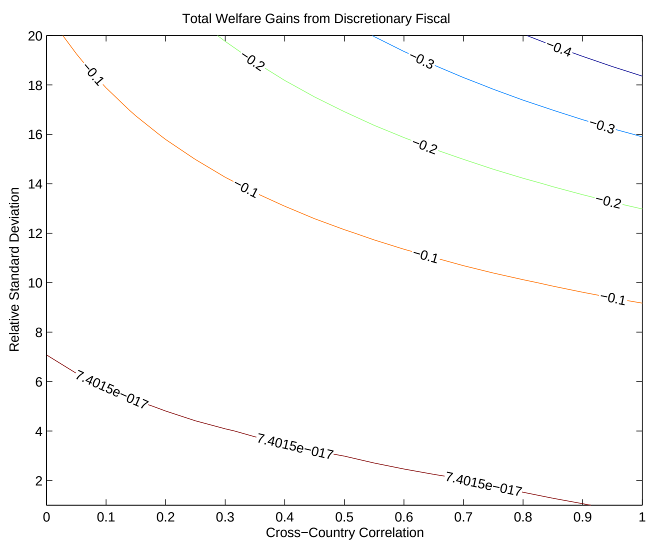


Figure 5: **Robustness. Welfare gain from committed fiscal policy as a function of cross-country correlation and relative standard deviation. $\rho_u = \rho_a = 0.95$.**

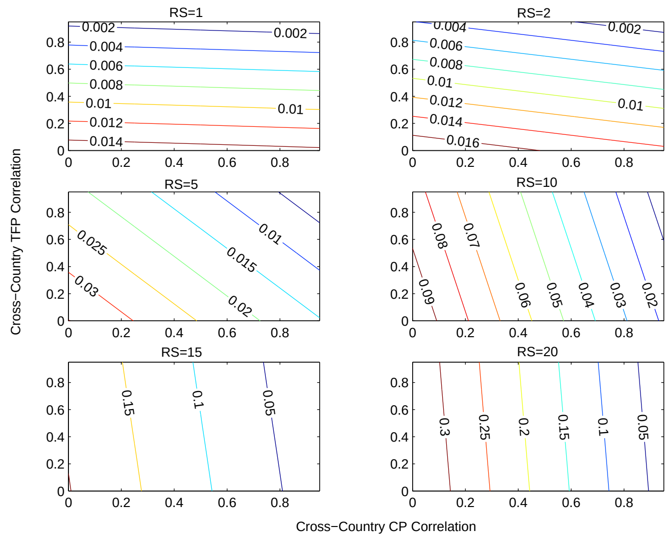


Figure 6: **Robustness. Welfare gain from discretionary fiscal policy as a function of cross-country correlation and relative standard deviation. $\rho_u = \rho_a = 0.95$.**

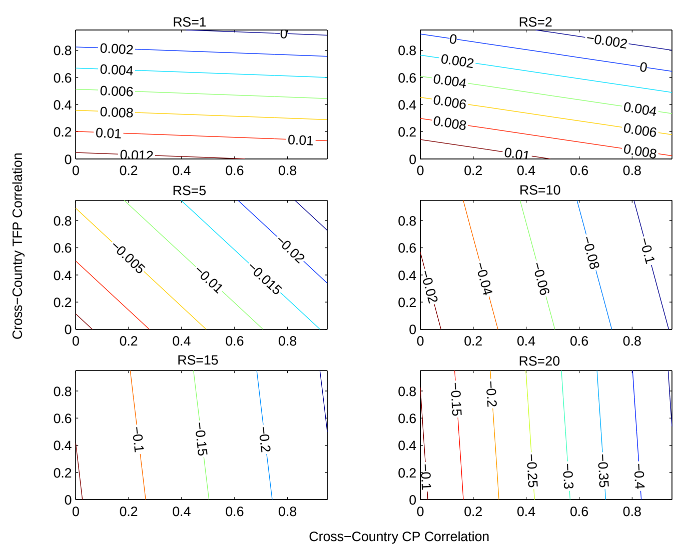


Figure 7: **Robustness. Welfare gain from committed fiscal policy as a function of cross-country TFP and cost-push correlation. Each box, first left to right and then top to bottom, sets ρ_u equal to 0, 0.05, 0.1, 0.15, ..., 0.95 respectively.**

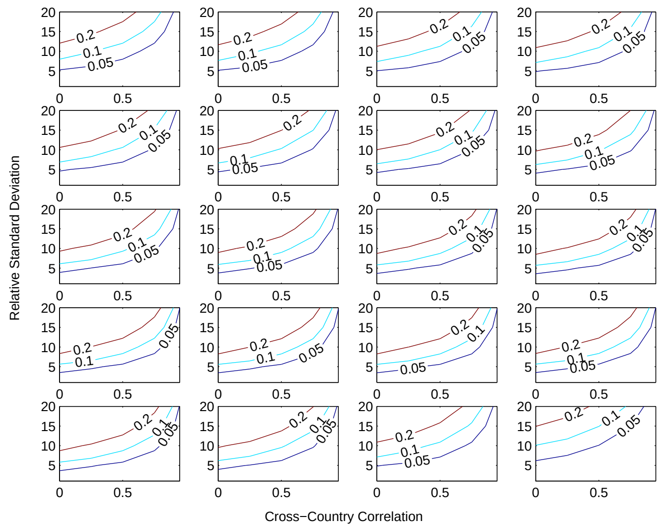
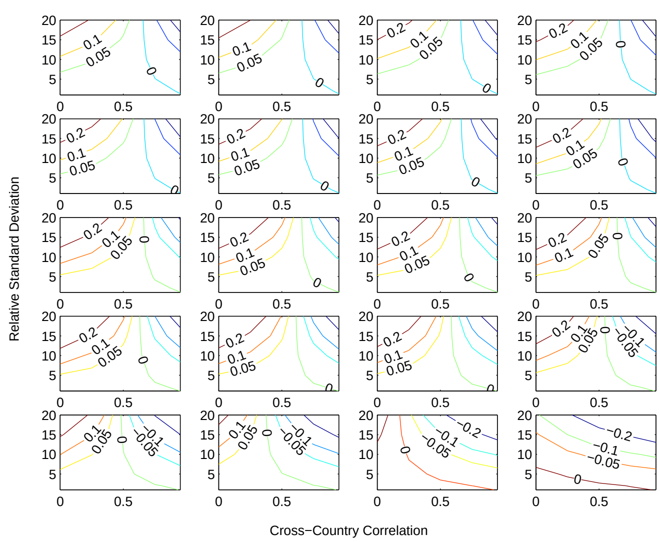


Figure 8: **Robustness. Welfare gain from discretionary fiscal policy as a function of cross-country TFP and cost-push correlation. Each box, first left to right and then top to bottom, sets ρ_u equal to 0, 0.05, 0.1, 0.15, ..., 0.95 respectively.**



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