FISCAL POLICY INTERACTIONS AND IMBALANCES IN A MONETARY UNION

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Are there important economic consequences from conducting fiscal policy at the national level within a monetary union? This paper investigates the consequences of strategic fiscal policy interactions in a two-country DSGE model of a monetary union with nominal rigidities and international financial frictions. I show that the fiscal policy makers in this framework face an incentive to set fiscal policy such as to switch the terms of trade in their favour. This incentive, the terms of trade externality, results in a Nash equilibrium where inflation differentials across countries and intra-union imbalances may be significantly larger than if the fiscal policy makers had cooperated. Indeed, the main results of the analysis is that strategic interactions between national fiscal policy makers can lead to excessive inflation differentials across countries as well as sub-optimally high current account imbalances within the monetary union. When this is the case, there are non-negligeable welfare losses associated with strategic national fiscal policy making in a monetary union.

1 Introduction

Are there important economic consequences from conducting fiscal policy at the national level within a monetary union? This question was first addressed in the 1960s in the framework of the theory of optimal currency areas, then regained interest with the construction of the Economic and Monetary Union (EMU) in the 1990s. Recently, the eurozone crisis has put the question into the spotlight once again. This paper aims at assessing the effects of strategic fiscal policy interactions between countries taking part in a monetary union. Specifically, I investigate the consequences for imbalances and price misalignments across countries.

The investigation is based on a two-country DSGE model of a monetary union in which there are international financial frictions. Furthermore, firms are monopolistically competitive and set prices sluggishly. These features imply inefficiencies in the face of country-specific shocks, and ensure a potential stabilization role for fiscal policies. The inefficiencies arising in this monetary union framework can be illustrated by imbalances, price misalignments, and output misallocations. I show that the importance of these inefficiencies depend on the strategic interaction of fiscal policy makers.

The analysis carried out in this paper contributes to the strand of the New Open Economy Macroeconomic literature dealing with the consequences of strategic interactions between policy makers.This literature first focused on monetary policy interactions; Obstfeld and Rogoff (2002) as well as Corsetti and Pesenti (2001) are part of that earlier literature. Corsetti and Pesenti (2001) show that national policy makers face an incentive to attempt to manipulate the terms of trade in their favor – they face a terms of trade externality. This terms of trade externality implies that inward-looking monetary policies are welfare-deteriorating, due to increased inflation volatility – unless the benchmark case of no spillovers across countries figuring in Obstfeld and Rogoff (2002) is considered.

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The strategic interaction of fiscal policy makers in open economies has been considered inter alia by Lombardo and Sutherland (2004), as well as by Benigno and Paoli (2010). My analysis departs from theirs in that I consider a monetary union with international financial frictions which affect misalignments and imbalances across countries and shape the fiscal policies. Indeed, the presence of internationally incomplete markets imply deviations from perfect risk sharing which affect not only the transmission of shocks, but also the optimal behavior of fiscal policy makers. The incentive to engage in strategic fiscal policy making and the consequences thus also depend on international financial markets.

The inclusion of international financial frictions is motivated by the empirical evidence on relatively low risk sharing across countries, also within the EMU, indicating that there are international financial frictions which prevent international risk sharing from taking place, see, e.g., Demyanyk, Ostergaard, and Sorensen (2008). Though the presence of international financial frictions and the resulting deviations from perfect risk sharing might have important consequences for welfare, optimal policy making and the transmission of shocks across countries, they have not been introduced into the literature on fiscal policy making in open economies.[1] I contribute to the literature by pointing out the potential importance of market incompleteness in a monetary union with independent fiscal policy makers.

I analyse strategic fiscal policy interactions in a two-country DSGE model of a monetary union with nominal rigidities and international financial frictions. I show that the fiscal policy makers in this framework face an incentive to switch the terms of trade in their favor. This incentive, the terms of trade externality, results in a Nash equilibrium where inflation differentials across countries and intra-union imbalances may be significantly larger than if the fiscal policy makers had cooperated. Indeed, the main results of the analysis is that strategic interactions between national fiscal policy makers can lead to excessive inflation differentials across countries as well as sub-optimally high current account imbalances within the monetary union. When this is the case, there are non-negligeable welfare losses associated with conducting national fiscal policies strategically.

These results seem important in the context of the current eurozone crisis. Indeed, they indicate that part of the excessive inflation differentials and current account imbalances observed between the core and the periphery of the zone could potentially be explained by the strategic conduct of fiscal policies. In the light of this analysis, it might be beneficial to reconsider the potential gains from fiscal policy cooperation within the EMU, since fiscal cooperation might lower imbalances arising in the face of country-specific shocks. Especially, if these imbalances have negative effects not considered here, e.g., through their effects on risk in the banking sector, fiscal cooperation could imply even larger benefits than those found here.

The next section presents the framework used for the investigation of strategic interactions between fiscal policy makers in a monetary union. The subsequent section derives analytical characterizations of optimal fiscal policy making under cooperation and non-cooperation. In Section 4 figures a numerical analysis emphasizing the effects of fiscal policy interactions on price misalignments, international imbalances, and welfare. Section 5 then concludes the paper.

[1] In the monetary policy literature, inter alia, Corsetti, Dedola and Leduc (2010) have emphasized the importance of international financial markets for optimal policy making.

2 Model

2.1 Households

The world is composed of two countries, denoted H (Home) and F (Foreign). There are respectively n and $1-n$ households in each of these countries. In the following, I will focus on the agents in the Home country.[2]

Households get utility from private consumption and government expenditures (respectively c and G), but disutility from work (l), and therefore a household's utility is given by:

$$v = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left[U^C(c_t) + U^G(G_t) - U^L(l_t) \right] \tag{1}$$

where E_t denotes the expectations at time t, and β is the discount factor. The functional forms are as follows:

$$U^C(c_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma}$$
$$U^G(G_t) = \chi \frac{G_t^{1-\sigma} - 1}{1-\sigma}$$
$$U^L(l_t) = \frac{l_t^{1+\eta}}{1+\eta}$$

where $\sigma > 0$ is the inverse of the intertemporal elasticity of substitution and the relative risk aversion coefficient, $\eta > 0$ is the inverse of the Frisch labor-supply elasticity, and χ is the weight given to public consumption relative to private consumption.

The differentiated goods produced by firms h and f in country H and F respectively, $c_t(h)$ and $c_t(f)$, are assembled by a Dixit-Stiglitz aggregator into the composite goods denoted respectively $C_{H,t}$ and $C_{F,t}$:

$$C_{H,t} = \left[\int_0^n c_t(h)^{\frac{\theta-1}{\theta}} dh \right]^{\frac{\theta}{\theta-1}}, \qquad C_{F,t} = \left[\int_n^1 c_t(f)^{\frac{\theta-1}{\theta}} df \right]^{\frac{\theta}{\theta-1}}$$

such that θ denotes the elasticity of substitution between the differentiated goods produced within a country.

Consumption is a CES index of consumption of the goods produced at Home and the goods produced in the Foreign country

$$C_t = \left[a_H^{\frac{1}{\phi}} C_{H,t}^{\frac{\phi-1}{\phi}} + (1-a_H)^{\frac{1}{\phi}} C_{F,t}^{\frac{\phi-1}{\phi}} \right]^{\frac{\phi}{\phi-1}}, \qquad 0 < a_H < 1, \quad \phi > 0, \tag{2}$$

where the constant elasticity of substitution between the home and foreign goods, also called the trade elasticity, is denoted ϕ. The trade elasticity is an important determinant of the transmission of shocks and policies across countries. It therefore plays a crucial role in determining optimal fiscal policy. I will assume, in the benchmark case, that the internationally traded goods are complements in utility, meaning that the marginal utility of consumption of the Foreign good is positively related to the marginal utility of consumption of the Home good.[3] a_H is the weight given to consumption of

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[2] Analogous relations hold for the agents in the Foreign country, unless otherwise specified.

[3] See discussion in Section 4.1.

the Home goods, whereas $1 - a_H$ is the weight attached to consumption of the Foreign goods. If $a_H > n$, then a home bias in consumption is present. The presence of home bias results in deviations from purchasing power parity, even when the law of one price holds.

Given that households choose their relative consumption demand such as to maximize utility for given expenditures, the domestic demand for respectively Home and Foreign goods are:

$$C_{H,t} = a_H \left(\frac{P_{H,t}}{P_t}\right)^{-\phi} C_t, \tag{3}$$

$$C_{F,t} = (1 - a_H) \left(\frac{P_{F,t}}{P_t}\right)^{-\phi} C_t. \tag{4}$$

where P_H and P_F respectively denote the price of the domestically produced generic good C_H and the foreign good C_F, whereas P and P^* denote the respective prices of the domestic and foreign consumption baskets C and C^*. The consumption-based price indices are defined analogously to the consumption bundles:

$$P_t = \left[a_H P_{H,t}^{1-\phi} + (1 - a_H) P_{F,t}^{1-\phi}\right]^{\frac{1}{1-\phi}}, \tag{5}$$

$$P_t^* = \left[(1 - a_H) {P_{H,t}^*}^{1-\phi} + a_H {P_{F,t}^*}^{1-\phi}\right]^{\frac{1}{1-\phi}}. \tag{6}$$

where:

$$P_{H,t} = \left[\int_0^n p_t(h)^{1-\theta} dh\right]^{\frac{1}{1-\theta}}, \qquad P_{F,t} = \left[\int_n^1 p_t(f)^{1-\theta} df\right]^{\frac{1}{1-\theta}}$$

The terms of trade are defined as the ratio between the price of imports and exports: $TOT_t \equiv \frac{P_{F,t}}{P_{H,t}^*}$, whereas the real exchange rate is defined as the price of the Foreign consumption bundlein terms of the Home consumption good:

$$Q_t \equiv \frac{P_t^*}{P_t} \tag{7}$$

Households face complete financial markets at the domestic level, and firms' profits are equally distributed among domestic households (because they all hold an equal share of each domestic firm) such that a representative household exists within each country. However, households are subject to frictions at the international level: only nominal one-period bonds with debt-elastic yields are traded across countries. The yields of the bonds are higher the higher is a country's external debt relative to the steady state level, as in Schmitt-Grohe and Uribe (2003). Apart from implying stationarity of the steady state, modelling financial frictions through a debt-elastic yield on bonds allows for yield differences across countries which mimic those recently observed across countries in the EMU.

In order to model the debt-dependent interest rates, I assume that bonds can only be traded internationally through intermediaries. These intermediaries demand a higher yield on bonds which are issued by countries with high external debt levels, for example because of an underlying risk of default that is increasing in debt.[4] For technical simplicity, the additional rent thus extracted by the intermediaries when lending to indebted countries (*i.e.*, countries with a current account deficit) is assumed to be distributed to households within the current account surplus country as lump-sum transfers.[5]

To illustrate the mechanism of the debt-elastic yield, consider the situation in which Home real bond holdings, denoted $\frac{B_{H,t}}{P_t}$, are above their steady state level, *i.e.*: $\frac{B_{H,t}}{P_t} > \frac{\bar{B}_H}{P}$ that is, the Foreign country has issued (excessive) debt: $\frac{B_{F,t}}{P_t^*} > \frac{\bar{B}_F}{P^*}$. In that case, the Foreign yield is multiplied by a function $\Phi(B_{F,t}/P_t^*) > 1$ (the premium), and the domestic interest rate is decreased, since it is multiplied by $\Phi(B_{H,t}/P_t^*) < 1$. The function Φ is assumed to depend positively on the deviation of debt from its steady state level ($\Phi'(.) < 0$), and satisfies $\Phi\left(\frac{\bar{B}_F}{P^*}\right) = \Phi\left(\frac{\bar{B}_H}{P}\right) = 1$. Hence, a yield spread across the countries arise, and it is increasing in the difference between the countries' external debt levels, or current accounts. The yield premium associated with holding bonds is assumed to be linear in the excessive borrowing/lending (in deviations from the steady state value). An example of a function satisfying the requirements above is $\Phi(b_t) = 1 - \delta(b_t - \frac{\bar{B}}{P})$, with $\delta \geq 0$ and $\frac{\bar{B}_F}{P^*} \equiv \frac{\bar{B}_H}{P} \equiv \frac{\bar{B}}{P}$.

Labor is immobile between countries but perfectly mobile within countries such that wages are identical across households within a country. It follows that labor supply and consumption decisions are identical for all households within each country. Every period, the representative household uses its labor income, its wealth accumulated in bonds, profits of firms in the domestic economy, and the lump-sum transfers resulting from intermediation activities, to purchase consumption and bonds and pay lump-sum taxes. I assume that individual households do not internalize the effect of changes in their own bond holdings on the yield, *i.e.*, they take the function $\Phi'(.)$ as given.

In the Home country, the household budget constraint thus amounts to:

$$c_t + \frac{b_t}{P_t(1+i_t)\Phi(B_{H,t}/P_t)} + T_t = \frac{w_t}{P_t}l_t + \frac{b_{t-1}}{P_t} + [\frac{1}{\Phi(B_{F,t}/P_t^*)} - 1]\frac{B_{F,t}}{(1+i_t)P_t} + pr_t \tag{8}$$

where c_t is consumption of the household considered such that $C_t \equiv \int_0^n c_t dh$, P_t is the CPI, i_t is the nominal interest set by the common central bank in period t, w_t is the wage rate, and l_t is the hours worked by the household, pr_t denote the profits, T_t denotes lump-sum taxes paid by the household, and b_t is the nominal bond holdings of a Home household such that $B_{H,t} \equiv \int_0^n b_t dh$, and similarly $B_{F,t} \equiv \int_n^1 b_t^* df$. The first-order conditions of the representative domestic household can be aggregated to yield:

$$\beta E_t[\frac{C_{t+1}^{-\sigma}}{C_t^{-\sigma}}\frac{1+i_t}{\pi_{t+1}}] = \frac{1}{\Phi(B_{H,t}/P_t)} \tag{9}$$

$$\frac{L_t^\eta}{C_t^{-\sigma}} = \frac{W_t}{P_t} \tag{10}$$

The first equation is the Euler equation, determining the intertemporal allocation of consumption. The second equation is the labor supply equation stating that in equilibrium, the

4 This risk is not modelled explicitly, and in equilibrium default never occurs.

5 This assumption could easily be replaced by the assumption of equal distribution of the rent across the whole union. The qualitative results would be unchanged by this alternative assumption.

marginal utility of consumption obtained from an extra hour of work must equal the marginal disutility of working that extra hour.

2.2 *Firms*

Firms are monopolistically competitive and set prices in a staggered fashion *à la* Calvo-Yun. That is, they reset their price at a time-independent random frequency. More specifically, each firm faces the probability $1-\alpha$ of getting the possibility to reset their price every period.

Firms are owned by domestic households, and all firms within a country are identical in that their technology is such that output is linear in labor, and depends on a country-specific productivity shock denoted A: $y_t(h) = A_t l_t(h)$, where h refers to a country H firm.

The optimisation problem of the firm producing good h and getting the opportunity to reset its price at time t consists in choosing a price $p_t(h)$ such as to maximize expected discounted future profits:

$$\max_{p_t(h)} E_t \sum_{s=0}^{\infty} \alpha^s \mu_{t,t+s}[((1-\tau)p_t(h) - \frac{W_{t+s}}{A_{t+s}})y_{t,t+s}(h)]$$

subject to demand:

$$y_{t,t+s}(h) = (\frac{p_t(h)}{P_{H,t+s}})^{-\theta}(C_{H,t+s} + G_{t+s}) + (\frac{p_t(h)}{P_{H,t+s}})^{-\theta}C^*_{H,t+s}$$

where $\mu_{t,t+s}$ is the stochastic discount factor of the firm, and τ is a tax on production. Given that the firms are owned by the households their discount factor is identical to the discount factor of the representative household: $\mu_{t,t+s} = \beta^s \frac{U_{C,t+s}}{P_{t+s}}\frac{P_t}{U_{C,t}}$.

The resulting first order conditions imply that prices are set according to expectations of future marginal costs and demand in the following way:

$$p_t(h) = \frac{\theta}{(\theta-1)(1-\tau)} \frac{\sum_{s=0}^{\infty}(\alpha\beta)^s \frac{C_{t+s}^{-\sigma}}{P_{t+s}}\frac{W_{t+s}}{A_{t+s}} y_{t,t+s}(h)}{\sum_{s=0}^{\infty}(\alpha\beta)^s \frac{C_{t+s}^{-\sigma}}{P_{t+s}} y_{t,t+s}(h)} \tag{11}$$

Because all firms that get to reset their price in a given period face the same expectations of marginal costs and demand, they all set the same price. Hence the following condition holds:

$$P_{H,t} = [\alpha P_{H,t-1}^{1-\theta} + (1-\alpha)p_t(h)^{1-\theta}]^{\frac{1}{1-\theta}} \Leftrightarrow (\frac{p_t(h)}{P_{H,t}})^{1-\theta} = \frac{1-\alpha\pi_{H,t}^{\theta-1}}{1-\alpha} \tag{12}$$

where $\pi_{H,t} \equiv \frac{P_{H,t}}{P_{H,t-1}}$.

Aggregating oputput across firms yields $Disp_t Y_{H,t} = A_t L_t$ where $Disp_t \equiv \int_0^n (\frac{p_t(h)}{P_{H,t}})^{-\theta} dh$ is a measure of the degree of price dispersion. This term is always larger or equal to unity.[6] The

[6] Proof: Let $v_t(h) = (\frac{P_{t,h}}{P_{H,t}})^{1-\theta}$, such that $Disp_t = \int_0^n (\frac{P_{t,h}}{P_{H,t}})^{-\theta} dh = \int_0^n v_t(h)^{\frac{\theta}{\theta-1}} dh$.

(continues)

evolution of price dispersion is dependent on inflation in the following way:

$$Disp_t = (1-\alpha)[\frac{1-\alpha\pi_{H,t}^{\theta-1}}{1-\alpha}]^{\frac{-\theta}{(1-\theta)}} + \alpha\pi_{H,t}^{\theta} Disp_{t-1} \tag{13}$$

The price setting process of firms thus introduces a distortion in that price dispersion among firms with identical technologies result.

Note that if firms operate in an environment with perfectly flexible prices, the representative domestic firm sets its price to equal a constant markup over marginal costs illustrated by the real wage rate adjusted for productivity:

$$\frac{P_{H,t}}{P_t} = \frac{\theta}{(\theta-1)(1-\tau)} \frac{1}{A_t} \frac{W_t}{P_t}$$

2.3 *Monetary and fiscal policies*

In this paper, I study the interaction of constrained optimal fiscal policy in a monetary union. Within each country, a policy maker sets a path for the fiscal policy instrument, government expenditure, such as to maximize the welfare of its own households, given the private sector's first order conditions, the government budget constraint as well as given the other country's policy.

2.3.1 *Fiscal policy*

Fiscal policy is defined as the path of government expenditures. These are assumed to be financed by lump-sum taxation and (non state-contingent) bond issuance.[7] That is, I focus on the effects of government spending rather than on its financing in the present paper.[8]

Government demand is entirely directed towards domestically produced goods[9] which are assembled by the government into a composite public good denoted G:

$$G_t = \left[\int_0^n y_t(h)^{\frac{\theta-1}{\theta}} dh \right]^{\frac{\theta}{\theta-1}}$$

The fiscal authorities impose a subsidy on production which eliminates monopolistic distortions in the steady state: $\tau = \frac{1}{1-\theta}$. Hence, under appropriately chosen government expenditure levels and zero inflation, the steady state will be efficient. Note that the subsidy is fixed: though it does constitute an expenditure for the government, it does not constitute a policy instrument that can be changed in the face of shocks.

Recall that $P_{H,t} = [\int_0^n p_t(h)^{1-\theta}]^{\frac{1}{1-\theta}} dh$. It follows that $\int_0^n (\frac{p_t(h)}{P_{H,y}})^{1-\theta} dh = 1 \Leftrightarrow [\int_0^n (\frac{p_t(h)}{P_{H,t}})^{1-\theta} dh]^{\frac{\theta}{\theta-1}} = 1$, or, equivalently that $[\int_0^n v_t(h) dh]^{\frac{\theta}{\theta-1}} = 1$. Noting that $f(v(h)) = v(h)^{\frac{\theta}{\theta-1}}$ is a convex function we can apply Jensen's inequality, and thereby conclude that $Disp_t = \int_0^n v_t(h)^{\frac{\theta}{\theta-1}} dh \geq [\int_0^n v_t(h) dh]^{\frac{\theta}{\theta-1}} = 1$.

7 I abstract from any implications of fiscal policy that relates to distortionary taxation issues. This is reasonable if the path of government expenditures can be considered as independent of the financing of it.

8 See, e.g., Ferrero (2009) for the role played by distortionary taxation and government debt.

9 This assumption is not crucial per se. The important feature is that the degree of home bias in government spending is larger than the degree of home bias in private consumption.

Imposing that in equilibrium, the bonds market must clear meaning that $nB_{H,t} + (1-n)B_{F,t} = 0 \; \forall t$, and using that $\int_0^n p_t(h)\, y_t(h) dh = P_{H,t}Y_{H,t}$ renders the government budget constraint:

$$\tau Y_{H,t} + T_t = G_t \tag{14}$$

A similar budget constraint holds for the Foreign government:

$$\tau^* Y_{F,t} + T_t^* = G_t^* \tag{15}$$

I restrict fiscal policy to follow certain functional rules, which will be specified later. Moreover, I consider two different set-ups for fiscal policy making: one in which the fiscal policy makers cooperate in that they set government spending such as to maximize union-wide welfare; and another in which each fiscal authority decides on its own government spending level, taking monetary policy and the other country's fiscal policy as given. The latter results in a Nash equilibrium.[10]

2.3.2 Monetary policy

Within the monetary union, the nominal exchange rate is normalized to unity and does therefore not constitute a policy instrument. The monetary policy instrument is the union-wide nominal interest rate paid on one-period bonds to the intermediaries, denoted i.[11]

I abstract from monetary frictions and can thus consider a "cashless economy" as in Woodford (2003). Hence, whereas monetary policy is neutral under flexible prices within the described framework, it affects the real economy in the presence of nominal rigidities, and through its effect on the debt burden of countries.

The common monetary policy instrument, the nominal interest rate, is set according to a simple Taylor-type rule. Indeed, I assume that the nominal interest rate i is set according to the rule

$$\log i_t = \phi_\pi [n \log \pi_{H,t} + (1-n) \log \pi_{F,t}] \tag{16}$$

where π_H and π_F denote respectively Home and Foreign producer price inflation, and n and $1-n$ are the respective sizes of the countries. $\phi\pi$ is a policy parameter determining the interest sensitivity to union-wide inflation. Since monetary policy cannot accommodate country-specific shocks, the precise form of the Taylor rule is not crucial for the results. Among other things, it would not change the results much if I would allow the Taylor rule to incorporate a response to output as well.

2.4 Market clearing and aggregation

Given the mentioned private and public demand, aggregate demand facing domestic producers amounts to:

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10 The computation of the Nash policies is explained in Section 4.

11 As explained in Woodford (2003) (p. 239, footnote 4), "In a cashless economy the central bank achieves its operating target for i_t by adjusting the interest rate i_t^m paid on the monetary base; an arbitrage relation then requires that $i_t = i_t^m$ in any equilibrium, given a positive supply of base money at all times. Here I simplify by supposing that the central bank can directly control the short-term market rate i_t...".

$$Y_{H,t} = a_H \left(\frac{P_{H,t}}{P_t}\right)^{-\phi} C_t + \frac{1-n}{n} a_H^* \left(\frac{P_{H,t}^*}{P_t^*}\right)^{-\phi} C_t^* + G_t \tag{17}$$

and aggregate demand for the foreign good amounts to:

$$Y_{F,t} = \frac{n}{1-n}(1-a_H) \left(\frac{P_{F,t}}{P_t}\right)^{-\phi} C_t + a_H \left(\frac{P_{F,t}^*}{P_t^*}\right)^{-\phi} C_t^* + G_t \tag{18}$$

Output is demand-determined in equilibrium, and, hence, the above equation can also be viewed as a goods market clearing condition.

Equilibrium on the financial markets requires that bonds and assets are in zero net supply:

$$nB_{H,t} + (1-n)B_{F,t} = 0 \tag{19}$$

Because there is not complete trade in assets across countries, consumption risk is not fully shared across countries. It is thus necessary to keep track of the evolution of the current account under incomplete markets. By combining the household's budget constraint and the government's budget constraint we obtain an aggregate resource constraint, characterizing the evolution of the current account. The Home aggregate resource constraint is:

$$C_t + \frac{B_{H,t}}{P_t(1+i_t)\Phi(B_{H,t}/P_t)} = \frac{P_{H,t}}{P_t}(Y_{H,t} - G_t) + \frac{1}{\pi_t}\frac{B_{H,t-1}}{P_{t-1}} + [\frac{1}{\Phi(B_{F,t}/P_t^*)} - 1]\frac{B_{F,t}}{P_t^*(1+i_t)}Q_t \tag{20}$$

The model might exhibit inefficiencies in the face of country-specific shocks because of distortions arising due to monopolistic competition, staggered price setting, and internationally incomplete markets. When these inefficiencies arise, policy makers face an incentive to reduce them by using the instruments available. Doing so, policy makers might face a trade-off between reducing the different inefficiencies.

As explained previously, an increase in government spending shifts demand towards the domestically produced goods. Through such a shift in demand government spending is capable of affecting relative prices, output, and consumption. Fiscal policy can thus potentially reduce some of the inefficiencies arising in the face of shocks. However, there is a cost to using government spending to stabilize the economies. Because government spending enters the utility function of households the first-best allocation implies a particular spending composition, relating government spending to private spending and prices. That is, any deviations from the optimal spending composition level in order to stabilize the economies introduces another inefficiency. Hence, the fiscal policy maker has to trade-off the welfare gains of reducing inefficiencies arising due to monopolistic power, staggered price setting, and internationally incomplete markets with the implied welfare loss associated with deviating from the optimal spending composition.

3 Cooperative and non-cooperative policies

In the following, I illustrate the policy problem facing respectively the cooperative and the non- cooperative policy makers by their quadratic loss functions. Indeed, I derive the cooperative and the non-cooperative loss functions under incomplete markets by approximating the relevant welfare function; the resulting quadratic loss function is correct up to second-order. The details of the derivation figure in the Technical Appendix. For simplicity I will here focus on the case where $\chi \rightarrow 0$, implying that government spending is wasteful. This simplification will allow me to point out the objectives of the policy maker, whatever the available instruments. I also restrict the results to the case of perfectly flexible prices, for clarity and without consequences for the main findings. First, the cooperative and non-cooperative loss functions under complete markets will be compared. Then, I will introduce international financial frictions and point out how these affect the objectives of the policy makers according to their strategic behaviour.

3.1 Complete markets

Under complete markets, the cooperative loss function illustrating the objectives, or targets, of the cooperative policy maker can be written as:

$$\begin{aligned}\mathcal{L}^C = E_0 \sum_{t=0}^{\infty} \{ & (\sigma+\eta)[(\hat{Y}_{H,t}-\tilde{Y}_{H,t})^2 + (\hat{Y}_{F,t}-\tilde{Y}_{F,t})^2] \\ & + 2a_H(1-a_H)\frac{(\phi\sigma-1)}{\sigma}[4a_H(1-a_H)\phi\sigma + (2a_H-1)^2]\hat{T}_t^2 \\ & - 4a_H(1-a_H)(\phi\sigma-1)\hat{T}_t(\hat{Y}_{H,t}-\hat{Y}_{F,t})\} + t.i.p.\end{aligned} \tag{21}$$

where *t.i.p.* denotes terms independent of policy making, such as exogenous shocks, and a variable with a tilde denotes the efficient deviation of that variable from steady state. The loss function can alternatively be expressed in the following way:

$$\begin{aligned}\mathcal{L}^C = E_0 \sum_{t=0}^{\infty} \{ & [\frac{a_H(1-a_H)}{\sigma^2}[4a_H(1-a_H)\eta(\phi\sigma-1)^2 + \phi\sigma(\sigma+2\eta) - 2\sigma - 3\eta] + \frac{\sigma+\eta}{2\sigma^2}](\hat{T}_t - \tilde{T}_t)^2 \\ & + (\sigma+\eta)(\hat{C}_t - \tilde{C}_t)^2 - \frac{(2a_H-1)(\eta+\sigma)}{2\sigma}\hat{T}_t\hat{C}_t\} + t.i.p.\end{aligned} \tag{22}$$

These loss functions show that the policy maker aims at minimising deviations from the efficient level of consumption (or, equivalently output gaps) as well as deviations from the efficient relative prices (terms of trade). The relative weights put on the different objectives, or targets, are illustrated by the coefficients in front of the different targets. They depend on the structural parameters of the model.

The non-cooperative loss function of the Home policy maker, instead, can be written as:

$$\begin{aligned}\mathcal{L}^{NC} = E_0 \sum_{t=0}^{\infty} \{ & \frac{(1-a_H)}{\sigma^2}[(2a_H-1)^2(1+(1-a_H)\eta) - 2\phi\sigma a_H(2a_H-1)(1+2(1-a_H)\eta) + \\ & a_H\phi\sigma^2(1+4(1-a_H)a_H\eta\phi)](\hat{T}_t - \tilde{T}_t)^2 \\ & + (\sigma+\eta)(\hat{C}_t - \tilde{C}_t)^2 + \frac{(1-a_H)(1+\eta)(1+2a_H(\phi\sigma-1))}{\sigma}\hat{T}_t\hat{C}_t\} + t.i.p.\end{aligned} \tag{23}$$

When home bias in consumption is present, then the weights differ across the two strategies. Notably, the weight put on avoiding deviations of the terms of trade from its efficient level relative to avoiding a domestic consumption gap, or equivalently, output gap is lower when no cooperation takes place. This is stated in Proposition 2.1.

Proposition 1 – *Under complete markets, flexible prices, and wasteful government spending, the relative weight attached to the terms of trade objective relative to the output gap objective in the quadratic approximation to the Ramsey policy maker's loss function is higher under cooperation than in the case where the policy makers are inward-looking, for* $\frac{1}{2} < a_H < 1$ *and* $\sigma > 1$.

Under complete markets and flexible prices, the efficient allocation ensuring zero output gaps (or consumption gap) and a zero terms of trade gap can be obtained under cooperation. At this efficient allocation, both countries' welfare is maximized, and the Nash policy maker will thus not have an incentive to deviate from the cooperative allocation. Hence, the difference in weights associated with the different objectives would not be observed. However, the loss function does illustrate the terms of trade externality facing Nash policy makers which implies a lower weight attached to reducing international price inefficiencies rather than reducing domestic output gaps. As a result, in the face of distortions such as staggered price setting or market incompleteness, larger price variations would arise under inward-looking policy making.

3.2 *Incomplete markets*

Under internationally incomplete markets, the loss function of the cooperative policy maker can be expressed as:

$$\begin{aligned}\mathcal{L}^C = E_0 \sum_{t=0}^{\infty} \{ & 2a_H(1-a_H)\frac{(\phi\sigma-1)}{\sigma}[4a_H(1-a_H)\phi\sigma+(2a_H-1)^2](\hat{T}_t-\tilde{T}_t)^2 \\ & +(\sigma+\eta)[(\hat{Y}_{H,t}-\tilde{Y}_{H,t})^2+(\hat{Y}_{F,t}-\tilde{Y}_{F,t})^2]+\frac{2a_H(1-a_H)}{\sigma}\widehat{Dgap}_t^2 \\ & -4a_H(1-a_H)(\phi\sigma-1)(\hat{T}_t-\tilde{T}_t)[(\hat{Y}_{H,t}-\tilde{Y}_{H,t})-(\hat{Y}_{F,t}-\tilde{Y}_{F,t})]\}\end{aligned} \tag{24}$$

The loss function is exactly similar to the one derived under the assumption of complete markets, (22), except for the introduction of demand imbalances into the loss function.

The non-cooperative loss function of the Home policy maker can be written in a similar way.

$$\begin{aligned}\mathcal{L}^{NC} = E_0 \sum_{t=0}^{\infty} \{ & \lambda_T^{NC}(\hat{T}_t-\tilde{T}_t)^2+\lambda_{Y,H}^{NC}(\hat{Y}_{H,t}-\tilde{Y}_{H,t})^2+\lambda_{Y,F}^{NC}(\hat{Y}_{F,t}-\tilde{Y}_{F,t})^2 \\ & +\lambda_D^{NC}\widehat{Dgap}_t^2+\lambda_{TY,H}^{NC}(\hat{T}_t-\tilde{T}_t)(\hat{Y}_{H,t}-\tilde{Y}_{H,t})+\lambda_{TY,F}^{NC}(\hat{T}_t-\tilde{T}_t)(\hat{Y}_{F,t}-\tilde{Y}_{F,t})+\lambda_{CA}^{NC}\widehat{CA}_t\}\end{aligned} \tag{25}$$

Because the coefficients are rather complex, they are not stated here, but can be obtained from the author. The loss function under non-cooperation departs from the cooperative loss function in several ways: not only deviations of the current account matter, but the sign of the deviations does too for $a_H > 1/2$. Furthermore, we can, by comparing the coefficients of the above stated loss functions, deduct the following:

Proposition 2 – *The relative importance of reducing international demand imbalances, as illustrated by the Dgap, as opposed to reducing the national output gap is higher under cooperative policy making than under non-cooperative policy-making:* $\frac{\lambda_D^C}{\lambda_{Y,H}^C} > \frac{\lambda_D^{NC}}{\lambda_{Y,H}^{NC}}$ *for any* $\phi \notin [\phi^l; \phi^h]$ *where* $\phi^l = f^l(a_H, \eta, \sigma)$ *and* $\phi^h = f^h(a_H, \eta, \sigma)$.

Given the fact that the relative weights put on the different objectives according to the strategic interaction of the policy makers is a function of the structural parameters of the model, I engage in a numerical investigation in the next section. In the numerical example chosen in the next section of this chapter, the Proposition 2.1 holds for all $\phi \notin [0.37; 0.40]$ implying that for the benchmark of $\phi = 0.5$, $\frac{\lambda_D^C}{\lambda_{Y,H}^C} > \frac{\lambda_D^{NC}}{\lambda_{Y,H}^{NC}}$ holds. We shall see how the cooperative equilibrium differs from the non-cooperative equilibrium.

4 A numerical investigation of fiscal policy interactions

4.1 Solution method and parameterization

The recursive solution to the model described in Section 2 consists in policy functions describing the response of variables to shocks and initial conditions, given the specified form of the rules for monetary and fiscal policies. Given that no closed-form solution to the model exists, I approximate the solution around a specified steady state, for given policy strategies. Indeed, by using the method of undetermined coefficients (perturbation methods), based on the knowledge of the derivatives of the equilibrium equations at the steady state, the model is solved by approximating the solution around the symmetric zero-inflation steady state in which monopolistic distortions are eliminated through appropriate subsidies.[12] Given the solution, I can compute the optimal parameters of the fiscal rules depending on the strategic behaviour of fiscal policy makers, thus specifying the constrained optimal fiscal policies. This computation is discussed in further details later.

The parameter values used throughout this section figure in the Table 1. Most of them are quite standard in the business cycle literature, and realistic for the EMU.[13]

The population of each of the countries are assumed to be identical. The discount factor is set such that the steady state annual real interest rate is 4 per cent. The Frisch elasticity of labor is set equal to 0.5. The inverse of the intertemporal elasticity of substitution, the risk aversion coefficient, is set to 1.5 in the benchmark calibration following Smets and Wouters (2003). χ is equal to 1/5 such that in steady state private consumption is three times larger than government consumption.

The degree of home bias is set to 0.8, implying that the steady state import ratio is 20 per cent. The elasticity of substitution between goods produced within a country is set equal to 7.66, such as to ensure a mark-up of 15 per cent. On average prices are sticky for a year: $\alpha = 0.75$. This value is in line with the GMM-estimates found by both Galí, Gertler and Lopez-Salido (2001) and the Bayesian DSGE estimations carried out by Smets and Wouters (2003).

The international trade elasticity is a particularly important determinant of the equilibrium dynamics of the model presented in Section 2, and thus of the trade-off faced by the policy maker. My benchmark parameterization figures a relatively low trade elasticity of 0.5, corresponding to the estimates found in the international macroeconomic literature, see, e.g., Hooper, Johnson and Márquez (2000) or Corsetti, Dedola and Leduc (2008). The low trade elasticity is crucial in ensuring complementarity of the internationally traded goods, a realistic feature for advanced, relatively specialised countries such as the countries within the EMU.

In the incomplete markets model, δ, the sensitivity of the bond yield to debt is set such as to roughly mimic the observed yield differences across the EMU before the debt crisis: the benchmark value of δ is such that for every ten percentage points increase in debt,[14] the annual interest increases by 0.5 percentage points.

[12] I used Dynare to solve the model by second-order approximation given monetary and fiscal policies. I then used those solutions to compute the constrained Ramsey optimal policies. I also used code developed by Schmitt-Grohe and Uribe (2004) to check that results are identical across the two packages.

[13] The parameter values used are within the range of estimates found by Smets and Wouters (2003) by engaging in Bayesian estimation of a DSGE model of the euro area, or follow Benigno (2004) who calibrates his model to the EMU. See also Galí and Monacelli (2008).

[14] This corresponds approximately to a similar increase in debt-to-steady state GDP.

Table 1

Parameter Values in Benchmark Case

Population in country *H*	n	0.5
Discount factor	β	$1.04^{-1/4}$
Inverse of the elasticity of labor supply	η	2
Risk aversion coefficient	σ	1.5
Degree of home bias	a_H	0.8
Price stickiness coefficient	α	0.75
Weight on government expenditures	χ	1/5
Intratemporal elasticity of substitution	θ	7.66
Trade elasticity	ϕ	0.5
Yield sensitivity to debt	δ	0.05
Taylor-rule coefficient on inflation	ϕ_π	1.5

Monetary policy is characterized by a Taylor-type rule, with a coefficient of 1.5 on population-weighted inflation.

The following process is assumed for the technology shocks:

$$\begin{bmatrix} \log A_t \\ \log A_t^* \end{bmatrix} = \begin{bmatrix} 0.95 & 0 \\ 0 & 0.95 \end{bmatrix} \begin{bmatrix} \log A_{t-1} \\ \log A_{t-1}^* \end{bmatrix} + \begin{bmatrix} v_t \\ v_t^* \end{bmatrix} \tag{26}$$

where v^t and v_t^* are white noise processes with standard deviations 0.01.

In the following, the parameter values listed above are used in order to investigate the effects of strategic behaviour of fiscal policy makers. The constrained optimal fiscal responses to a country- specific shock are computed, and the consequences of having independent fiscal policies rather than cooperative fiscal policies are put forward.

4.2 *Constrained optimal fiscal policy*

Fiscal rules – I restrict cooperative and non-cooperative fiscal policies to follow fiscal rules. In particular, I specify government spending to follow rules which ensure that government spending levels satisfy the optimal spending composition, unless shocks hit the economies. Moreover, I only consider rules which are easily implementable. Specifically, this analysis focuses on two types of rules: rules which allow government spending to deviate from the optimal spending composition in the presence of deviations of output from steady state; and rules which imply a response of government spending to national inflation.

The specific forms of the fiscal rules to which I restrict my analysis are thus:

- rules in deviations from steady state output:

$$\log G_t = \log G_t^{OSC} + \alpha_Y \log(\frac{Y_{H,t}}{\bar{Y}_H})$$
$$\log G_t^* = \log G_t^{*OSC} + \alpha_Y^* \log(\frac{Y_{F,t}}{\bar{Y}_F}) \tag{27}$$

- rules in inflation:

$$\log G_t = \log G_t^{OSC} + \alpha_\pi \log(\frac{\pi_{H,t}}{\bar{\pi}_H})$$
$$\log G_t^* = \log G_t^{*OSC} + \alpha_\pi^* \log(\frac{\pi_{F,t}}{\bar{\pi}_F}) \tag{28}$$

The computation of constrained optimal policies consist in deriving the optimal policy parameters of the imposed rules. In this computation, I restrict the analysis to parameter values which ensure the existence of a unique equilibrium.

I consider two scenarios for strategic interaction of fiscal policy makers: One in which there is a unique fiscal policy maker who chooses the parameters of the rules $\{a_Y^C, a_Y^{*C}\}$ or $\{a_\pi^C, a_\pi^{*C}\}$, such as to maximize union-wide welfare, corresponding to the cooperative case; The other in which there are independent fiscal policy makers who may act strategically such as to maximize their own agents' welfare. The resulting $\{a_Y^{NC}, a_Y^{*NC}\}$ or $\{a_\pi^{NC}, a_\pi^{*NC}\}$ will differ from the ones obtained under cooperation if the national fiscal policy makers fail to internalize the result of their choice on the other policy maker's choice of parameters. The extent to which fiscal policies differ between these two scenarios, the consequences, and the welfare implications constitute the object of the analysis carried out in the following.

Cooperative and non-cooperative fiscal policies – The cooperative fiscal policy maker chooses the policy parameters such as to maximize union-wide welfare. On the contrary, the strategically competitive fiscal policy makers maximize national welfare, given the other country's fiscal policy. The computation procedure for this case consists in the following steps:

1. An initial guess for the policy parameters is chosen, for example the cooperative policy parameters.
2. Home country fiscal authority chooses the policy parameter which, given the initial guess for the Foreign policy parameter and the specification of monetary policy, yields the highest welfare for his agents.
3. Given those optimal Home parameters, the Foreign fiscal policy maker optimizes his agents' welfare by choosing a parameter to his rule.
4. This procedure continues until the policy makers arrive to a point in which they have chosen the same parameter values. At this point, they have no incentive to deviate from the chosen parameter of the rules.

The resulting optimal policy parameter values, in the benchmark case, figure here: The rules show that the cooperative policies respond more aggressively to changes in output or inflation than the non-cooperative fiscal policies do. This has relatively large welfare consequences: around 0.20 per cent of consumption every quarter under output rules, and 0.06 per cent under inflation targeting rules. It is interesting to notice that the welfare losses are 3 times larger when government spending reacts to deviations from the steady state output rather than inflation.

Table 2

Optimal Policy Parameters Under Complementarity

$\phi = 0.5$	Cooperation	Non-cooperation	Welfare loss from non-cooperation
$a_Y = a_Y^*$	2.66	0.74	0.20
$a_\pi = a_\pi^*$	–54.27	–11.89	0.06

The welfare loss is computed in percent of steady state consumption.

The lack of response under non-cooperation can be explained by the "terms of trade externality" facing policy makers in open economies. This externality has been put forward for the conduct of monetary policy by authors such as Obstfeld and Rogoff (2002) and Corsetti and Pesenti (2001), and for the conduct of fiscal policy by Benigno and Paoli (2010).[15] The terms of trade externality is indeed inherent to open economies, and results from the incentive which national policy makers might face to tilt the terms of trade in their favour. By doing so, policy makers attempt to increase national welfare by allowing their households to consume more without higher labor effort. In the framework presented here, by varying government spending, the fiscal policy makers can exploit the terms of trade externality. To understand the trade-off faced by the policy makers, and the effects of the terms of trade externality, it is useful to consider the constrained optimal response to a country-specific shock.

Consider first the cooperative response. The optimal policy parameters under cooperation implies a rise in domestic government spending in the face of a positive Home technology shock which raises output above its steady state level and reduces inflation. This ensures that the fall in Home prices induced by the technology shock is dampened. Given the domination of the income effect over the substitution effect under complementarity of the goods, this fiscal policy increases Home output further. As a result, the Home current account deficit, originating in the technology shock which temporarily reduces Home income through its negative effect on the price of the Home good, is reduced. That is, the cooperative fiscal policy consists in reducing the distortionary international demand imbalances while raising the output gaps. This is very much in line with the results of the unconstrained Ramsey policy analysed in Hjortsø (2012): optimal cooperative fiscal policy reduces international imbalances at the expense of larger output gaps.

Consider now the non-cooperative response obtained in a Nash equilibrium. When the national fiscal authorities do not cooperate, the optimal policy parameters differ from the cooperative parameters. Indeed, the national fiscal authorities do not internalize the outcome of their policy on the other country's policy. Hence, they face an incentive to deviate from the cooperative solution. By deviating slightly from the cooperative solution, policy makers can affect the terms of trade such as to reduce production and thus disutility from labor effort without an equivalent decrease in the utility of consumption (in the aftermath of a positive technology shock). This can be achieved by reducing government spending in the Home country, thereby reducing relative prices and thus, through the income effect, reducing demand and labor effort. These deviations from the cooperative fiscal policy arise because the national fiscal policy

[15] The latter authors consider the desirability of distortionary taxation in a small open economy, *i.e.*, in the presence of the terms of trade externality. This paper departs from the analysis of Benigno and Paoli (2010) in several aspects: I do not assume perfect risk sharing takes place; I consider a two-country model with strategic interactions between policy makers rather than a small open economy; the fiscal policy instrument is government spending rather than taxation.

makers do not internalize the effect of their policy on foreign policy and thereby on the equilibrium levels of inflation, output, and demand imbalances. As a result the Nash equilibrium illustrates the well-known terms of trade externality: the national fiscal policy maker attempts to increase the purchasing power of its agents without taking into account the effect on the other country's welfare and thus on its policy response, an effect transmitted through changes in the terms of trade.

The difference between the cooperative fiscal response to a Home productivity shock, and the Nash equilibrium response is illustrated below. In Figure 1 the optimal response under the rule (27) is illustrated, whereas the optimal response under the rule (28) figures in Figure 2. Though the rules differ in their quantitative optimal fiscal response to a country-specific shock, their qualitative response is similar. The Nash policies result in lower output gaps than those resulting under cooperation, but these are obtained at the expense of higher inflation as well as higher demand imbalances.

The terms of trade externality present under strategically competitive fiscal policy making has important consequences, both for welfare and for the volatility of variables such as inflation and current account imbalances. These implications are spelled out in the next subsection.

4.3 The consequences of non-cooperation

The strategic interaction of fiscal policy makers in open economies implies optimal policies which differ substantially from the optimal cooperative policies, as illustrated in Figure 1 and in Figure 2. This implies different equilibrium dynamics, and has consequences for union-wide welfare. Here, I discuss the effects of the strategic behaviour of fiscal policy makers on the volatility of certain variables such as output, inflation and imbalances. Indeed, in the context of the current eurozone crisis, many economists have emphasized the crucial role played by current account imbalances and inflation differentials between the Northern countries and the Southern countries in the eurozone. This subsection suggests that fiscal policy cooperation within a monetary union can contribute to lower the imbalances and price misalignments across countries.[16]

Inflation differentials – In the benchmark case, strategically competitive policy making results in excessive inflation differentials across countries when a country-specific shock hits. A technology shock to country *H* of one standard deviation results in an immediate producer price deflation of 0.25 per cent in *H*, and a similar rise of producer prices in country *F*. This is almost five times as high an inflation differential as the one which would prevail under fiscal cooperation, see Figure 3.

This inflation differential is distortionary due to staggered price setting, and is therefore costly in terms of welfare. It is an inefficiency which could be partly eliminated through cooperation in fiscal policy. Moreover, not only does this excessive inflation differential arising under Nash fiscal policy making imply direct welfare costs in terms of inflation. It could also capture or result in other inefficiencies which are not captured in this model. For example, it could affect productivity if there are frictions in the labor market.

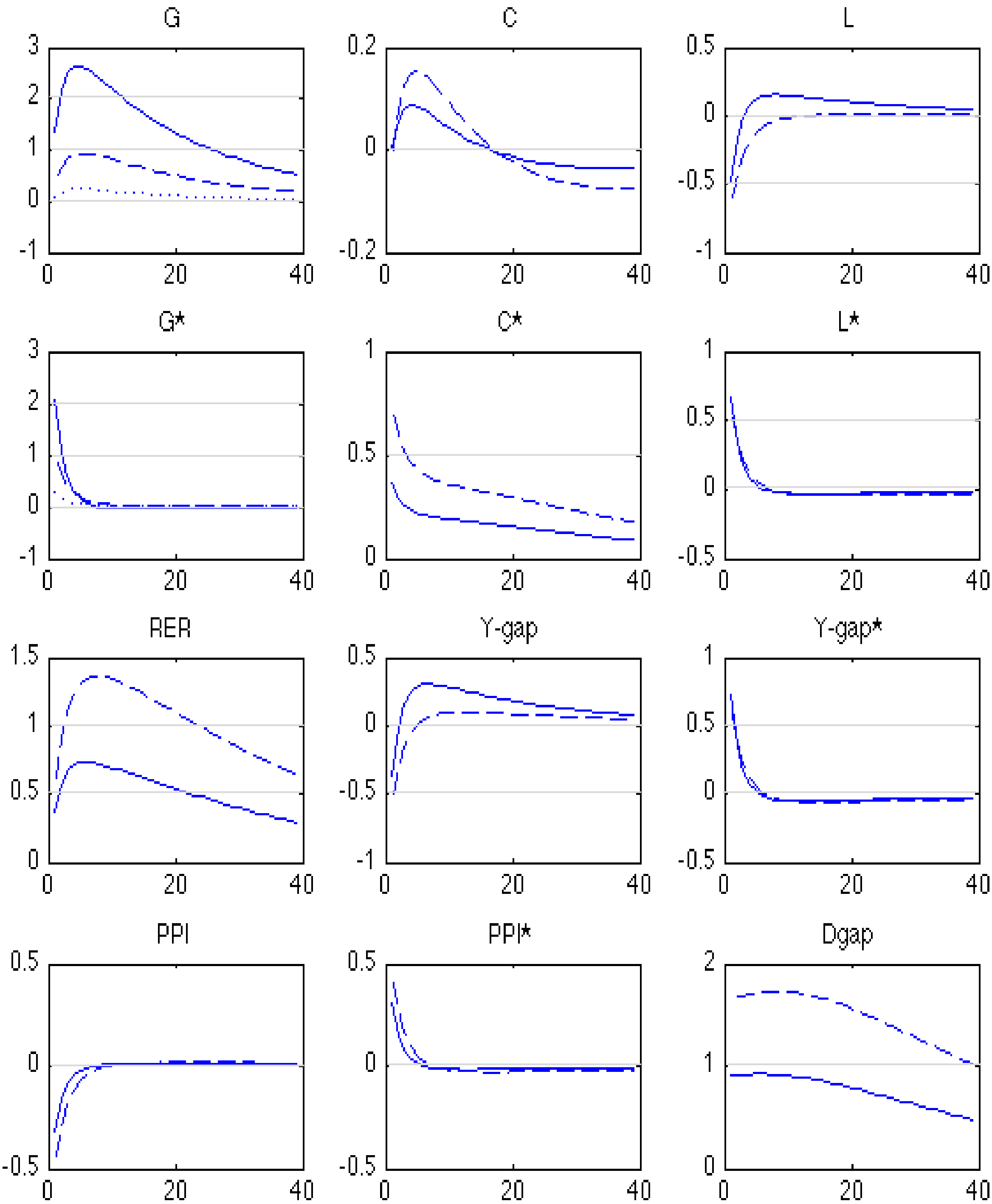
The excessive inflation differentials arising because of non-cooperative fiscal policies in a monetary union is quite robust to most parameters conditional on the trade elasticity being relatively low as in the benchmark case. Even when the countries are completely open and

[16] The analysis carried out here is constrained by the fiscal rule being of the form (28), *i.e.*, dependent on inflation. This is not of importance for the qualitative results, but nevertheless for the quantitative results.

Figure 1

Impulse Responses Following a Home Technology Shock

(output rule)

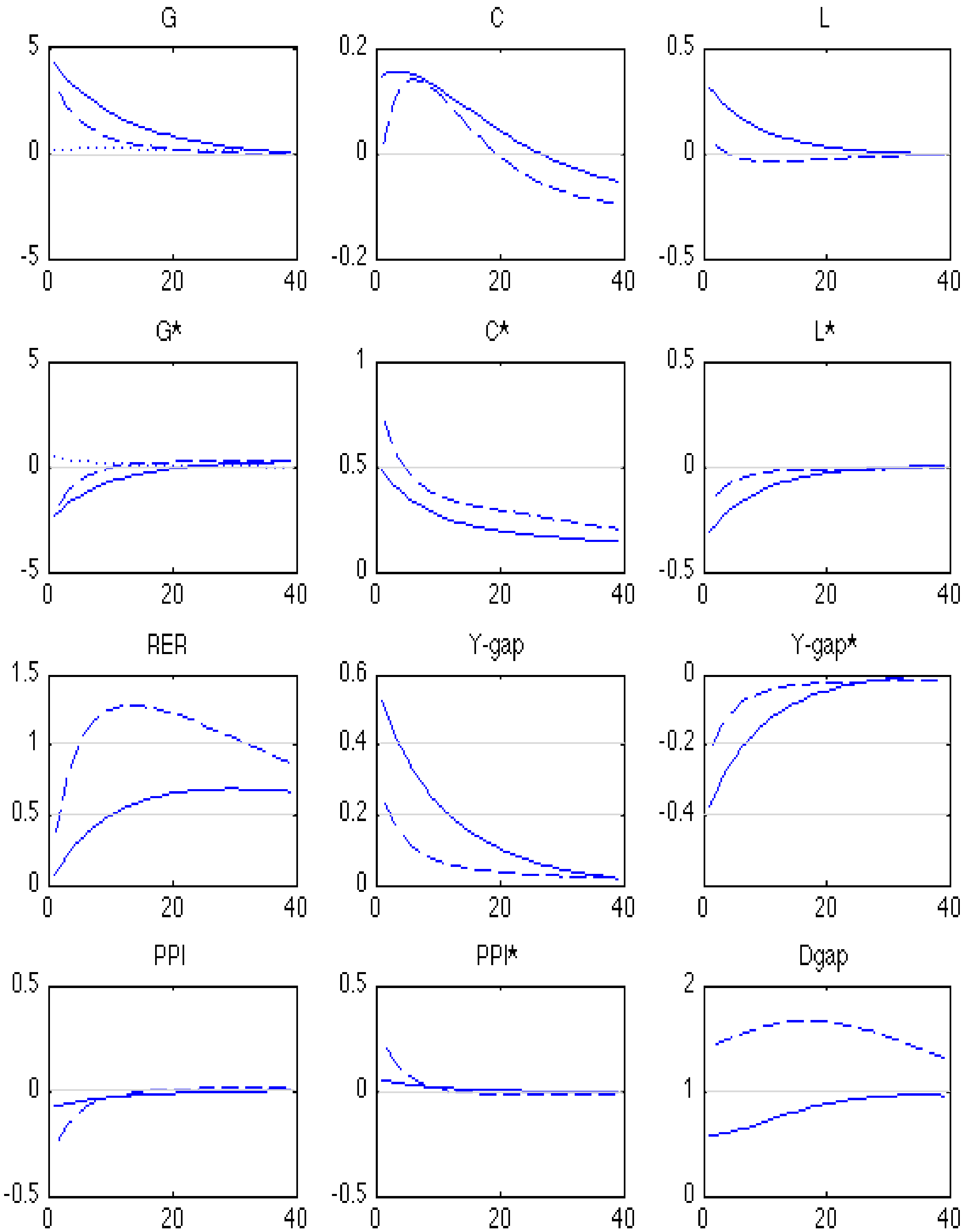


This figure depicts the impulse response functions following a positive one standard deviation shock to Home productivity. Percentage deviations from the steady state are on the y-axes. On the x-axes figure the time periods (quarters) after the shock. The impulse responses are depicted for the case where the constrained optimal fiscal policy is cooperative (the solid line), and the case where each of the fiscal policy makers engage in non-cooperative fiscal policy making leading to a Nash equilibrium (the dashed line). The dotted line represents the government spending level satisfying the optimal spending composition under cooperative fiscal policies.

Figure 2

Impulse Responses Following a Home Technology Shock

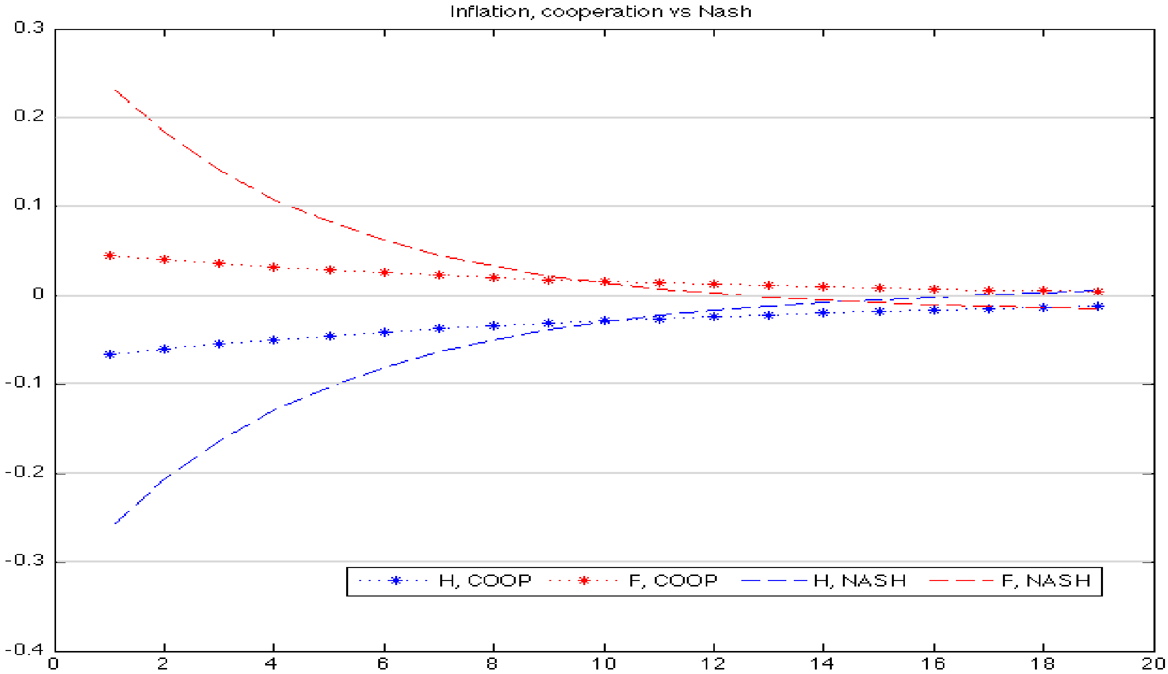
(inflation rule)



See footnote for Figure 1.

Figure 3

Inflation Following Home Technology Shock



Home producer price inflation dynamics following a positive one standard deviation shock to Home productivity, under constrained optimal fiscal policies following rule (28). The solid line depicts the outcome under cooperative fiscal policies, whereas the dashed line illustrates the outcome in the Nash equilibrium.

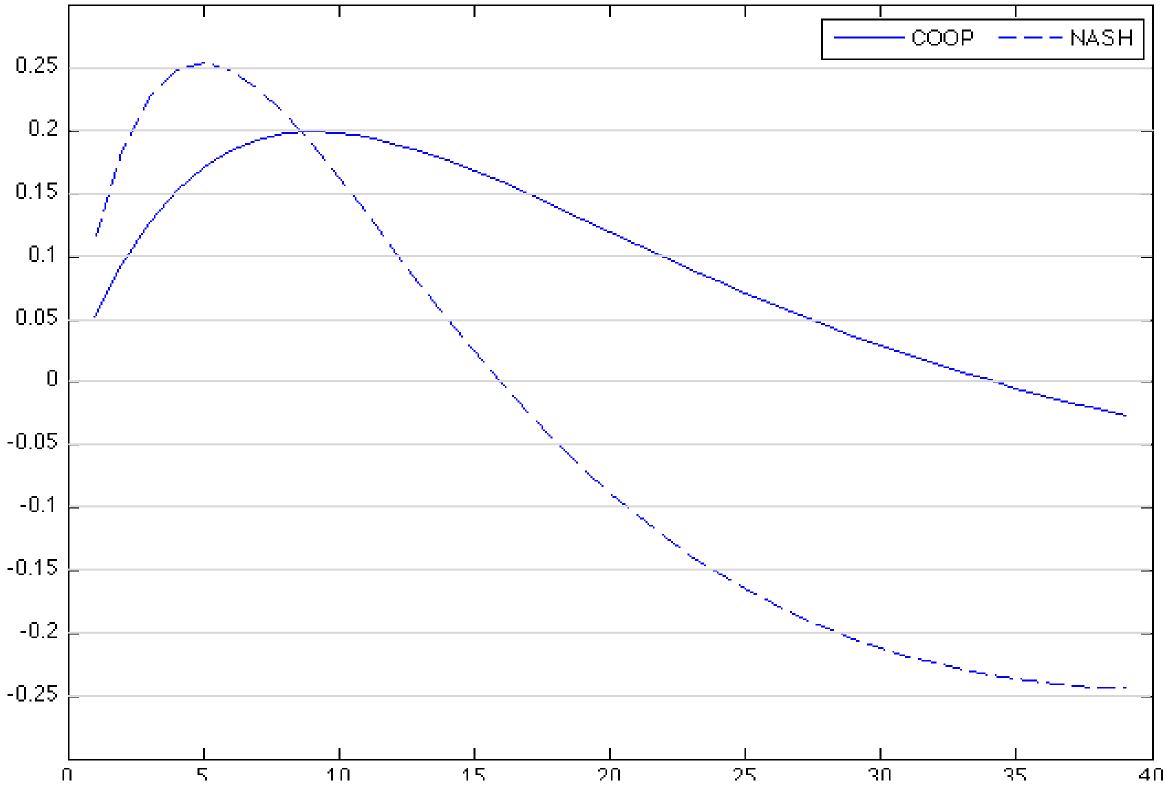
households exhibit no home bias in consumption preferences, does the initial inflation differential between the Nash equilibrium and the cooperative equilibrium persist. Similarly, the excessive inflation resulting from Nash fiscal policy making persists for different risk aversion degrees as well. Concerning the sensitivity of the results to the degree of price stickiness, we can notice that the higher the stickiness, the less do prices in general vary. However, at the same time, the more sticky are prices, the higher is the inflation differential between the cooperative case and the non-cooperative case.

Current account imbalances – The strategic interaction of fiscal policies not only shapes inflation differentials across countries but also affects the volatility of current account imbalances significantly. Indeed, following a country-specific productivity shock, the current account imbalances are more pronounced and volatile when the fiscal policy makers act strategically such as to maximize their own country's welfare. This is apparent in Figure 4.

This results from the terms of trade externality which implies larger inflation differentials and thus larger income differentials under non-cooperation when the internationally traded goods are complements. Hence, in line with the sensitivity of inflation differentials, is the volatility of current account imbalances increasing in the degree of home bias, and also remains excessive even when there is no home bias in consumption present. Moreover, the presence of excessive imbalances is robust to the coefficient of relative risk aversion, and increasing in the degree of price stickiness. It is interesting to note that the structure of fiscal policies can lead to large excessive current account imbalances within the monetary union.

Figure 4

Current Account Following Home Technology Shock



This figure depicts the deviations of the current account from its steady state value in percent of steady state output. The solid line depicts the outcome under cooperative fiscal policies, whereas the dashed line illustrates the outcome in the Nash equilibrium.

Indeed, Figure 4 shows that the current account imbalances not only are twice as large as under fiscal cooperation - they are also much more volatile. Given the importance attributed to the role of current account imbalances in the current eurozone crisis, it is interesting to note this point. Indeed, if current account imbalances affect risk in a way not modelled here, e.g., through the banking sector, these excessive imbalances might have other consequences than those appearing in this model. Indeed, this model indicates that if this is so, then fiscal cooperation could proof particularly beneficial.

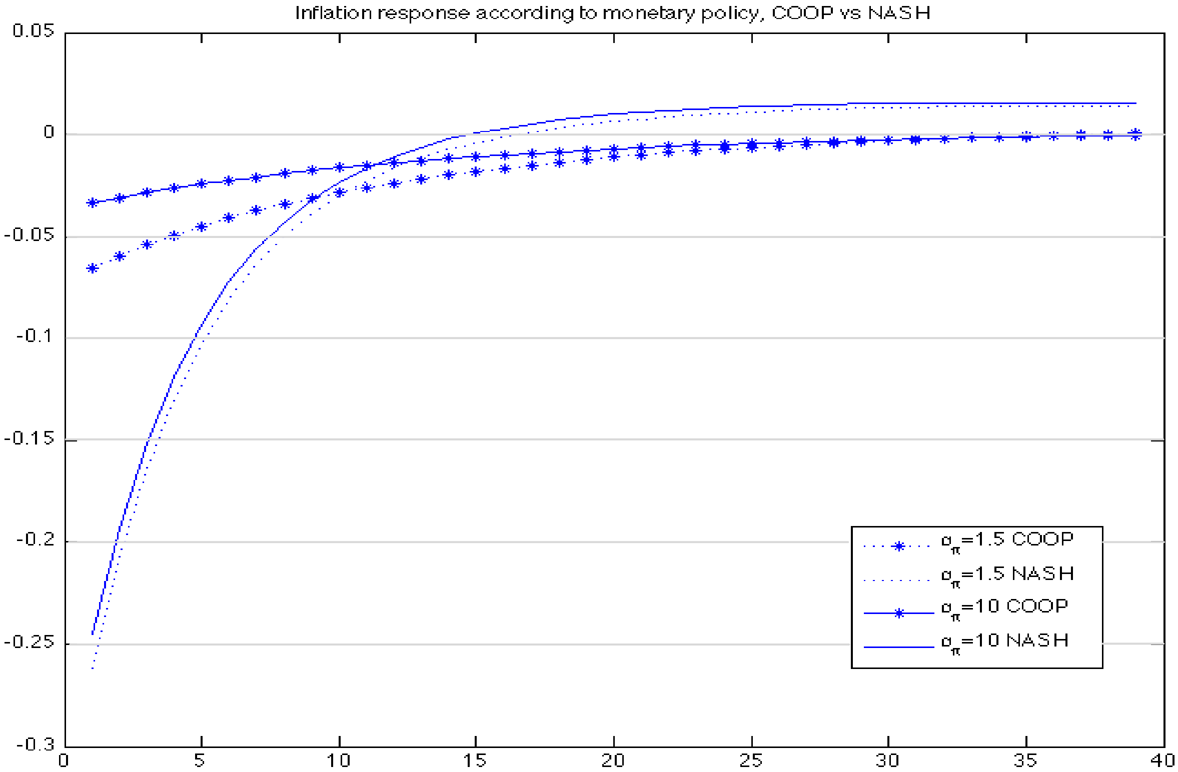
The role of monetary policy – Can monetary policy play a role in affecting the strategic behaviour of policy makers and the resulting imbalances and misalignments?

Figure 5 shows that the aggressiveness of monetary policy does not have much influence on the volatility or level of inflation arising in the face of country-specific shocks when fiscal policies are set in a strategically competitive way. Only under cooperation does the aggressiveness of monetary policy play a significant role in reducing price volatility.

The effect of monetary policy on the current account imbalances is also dampened by strategic competition of fiscal policy makers. The more hard-nosed is the common central bank, the lower is the volatility of imbalances under fiscal cooperation. However, when the fiscal authorities do not cooperate, then the effect on the volatility is quasi inexistent, see Figure 6.

Figure 5

Inflation Dynamics Following Home Technology Shock



In other words: the power of the common central bank in reducing cross-country imbalances and inflation differentials is hampered by the strategic behaviour of fiscal policy makers!

Sensitivity to the trade elasticity – While the results are rather robust to different parameter values, there is one exception: the trade elasticity. The importance of this parameter is evident in that it governs the interaction between the two countries, and thus the incentive to deviate from the cooperative solution. It thus plays a crucial role in determining the inflation differentials arising due to strategically competitive fiscal policy making. When the internationally traded goods are complements, then strategic competition in fiscal policy implies excessive inflation differentials. As a result, when the internationally traded goods are complements, then the current account imbalances are always excessive when fiscal policies are set strategically.

However, when the trade elasticity is so large that the internationally traded goods are substitutes, then the terms of trade externality becomes insignificant for fiscal policy making. As a result, the non-cooperative and the cooperative constrained optimal fiscal policies are almost identical, as shown in Table 3 for a value of the trade elasticity of 4.

Welfare effects of non-cooperation in a monetary union – The previous paragraphs have shown that when fiscal authorities in a monetary union engage in strategic policy making, then excessive inflation differentials and sub-optimally high imbalances across countries may arise. These inefficiencies have welfare implications which have already been pointed out in Table 2. The welfare losses associated with non-cooperative fiscal policies are higher the more hard-nosed is the central banker, that is the higher is the Taylor coefficient. This is illustrated in Figure 7.

Figure 6

Current Account Dynamics Following Home Technology Shock

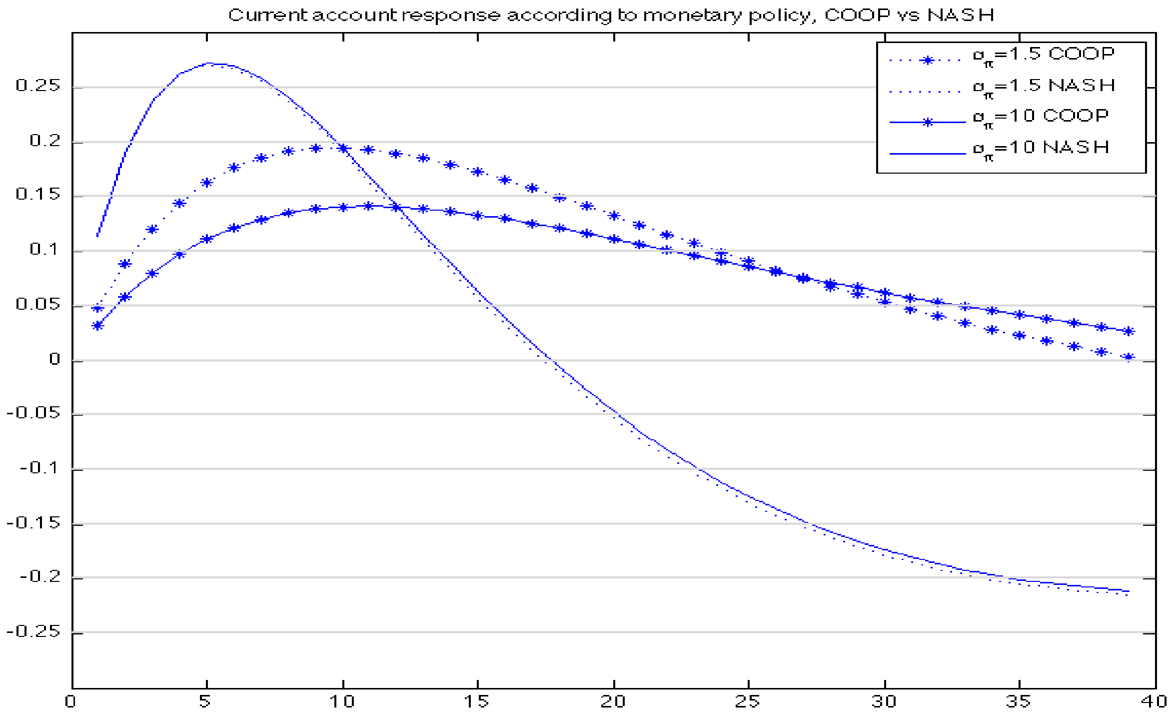


Table 3

Optimal Policy Parameters Under Substitutability

$\phi = 4$	Cooperation	Non-cooperation	Welfare Loss from Non-cooperation
$a_Y = a_Y^*$	0.07	0.05	9×10^{-6}
$a_\pi = a_\pi^*$	–4.82	–5.80	2×10^{-5}

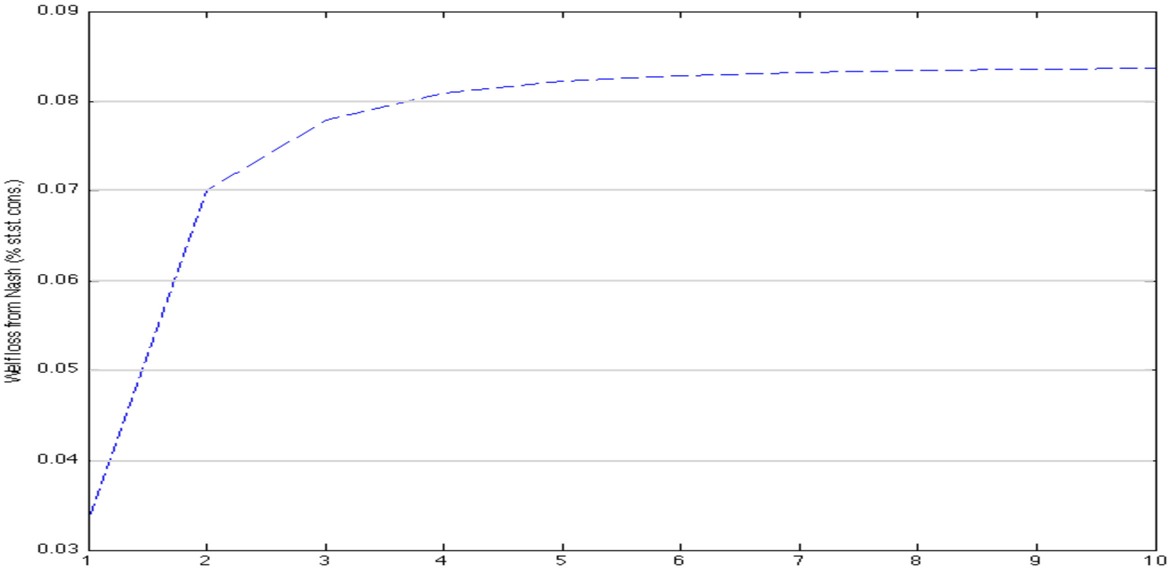
The welfare loss is computed in percent of steady state consumption.

Moreover, we can note that the welfare loss associated with non-cooperative fiscal policy making is increasing in the degree of home bias in consumption, as Figure 8 shows.

This section has provided a numerical analysis of the implications of strategic fiscal policy interactions within a monetary union. I have shown that the consequences can be non-negligeable for rather realistic values of the trade elasticity: current account imbalances and inflation differentials are excessively large under non-cooperation of the fiscal authorities. This implies that there are relatively important welfare gains from engaging in fiscal policy cooperation within the monetary union framework analysed.

Figure 7

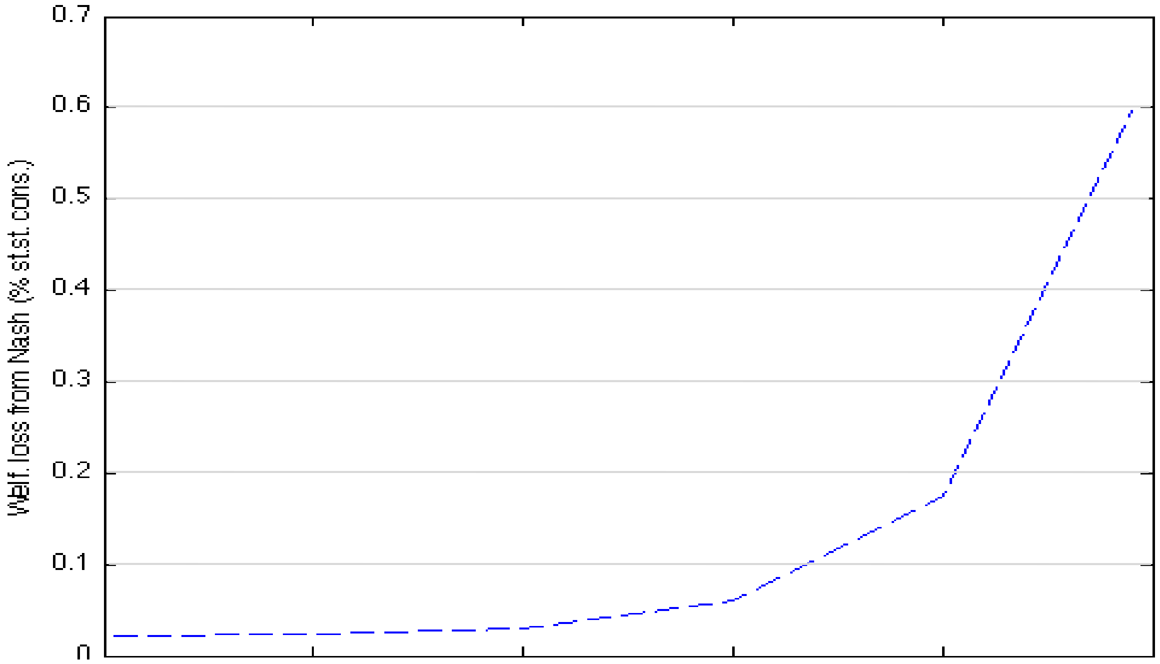
Welfare Loss According to Monetary Policy



The welfare loss from non-cooperative fiscal policies is illustrated in percent of steady state consumption, as a function of the parameter α_π figuring in the Taylor rule of the monetary authority.

Figure 8

Welfare Sensitivity to Home Bias



The welfare loss from non-cooperative fiscal policies is illustrated in percent of steady state consumption, as a function of the degree of home bias in consumption, a_H.

5 Conclusion

This paper sheds light on the potential implications of strategic fiscal policy interactions in a monetary union with international financial frictions. I have shown that the objective of the policy maker differs according to whether it aims a maximizing union-wide welfare or national welfare. More specifically, I have pointed out that, for most parameter combinations, is the relative importance of international demand imbalances lower under non-cooperation than when the fiscal authorities cooperate. I have also shown, by engaging in a numerical analysis, that strategic fiscal policy making results in a Nash equilibrium which exhibits excessive inflation differentials across countries as well as sub-optimally high volatility of the current account. These characteristics of the Nash equilibrium implies that there might be important welfare gains associated with fiscal policy cooperation in a monetary union.

By pointing out the importance of fiscal policy cooperation within a monetary union, this paper underlines the fact that the best outcome for the monetary union as a whole cannot be achieved by conducting strategically competitive fiscal policies. This, of course, raises questions concerning the optimal conduct of fiscal policies within monetary unions such as the EMU, and more specifically, it points out the welfare improvements which might arise from fiscal policy cooperation.

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