The Policy Mix in a Two-tier Monetary Union with Constraints on Stabilization Policy

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Abstract

The paper studies the interaction between the monetary and fiscal authorities in the Euro area and the block of outside countries during the Third Stage of EMU. Restraints on fiscal policies and outside monetary policy are introduced as utility costs related to the use of the tax instruments and, for the outside central bank, the volatility of the outside/Euro nominal exchange rate. Due to the asymmetries of the macromodel, I use simulations to analyze the constrained policy games that arise in response to supply and demand shocks. The exercises in the paper illustrate the importance of taking into account the interaction between the different policymakers when imposing restrictions on a subset of these policymakers.

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1 Introduction

In May 1998, the European Council decided that eleven EU countries would launch the Third Stage of the Economic and Monetary Union in January 1st 1999. The EU countries will then be separated into a large group of core countries that form the European currency union, and a small group of periphery countries that for various reasons remain, at least initially, outside the currency union.

The European Central Bank (ECB) will pursue a goal of price stability in the monetary union. The fiscal policy stance in the monetary union will predominantly be determined by the national governments, subject to the co-ordination of policies that may take place in EcoFin, or in the still unofficial "Euro-11". The fiscal policy of the insider countries will be restrained by the Stability and Growth Pact as well as by the Maastricht convergence criteria. The fiscal policy of the outsider countries will also be restrained by the Maastricht convergence criteria, however without being subject to possible sanctions. The outsider countries will have a choice concerning exchange rate regime, but this choice might matter for their possibilities to enter into EMU. The currencies of the outsider countries participating in ERM2 will have a (negotiated) central parity with the Euro and a rather large fluctuation band, ±15%, around this central parity.[1] Another possibility is that the outsider countries initially choose a flexible exchange rate regime, using a domestic monetary target aiming at price stability (most likely a targeted inflation rate or money stock growth). Currently it is not clear whether such a strategy, if resulting in a stable exchange rate, will be considered to be in accordance with the Maastricht convergence criteria, or if participation in ERM2 at some stage will be necessary before an outsider can become an insider.

This multi-country policy game involving governments and monetary authorities raises a number of questions; what are the costs and benefits of different monetary regimes within EU? What tensions may arise between the ECB, EcoFin, national governments and national central banks? What are the rationales for various types of fiscal constraints as well as constraints on exchange rate fluctuations?[2]

In this paper I use a 2-country Mundell-Fleming macromodel to study the interaction between the monetary and fiscal authorities in the Euro area and the block of outside countries during the Third Stage of EMU. The focus of the paper is on the policy mix that emerges from the

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[1] The size of this fluctuation margin might vary between countries. The Danish krone will participate in ERM2 with a fluctuation band of ±2.25%, while the Greek drachma will participate with a ±15% margin.

[2] See for instance Artis and Winkler (1997), Beetsma and Bovenberg (1995a,b), Beetsma and Uhlig (1997), Ghironi and Giavazzi (1997b), and Persson and Tabellini (1996).

monetary-fiscal stabilization game between the four policymakers. Monetary and fiscal policies are based on explicitly stated preferences over price and employment stability. The central banks are more concerned with price stability, while the fiscal authorities emphasize stable employment. The credibility of economic policy is not an issue in the paper, since the policymakers do not have over-ambitious targets for employment and consumer prices. [3] Restraints on fiscal policies and outside monetary policy are introduced as utility costs related to the use of the tax instruments and, for the outside central bank, the volatility of the outside/Euro nominal exchange rate.[4]

An important property of the model is that fiscal policy has a non-Keynesian flavor in that budget-balanced expenditure -and tax - rate reductions are expansionary. This characteristic is due to the mechanism that supply side distortions are alleviated when the tax rate is reduced, which more than compensates for the accompanying decrease in government demand. Contrary to the classical Mundell-Fleming model, fiscal policy measures that expand domestic output will contract foreign output while the spillover effect from expansive monetary policy on foreign output is positive. Due to the asymmetries of the macromodel, analytical solutions are intractable. Instead, I parameterize the model and simulate the outcome of the constrained policy games that arise in response to supply and demand shocks.

As the model is set up, the outcome of the policy game is first best when there are no costs related to the tax rates and the volatility in the nominal outside/Euro exchange rate. The policymakers then succeed in completely eliminating the effects of the various shocks on the target variables employment and inflation. In the presence of such costs, the interaction between the four policymakers will stabilize consumer prices but magnify the employment losses when the EU countries are hit by a common (negative) supply shock. When fiscal policy is restricted, negative externalities in monetary policy will bring about a very poor equilibrium, with both high unemployment and high inflation.

In the event of an asymmetric demand shock shifting aggregate demand from the outside good to the Euro good, the interaction between the four policymakers will stabilize consumer prices in both areas, but the overemployment problem in the Euro area will be amplified. In contrast to the symmetric supply shock case, the Euro authorities will benefit from increased fiscal

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[3] The paper is thus more related to the literature on economic policy coordination than to the more recent research field dealing with credibility issues.

[4] The paper does not deal with the benefits of restraining (national) fiscal policy in a monetary union. For instance, the Stability Pact may be instrumental in reducing the likelihood of public debt crises and inflationary bailouts in EMU. This would enhance the credibility of the ECB. See Eichengreen and Wyplosz (1998) for an extensive discussion of the costs and benefits of the Stability Pact.

rigidity in the outside area, since this will lead to better stabilization of both Euro employment and consumer prices.

When consumer preferences are such that the import share equals the relative size of the partner region, the optimal stabilization of a common (negative) aggregate demand shock will be a symmetric expansion of the money supplies and fiscal policy will be completely inactive. This result does not hold in the presence of differing home bias. In this case, and differently from the two earlier cases, the monetary-fiscal policy game will stabilize consumer prices and employment in both regions.

The exercises in the paper illustrate the importance of taking into account the interaction between the different policymakers when imposing restrictions on a subset of these policymakers. The general message is that modifications of the fiscal policy framework should not be undertaken isolated from the monetary policy framework.

In Section 2 I describe the policymakers' decision problems and the underlying 2-country macromodel. In Section 3 I parameterize the model and discuss the reduced forms. I also discuss the employment-inflation tradeoffs faced by the policymakers, which play a major role in the analysis. Section 4 contains the results from simulations with the model. In Section 5 I extend the framework by introducing a home bias in consumption. Section 6 concludes.

2 The model

The economic regions in the model consist of the Euro area, and the block of EU countries that initially are outside EMU. The monetary policy of the Euro area is determined by the European Central Bank (ECB). I also assume that some European Fiscal Authority (EFA) determines the fiscal policy of the Euro area. The monetary and fiscal policies of the block of outside countries are represented by the actions of an outside central bank (OCB) and an outside fiscal authority (OFA).[5]

[5] The model used in this paper is close to the setup in Ghironi and Giavazzi (1997b) and Eichengreen and Ghironi (1997). However, these authors include a third "country" in their models. Ghironi and Giavazzi study the issue of the optimal size of the Euro area and of the optimal intra-EU exchange rate regime. For different monetary and fiscal regimes, Ghironi and Giavazzi simulate their model and evaluate the losses of the policymakers that arise in the stabilization game following a symmetric supply disturbance (optimality is defined in terms of the policymakers' loss functions). Eichengreen and Ghironi analyze the U.S. – European policy interactions in case of a symmetric supply shock under different assumptions about the intra-EU exchange rate arrangements and the effects on output of budget-balanced fiscal policy measures.

The economic behavior of firms and households in the two EU regions is represented by a two-country Mundell-Fleming macromodel. The macromodel differs from the standard textbook treatment in two respects. First, a distortionary tax on the firms' total revenues is used to finance government expenditures. The presence of the distortionary tax, and the balanced-budget requirement, gives the model a non-Keynesian property in that increases in government expenditure (taxes) are contractionary.[6, 7] Second, the specification of the demand functions for the respective good allows for two kinds of asymmetries, differences in country size and differences in propensity to import. The size of the Euro area, measured as the share of total EU production (in common currency) is represented by the parameter a. That a relatively large number of EU countries participate in the monetary union is represented by the choice of a=0.75. In the main analysis I follow Ghironi and Giavazzi (1997a, b) and assume that the import share in each EU region is equal to the size of the partner region.[8]

All variables are expressed as deviations from no-disturbance equilibrium values, and are in logs except for interest rates, tax rates and public expenditure rates. Superindex E is attached to Euro area variables and superindex O is attached to outside variables. The notation $E_t\left[X_{t+1}\right]$ is used for the rationally expected value of the variable X in period t+1, based on information in period t.

2.1 The policymakers: preferences, restrictions and policy variables

The four policymakers are assumed to care about employment, (n_t^E, n_t^O), and consumer prices, (q_t^E, q_t^O).

Both central banks experience disutility when consumer prices and employment levels deviate from their no-disturbance equilibrium values. In addition to this, the outside central bank may suffer from the volatility in the outside/Euro nominal exchange rate. This can be seen as a crude way to capture that stability of the nominal exchange rate is one of the Maastricht convergence criteria. In particular, participation in the ERM2 requires that the outside nominal exchange rate is stable relative to the Euro.[9]

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[6] This non-Keynesian character of the macromodel also depends on the parameterization of the model. See Section 3.2.

[7] Another reason why a contractionary fiscal policy can be expansionary is that expectations of future distortionary taxes may be reduced, which would stimulate the demand side of the economy. See Eichengreen and Ghironi (1997) and references therein.

[8] Ghironi and Giavazzi (1997b) examine the effects of varying the size of the Euro area. The assumed trade pattern requires (is compatible with) that consumer preferences in the EU are identical and such that the expenditure shares on the various goods are constant, i.e. European consumers are assumed to have identical Cobb-Douglas preferences. In Section 5 I check for the importance of this assumption and allow for "home bias"; in this case the import shares are assumed to be smaller than the relative size of the partner region.

[9] With this interpretation, participation in ERM2 would correspond to a large weight on the outside/Euro nominal exchange rate. In the literature, see for instance Ghironi and Giavazzi (1997a,b), the ERM2 regime has been

Specifically, the loss function of the central bank in the Euro area is

(2.1) $$L^{ECB} = \frac{1}{2}\left\{\psi^{ECB}(q_t^E)^2 + (1-\psi^{ECB})(n_t^E)^2\right\}$$

and the loss function of the central bank in the outside block is

(2.2) $$L^{OCB} = \frac{1}{2}\left\{\psi^{OCB}(q_t^O)^2 + (1-\psi^{OCB})(n_t^O)^2 + \chi^{OCB}(s_t^O)^2\right\}.$$

The relative weight given to price stability is $0 < \psi^{ICB} < 1$, for $I = E, O$. The importance accorded to keeping down the volatility of the outside nominal/Euro exchange rate is captured by the weight $\chi^{OCB} \geq 0$ in the OCB loss function.

The central banks choose money supplies in order to minimize their losses in the face of a shock.[10] The first-order condition for the ECB is

(2.3) $$\psi^{ECB} q^E \frac{\partial q^E}{\partial m^E} + (1-\psi^{ECB}) n^E \frac{\partial n^E}{\partial m^E} = 0.$$

The OCB also has to take into consideration constraints on (costs related to) the volatility of the nominal exchange rate, which gives rise to a third term in the first-order condition,

(2.4) $$\psi^{CB} q \frac{\partial q}{\partial m} + (1-\psi^{CB}) n \frac{\partial n}{\partial m} + \chi^{CB} s \frac{\partial s}{\partial m} = 0.$$

Fiscal policy is constrained by the need to comply with the Maastricht convergence criteria and the Stability Pact.[11] A crude way to capture this is to assume that the national budgets must balance. A drawback with this assumption is that there is no way to analyze how fiscal policy

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modeled as a fixed exchange rate regime in which ECB sets the Euro money supply and OCB sets the outside/Euro nominal exchange rate. As Ghironi and Giavazzi note, however, such a fixed exchange rate representation of EMR2 is more a model of how the central parity is set than of how the nominal exchange rate fluctuates around this central parity. The simulations in the present paper correspond to situations when the shocks are not so important that a change in central parity is called for.

[10] The policy games studied in later sections are non-cooperative, so the policymakers only care about the effect on their own loss functions.

[11] The Stability Pact clarifies the meaning of the excessive deficit provision in the Maastricht Treaty. The Pact also specifies how sanctions shall be applied to countries that are deemed to have an excessive deficit. The specifics of the excessive deficit procedures are not taken into account in the present study. For a closer presentation of the Stability Pact, see Artis and Winkler (1997) and Eichengreen and Wyplosz (1998).

choices affect the rate at which the outside country converges.[12] In order to keep an already complex problem manageable I nevertheless make this assumption. Active fiscal policy in the shape of budget-balanced variations in tax and government spending rates is still possible. In addition to the requirement of balanced budgets, the governments are assumed to bear costs related to the size of budget-balanced tax rate.

Neglecting seigniorage[13], the government budget constraints are

(2.5) $g = \tau$ for $I = E, O$.

The government's policy variables are thus effectively reduced to one, either the expenditure share (of total income =output) g or the tax rate (on total output) τ_t^I.

The loss function of the government (fiscal authority) in the Euro area is

(2.6) $$L^{EFA} = \frac{1}{2}\left\{\left[\psi^{EFA}(q_t^E)^2 + (1-\psi^{EFA})(n_t^E)^2\right] + \vartheta^{EFA}(\tau_t^E)^2\right\},$$

where $0 < \psi^{EFA} < 1$ measures the weight the fiscal authority in the Euro area attaches to inflation relative to employment and $\vartheta^{EFA} \geq 0$ is a measure of constraints on fiscal activism. When ϑ^{EFA} is high, a high weight is put on changes in the tax rate relative to inflation and employment. This is meant to capture the situation when the fiscal authority in the Euro area cannot vary its fiscal instruments freely in response to shocks.

The loss function of the government (fiscal authority) in the outside area is

(2.7) $$L^{FA} = \frac{1}{2}\left\{\left[\psi^{FA}(q_t)^2 + (1-\psi^{FA})(n_t)^2\right] + \vartheta^{FA}(\tau_t)^2\right\}$$

with analogous interpretations of ψ^{FA} and ϑ^{OFA}.[14]

The fiscal authorities will choose tax rates in order to minimize their losses, according to the first order condition

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[12] Even if the budget is balanced, the country may fail other Maastricht convergence criteria, as e.g. the debt criterion.

[13] Seigniorage is a minor source of government revenue in most EU countries.

[14] Arguably, the outside government would also suffer from excessive movements in the nominal exchange rate. In this paper, however, the purpose of introducing costs related to the volatility in the nominal exchange rate is to restrain outside monetary policy.

$$(2.8) \qquad \psi^{FA} q \frac{\partial q}{\partial \tau} + (1-\psi^{FA}) n \frac{\partial n}{\partial \tau} + \vartheta^{FA} \tau = 0 \qquad I = E, O.$$

In the recent academic literature as well as in the creation of the new European monetary institution, the importance of appointing inflation-averse (and independent) central bankers and/or give central banks explicit instructions to target (low) inflation to reduce problems caused by time inconsistency problems has been stressed. Although time inconsistency problems are not an issue here - since the policymakers' targets for employment and consumer prices coincide with the no-disturbance values – such considerations motivate that central bankers are assumed to put a larger weight on stable prices compared to output than the governments. In terms of preference parameters in the central banks' loss functions, when the central banks are equally averse to inflation, this is parameterized as $\psi^{E} = \psi^{OCB}$ =0.9. Similarly, the governments relatively strong preferences for stable employment is captured by the choice of $\psi = \psi^{O}$ =0.1.

In the simulations I vary the degree of disutility the fiscal authorities experience from the volatility in tax rates. Interpreting this as the degree of rigidity of fiscal policy $\vartheta = 0.25$ (for $I = E, O$) would correspond to the case of flexible fiscal policy, and $\vartheta^{IFA} = 4$ (for $I = E, O$) to the case with rigid fiscal policy. Similarly, the tightness of the constraints on the volatility of the nominal outside/Euro exchange rate is captured by two levels of χ . χ =0.25 corresponds to the case with loose exchange rate restrictions, while χ =4 corresponds to the case with a tight exchange rate constraint.

2.2 The macromodel

The aggregate supply functions are given by

$$(2.9) \qquad y^{I} = \frac{\gamma}{1-\gamma}(p^{I} - w^{I} - \tau^{I}) - \frac{1}{1-\gamma} x^{I} \qquad \text{for } I = E, O,$$

where (y_t^E, y_t^O) are the production levels in the Euro and outside areas, (p_t^E, p_t^O) are the producer prices in the Euro and the outside areas, (w_t^E, w_t^O) are the nominal wage levels in the Euro and outside areas, (τ_t^E, τ_t^O) are the tax rates on the firms' total revenues, γ is the elasticity of output with respect to employment and (x_t^E, x_t^O) are productivity disturbances, identically and independently distributed with zero mean.[15]

[15] See Appendix A for details.

Nominal wages are predetermined. One period ahead, nominal wages are set in order to minimize the expected deviation in employment from the steady-state level of employment. The wage-setting rule is then

$$(2.10) \quad w_t^I = E_{t-1}\left[p_t^I - \tau_t^I\right] \qquad I = E, O.$$

It is assumed that the firms' demand for labor at the given nominal wage always is satisfied.[16]

The real outside/Euro exchange rate (terms-of-trade), z_t^O, is defined as

$$(2.11) \quad z_t^O = p_t^E + s_t^O - p_t^O,$$

where p_t^E, p_t^O are the producer prices in the Euro and the outside areas, and s_t^O is the outside/Euro nominal exchange rate. The real interest rate relevant for consumers equals the nominal interest rate less the expected change in the consumer price index,

$$(2.12) \quad r_t^I = i_t^I - E_t\left[q_{t+1}^I\right] + q_t^I \qquad \text{for } I = E, O.$$

The consumer price index depends on the producer prices of domestic and foreign goods and the import share. The share of outside goods in private consumption expenditure in the Euro area is denoted by β^E; the share of Euro goods in private consumption expenditure in the outside area is denoted by β^O. Using the definition of the real exchange rate the consumer price index in the Euro area can be expressed as

$$(2.13) \quad q \quad = p \quad - \beta \; z^O$$

and the outside consumer price index can be expressed as

$$(2.14) \quad q_t^O = p_t^O + \beta^O z_t^O.$$

The equilibrium conditions[17] on the goods markets are

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[16] This is a common assumption about the functioning of the labor market in this kind of models. See also Canzoneri and Henderson (1991).

[17] These are log-linear approximations to equilibria close to the no-disturbance equilibrium. In Appendices B and C, partial microfoundations for the aggregate demand side of the economy are given. However, the demand side remains largely *ad hoc*.

$$y_t^E = -(1-a)\delta z_t^O + \varepsilon\left[(1-\beta^E)y_t^E + \frac{(1-a)}{a}\beta^O y_t^O\right] - \nu\left[(1-\beta^E)r_t^E + \frac{(1-a)}{a}\beta^O r_t^O\right]$$

(2.15)

$$+(1-\beta^E)g_t^E + \frac{(1-a)}{a}\beta^O g_t^O + u_t^E$$

and

$$y_t^O = a\delta z_t^O + \varepsilon\left[\frac{a}{1-a}\beta^E y_t^E + (1-\beta^O)y_t^O\right] - \nu\left[\frac{a}{1-a}\beta^E r_t^E + (1-\beta^O)r_t^O\right]$$

(2.16)

$$+\frac{a}{1-a}\beta^E g_t^E + (1-\beta^O)g_t^O + u_t^O.$$

The income and real interest rate elasticities of total private real consumption, ε and ν, are assumed to be the same in both areas. The increase in aggregate demand following a real depreciation depends on the relative size of the other region as well as of a common elasticity parameter δ.[18]

The factors $\frac{1-a}{a}$ in equation (2.15) and $\frac{a}{1-a}$ in equation (2.16) correct for the difference in size between the two areas. Demand for the Euro good depends negatively on the real outside/Euro exchange rate (terms-of-trade), z_t^O, while demand for the outside good depends positively on the real exchange rate. With a larger Euro area a real depreciation of the outside/Euro exchange rate - an increase in z_t^O - has a larger impact on the demand for outside goods.

The governments also demand goods from the two areas. The share of imported goods in government expenditure is assumed to be equal to the import share in private consumption.[19]

The aggregate demand disturbances, u_t^i, are assumed to be identically and independently distributed with zero mean.

The money market equilibrium condition is

(2.17) $m_t^I - p_t^I = y_t^I - \lambda i_t^I$ for $I = E, O$.

Only domestic residents hold domestic money, and the demand for real money balances depends positively on real output and negatively on the nominal interest rate. The semi-elasticity of real

[18] For a discussion of this assumption, see Ghironi and Giavazzi (1997b).

[19] This assumption reflects the view that EU governments can not favor domestic producers, but neglects that non-traded goods may represent a more important share in government consumption than in private consumption.

money demand with respect to the nominal interest rate, λ, is assumed to be the same in the two areas.

Bonds denominated in the two currencies are regarded as perfect substitutes, so the uncovered interest parity (UIP) condition holds,

$$(2.18) \quad i_t^O = i_t^E + E_t\left[s_{t+1}^O\right] - s_t^O .$$

When consumer preferences are such that they yield an import share equal to the size of the partner area, we have $\beta^O = a$ and $\beta^E = 1 - a$. The share of imports in the outside EU countries of goods from the Euro area would in this case increase one-to-one as the relative size of the Euro area increases, and the share of imports in the Euro area of goods from the outside EU countries would decrease one-to-one. In this case, the equilibrium conditions on the goods markets simplify to

$$(2.15)' \quad y_t^E = -(1-a)\delta z_t^O + \varepsilon\left[a y_t^E + (1-a) y_t^O\right] - \nu\left[a r_t^E + (1-a) r_t^O\right] + a g_t^E + (1-a) g_t^O + u_t^E$$

and

$$(2.16)' \quad y_t^O = a\delta z_t^O + \varepsilon\left[a y_t^E + (1-a) y_t^O\right] - \nu\left[a r_t^E + (1-a) r_t^O\right] + a g_t^E + (1-a) g_t^O + u_t^O .$$

3 Reduced forms and the employment-inflation tradeoffs

The objective of this section is to find reduced form expressions for the five endogenous variables that enter into the policymakers loss functions; the inflation rates in the Euro and outside areas, q_t^E and q_t^O, the employment rates in the Euro and outside areas, n_t^E and n_t^O, and the nominal outside/Euro exchange rate, s_t^O. I also discuss the employment-inflation tradeoffs faced by the four policymakers.

3.1 Deriving the reduced forms

As a preliminary, I simplify the structural equations of the model, taking account of the fact that expected future deviations from no-disturbance equilibrium values are zero.[20] Expected values of (the deviation from no-disturbance equilibrium values in) the producer and consumer price indexes, the nominal exchange rate and the tax rates will therefore also be zero, that is

[20] This is due to the quadratic-linear setup, the absence of time-consistency problems and that expected disturbances are zero. A formal proof, available from the author on request, follows directly from Appendix A in Canzoneri and Henderson (1991).

(3.1) $E_t\left[p_{t+1}^I\right] = E_t\left[q_{t+1}^I\right] = E_t\left[s_{t+1}^O\right] = E_t\left[\tau_{t+1}^I\right] = 0$ for $I = E, O$.

Since equation (3.1) holds at all times, an immediate result is that the nominal wages are set – one period ahead - at their no-disturbance equilibrium values. According to equation (2.10) $w_t^I = 0$. This leaves us with a system of 12 equations ((2.9), (2.11)-(2.18)) to be solved for 12 endogenous variables as functions of the policy variables and the disturbances. Since the policymakers are assumed to have preferences over employment, rather than output, the production functions

(3.2) $y_t^I = \gamma n_t^I - x_t^I$ for $I = E, O$

are inverted to derive reduced forms for employment.

3.2 Parameterizing the reduced forms

The coefficients in the reduced form equations are complicated functions of the basic parameters of the model. The asymmetries in the model make analytical solutions intractable, so I resort to simulations. I choose values for these parameters so that the parameterized model is comparable to the European Union (2-country model) block in Ghironi and Giavazzi (1997b). This means that I set δ=0.8, γ =0.66, λ=0.6, ε=0.8, and ν=0.4.

Reflecting the fact that the Euro area is large I set a=0.75. Assuming that consumer preferences in the two areas are such that they yield an import share equal to the size of the partner area, that is β^E = 0.25 and β^O=0.75, the reduced forms for employment in the Euro area and in the block of outside countries are given by

(3.3)

$$n^E = 0.682m^E + 0.031m^O - 0.289\tau^E + 0.218\tau^O - 0.138x^E - 0.076x^O + 0.913u^E + 0.157u^O$$

and

(3.4)

$$n^O = 0.620m^O + 0.094m^E - 0.724\tau^O + 0.653\tau^E + 0.013x^O - 0.227x^E + 0.599u^O + 0.471u^E.$$

Consumer prices are given by

(3.5)

$$q^E = 0.353m^E - 0.111m^O + 0.708\tau^E + 0.268\tau^O + 0.659x^E + 0.269x^O + 0.089u^E + 0.275u^O$$

and

(3.6)

$$q^O = 0.575m^O - 0.332m^E + 0.171\tau^O + 0.805\tau^E + 0.121x^O + 0.806x^E - 0.461u^O + 0.825u^E \; .$$

Finally, the reduced form for the nominal outside/Euro exchange rate is

(3.7)

$$s^O = 0.686m^O - 0.686m^E - 0.097\tau^O + 0.097\tau^E - 0.147x^O + 0.147x^E - 0.736u^O + 0.736u^E \; .$$

The reduced form coefficients in equations (3.3)-(3.7) can be used in discussing some of the properties of the macromodel. First, look at the effects of a monetary expansion on domestic employment and domestic CPI. An increase in the money supply reduces the nominal and real interest rates, so aggregate demand increases. With given nominal wages, real wages fall and employment increases. The effect of outside money supply on outside employment is only slightly smaller than the expansionary effect from the Euro money supply on Euro employment, but outside CPI inflation increases significantly more than the Euro CPI inflation. Since the import share is much larger in the outside block, outside CPI will react much stronger to variations in the exchange rate. Next, look at the spillover effects. In the classical fixed-price Mundell-Fleming two-country model a monetary expansion increases domestic output but decreases foreign output.[21] This "beggar-thy-neighbor"-property of monetary policy is absent from the present flexible-price model. Instead, a monetary expansion increases foreign output.[22] On the other hand, a monetary expansion decreases foreign CPI inflation. Take an increase in the outside money supply. The real outside/Euro exchange rate (terms-of-trade) has to depreciate, that is z_t^O has to increase. This increase in z_t^O will reduce the Euro CPI inflation according to equation (2.13). The spillover effects of money supplies on employment and consumer prices reflect that the Euro area is three times as large as the block of outside countries. An increase of

[21] See Mundell (1968).

[22] That monetary expansions have positive spillover effects on foreign income is consistent with the empirical results presented for instance in Taylor (1993). However, the empirical evidence on the spillover effects from monetary and fiscal policy measures is mixed, see for instance Douven and Peters (1997).

outside money supply will depreciate the nominal outside/Euro exchange rate, while equal changes in the outside and Euro money supplies leave the nominal exchange rate unchanged.

The treatment of fiscal policy in the present model constitutes an even more drastic departure from the classical Mundell-Fleming model, in that budget-balanced increases are contractionary. This non-Keynesian flavor of the model is due to the mechanism that the negative effect on employment of the increased tax distortion outweighs the positive demand effect from increased government consumption.[23] The strength of this effect depends on the size of the economy. An increase of the Euro tax rate by one percentage point (accompanied by an increase in the Euro expenditure ratio of equal size) leads to a fall of 0.3 per cent of Euro employment on impact. A budget-balanced one percentage point increase of the outside tax rate will reduce the outside employment level by 0.7 per cent. The difference is due to the fact that an increase in the tax rate directly hits only domestic supply, while the increase in government expenditure spills over in demand for the foreign good. Since the block of outside countries is more open than the Euro area, the net effect on own employment is more negative. Furthermore, in the Mundell-Fleming model, fiscal policy has a "locomotive" property; a fiscal expansion increases foreign income as well as domestic income. In the present model, expansionary fiscal policy corresponds to a budget-balanced reduction in tax and expenditure rates. Such a reduction will have a negative spillover effect on foreign employment (income). A budget-balanced tax increase will increase domestic as well as foreign CPI. The effect on domestic CPI is much larger in the Euro area than in the outside area. The spillover effects on employment and consumer prices reflect the relative size of the Euro area.

3.3 The employment-inflation tradeoffs

When the monetary policymakers set their policy variables so as to minimize their loss functions in equations (2.1), (2.2), (2.6) and (2.7), the constraints they face are given by the reduced forms in equations (3.3)-(3.7). In trying to reduce their losses, the policymakers face a tradeoff between employment and inflation that is captured by the reduced form coefficients.

In a symmetric (flexible exchange rate) monetary regime, in which both central banks set money supplies, the central banks' tradeoffs are given by

[23] This property depends on the parameterization of the model. For instance, reducing the elasticity of aggregate demand w.r.t the real interest rates, ν, from 0.4 to 0.3 and increasing the interest rate semi-elasticity of money demand, λ, from 0.6 to 0.8 will change the impact of Euro tax rate changes on Euro employment. With this change a cut in the Euro tax rate will reduce Euro employment as well as Euro CPI. Assuming that domestic goods represent a more important share in government expenditure would also give the model more Keynesian properties.

(3.8) $$\left.\frac{\partial q^I}{\partial n^I}\right|_{ICB} = \frac{\partial q^I / \partial m^I}{\partial n^I / \partial m^I} \qquad \text{for } I = E, O.$$

For a central bank that places a large weight on price stability, compared to stable employment levels, it is better with a steeper tradeoff, i.e. a higher value for the tradeoff. A steeper tradeoff allows the central bank to stabilize prices at a lesser cost in terms of employment variability. As an example, consider a negative supply shock that increases inflation and creates unemployment. With a loss function as in equation (2.1), and with a high weight on price stability, the central bank will want to contract the money supply in order to counter the inflationary impulse from the supply shock. However, a monetary contraction will further increase the unemployment problem. The steeper the employment-inflation tradeoff, the less will employment fall for a given reduction in prices.

The fiscal authorities' tradeoffs are given by

(3.9) $$\left.\frac{\partial q^I}{\partial n^I}\right|_{IFA} = \frac{\partial q^I / \partial \tau^I}{\partial n^I / \partial \tau^I} \qquad \text{for } I = E, O$$

Since the underlying macroeconomic model has non-Keynesian features the slope of the government's employment-inflation tradeoff will be negative, since a tax cut will increase employment and reduce inflation.

For a government/fiscal authority that places a relatively large weight on employment compared to inflation, one can argue that it is better with a flatter tradeoff, i.e. a less negative value for the tradeoff.[24] A flat tradeoff allows the fiscal authority to vary the employment level at a lesser cost in terms of inflation.

Table 3.1 Employment-inflation tradeoffs

Outside central bank	*Euro central bank*	*Outside fiscal authority*	*Euro fiscal authority*
0.93	0.52	-0.24	-2.45

Comparing the tradeoffs for the two central banks in *Table 3.1* , we see that the outside central bank faces a better tradeoff than the ECB. The reason behind this result is that a large Euro area also implies a large share of imports in the outside area. With a large share of imports in the CPI,

[24] See Eichengreen and Ghironi (1997).

the effect on CPI of a change in the exchange rate is large, so the outside central bank does not have to contract the economy so much to get the desired reduction of CPI inflation.[25]

Since the outside fiscal authority also faces a better (since flatter) tradeoff than the Euro fiscal authority, the underlying macromodel is such that the two outside authorities have the “upper hand” compared to their Euro colleagues.

4 Monetary and fiscal policy interaction in a two-region Europe

The type of policy game studied in this paper is non-cooperative: when the EU countries are hit by shocks each of the four policymakers will try to minimize its own losses, as described in Section 2.1. This seems to be a natural point of departure. An important feature of the Maastricht treaty (as well as of recent national central banking legislation in Europe) is the independence accorded to the ECB and the outside central banks.

4.1 The monetary and fiscal policy game

In the Nash equilibrium of the monetary and fiscal policy game the four policymakers are fully aware of the shock that has hit the European economies, and each policymaker chooses his best policy, given the policy choices of the three other policymakers. The Nash equilibrium is therefore described by the four equation system consisting of the first-order conditions for the policymakers, equations (2.3), (2.4) and (2.8).

The employment-inflation tradeoffs discussed in Section 3.3 are useful when analyzing the mechanisms behind the outcome of the policy game. Another important determinant of the outcome is the presence of externalities between the four policymakers.[26] These externalities occur both between regions (Euro area versus the outside area) and within regions (central bank versus the fiscal authority). Whether the externalities are positive or negative depends on the shocks that hit the two regions, the mechanisms built into the macromodel and the assumed preferences of the policymakers. [27]

[25] See Ghironi and Giavazzi (1997a) for a discussion of how central banks employment-inflation tradeoffs are affected by monetary regime and monetary union size.

[26] See also the discussion in Canzoneri and Henderson (1991) for the case with two monetary policymakers.

[27] The central banks are mainly concerned about price stability and the fiscal authorities care more about stable employment.

4.2 The shocks

The macromodel presented in section 2.2 allows for (real) shocks to the supply and aggregate demand for the two goods. The shocks are by assumption temporary and uncorrelated.[28] I consider four combinations of shocks.

(1) a symmetric supply shock reduces output in both regions ($x^O,\ x^E > 0$). [29]

(2) asymmetric supply shocks reduce output in the outside area and increase output in the Euro area ($x^O > 0,\ x^E < 0$).

(3) a symmetric negative demand shock reduces aggregate demand in both regions ($u^O, u^E < 0$)

(4) asymmetric demand shocks reduce aggregate demand for the outside good and increase aggregate demand for the Euro good ($u^O < 0, u^E > 0$).

In the first three cases, the shocks are assumed to be of the same relative magnitude, i.e. one per cent. In the case with asymmetric demand shocks I assume that aggregate demand for the outside good falls by one per cent, while aggregate demand for the Euro good increases by 1/3 of one per cent. This corresponds to a shift in aggregate demand from the outside good to the Euro good, with total aggregate demand unchanged. Since total aggregate demand is unchanged in this experiment, the policy measures undertaken are solely related to the shift in demand between outside and Euro goods.

Table 4.1 Impact effects from shocks.

Type of shock	*Supply shock*		*Demand shock*	
	Symmetric	*Asymmetric*	*Symmetric*	*Asymmetric*
Euro CPI	0.927	-0.390	-0.364	-0.245
Outs' CPI	0.927	-0.684	-0.364	0.736
Euro employment	-0.214	0.063	-1.070	0.147
Outs' employment	-0.214	0.239	-1.070	-0.441

[28] It is common in empirical studies of the costs and benefits of membership in EMU to distinguish between aggregate demand shocks which have no permanent effects on output and aggregate supply shocks which do have permanent effects on output. In the present model, there are only temporary effects on output.

[29] Recall from equation (2.9) that a positive value for x^I represents a negative supply shock.

With symmetric shocks the impact effects on the two EU regions are rather straightforward, see *Table 4.1* . The initial effects – before any economic policy responses - of the common (negative) supply shock are similar in both EU regions; employment falls by 0.21% and consumer prices increase by 0.93%.[30] A symmetric exogenous reduction of aggregate demand reduces, on impact, the employment levels by 1.07% and consumer prices by 0.36%.

When shocks are asymmetric the differences in size (and import shares) between the two regions will begin to matter. An asymmetric supply shock, reducing productivity by one per cent in the outside block of countries and adding one per cent to Euro productivity, will call for increases in employment in both regions, in the outside block of countries by 0.24% and in the Euro area by 0.06%. The increase in supply of Euro output will cause the Euro producer prices to fall and the reduction in outside output will cause the outside producer prices to increase. However, since Euro goods account for a large share of outside consumption, the outside consumer prices will fall. Consumer prices in both areas will fall, in the outside block by 0.68% and in the Euro area by 0.39%.

An asymmetric demand shock, shifting demand from the outside good to the Euro good, will put upward pressure on Euro employment and downward pressure on outside employment. The shift in demand leads to a tendency to excess demand for the Euro good and excess supply for the outside good. In order to restore equilibrium the real outside/Euro exchange rate has to depreciate, i.e. z^O has to increase. A depreciation of the real exchange rate can happen through a depreciation of the nominal outside/Euro exchange rate, an increase in Euro producer prices, a decrease in outside producer prices or a combination of the three. From the reduced forms in equations (3.3)-(3.6) it can be seen that the effect from the depreciation of the nominal exchange rate dominates the effect on consumer prices, leading to a downward pressure on Euro CPI and an upward pressure on outside CPI.[31] The shift in aggregate demand from outside goods to Euro goods will decrease outside employment by 0.44% and increase Euro employment by 0.15%, while outside CPI will increase by 0.74% and Euro CPI fall by 0.24%.

4.3 Benchmark case: unconstrained stabilization policies

In order to get a point of reference for the simulations when the policymakers experience disutility from volatility in tax rates or the nominal exchange rate, I first look at the Nash equilibria when the policymakers freely can choose how to set their instruments. It is also easier

[30] The impact effects given in *Table 4.1* are calculated from the reduced form coefficients in equations (3.3-3.6).
[31] The impact effects on the CPIs from the asymmetric demand shock may seem counterintuitive. However, they are not particular to the present parameterization of the model. For instance, the two-country model in Canzoneri and Henderson (1991) shares the same property.

to discuss the basic mechanisms of the model in this benchmark case. The results are reported in *Table 4.2*.[32]

The model is set up so that in the absence of costs for the use of stabilization policies the outcome of the policy game is first best. The policymakers succeed in completely eliminating the effects of the various shocks on the target variables employment and inflation. Since there are four target variables and four policy variables, this reminds of the Tinbergen controllability result. A general observation is that no change in the nominal exchange rate is required. Even though nominal wages are rigid, perfect flexibility in (consumer and producer) prices is sufficient to reach first best.

On impact, a symmetric (negative) supply shock lowers employment (and output) and increases consumer prices in both areas. The common fiscal response to this development is to decrease tax (and expenditure) rates, which will be a remedy for both the rising unemployment problem and the price hike. As the tax cuts are balanced by equally sized cuts in government spending, there is a tendency for aggregate demands for the two goods and prices to fall. Central banks are able to fully remove this effect on consumer prices by expanding the money supplies, causing real interest rates to fall and private consumption to increase sufficiently to replace government consumption.[33, 34]

When the outside area is hit by a negative supply shock and the Euro area is hit by a positive supply shock of equal (relative) size, both outside and Euro employment will tend to increase and CPI will tend to decrease, before any policy measures are taken. Both fiscal policymakers will want to increase taxes in order to stop domestic employment from rising above the no-disturbance level. The rise in tax rates will also reduce the fall in CPI. In fact, the accompanying increase in government expenditure will create a tendency for the Euro CPI to

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[32] These equlibria are the solutions to the four equation system consisting of (2.3), (2.4) and (2.8), when $\vartheta^{EFA} = \vartheta^{EFA} = \chi^{OCB} = 0$, and the shock terms take the values described above.

[33] In the case with constant and identical expenditure shares Purchasing Power Parity holds in terms of the CPIs and the real interest rates in the two regions will equalize. Inserting (2.11) into (2.14) and rewriting, using (2.13), gives $q^O = p^O + a\left(p^E + s^O - p^O\right) = s^O + p^E - (1-a)z^O = s^O + q^E$. Using the real interest rate definition, uncovered interest parity and the definitions of the CPIs and the real exchange rate, one gets $r_t^O = r_t^E - (1 - \beta^E - \beta^O)z^O$. In the special case that $\beta^O = a$ and $\beta = 1 - a$ the real interest rates will be equal.

[34] A decrease of the Euro tax rate will lower employment in the outside area, and vice versa, because the balanced-budget constraint requires a cut in government expenditure that will lower demand for both goods. There is thus a negative externality in fiscal policy making. The budget-balanced reduction in taxes will reduce inflation in both areas, but this is less important for the governments. As for monetary policy a contractionary monetary policy in the Euro area, to keep Euro price increases down, will fuel inflation in the outside area, and vice versa. There is thus also a negative externality between the monetary policymakers.

increase. By a monetary contraction, the ECB raises the real interest rate so that private consumption demand is reduced to a sufficient degree.

Table 4.2 Benchmark Nash equilibrium in monetary and fiscal policies flexible exchange rate regime, with no restrictions on exchange rate or tax rate volatility.

Type of shock	*Supply shock*		*Demand shock*	
	Symmetric	*Asymmetric*	*Symmetric*	*Asymmetric*
Euro money	0.2	-0.225	1.5	0.417
Outs' money	0.2	0.275	1.5	-1.25
Euro taxes	-1	0.375	0	0.417
Outs' taxes	-1	0.875	0	-1.25
Nominal exchange rate	0	0	0	0
Real exchange rate	0	-2.5	0	1.667
Real interest rate	-2	1	-2.5	0
Euro producer prices	0	-0.625	0	0.417
Outs' producer prices	0	1.875	0	-1.25
Euro CPI	0	0	0	0
Outs' CPI	0	0	0	0
Euro employment	0	0	0	0
Outs' employment	0	0	0	0

The case of a symmetric demand shock differs from the other cases in one important respect; fiscal policy is completely inactive. Together with the earlier observation that the nominal exchange rate is unchanged, this implies that adding positive costs related to the volatility in tax rates and the nominal exchange rate will not matter for the monetary and fiscal policy equilibrium. The optimal (constrained) stabilization will always consist of a symmetric expansion of the money supplies. Note that this result is obtained in a non-cooperative setting. There is no presumption that the two central banks cooperate, each one chooses the best policy given the monetary policy of the other central bank. A symmetric negative aggregate demand shock can be interpreted as a general slump in the European economies (perhaps due to a fall in world demand, although the rest of the world is not formally introduced into the model). In this simple two-country model there is thus no ground to claim that constraints on fiscal policy, like those imposed by the Stability Pact, will impinge on the optimal stabilization in the face of a general EU recession. Irrespective of such constraints, the best response is to expand money supplies and let fiscal policy remain inactive.[35, 36]

[35] A more complete analysis would take into account third-country reactions on this kind of monetary policy.
[36] As shown in Section 5, this result is sensitive to assumptions on the pattern of trade (the degree of home bias).

An asymmetric demand shock, shifting demand from the outside good to the Euro good, will put upward pressure on Euro employment and downward pressure on outside employment. The shift in demand will also put a downward pressure on Euro CPI and an upward pressure on outside CPI, for the reasons discussed in Section 3.2.[37] The Euro fiscal policy response is to tighten fiscal policy by an increase in taxes/expenditure, which reduces the impact on both employment and prices. The outside government will want to reduce taxes in order to reduce unemployment (and at the same time reduce inflation). ECB has an incentive to expand Euro money supply to fight deflation, while the outside central bank will contract in order to reduce the inflationary effects of the demand shock.[38]

In the following two sections I study the effects of introducing costs for volatility in the tax rates and in the nominal exchange rate in two cases; a symmetric (negative) supply shock and an asymmetric demand shock that shifts aggregate demand from the outside good to the Euro good.

4.4 Monetary and fiscal policy responses to common supply shocks

Two cases of constrained fiscal policy making are considered; flexible fiscal policy making, which corresponds to setting $\vartheta^{IFA} = 0.25$ (for $I = E, O$) ; and rigid fiscal policy making, which corresponds to setting $\vartheta^{IFA} = 4$ (for $I = E, O$) . The restrictions on the volatility of the nominal outside/Euro exchange rate are also examined for two cases; loose restrictions (low costs) corresponds to χ^{CB}=0.25 and tight restrictions (high costs) correspond to χ^{CB}=4.[39]

In *Table 4.3* I present the results from the stabilization game when efforts to stabilize the economies are costly. In this exercise it is assumed that the outside central bank has positive but low costs related to the volatility of the nominal exchange rate (loose restrictions). The table shows how the outcome of the stabilization game varies with the degree of rigidity in fiscal policies. A general pattern in the simulations reported in *Table 4.3* is that in relation to the impact effects of the symmetric supply shock, see *Table 4.1* , the monetary-fiscal policy game will amplify employment losses while the inflation rates are stabilized.

When the negative supply shock hits the EU area, the fiscal authorities will try to cushion the negative effect on employment by lowering the tax rates. Although the constraint of a balanced

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[37] An excess supply of the outside good will necessitate a real depreciation.

[38] Since an increase in Euro taxes/expenditure will increase outside employment, Euro fiscal policy will in this case have a positive externality on OFA. Likewise, outside fiscal policy will have a positive externality on EFA. Since an expansion of the Euro money stock reduces outside CPI inflation, and a contraction of the outside money stock increases Euro CPI, there is also a positive externality between the two monetary policymakers.

[39] Of course, these weights can only be suggestive. The weighting of the volatility of the tax rates corresponds to the one used by Ghironi and Giavazzi (1997b) and Eichengreen and Ghironi (1997), taking into account that the fiscal authorities' loss functions are differently, but equivalently, formulated. These authors do not take into account costs/restrictions on nominal exchange rate volatility.

budget means that the government expenditure ratios also must fall, the net effect will be positive on employment. However, when the fiscal authorities are restrained in their use of taxes/expenditure, they will not cut taxes as much as in the unconstrained equilibrium. Lower tax cuts means that consumer prices will tend to by higher. This in turn will induce the central banks to pursue contractionary monetary policies.

Table 4.3 Symmetric negative supply shock. Low costs for exchange rate volatility $(\chi^{OCB} = 0.25)$. Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* $(\vartheta^{EFA} = \vartheta^{OFA} = 0.25)$	*Rigid Euro fiscal policy Outs' fiscal policy flexible* $(\vartheta^{EFA} = 4, \vartheta^{OFA} = 0.25)$	*Rigid fiscal policies* $(\vartheta^{EFA} = \vartheta^{OFA} = 4)$
Euro money	-0.472	-1.194	-1.895
Outs' money	-0.604	-1.606	-2.085
Euro taxes	-0.635	-0.091	-0.110
Outs' taxes	-0.947	-1.249	-0.257
Nominal exchange rate	-0.060	-0.170	-0.116
Real exchange rate	0.178	0.699	0.022
Real interest rate	-1.111	-0.085	0.658
Euro producer prices	0.168	0.459	0.348
Outs' producer prices	-0.070	-0.411	0.210
Euro CPI	0.124	0.284	0.342
Outs' CPI	0.063	0.114	0.226
Euro employment	-0.577	-1.324	-1.596
Outs' employment	-0.362	-0.476	-1.569

In the Nash equilibrium with flexible fiscal policies and a loose exchange rate constraint, the outside fiscal authority will cut taxes almost as much as when unconstrained, i.e. 0.95% instead of 1%, and the Euro fiscal authority cuts taxes by 0.64% instead of by 1%. The Euro central bank cuts the money supply by 0.5%, while the outside central bank cuts money supply by 0.6%. The outcome of the monetary-fiscal policy game is that Euro employment falls by 0.6% and outside employment falls by 0.4%. The Euro CPI will be 0.12% higher and outside CPI 0.06% higher than in the no-disturbance equilibrium. The two outside authorities can exploit their better employment-inflation tradeoffs to export both unemployment and inflation to the Euro area.

The Stability and Growth Pact imposes restrictions/costs on the use of budget deficits in active fiscal policy within the Euro area. Outside fiscal authorities are also subject to these restrictions, but without having to pay "fines" in case of misbehavior. There is therefore ground to suspect that fiscal policy in the Euro area will be more rigid than the fiscal policy in the outside area. The third column in *Table 4.3* corresponds to the case where the fiscal policy conducted by EFA is more rigid than that conducted by OFA. In fact, the Euro tax rate now barely moves, EFA reduces the tax rate by 0.09% instead of by 0.64% in the flexible fiscal policy equilibrium in the second column of *Table 4.3*. In the case of a symmetric supply shock there are negative externalities between the fiscal policymakers. This follows from the impact effects of the common supply shock and the reduced form coefficients on fiscal policies (tax rates). From equation (3.4), with a less negative value for the Euro tax rate, *ceteris paribus,* OFA can obtain the same stabilization of outside employment with a smaller reduction in the outside tax rate. [40] A more rigid Euro fiscal policy would therefore, by itself, imply that outside fiscal policy could be less expansive. However, the outside fiscal authority will reduce taxes more when Euro fiscal policy is rigid, in fact even more than in the unconstrained equilibrium in *Table 4.2* (by 1.25% instead of 1%). The reason for this can be understood by looking at the central banks' behavior. When Euro fiscal policy can not be used to stop unemployment and consumer prices from rising, the ECB – mostly concerned about the rise in consumer prices – reduces the Euro money supply. This monetary contraction in the Euro area spills over in increases in outside CPI. Outside tax reductions will be insufficient to keep outside CPI at a level acceptable to the outside central bank, so OCB will try to keep CPI in check by decreasing the outside money stock. The negative externalities in monetary policy will lead to drastic cuts in money supplies; in equilibrium the Euro money supply is reduced by 1.2% and the outside money supply by 1.6%. In spite of this general tightness of monetary policy conditions, the Euro CPI is up 0.3% and outside CPI is up 0.1% from the unconstrained equilibrium. The most drastic effect, however, is found on the Euro labor market. The combined effect of contractionary EU monetary policies, heavy tax reductions in the outside area and practically inactive Euro fiscal policy is that employment in the Euro area falls by 1.3% from its no-disturbance equilibrium value. Outside employment is also negatively affected by the tight monetary conditions, but to a much lesser degree.

In the last column of *Table 4.3* I examine the case where outside fiscal policy is subject to the same constraints/costs as Euro fiscal policy. This could correspond to a development in which the Euro government manages to impose its own degree of fiscal discipline on the outside government, or that the outside government for other reasons would feel compelled to be as rigid as its Euro colleague. Would that improve matters? The answer – in the present setting - is no. The "chicken race" between the two central banks will be even fiercer, since the outside central bank now has to compensate for the lack of outside fiscal policy when trying to keep CPI down. The reduction in employment will now be nearly the same in the outside area as in

[40] Outside CPI would less well stabilized, but price stability carries a much lower weight than employment stability in the outside fiscal authority's loss function.

the Euro area (1.6%). The increases in consumer prices are also up compared to the case with flexible outside fiscal policy.

As noted in Section 3.3, the outside central bank has a more advantageous employment-inflation tradeoff than the ECB in the present setup. One way to reduce this advantage is to make the OCB incur costs/disutility from volatility in the outside/Euro nominal exchange rate. Such costs would make the OCB less willing to use monetary policy to export inflation to the Euro area. The consequences of introducing higher costs for exchange rate volatility are investigated in *Table 4.4*.

Table 4.4 Symmetric negative supply shock. High costs for exchange rate volatility ($\chi^{OCB} = 4$). Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* ($\vartheta = \vartheta^{O} = 0.25$)	*Rigid Euro fiscal policy Outs' fiscal policy flexible* ($\vartheta = 4$, $\vartheta^{O} = 0.25$)	*Rigid fiscal policies* ($\vartheta = \vartheta^{O} = 4$)
Euro money	-0.483	-1.218	-1.873
Outs' money	-0.541	-1.422	-1.929
Euro taxes	-0.634	-0.090	-0.108
Outs' taxes	-0.913	-1.150	-0.242
Nominal exchange rate	-0.013	-0.036	-0.025
Real exchange rate	0.188	0.725	0.077
Real interest rate	-1.088	-0.028	0.657
Euro producer prices	0.171	0.463	0.357
Outs' producer prices	-0.031	-0.298	0.254
Euro CPI	0.123	0.282	0.338
Outs' CPI	0.110	0.245	0.312
Euro employment	-0.576	-1.314	-1.573
Outs' employment	-0.347	-0.435	-1.480

The OCB is indeed less aggressive when the costs related to exchange rate volatility are high. With the tighter constraint on (higher costs related to) nominal exchange rate volatility, the nominal exchange rate will deviate much less from its no-disturbance equilibrium value, the deviation is about ¼ of the deviation reported in *Table 4.3*. However, the real exchange rate now depreciates even more. When movements in the nominal exchange rate are reduced, the producer prices adjust instead. The outside producer prices do not fall as much as with loose constraints (low costs) on nominal exchange rate volatility. The major effect of the tighter constraint on the nominal exchange rate is that the outside consumer prices will be higher – the Euro CPI will be marginally lower – since the OCB can not export inflation to the Euro area to the same extent as in the case with loose restrictions on nominal exchange rate volatility. Outside CPI inflation will be between one and a half times and twice as large as with low costs. Another effect of the less contractionary outside monetary policy is that unemployment in both the outside and the Euro area will be lower.

To sum up, in the case of an EU-wide supply shock all four authorities loose from imposing restrictions on fiscal policy. In the case when Euro fiscal policy is rigid while outside fiscal policy is relatively flexible, unemployment and inflation in the Euro area will be considerably higher. The ECB will be more contractive, and the externalities in monetary policy will make outside inflation and unemployment higher as well compared to the case with flexible EU fiscal policy. However, the Euro area is relatively worse off. Making outside fiscal policy as rigid as Euro fiscal policy worsens the unemployment situation in the outside area, and the increase in outside CPI will be larger. Consumer prices and unemployment in the Euro area would also be higher in the case with rigid outside fiscal policy. The Euro authorities would benefit – although not by much with the present calibration - from restrictions on the nominal outside/Euro exchange rate; both Euro consumer prices and employment are marginally better stabilized. The outside fiscal authority also benefits from restrictions on the nominal outside/Euro exchange rate, since outside unemployment will be lower.[41] The most important effect of imposing higher volatility costs on the nominal outside/Euro exchange rate is that outside CPI inflation will be higher in the event of a symmetric (negative) supply shock.

4.5 Monetary and fiscal policy responses to asymmetric demand shocks

In this section I study the stabilization game when an aggregate demand shock shifts demand from the outside good to the Euro good.

Compared to the impact effects of the asymmetric demand shock the interaction between the four policymakers will stabilize CPI in both the Euro area and in the outside block of countries, but the over-employment problem in the Euro area will be amplified. In the flexible fiscal policy equilibrium Euro CPI falls by 0.04% (impact effect -0.24%), outside CPI increases by 0.02% (impact effect 0.74%), Euro employment increases by 0.19% (impact effect 0.15%) and outside employment falls by 0.31% (impact effect -0.44%). When outside fiscal policy is flexible, tax cuts can be used to reduce the negative impact effect on outside employment. However, with rigid fiscal policy in both the Euro area and the outside area the outside unemployment problem will be aggravated by the monetary-fiscal stabilization game. Contractionary outside monetary policy will reduce employment as well as stabilize consumer prices.

[41] Even though CPI in the outside area is higher when outside monetary policy is restricted, OFA is still better off given its relatively high preference for stable employment.

Table 4.5 Asymmetric demand shock. Low costs for exchange rate volatility $(\chi^{OCB} = 4)$. Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* $(\vartheta = \vartheta^{O} = 0.25)$	*Rigid Euro fiscal policy Outs' fiscal policy flexible* $(\vartheta = 4, \vartheta^{O} = 0.25)$	*Rigid fiscal policies* $(\vartheta = \vartheta^{O} = 4)$
Euro money	0.457	0.694	0.292
Outs' money	-1.033	-0.704	-0.979
Euro taxes	0.208	0.030	0.019
Outs' taxes	-0.815	-0.716	-0.147
Nominal exchange rate	0.059	0.095	0.126
Real exchange rate	1.253	1.082	0.693
Real interest rate	-0.140	-0.477	-0.051
Euro producer prices	0.273	0.177	0.114
Outs' producer prices	-0.922	-0.810	-0.454
Euro CPI	-0.041	-0.093	-0.060
Outs' CPI	0.018	0.002	0.066
Euro employment	0.189	0.434	0.278
Outs' employment	-0.312	-0.275	-0.902

An important difference between the case of an asymmetric demand shock and the case with a symmetric supply shock is that there are positive externalities between the fiscal policymakers. This means that the domestic and foreign policymakers agree on the direction in which the domestic policy variable should go. For instance, when EFA increase taxes in order to reduce Euro (over-) employment, outside employment will increase, which is what OFA would like to see happen. This positive externality in fiscal policy measures reduces the need for outside tax reductions to stimulate outside employment.

With four policymakers there are more interactions to take into account, compare the second and third columns in *Table 4.5*. The asymmetric demand shock calls for increases in Euro taxes and money supply, and decreases in outside taxes and money supply. When Euro fiscal policy is more rigid, Euro taxes will not be increased so much. By itself, and since there are positive fiscal externalities, lower tax increases in the Euro area ought to lead to more cuts in outside taxes. However, this is not what we see happen here. In effect, OFA is less aggressive. The mechanism behind this is the following; when the use of Euro taxes is limited, the ECB will want to expand the money supply more in order to stop Euro CPI from falling; the more expansionary Euro monetary stance will mean more severe over-employment in the Euro area, less outside unemployment and lower outside CPI inflation; the tendency to lower outside CPI inflation reduces the need for OCB to contract outside money supply, which will also lead to less outside unemployment; all this is good news for the outside government, which will not have to decrease taxes as much to avoid a large unemployment problem as a result of the asymmetric demand shock.

The end result of the more rigid Euro fiscal policy is that the over-employment problem in the Euro area will be more severe, and that Euro CPI inflation will not be stabilized to the same extent as with flexible Euro fiscal policy. For the two outside policymakers a more rigid Euro fiscal policy is beneficial, outside unemployment is lower and outside CPI is better stabilized.

With a symmetric supply shock, making outside fiscal policy more rigid as well did not improve the situation for the Euro policymakers. When it comes to stabilizing the EU economies in the face of an asymmetric demand shock, the Euro authorities clearly have an interest in restricting outside fiscal policy. When outside fiscal policy is rigid, OFA can not lower taxes so aggressively. Since this means that the contribution from fiscal policy to keep down outside CPI will be reduced, the OCB will tighten monetary policy. The tighter outside monetary stance will increase Euro CPI, allowing the ECB to be less expansionary. This in turn will reduce the problem of over-employment in the Euro area. In the outside area, inflation is higher, and the fall in employment is massive – of the order of 0.9% instead of 0.3%.

Table 4.6 Asymmetric demand shock. High costs for exchange rate volatility $(\chi^{OCB} = 4)$. Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* $(\vartheta = \vartheta^{O} = 0.25)$	*Rigid Euro fiscal policy* *Outs' fiscal policy flexible* $(\vartheta = 4, \vartheta^{O} = 0.25)$	*Rigid fiscal policies* $(\vartheta = \vartheta^{O} = 4)$
Euro money	0.468	0.708	0.268
Outs' money	-1.094	-0.807	-1.147
Euro taxes	0.207	0.029	0.017
Outs' taxes	-0.849	-0.771	-0.163
Nominal exchange rate	0.013	0.020	0.028
Real exchange rate	1.243	1.068	0.633
Real interest rate	-0.163	-0.508	-0.049
Euro producer prices	0.270	0.175	0.104
Outs' producer prices	-0.960	-0.872	-0.502
Euro CPI	-0.040	-0.092	-0.055
Outs' CPI	-0.028	-0.072	-0.027
Euro employment	0.188	0.428	0.254
Outs' employment	-0.326	-0.298	-0.998

How will the policy mix be affected by the introduction of costs for the outside central bank related to the volatility of the nominal outside/Euro exchange rate? From *Table 4.6* we see that the equilibrium values for Euro policy variables, CPI and employment are hardly affected when OCB experience higher costs related to volatility in the nominal exchange rate, and hence is less willing to let the nominal exchange rate fluctuate. Nonetheless, when the volatility in the nominal outside/Euro exchange rate is important in the loss function of the OCB, the Euro target variables are both better stabilized. Although outside fiscal policy is more aggressive, unemployment in the outside block will be somewhat higher irrespective of how severe the constraints/costs related to active outside fiscal policy are. The behavior of outside CPI is, however, quite different. Compared to the case with low costs for exchange rate volatility, outside CPI is now less stable when outside fiscal policy is flexible, but more stable when both Euro and outside fiscal policies are rigid.[42, 43]

Summing up, in the case of a shift in demand from outside goods to Euro goods, the Euro target variables are both less well stabilized when the Euro fiscal policy is more rigid. Now rigid Euro fiscal policy is good for the outside area; Euro monetary policy gets more expansive and as monetary policy has positive spillover effects this helps to fight outside inflation and unemployment. On the other hand, the Euro authorities have an interest in restricting outside fiscal policy as well. As in the symmetric supply shock case, the benefits to the Euro area from restricting outside monetary policy are small. From the perspective of the outside authorities, making outside fiscal policy more rigid will have a cost in terms of an increase in unemployment. Imposing high costs related to the volatility in the nominal outside/Euro exchange rate would, *ceteris paribus*, increase outside unemployment. With low costs for exchange rate volatility, making outside fiscal policy more rigid will make outside CPI less stable. With high costs for exchange rate volatility, making outside fiscal policy more rigid will allow OCB to better stabilize outside CPI.

5 Allowing for home bias in consumption

In the main analysis of the paper I have followed Ghironi and Giavazzi (1997a, b) in assuming that the import share in the EU regions equals the relative size of the partner area. Assuming that the import share equals the relative size of the partner area is clearly a restrictive assumption, which moreover is at odds with the internal EU trade statistics.

[42] Outs CPI actually fall in *Table 4.6* instead of increasing, as in *Table 4.5*. Stability of CPI is discussed with respect to the absolute deviation from no-disturbance equilibrium.

[43] This illustrates that even in a rather simple model, the interaction between the external effects of policymaking and restrictions on some of the policymakers may lead to results that are hard to interpret.

Table 5.1 Intra-EU trade 1995.

	Euro area	*Outside area*
Share of EU GDP (%)	81	19
Imports from the other EU region (% of GDP)	3	13

Euro area = Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain
Outside area = Denmark, Greece, Sweden and the U.K.
Source: European Commission (GDP data) and Eurostat (unpublished Intrastat data on trade flows)

In *Table 5.1*, I have calculated the intra-EU trade flows between the Euro area and the remaining block of (outside) EU countries. The Euro area includes all EU countries except Denmark, Greece, Sweden and the U.K. The Euro area produced 81% of total EU GDP in 1995, which implies a size parameter $a = 0.81$. The share of Euro imports from the outside block in 1995 was 3%, while the share of imports from the Euro area amounted to 13% in the outside block.

A direct comparison between the actual trade and GDP data and the assumptions in the 2-country macromodel is not possible, since a 2-country model by construction ignores the rest of the world. But even allowing for this inconsistency, the difficulties in measuring the intra-EU trade flows, and for the possibility that the intra-EU trade patterns may change rapidly, the difference between the actual import share in the outside block and the extension of the Euro area is simply too big to be neglected. Since the import shares and the size of the Euro area matter for the spillover effects between the two areas, it is important to investigate how the assumptions on import shares affect the earlier conclusions.

That EU import shares are smaller than the size of the partner region can be interpreted as "home bias" in consumption. I look at two cases of home bias. In the first case I assume equal degree of home bias in the EU, with import shares equaling 6/10 of the partner area's relative size. In the second case I assume that the home bias is larger in the Euro area, the Euro import share is assumed to be ½ of the size of the outside area while the outside import share is assumed to be 7/10 of the size of the Euro area.[44]

Table 5.2 Employment-inflation tradeoffs for various degrees of home bias.

Degree of home bias	*Outside central Bank*	*Euro central bank*	*Outside fiscal authority*	*Euro fiscal Authority*
No home bias ($\beta^O = 0.75$, $\beta^E = 0.25$)	0.93	0.52	-0.24	-2.45
Equal home bias ($\beta^O = 0.45$, $\beta^E = 0.15$)	0.57	0.41	-0.53	-2.84
Differing home bias ($\beta^O = 0.525$, $\beta^E = 0.125$)	0.65	0.39	-0.45	-2.74

[44] It can be noted that the data in *Table 5.1* imply the same degree of home bias in the two regions. The ratio between the actual import share and the size of the partner region is 0.16 in both regions.

In *Table 5.2* , the effects on the employment-inflation tradeoffs from home bias in goods trade are shown (for convenience, the results for the “no home bias” case from *Table 3.1* are repeated).[45] When the trade pattern is home biased the tradeoffs worsen for all four authorities.[46] However, the tradeoffs for the outside central bank worsens relatively more than for the Euro central bank, while the worsening of the tradeoff is relatively larger for the outside fiscal authority than for the Euro fiscal authority.[47]

Home bias in consumption does not affect the general property of the benchmark equilibrium (with no costs for volatility in the tax rates and in the nominal exchange rate) that the policymakers can eliminate the effects of the shocks on the target variables. In fact, for symmetric shocks the strategic policy game equilibria with equal home bias are the same as in the no home bias case, see *Table 5.3* . In particular, symmetric demand shocks can be neutralized using only monetary policy. Hence, allowing for equal home bias in consumption does not affect the earlier conclusion that the type of restrictions on monetary and fiscal policy used in this paper does not affect the possibilities to successfully combat a general fall in EU aggregate demand by monetary policies alone.

The introduction of equal home bias in consumer preferences affects the Nash equilibria when the EU economies are hit by asymmetric shocks, even without costs for volatility in taxes and the nominal exchange rate. With home bias, Purchasing Power Parity no longer holds in the model, so the real interest rates are no longer necessarily equalized.[48] This introduces another mechanism for changing the relative aggregate demands, since differing real interest rates will affect private demand differently in the Euro area and in the block of outside countries. In the case of an asymmetric demand shock and no home bias, real interest rates did not deviate from their no-disturbance levels. With equal home bias the outside real interest rate falls, which stimulates outside aggregate demand, while the Euro real interest rate increases thereby reducing Euro aggregate demand.

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[45] The reduced form coefficients for employment and consumer prices in the home bias cases can be found in Appendix D.

[46] Recall that a steeper tradeoff is better for a central bank that emphasizes price stability, while a flatter tradeoff is better for a fiscal authority that gives priority to stable employment. As discussed by Ghironi and Givazzi (1997a), with a smaller share of imports the employment-inflation tradeoff for a central bank will be less favorable since the effect on CPI of a change in the exchange rate will be smaller.

[47] One can also note that while the relation between the degree of home bias and the employment-inflation tradeoff seems to be monotonous for the two central banks and the outside fiscal authority, this is not the case for the Euro fiscal authority.

[48] See footnote 33.

Table 5.3 Benchmark Nash equilibrium in monetary and fiscal policies flexible exchange rate regime, assuming equal home bias.

Type of shock	*Supply shock*		*Demand shock*	
	Symmetric	*Asymmetric*	*Symmetric*	*Asymmetric*
Euro money	0.2	0.319	1.5	0.192
Outs' money	0.2	-1.358	1.5	-0.577
Euro taxes	-1	0.865	0	0.321
Outs' taxes	-1	-0.596	0	-0.962
Nominal exchange rate	0	-0.359	0	0.855
Real exchange rate	0	-0.897	0	2.137
Euro real interest rate	-2	0.910	-2.5	0.214
Outs' real interest rate	-2	1.269	-2.5	-0.641
Euro producer prices	0	-0.135	0	0.321
Outs' producer prices	0	0.404	0	-0.962

How will the introduction of home bias affect the solution when there are costs related to volatility in the policy variables? Appendix E contains the results for the case of a symmetric supply shock and an asymmetric demand shock. In *Tables E.1* and *E.2*, assuming equal home bias, I vary the fiscal rigidity in the Euro and outside area, while the costs related to volatility in the outside/Euro nominal exchange rate are assumed to be high (compare *Table 4.4* and *Table 4.6*).

Since the employment-inflation tradeoffs for the outside authorities become relatively less favorable with the assumed home bias, one would expect that the outcome of the policy game would reflect that change. However, allowing for home bias will also affect the interaction between the fiscal authority relative to the central bank in each region. The total effect of introducing home bias will be a combination of these two forces.

In the case of a symmetric supply shock, allowing for home bias does not give any clear-cut results. The Euro CPI will be higher with equal home bias than in the no home bias case, while Euro unemployment will be lower (except when fiscal policies are flexible in both regions). Outside CPI will be lower and outside unemployment will be higher except in the case when fiscal policy is rigid in both the Euro area and in outside block.

In the case of an asymmetric demand shock the outcome for the outside authorities is dramatically worse. It is much more difficult for the outside central bank to stabilize consumer prices in the event of a shift in aggregate demand from outside to Euro goods. Outside unemployment is also considerably larger with home bias than in the no home bias case. As for Euro target variables, the EFA manages to stabilize employment better. The Euro CPI will on the other hand deviate more from its target value, except when fiscal policies are rigid in both the Euro area and in the outside block.

That the degree of home bias would be about the same in the Euro area as in the block of outside countries is not contradicted by the EU trade statistics, although the analysis of the trade data is definitely preliminary. In *Table 5.4* I look at the implications of a differing degree of home bias in the two regions.

Table 5.4 Benchmark Nash equilibrium in monetary and fiscal policies flexible exchange rate regime with differing degree of home bias $(\beta^E = 0.125, \beta^O = 0.525)$.

Type of shock	*Supply shock*		*Demand shock*	
	Symmetric	*Asymmetric*	*Symmetric*	*Asymmetric*
Euro money	0.159	0.267	1.541	0.276
Outs' money	0.300	-1.279	1.400	-0.668
Euro taxes	-1.040	0.871	0.040	0.268
Outs' taxes	-0.831	-0.459	-0.169	-1.126
Nominal exchange rate	-0.113	-0.360	0.113	0.751
Real exchange rate	-0.322	-1.030	0.322	2.145
Euro real interest rate	-1.998	1.006	-2.502	-0.013
Outs' real interest rate	-1.885	1.367	-2.615	-0.764
Euro producer prices	-0.040	-0.129	0.040	0.268
Outs' producer prices	0.169	0.541	-0.169	-1.126

One conclusion of the analysis above was that costs related to the volatility of the tax rates and the nominal exchange rate will not matter for the stabilization of employment and consumer prices when the EU countries are subjected to a symmetric demand shock. As can be seen from column four in *Table 5.4* , this conclusion is not robust to the change in the assumption on home bias. With differing degrees of home bias, tax rates are used to stabilize the EU economies, and not only monetary policy as in the equal degree (or no) home bias case. Introducing costs related to the activity of fiscal and monetary policy will therefore matter for the outcome.

In *Table 5.5* I look at the case when the outside central bank faces high costs related to the volatility in the nominal outside/Euro exchange rate. A general observation is that in the case of a symmetric demand shock, the monetary-fiscal policy game will improve the situation for all four policymakers compared to the impact effects of the shock.[49] This differs from what we saw earlier when analyzing the repercussions from the symmetric supply shock and the asymmetric demand shock. When aggregate demand falls in the EU countries, the monetary policy stance will be expansionary in order to reduce the fall in CPI and employment levels. In fact, the expansionary effect from the increase in Euro money supply is so strong that the employment in the Euro area actually increases – in spite of EFA trying to stabilize employment by increases in the tax rate. In the outside block, the negative aggregate demand shock will create unemployment. In the benchmark Nash equilibrium, see *Table 5.4* , the nominal and real outside/Euro exchange rate depreciated in order to stabilize employment and (consumer) prices when aggregate demand in the EU fell. When high volatility in the nominal outside/Euro exchange rate hurts the OCB, outside monetary policy is less expansionary and the nominal and real exchange rate depreciate less. Instead, the outside fiscal authority will more aggressively cut taxes in order to reduce unemployment. With a more rigid fiscal policy in the Euro area the Euro employment is less stabilized, but the outcome in the outside block is not much affected. If, however, the same degree of fiscal rigidity were imposed on the outside fiscal authority the outside unemployment problem would become much more severe.[50] Compared to the case with rigid Euro fiscal policy and flexible outside fiscal policy, the Euro authorities would better manage to stabilize both employment and prices (compare columns four and three in *Table 5.5*).

When the EU countries are hit by a common negative supply shock or demand is shifted from the outside good to the Euro good, the simulations discussed above showed that the Euro target variables were marginally better stabilized when the OCB was subjected to costs related to the volatility in the nominal exchange rate. These results imply that it might be to the advantage of the Euro authorities if the outside currencies were linked to the Euro in an ERM2-arrangement, but that the gain for the Euro area would not be very important. In the event of a symmetric demand shock, whether the Euro target variables would be more stable or less stable with outside monetary policy thus constrained, depends on the degree of rigidity of outside fiscal policy. When outside fiscal policy is flexible, the Euro target variables are actually less stabilized when OCB faces higher costs from a volatile nominal exchange rate.[51] When both Euro and outside fiscal policy are rigid, the Euro target variables are better stabilized when the volatility of the nominal outside/Euro exchange rate is important in the OCB loss function. Again, with the present choice of parameter values, these effects are rather small.

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[49] The introduction of home bias changes the reduced form coefficients and hence also the impact effects of the shocks. In the differing home bias case, the symmetric demand chock will on impact reduce Euro employment by 1.06% and outside employment by 1.09%, while Euro CPI will fall by 0.37% and outside CPI by 0.34%.

[50] On the other hand, outside CPI will be better stabilized since outside taxes are less deflationary.

[51] See *Table E.3* in Appendix E. The simulated effects are rather small. For instance, when fiscal policies are flexible and the exchange rate volatility cost is low, the Euro CPI falls by 0.0052. With high exchange rate volatility costs, the Euro CPI falls by 0.0053.

Table 5.5 Symmetric negative demand shock. Differing degree of home bias $(\beta^E = 0.125, \beta^O = 0.525)$. High costs for exchange rate volatility $(\chi^O = 4)$. Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* $(\vartheta^E = \vartheta^O = 0.25)$	*Rigid Euro fiscal policy Outs' fiscal policy flexible* $(\vartheta^E = 4, \vartheta^O = 0.25)$	*Rigid fiscal policies* $(\vartheta^E = \vartheta^O = 4)$
Euro money	1.570	1.595	1.516
Outs' money	1.261	1.292	1.268
Euro taxes	0.021	0.003	0.002
Outs' taxes	-0.193	-0.183	-0.030
Nominal exchange rate	0.015	0.015	0.011
Real exchange rate	0.265	0.244	0.118
Euro real interest rate	-2.555	-2.592	-2.494
Outs' real interest rate	-2.647	-2.677	-2.535
Euro producer prices	0.028	0.018	0.009
Outs' producer prices	-0.221	-0.211	-0.100
Euro CPI	-0.005	-0.012	-0.006
Outs' CPI	-0.083	-0.083	-0.036
Euro employment	0.019	0.044	0.021
Outs' employment	-0.085	-0.081	-0.202

To sum up; allowing for home bias in consumption does not much affect the previous results in the case of a common supply shock, but the outside target variables will fluctuate more in the case of an asymmetric demand shock. Taking home bias into account will be most important in the case of a symmetric demand shock. Costs related to the activity of fiscal and monetary policy will now matter for the outcome of the monetary-fiscal policy game. Given that Euro fiscal policy is rigid, the Euro target variables will be better stabilized if outside fiscal policy is rigid as well. In the case of rigid fiscal policies in the EU, the Euro authorities would also benefit if outside monetary policy had a tight constraint (high costs) related to the volatility in the nominal outside/Euro exchange rate. However, if outside fiscal policy is flexible compared to the fiscal policy in the Euro area, the Euro target variables will be less well stabilized if outside monetary policy has a tight constraint related to the volatility in the nominal outside/Euro exchange rate.

6 Concluding remarks

Needless to say, the results presented in the paper are specific to the assumptions of the underlying macromodel. In particular, the macromodel has non-Keynesian features in that budget-balanced expenditure/tax rate increases are contractionary. As discussed by Eichengreen and Ghironi (1997), this might be a reasonable assumption for some of the outside countries, but not necessarily for the Euro area. Reasonable modifications of some parameter values would make budget-balanced Euro tax increases expansionary. However, the objective of this paper is not so much to give a definite answer to the question of what the Stability Pact and the participation in ERM2 imply for the policy mix in EU, but to expose some mechanisms that may be relevant for the issue.

The Stability Pact and the Maastricht criteria restrict the size of government budget deficits (and debts) rather than limiting fiscal activity as such. A starting point for the analysis has been that these constraints on the possibilities to run deficits can be meaningfully approximated by utility losses related to the volatility of (budget-balanced) tax rates, in that the governments' willingness to use fiscal policy in order to stabilize employment (and consumer prices) is reduced. I have also assumed that outside monetary policy can be subject to "costs" related to the volatility of the nominal exchange rate, as an approximation to the restraining effects of the fluctuation bands in ERM2, or the Maastricht convergence criterion on stable nominal exchange rates. My defense for these simple (not to say simplistic) assumptions is that they enable me to set up and analyze a model of strategic interaction between the fiscal and monetary policymakers in the Euro area and in outside block of countries. With this model I study in some detail the stabilization games following a common (negative) supply shock, an asymmetric demand shock shifting aggregate demand from the outside good to the Euro good and a common (negative) aggregate demand shock.

In the benchmark case – without costs (or constraints) related to the volatility of the nominal exchange rate or the tax rates - the policymakers succeed in completely eliminating the effects of the various shocks on the target variables employment and inflation. The effects of imposing these costs will depend on the type of shock considered.

When the EU countries are hit by a common (negative) supply shock the interaction between the four policymakers will magnify the employment losses but consumer prices will be stabilized. If Euro fiscal policy becomes more rigid – approximating the case where the Stability Pact will reduce the flexibility in Euro fiscal policy, but will not affect the flexibility in outside fiscal policymaking – the Euro unemployment problem will become dramatically worse. When Euro fiscal policy contributes less to stabilize consumer prices, the ECB will tighten monetary policy. Negative externalities in monetary policy will lead to drastic cuts in both Euro and outside money supply. In order to reduce the negative impact from the tighter monetary conditions on outside employment, the outside government will reduce the tax rate further, which will have a negative effect on Euro employment. One might think that limiting the flexibility of outside fiscal policy would ameliorate the employment situation in the Euro area. However, this is not the case in the present model. With rigid outside fiscal policy the OCB will compensate with even tighter monetary policy to keep outside inflation down, which in turn will induce the ECB to further reduce the Euro money supply. This will result in heavy employment losses in both areas, and consumer prices will be higher.

In the event of an asymmetric demand shock shifting aggregate demand from the outside good to the Euro good, the interaction between the four policymakers will stabilize CPI in both areas, but the overemployment problem in the Euro area will be amplified. When outside fiscal policy is flexible, tax cuts can be used to reduce the negative impact effect on outside employment. With rigid fiscal policy in both the Euro area and the outside area the outside unemployment problem will be aggravated by the monetary-fiscal stabilization game. In contrast to the symmetric supply shock case, the Euro authorities will benefit from increased fiscal rigidity in the outside area, since this will lead to better stabilization of both Euro employment and CPI.

When consumer preferences are such that the import share equals the relative size of the partner region, the optimal stabilization of a common (negative) aggregate demand shock will be a symmetric expansion of the money supplies and fiscal policy will be completely inactive. This holds in the present model whether or not any costs related to the volatility in tax rates or the nominal outside/Euro exchange rate are imposed. This conclusion continues to hold when equal home bias is introduced, but it does not hold in the presence of differing home bias. In the paper I assume that the degree of home bias is larger in the Euro area. In this case, and differently from the two earlier cases, the monetary-fiscal policy game will stabilize CPI and employment in both regions. Furthermore, the Euro authorities gain from increasing outside fiscal rigidity.

The exercises presented in the paper point to the importance of taking into account the interaction between the different policymakers when imposing restrictions on a subset of these policymakers. One example of this is the case with a common negative supply shock. When the fiscal policy of the Euro government (or both governments) is restricted, the negative externalities in monetary policy will bring about a very poor equilibrium, with both high unemployment and high inflation. The general message is that modifications of the fiscal policy framework should not be undertaken isolated from the monetary policy framework. For instance, from the point of view of stabilization policy one can argue that the constraints on fiscal policy contained in the Stability and Growth Pact ought to influence how much weight the ECB is to put on price stability versus employment stabilization.

A natural subject for future research is to modify the assumptions of the macromodel to allow an analysis of the Keynesian regime of fiscal policymaking. A more challenging task would be to better represent the specifics of the Stability Pact, in particular, recognizing that the Stability Pact limits budget deficits rather than budget-balanced changes in the tax rates.

Appendix A: Aggregate supply

Competitive firms produce output according to the production function

(A.1) $y_t^i = \gamma n_t^i - x_t^i$ for $i = E, O$

where (y_t^E, y_t^O) are the production levels in the Euro and outside areas, (n_t^E, n_t^O) are the employment levels, γ is the elasticity of output w.r.t. employment and (x_t^E, x_t^O) are productivity disturbances, identically and independently distributed with zero mean.

The labor demand of firms are derived from the (static) optimization problem[1, 2]

(A.2) $\max_{N_t^i} \left(1-\tau_t^i\right) P_t^i Y_t^i - W_t^i N_t^i$ for $i = E, O$

(A.3) s.t. $Y_t^i = (N_t^i)^\gamma / X_t^i$.

(W_t^E, W_t^O) are the nominal wage levels in the Euro and outside areas, (P_t^E, P_t^O) are the producer prices and (τ_t^E, τ_t^O) are the tax rates on the firms' total revenue.

The first-order condition is

(A.4) $(1-\tau_t^i)\gamma P_t^i (N_t^i)^{\gamma-1} / X_t^i = W_t^i$.

Taking logs, using the approximation $\log(1-\tau) = -\tau$ and omitting the constant $\log\gamma$, the FOC can be written

(A.5) $w_t^i - p_t^i = (\gamma-1)n_t^i - \tau_t^i - x_t^i$ for $i = E, O$.

Using (A.5) in (A.1) leads to the aggregate supply function

(A.6) $y_t^i = \dfrac{\gamma}{1-\gamma}(p_t^i - w_t^i - \tau_t^i) - \dfrac{1}{1-\gamma} x_t^i$ for $i = E, O$.

Nominal wages are predetermined. One period ahead, nominal wages are set in order to minimize the expected deviation in employment from the steady-state level of employment.[3]

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[1] The usual reference on this way of introducing distortionary taxation is Alesina and Tabellini (1987).
[2] Upper-case letters denote anti-logs.
[3] This follows Canzoneri and Henderson (1991).

That is, the wage setters are aware of the firms optimizing behavior, and the rest of the model, when they minimize

(A.7) $$\frac{1}{2}E_{t-1}\left[\left(n_t^i\right)^2\right] \qquad i = E, O.$$

The first-order condition is therefore

(A.8) $$\frac{1}{\gamma-1}E_{t-1}\left[w_t^i - p_t^i + \tau_t^i + x_t^i\right] = 0 \qquad i = E, O$$

which can be solved to give

(A.9) $$w_t^i = E_{t-1}\left[p_t^i - \tau_t^i\right] \qquad i = E, O.$$

Appendix B : Equilibrium conditions for the goods markets

The equilibrium conditions for the goods markets in the two countries are

(B.1) $$Y_t^i = D_t^i + GD_t^i + X_t^i + F_t^i \qquad \text{for } i = E, O$$

where variables in capital letters are in levels, expressed in units of respective good, and

Y_t^i domestic production in country *i*
D_t^i domestic private demand for domestic production in country *i*
GD_t^i domestic government demand for domestic production in country *i*
X_t^i foreign private demand (in country *j*) for the good produced in country *i*
F_t^i foreign government demand (in country *j*) for the good produced in country *i*

In the zero-shock equilibrium, (B.1) becomes

(B.2) $$\overline{Y}_t^i = \overline{D}_t^i + \overline{GD}_t^i + \overline{X}_t^i + \overline{F}_t^i \qquad \text{for } i = E, O$$

where the overbars designate zero-shock equilibrium values.

In zero-shock equilibrium, with output in the two areas measured in common currency, the relative size of the Euro area is measured by the parameter a. Let S_t^O be the outside/Euro nominal exchange rate (units of outside currency per Euro), and let the outside/Euro terms-of-trade be defined as

(B.3) $$Z_t^O = S_t^O P_t^E / P_t^O \ .$$

Expressed in units of outside goods, the Euro area production level is then $Z_t^O Y_t^E$. The share of the Euro area in total EU production in zero-shock equilibrium is defined from

(B.4) $$\overline{Z}_t^O \overline{Y}_t^E = a\left(\overline{Y}_t^O + \overline{Z}_t^O \overline{Y}_t^E\right).$$

Next, the equilibrium condition (B.1) is log-linearized around the zero-shock equilibrium (B.2). This is done as follows. First, simply rewrite (B.1) as

(B.5) $$Y_t^i = \exp\left[d_t^i\right] + \exp\left[gd_t^i\right] + \exp\left[x_t^i\right] + \exp\left[f_t^i\right] \qquad \text{for } i = E, O$$

where $d_t^i = \log D_t^i$ etc. Then make a Taylor expansion round zero-shock equilibrium, (B.6) $$Y_t^i = \overline{Y}_t^i + \overline{D}_t^i \hat{d}_t^i + \overline{GD}_t^i \widehat{gd}_t^i + \overline{X}_t^i \hat{x}_t^i + \overline{F}_t^i \hat{f}_t^i \qquad \text{for } i = E, O$$

where $\hat{d}_t^i = d_t^i - \overline{d}_t^i = \log(D_t^i / \overline{D}_t^i)$ etc. Define the zero-shock equilibrium shares of domestic and foreign demand of domestic production as $\mu_D^i = \overline{D}_t^i / \overline{Y}_t^i$, $\mu_G^i = \overline{GD}_t^i / \overline{Y}_t^i$, $\mu_X^i = \overline{X}_t^i / \overline{Y}_t^i$ and $\mu_F^i = \overline{F}_t^i / \overline{Y}_t^i$. (B.6) can then be further approximated by

(B.7) $$\hat{y}_t^i = \mu_D^i \hat{d}_t^i + \mu_G^i \widehat{gd}_t^i + \mu_X^i \hat{x}_t^i + \mu_F^i \hat{f}_t^i \qquad \text{for } i = E, O.$$

The zero-shock equilibrium shares are related to structural characteristics of the economies as follows.

Preferences are assumed to be such that the share of imports in total aggregate consumption expenditure is a function of the terms-of-trade, i.e. domestic private demand for the domestic good is given by[4]

(B.8) $$D_t^i = \left(1 - \beta^i (Z_t)\right) C_t^i \qquad \text{for } i = E, O$$

where C_t^i is total consumption expenditure measured in units of the domestic good, i.e.

(B.9) $$C_t^i = H_t^i / P_t^i \qquad \text{for } i = E, O$$

and H_t^i is defined in (C.2) . As shown in Appendix C, when the intratemporal utility function is CES, the share of imports in consumption expenditure in the outside area, as a function of the outside/Euro terms-of-trade, is given by

(B.10) $$\beta^O (Z_t^O) = (1 - \omega^O)\left[1 - \omega^O + \omega^O (Z_t^O)^{\theta - 1}\right]^{-1}$$

where θ is the elasticity of substitution between outside and Euro goods, and ω^O is a parameter in the utility function. In the case that $\theta = 1$, the consumer preferences are of the Cobb-Douglas type, so the expenditure on imports will be a fixed share, $1 - \omega^O$, of total consumption expenditure.

The share of imports in the Euro area is analogously given by

(B.11) $$\beta \; (Z_t^O) = (1 - \omega \;)\left[1 - \omega \; + \omega \; (Z_t^O)^{1 - \theta}\right]^{-1}.$$

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[4] See Appendix C.

In steady state, assuming that domestic consumers own all domestic firms, total private consumption equals total disposable income, i.e.

$$\text{(B.12)} \qquad \overline{C}^{i} = (1-\overline{\tau}^{i})\overline{Y}^{i} \qquad \text{for } i = E, O$$

where τ^{i} is the tax rate on total output. Then, using equations (B.8), (B.9), (B.12), (B.3) and (B.4), the steady state shares in domestic output of domestic private consumption expenditure on domestic goods and exports are found to be

$$\text{(B.13)} \qquad \mu_{D}^{i} = \left(1-\overline{\beta}^{i}\right)\left(1-\overline{\tau}^{i}\right) \qquad \text{for } i = E, O,$$

$$\text{(B.14)} \qquad \mu_{X}^{O} = \frac{a}{1-a}\left(1-\overline{\tau}^{E}\right)\overline{\beta}^{E}$$

and

$$\text{(B.15)} \qquad \mu_{X}^{E} = \frac{1-a}{a}\left(1-\overline{\tau}^{O}\right)\overline{\beta}^{O}.$$

For the government steady state expenditure share, it is assumed that the budget is balanced, and that a proportion equal to the private sector import share, $\overline{\beta}^{i}$, is devoted to imported goods. These assumptions imply

$$\text{(B.16)} \qquad \mu_{G}^{i} = \left(1-\overline{\beta}^{i}\right)\overline{\tau}^{i} \qquad \text{for } i = E, O,$$

$$\text{(B.17)} \qquad \mu_{F}^{O} = \frac{a}{1-a}\overline{\tau}^{E}\overline{\beta}^{E}$$

and

$$\text{(B.18)} \qquad \mu_{F}^{E} = \frac{1-a}{a}\overline{\tau}^{O}\overline{\beta}^{O}.$$

Next, the expressions for $\hat{d}_{t}^{i}$. Using (B.6) and (B.12)

$$\text{(B.19)} \quad \hat{d}_{t}^{i} = \log\left(D_{t}^{i}/\overline{D}^{i}\right) = \log\left(\frac{\left[1-\beta^{i}(Z_{t}^{O})\right]C_{t}^{i}}{\left[1-\overline{\beta}^{i}\right]\overline{Y}^{i}}\right) = \log\left(\frac{\left[1-\beta^{i}(Z_{t}^{O})\right]}{\left[1-\overline{\beta}^{i}\right]}\right) + \hat{c}_{t}^{i} \quad \text{for } i = E, O.$$

The sensitivity of private domestic demand for domestic goods to movements in the terms-of-trade depends on the function β^i. In the CES case, the logarithmic term in the extreme RHS of (B.19) can be expanded around the steady state as follows. For the outside area,

(B.20)
$$\log\left(\frac{1-\beta^O(Z_t^O)}{1-\overline{\beta}^O}\right)=\left(\frac{-1}{1-\overline{\beta}^O}\right)\left[\frac{d\beta^O}{dZ_t^O}\bigg|_{Z_t^O=\overline{Z}^O}\right]\left(Z_t^O-\overline{Z}^O\right)=$$
$$\left(\frac{-(\overline{\beta}^O)^2}{1-\overline{\beta}^O}\right)\left(\frac{\omega^O}{1-\omega^O}\right)\left[(1-\theta)(\overline{Z}^O)^{\theta-2}\right]\left(Z_t^O-\overline{Z}^O\right)=(\theta-1)\overline{\beta}^O\hat{z}_t^O$$

where the last equality in (B.20) follows from (B.10), i.e. a simple manipulation shows that

(B.21) $$\frac{\omega^O}{1-\omega^O}\overline{\beta}^O(\overline{Z}^O)^{\theta-1}=1-\overline{\beta}^O\ .$$

For the Euro area

(B.22)
$$\log\left(\frac{1-\beta^E(Z_t^O)}{1-\overline{\beta}^E}\right)=\left(\frac{-1}{1-\overline{\beta}^E}\right)\left[\frac{d\beta^E}{dZ_t^O}\bigg|_{Z_t^O=\overline{Z}^O}\right]\left(Z_t^O-\overline{Z}^O\right)=$$
$$\left(\frac{-(\overline{\beta}^E)^2}{1-\overline{\beta}^E}\right)\left(\frac{\omega^E}{1-\omega^E}\right)\left[(\theta-1)(\overline{Z}^O)^{-\theta}\right]\left(Z_t^O-\overline{Z}^O\right)=(1-\theta)\overline{\beta}^E\hat{z}_t^O$$

Inserting (B.20) and (B.22) into the relevant version of (B.19) gives

(B.23) $$\hat{d}_t^O=(\theta-1)\overline{\beta}^O\hat{z}_t^O+\hat{c}_t^O$$

and

(B.24) $$\hat{d}_t^E=-(\theta-1)\overline{\beta}^E\hat{z}_t^O+\hat{c}_t^E\quad .$$

Demand for exports from the outside area is given by

(B.25)
$$\hat{x}_t^O=\log\left(X_t^O/\overline{X}^O\right)=\log\left(\frac{Z_t^O M_t^E}{\overline{Z}^O\overline{M}^E}\right)=\log\left(\frac{Z_t^O\beta^E(Z_t^O)C_t^E}{\overline{Z}^O\overline{\beta}^E\overline{Y}^E}\right)=$$
$$\hat{z}_t^O+\log\left(\frac{\beta^E(Z_t^O)}{\overline{\beta}^E}\right)+\hat{c}_t^E$$

As above, in the CES case the logarithmic term in the extreme RHS of (B.25) can be expanded around the steady state,

(B.26) $$\log\left(\frac{\beta^{E}(Z_t^{O})}{\overline{\beta}^{E}}\right) = (\theta - 1)(1 - \overline{\beta}^{E})\hat{z}_t^{O}$$

so (B.25) can be written

(B.27) $$\hat{x}_t^{O} = \hat{z}_t^{O}\left[1 + (\theta - 1)(1 - \overline{\beta}^{E})\right] + \hat{c}_t^{E} \quad .$$

Similarly, for exports from the Euro area

(B.28) $$\hat{x}_t^{E} = -\hat{z}_t^{O}\left[1 + (\theta - 1)(1 - \overline{\beta}^{O})\right] + \hat{c}_t^{O} \quad .$$

It is assumed that (the deviation from zero-shock equilibrium values of) the total consumption expenditure measured in units of the domestic good depends on disposable income, y^{Di} and the real interest rate, i.e.

(B.29) $$\hat{c}^{i} = \varepsilon \hat{y}^{Di} - \nu \tilde{r}^{i} \qquad \text{for } i = E, O$$

where a tilde indicates deviation from zero-shock equilibrium value.

The change in disposable income in turn is determined by the (percentage) change in total output and by the change in the aggregate tax rate, according to

(B.30) $$\hat{y}_t^{Di} = \hat{y}_t^{i} - \frac{\tilde{\tau}_t^{i}}{1 - \overline{\tau}^{i}} \qquad \text{for } i = E, O.$$

Each government is restricted to follow balanced-budget policies, and it is furthermore assumed that the composition of goods demanded by each government is constant. Then

(B.31) $$\widehat{gd}_t^{i} = \log\left(\frac{(1 - \overline{\beta}^{i})G_t^{i}}{(1 - \overline{\beta}^{i})\overline{G}_t^{i}}\right) = \log\left(\frac{G_t^{i}}{\overline{G}_t^{i}}\right) = \hat{g}_t^{i} \qquad \text{for } i = E, O,$$

(B.32) $$\hat{f}_t = \log\left(\frac{F_t}{\overline{F}}\right) = \log\left(\frac{Z_t \; \overline{\beta} \; G_t}{\overline{Z} \; \overline{\beta} \; \overline{G}_t}\right) = \hat{z}_t + \hat{g}_t$$

and

(B.33) $$\hat{f}_t^E = \log\left(\frac{F_t^E}{\overline{F}^E}\right) = \log\left(\frac{\overline{\beta}^O G_t^O / Z_t^O}{\overline{\beta}^O \overline{G}_t^O / \overline{Z}^O}\right) = -\hat{z}_t^O + \hat{g}_t^O \quad .$$

Finally, putting all the pieces together, i.e. inserting (B.13)-(B.18), (B.23), (B.24) and (B.27)-(B.32) into(B.7),

(B.34)
$$\hat{y}_t^O = \left(1-\overline{\beta}^O\right)\left(1-\overline{\tau}^O\right)\left[(\theta-1)\overline{\beta}^O \hat{z}_t^O + \varepsilon\left(\hat{y}_t^O - \frac{\tilde{\tau}^O}{1-\overline{\tau}^O}\right) - \nu\tilde{r}\right] + \left(1-\overline{\beta}^O\right)\overline{\tau}^O \hat{g}_t^O$$
$$+ \frac{a}{1-a}\overline{\beta}^E\left(1-\overline{\tau}^E\right)\left\{\hat{z}_t^O\left[1+(\theta-1)\left(1-\overline{\beta}^E\right)\right] + \varepsilon\left(\hat{y}_t^E - \frac{\tilde{\tau}^E}{1-\overline{\tau}^E}\right) - \nu\tilde{r}_t^E\right\} + \frac{a}{1-a}\overline{\beta}^E\overline{\tau}^E\left(\hat{z}_t^O + \hat{g}_t^E\right)$$

Collecting terms,

(B.35)
$$\hat{y}_t^O = \left[\overline{\beta}^O\left(1-\overline{\tau}^O\right)(\theta-1)\left(1-\overline{\beta}^O\right) + \frac{a}{1-a}\left[\overline{\beta}^E\left(1-\overline{\tau}^E\right)\left(1+(\theta-1)(1-\overline{\beta}^E)\right) + \overline{\beta}^E\overline{\tau}^E\right]\right]\hat{z}_t^O$$
$$+\varepsilon\left[\left(1-\overline{\beta}^O\right)\left(1-\overline{\tau}^O\right)\hat{y}_t^O + \frac{a}{1-a}\overline{\beta}^E\left(1-\overline{\tau}^E\right)\hat{y}_t^E\right] - \nu\left[\left(1-\overline{\beta}^O\right)\left(1-\overline{\tau}^O\right)\tilde{r}_t^O + \frac{a}{1-a}\overline{\beta}^E\left(1-\overline{\tau}^E\right)\tilde{r}_t^E\right]$$
$$+\left(1-\overline{\beta}^O\right)\tilde{g}_t^O - \varepsilon\left(1-\overline{\beta}^O\right)\tilde{\tau}_t^O + \frac{a}{1-a}\overline{\beta}^E\tilde{g}_t^E - \varepsilon\frac{a}{1-a}\overline{\beta}^E\tilde{\tau}_t^E$$

For the Euro area,

(B.36)
$$\hat{y}_t^E = \left(1-\overline{\beta}^E\right)\left(1-\overline{\tau}^E\right)\left[-(\theta-1)\overline{\beta}^E\hat{z}_t^O + \varepsilon\left(\hat{y}_t^E - \frac{\tilde{\tau}_t^E}{1-\overline{\tau}^E}\right) - \nu\tilde{r}_t^E\right] + \left(1-\overline{\beta}^E\right)\overline{\tau}^E\hat{g}_t^E$$
$$+ \frac{1-a}{a}\overline{\beta}^O\left(1-\overline{\tau}^O\right)\left\{-\hat{z}_t^O\left[1+(\theta-1)\left(1-\overline{\beta}^O\right)\right] + \varepsilon\left(\hat{y}_t^O - \frac{\tilde{\tau}_t^O}{1-\overline{\tau}^O}\right) - \nu\tilde{r}_t^O\right\} + \frac{1-a}{a}\overline{\beta}^O\overline{\tau}^O\left(-\hat{z}_t^O + \hat{g}_t^O\right)$$

Collecting terms,

(B.37)

$$\hat{y}_t^E = \left[-(1-\overline{\beta}^E)(1-\overline{\tau}^E)(\theta-1)\overline{\beta}^E - \frac{1-a}{a}\left(\overline{\beta}^O(1-\overline{\tau}^O)\left[1+(\theta-1)(1-\overline{\beta}^O)\right] + \overline{\beta}^O\overline{\tau}^O\right)\right]\hat{z}_t^O$$
$$+\varepsilon\left[(1-\overline{\beta}^E)(1-\overline{\tau}^E)\hat{y}_t^E + \frac{1-a}{a}\overline{\beta}^O(1-\overline{\tau}^O)\hat{y}_t^O\right] - \nu\left[(1-\overline{\beta}^E)(1-\overline{\tau}^E)\tilde{r}_t^E + \frac{1-a}{a}\overline{\beta}^O(1-\overline{\tau}^O)\tilde{r}_t^O\right]$$
$$+(1-\overline{\beta}^E)\tilde{g}_t^E - \varepsilon(1-\overline{\beta}^E)\tilde{\tau}_t^E + \frac{1-a}{a}\overline{\beta}^O\tilde{g}_t^O - \varepsilon\frac{1-a}{a}\overline{\beta}^O\tilde{\tau}_t^O$$

Assuming that that the (steady state) tax (and government expenditure) rates are the same in the two regions,

(B.38) $$\overline{\tau}^O = \overline{\tau}^E = \overline{\tau}$$

and defining

(B.39) $$\Delta = (1-\overline{\tau})(\theta-1)\left((1-\overline{\beta}^O)\frac{\overline{\beta}^O}{a} + (1-\overline{\beta}^E)\frac{\overline{\beta}^E}{1-a}\right)$$

the equations (B.35) and (B.37) can be written

(B.40)
$$\hat{y}_t^O = \left[a\Delta + \frac{a}{1-a}\overline{\beta}^E\right]\hat{z}_t^O + (1-\overline{\tau})\varepsilon\left[(1-\overline{\beta}^O)\hat{y}_t^O + \frac{a}{1-a}\overline{\beta}^E\hat{y}_t^E\right]$$
$$-(1-\overline{\tau})\nu\left[(1-\overline{\beta}^O)\tilde{r}_t^O + \frac{a}{1-a}\overline{\beta}^E\tilde{r}_t^E\right] + (1-\overline{\beta}^O)\tilde{g}_t^O - \varepsilon(1-\overline{\beta}^O)\tilde{\tau}_t^O$$
$$+\frac{a}{1-a}\overline{\beta}^E\tilde{g}_t^E - \varepsilon\frac{a}{1-a}\overline{\beta}^E\tilde{\tau}_t^E$$

(B.41)
$$\hat{y}_t^E = \left[-(1-a)\Delta - \frac{1-a}{a}\overline{\beta}^O\right]\hat{z}_t^O + (1-\overline{\tau})\varepsilon\left[(1-\overline{\beta}^E)\hat{y}_t^E + \frac{1-a}{a}\overline{\beta}^O\hat{y}_t^O\right]$$
$$-(1-\overline{\tau})\nu\left[(1-\overline{\beta}^E)\tilde{r}_t^E + \frac{1-a}{a}\overline{\beta}^O\tilde{r}_t^O\right] + (1-\overline{\beta}^E)\tilde{g}_t^E - \varepsilon(1-\overline{\beta}^E)\tilde{\tau}_t^E$$
$$+\frac{1-a}{a}\overline{\beta}^O\tilde{g}_t^O - \varepsilon\frac{1-a}{a}\overline{\beta}^O\tilde{\tau}_t^O$$

The respective elasticity w.r.t. the terms-of-trade can be written,

(B.42) $$a\Delta^O = a\left(\Delta + \frac{\overline{\beta}^E}{1-a}\right)$$

for the outside area and

(B.43) $$-(1-a)\Delta^{E} = -(1-a)\left(\Delta + \frac{\overline{\beta}^{O}}{a}\right)$$

for the Euro area.

In the main text, it is assumed that governments follow balanced budget rules, i.e. $\tilde{g}_t^i = \tilde{\tau}_t^i$. Using this assumption and replacing from (B.42-43), equations (B.40-41) can be written,

(B.44) $$\begin{aligned}\hat{y}_t^O &= a\Delta^O \hat{z}_t^O + (1-\overline{\tau})\varepsilon\left[\left(1-\overline{\beta}^O\right)\hat{y}_t^O + \frac{a}{1-a}\overline{\beta}^E \hat{y}_t^E\right] \\ &- (1-\overline{\tau})\nu\left[\left(1-\overline{\beta}^O\right)\tilde{r}_t^O + \frac{a}{1-a}\overline{\beta}^E \tilde{r}_t^E\right] + \left(1-\overline{\beta}^O\right)(1-\varepsilon)\tilde{\tau}_t^O + \frac{a}{1-a}\overline{\beta}^E(1-\varepsilon)\tilde{\tau}_t^E\end{aligned}$$

and

(B.45) $$\begin{aligned}\hat{y}_t^E &= -(1-a)\Delta^E \hat{z}_t^O + (1-\overline{\tau})\varepsilon\left[\left(1-\overline{\beta}^E\right)\hat{y}_t^E + \frac{1-a}{a}\overline{\beta}^O \hat{y}_t^O\right] \\ &- (1-\overline{\tau})\nu\left[\left(1-\overline{\beta}^E\right)\tilde{r}_t^E + \frac{1-a}{a}\overline{\beta}^O \tilde{r}_t^O\right] + \left(1-\overline{\beta}^E\right)(1-\varepsilon)\tilde{\tau}_t^E + \frac{1-a}{a}\overline{\beta}^O(1-\varepsilon)\tilde{\tau}_t^O\end{aligned}$$

Ghironi-Giavazzi(1997a,b) make assumptions amounting to the steady state import share in the outside area equaling the share of the Euro area in total (EU) production (i.e. $\overline{\beta}^O = a$) and the import share in the Euro area equaling the share of the outside area in total (EU) production (i.e. $\overline{\beta}^E = 1-a$).[5]

Using these assumptions in equation (B.39) leads to

(B.46) $$\Delta = (1-\overline{\tau})(\theta - 1).$$

The output elasticity w.r.t. to the terms-of-trade in the outside area becomes, from (B.42)

(B.47) $$a\Delta^O = a(1+\Delta) = a\delta$$

[5] In the present 2-good CES setup this would hold if consumers in the two areas have identical Cobb-Douglas preferences leading to a share equal to a of income being spent on Euro goods. This requires $\omega^O = 1-a$ and $\omega^E = a$, see equations (B.10) and (B.11).

and for the Euro area , from (B.43),

(B.48) $$-(1-a)\Delta^{E} = -(1-a)(1+\Delta) = -(1-a)\delta \,.$$

Inserting these results into equations (B.40-41), and using the assumptions $\overline{\beta} = a$ and $\overline{\beta}^{E} = 1-a$, gives the following log-linearized approximations to the goods market equilibria

(B.49) $$\hat{y}_t^O = a\delta\tilde{z}_t^O + (1-\overline{\tau})\varepsilon\left[(1-a)\hat{y}_t^O + a\hat{y}_t^E\right] - (1-\overline{\tau})\nu\left[(1-a)\tilde{r}_t^O + a\tilde{r}_t^E\right] + (1-a)(\tilde{g}_t^O - \varepsilon\tilde{\tau}_t^O) + a(\tilde{g}_t^E - \varepsilon\tilde{\tau}_t^E)$$

(B.50) $$\hat{y}_t^E = -(1-a)\delta\tilde{z}_t^O + (1-\overline{\tau})\varepsilon\left[a\hat{y}_t^E + (1-a)\hat{y}_t^O\right] - (1-\overline{\tau})\nu\left[a\tilde{r}_t^E + (1-a)\tilde{r}_t^O\right] + a(\tilde{g}_t^E - \varepsilon\tilde{\tau}_t^E) + (1-a)(\tilde{g}_t^O - \varepsilon\tilde{\tau}_t^O)$$

Equations (B.49) and (B.50) should correspond to the goods markets equilibrium conditions used by Ghironi-Giavazzi (1997a,b). There are some differences, though. Ghironi-Giavazzi (i) do not include the terms in the tax rates, i.e. the terms of the form $-\varepsilon a\tilde{\tau}_t^i$ and $-\varepsilon(1-a)\tilde{\tau}_t^i$, (ii) includes the (after-) tax factor $(1-\overline{\tau})$ in the income elasticity of aggregate demand. Furthermore, if the assumption of Cobb-Douglas preferences is strictly applied, the common real exchange rate elasticity parameter δ would be equal to unity. With a Cobb-Douglas utility function the intratemporal elasticity of substitution equals unity, i.e $\theta = 1$, so (B.46) actually simplifies to

(B.46)’ $$\Delta = 0$$

in the Cobb-Douglas case.

In the main text of the paper I do not take full account of the implications of the 2-goods CES set-up. Instead, I adopt the less restricted macromodel that is commonly used in the literature with the modifications implied by the asymmetry regarding the sizes of the two regions.

Appendix C : Private consumption demand

Instead of assuming intertemporal optimisation of consumption, in the macromodel (and in appendix B) I adopt an *ad hoc* consumption function, according to which total consumption expenditure depends on disposable income and the real interest rate

Given a level of aggregate consumption expenditure H_t the consumers solve the intratemporal optimisation problem

(C.1) $$\max_{C_t^h, C_t^f} \quad V(C_t^h, C_t^f) = \left[\gamma^{\frac{1}{\theta}} (C_t^h)^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} (C_t^f)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}$$

subject to

(C.2) $$P_t^h C_t^h + S_t P_t^f C_t^f = Q_t V_t = H_t$$

where the nominal exchange rate S_t is measured as units of domestic currency per unit of foreign currency. The intratemporal elasticity of substitution is $\theta\ (>0)$. The (ideal) consumer price index Q_t will be derived below.

The first-order condition for this problem is

(C.3) $$\frac{\gamma^{\frac{1}{\theta}} (C_t^h)^{-\frac{1}{\theta}}}{P_t^h} = \frac{(1-\gamma)^{\frac{1}{\theta}} (C_t^f)^{-\frac{1}{\theta}}}{S_t P_t^f}.$$

Multiplying numerator and denominator on the left hand side by C_t^h and on the right hand side by C_t^f, and using (C.2) leads to

(C.4) $$\frac{\gamma^{\frac{1}{\theta}} (C_t^h)^{1-\frac{1}{\theta}}}{P_t^h C_t^h} = \frac{(1-\gamma)^{\frac{1}{\theta}} (C_t^f)^{1-\frac{1}{\theta}}}{S_t P_t^f C_t^f} = \frac{\gamma^{\frac{1}{\theta}} (C_t^h)^{1-\frac{1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} (C_t^f)^{1-\frac{1}{\theta}}}{P_t^h C_t^h + S_t P_t^f C_t^f} = \frac{V_t^{1-\frac{1}{\theta}}}{Q_t V_t}.$$

Rewriting the extreme left and right hand sides of (C.4),

(C.5) $$\frac{\gamma^{\frac{1}{\theta}} (C_t^h)^{-\frac{1}{\theta}}}{P_t^h} = \frac{V_t^{-\frac{1}{\theta}}}{Q_t}$$

and rearrange to get

(C.6) $$C_t^h = \gamma\left(\frac{P_t^h}{Q_t}\right)^{-\theta} V_t\,.$$

By symmetry,

(C.7) $$C_t^f = (1-\gamma)\left(\frac{S_t P_t^f}{Q_t}\right)^{-\theta} V_t\,.$$

The expression for the (ideal) consumer price index Q_t is simply derived from inserting (C.6) and (C.7) into (C.2) and rearranging,

(C.8) $$Q_t = \left[\gamma\left(P_t^h\right)^{1-\theta} + (1-\gamma)\left(S_t P_t^f\right)^{1-\theta}\right]^{1/(1-\theta)}.$$

Defining the terms-of-trade Z_t as

(C.9) $$Z_t = S_t P_t^f \big/ P_t^h$$

the relative prices in (C.6) and (C.7) can be expressed as

(C.10) $$P_t^h \big/ Q_t = \left[\gamma + (1-\gamma)Z_t^{1-\theta}\right]^{1/(\theta-1)}$$

and

(C.11) $$S_t\, P_t^f \big/ Q_t = \left[1-\gamma+\gamma Z_t^{\theta-1}\right]^{1/(\theta-1)}.$$

From (C.4), (C.7) and (C.11), the share of imports in total consumption expenditure, as a function of the terms-of-trade is,

(C.12)
$$\beta(Z_t) = \frac{S_t P_t^f C_t^f}{Q_t V_t} = (1-\gamma)^{\frac{1}{\theta}}\left[\frac{C_t^f}{V_t}\right]^{1-\frac{1}{\theta}} = (1-\gamma)\left[\frac{S_t P_t^f}{Q_t}\right]^{1-\theta} = (1-\gamma)\left[1-\gamma+\gamma Z_t^{\theta-1}\right]^{-1}.$$

For future reference, the share of expenditure on domestic goods in total consumption expenditure is

(C.13) $$\frac{P_t^h C_t^h}{Q_t V_t} = 1 - \beta(Z_t) = \gamma\left[\gamma + (1-\gamma) Z_t^{1-\theta}\right]^{-1}.$$

Defining C_t as total consumption expenditure measured in units of the domestic good, i.e.

(C.14) $$C_t = H_t / P_t^h$$

equation (C.13) can also be written

(C.15) $$C_t^h = \left[\frac{P_t^h}{Q_t}\right]^{1-\theta} C_t = \left[1 - \beta(Z_t)\right] C_t .$$

Appendix D : Reduced form coefficients in the 2-country macromodel

(a) assuming indentical Cobb-Douglas preferences (a =0.75, β^{O}=.75, β^{E} =.25)

	m_E	m_O	t_E	t_O	x_E	x_O	u_E	u_O
n_E	0.682	0.031	-0.289	0.218	-0.138	-0.076	0.913	0.157
n_O	0.094	0.620	0.653	-0.724	-0.227	0.013	0.471	0.599
q_E	0.353	-0.111	0.708	0.268	0.659	0.269	0.089	0.275
q_O	-0.332	0.575	0.805	0.171	0.806	0.121	0.825	-0.461
s_O	-0.686	0.686	0.097	-0.097	0.147	-0.147	0.736	-0.736

(b) with equal home bias (a =.75, β^{O}=.45, β^{E} =.15)

	m_E	m_O	t_E	t_O	x_E	x_O	u_E	u_O
n_E	0.700	0.013	-0.272	0.200	-0.182	-0.032	0.917	0.153
n_O	0.040	0.673	0.601	-0.672	-0.097	-0.117	0.459	0.611
q_E	0.289	-0.047	0.770	0.206	0.814	0.114	0.174	0.190
q_O	-0.141	0.383	0.617	0.359	0.341	0.586	0.570	-0.206
s_O	-0.567	0.567	0.213	-0.213	-0.141	0.141	0.764	-0.764

(c) with differing home bias (a =.75, β^{O}=.525, β^{E} =.125)

	m_E	m_O	t_E	t_O	x_E	x_O	u_E	u_O
n_E	0.704	0.029	-0.493	0.420	-0.191	-0.070	0.738	0.320
n_O	0.022	0.668	0.383	-0.452	-0.054	-0.104	0.294	0.790
q_E	0.314	-0.086	0.605	0.372	0.754	0.209	0.028	0.345
q_O	-0.097	0.362	0.448	0.525	0.235	0.638	0.412	-0.062
s_O	-0.530	0.602	0.207	-0.214	-0.229	0.055	0.739	-0.784

Appendix E: Nash equilibrium in monetary-fiscal policy game with home bias in consumption

Table E.1 Symmetric supply shock. Equal home bias in consumer preferences. High costs for exchange rate volatility (χ^{OCB}=4). Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* *($\vartheta^{EFA} = \vartheta^{OFA}$ =0.25)*	*Rigid Euro fiscal policy Outs' fiscal policy flexible* *(ϑ^{EFA} =4, ϑ^{OFA} =0.25)*	*Rigid fiscal policies* *($\vartheta^{EFA} = \vartheta^{OFA}$ =4)*
Euro money	-0.480	-1.157	-1.725
Outs' money	-0.593	-1.566	-1.790
Euro taxes	-0.612	-0.084	-0.097
Outs' taxes	-0.924	-1.257	-0.215
Nominal exchange rate	0.002	0.018	-0.011
Real exchange rate	0.248	0.934	0.086
Euro real interest rate	-1.026	0.007	0.670
Outs' real interest rate	-1.125	-0.366	0.636
Euro producer prices	0.192	0.482	0.406
Outs' producer prices	-0.053	-0.434	0.308
Euro CPI	0.155	0.342	0.393
Outs' CPI	0.058	-0.014	0.347
Euro employment	-0.577	-1.274	-1.462
Outs' employment	-0.379	-0.520	-1.401

Table E.2 Asymmetric demand shock. Equal home bias. High costs for exchange rate volatility (χ^{OCB}=4). Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* *($\vartheta^{EFA} = \vartheta^{OFA}$ =0.25)*	*Rigid Euro fiscal policy Outs' fiscal policy flexible* *(ϑ^{EFA} =4, ϑ^{OFA} =0.25)*	*Rigid fiscal policies* *($\vartheta^{EFA} = \vartheta^{OFA}$ =4)*
Euro money	0.488	0.682	0.140
Outs´ money	-1.651	-1.372	-1.585
Euro taxes	0.175	0.024	0.012
Outs' taxes	-1.295	-1.200	-0.205
Nominal exchange rate	0.118	0.113	0.086
Real exchange rate	1.840	1.643	0.834
Euro real interest rate	-0.290	-0.586	0.046
Outs' real interest rate	-1.026	-1.244	-0.288
Euro producer prices	0.232	0.148	0.075
Outs' producer prices	-1.490	-1.381	-0.672
Euro CPI	-0.044	-0.098	-0.050
Outs' CPI	-0.662	-0.642	-0.297
Euro employment	0.165	0.365	0.185
Outs' employment	-0.575	-0.534	-1.374

Table E.3 Symmetric negative demand shock. Differing home bias. Low costs for exchange rate volatility (χ^{OCB} =0.25). Varying degrees of rigidity in fiscal policy-making.

Fiscal policy regime	*Flexible fiscal policies* ($\vartheta^{EFA} = \vartheta^{OFA}$ =0.25)	*Rigid Euro fiscal policy Outs' fiscal policy flexible* (ϑ^{EFA} =4, ϑ^{OFA} =0.25)	*Rigid fiscal policies* ($\vartheta^{EFA} = \vartheta^{OFA}$ =4)
Euro money	1.550	1.574	1.519
Outs´ money	1.363	1.392	1.354
Euro taxes	0.021	0.003	0.002
Outs' taxes	-0.135	-0.127	-0.022
Nominal exchange rate	0.075	0.075	0.060
Real exchange rate	0.257	0.238	0.144
Euro real interest rate	-2.523	-2.559	-2.492
Outs' real interest rate	-2.613	-2.642	-2.542
Euro producer prices	0.027	0.018	0.011
Outs' producer prices	-0.155	-0.145	-0.074
Euro CPI	-0.005	-0.012	-0.007
Outs' CPI	-0.020	-0.020	-0.002
Euro employment	0.018	0.043	0.026
Outs' employment	-0.058	-0.054	-0.150

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