Out in the Sunshine?
Outsiders, Insiders and the United States in 1998*

Fabio Ghironi and Francesco Giavazzi

Ghironi: Department of Economics, University of California, Berkeley CA 94720-3880, USA
Giavazzi: IGIER, Universita' Bocconi, via Salasco 3-5, 20136 Milano, Italy
Email: ghiro@econ.berkeley.edu and giavazzi@uni-bocconi.it

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Abstract

This paper analyzes monetary and fiscal policy interactions in a three-country world, interpreted to represent two EU economies and the rest of the world. The analysis extends well-known results in the literature on international policy spillovers by investigating the effects of different sizes of the two EU economies. A set of general results is derived, which allows a reinterpretation of earlier findings in the literature on policy-making in interdependent economies.

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1 Introduction

As the date approaches, when a decision will have to be made on which European states will join the monetary union from the start, two separate camps are emerging in the countries that are likely candidates to be admitted to the currency union. On the one side lie the central bankers, mainly concerned about the credibility and the reputation of the new European central bank (ECB), and about the extent to which the countries that will adopt the euro will come close to forming an optimum currency area. On the other side lie industry and the trade unions, mainly worried about competitiveness, *i.e.* about the effects that splitting Europe in two separate groups of countries, the *ins* and the *outs*, may have on relative prices inside the European Union (EU.) The sophisticated argument is that the single market could not survive if exchange rate volatility between the *ins* and the *outs* were high. The unsophisticated argument is that both -- industry and the unions -- are scared at the prospect of the *outs* using the exchange rate strategically.

The argument of the central bankers runs as follows. The ECB will not inherit overnight the reputation of the Bundesbank. For some time it will be carefully watched and tested by the markets -- until it builds its own credibility and reputation. How long will it take for the ECB to achieve this ? It depends, say the central bankers, on the type of countries that will join the currency union from the start. If the first group of *ins* consisted of those countries that already belong to the "Greater D-mark area", building a reputation will not take long -- as the ECB will look very similar to the Bundesbank since the start. However, as the number of the first group of *ins* increases, and the board of the ECB starts speaking more and more languages (and languages that are increasingly distant from German), building a reputation will take longer and longer. Not only because the European Council will appoint to the Board of the ECB individuals from states whose anti-inflationary reputation is doubtful, but also, and perhaps more importantly, because the monetary union will include regions that less and less resemble to an optimum currency area -- thus increasing the pressures likely to be exerted on the central bank. Hence, conclude the central bankers, let us start with a small union; this will make it easier for the ECB to build a reputation; once this is achieved, more countries can be allowed in without prejudice to the new monetary institution which, by then, will have a strong anti-inflationary reputation of its own.

While the reputation argument is certainly relevant (see de Grauwe 1996, for an analysis) there are other dimensions to the choice of the optimal size of the currency union. An important one are the strategic interactions that will take place among the various actors in the EMU game: between the ECB and the central banks of the *outs*; between the ECB and the fiscal authorities of the currency union, *i.e.* the Ecofin Council; between the central banks of the *outs* and their own fiscal authorities; and between these institutions and the rest of the world. (In this paper we think of the rest of the world as simply the United States, but further work should allow for the growing impact on Europe of other areas of the world, the Far-east in particular.) For example, following a negative supply shock, if the *outs* were able to engineer a real appreciation, thus successfully shifting some of their inflation upon the *ins*, the ECB would have a greater incentive to contract its monetary policy and to export inflation to the U.S. appreciating the euro against the dollar. If the Federal Reserve reacts by tightening as well, overall these monetary interactions would have negative consequences for employment both in Europe and in the United States, possibly against the governments' preferences. (This is the case studied in this paper, but one could think of different situations, such as, for example, the incentive that the *ins* may have, whenever they are faced with a loss of competitiveness relative to the *outs*, to affect their dollar exchange rate in an attempt to increase their competitiveness vis-à-vis the United States. In the situation we analyze, it is likely that Ecofin would put pressure on the ECB towards loosening the monetary contraction by removing the contractionary bias of non coordinated policies with the Fed. See Ghironi and Eichengreen, 1996, on this point.)

In Europe different policymakers are concerned about different aspects of these strategic interactions. Those based in the individual states are above all concerned with the consequences of a division of the EU between *ins* and *outs*: thus, the strategic interactions they are interested in are those that may occur between the authorities of one group of countries and of the other. The European Commission, instead, works under the assumption that the transition will be short, and that the EMU will soon include all EU states. What worries the officials in Brussels are the effects on the international monetary system of the come to stage of a new currency. This paper makes the point that <u>these two aspects cannot be separated</u>. The interactions between *ins* and *outs* cannot be studied in isolation, since they will be affected by the presence of the rest of the world -- as hinted at in the example of the previous paragraph. The interactions between EMU and the rest of the world depend, in turn, on the size of the EMU, and cannot be studied independently of the *ins* vs. *outs* question.

This paper brings these two aspects together. We study the incentives that various European policymakers face in determining the optimal size of the currency union explicitly accounting for the effects of the interactions inside Europe and between Europe and the rest of the world. We overlook the ECB credibility problem -- which is well understood -- and ask if there are <u>other</u> reasons why the central bankers of the likely *ins* may want to keep the currency union relatively small. At the same time we ask if the optimal dimension of the union, as seen from the viewpoint of the fiscal authorities, is different, thus giving rise to a potential conflict between Ecofin and the central bankers at the time of deciding who should join the union. Throughout the paper we discuss how the choices faced by European policymakers are affected by the presence of the United States (the rest of the world) and, in turn, how the United States will be affected by the birth of the euro and by the size of EMU.

The analytical tool we use to address these questions is a 3-country model designed to describe the interactions among monetary and fiscal authorities, in the tradition of Canzoneri and Henderson (1991.) An attractive feature of the model is that it allows us to study the effects of different dimensions of the European currency union -- in a continuum that encompasses a currency union that extends to the entire EU (except perhaps for a few states of negligible magnitude) as well as one that does not extend beyond Germany and Austria.[1] As common in the literature on the international spillovers of fiscal and monetary policies, the model is essentially a three-country version of the Mundell-Fleming model, in which the authorities of each region minimize quadratic loss functions whose parameters differ across different authorities. This particular model has been first studied in Ghironi (1993), and used to address different questions in Ghironi and Eichengreen (1996.)

Inside each region the central bank controls a nominal variable (the money supply or the level of the exchange rate), while the fiscal authority controls taxes or public spending. The interactions among different regions occur via trade flows in the goods market, and via capital flows in the assets markets; we assume that assets are perfect substitutes, so that interest rates and nominal exchange rates in the three regions are linked through arbitrage conditions. We use the model to study the response to a common supply shock that hits the three regions simultaneously. The model has two periods: nominal wages are predetermined and set based on the expectation of future variables (prices, interest rates, and the policy instruments); the ex-ante return on financial assets also depends on expected exchange rate changes. However, because the only stochastic factors are exogenous shocks, whose expectation one-period ahead is equal to zero, the rational expectations solution of the model (in the absence of time-consistency problems, that we overlook) is straight-forward, since all expectations are equal to zero; thus the model reduces to a static structure (see also Giavazzi and Giovannini, 1989, for a similar solution.)

A distinct feature of the model is the assumption about fiscal policy. We rule out debt accumulation, by imposing that tax revenue equals spending in each period. Government spending falls on home and foreign goods, according to the same pattern as for private consumption (to be

[1] Using a similar framework, von Hagen and Fratianni (1991) study a different type of asymmetry -- the effects of asymmetric demand and supply shocks on otherwise symmetric economies.

described later.) We follow Alesina and Tabellini (1987) assuming that government revenue accrues exclusively from a tax on firms' total revenues, which provides a simple and neat way to capture the distortionary effects of taxation. Firms' demand for labor is a decreasing function of the tax rate: for a given level of demand, a tax cut raises employment. This effect, however, is accompanied by the contemporaneous fall in demand produced by the cut in government spending that must accompany the tax cut. Hence, the net effect on equilibrium employment remains ambiguous, although for plausible parameter values the supply effect dominates -- *i.e.* a tax cut unambiguously raises employment. (See Giavazzi and Pagano, 1996, for empirical evidence on episodes of expansionary spending cuts.) The fiscal authority responds to a negative supply shock (which raises prices and lowers output) by cutting taxes, thus contributing to raise employment and to stabilize the price level because the tax cut creates excess supply in the goods market.

The trade pattern across the three regions (shown in Figure 1) is the novel feature of our model, which will allows us to compare different sizes of the currency union. We start from the pattern of transatlantic trade: U.S. consumers spend a fraction $(1-b)$ of total consumption on home goods, and a fraction b on goods imported from Europe; this in turn is allocated in a fraction a which falls on goods produced by the *ins*, and a fraction $(1-a)$ which falls on goods produced by the *outs*. European consumers in both regions spend a fraction b on goods imported from the U.S., and a fraction $(1-b)$ on European goods; the latter fraction is distributed in a fraction a which falls on goods produced by the *ins*, and a fraction $(1-a)$ which falls on goods produced by the *outs*.[2] The parameter a characterizes the size of the currency union. As a increases, the share of U.S. imports from Europe that comes from the *ins* increases, while the import share from the *outs* falls, thus describing a situation in which the size of the *ins*, relative to the *outs* increases. As a approaches 1, the EU and the *ins* tend to overlap: the currency union includes all EU states, except for a small "residual" economy whose actions do not affect the *ins* and the U.S.; when a falls, the number of countries in the currency union becomes smaller and smaller.

As mentioned above, there are two authorities in each region: a fiscal authority and a central bank.[3] Each of them minimizes a loss function which includes, as arguments, the fluctuations of

[2] Our assumptions on the trade pattern are consistent with the implicit assumption that consumers on the two sides of the Atlantic have asymmetric Cobb-Douglas preferences, which lead to constant shares of income being spent on the various goods according to the assumed pattern.

[3] By doing this we assume that inside the currency union there is a single fiscal authority, represented by the Ecofin Council. This implies two strong assumptions. First, all the members of the EU are currently represented in the Ecofin Council: assuming that Ecofin is the fiscal authority of the insiders alone may appear inconsistent with the current institutional framework of the Union. However, officials in Europe are now discussing the possibility of a two-level structure for the Ecofin Council, with the representatives of the insiders constituting the first layer of the structure. If, for any reason, there is no cooperation between the two subsets, *i.e.* the two levels, of Ecofin, nothing prevents us from treating them as two separate authorities, with the first layer, to which we simply refer as Ecofin in our paper, being

employment and the CPI around their equilibrium values. In addition, the fiscal authorities also care about the distortions associated with taxation. We shall first consider the case when none of them cooperates -- neither internationally, nor within the region. The monetary policy regime between the *ins* and the United States is symmetric, and, in the absence of international monetary cooperation, it is subject to the well-known inefficiency associated with flexible exchange rates. Each central bank controls its own money stock and believes that, by changing it, it can affect the bilateral exchange rate. Since exchange rates feed back into the domestic CPI, each central bank believes that monetary policy can affect prices at a relatively smaller cost in terms of output. In the non-cooperative equilibrium monetary policy turns out to be overly contractionary.

Inside Europe, instead, we study two different monetary regimes. The first is asymmetric: the central bank of the *ins* (the ECB) controls its own money stock, but -- contrary to the situation relative to the dollar -- it is unable to affect the infra-European exchange rate because its partner (the *outs*) accommodates any change in the money stock of the *ins*. Therefore, the ECB minimizes its loss function subject to the European-wide tradeoff between output and the price level. The central bank of the *outs*, instead, controls the bilateral exchange rate. The alternative regime is symmetric, exactly as we have assumed for the ECB and the Fed.

Which regime will characterize Europe, after EMU is born, is still undecided. Policymakers (the Commission and the Ecofin Council) are studying a new EMS, linking the single currency with the currencies of the *outs*: as argued in Giavazzi and Giovannini (1989), we believe that our asymmetric regime is a good characterization of an EMS-type arrangement where realignments are non cooperative. The alternative view -- held by the UK authorities and by a number of academic economists, see in particular Persson and Tabellini (1996) -- is that a new EMS would not survive speculative attacks, especially since the ECB will be unwilling to provide unlimited intervention. Instead the *outs* should concentrate on a domestic monetary rule (inflation targeting is the common proposal) and let the bilateral exchange rate vis-à-vis the euro fluctuate. [4]

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the fiscal authority of the *ins*, separated from the fiscal authority of the *outs*. Second, the first layer itself will include a number of independent fiscal authorities, one for each member of the currency union: we thus overlook the strategic interactions among them. (These are studied in Ghironi, 1993, and Ghironi and Eichengreen 1996.) Finally, we also assume that the *outs* can be aggregated into a single entity, with a single central bank and a single fiscal authority. We therefore overlook the consequences of non-cooperation among the authorities of the *outs*, studied in Buiter, Corsetti and Pesenti (1996.)

[4] Kenen (1995), Spaventa (1996) and Wyplosz (1996), among others, provide a thorough analysis of the arguments in favour and against a new EMS regime between the *ins* and the *outs*. Persson and Tabellini (1996) argue that a regime that combines inflation targeting with flexible exchange rates is strictly superior to an EMS-type regime. They suggest that this regime would approximate the first best cooperative outcome of their model quite closely, removing existing incentives to run competitive devaluations, and would outperform an exchange rate-based regime.

Within this framework we ask whether different authorities (in particular Ecofin and the ECB), concerned about the consequences of supply-side disturbances, would agree on the desirable size of the currency union.

In Section 2, we present the model used throughout the paper. In Section 3, we briefly summarize the general results shown in Ghironi and Giavazzi (1997) on how the output-inflation tradeoff faced by the monetary authority of a region changes, when its relative size, and the monetary regime that links it to the rest of the world change. These general results provide a theoretical background for the discussion of the stabilization game in the following sections.

Because some of the reduced form coefficients of the model cannot be signed unambiguously, we proceed to numerical illustrations of the game for reasonable values of the parameters. Interestingly, our 3-country model vindicates some of the facts described at the beginning of this introduction. For example, in a situation where fiscal authorities are prevented from using the tax instruments (and thus in a situation that closely resembles what could be the consequences of a strict "fiscal stability pact"), and strategic interactions are limited to those occurring among central banks in an asymmetric exchange-rate regime (Section 4), the ECB would prefer the currency union to be rather small if the *outs* were non negligible; Ecofin, instead, prefers a situation in which relatively more states join the currency union. In the same section, we compare the results with those obtained assuming monetary cooperation between the *ins* and the *outs*. Section 5 is devoted to the analysis of what happens when fiscal activism is allowed. In Section 6 we start exploring the importance of the presence of the United States in causing our results by studying what would happen were the U.S. and Europe completely closed with respect to one another, *i.e.* if there were no transatlantic policy spillovers. We find that the conflict of interests between the ECB and Ecofin would disappear in this situation. In Section 7, we reintroduce transatlantic policy spillovers and we compare the results obtained under an asymmetric infra-EU regime with those obtained assuming a symmetric flexible exchange rate regime between the *ins* and the *outs*. The comparison, which is based on the results about the tradeoffs summarized in Section 3, allows to shed more light on the policymakers' incentives and on the role of the United States in our analysis.

2 A three-country model of strategic policy interactions

The world is divided into three countries, the United States, the *ins*, and the *outs*. The two European goods are imperfect substitutes for the U.S. good and for one another. In the absence of disturbances, Europe and the U.S. are symmetric to one another. All variables represent deviations of actual values from zero-shock equilibrium values. All variables except interest rates, public expenditures, and tax rates are expressed in logarithms, and time subscripts are dropped whenever possible.

Output in each country (y^{US}, y^I, y^O) is an increasing function of employment (n^{US}, n^I, n^O) and a decreasing function of a world productivity disturbance (x):

$$(1) \qquad y^j = (1-\alpha)n^j - x, \qquad\qquad j = US, I, O,$$

where $(1 - \alpha)$, with $0 < \alpha < 1$, the elasticity of output with respect to employment, is the same in all countries. The productivity disturbance is identically and independently distributed with zero mean.

The labor demand of firms is implicit in the following profit maximization condition, where τ indicates the rate of taxation of total revenues:[5]

$$(2) \qquad w^j - p^j = -\alpha n^j - \tau^j - x, \qquad\qquad j = US, I, O.$$

Real wages are nominal wages (w^{US}, w^I, w^O) minus product prices (p^{US}, p^I, p^O).

Consumer price indexes (q^{US}, q^I, q^O) are weighted averages of the prices of U.S., *ins*', and *outs*' goods. As shown above in Figure 1, American consumers allocate a fraction b of their spending to European goods (a to the good produced by the *ins*, and $(1-a)$ to that produced by the *outs*) so the U.S. CPI is:

$$(3) \qquad q^{US} = (1-b)p^{US} + ab\left(p^I + e^1\right) + (1-a)b\left(p^O + e^2\right).$$

Exchange rates e^1 and e^2 are the dollar prices of the euro and of the currency of the *outs*, respectively. Equation (3) can be rewritten as:

$$(4) \qquad q^{US} = p^{US} + abz^1 + (1-a)bz^2;$$

where z^1 and z^2 are the dollar-euro and dollar-*outs* real exchange rates, respectively:

$$(5) \qquad \begin{aligned} z^1 &= e^1 + p^I - p^{US}, \\ z^2 &= e^2 + p^O - p^{US}. \end{aligned}$$

European consumers allocate a fraction b of their spending to the U.S. good, and divide the rest of their spending between the two European goods, a to the *ins*' good and $(1-a)$ to the *outs*'. The European CPIs are:

$$(6) \qquad \begin{aligned} q^I &= a(1-b)p^I + (1-a)(1-b)\left(p^O + e^2 - e^1\right) + b\left(p^{US} - e^1\right), \\ q^O &= (1-a)(1-b)p^O + a(1-b)\left(p^I + e^1 - e^2\right) + b\left(p^{US} - e^2\right), \end{aligned}$$

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[5] Using upper-case letters to denote anti-logs, domestic firms maximize $Profit = (1-\tau)PY - WN$, subject to $Y = N^{1-\alpha}/X$. Each firm is a price taker in the output and in the labor market and is taxed on its total revenues. The first order condition for maximization with respect to N is $(1-\tau)P(1-\alpha)N^{-\alpha}/X = W$. Taking logs, approximating $ln(1 - \tau)$ with $-\tau$, and omitting unimportant constants, we obtain equation (2.) (See Alesina and Tabellini, 1987.)

or:

$$
(7)\qquad
\begin{aligned}
q^I &= p^I - bz^1 - (1-a)(1-b)(z^1 - z^2),\\
q^O &= p^O - bz^2 + a(1-b)(z^1 - z^2).
\end{aligned}
$$

The *outs*-euro real exchange rate is $z^3 = z^1 - z^2$.

Demand for all goods increases with output. Residents of each country increase their spending by the same fraction ($0 < \varepsilon < 1$) of an increase in output. The marginal propensity to spend is equal to the average propensity to spend for all goods for residents of all countries. The *ins'* propensity to import from the *outs* is (1-*a*) times one minus the *ins'* propensity to import from the United States. Thus, if the *ins'* propensity to import from the U.S. is *b*, the *ins'* propensity to import from the *outs* is (1-*a*) times (1-*b*), and the total propensity to import of the *ins* is $[b + (1-a)(1-b)]$.

An increase in *ex ante* real interest rates (r^{US}, r^I, r^O) reduces the demand for all goods: residents of each country decrease spending by the same amount ($0 < \nu < 1$) for each percentage point increase in the *ex ante* real interest rate facing them.

Equilibrium conditions for the three goods are:

(8)

$$
\begin{aligned}
y^{US} &= \delta\left[az^1 + (1-a)z^2\right] + \varepsilon\left[(1-b)y^{US} + aby^I + (1-a)by^O\right] - \nu\left[(1-b)r^{US} + abr^I + (1-a)br^O\right] +\\
&\quad + (1-\eta)g^{US} + a\eta g^I + (1-a)\eta g^O + u,\\
y^I &= \delta\left[-z^1 - (1-a)(z^1 - z^2)\right] + \varepsilon\left[by^{US} + a(1-b)y^I + (1-a)(1-b)y^O\right] +\\
&\quad - \nu\left[br^{US} + a(1-b)r^I + (1-a)(1-b)r^O\right] + \eta g^{US} + a(1-\eta)g^I + (1-a)(1-\eta)g^O - u,\\
y^O &= \delta\left[-z^2 + a(z^1 - z^2)\right] + \varepsilon\left[by^{US} + a(1-b)y^I + (1-a)(1-b)y^O\right] +\\
&\quad - \nu\left[br^{US} + a(1-b)r^I + (1-a)(1-b)r^O\right] + \eta g^{US} + a(1-\eta)g^I + (1-a)(1-\eta)g^O - u.
\end{aligned}
$$

Ex ante real interest rates are:

$$
(9)\qquad r^j = i^j - E\left(q^j_{+1}\right) + q^j, \qquad\qquad j = US, I, O,
$$

where i^{US}, i^I, and i^O are nominal interest rates on bonds denominated in dollars, euros, and the *outs'* currency, respectively, and $E(\bullet_{+1})$ indicates the expected value of a variable tomorrow on the basis of information available today. Real depreciation of a currency shifts world demand toward that country's good.[6] We also assume that a random disturbance (*u*), identically and independently distributed with zero mean, can shift the world demand from European goods to the U.S. goods.

[6] The increase in demand due to a real depreciation of the domestic currency depends on two factors: the common elasticity parameter δ and the size of the country with respect to whose currency the domestic currency is depreciating.

The government budget constraints are given by:

(10) $g^j = \tau^j$, $j = US, I, O.$

Government spending falls entirely on goods (transfers are considered negative taxes and are included in τ); g^j defines the ratio $G^j / P^j Y^j$ and government j's budget constraint is: $G^j = \tau^j P^j Y^j$, $j = US, I, O$. In equations (8) we have implicitly assumed that the international allocation of governments' consumption resembles that of private consumption, with the parameter η replacing b, and η presumably not greater than b.

There are three stocks of bonds, each denominated in one of the three currencies. Residents of each country, who regard bonds denominated in all three currencies as perfect substitutes, hold positive amounts of all kinds of bonds only when their expected returns, measured in a common currency, are equal:

Thus, for example, in the case $a = .5$, if the euro depreciates against the dollar, the increase in demand for *ins*' goods is twice as much as it would be were the euro depreciating against the *outs*' currency, reflecting the fact that the U.S. economy is twice the *outs* one and that, with perfect mobility of goods, "depreciation against a larger market is more profitable." The larger a, the smaller the impact of a real depreciation against the *outs*, for given impact of an analogous depreciation against the dollar. If the *outs* are a small economy, their impact on the demand for the *ins*' goods is correspondingly small. This intuition is consistent with our assumptions about the pattern of trade: as a approaches 1, the *outs* spend a larger share of their income on the *ins*' goods, but their size is small. Also, the *ins* spend a smaller share of their income on the *outs*' goods. Thus, a real depreciation of the euro against the *outs*' currency has a smaller impact on the demand for the *ins*' goods as a increases.
An alternative explanation for a higher elasticity of demand for European goods to the transatlantic real exchange rates than to the infra-European one could be based on the characteristics of the goods that are traded and on the presence of impediments to perfect mobility of goods across the Atlantic. In this sense, if the euro depreciates against the dollar, this may have a larger impact on demand for the *ins*' goods than a depreciation against the *outs*' currency, because, goods being imperfect substitutes, the characteristics of international trade may make it easier and more convenient for *ins* consumers to shift from U.S. goods to insiders' than from outsiders' goods to insiders'.
However, a more careful way of dealing with the question would be by having the effect of real depreciations on demand explicitly dependent also on the size of transatlantic trade. For example, one could assume that the real exchange rate terms in equations (8) be given by: $\delta\left[abz^1 + (1-a)bz^2\right]$ in the equation for y^{US}, $\delta\left[-bz^1 - (1-a)(1-b)(z^1 - z^2)\right]$ in the equation for y^I, and $\delta\left[-bz^2 + a(1-b)(z^1 - z^2)\right]$ in the equation for y^O.
If we define the effective real exchange rates of the U.S., the insiders, and the outsiders as: $z^{US} \equiv abz^1 + (1-a)bz^2$, $z^I \equiv bz^1 + (1-a)(1-b)z^3$, and $z^O \equiv bz^2 - a(1-b)z^3$, respectively, this specification would imply that the demand for each region's goods increases when its effective real exchange rate depreciates. In this case one can verify that, for given propensity to import from the U.S. (b), the elasticity of y^I to z^3 is larger than the elasticity to z^1 when $a < (1-2b)/(1-b)$ and the elasticity of y^O to z^3 is larger than that to z^2 when $a > b/(1-b)$. If we assume that $b < 1/3$, which is realistic, then demands for European goods are more sensitive to the infra-EU exchange rate than to the transatlantic ones whenever $b/(1-b) < a < (1-2b)/(1-b)$. For values of a in this range, *i.e.* when the *ins* and the *outs* have comparable sizes, the demands for their outputs are more elastic to the infra-European than to the transatlantic real exchange rates. If a is sufficiently large, the demand for y^I becomes more elastic to the dollar/euro exchange rate, for the reasons discussed above. If a is small, the demand for y^O is more elastic to the exchange rate between the dollar and the *outs*' currency for analogous reasons. Although the alternative specification gives an appealing and intuitive solution to the issue of the relative size of the elasticities to infra-EU and transatlantic exchange rates, we stick to the specification in equations (8) for its simplicity.

$$(11) \quad \begin{aligned} i^{US} &= i^{I} + E\left(e^{1}_{+1}\right) - e^{1}, \\ i^{US} &= i^{O} + E\left(e^{2}_{+1}\right) - e^{2}. \end{aligned}$$

In contrast, each country's currency is held only by its residents. Demands for real money balances are given by:

$$(12) \quad m^{j} - p^{j} = y^{j} - \lambda i^{j}, \qquad j = US, I, O.$$

Firms' labor demands can be rewritten as:

$$(13) \quad p^{j} = w^{j} + \alpha n^{j} + \tau^{j} + x, \qquad j = US, I, O.$$

Substituting equations (1) and (13) into the demands for real money balances and solving for employment, we obtain:

$$(14) \quad n^{j} = m^{j} - w^{j} - \tau^{j} + \lambda i^{j}, \qquad j = US, I, O.$$

At the end of the previous period, competitive unions and firms sign contracts specifying nominal wages for the current period. Unions choose nominal wages to minimize a linear convex combination of expected deviations of employment and the real wage from equilibrium values. Thus, they minimize:

$$(15) \quad L^{u^j} = \frac{1}{2}\left\{\omega E_{-1}\left[\left(n^{j}\right)^{2}\right] + (1-\omega)E_{-1}\left[\left(w^{j} - q^{j}\right)^{2}\right]\right\}, \qquad 0 < \omega < 1, \qquad j = US, I, O.$$

Unions take into account the constraints given by the labor demands of firms. Thus they solve:

$$\min_{w^j} \frac{1}{2}\left\{\omega E_{-1}\left[\left(m^{j} - w^{j} - \tau^{j} + \lambda i^{j}\right)^{2}\right] + (1-\omega)E_{-1}\left[\left(w^{j} - q^{j}\right)^{2}\right]\right\}, \qquad j = US, I, O.$$

The first order condition leads to the wage setting rule:

$$(16) \quad w^{j} = \omega E_{-1}\left(m^{j} + \lambda i^{j} - \tau^{j}\right) + (1-\omega)E_{-1}\left(q^{j}\right), \qquad j = US, I, O.$$

Nominal wages are determined as a weighted average of the expected total labor cost of firms (because $m^{j} + \lambda\, i^{j} - \tau^{j} = w^{j} + n^{j}$), and of the expected CPI. If any of these components increases, the nominal wage increases as well, causing lower employment. Note that if expected taxation increases, the required nominal wage declines: this is because higher taxes reduce firms' total revenues and thus the demand for labor; to the extent that unions care about the level of employment ($\omega > 0$) they will set lower nominal wages.

To focus on international interactions, we assume that no time inconsistency problem exists and that all random disturbances are unexpected. The endogenous variables are shown in the Appendix to be linear functions of the policy instruments and of the shocks. Expected values of both the authorities' instruments and of the endogenous variables therefore coincide with their no-disturbance equilibrium values, *i.e.* zero.

It will become apparent that zero values for the authorities' instruments are optimal in the absence of disturbances.[7] Thus the wage setting rule simplifies to:

(17) $w^j = 0,$ $\qquad j = US, I, O.$

Plugging this result into the previously obtained expressions for employment and producer prices, we obtain:

(18) $n^j = m^j - \tau^j + \lambda i^j,$

(19) $p^j = \alpha n^j + \tau^j + x,$ $\qquad j = US, I, O.$

Equations (1)-(19) comprise the structural model. Obtaining reduced form expressions requires tedious algebra, as shown in the Appendix. Here, we simply present the policymakers' preferences and the main reduced form equations.

Each central bank chooses its instrument to minimize:

(20) $L^{cb^j} = \frac{1}{2}\left[\gamma_1 (q^j)^2 + (1-\gamma_1)(n^j)^2\right], \quad 0 < \gamma_1 < 1, \qquad j = US, I, O.$

where γ_1 measures the weight attached to inflation relative to employment by central banks.
The ECB and the Fed control the respective money supplies, and the exchange rate between the euro and the dollar is flexible. For the reasons discussed in the introduction, within Europe we compare two different monetary regimes: *(i)* an asymmetric regime, in which the ECB sets the money supply, while the outsiders' central bank sets the value of $e^3 = e^1 - e^2$, the nominal exchange rate between the outsiders' currency and the euro; *(ii)* a symmetric regime, in which both the ECB and the outsiders' central bank set the money supply, and the infra-European exchange rate is floating.

When it plays actively, the government in each country chooses taxes to minimize a quadratic loss function which depends on the deviations of inflation, employment, and taxation from their equilibrium values. We assume that the volatility of taxation represents a cost for fiscal authorities. This could be motivated but the presence of convex distortions, but it could also capture the idea that fiscal policy is difficult to fine tune relative to monetary policy.[8] Thus, country *j*'s government minimizes:

(21) $L^{fa^j} = \frac{1}{2}\left\{\vartheta_1\left[\vartheta_2 (q^j)^2 + (1-\vartheta_2)(n^j)^2\right] + (1-\vartheta_1)(\tau^j)^2\right\}, \quad 0 < \vartheta_1,\ \vartheta_2 < 1, \quad j = US, I, O.$

When ϑ_1 is low, the degree of fiscal activism is reduced and the government is forced (*e.g.* by unmodelled institutional and political constraints) not to use its instrument aggressively in order to act on inflation and employment. The parameter ϑ_2 measures the weight attached to inflation relative to employment by the

[7] In Rogoff's (1985) terminology, static expectations are rational.
[8] Also, volatile taxation could be a source of unfavourable consequences for politically motivated governments.

fiscal authorities. We assume that, in the limiting case $\vartheta_1 = 0$, in which governments do not play actively, and taxes are zero, they still care about inflation and employment: their welfare is thus evaluated according to the criterion:

$$(22) \qquad \tilde{L}^{fa^j} = \frac{1}{2}\left[\vartheta_2 (q^j)^2 + (1-\vartheta_2)(n^j)^2\right], \qquad j = US, I, O.$$

Once reduced form equations for interest rates and exchange rates are obtained, we see that endogenous variables in each country are linear functions of the policy instruments and of the disturbances. This implies that when $x = u = 0$, zero values of the instruments ensure zero losses for all authorities, and proves the rationality of static expectations under the assumption that disturbances have zero mean.

We next show the reduced form equations for employment and the CPI in each country, in the two European monetary regimes. In the equations that follow, all parameters indexed by a number are functions of a, the parameter which defines the size of the currency union. When $a < 1$, reduced forms for employment in the three countries are :

(i) managed exchange rates inside Europe :

$$(23) \qquad \begin{aligned} n^{US} &= \Lambda m^{US} - \Omega\tau^{US} - \Theta m^I + \Psi_1\tau^I + \Psi_2\tau^O - \Delta_1 e^3 + \mathrm{K}u - \mathrm{H}x, \\ n^I &= \Lambda m^I - \Omega_1\tau^I + \Omega_2\tau^O - \Theta m^{US} + \Psi\tau^{US} + \Delta_2 e^3 - \mathrm{K}u - \mathrm{H}x, \\ n^O &= \Lambda m^I - \Omega_3\tau^O + \Omega_4\tau^I - \Theta m^{US} + \Psi\tau^{US} + \Delta_3 e^3 - \mathrm{K}u - \mathrm{H}x; \end{aligned}$$

and the following relations hold among the reduced form parameters:

$$\Psi_1 + \Psi_2 = \Psi, \ -\Omega_1 + \Omega_2 = -\Omega_3 + \Omega_4 = -\Omega;$$

(ii) flexible exchange rates inside Europe :

$$(23') \qquad \begin{aligned} n^{US} &= \Lambda m^{US} - \Omega\tau^{US} - \Theta_1 m^I - \Theta_2 m^O + \Psi_1\tau^I + \Psi_2\tau^O + \mathrm{K}u - \mathrm{H}x, \\ n^I &= \Lambda_1 m^I + \Lambda_2 m^O - \Omega_1\tau^I + \Omega_2\tau^O - \Theta m^{US} + \Psi\tau^{US} - \mathrm{K}u - \mathrm{H}x, \\ n^O &= \Lambda_3 m^O + \Lambda_4 m^I - \Omega_3\tau^O + \Omega_4\tau^I - \Theta m^{US} + \Psi\tau^{US} - \mathrm{K}u - \mathrm{H}x; \end{aligned}$$

and the following relations hold among the reduced form parameters:

$\Theta_1 + \Theta_2 = \Theta, \ \Psi_1 + \Psi_2 = \Psi, \ \Lambda_1 + \Lambda_2 = \Lambda_3 + \Lambda_4 = \Lambda, \ -\Omega_1 + \Omega_2 = -\Omega_3 + \Omega_4 = -\Omega.$[9]

When $a = 1$ the outsiders are a "small open economy" which is affected by the U.S. and the insiders' policies but whose choices have no effect abroad; equations (23) and (23') reduce to:

[9] The expression is further simplified when $a = .5$, in which case the two European countries are symmetric in *each* respect. In this case we have: $\Theta_1 = \Theta_2 = \Theta/2, \ \Psi_1 = \Psi_2 = \Psi/2$. U.S. variables depend on U.S. policy instruments and on the arithmetic average of the European ones -- and also: $\Lambda_1 = \Lambda_3, \ \Lambda_2 = \Lambda_4, \ \Omega_1 = \Omega_3, \ \Omega_2 = \Omega_4$.

(i) managed exchange rates inside Europe:

$$
\begin{aligned}
&n^{US} = \Lambda m^{US} - \Omega\tau^{US} - \Theta m^{I} + \Psi\tau^{I} + \mathrm{K}u - \mathrm{H}x,\\
(24)\qquad &n^{I} = \Lambda m^{I} - \Omega\tau^{I} - \Theta m^{US} + \Psi\tau^{US} - \mathrm{K}u - \mathrm{H}x,\\
&n^{O} = \Lambda m^{I} - \Omega_3\tau^{O} + \Omega_4\tau^{I} - \Theta m^{US} + \Psi\tau^{US} + \Delta_3 e^3 - \mathrm{K}u - \mathrm{H}x.
\end{aligned}
$$

(ii) flexible exchange rates inside Europe:

$$
\begin{aligned}
&n^{US} = \Lambda m^{US} - \Omega\tau^{US} - \Theta m^{I} + \Psi\tau^{I} + \mathrm{K}u - \mathrm{H}x,\\
(24')\qquad &n^{I} = \Lambda m^{I} - \Omega\tau^{I} - \Theta m^{US} + \Psi\tau^{US} - \mathrm{K}u - \mathrm{H}x,\\
&n^{O} = \Lambda_3 m^{O} + \Lambda_4 m^{I} - \Omega_3\tau^{O} + \Omega_4\tau^{I} - \Theta m^{US} + \Psi\tau^{US} - \mathrm{K}u - \mathrm{H}x.
\end{aligned}
$$

Similarly, when $a < 1$, reduced forms for the CPIs' are:

(i) managed exchange rates inside Europe:

$$
\begin{aligned}
&q^{US} = \mathrm{A}m^{US} - \mathrm{B}m^{I} + \mathrm{E}\tau^{US} + \Gamma_1\tau^{I} + \Gamma_2\tau^{O} - \mathrm{M}_1 e^3 + \Phi u + \Sigma x,\\
(25)\qquad &q^{I} = \mathrm{A}m^{I} - \mathrm{B}m^{US} + \mathrm{E}_1\tau^{I} + \mathrm{E}_2\tau^{O} + \Gamma\tau^{US} - \mathrm{M}_2 e^3 - \Phi u + \Sigma x,\\
&q^{O} = \mathrm{A}m^{I} - \mathrm{B}m^{US} + \mathrm{E}_2\tau^{O} + \mathrm{E}_1\tau^{I} + \Gamma\tau^{US} + \mathrm{M}_3 e^3 - \Phi u + \Sigma x;
\end{aligned}
$$

and $\Gamma_1 + \Gamma_2 = \Gamma$, $\mathrm{E}_1 + \mathrm{E}_2 = \mathrm{E}$. Note that the insiders' fiscal policy has the same impact on both the insiders' and the outsiders' CPIs', and the same is true for the outsiders' fiscal policy. This can be seen observing that, subtracting q^O from q^I, one obtains: $q^I - q^O = -(\mathrm{M}_2 + \mathrm{M}_3)e^3$, independent of τ. Recalling the expressions for q^O and q^I in terms of PPIs' and real exchange rates (equations (7)) and using the definitions of z^1 and z^2, it is possible to show that it actually has to be the case that $q^I - q^O = -e^3$, *i.e.* that it has to be $\mathrm{M}_2 + \mathrm{M}_3 = 1$.[10]

(ii) flexible exchange rates inside Europe:

$$
\begin{aligned}
&q^{US} = \mathrm{A}m^{US} - \mathrm{B}_1 m^{I} - \mathrm{B}_2 m^{O} + \mathrm{E}\tau^{US} + \Gamma_1\tau^{I} + \Gamma_2\tau^{O} + \Phi u + \Sigma x,\\
(25')\qquad &q^{I} = \mathrm{A}_1 m^{I} - A_2 m^{O} - Bm^{US} + \mathrm{E}_1\tau^{I} + \mathrm{E}_2\tau^{O} + \Gamma\tau^{US} - \Phi u + \Sigma x,\\
&q^{O} = \mathrm{A}_3 m^{O} - A_4 m^{I} - \mathrm{B}m^{US} + \mathrm{E}_3\tau^{O} + \mathrm{E}_4\tau^{I} + \Gamma\tau^{US} - \Phi u + \Sigma x;
\end{aligned}
$$

[10] This is because the two European countries have identical consumption bundles (see the pattern of trade), and therefore Purchasing Power Parity (PPP) holds in terms of CPIs. The same is not true for the U.S. versus European economies, because the consumption baskets are asymmetric across the Atlantic. This is due to our implicit assumption that consumers on the two sides of the Atlantic have asymmetric Cobb-Douglas preferences (recall footnote 2.)

and $B_1 + B_2 = B, \Gamma_1 + \Gamma_2 = \Gamma, A_1 - A_2 = A_3 - A_4 = A, E_1 + E_2 = E_3 + E_4 = E$. [11] As a consequence of the change in the infra-European exchange rate regime, it is no longer the case that the insiders' fiscal policy has the same impact on both the insiders' and the outsiders' CPI's, and that the same holds for the outsiders' fiscal policy.

If the outsiders are very small ($a = 1$), the previous reduced form equations become:

(i) managed exchange rates inside Europe:

$$
\begin{aligned}
q^{US} &= \mathrm{A}m^{US} - \mathrm{B}m^{I} + \mathrm{E}\tau^{US} + \Gamma\tau^{I} + \Phi u + \Sigma x, \\
(26)\quad q^{I} &= \mathrm{A}m^{I} - \mathrm{B}m^{US} + \mathrm{E}\tau^{I} + \Gamma\tau^{US} - \Phi u + \Sigma x, \\
q^{O} &= \mathrm{A}m^{I} - \mathrm{B}m^{US} + \mathrm{E}\tau^{I} + \Gamma\tau^{US} + e^{3} - \Phi u + \Sigma x.
\end{aligned}
$$

Note that, while the outsiders' fiscal policy still affects n^O when $a = 1$, it no longer affects q^O. Also, in this situation, movements of e^3 have a one-to-one impact on the insiders' CPI.[12]

(ii) flexible exchange rates inside Europe:

$$
\begin{aligned}
q^{US} &= \mathrm{A}m^{US} - \mathrm{B}m^{I} + \mathrm{E}\tau^{US} + \Gamma\tau^{I} + \Phi u + \Sigma x, \\
(26')\quad q^{I} &= \mathrm{A}m^{I} - \mathrm{B}m^{US} + \mathrm{E}\tau^{I} + \Gamma\tau^{US} - \Phi u + \Sigma x, \\
q^{O} &= \mathrm{A}_3 m^{O} - \mathrm{A}_4 m^{I} - \mathrm{B}m^{US} + \mathrm{E}_3\tau^{O} + \mathrm{E}_4\tau^{I} + \Gamma\tau^{US} - \Phi u + \Sigma x.
\end{aligned}
$$

When the European exchange rate regime is symmetric, it is no longer the case that the outsiders' fiscal policy has no impact on q^O when the outsiders are very small.

The reduced form parameters in the preceding equations are functions of the structural parameters. Their signs are often ambiguous, since they depend on the interaction of several channels of transmission. In equations (23, 23')-(26, 26') all the coefficients are assumed to be positive; the signs are those implied by our assumptions on the value of the structural parameters, which are chosen in order to provide clearcut conclusions in the response to a supply shock. Recall also that the values of the reduced form parameters which are not indexed by a number do not change as a does, for given values of the other structural parameters of the model.[13]

---

[11] Again, matters are simpler when a=.5, in which case we have:
$B_1 = B_2 = B/2, \Gamma_1 = \Gamma_2 = \Gamma/2, A_1 = A_3, A_2 = A_4, E_1 = E_2, E_3 = E_4$.

[12] This is a consequence of the outsiders' consumption pattern: in the case $a = 1$, the outsiders consume only the U.S. and the insiders' goods. The outsiders' CPI can be rewritten as $q^O = p^O + (1-b)z^1 - z^2$. Using $z^2 = e^2 + p^O - p^{US}$ and the definition of e^3, q^O becomes: $q^O = (1-b)z^1 - e^1 + e^3 + p^{US}$. This equation shows the one-to-one impact of e^3 on q^O and proves that the latter is left unaffected by changes in the outsiders' fiscal policy, as z^1, e^1, and p^{US} do not depend on the outsiders' policy instruments.

[13] Moreover, the parameters whose value does not depend on a are identical across infra-European exchange rate regimes, as our choice of notation indicates. The intuition for this result is apparent if one observes the reduced form equations for the case $a = 1$. The parameters we are referring to are indeed those that would characterize the interaction between the U.S. and a

The values we assign to the structural parameters are: $\alpha = .34$, $\delta = .8$, $\varepsilon = .8$, $\nu = .4$, $\lambda = .6$, $b = \eta = .1$.

We consider three alternative values for a: .5, .75, and 1. Approximate values of the reduced form parameters which are invariant with respect to a are given in Table 1. We assume that there is no demand disturbance ($u = 0$) and therefore we omit the values of K and Φ.

Table 2 shows approximate values of the reduced form parameters which change with the size of the currency union. As noted above, these parameters differ across exchange rate regimes.

Finally, we make the following assumptions about policymakers' preferences. Three alternative values of ϑ_1 are considered (0, .2, .8), the degree of fiscal activism being an increasing function of that parameter. For given flexibility of fiscal policy, we make the realistic assumption that central banks care much more about CPI inflation than about employment ($\gamma_1 = .9$) while the opposite is true for fiscal authorities ($\vartheta_2 = .1$.)

3 Country size, monetary regimes, and the employment-inflation tradeoff

Before proceding with the experiments that occupy the remainder of this paper it is useful to pause and ask how the employment-inflation tradeoff faced by the monetary authority in an open economy is affected by the relative size of the economy and by the exchange rate regime. These results are derived formally in Ghironi and Giavazzi (1997): in this section we briefly review their intuition. [14]

The main point is that the tradeoff a country faces depends on the size of the economy for which the monetary authority sets its instrument. Under a non-cooperative flexible exchange rate regime, each central bank sets the money supply for its own economy, taking the money supply of the other country as given; thus, in such a regime, the relevant size for each central bank is that of its own country. Things, however, are different in an asymmetric regime where one central bank (that of the core country) sets the money supply for the entire region, while the other central bank controls the bilateral exchange rate. In such a regime the relevant size for the central bank of the core country is the entire region, while the size that is relevant for the peripheral central bank remains that of its own country.

It can be shown that, in general, the tradeoff a country faces improves the smaller the size of the "relevant" economy. The intuition is straightforward. Consider for instance the peripheral

---

European currency union whose size were identical to that of the United States. These two entities are unaffected by the outsiders' policy choices, being the *outs* a negligible entity. For the same reason, the infra-European exchange rate regime does not affect the values of the parameters in the reduced form equations for *ins*' and U.S. variables when $a = 1$.

[14] Throughout, we refer to the tradeoff faced by a country's central bank as the country's tradeoff. Fiscal authorities in all countries face employment-inflation tradeoffs which are defined by $\partial q/\partial n \equiv (\partial q/\partial \tau)/(\partial n/\partial \tau)$. In what follows, we focus on the tradeoffs faced by the central banks.

country in an asymmetric regime. The smaller the economy, the larger the share of imports in the domestic CPI. Thus the impact of a given change in the exchange rate on the CPI increases as the size of the economy gets smaller -- and thus it becomes more open. A small, open economy therefore needs to engineer a relatively milder recession to stabilize prices, compared to a large country where the exchange rate has only a small impact on the domestic CPI.

This result has two corollaries. Consider, first, the following comparison: the central bank of a peripheral country in an asymmetric regime, and the same central bank in a symmetric flexible exchange rate regime. The size of the relevant economy is the same in the two situations -- and thus the tradeoff the central bank faces is also identical in the two regimes. This is not true, however, for the central bank of the core country in an asymmetric regime, compared with the situation under flexible exchange rates. The tradeoff this central bank faces is always less favourable in the asymmetric regime, when the relevant economy encompasses the entire region, and the two tradeoffs coincide when the size of the peripheral country becomes negligible -- the Federal Reserve is indifferent between a regime of fixed or flexible exchange rates vis-à-vis Grenada, but it clearly cares about the exchange rate regime vis-à-vis Germany or Japan.

These results are summarized in Figures 2, 3, and 4. Figure 2 shows the employment-inflation tradeoff faced by the peripheral country (the *outs* in our discussion of the European monetary union) in an asymmetric regime. (These figures are drawn assuming that the countries are hit by a positive realization of the supply shock which causes inflation and unemployment.) The steeper line -- the one along which the tradeoff is more favourable -- corresponds to the case where the size of the currency union is relatively large, and, as a consequence, the *outs* are relatively small. Figure 3 illustrates the tradeoffs when the exchange rate regime inside Europe is symmetric (flexible exchange rates) and thus coincides with the exchange rate regime between Europe and the United States. The size of the U.S. coincides with that of Europe: thus the tradeoff the U.S. faces is always worse than the tradeoff faced by the European countries, and coincides with the tradeoff faced by the *ins*, when $a = 1$, *i.e.* when the size of the *outs* is negligible. Inside Europe the smaller country faces the best tradeoff, and the tradeoffs coincide for $a = .5$. If instead the exchange rate regime inside Europe is asymmetric, the central bank of the core country, the *ins*, always faces the same tradeoff as the Fed, irrespective of the actual size of the *ins*' economy, whereas the *outs* face the same tradeoff they would face under the symmetric regime, which is always better than that faced by the *ins*.

4 Monetary policy interactions between the *ins*, the *outs*, and the United States

The general results stop with those discussed in the previous section -- and this is not surprising. Remember that what we are looking for are situations in which some policymakers prefer a relatively larger currency union, while others prefer a relatively smaller one, but all policymakers minimize employment and price-level fluctuations, albeit with different weights. If it turned out that a given size of the currency union was best independently of parameter values, then policymakers would never disagree. Therefore what we are going to show are situations in which, for instance, the policymakers that give a larger weight to price-level, relative to employment fluctuations, prefer, say a relatively smaller union, while the opposite holds for policymakers with different relative weights.

Our first exercise only considers monetary policy interactions; we thus assume that the tax rate (τ) is held exogenously constant -- for instance because of an institutional constraint on the active use of fiscal policy. The three fiscal authorities passively watch the interactions among central banks, and their loss functions only include the employment and CPI terms, as in equation (22.) The three central banks do not cooperate, and the infra-EU exchange rate system is asymmetric.

We believe that this is a good characterization of the way EMU might work, at least for some time. The "fiscal stability pact", if approved, will tie the hands of the fiscal authorities of the *ins*, while the efforts to meet the Maastricht deficit criteria will in turn prevent the *outs* from actively using fiscal policy to respond to shocks. The desire of reducing the U.S. public debt may motivate inaction by the U.S. government. The assumption that monetary authorities do not cooperate is also a serious possibility. The ECB was designed to be independent; even if a new EMS-type arrangement is introduced, linking the currencies of the *ins* and the *outs*, it is unlikely that the ECB would deviate from its objectives in order to support the currencies of the *outs*. As a consequence, the latter central banks could use the exchange rate strategically in the attempt to shift upon the *ins* some of the cost of adjusting to exogenous shocks -- precisely as in the managed exchange rate regime described in the introduction.

Within this institutional framework we ask what incentives will drive European policymakers at the time of deciding how many states should be admitted into the currency union. Although formally this decision is the responsibility of the European Council on a recommendation by Ecofin, central bankers (the EMI at that stage, since the ECB will not yet be born) will be very influential. (The European Council will decide based on a recommendation by Ecofin, which in turn will receive two reports, one from the EMI, and one from the European Commission.) We would like to know if the two bodies, Ecofin and the EMI, will have different views, and what determines such differences.[15] More precisely, we ask the following question: for a given policy regime -- no cooperation among central banks, monetary policy asymmetry inside Europe and frozen fiscal policy -- following an exogenous supply shock, how large a currency union would each authority prefer, *i.e.* how does the loss function of each authority change, as the parameter a changes ?

Solving the central banks' minimization problem under the assumption of no cooperation among the three central banks leads to first order conditions of the form:

$$(27) \qquad .9q^j \frac{\partial q^j}{\partial m^j} + .1n^j \frac{\partial n^j}{\partial m^j} = 0, \qquad j = US, I;$$

$$(28) \qquad .9q^O \frac{\partial q^O}{\partial e^3} + .1n^O \frac{\partial n^O}{\partial e^3} = 0.$$

These conditions comprise a system of three linear equations in three unknowns (m^{US}, m^I, e^3.) They define each central bank's Nash reaction function to the other monetary authorities' policy actions. The solution of the system, using our assumptions about the parameter values, together with the implied values of endogenous variables and loss functions, is summarized in Table 4.

For both the *ins* and the *outs* we report the values of the main variables (CPI, employment and the real exchange rate) and the value of the policymakers' loss function in equilibrium. (Remember that, when fiscal policymakers do not play actively, their welfare is evaluated according to the criterion in equation (22).) We compare two situations: $a = .5$ and $a = .75$. How closely do these numbers reflect the possible situation in Europe ? In an EMU that included only Germany, Austria, France and the Benelux countries a would be approximately equal to .5. A value of .75 would characterize an EMU that also includes Italy and Spain, but leaves out the UK, and the Nordic countries. Finally, we report the results for $a = 1$, *i.e.* for the case where the dimension of the *outs* is negligible. This reference case is of interest because it describes a situation where the *outs*' policy choices no longer affect the other economies, and the European currency union and the United States face one another as two large symmetric entities.

When the outsiders are relatively small, and the tradeoff is relatively more favourable, their central bank "rides" it more aggressively. In the equilibrium prices are lower than in the case $a = .5$, but output is also lower, notwithstanding the relatively favourable tradeoff (see Figure 2.) Given our assumptions about the preferences of central banks and fiscal authorities, the outsiders' central bank prefers a relatively large union ($a = .75$), while the opposite is true for the outsiders' fiscal authority, which suffers because of the larger employment loss when $a = .75$.

[15] This discussion of the role of Ecofin is implicitly consistent with all members of the EU being represented in that institution. Recall footnote 3.

We now turn to the insiders. Given the real appreciation engineered by the outsiders, the ECB responds with a tougher monetary contraction compared with what it would have done had it not imported additional inflation from the *outs*. In Table 4 this can be seen comparing the outcome for $a < 1$ with the case $a = 1$, and remembering that with $a = 1$ the impact of the *outs* on the *ins* and on the United States is negligible ($m^I|_{a=.5} < m^I|_{a=.75} < m^I|_{a=1} < 0$.) Symmetrically to what happens in the *outs*, the ECB prefers a relatively small currency union, while Ecofin would rather have a larger number of states in the union. Let us first try to understand why the ECB prefers a relatively small union. As we have argued in Section 3, contrary to the outsiders, insiders face the same output-inflation tradeoff, independently of the size of the currency union.

Thus, in the EMS-2 regime, the insiders' central bank does not have the option of choosing a more favourable tradeoff when expressing a preference over the size of the European currency union. For any value of a, the tradeoff is always the same, and given that tradeoff, the ECB can only respond to the other players' policies by varying the degree of monetary contraction. When the outsiders are relatively small, even if they aggressively shift inflation abroad, the insiders' effective real exchange rate does not depreciate very much, precisely because the outsiders are small.[16] Faced with lower imported inflation, the insiders' central bank contracts less than for $a = .5$, and thus domestic producer prices remain relatively high.[17] As a consequence, the insiders' CPI also remains higher, and the central bank ends up being worse off. However, the insiders' fiscal authority benefits from the milder contraction, and thus prefers a relatively larger currency union.

Finally we look at the situation in the United States. For $a < 1$, the strategic interaction between *ins* and *outs* inside Europe also affects the United States whose effective real exchange rate depreciates[18]. The Fed suffers from the strategic interaction inside Europe, the more so the larger is the currency union, for the same reason that induces the ECB to prefer a smaller union. When $a = .75$, the *outs*' central bank is more aggressive not only towards the ECB, but also towards the Fed.[19] Nonetheless, the Fed, analogously to the ECB, chooses a milder monetary contraction in that situation, and ends up suffering because of higher inflation. Hence, when the *outs* are non negligible, the Fed prefers to face a small currency union in Europe rather than a large one, even though $a = 1$ would be the first best situation for both the ECB and the Fed. Analogously to Ecofin, the U.S. government prefers a large rather than a small union, since the Fed's monetary contraction is milder

[16] The effective real exchange rate of the insiders was defined in footnote 6 as: $z^I \equiv b\, z^1 + (1\text{-}a)(1\text{-}b)\, z^3$.
[17] When $a = .75$, producers prices (p^I) are equal to $.4681x$; when instead $a = .5$, they are equal to $.4618x$.
[18] Recall that the effective real exchange rate of the United States is defined as: $z^{US} \equiv ab\, z^1 + (1\text{-}a)b\, z^2$.
[19] Remember that the *outs*' tradeoff improves with respect to both the *ins*' and the U.S. tradeoff as a increases from .5 to .75.

in the former case and the employment loss is smaller. Note that both the *ins* and the U.S. face the same employment-inflation tradeoff as a consequence of the exchange rate regime in Europe, which presents the *ins*' authorities with the European-wide tradeoff, independently of the size of the currency union. Consequently, the presence of non negligible outsiders -- and the absence of infra-European monetary cooperation, as we shall see below -- is crucial to have movements in the dollar-euro exchange rate in the framework we are examining. In fact, if the outsiders were negligible -- or if they were non negligible but cross-country externalities in Europe were internalized -- equal tradeoffs would lead to equal equilibrium policies in the U.S. and in the currency union and there would be no changes in the dollar-euro exchange rate.[20]

The results presented in Table 4 allow us also to make an interesting comparison with the analysis of Alesina and Grilli (1994.) There the authors show that if EMU does not include all EU central banks from the start and monetary authorities in Europe have different degrees of inflation aversion, it may be the case that the initial insiders will not want the number of the *ins* to increase, even if a currency union encompassing all EU members would be the first best.

Something analogous happens in our model. If we think of the three values of a that we have considered as steps towards global monetary unification of Europe, if initially $a = .5$, subsequently, the ECB will not want to take the intermediate step towards a = .75, even if $a = 1$ would be the first best solution. Interestingly, the Fed would share the ECB's preferences, and -- in a sense -- shortsightedness, contrary to the respective governments, which would always prefer a large currency union in Europe. We remark that we obtain the Alesina-Grilli result in a framework in which all central bankers have the same inflation aversion throughout the world. In our view, this shows that strategic interactions per se may matter at least as much as different degrees of inflation aversion in shaping policymakers' incentives and behaviour.

How do these results compare with the case of cooperation among central banks in Europe ? We study this case because, according to some officials (but also according to Spaventa, 1996), the exchange rate arrangement that should link the *ins* and the *outs* after January 1st, 1999 (the EMS-2) will entail -- contrary to our assumption so far -- some form of cooperation between the ECB and

[20] This observation shows that facing a more favourable tradeoff is not *necessary* in order to successfully run beggar-thy-neighbour policies: the Fed faces the same tradeoff as the ECB, but still manages to appreciate the dollar in real terms against the euro, thus exporting some inflation to the currency union. The absence of infra-EU cooperation and the presence of non negligible outsiders which successfully export inflation to both the *ins* and the U.S. shifts the balance between the Fed and the ECB in a direction that is favourable to the U.S. authority. Ghironi (1993) and Ghironi and Eichengreen (1996) show that the dollar-euro exchange rate would move also in a situation in which there are no outsiders -- so that the currency union has the same size as the U.S. -- but fiscal authorities inside the currency union do not cooperate.

the central banks of the countries that will not join the currency union from the start. Their interpretation of how the new system could work is that of a cooperative managed exchange rate system. The response of EU central banks to exogenous shocks would entail a EU wide change in the money supply, and, possibly, a cooperative realignment of infra-EU exchange rates.

We have computed the equilibrium of our model following an exogenous supply shock assuming that the ECB and the outsiders' central bank cooperate with one another -- though neither of them cooperates with the Fed. This is the only behavioural assumption that is changed with respect to the situation analyzed above. The first order condition for the Fed choice is unchanged. Instead, the ECB and the outsiders' central bank jointly minimize a weighted sum of their loss functions, with weights equal to a and (1 - a), respectively. This implies that the weight attached to each central bank's loss function in the cooperative agreement is determined by the relative dimensions of the European economies. Although more complicated bargaining mechanisms could be envisaged, we believe that our simple assumption is not unrealistic. Hence, m^I and e^3 are chosen so that:

(29) $$a\left(.9q^I \frac{\partial q^I}{\partial m^I} + .1n^I \frac{\partial n^I}{\partial m^I}\right) + (1-a)\left(.9q^O \frac{\partial q^O}{\partial m^I} + .1n^O \frac{\partial n^O}{\partial m^I}\right) = 0,$$

(30) $$a\left(.9q^I \frac{\partial q^I}{\partial e^3} + .1n^I \frac{\partial n^I}{\partial e^3}\right) + (1-a).\left(9q^O \frac{\partial q^O}{\partial e^3} + .1n^O \frac{\partial n^O}{\partial e^3}\right) = 0.$$

When combined with the first order condition for the Fed, (29) and (30) give a system of linear equations to be solved to determine the optimal values of the policy instruments. The relevant results are summarized in Table 5. We limit ourselves to values of a strictly smaller than 1 because the ECB will have no incentives to cooperate with a region of negligible outsiders.

The first, unsurprising, observation is that the cooperative response of central banks does not entail a change in the infra-EU exchange rate: the result is unsurprising because, as we have seen above, realignments are the result of the successful attempt by the outsiders to shift some of their inflation on the insiders -- a behaviour that is ruled out in a cooperative solution. Following the shock, the infra-EU exchange rate remains fixed independently of the relative size of the *ins* and the *outs*.

The equilibrium values of the loss functions (of both fiscal and monetary authorities) are now independent of relative sizes -- because size only matters when central banks play beggar-thy-neighbour policies. The loss of Ecofin and the ECB is unambiguously lower than in the case of non-cooperation. Note that, not surprisingly, in the case of monetary cooperation in Europe, all variables for the insiders and for the U.S. have the same values they had in the case of no cooperation when a

= 1, so that monetary cooperation between *ins* and *outs* is equivalent to no cooperation when $a = 1$ from the perspective of the U.S. and of the *ins*. The ECB's gain from cooperation increases as the size of the union increases, where the gain is defined as the difference between the loss in the absence of cooperation and the loss under the cooperative EMS-2 regime. This result is intuitive: as we have argued above, smaller outsiders are more aggressive, and this makes the potential gains for the ECB from cooperating with the *outs*' central bank larger.

The situation, however, is different for the outsiders. The outsiders' central bank is better off in the absence of cooperation -- the more so the larger is the currency union -- because it is then allowed to appreciate vis-à-vis the insiders. (This is also true when the size of the outsiders is negligible ($a = 1$).)[21] The outsiders' government, instead, always prefers monetary cooperation in Europe because it benefits from less contractionary monetary policies. Finally, monetary cooperation inside Europe benefits the Fed and the U.S. government -- because infra-European cooperation removes the more aggressive behaviour by the *outs*' central bank, which induced a real depreciation of the dollar against the outsiders' currency, and alleviates the deflationary bias associated with the lack of monetary cooperation in Europe.

5 The interplay of monetary and fiscal policy interactions

As we have argued, the results obtained assuming that the fiscal authorities passively watch the interactions among central bankers characterize a currency union accompanied by a very tight "fiscal stability pact" that de-facto prevents governments from using their fiscal instruments. In such a situation we have shown that a disagreement between the Ecofin Council and the central bankers on the optimal size of the union may arise simply as a result of the lack of cooperation among EU monetary authorities, and thus quite independently of the consideration that -- at least for some time -- the ECB could be more credible in a relatively smaller and more homogeneous union.

Would such a disagreement disappear if governments were allowed to use fiscal policy to respond to exogenous shocks ? The answer would almost certainly be positive if the two instruments (money and taxes) were set cooperatively. The ECB, however, will be independent, and throughout

[21] When it plays cooperatively, the central bank of non negligible *outs* is driven to the same situation as that of the ECB and the Fed with $a = 1$ and no cooperation, and is even worse off than the central bank of negligible *outs* when there is no cooperation. The result that international monetary cooperation may be counterproductive from the perspective of some or all of the players, is not new in the literature on international interactions. In Rogoff (1985) cooperation can be counterproductive when it exacerbates time inconsistency problems in the conduct of monetary policy. In Ghironi and Eichengreen (1996), ECB-Fed cooperation can be counterproductive from the central banks' perspective due to the induced adjustments in fiscal policies. Here we show a situation in which no time inconsistency problem exists and cooperation is counterproductive from a player's perspective essentially because it prevents the player from "riding a favourable tradeoff" as much as it would without cooperation.

the EU member states are changing the statutes of their central banks so as to grant them more independence. The appropriate framework thus appears to be one where both inside and outside the currency union central banks and fiscal authorities do not cooperate. We have considered two situations: first, the case where the ECB and the central banks of the *outs* cooperate among themselves, but do not cooperate with the two European fiscal authorities -- and neither with fiscal, nor with monetary authorities in the U.S., which also are assumed not to cooperate among themselves. We shall then consider the case where all six institutions act non-cooperatively.

When fiscal authorities are active players in the game, and the same behavioural assumptions of the previous case are maintained (*i.e.* cooperation between the monetary authorities inside Europe, though not between U.S. and European monetary authorities) the first order conditions for the central banks' problem remain those given by equations (29) and (30) above, plus the usual condition for the Fed's choice. The optimal choice of fiscal instruments is determined by:

$$\vartheta_1\left(.1q^j\frac{\partial q^j}{\partial\tau^j}+.9n^j\frac{\partial n^j}{\partial\tau^j}\right)+\left(1-\vartheta_1\right)\tau^j=0, \qquad j=US, I, O; \tag{31}$$

where ϑ_1 is a measure of the degree of fiscal activism, either .2 or .8 according to our choice of parameter values. Conditions (31), combined with (29), (30), and the Fed's optimality condition, define each player's reaction function to the other policymakers' choices. The solution to this system of six equations in six unknowns is summarized in Table 6, together with the implied values of endogenous variables and loss functions. Now, the fiscal authorities' loss is evaluated according to the loss function (21). Governments are no longer forced to "stay out of the game", but are still worried about the costs that distortionary taxes impose on the economy.

Let us focus on the case $\vartheta_1 = .2$, which is closer to the case of rigid fiscal policy studied above, and seems to be more realistic if we want to capture the relative rigidity of fiscal policy. The reader can interpret the results for the case $\vartheta_1 = .8$ on the basis of the intuitions provided below.

Following a negative supply shock, all fiscal authorities cut taxes. This happens because, for the parameter values that we have chosen (though not unambiguously[22]), a tax cut raises employment and output, thus contributing to stabilize prices. Note that the strategic interaction among European fiscal authorities induces the infra-European exchange rate to be adjusted even if the ECB and the *outs*' central bank are cooperating with one another -- thus deviating from the case where fiscal policy did not operate (Table 5) which implied a constant infra-European real exchange

[22] Remember that a tax cut raises firms' labor demand, while at the same time reducing government spending because of our assumption that the government budget is always balanced. Thus the net effect on output is ambiguous. However, if the interest rate semi-elasticity of money demand is sufficiently small, a tax cut unambiguously raises output and employment.

rate. We observe that in all cases optimal policies produce a real depreciation of the *outs'* currency against the euro (z^3 positive); the magnitude of the real depreciation increases as the relative size of the currency union becomes larger. The point is that, like monetary policymakers have an incentive to export inflation abroad, fiscal authorities have an incentive to export unemployment abroad. Central banks can achieve their goal by appreciating their currencies in real terms. Governments, instead, will export unemployment by trying to engineer a real depreciation. When the central banks are cooperating, only the second type of behaviour is at work. Under the assumptions of our exercise, one can show that the *outs*' government faces a more favourable employment-inflation tradeoff than the *ins*' government, and that the advantage of the outsiders increases as the size of the currency union becomes larger.[23] Hence, consistently with the intuition that policymakers manage to engineer beggar-thy-neighbour policies when they face more favourable tradeoffs than their neighbours, the *outs*' government manages to export unemployment to the *ins* via real depreciation, the more so the larger the currency union, as it is confirmed by the results on employment. This explains why the equilibrium value of the loss function of Ecofin increases when the size of the currency union becomes larger.

What seems counterintuitive is that the ECB's loss also increases with the size of the currency union, even if the real appreciation of the euro against the *outs*' currency becomes larger. Looking at fiscal authorities' behaviour is helpful, though. When a increase from .5 to .75, the *outs*' government becomes more aggressive. But, like what happened in the case of only monetary interactions in the interplay between the ECB and the *outs*' central bank, the *ins* government reacts by reducing the degree of its fiscal expansion. Due to the fact that a tax cut stabilizes inflation in our exercises, this ends up inducing higher inflation in the *ins*' economy even if the ECB goes for a sharper contraction when a = .75. As a consequence, in this case there is no disagreement between the ECB and Ecofin on the desired size of the currency union and both EMU authorities prefer the small union outcome.

The *outs*' government is more aggressive when $a = .75$ and achieves a better stabilization of employment than when $a = .5$. Nonetheless, in order to do so, it pays the price that a more active fiscal policy implies in terms of higher loss.[24] The employment gain is more than offset by the loss due to more volatile taxes, and the *outs*' government is better off when the currency union is small. Instead, the outsiders' central bank still prefers the large union outcome, even though inflation is higher in that situation. Even though central banks mainly care about inflation, the gain from a better

[23] Governments' tradeoffs were defined in footnote 14.

[24] Remember that the governments' loss function depends also on the volatility of taxation when governments play actively.

stabilization of employment when $a = .75$ more than offsets the higher inflation loss. Note that the *outs*' central bank and the ECB cooperatively realign the nominal exchange rate between the *outs*' currency and the euro and let the former appreciate against the latter, the more so the larger the currency union. This is entirely consistent with the observed behaviour of the real exchange rate: when the *outs*' currency depreciates in real terms against the euro due to the fiscal authorities' behaviour, inflation in the *outs*' economy tends to rise. This phenomenon is more relevant when the currency union is large, as the *outs*' government is more aggressive in that case. The ECB and the *outs*' central bank are now jointly optimizing the respective loss functions, *i.e.* they are jointly stabilizing the respective inflation rates. Thus, the optimal cooperative reaction to the inflationary effect on the *outs*' economy of the real depreciation of their currency is given by a nominal appreciation intended to stabilize the *outs*' CPI. The nominal appreciation of the *outs*' currency against the euro is no longer a successful beggar-thy-neighbour policy allowed by the *outs*' central bank's more favourable tradeoff. Rather, it is the optimal cooperative reaction of the two European central banks to the fiscal policymakers' actions.

What is the role of the U.S. in this picture?

While infra-EU monetary interactions are cooperative, both monetary and fiscal interactions are non cooperative across the Atlantic. Even if we do not do it here, one can show that under the assumptions of this exercise, both European governments face more favourable tradeoffs than the U.S. government, which always faces the same tradeoff irrespective of the size of the currency union. Besides, the *ins*' government' tradeoff approaches the U.S. government's as a approaches 1, while the *outs*' government's tradeoff becomes more and more favourable. The consequences of this can be seen in the pattern of transatlantic real exchange rates. The dollar appreciates against both European currencies, so that both European governments manage to export some unemployment to the United States. The real depreciation of the *outs*' currency against the dollar increases with the size of the currency union, while the real depreciation of the euro decreases, consistently with what the changes in the tradeoffs would suggest. In fact, we know that the *outs*' government becomes more aggressive as a increases, while the *ins*' government becomes less aggressive. The real appreciation of the dollar is harmful for the U.S. government, but helpful for the Federal Reserve, as it helps stabilize the U.S. CPI at the expenses of the European ones. However, it is easy to check that the effective real appreciation of the dollar is larger when $a = .5$ than when $a = .75$. Thus, in an attempt at reducing the U.S. inflation, the Fed adopts a sharper contraction in the latter case. This contraction proves itself harmful for the U.S. employment and contributes to make the U.S.

government worse off when the currency union is large. Notwithstanding a tougher monetary policy, the U.S. CPI is higher when $a = .75$ and the Fed is worse off in that situation, as well.

Finally we consider the case where none of the authorities cooperate. To compute the solution we go back to the situation in which there is no monetary cooperation, but we maintain an active role for fiscal policies. Optimal monetary policies are chosen according to conditions (27) and (28), while conditions (31) determine the optimal values of the fiscal instruments. Now all players are active in the game and no distortion due to the externalities that they impose to one another is removed. Results are summarized in Table 7. All loss functions are uniformly lower than when fiscal policy cannot be used, even when we compare them with the case of cooperation among European central banks (Table 5), and even in the case where fiscal authorities can only move taxes by a little ($\vartheta_1 = .2$.) The benefits stemming from the ability to use two instruments exceed the inefficiencies introduced by the absence of cooperation. As in the case of no fiscal policy response, the outsiders' central bank is better off in the absence of cooperation than when European central banks coordinate their policies, as the non cooperative regimes allows the outsiders' monetary policy to strategically ride its more favourable tradeoff. The ECB is correspondingly worse off. Both EMU authorities prefer the small union situation. Observe also that, when fiscal policy is used together with monetary policy, the Fed and the U.S. government are basically indifferent with respect to the presence or absence of infra-European monetary cooperation (see tables 6 and 7). This result suggests that, when both policy instruments are available, flexible exchange rates between the U.S. and Europe provide a good degree of insulation to the U.S. economy with respect to changes in the way European monetary policies are conducted.[25] We leave it to the reader to use the results and intuitions provided thus far in order to complete the analysis of the results displayed in Table 7.[26]

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[25] See also Ghironi and Eichengreen (1996) on this point.

[26] Comparing the results in Table 7 to those in Table 6 provides more insights on the behaviour of exchange rates when fiscal policies are active and on the players' incentives to cooperate. In particular. observe that the difference $q^I - q^O$ decreases as we move from Table 7 (non cooperative EMS-2) to Table 6 (cooperative EMS-2). Consider the case $\vartheta_1 = .2$ in Table 7 and the situations in which the *outs* are non negligible. In these cases. the *outs*' currency appreciates in real terms against the euro (z^3 negative) and q^O is much lower than q^I. Nominal appreciation of the *outs*' currency against the euro is much larger than in Table 6, indicating that the outsiders' central bank uses its instrument aggressively. In fact, as a consequence of PPP, when the *outs*' central bank is free to choose e^3 non cooperatively, it is also free to choose the inflation differential against the *ins*' (as $q^I - q^O = -e^3$, see footnote 10.) In the presence of cooperation (Table 6), the change in e^3 is therefore smaller. Correspondingly, the *outs* do not appreciate their currency in real terms against the euro. Rather, the nominal appreciation is more of a reaction to the real depreciation caused by the fiscal authorities' behaviour along the lines suggested above. The *outs*' CPI is driven close to the *ins*', increasing the loss for the monetary authority of the outsiders. When $\vartheta_1 = .8$, the *outs*' aggressiveness in using e^3 in Table 7 (non cooperative EMS-2) is reduced, because fiscal policy already gives a substantial contribution to inflation stabilization. As a consequence, the *outs*' government's incentives prevail in influencing the real exchange rate: z^3 depreciates, and cooperation, which again drives the *outs*' CPI close to the *ins*', reinforces this effect (Table 6). Again, the ECB prefers to cooperate, while the *outs*' central bank does not.

Table 8 allows a comparison of the losses of Ecofin and the ECB across the different policymaking regimes and summarizes some of the main results obtained thus far. When two instruments are available (money and taxes), both Ecofin and the ECB are better off -- even in the case $\vartheta_1 = .2$ where fiscal authorities move taxes by very little. More importantly, the conflict between the ECB and Ecofin over the optimal size of the currency union disappears: for the reason suggested above both prefer a relatively smaller currency union.

6 Closing Europe with respect to the United States

In this section we ask to what extent our results on the choices of European policymakers depend on the presence of the United States -- *i.e.* were the two Western blocs completely isolated with respect to one another would European policymakers behave differently ? We study this possibility by closing the European economy with respect to the U.S., so that no transatlantic policy spillovers exist and the only strategic interactions are those among the two groups of European countries.

Two assumptions are necessary in order to close the European economy with respect to the United States. The first one is that no transatlantic trade in goods happens, *i.e.* that $b = 0$ in our model. Although such an extreme value for b is obviously unrealistic, trade flows across the Atlantic are of much less relevance than those occurring inside Europe, and the extreme case we want to study may still be of interest, as we shall see below.

However, the assumption of no trade in goods between Europe and the U.S. does not prevent U.S. (European) policies from having effects on the European (U.S.) economy. Trade in assets provides a second channel of transmission, that works through the uncovered interest parity conditions and the impact of nominal interest rate changes on the equilibrium in the money markets. A simple way to remove this channel of transmission is by assuming that the demand for real money balances in each country is completely inelastic to the nominal interest rate, *i.e.* by setting $\lambda = 0$ in equations (12). In this case, although capital mobility remains perfect, economic policy choices have no external effects across the Atlantic. The U.S. becomes a large economy totally unaffected by

While in the case of fixed fiscal policies the ECB has a greater incentive to cooperate when the currency union is large, in the case of active fiscal policies, at least if $\vartheta_1 = .2$, the ECB prefers a small union and its gain from cooperation decreases as the size of the union increases, *i.e.* the ECB's incentive to cooperate is higher when the union is small. This seems counterintuitive if we recall that small outsiders are more aggressive. Fiscal policy is crucial in determining the result. If we move from the non cooperative EMS-2 case of Table 7 to the cooperative one in Table 6, the insiders' fiscal policy, which no longer has to cope with the contractionary bias of non coordinated monetary policies in Europe, changes in a direction that is not favourable to inflation stabilization, and this change is more relevant when $a = .5$. Consequently, even though the outsiders are less aggressive when their size is the same as the *ins*', it becomes more attractive for the ECB to coordinate its monetary policy with that of the *outs*' central bank.

European policies, and insiders' and outsiders' choices affect only on the two European economies.[27]

When the previous assumptions are made, and the monetary regime inside Europe is asymmetric, the reduced form equations for employment in the three countries (equations (24) in Section 2) are simply given by:

(32) $$n^j = m^j - \tau^j; \qquad j = US, I;$$

(33) $$n^O = m^I + \chi(\tau^I - \tau^O) + \phi e^3 - \tau^O;$$

where our assumptions about structural parameter values imply $\chi = .33$ and $\phi = 1.33$. Note that, if the exchange rate regime in Europe were symmetric and both European central banks controlled the respective money supplies -- as in equations (24') -- setting $\lambda = 0$ would imply that domestic policies have no effects on employment abroad. Endogeneity of the outsiders' money supply due to the managed exchange rate regime in Europe allows insiders' policies to have an impact on employment in the outsider countries.

Reduced form equations for the CPI's when $a < 1$ are as follows:

(34) $$\begin{aligned} q^{US} &= \mathrm{A}m^{US} + \mathrm{E}\tau^{US} + x; \\ q^I &= \mathrm{A}m^I + \mathrm{E}_1\tau^I + \mathrm{E}_2\tau^O - \mathrm{M}_2 e^3 + x; \\ q^O &= \mathrm{A}m^I + \mathrm{E}_2\tau^O + \mathrm{E}_1\tau^I + \mathrm{M}_3 e^3 + x; \end{aligned}$$

where we have maintained the convention that parameters which are not indexed by a number do not depend on a and $\mathrm{E}_1 + \mathrm{E}_2 = \mathrm{E}$, as before, $\mathrm{M}_2 = \mathrm{E}_2$ and $\mathrm{M}_2 + \mathrm{M}_3 = 1$.

In the case in which the *outs* are a small open economy ($a = 1$), the U.S. and the *ins* face each other as two large closed blocs, and CPI's are given by:

(35) $$q^j = \mathrm{A}m^j + \mathrm{E}\tau^j + x; \qquad j = US, I;$$

(36) $$q^O = \mathrm{A}m^I + \mathrm{E}\tau^I + e^3 + x.$$

Our assumptions about structural parameters imply the values for the reduced form parameters displayed in Table 9.

[27] A zero value for the interest rate semi-elasticity of money demand is the standard assumption of many models of international policy interactions (See Canzoneri and Henderson, 1991 for an example.) It implies, however, that economic policies have no effect on output and employment abroad if exchange rates are flexible, and it prevents a negative supply side shock from causing unemployment. Moreover, setting $\lambda = 0$ not only insulates the European and U.S. blocs, when the assumption is combined with $b = 0$, but also removes a channel of transmission of *infra*-European policy spillovers. Thus, the situation that we are going to consider for the two European regions differs from that of a 2-country model in which both channels of transmission matter. Nonetheless, the results that follow about the two European regions -- which correspond to those that would be obtained in a simple 2-country model in which externalities only originated from trade in goods -- allow us to make explicit comparisons between the situation in which there are transatlantic policy spillover and that in which the two Western blocs are completely closed with respect to each other.

Computing the equilibrium for the non-cooperative EMS-2 regime with fixed taxes leads to the results summarized in Table 10 (see Table 4 for the corresponding results in the presence of transatlantic spillovers.)

The first thing to be observed is that the conflict of interest between Ecofin and the ECB over the dimension of the currency union vanishes: both authorities are monotonically better off when the size of the union increases. In the case of the ECB, this is a consequence of the CPI being a decreasing function of a. As the currency union gets larger, the outsiders' central bank becomes more aggressive -- consistently with the results obtained above; however, imported inflation from the *outs* is less relevant for the *ins* than when the size of the union is relatively small, since imports from the *outs* decrease with their size.[28] Consequently, the degree of monetary contraction by the ECB decreases as the union becomes larger, being equal to the Fed's contraction when $a = 1$. However, differently from what happened in Table 4, the *ins'* CPI decreases monotonically as the union gets larger, indicating that even if the monetary contraction becomes milder, the effect of lower imported inflation from the *outs* dominates that of less PPI stabilization, thus allowing the ECB to achieve a better outcome in terms of the CPI.[29] Ecofin benefits from the milder monetary contraction when the union gets larger, as this directly implies a smaller employment loss.

We have observed above -- see footnote 27 -- that our exercise does not exactly reproduce what would happen in a 2-country model in which both channels of international transmission (goods and assets markets) matter. However, the results in Table 10 show that, in the framework of our 3-country model, allowing for the presence of transatlantic monetary spillovers is crucial to obtain a conflict of interests between the ECB and the Ecofin Council. In the following section we reintroduce transatlantic spillovers and we compare the results under the asymmetric infra-EU exchange rate regime analyzed thus far with those obtained under a symmetric regime. The discussion is based on the theoretical results summarized in Section 3 and will clarify how the presence of the U.S. is important in determining the results presented in Section 4.

As in Table 4, the *outs*' central bank is always better off when a increases, thanks to its more aggressive behaviour and the consequently lower CPI.[30] In Table 4, however, the *outs*' government

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[28] The effective real exchange rate of the insiders is now given by: $z^I = (1 - a)z^3$. When $a = 1$, this is obviously zero. When a increases from .5 to .75, the effective depreciation of the euro with respect to the *outs'* currency diminishes from -.0415 to -.0268.

[29] Under the assumptions of this exercise, the reduced form for the insiders' PPI reduces to: $p^I = \alpha n^I + \tau^I + x = \alpha m^I + (1-\alpha)\tau^I + x$. Since an analogous expression holds for the U.S., one immediately finds the expressions for the reduced form parameters A (= α) and E (= $1 - \alpha$). When a increases from .5 to .75 and 1, p^I increases from .4689x to .4764x and .4901x.

[30] The intuition for why the central bank of the outsiders is more aggressive when $b = \lambda = 0$ than in Table 5 is explained in footnote 31 below.

monotonically preferred a small currency union in Europe rather than a large one. This was intuitively explained by the lower employment loss induced by less aggressive exchange rate policies. Here, instead, even though $a = .5$ remains the first best outcome for the *outs*' government, the situation in which the outsiders are only a small open economy ($a = 1$) is preferred to that of large union coupled with still significant *outs* ($a = .75$.) Even though the outsiders' central bank's policy is more aggressive when $a = 1$, the milder monetary contraction by the ECB in that situation ends up inducing a smaller employment loss for the *outs* than when $a = .75$. On the contrary, when $a = .5$ the reduced aggressiveness of the *outs*' central bank prevails on the more contractionary stance of the ECB in affecting the outsiders' employment. Hence, under the assumptions of this exercise, one would expect the government of the outsiders to oppose the choice of a large rather than a small currency union, but to be in favour of a union encompassing all EU countries except a very small one rather than a large union with still significant *outs*.

The U.S. economy is obviously indifferent with respect to what happens in Europe. Note that both U.S. authorities are better off under the assumptions of this exercise than when transatlantic policy spillovers are present. If anything, this suggests that the U.S. government and the Federal Reserve may be increasingly in favour of a closure of the U.S. economy with respect to Europe, with this conclusion being stronger the smaller the size of the currency union. In the case in which $a = 1$, CPI inflation in the U.S. and in the currency union is higher than in the presence of transatlantic spillovers, but , even if the weight attached to employment in the central banks' loss functions is much smaller than that attached to inflation, the employment gain from the closure more than offsets the increased inflation loss, making closure attractive not only for the U.S. but also for European authorities. The lower unemployment more than offsets the higher inflation loss for the Fed also when the *outs* are non negligible. The only case in which a policymaker prefers the situation in which transatlantic spillovers exist is given by the ECB when the currency union is small. In that case a higher inflation loss, when cross-Atlantic spillovers do not exist, more than offsets the employment gain and induces the ECB to prefer the situation in which policies have effects on both sides of the Atlantic.

Our results suggest a reason why policymakers in Europe and in the United States may find it optimal to adopt unmodelled policies aimed at removing transatlantic monetary spillovers. By closing the U.S. and the European economy with respect to one another, policymakers remove the source of the contractionary bias that affects noncooperative transatlantic monetary interactions when policies have effects on the other side of the Ocean. The outcome -- in terms of less contractionary policies --

is similar to the one that would be achieved in the presence of transatlantic monetary cooperation.[31] However, the implicit "desirability of two isolated Western blocs" that we find for most players must

[31] Although different from that and also from the outcome achievable under a scheme of global monetary cooperation. The intuition for the difference between "closure" as we have modelled it and transatlantic monetary cooperation runs as follows. Each country's policy affects the other countries' endogenous variables through two channels of international transmission when transatlantic spillovers are allowed: trade in goods and trade in assets. Transatlantic monetary cooperation without infra-European cooperation would internalize transatlantic externalities, leaving *both* infra-European externalities at work. Setting $b = \lambda = 0$ removes both channels of international transmission across the Atlantic, but also eliminates the infra-European externality going through the financial markets, thus removing one of the sources of inefficiency in non cooperative infra-EU policymaking as well. Besides, there would be the problem of how to solve for the equilibrium with transatlantic cooperation but without infra-EU cooperation in our model. ECB-Fed cooperation would lead to the solution of the following problem:

$$\min_{m^{US}, m^{I}} hL^{Fed} + (1-h)L^{ECB}.$$

Cooperation between the Fed and the *outs*' central bank would dictate:

$$\min_{m^{US}, e^{3}} fL^{Fed} + (1-f)L^{CBO};$$

where, following our previous assumption about cooperative regimes, the weights attached to the loss functions reflect the relative dimensions of the involved economies in both problems (thus, when $a = .5$, each European economy is half the size of the U.S. economy, and $h = f = 2/3$; when $a = .75$, the *ins*' and the *outs*' economies are equal to 3/4 and 1/4 of the U.S. economy respectively, and solutions to $(1-h)=(3/4)h$ and $(1-f)=(1/4)f$ give $h = 4/7$ and $f = 4/5$.)
However, the first order conditions for the above problems, when combined, give a system of four linear equations in three unknowns, which has no solution under our assumptions. Conceptually, the problem is that we have two coalitions of players which play Nash against each other. But there is one player -- the Fed -- which is a member of both coalitions. Thus, in a sense, there is a player which is playing Nash *against* itself, and this causes the non-existence of an equilibrium.
Global monetary cooperation, on the other hand, assumes that all three monetary authorities jointly minimize an objective function of the following form with respect to their instruments:

$$L = \frac{1}{2}L^{Fed} + \frac{1}{2}\left[aL^{ECB} + (1-a)L^{CBO}\right].$$

One can check that, when transatlantic monetary spillovers exist and only monetary policies are active, that would lead to $m^{I} = m^{US} = -1.8026x$, $e^{3} = 0$, $q^{j} = .4901x$ and $n^{j} = -1.4997x$, $j = US, I, O$. Therefore, eliminating transatlantic monetary spillovers drives the values of the U.S. endogenous variables to those that would be achieved when spillovers matter under global cooperation for each value of a, but it does not do so for the insiders, which achieve the globally cooperative welfare through transatlantic spillover elimination only when $a = 1$. The difference is again given by the role of infra-European externalities: removing transatlantic externalities eliminates the source of the contractionary bias in *transatlantic* monetary interactions -- which is already welfare improving for all players in most cases -- but does not remove *completely* the inefficiency of non cooperative policymaking between the two European monetary authorities, as it is done by global monetary cooperation. Note that, from the *outs*' central bank's perspective, this inefficiency is a sources of gains, because it allows to achieve a lower inflation through aggressive exchange rate policies.
Indeed, it turns out that the central bank of the outsiders is more aggressive when $b = \lambda = 0$ -- when only one of the sources of the inefficiency exists -- than when that is not the case (as the reader can check by comparing the results in Tables 4 and 10.) An intuition for this result is as follows. In our model, central banks can achieve CPI stabilization via PPI stabilization and real appreciation. If λ differs from zero, interest rate movements induced by changes in policies affect the PPI (see equations (18) and (19).) For example, since $i^{O} = i^{I} - e^{3}$, for given i^{I}, the nominal appreciation engineered by the *outs*' central bank tends to raise i^{O} one-for-one, with a destabilizing impact on the *outs*' PPI proportional to $\alpha\lambda$. This dampens the *outs*' central banks incentives to appreciate when λ differs from zero, but this effect no longer works when money demands are not interest rate elastic, which makes appreciation more attractive. Of course, things are made more complicated by the endogeneity of i^{I}, but even if i^{O} indeed declined in equilibrium, setting $\lambda = 0$ would mean that the beneficial effect of the lower interest rate on the PPI no longer exists, which has again the effect of making appreciation against the euro a more attractive means of stabilizing CPI inflation. Observe also that, according to equations (7), when $b = 0$, a given change in z^{3} is more effective in stabilizing q^{O}. By itself, this would induce the central bank of the outsiders to pursue a smaller real appreciation against the euro to achieve a *given* degree of stabilization of the *outs*' CPI. Nonetheless, the central bank of the *outs*

not be overstated. On the one hand, it may be easier for the involved authorities to improve their welfare by explicitly coordinating their policies rather than by working to close the respective economies. On the other hand, our model is an extremely simplified description of reality: even though under the assumptions of this section policies aimed at closing the two blocs with respect to one another would be mutually beneficial in most cases, in a more realistic setting, in which, for example, trade policy is explicitly considered, policies to close the U.S. and European blocs may well have welfare decreasing effects also due to the retaliations that aggressive trade policies are likely to cause.[32] Besides, even without considering trade policy, it may be possible that, if fiscal policymakers are active players in the game, conflicts of interests among the players over the benefits from "closure" of the two Western blocs or transatlantic monetary cooperation become relevant.[33] [34]

7 A symmetric exchange rate regime in Europe

We now reintroduce transatlantic policy spillovers and compare the results obtained so far, under the assumption of an asymmetric monetary regime in Europe, with the case of flexible exchange rates: both the ECB and the central bank of the outsiders control the respective money supplies and e^3 is determined endogenously and left free to float. As mentioned in the introduction such a regime is the relevant alternative to the policymakers' plan to set up a new EMS linking insiders and outsiders.[35]

When the infra-European monetary regime is symmetric, the reduced forms of the model are given by equations (23') through (26'.) The computations for the non cooperative monetary game when fiscal policies are fixed are summarized in Table 11. When we compare the results in this table with those reported in Table 4, for the corresponding case of an asymmetric monetary regime, we immediately see that once again -- like when we had assumed away all transatlantic policy spillovers

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has a zero CPI target -- which is different from achieving the same CPI as in Table 4 -- and this consideration, coupled with the arguments sketched above about the impact of $\lambda = 0$, helps understanding the central bank's increased aggressiveness when transatlantic spillovers are removed.

[32] Basevi, Delbono, and Denicolo' (1990) analyze a formal model of monetary and trade interactions. For some contributions to the debate on trade and currency areas, see Federal Reserve Bank of Kansas City (1991.)

[33] See Ghironi and Eichengreen (1996) for a discussion of disagreements between central banks and governments on the desirability of transatlantic monetary cooperation.

[34] As the results of Table 10 are sufficient to make the point that "the presence of the U.S. does make a difference" in our model, we do not discuss here the results of the simulated game when infra-EU monetary cooperation and fiscal activism are considered. It is possible to show that, when monetary cooperation is coupled with (limited) fiscal activism, all players agree on the desirability of a small currency union under the assumptions of this section. The results of the simulations are available from the authors upon request.

[35] The debate mainly focuses on an EMS-style arrangement versus a flexible exchange rate regime coupled with inflation targeting. Here, in order to focus on the role of the exchange rate regime in affecting the results, rather than assuming rigid inflation targeting rules, we maintain the assumption that central banks choose their instruments to minimize loss functions in which a much larger weight is attached to inflation than to unemployment. The implications of rigid inflation targeting are discussed by Persson and Tabellini (1996.) Frankel (1989) analyzes alternative rules for the conduct of monetary policy.

-- the conflict of interests between the ECB and the Ecofin Council disappears. Both authorities monotonically prefer a large union to a small one. Ecofin's preference for the large union is intuitively justified by the behaviour of employment as a varies. Instead, the ECB turns out to be better off when inflation is relatively high than when it is lowest ($a = .5$.)

In order to interpret the results for the alternative infra-EU regimes and to understand the role of the U.S. in our model, it is important to refer to the results summarized in Section 3 about the tradeoffs faced by the various policymakers. We know from the discussion in that section that, under the symmetric infra-EU exchange rate regime, when the *outs*' size is non negligible ($a < 1$), the insiders face a more favourable tradeoff than the United States. Nonetheless, the ECB ends up being worse off than the Fed, and this happens not withstanding the fact that q^I is smaller than q^{US}. The crucial point is that the ECB, which has to cope with the impact of the *outs*' central bank aggressive policy when $a < 1$, "rides" its more favourable tradeoff with respect to the Fed's one much more aggressively, the more so the smaller is a, in a successful attempt at exporting inflation to the U.S. via real appreciation of the euro against the dollar. However, in doing so, the ECB imposes an employment loss to the *ins*' economy which more than offsets the inflation gain, even if the weight attached to employment in the central banks' loss functions is much smaller than that attached to inflation. As we move from the small currency union towards the situation in which the *outs* are negligible, the *ins*' tradeoff approaches the United States', and the incentive for the ECB to "ride" aggressively a more favourable tradeoff with respect to the Fed's is removed. Even if q^I rises, the ECB is made better off by the relevant employment gain.

When the infra-EU exchange rate regime was asymmetric and significant *outs* existed (Table 4), the ECB preferred a small union because, facing the same tradeoff as the U.S. irrespective of the union's size, the *ins*' central bank had a smaller incentive to dump the *outs*' aggressive behaviour to the U.S. economy. As a consequence of this, the ECB's monetary stance was always less contractionary than in Table 11 and, as we have seen, when the union was large, the milder monetary contraction ended up destabilizing the PPI. With a symmetric exchange rate regime in Europe, the ECB prefers the large union for exactly the opposite reason: facing a more favourable tradeoff than the U.S., the *ins*' monetary authority has a much stronger incentive to "ride" it aggressively in order to export to the U.S. the inflation it imports from the *outs* -- the more so the smaller the currency union -- but this has destabilizing consequences on employment which outweigh the inflation gain.[36]

[36] This argument is consistent with the pattern of the dollar-euro real exchange rate that we observe in our simulations: the dollar appreciates in real terms against the euro under the EMS-2 regime, but it depreciates under the symmetric regime, when the ECB implements a much more aggressive monetary policy vis-à-vis the Fed. Besides, the results of this exercise seem to suggest that the potential gains from "approximating transatlantic cooperation via

Note that, as it should have been expected, the infra-European exchange rate regime is irrelevant when $a = 1$ -- in that case the results in Table 11 and in Table 4 are identical. When the outsiders are negligible, the monetary arrangement governing infra-EU interactions is irrelevant also from the *outs*' perspective because in that case the tradeoffs faced by *all* authorities do not change across exchange rate regimes in Europe.

If the *outs*' are non negligible and the infra-EU regime is symmetric, their central bank prefers a large rather than a small union -- as it happened in Table 4 -- because in that situation it achieves a better stabilization of the CPI, which offsets the employment loss due to a more contractionary stance. The central bank of the outsiders is more aggressive when $a = .75$ than when $a = 1$, even though its tradeoff is better in the latter case. Still, the *outs*' central bank achieves a better outcome in terms of the CPI when $a = 1$, and suffers a smaller employment loss than when the *outs* are non negligible. This is an example of a situation in which, faced with a more favourable tradeoff, the policymaker refrains from "riding it" very aggressively, optimally trading control of inflation for employment stabilization. When the infra-EU exchange rate regime is symmetric and their size is negligible, the *outs* can thus achieve the same outcome as under the EMS-2 regime without having to increase the contractionary character of their policy with respect to the case $a = .75$. The intuition for this result lies in the different characteristics of the alternative exchange rate regimes in Europe. As the reader can check by comparing the reduced form equations under the two regimes, when the managed exchange rate regime is implemented in Europe, due to the endogeneity constraint on m^O, the reduction in the *ins*' monetary contraction going from $a = .75$ to $a = 1$ has a *harmful* impact on the *outs*' CPI. As a consequence, the *outs*' central bank optimally reacts by strengthening its contractionary stance. When the endogeneity constraint on m^O is removed and the infra-European monetary arrangement is symmetric, going from $a = .75$ to $a = 1$, the less contractionary policy by the ECB is *beneficial* in terms of stabilizing q^O -- and m^I has a larger impact on it. Consequently, the central bank of the outsiders reacts optimally by loosening its stance. Note that when $a = .75$, the *outs*' CPI is lower under the symmetric regime than under the asymmetric one, but this reduction in the CPI is achieved at the cost of a relevant employment loss, which ends up making the *outs*' central bank worse off under the symmetric regime.

The previous observations make it clear why the government of the outsiders considers being a "small open economy" the first best situation under a symmetric regime, but would choose the small union outcome rather than the large union. In Tables 4 and 10, $a = .5$ was the best possible

isolation of the two Western blocs", could be bigger when both European central banks control the respective money supplies, as this induces more contractionary transatlantic interactions than those in Table 4.

outcome for the *outs*' government, as explained above. As we go through our exercises, $a = 1$ raises from the bottom to the top position in the ranking of the *outs*' government's preferences.[37] The change between the EMS-2 regime with and without transatlantic externalities has been motivated in Section 5, whereas the difference between the asymmetric and the symmetric regimes with transatlantic spillovers is intuitively explained by the *outs*' central bank behaviour. With $a = .5$ there is no way for the central bank of the outsiders to actually export inflation to the *ins*, given the completely symmetric positions of the two European central banks. Thus, although the contractionary bias of non cooperative policies still exists, the monetary stance of the *outs*' central bank is less contractionary than when $a = .75$, when the central bank can actually take advantage of a more favourable tradeoff than the *ins*' and does it aggressively. When a rises from .75 to 1, the outsiders' employment-inflation tradeoff improves further, as it happened under the asymmetric regime, but the central bank manages to achieve the same outcome as under that regime by means of a less contractionary policy than when $a = .75$ and only slightly more contractionary than when $a = .5$. Combined with the ECB's and the Fed's less contractionary policies -- motivated by the fact that their tradeoffs are now equal -- this contributes to give the best employment outcome for the *outs*' economy when $a = 1$, contrary to what happened under the asymmetric regime.

Finally some remarks on the U.S. authorities. Differently from the ECB, the Fed's ranking of preferences when the infra-EU regime is symmetric is driven by the inflation outcome. The U.S. central bank considers $a = 1$ the best possible situation, but would prefer a large union rather than a small one when the *outs*' are a significant entity. Hence, when $a < 1$, there is a preference reversal with respect to what happened when the EMS-2 regime was implemented in Europe. Again, the results summarized in Section 3 help us understand what happens. Under the EMS-2 regime, both the ECB and the Fed always face identical tradeoffs, and both suffer from the *outs*' aggressive behaviour when $a = .75$. When the infra-EU regime is asymmetric, the ECB does not have the possibility of exploiting a more favourable tradeoff when the *ins*' size is smaller than the United States'. Instead, if the exchange rate regime in Europe is symmetric and the *outs* are non negligible, the ECB faces a more favourable tradeoff than the Fed, the more so the smaller the currency union. As we have noted above, a consequence of this is that the ECB's attitude towards the U.S. monetary authority in dumping on it the consequences of non cooperative policies within Europe is much more aggressive when $a = .5$ than when $a = .75$. Besides, as it happened under the EMS-2 regime, the *outs*' central bank always faces a better tradeoff than the Fed, and it faces the same tradeoff as the

[37] Letting $\succ$ denote "preferred to" and omitting the a's, under the EMS-2 regime, the ranking of the *outs*' government preferences was: $.5 \succ .75 \succ 1$; under "closure" of the two Western blocs, it was: $.5 \succ 1 \succ .75$; and under the symmetric regime we have $1 \succ .5 \succ .75$.

ECB's when $a = .5$. Even though the tradeoff faced by the *outs*' worsens as a changes from .75 to .5, when the infra-EU exchange rate regime is symmetric, the overall monetary stance of Europe towards the U.S. -- measured by $[am^I + (1-a)m^O]$ -- is more aggressive when the currency union is small. When $a = .75$, the ECB's policy is less contractionary, while the *outs*' central bank is more aggressive. Combining these observations with the fact that, as the reader can check, the effect of m^I on q^{US} is larger when $a = .75$ and the impact of m^O is larger when $a = .5$ explains why the U.S. central bank suffers a bigger loss in the latter situation.[38]

Thanks to the change in the Fed's ranking of preferences, both the monetary authority and the U.S. government share the same ranking of preferences when the infra-European monetary arrangement is symmetric -- and no cross-regime preference-reversal happens for the U.S. government. The monetary contraction implemented by the Fed is tougher the smaller the currency union, reacting to the policies implemented by the two European central banks. As a consequence, even though the Fed does not achieve the goal of having lowest inflation when the union is smallest, the employment loss increases as the size of the currency union decreases, and the U.S. government monotonically prefers a large union outcome rather than the small union case.

What would happen if the two European central banks cooperated with one another in the game in which only monetary policies are used actively? The answer is straightforward, as we know from Section 4. Results for the U.S. and insiders' authorities would coincide with those obtained in the absence of cooperation with $a = 1$, while the *outs*' variables and losses would be "driven" to the same values as for the U.S. and the *ins*' ones in the $a = 1$- no cooperation case. No exchange rate change would be observed. Consequently, policymakers in the U.S. and in the insider countries would favour monetary cooperation inside Europe, analogously to what happened under the asymmetric exchange rate regime of Section 4. Instead, a conflict of interests would arise between the outsiders' government and central bank. The former would like European central banks to cooperate, as this would greatly reduce its unemployment loss. But the latter would be prevented from using the exchange rate as a strategic device to stabilize inflation, and would suffer from a larger loss.

Tables 12 and 13 describe the outcome when (limited) fiscal activism is introduced, in the case of a symmetric monetary regime with and without cooperation, respectively.[39]

[38] We remark that the key in driving the result is the change in the position of the *ins*' employment-inflation tradeoff with respect to the U.S. one, the *outs*' tradeoff being unchanged across infra-EU regimes.

[39] We recall that in the case of limited fiscal activism governments choose taxes to minimize:

$$L^{fa^j} = \frac{1}{2}\left\{.2\left[.1\left(q^j\right)^2 + .9\left(n^j\right)^2\right] + .8\left(\tau^j\right)^2\right\}; \qquad j = US, I, O.$$

As in Section 5, adding active fiscal policies as stabilizing devices against the impact of the shock has a welfare improving effect for all players. In the case of monetary cooperation, since the infra-EU exchange rate regime is symmetric, if $a = .5$, even if fiscal externalities are not internalized, the euro-*outs* exchange rate does not move because optimal policies are identical for both the *ins*' and the *outs*' policymakers. The exchange rate between insiders and outsiders does move when $a = .75$, in which case optimal policies differ. Insiders' authorities prefer a small rather than a large union and the same is true for U.S. policymakers. Instead, the outsiders' central bank and government both prefer a large rather than a small union. These results are analogous to those presented in Table 6 for the case of an asymmetric regime in Europe. We leave it to the reader to interpret them on the basis of the intuitions and tools provided throughout the paper.

All policymakers are better off when governments can use fiscal policy to react to exogenous shocks, even in the absence of monetary cooperation. In this case we observe again a conflict of interests between Ecofin and the ECB on the desired size of the European currency union: the ECB prefers a small union, while Ecofin prefers a large one. This is different from what happened under the EMS-2 regime in Europe (Table 7), in which case both the insiders' authorities preferred the small union outcome. The difference in the ranking of Ecofin's preferences with respect to Table 7 is due to the fact that, under the symmetric regime, the employment loss increases as the size of the union decreases, while the opposite happened under the EMS-2 regime. When $a = .5$ and the exchange rate regime is symmetric, the European authorities face identical employment-inflation tradeoffs. As the size of the *outs* increases from $a = 1$ to $a = .5$, the tradeoff faced by the ECB becomes steeper. The symmetry between *ins* and *outs* that is achieved when $a = .5$ induces the ECB to behave more aggressively, differently from what happened in the EMS-2 case of Table 7, with contractionary consequences on the *ins*' economy. The small union case represents the first best for the *outs*' government, whereas the central bank monotonically prefers a large union. Both U.S. policymakers favour the small union case over the large one. Again, we leave it to the reader to go deeper into the interpretation of the results presented above.[40]

8 Conclusions

In this paper we have addressed the issue of the optimal size of the European currency union concentrating our attention on the effects of the interactions among fiscal and monetary authorities in Europe, and between Europe and the rest of the world. We have argued that explicitly considering

[40] A thorough discussion of the results obtained when fiscal authorities are active players in the game would require references to the tradeoffs faced by the governments under the symmetric infra-EU regime. We refrain from exploring the issue here for reasons of brevity.

the presence of the rest of the world -- that we have called "the U.S." -- is important in understanding policymakers' incentives and behaviour. In our analysis, we have always maintained the same assumptions about the way European and U.S. authorities interact with each other, *i.e.* non cooperatively and under a flexible exchange rate regime.[41]

Consider the institutional setup that, we believe, will most likely characterize the future working of EMU: frozen fiscal policies and non cooperative monetary policies under an EMS-2 regime in Europe. In this setup, the view that central bankers would prefer the currency union to be relatively small, while Ecofin would prefer it to be relatively larger, is confirmed by our analysis -- provided the size of the outsiders is non negligible. The only way to obtain an agreement between Ecofin and the ECB on the desired size of the currency union is either by convincing the central banks of the *ins* and *outs* to cooperate (in which case the size of the currency union becomes irrelevant), or by allowing governments to actively use fiscal policy in response to exogenous shocks. But the outsider central bank stands to loose from cooperating with the ECB -- independently of the degree of fiscal policy activism and of the size of the outsiders relative to the insiders. Moreover, it always prefers the currency union to be relatively large because this is the situation in which it can best exploit its ability to export inflation to the insiders by aggressively "riding" the more favourable output-inflation tradeoff it faces. This suggests a potentially important reason (which may run against different arguments in favour of joining the single currency) why some states may be unwilling to join the currency union and, once they are out, their central banks may be unwilling to enter a cooperative agreement with the ECB.

Table 14 shows the preference rankings of the various players over the size of the European currency union for the case of non cooperative monetary interactions with fixed taxes in the three different environments that we have analyzed: EMS-2, closed Western blocs, and flexible exchange rates in Europe. In the table, the a's are omitted to save on notation, and $\succ$ denotes "preferred to", whereas $\approx$ denotes "indifferent to".

For almost all players and in all the three different settings that we have analyzed, the situation in which the currency union in Europe encompasses the whole EU except for a small entity is the first best outcome. This result parallels that obtained by Alesina and Grilli (1994), though in a different model and under different assumptions. The one authority which does not always prefer that outcome is the *outs*' government, which ranks $a = 1$ first only when the exchange rate regime in Europe is symmetric for the reasons discussed above.

[41] Alternative transatlantic arrangements are studied in Ghironi (1993) and Ghironi and Eichengreen (1996.) In both those analyses, EMU is assumed to encompass the whole EU, so that there are no *outs*. Those models, however, allow for the absence of fiscal cooperation within the currency union.

Potential conflicts of interests can arise within one country over the optimal size of the currency union. Not only we find a conflict between Ecofin and the ECB under the EMS-2 regime in Europe, but also, while the central bank of the outsiders always prefers $a = .75$ to $a = .5$, the opposite holds for the *outs*' government. Given a significant size for the *outs*, the latter would always choose a small rather than a large currency union. Also the Federal Reserve and the U.S. government may disagree over the optimal size of the European currency union if an EMS style regime were to be implemented in Europe, with the Fed preferring a small union and the U.S. a large one if $a < 1$. Nonetheless, even if U.S. policymakers will be interested spectators of what happens in Europe and transatlantic interactions do affect all policymakers' welfare, it does not seem likely that European policymakers will condition their choices about the size of the currency union in 1998 and in the following years on U.S. authorities' preferences.

As our model suggests, in 1998, when the initial size of the currency union is to be decided, strategic interactions among players could justify considerable strain in the choice process. This may be true irrespective of monetary and fiscal policymakers having different preferences across countries. The outcome will depend on the relative bargaining power of the various involved policymakers as well as on other political considerations that our model does not capture. The institutional framework within which the policymakers interact will play a crucial role in this process.

Note that the *outs*' government always prefers a small rather than a large union, when a is not 1, and that a currency union leaving only a negligible entity outside is not likely in 1998. This observation suggests that, if we explicitly allow for a multiplicity of outsiders' governments, rather than a single government which has "preferences over the size of its country", all of them could want to stay out of the union when this comes to life, because the small union outcome is more attractive to them. As a consequence, it would be hard to find *outs*' governments actually willing to join the union either from its beginning or after that time. Resistance by outsiders' governments to join could lead to an initially relatively small currency union, thus meeting the preferences of the ECB if the EMS-2 regime were to be implemented. The intuition about a multiplicity of *outs*' governments cannot be overstated, however. The conclusion of our model is based on the assumption that the *outs* act as a unified bloc, which is analogous to assuming that all *outs*' central banks cooperate with each other and all *outs*' governments do the same. Allowing for the possibility of non cooperative strategic interactions within the group of the outsiders may significantly affect the results, and would allow a better analysis of the problem.[42] We leave this issue for further research on the topic.

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[42] Recall that we have also implicitly assumed that all *ins*' governments cooperate within the Ecofin Council, but this need not be the case.

The previous observations lead us naturally to a second set of remarks. After the initial size of the currency union has been chosen, the natural evolution of the union itself as dictated by the Maastricht Treaty would be its enlargement over time to cover the whole European Union. Our result that $a = 1$ is the first best outcome for most players -- including the U.S.! -- lends support to the advocates of the desirability of such outcome. Suppose that potential conflicts between the ECB and the Ecofin Council either are not an issue or are resolved in favour of the enlargement option.[43] Still, the results of our simulations suggest that the remaining *outs*' governments may not find joining the union attractive.

The analysis of our paper assumes that all players approach 1998 and the subsequent period starting from equal initial conditions, their economies being in equilibrium, and addresses the topic from the limited perspective of the optimal reactions to a supply side disturbance. Reality is much more complicated, though. In 1998 European countries will be likely to be characterized by different economic situations. *Outs* may be *outs* either because they are not attracted by the perspective of joining the union or because they are not accepted in it or for both reasons. It is plausible that most outsiders economies will be classified as relatively weak or plagued by significant disequilibria. If their governments do not have strong incentives to join the European currency union -- and our model suggests potential reasons why this could happen -- the process of enlargement of the union envisioned in the Maastricht Treaty could prove itself slower and more conflictive than optimists normally argue.

One of the interpretations of how the process of European integration in different fields has evolved over time has to do with the idea of positive spillovers from the economic to the social and political arena, with integration starting in the economic field, deepening and then being extended to the other areas. The facts of the past lend support to this idea. But if the preferences of the *outs*' governments were to become an obstacle, this could break down the whole process when the biggest obstacle of the past -- German resistance and fear -- seems to be overcome. Fortunately, strong objections can be raised against this argument. The obvious one is that the simple analysis of this paper overlooks important political economy arguments that would explain why the outsiders are indeed likely to eventually join the union.[44] The process of integration in Europe is indeed driven

[43] At least in the first few years after the beginning of Stage III, it is likely that also the European Council will indeed attach a great value to monetary stability and to the establishment of the reputation of the ECB. Nonetheless, it is not unrealistic to think about conflictive situations of the type that we are analyzing being resolved in favour of the Ecofin Council. Our model is not suited to analyze if this could have negative consequences on the ECB's reputation, even if a simple intuition suggests that this may not be the case, as the ECB would be *forced* to accept the Council's decisions.

[44] See Eichengreen and Ghironi (1996) for a discussion of these arguments.

mainly by political reasons, which have their roots in historical events. A failure in the process of Western European integration *before*, or at least together with, enlargement to the Eastern European countries, would probably lead to Germany -- and *not* the EU -- deepening its integration with the latter countries, facilitated by historical linkages and economic interdependencies. As a consequence of the potential economic strength of this bloc, Mediterranean countries, but also the UK, would bear the risk of living "... in a Continent that, in any case, will dance to the tune of Germany, but where other countries will find their views much more difficult to be heard." Our model cannot capture these aspects of the whole process, but it suggests reasons other than cross-country differences in preferences why different policymakers may have different incentives in approaching EMU. Combining these economic incentives with political considerations in a unified framework would allow to give a comprehensive analysis of the problem, but this is well beyond the aims of this paper and it is also left for future work.

Finally, there is another dimension of the choices that the various policymakers will face by 1998 which deserves attention in this conclusion: for given initial size of the currency union, what is going to be the optimal infra-European monetary arrangement? Our analysis has been mainly focused on the choice of the optimal size of the European currency union, but the results that we have obtained with our simulations allow to give tentative answers to this other crucial question. In order to give an example, we focus our attention on the case of fixed fiscal policies and no cooperation, which seems to be the most likely one. Table 15 summarizes the players' preference rankings in the choice between a non-cooperative EMS-2 regime (denoted by A) and the non-cooperative flexible exchange rate regime (denoted by B.) The rankings are based on the results reported in Table 4 and in Table 11.

When the European currency union includes all countries except for a small open economy, all players are indifferent as for the exchange rate regime that prevails in Europe, which is intuitively justified by the absence of any impact of the *outs*' policy choices on the rest of the world. But when the outsiders are non-negligible, in most cases the EMS-2 regime turns out to be preferred to the flexible exchange rate regime. This is justified by the results that we have discussed in the previous sections. Controlling the exchange rate allows the outsiders' central bank to achieve a better outcome than what would be achieved by controlling the money supply. Under the asymmetric regime, the employment loss is smaller, and the *outs*' government is consequently better off. Therefore, at least if fixed fiscal policies and no cooperation represent a likely scenario, the results of our exercise suggest that the *outs*' authorities will favour the adoption of an EMS style regime over that of a flexible rate arrangement. Instead, we observe a conflict of interests between the ECB and

Ecofin over what regime should be implemented. As it could have been expected on the basis of the results and intuitions discussed above, the ECB would like a flexible exchange rate regime to be adopted since this would allow it to achieve a significantly better inflation outcome by depriving the *outs*' central bank of control over the exchange rate. Nonetheless, this would come at the cost of higher employment losses, which induce Ecofin to prefer the managed exchange rate regime.

This further conflictive dimension of the debate among different policymakers over the optimal features of the European currency union does not seem to be completely unlikely. Reasons of brevity prevent us from presenting analogous tables for the other policymaking regimes we have considered. The interested reader can easily reconstruct them from the material presented above and interpret the results using the tools and intuitions discussed in the paper. Nonetheless, tables 14 and 15 are enough to drive home an important point of this paper: as 1998 approaches, conflicts of interests between policymakers are likely to arise on the different issues they face. We have discussed above the problems that may be caused by disagreements over the optimal size of the union. But also, analyses of alternative monetary arrangements between the *ins* and the *outs* in the post-EMU era should take the possibility of conflicts of interests among policymakers within one group or the other as well as across countries into account. This would increase the realism of the discussions and could improve the reliability of any normative suggestion based on them. Some ways to deal with the conflicts to which we have referred -- and with the many others that we have probably overlooked -- will have to be found to ensure a proper functioning to the European integration process. The way institutions are designed and political developments will play a crucial role with respect to these problems.

One more observation is in order before closing this paper. In all our simulations we have seen that some degree of fiscal activism makes all authorities better off with respect to the situation in which only monetary policy is used to react against the consequences of the supply side shock. This result may be interpreted as an argument against the rigid application of a "fiscal stability pact" in Europe. However, the way fiscal policy is modelled in our paper is extremely simplified. Indeed, if fiscal stability is interpreted as referring to the behaviour of deficits and debts, active budget balancing fiscal policies as those considered in the paper are not inconsistent with a "fiscal stability pact" and some flexibility of fiscal policy would be welfare improving, as the results of our simulations suggest. In order to provide a more thorough analysis of the role of fiscal policy as an active instrument available to policymakers and of the issue of fiscal discipline, extending the model to a multiperiod framework in which deficits and debt accumulation are allowed would be necessary. This is another line along which we believe it is worth extending our research in the future.

Appendix: Solution of the Model

This Appendix presents the solution of the model. The goal is finding the reduced form equations for employment and the CPI in the U.S., the *ins*, and the *outs* economies that we have presented in sections 2 and 6. Given equations (18) and (19) in the text and the definitions of the CPIs, in order to find the desired reduced forms, we need to find equations for the real exchange rates and for the nominal interest rates.

Expressions for the dollar-euro and dollar-*outs*' currency real exchange rates are obtained in several steps. Subtracting the sum of equations (8*I*) and (8*O*) from equation (8*US*), rearranging, and dividing by 2 yields the following condition:

$$y^{US} - \frac{y^I + y^O}{2} = \varepsilon(1-2b)\left[y^{US} - ay^I - (1-a)y^O\right] - \nu(1-2b)\left[r^{US} - ar^I - (1-a)r^O\right] +$$
$$+\delta\left(z^1 + z^2\right) + (1-2\eta)\left[g^{US} - ag^I - (1-a)g^O\right] + 2u.$$

We define the following notation to keep things simple in what follows. For any variable x^j, $j = US, I, O$, we let:

$$x \equiv x^{US} - \frac{x^I + x^O}{2};$$
$$\tilde{x} \equiv x^{US} - ax^I - (1-a)x^O.$$

Hence, the condition above can be rewritten as:

(A.1) $\quad y = \varepsilon(1-2b)\tilde{y} - \nu(1-2b)\tilde{r} + \delta\left(z^1 + z^2\right) + (1-2\eta)\tilde{g} + 2u.$

Now we need to find expressions for y, $\tilde{y}$, and $\tilde{r}$.

Equations (1), together with equations (18), allow us to write:

(A.2) $\quad \tilde{y} = (1-\alpha)\left(\tilde{m} - \tilde{\tau} + \lambda\ \tilde{i}\right).$

Imposing a no speculative bubbles condition on the nominal exchange rate[45] and using the uncovered interest parity conditions (equations (11) in the text), we obtain:

(A.3) $\quad \tilde{i} = -ae^1 - (1-a)e^2.$

Using the definitions of the real exchange rates, this equation yields:

(A.4) $\quad \tilde{i} = -az^1 - (1-a)z^2 - \tilde{p}.$

Combining equations (18) and (19) gives:

(A.5) $\quad \tilde{p} = \alpha\ \tilde{m} + \alpha\lambda\ \tilde{i} + (1-\alpha)\tilde{\tau}.$

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[45] Recall that static expectations are rational in our model. Expected values of all disturbances for tomorrow and beyond based on today's information are zero, and expected exchange rates for tomorrow and beyond based on today's information are independent of expected future money supplies because expected nominal wages and output prices are flexible. We can therefore impose a no speculative bubble condition such that $E(e^1_{+1}) = E(e^2_{+1}) = 0$.

Plugging this last equation into (A.4) and solving for $\tilde{i}$ yields:

$$\text{(A.6)}\quad \tilde{i} = -\frac{1}{1+\alpha\lambda}\left[az^1 + (1-a)z^2 + \alpha\ \tilde{m} + (1-\alpha)\tilde{\tau}\right].$$

Substituting (A.6) into (A.2) and rearranging, we have the desired expression for $\tilde{y}$:

$$\text{(A.7)}\quad \tilde{y} = \frac{1-\alpha}{1+\alpha\lambda}\left\{\tilde{m} - (1+\lambda)\tilde{\tau} - \lambda\left[az^1 + (1-a)z^2\right]\right\}.$$

Setting $a = 1/2$ in the previous equation, one can immediately find the expression for y:

$$\text{(A.8)}\quad y = \frac{1-\alpha}{1+\alpha\lambda}\left[m - (1+\lambda)\tau - \lambda\frac{z^1 + z^2}{2}\right].$$

We still need to find an expression for $\tilde{r}$. Using the definitions of the real interest rates and imposing a no-speculative bubbles condition on the CPIs, we obtain:

$$\text{(A.9)}\quad \tilde{r} = \tilde{i} + \tilde{q}.$$

However, the definitions of the CPIs allow to write:

$$\text{(A.10)}\quad \tilde{q} = \tilde{p} + 2b\left[az^1 + (1-a)z^2\right].$$

Plugging (A.10) into (A.9) and using (A.4), we find:

$$\text{(A.11)}\quad \tilde{r} = -(1-2b)\left[az^1 + (1-a)z^2\right].$$

Once equations (A.7), (A.8), and (A.11) are substituted into (A.1) and the governments budget constraints are taken into account, we have an expression for z^1 and z^2 as functions of the policy instruments and of the realization of the demand disturbance, u. In order to solve for the real exchange rates we need another equation that links them to the policy instruments. This is obtained as follows.

Subtracting equation (8*O*) from equation (8*I*) and rearranging gives:

$$\text{(A.12)}\quad -\left(y^I - y^O\right) - 2\delta\left(z^1 - z^2\right) = 0.$$

It is easy to verify that the following equations hold:

$$y^I - y^O = (1-\alpha)\left[m^I - m^O - \left(\tau^I - \tau^O\right) + \lambda\left(i^I - i^O\right)\right];$$

$$i^I - i^O = \frac{1}{1+\alpha\lambda}\left[z^1 - z^2 - \alpha\left(m^I - m^O\right) - (1-\alpha)\left(\tau^I - \tau^O\right)\right].$$

Hence:

$$\text{(A.13)}\quad y^I - y^O = \frac{1-\alpha}{1+\alpha\lambda}\left[m^I - m^O - (1+\lambda)\left(\tau^I - \tau^O\right) + \lambda\left(z^1 - z^2\right)\right].$$

Equations (A.12) and (A.13) allow to solve for the real exchange rate between the *outs*' currency and the euro:

$$\text{(A.14)}\quad z^1 - z^2 = -\gamma\left[m^I - m^O - (1+\lambda)\left(\tau^I - \tau^O\right)\right];$$

where we have defined:

$$\gamma \equiv \frac{1-\alpha}{\lambda(1-\alpha)+2\delta(1+\alpha\lambda)} > 0.$$

Combining equation (A.14) with the equation that results from plugging (A.7), (A.8), and (A.11) into (A.1) yields the reduced form equations for z^1 and z^2:

(A.15) and (A.16)

$$z^1 = \frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right] - \frac{\rho\varepsilon(1-2b)}{\beta}\tilde{m} + \varphi\tilde{\tau} - \gamma(1-\mu)\left[m^I - m^O - (1+\lambda)(\tau^I - \tau^O)\right] - \frac{2}{\beta}u;$$

$$z^2 = \frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right] - \frac{\rho\varepsilon(1-2b)}{\beta}\tilde{m} + \varphi\tilde{\tau} + \gamma\mu\left[m^I - m^O - (1+\lambda)(\tau^I - \tau^O)\right] - \frac{2}{\beta}u;$$

where we have defined:

$$\beta \equiv \frac{\lambda(1-\alpha)}{1+\alpha\lambda}\left[1-\varepsilon(1-2b)\right] + \nu(1-2b)^2 + 2\delta;\ \ \rho \equiv \frac{1-\alpha}{1+\alpha\lambda} > 0;$$

$$\varphi \equiv \frac{\varepsilon\rho(1-2b)(1+\lambda)-(1-2\eta)}{\beta};\ \ \mu \equiv \frac{\delta + a\nu(1-2b)^2 - \lambda\rho\left[\varepsilon a(1-2b) - \frac{1}{2}\right]}{\beta}.$$

In footnote 6 we have defined the real effective exchange rate between the U.S. and Europe as $z^{US} \equiv b\left[az^1 + (1-a)z^2\right]$. Using equations (A.15) and (A.16), the reduced form for the normalized variable $z \equiv z^{US}/b$ is given by:

(A.17)
$$z = az^1 + (1-a)z^2 = \frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right] - \frac{\rho\varepsilon(1-2b)}{\beta}\tilde{m} + \varphi\tilde{\tau} + \gamma(\mu-a)\left[m^I - m^O - (1+\lambda)(\tau^I - \tau^O)\right] - \frac{2}{\beta}u.$$

Also, equations (A.3) and (A.6) allow to write the normalized nominal effective exchange rate between the US and Europe -- $e \equiv e^{US}/b$ -- as:

$$e = ae^1 + (1-a)e^2 = \frac{1}{1+\alpha\lambda}\left[az^1 + (1-a)z^2 + \alpha\tilde{m} + (1-\alpha)\tilde{\tau}\right].$$

So that, plugging (A.17) into this equation yields the reduced form:

(A.18)
$$e = \frac{1}{1+\alpha\lambda}\left\{\begin{array}{l} \frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right] + \left[\alpha - \frac{\rho\varepsilon(1-2b)}{\beta}\right]\tilde{m} + (\varphi+1-\alpha)\tilde{\tau} + \\ +\gamma(\mu-a)\left[m^I - m^O - (1+\lambda)(\tau^I - \tau^O)\right] - \frac{2}{\beta}u \end{array}\right\}.$$

It is easy to show that if $a = .5$, then it is also $\mu = .5$, which implies that, when the *ins* and the *outs* are exactly symmetric, differences between economic policies inside Europe do not affect the effective exchange rates between the U.S. and Europe.

In order to find reduced form equations for the employment and the CPIs, we now need to find expressions for the nominal and real interest rates in our world economy. To do that, we define the world nominal and real interest rates as follows:[46]

(A.19) $i^W \equiv \frac{i^{US}}{2} + \frac{1}{2}\left[ai^I + (1-a)i^O\right];$

(A.20) $r^W \equiv \frac{r^{US}}{2} + \frac{1}{2}\left[ar^I + (1-a)r^O\right].$

We know from equation (A.11) and from the definition of z that: $\tilde{r} = -(1-2b)z$.

Also: $ai^I + (1-a)i^O = 2i^W - i^{US}$.

Plugging this into $\tilde{i} = -e$ -- which follows from (A.3) and the definition of e -- and rearranging, we have:

(A.21) $i^{US} = i^W - \frac{1}{2}e.$

And therefore:

(A.22) $ai^I + (1-a)i^O = i^W + \frac{1}{2}e.$

Recalling the definition of $\tilde{r}$, substituting $ar^I + (1-a)r^O = 2r^W - r^{US}$ into $\tilde{r} = -(1-2b)z$ and rearranging gives:

(A.23) $r^{US} = r^W - \frac{1}{2}(1-2b)z.$

So that:

(A.24) $ar^I + (1-a)r^O = r^W + \frac{1}{2}(1-2b)z.$

The world CPI is defined as:

$$q^W \equiv \frac{q^{US}}{2} + \frac{1}{2}\left[aq^I + (1-a)q^O\right];$$

[46] In the remainder of the appendix, given any variable x^j, $j = US, I, O$, the corresponding world variable is defined as $x^W \equiv \frac{x^{US}}{2} + \frac{1}{2}\left[ax^I + (1-a)x^O\right]$.

and, using the definitions of q^{US}, q^{J}, and q^{O} given in the text -- equations (4) and (7), it is easy to show that the world CPI coincides with the world PPI -- $q^{W} = p^{W}$ -- as the effects of real exchange rate movements cancel on a world scale.

Also, using equations (18) and (19), one can verify that:

(A.25) $q^{W} = p^{W} = \alpha m^{W} + (1-\alpha)\tau^{W} + \alpha\lambda\, i^{W} + x.$

Imposing the no speculative bubble condition on the world consumer price index, it follows that:

(A.26) $r^{W} = i^{W} + q^{W}.$

Hence, making use of (A.25):

(A.27) $r^{W} = (1+\alpha\lambda)i^{W} + \alpha m^{W} + (1-\alpha)\tau^{W} + x.$

In order to find reduced forms for the world interest rates, we need one more equation that expresses them as functions of the world policy instruments. From equations (8) in the text it follows that:

$$\text{(A.28)}\quad \begin{aligned} &y^{US} + ay^{J} + (1-a)y^{O} = \varepsilon\left[y^{US} + ay^{J} + (1-a)y^{O}\right] + \\ &-\nu\left[r^{US} + ar^{J} + (1-a)r^{O}\right] + g^{US} + ag^{J} + (1-a)g^{O}. \end{aligned}$$

Dividing both sides of this equation by 2, (A.28) can be rewritten as:

(A.29) $(1-\varepsilon)y^{W} = -\nu\, r^{W} + g^{W},$

which can be solved for the world real interest rate:

(A.30) $r^{W} = \dfrac{1}{\nu}g^{W} - \dfrac{1-\varepsilon}{\nu}y^{W}.$

If we observe that:

$y^{W} = (1-\alpha)n^{W} - x;$

$n^{W} = m^{W} - \tau^{W} + \lambda i^{W};$

$g^{W} = \tau^{W};$

(A.30) can be rewritten as:

(A.31) $r^{W} = \dfrac{1}{\nu}\tau^{W} - \dfrac{1-\varepsilon}{\nu}(1-\alpha)\left(m^{W} - \tau^{W} + \lambda\, i^{W}\right) + \dfrac{1-\varepsilon}{\nu}x.$

Finally, equating the right hand sides of equations (A.27) and (A.31) and solving for i^{W}, we have:

(A.32) $i^{W} = -\dfrac{\xi}{\vartheta}m^{W} + \dfrac{\sigma}{\vartheta}\tau^{W} - \dfrac{\varsigma}{\vartheta}x;$

where:

$$\xi = \alpha + \frac{(1-\alpha)(1-\varepsilon)}{\nu} > 0;\quad \sigma = \frac{1}{\nu} - 1 + \alpha + \frac{(1-\alpha)(1-\varepsilon)}{\nu} > 0;$$

$$\varsigma = 1 - \frac{1-\varepsilon}{\nu} > 0 \Leftrightarrow \varepsilon + \nu > 1;\quad \vartheta = 1 + \alpha\lambda + \frac{\lambda(1-\alpha)(1-\varepsilon)}{\nu} > 0.$$

Plugging (A.32) into (A.25):

(A.33) $q^W = p^W = \alpha\left(1-\frac{\lambda\xi}{\vartheta}\right)m^W + \left(1-\alpha+\frac{\alpha\lambda\sigma}{\vartheta}\right)\tau^W + \left(1-\frac{\alpha\lambda\varsigma}{\vartheta}\right)x.$

Increases in the world money supply raise the world consumer price index if $\lambda\xi/\vartheta < 1$. Higher world taxation has an inflationary effect. Finally, in order for the productivity disturbance to have an inflationary impact on a world scale, we assume that $\alpha\lambda\varsigma/\vartheta < 1$.

A reduced form equation for the world real interest rate can be found by plugging (A.32) into (A.27):

(A.34) $r^W = \zeta m^W + \iota\tau^W + ox;$

where:

$$\zeta = \alpha - \frac{\xi(1+\alpha\lambda)}{\vartheta} > 0 \Leftrightarrow \alpha > \frac{\xi(1+\alpha\lambda)}{\vartheta};\quad \iota = 1-\alpha+\frac{\sigma(1+\alpha\lambda)}{\vartheta} > 0;$$

and $o = 1 - \frac{(1+\alpha\lambda)\varsigma}{\vartheta} > 0$ if $1-\frac{\alpha\lambda\varsigma}{\vartheta} > \frac{\varsigma}{\vartheta}$, i.e. if the effect of the productivity disturbance on the world CPI is bigger than the effect on the nominal world interest rate in absolute value.

Given the previous results, it is easy to find reduced forms for the European and U.S. real interest rates. We omit those equations for reasons of brevity and we focus instead on the nominal interest rates, which are necessary to obtain reduced form equations for employment and CPIs. Equations (A.18), (A.21), (A.22), and (A.32) yield:

$$\text{(A.35)}\quad i^{US} = -\frac{\xi}{\vartheta}m^W + \frac{\sigma}{\vartheta}\tau^W - \frac{\varsigma}{\vartheta}x + -\frac{1}{2(1+\alpha\lambda)}\left\{\begin{array}{l}\frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right]+\left[\alpha-\frac{\rho\varepsilon(1-2b)}{\beta}\right]\tilde{m}+(\varphi+1-\alpha)\tilde{\tau}+\\ +\gamma(\mu-a)\left[m^I-m^O-(1+\lambda)(\tau^I-\tau^O)\right]-\frac{2}{\beta}u\end{array}\right\};$$

$$\text{(A.36)}\quad ai^I+(1-a)i^O = -\frac{\xi}{\vartheta}m^W + \frac{\sigma}{\vartheta}\tau^W - \frac{\varsigma}{\vartheta}x + +\frac{1}{2(1+\alpha\lambda)}\left\{\begin{array}{l}\frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right]+\left[\alpha-\frac{\rho\varepsilon(1-2b)}{\beta}\right]\tilde{m}+(\varphi+1-\alpha)\tilde{\tau}+\\ +\gamma(\mu-a)\left[m^I-m^O-(1+\lambda)(\tau^I-\tau^O)\right]-\frac{2}{\beta}u\end{array}\right\}.$$

Now recall that the following equation holds:

$$i^I - i^O = \frac{1}{1+\alpha\lambda}\left[z^1 - z^2 - \alpha\left(m^I-m^O\right)-(1-\alpha)\left(\tau^I-\tau^O\right)\right].$$

Plugging (A.14) into this equation we find:

(A.37) $i^I - i^O = -\frac{1}{1+\alpha\lambda}\left\{(\gamma+\alpha)\left(m^I - m^O\right) + \left[1-\alpha-\gamma(1+\lambda)\right]\left(\tau^I - \tau^O\right)\right\}.$

Equations (A.36) and (A.37) can be solved to obtain reduced form equations for the *ins*' and the *outs*' nominal interest rates. We find:

(A.38) and (A.39)

$$i^I = -\frac{1-a}{1+\alpha\lambda}\left\{(\gamma+\alpha)\left(m^I - m^O\right) + \left[1-\alpha-\gamma(1+\lambda)\right]\left(\tau^I - \tau^O\right)\right\} - \frac{\xi}{\vartheta}m^W + \frac{\sigma}{\vartheta}\tau^W - \frac{\varsigma}{\vartheta}x +$$
$$+\frac{1}{2(1+\alpha\lambda)}\left\{\begin{array}{l}\frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right] + \left[\alpha - \frac{\rho\varepsilon(1-2b)}{\beta}\right]\tilde{m} + (\varphi+1-\alpha)\tilde{\tau} + \\ +\gamma(\mu-a)\left[m^I - m^O - (1+\lambda)\left(\tau^I - \tau^O\right)\right] - \frac{2}{\beta}u\end{array}\right\};$$

$$i^O = \frac{a}{1+\alpha\lambda}\left\{(\gamma+\alpha)\left(m^I - m^O\right) + \left[1-\alpha-\gamma(1+\lambda)\right]\left(\tau^I - \tau^O\right)\right\} - \frac{\xi}{\vartheta}m^W + \frac{\sigma}{\vartheta}\tau^W - \frac{\varsigma}{\vartheta}x +$$
$$+\frac{1}{2(1+\alpha\lambda)}\left\{\begin{array}{l}\frac{\rho}{\beta}\left[m-(1+\lambda)\tau\right] + \left[\alpha - \frac{\rho\varepsilon(1-2b)}{\beta}\right]\tilde{m} + (\varphi+1-\alpha)\tilde{\tau} + \\ +\gamma(\mu-a)\left[m^I - m^O - (1+\lambda)\left(\tau^I - \tau^O\right)\right] - \frac{2}{\beta}u\end{array}\right\}.$$ [47]

Given the expressions for the nominal interest rates and equations (A.14), (A.15), and (A.16) for the real exchange rates, it is possible to obtain the desired reduced forms for employment and CPIs by using those equations, equations (18) and (19) in the text and the definitions of the CPIs (equations (4) and (7) in the text.) Using *Maple V R3 for Windows,* it is easy to obtain the reduced forms presented in section 6. The reduced form parameters are complicated functions of the structural parameters, whose sign is *a priori* ambiguous in several cases due to the different channels of transmission through which policies affect prices and employment.

The solution procedure that we have followed so far implicitly assumes that both European central banks control the respective money supplies, and thus yields the reduced form equations for the case of a symmetric exchange rate regime in Europe. In order to obtain the reduced forms for the EMS-2 regime that are presented in section 2, we can observe that, if the uncovered interest parity conditions are taken into account, equation (A.37) yields:

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[47] By collecting the terms ($m^I - m^O$) and ($\tau^I - \tau^O$) in the expressions for i^I and i^O one can verify that, when $a = 1/2$, the impact of ($m^I - m^O$) on i^I, i^O, is given by $-\frac{\alpha+\gamma}{2(1+\alpha\lambda)}, \frac{\alpha+\gamma}{2(1+\alpha\lambda)}$, respectively, and the impact of ($\tau^I - \tau^O$) on i^I, i^O, is given by $-\frac{1-\alpha-\gamma(1+\lambda)}{2(1+\alpha\lambda)}, \frac{1-\alpha-\gamma(1+\lambda)}{2(1+\alpha\lambda)}$, respectively.

$$(A.40)\ i^I - i^O = -\frac{1}{1+\alpha\lambda}\left\{(\gamma+\alpha)(m^I - m^O) + [1-\alpha-\gamma(1+\lambda)](\tau^I - \tau^O)\right\} = e^1 - e^2 \equiv e^3.$$

This equation can be solved for m^O as a function of e^3, m^I, τ^O, and τ^I, thus yielding the endogeneity constraint that is imposed on the *outs*' money supply under the EMS-2 regime:

$$(A.41)\quad m^O = m^I + \chi(\tau^I - \tau^O) + \phi e^3;$$

where we have defined the parameters χ and ϕ to simplify the notation. The reader can easily check from the definition of γ and by working out the expressions for χ and ϕ that these parameters do not depend on the size of the European currency union, *a*. By plugging equation (A.41) into the reduced forms obtained following the procedure described above, one obtains the reduced form equations for the EMS-2 regime presented in section 2.

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Table 1. Reduced form parameters that are independent of a

$\mathrm{A} = .26$	$\mathrm{B} = .02$	$\mathrm{E} = .75$	$\Gamma = .22$	$\Sigma = .93$
$\Lambda = .75$	$\Omega = .56$	$\Theta = .03$	$\Psi = .49$	$\mathrm{H} = .21$

Table 2. Reduced form parameters whose value depends on a

(i) managed exchange rates inside Europe:

$a = .5$								
$E_1 = .42$	$E_2 = .33$	$\Gamma_1 = .11$	$\Gamma_2 = .11$	$M_1 = .02$	$M_2 = .25$	$M_3 = .75$		
$\Omega_1 = .82$	$\Omega_2 = .26$	$\Omega_3 = 1.07$	$\Omega_4 = .51$	$\psi_1 = .24$	$\psi_2 = .25$	$\Delta_1 = .03$	$\Delta_2 = .06$	$\Delta_3 = 1.38$
$a = .75$								
$E_1 = .59$	$E_2 = .16$	$\Gamma_1 = .16$	$\Gamma_2 = .06$	$M_1 = .01$	$M_2 = .12$	$M_3 = .88$		
$\Omega_1 = .69$	$\Omega_2 = .13$	$\Omega_3 = 1.2$	$\Omega_4 = .64$	$\psi_1 = .36$	$\psi_2 = .13$	$\Delta_1 = .02$	$\Delta_2 = .03$	$\Delta_3 = 1.36$
$a = 1$								
$\Omega_3 = 1.33$	$\Omega_4 = .77$	$\Delta_3 = 1.33$						

(ii) flexible exchange rates inside Europe: *

$a = .5$					
$A_1 = .39$	$A_2 = .13$	$A_3 = .39$	$A_4 = .13$	$B_1 = .01$	$B_2 = .01$
$E_1 = .46$	$E_2 = .29$	$E_3 = .46$	$E_4 = .29$	$\Gamma_1 = .11$	$\Gamma_2 = .11$
$\Lambda_1 = .72$	$\Lambda_2 = .03$	$\Lambda_3 = .72$	$\Lambda_4 = .03$	$\Theta_1 = .015$	$\Theta_2 = .015$
$\Omega_1 = .83$	$\Omega_2 = .27$	$\Omega_3 = .83$	$\Omega_4 = .27$	$\Psi_1 = .245$	$\Psi_2 = .245$
$a = .75$					
$A_1 = .33$	$A_2 = .07$	$A_3 = .45$	$A_4 = .19$	$B_1 = .015$	$B_2 = .005$
$E_1 = .61$	$E_2 = .14$	$E_3 = .32$	$E_4 = .43$	$\Gamma_1 = .16$	$\Gamma_2 = .06$
$\Lambda_1 = .735$	$\Lambda_2 = .015$	$\Lambda_3 = .705$	$\Lambda_4 = .045$	$\Theta_1 = .024$	$\Theta_2 = .008$
$\Omega_1 = .69$	$\Omega_2 = .13$	$\Omega_3 = .97$	$\Omega_4 = .41$	$\Psi_1 = .36$	$\Psi_2 = .13$
$a = 1$					
$A_3 = .52$	$A_4 = .26$	$E_3 = .17$	$E_4 = .58$		
$\Lambda_3 = .69$	$\Lambda_4 = .06$	$\Omega_3 = 1.1$	$\Omega_4 = .54$		

* The values of Γ_1, Γ_2, Ω_1, Ω_2, Ψ_1, and Ψ_2 that appear in this part of the table can induce the reader to believe that also these parameters are identical across infra-EU exchange rate regimes. Indeed, this is not the case, and the similarity is only due to approximation. If the first value is that under flexible exchange rates and that in parenthesis refers to the EMS-2 regime, we have: if $a = .5$, $\Gamma_1 = .1112$ (.1077), $\Gamma_2 = .1112$ (.1147), $\Omega_1 = .83081$ (.82126), $\Omega_2 = .2715$ (.2619), $\Psi_1 = .24399$ (.23844), and $\Psi_2 = .24399$ (.24954); if $a = .75$, $\Gamma_1 = .1668$ (.16505), $\Gamma_2 = .05561$ (.05737), $\Omega_1 = .69505$ (.69028), $\Omega_2 = .13575$ (.13097), $\Psi_1 = .36599$ (.36321), and $\Psi_2 = .12199$ (.12477).

Table 3. Employment-inflation tradeoffs faced by outsiders and insiders

	Outs	*Ins*
$a = .5$		
	.54486	.54486
	.54486	.35337
$a = .75$		
	.64654	.44722
	.64654	.35337
$a = 1$		
	.7525	.35337
	.7525	.35337

Table 4.* Non-cooperative EMS-2, fixed taxes.	*Outs*' size negligible ($a = 1$)	*Outs*' size small ($a = .75$)	*Outs*' size equal to *ins*' ($a = .5$)
Ins' money (m^I)	- 1.8423	- 1.8843	- 1.9060
U.S. money (m^{US})	- 1.8423	- 1.8506	- 1.8550
Nominal *outs*/euro (e^3)	- 0.2130	- 0.1815	- 0.1376
Real *outs*/euro (z^3)	- 0.1168	- 0.0995	- 0.0754
Real dollar/euro (z^1)	0	- 0.0127	- 0.0193
Real dollar/*outs* (z^2)	0.1168	0.0868	0.0561
Ins' CPI (q^I)	0.4805	0.5127	0.4977
Outs' CPI (q^O)	0.2674	0.3312	0.3601
U.S. CPI (q^{US})	0.4805	0.4843	0.4813
Ins' employment (n^I)	- 1.5281	- 1.5680	- 1.5829
Outs' employment (n^O)	- 1.8111	- 1.8093	- 1.7658
U.S. employment (n^{US})	- 1.5281	- 1.5282	- 1.5308
Loss ECB	0.2206	0.2412	0.2367
Loss *ins*' government	1.0622	1.1196	1.1399
Loss *outs*' central bank	0.1962	0.2130	0.2142
Loss *outs*' government	1.4797	1.4786	1.4095
Loss Fed	0.2206	0.2223	0.2214
Loss U.S. government	1.0622	1.0626	1.0661

* In this table, and in the following ones, the values of the policy instruments and of the endogenous variables should be multiplied by x, while the values of the loss functions should be multiplied by x^2. A positive realization of x is a negative supply side shock, which lowers employment and raises the CPI.

Table 5. Cooperative EMS-2, fixed taxes.	*Outs*' size small ($a = .75$)	*Outs*' size equal to *ins*' ($a = .5$)
Ins' money (m^I)	- 1.8423	- 1.8423
U.S. money (m^{US})	- 1.8423	- 1.8423
Nominal *outs*/euro (e^3)	0	0
Real *outs*/euro (z^3)	0	0
Real dollar/euro (z^1)	0	0
Real dollar/*outs* (z^2)	0	0
Ins' CPI (q^I)	0.4805	0.4805
Outs' CPI (q^O)	0.4805	0.4805
U.S. CPI (q^{US})	0.4805	0.4805
Ins' employment (n^I)	- 1.5281	- 1.5281
Outs' employment (n^O)	- 1.5281	- 1.5281
U.S. employment (n^{US})	- 1.5281	- 1.5281
Loss ECB	0.2206	0.2206
Loss *ins*' government	1.0622	1.0622
Loss *outs*' central bank	0.2206	0.2206
Loss *outs*' government	1.0622	1.0622
Loss Fed	0.2206	0.2206
Loss U.S. government	1.0622	1.0622

Table 6. Cooperative EMS-2, active fiscal policies.	Rigid fiscal policies ($\vartheta_1 = .2$)		Flexible fiscal policies ($\vartheta_1 = .8$)	
	Outs' size small ($a = .75$)	*Outs'* size equal to *ins'* ($a = .5$)	*Outs'* size small ($a = .75$)	*Outs'* size equal to *ins'* ($a = .5$)
Ins' money (m^I)	- 1.4353	- 1.4034	- 0.2204	- 0.1907
U.S. money (m^{US})	- 1.4557	- 1.4340	- 0.2418	- 0.2221
Nominal *outs*/euro (e^3)	- 0.0171	- 0.0084	- 0.0156	- 0.0074
Ins' taxes (τ^I)	- 0.1956	- 0.2227	- 0.7937	- 0.8203
U.S. taxes (τ^{US})	- 0.1670	- 0.1668	- 0.7605	- 0.7592
Outs' taxes (τ^O)	- 0.3000	- 0.2737	- 0.8888	- 0.8654
Real *outs*/euro (z^3)	0.0479	0.0234	0.0435	0.0206
Real dollar/euro (z^1)	- 0.0209	- 0.0374	- 0.0235	- 0.0401
Real dollar/*outs* (z^2)	- 0.0688	- 0.0608	- 0.0670	- 0.0607
Ins' CPI (q^I)	0.3798	0.3677	0.0932	0.0816
Outs' CPI (q^O)	0.3627	0.3594	0.0776	0.0742
U.S. CPI (q^{US})	0.3986	0.3979	0.1134	0.1132
Ins' employment (n^I)	- 1.2233	- 1.1845	- 0.3106	- 0.2728
Outs' employment (n^O)	- 1.1070	- 1.1270	- 0.2049	- 0.2227
U.S. employment (n^{US})	- 1.2678	- 1.2657	- 0.3607	- 0.3601
Loss ECB	0.1397	0.1310	0.0087	0.0067
Loss *ins'* government	0.1514	0.1474	0.0980	0.0943
Loss *outs'* central bank	0.1205	0.1217	0.0048	0.0049
Loss *outs'* government	0.1476	0.1458	0.0943	0.0930
Loss Fed	0.1519	0.1514	0.01229	0.01225
Loss U.S. government	0.1574	0.1569	0.1052	0.1048

Table 7.
Non cooperative
EMS-2,
active fiscal policies.

	Rigid fiscal policies ($\vartheta_1 = .2$)			Flexible fiscal policies ($\vartheta_1 = .8$)		
	Outs' size negligible ($a = 1$)	*Outs'* size small ($a = .75$)	*Outs'* size equal to *ins'* ($a = .5$)	*Outs'* size negligible ($a = 1$)	*Outs'* size small ($a = .75$)	*Outs'* size equal to *ins'* ($a = .5$)
Ins' money (m^I)	- 1.5000	- 1.4408	- 1.4174	- 0.2838	- 0.2088	- 0.1771
U.S. money (m^{US})	- 1.5000	- 1.4513	- 1.4280	- 0.2838	- 0.2371	- 0.2150
Nominal *outs*/euro (e^3)	- 0.2122	- 0.1705	- 0.1217	- 0.0840	- 0.0605	- 0.0387
Ins' taxes (τ^I)	- 0.1676	- 0.1976	- 0.2269	- 0.7631	- 0.7914	- 0.8187
U.S. taxes (τ^{US})	- 0.1676	- 0.1671	- 0.1668	- 0.7631	- 0.7603	- 0.7589
Outs' taxes (τ^O)	- 0.3802	- 0.3431	- 0.3055	- 0.9673	- 0.9239	- 0.8892
Real *outs*/euro (z^3)	0.0002	- 0.0137	- 0.0236	0.0659	0.0394	0.0174
Real dollar/euro (z^1)	0	- 0.0352	- 0.0586	0	- 0.0275	- 0.0462
Real dollar/*outs* (z^2)	- 0.0002	- 0.0215	- 0.0350	- 0.0659	- 0.0669	- 0.0636
Ins' CPI (q^I)	0.3999	0.3886	0.3793	0.1138	0.0972	0.0855
Outs' CPI (q^O)	0.1877	0.2181	0.2577	0.0298	0.0367	0.0470
U.S. CPI (q^{US})	0.3999	0.3986	0.3981	0.1138	0.1133	0.1132
Ins' employment (n^I)	- 1.2719	- 1.2361	- 1.2065	- 0.3620	- 0.3093	- 0.2720
Outs' employment (n^O)	- 1.2714	- 1.2694	- 1.2637	- 0.2022	- 0.2137	- 0.2290
U.S. employment (n^{US})	- 1.2719	- 1.2679	- 1.2660	- 0.3620	- 0.3606	- 0.35997
Loss ECB	0.1529	0.1444	0.1375	0.0124	0.0090	0.0070
Loss *ins'* government	0.1584	0.1547	0.1530	0.1059	0.0975	0.0939
Loss *outs'* central bank	0.0967	0.1020	0.1097	0.0024	0.0029	0.0036
Loss *outs'* government	0.2036	0.1926	0.1817	0.1083	0.1018	0.098
Loss Fed	0.1529	0.1519	0.1514	0.0124	0.01228	0.01224
Loss U.S. government	0.1584	0.1574	0.1569	0.1059	0.1051	0.1048

Table 8. Comparison of losses.

	Loss ECB		Loss *ins*' government	
	Outs' size small ($a = .75$)	*Outs*' size equal to *ins*' ($a = .5$)	*Outs*' size small ($a = .75$)	*Outs*' size equal to *ins*' ($a = .5$)
Non-cooperative EMS-2, fixed taxes.	0.2412	0.2367	1.1196	1.1399
Cooperative EMS-2, fixed taxes.	0.2206	0.2206	1.0622	1.0622
Cooperative EMS-2, active fiscal policies, rigid taxes.	0.1397	0.131	0.1514	0.1474
Cooperative EMS-2, active fiscal policies, flexible taxes.	0.0087	0.0067	0.098	0.0943
Non-cooperative EMS-2, active fiscal policies, rigid taxes.	0.1444	0.1375	0.1547	0.1530
Non-cooperative EMS-2, active fiscal policies, flexible taxes.	0.0090	0.0070	0.0975	0.0939

Table 9. Reduced form parameters when no transatlantic spillovers exist

A = .34	E = .66		
a = .5			
E_1 = .39	E_2 = .27	M_2 = .27	M_3 = .73
a = .75			
E_1 = .52	E_2 = .14	M_2 = .14	M_3 = .86

Table 10. Non-cooperative EMS-2, fixed taxes, closed Europe ($b = 0$, $\lambda = 0$).	*Outs*' size negligible ($a = 1$)	*Outs*' size small ($a = .75$)	*Outs*' size equal to *ins*' ($a = .5$)
Ins' money (m^I)	- 1.4997	- 1.5398	- 1.5621
U.S. money (m^{US})	- 1.4997	- 1.4997	- 1.4997
Nominal *outs*/euro (e^3)	- 0.2246	- 0.1953	- 0.1517
Real *outs*/euro (z^3)	- 0.1231	- 0.1071	- 0.0831
Real dollar/euro (z^1)	0	- 0.0199	- 0.0308
Real dollar/*outs* (z^2)	0.1231	0.0872	0.0523
Ins' CPI (q^I)	0.4901	0.5032	0.5105
Outs' CPI (q^O)	0.2655	0.3079	0.3587
U.S. CPI (q^{US})	0.4901	0.4901	0.4901
Ins' employment (n^I)	- 1.4997	- 1.5398	- 1.5621
Outs' employment (n^O)	- 1.7981	- 1.7994	- 1.7637
U.S. employment (n^{US})	- 1.4997	- 1.4997	- 1.4997
Loss ECB	0.2205	0.2325	0.2393
Loss *ins*' government	1.0241	1.0797	1.1111
Loss *outs*' central bank	0.1933	0.2045	0.2134
Loss *outs*' government	1.4585	1.4618	1.4062
Loss Fed	0.2205	0.2205	0.2205
Loss U.S. government	1.0241	1.0241	1.0241

Table 11. Non-cooperative monetary game, fixed taxes, symmetric infra-EU regime.	*Outs*' size negligible ($a = 1$)	*Outs*' size small ($a = .75$)	*Outs*' size equal to *ins*' ($a = .5$)
Ins' money (m^I)	- 1.8423	- 2.0955	- 2.2497
Outs' money (m^O)	- 2.2532	- 2.3023	- 2.2497
U.S. money (m^{US})	- 1.8423	- 1.8619	- 1.8685
Real *outs*/euro (z^3)	- 0.1168	- 0.0588	0
Real dollar/euro (z^1)	0	- 0.0138	0.3810
Real dollar/*outs* (z^2)	0.1168	0.0726	0.3810
Ins' CPI (q^I)	0.4804	0.4272	0.3735
Outs' CPI (q^O)	0.2674	0.3200	0.3735
U.S. CPI (q^{US})	0.4804	0.4818	0.4823
Ins' employment (n^I)	- 1.5281	- 1.7195	- 1.8315
Outs' employment (n^O)	- 1.8111	- 1.8620	- 1.8315
U.S. employment (n^{US})	- 1.5281	- 1.5324	- 1.5339
Loss ECB	0.2206	0.2230	0.2305
Loss *ins*' government	1.0623	1.3397	1.5164
Loss *outs*' central bank	0.1962	0.2194	0.2305
Loss *outs*' government	1.4797	1.5653	1.5164
Loss Fed	0.2206	0.2219	0.2223
Loss U.S. government	1.0623	1.0683	1.0704

Table 12. Cooperative monetary game in EU, limited fiscal activism, symmetric infra-EU regime.	*Outs*' size small (a = .75)	*Outs*' size equal to *ins*' (a = .5)
Ins' money (m^I)	- 1.4471	- 1.4294
Outs' money (m^O)	- 1.4463	- 1.4294
U.S. money (m^{US})	- 1.4638	- 1.4519
Ins' taxes (τ^I)	- 0.1973	- 0.2263
Outs' taxes (τ^O)	- 0.2553	- 0.2263
U.S. taxes (τ^{US})	- 0.1671	- 0.1670
Real *outs*/euro (z^3)	0.0265	0
Real dollar/euro (z^1)	- 0.0203	- 0.0358
Real dollar/*outs* (z^2)	- 0.0468	- 0.0358
Ins' CPI (q^I)	0.3824	0.3734
Outs' CPI (q^O)	0.3728	0.3734
U.S. CPI (q^{US})	0.3988	0.3985
Ins' employment (n^I)	- 1.2246	- 1.1877
Outs' employment (n^O)	- 1.1602	- 1.1877
U.S. employment (n^{US})	- 1.2685	- 1.2674
Loss ECB	0.1408	0.1333
Loss *ins*' government	0.1520	0.1488
Loss *outs*' central bank	0.1299	0.1333
Loss *outs*' government	0.1486	0.1488
Loss Fed	0.1520	0.1518
Loss U.S. government	0.1576	0.1573

Table 13. Non-cooperative monetary game, limited fiscal activism, symmetric infra-EU regime.	*Outs*' size negligible ($a = 1$)	*Outs*' size small ($a = .75$)	*Outs*' size equal to *ins*' ($a = .5$)
Ins' money (m^I)	- 1.5000	- 1.6083	- 1.6941
Outs' money (m^O)	- 1.8401	- 1.7721	- 1.6941
U.S. money (m^{US})	- 1.5000	- 1.4587	- 1.4443
Ins' taxes (τ^I)	- 0.1676	- 0.2148	- 0.2588
Outs' taxes (τ^O)	- 0.3300	- 0.2981	- 0.2588
U.S. taxes (τ^{US})	- 0.1676	- 0.1673	- 0.1671
Real *outs*/euro (z^3)	- 0.0228	- 0.0087	0
Real dollar/euro (z^1)	0	- 0.0218	- 0.0268
Real dollar/*outs* (z^2)	0.0228	- 0.0131	- 0.0268
Ins' CPI (q^I)	0.3999	0.3332	0.2789
Outs' CPI (q^O)	0.1960	0.2341	0.2789
U.S. CPI (q^{US})	0.3999	0.3991	0.3988
Ins' employment (n^I)	- 1.2719	- 1.3413	- 1.3675
Outs' employment (n^O)	- 1.3272	- 1.3623	- 1.3675
U.S. employment (n^{US})	- 1.2719	- 1.2695	- 1.2685
Loss ECB	0.1529	0.1399	0.1285
Loss *ins*' government	0.1584	0.1815	0.1959
Loss *outs*' central bank	0.1053	0.1175	0.1285
Loss *outs*' government	0.2025	0.2031	0.1959
Loss Fed	0.1529	0.1523	0.1520
Loss U.S. government	0.1584	0.1578	0.1576

'**Table 14.** Summary of preference rankings

	ECB	*Ins'* government
Non cooperative EMS-2.	$1 \succ .5 \succ .75$	$1 \succ .75 \succ .5$
Closed Western blocs.	$1 \succ .75 \succ .5$	$1 \succ .75 \succ .5$
Symmetric regime in Europe.	$1 \succ .75 \succ .5$	$1 \succ .75 \succ .5$
	Outs' central bank	*Outs'* government
Non cooperative EMS-2.	$1 \succ .75 \succ .5$	$.5 \succ .75 \succ 1$
Closed Western blocs.	$1 \succ .75 \succ .5$	$.5 \succ 1 \succ .75$
Symmetric regime in Europe.	$1 \succ .75 \succ .5$	$1 \succ .5 \succ .75$
	Fed	U.S. government
Non cooperative EMS-2.	$1 \succ .5 \succ .75$	$1 \succ .75 \succ .5$
Closed Western blocs.	$1 \approx .75 \approx .5$	$1 \approx .75 \approx .5$
Symmetric regime in Europe.	$1 \succ .75 \succ .5$	$1 \succ .75 \succ .5$

Table 15. Preference rankings over exchange rate regimes in Europe. No cooperation.	*Outs'* size negligible ($a = 1$)	*Outs'* size small ($a = .75$)	*Outs'* size equal to *ins'* ($a = .5$)
ECB	A $\approx$ B	B $\succ$ A	B $\succ$ A
Ins' government	A $\approx$ B	A $\succ$ B	A $\succ$ B
Outs' central bank	A $\approx$ B	A $\succ$ B	A $\succ$ B
Outs' government	A $\approx$ B	A $\succ$ B	A $\succ$ B
Fed	A $\approx$ B	B $\succ$ A	A $\succ$ B
U.S. government	A $\approx$ B	A $\succ$ B	A $\succ$ B

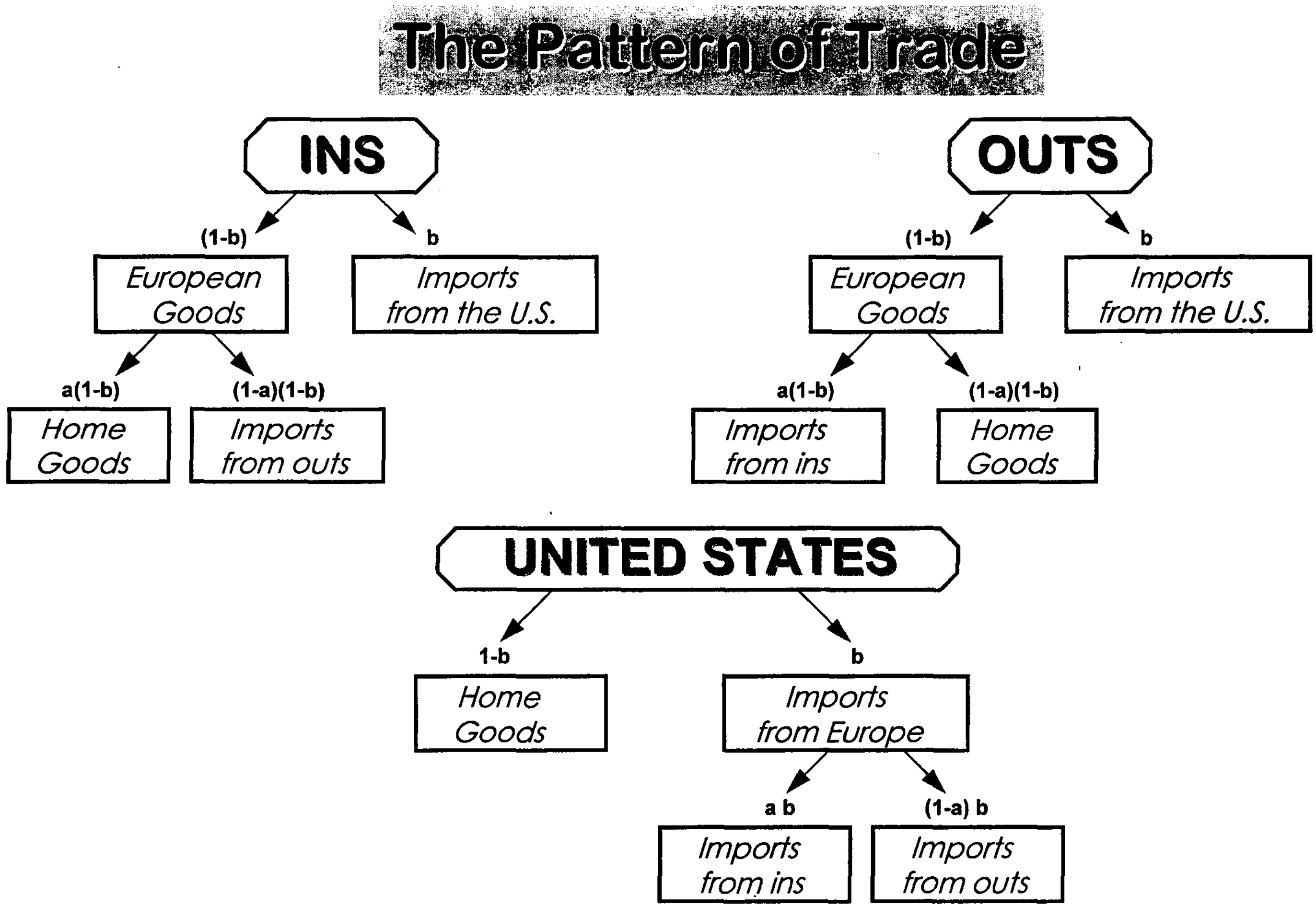
The Pattern of Trade
INS
(1-b)
b
European Goods
Imports from the U.S.
a(1-b)
(1-a)(1-b)
Home Goods
Imports from outs
OUTS
(1-b)
b
European Goods
Imports from the U.S.
a(1-b)
(1-a)(1-b)
Imports from ins
Home Goods
UNITED STATES
1-b
b
Home Goods
Imports from Europe
a b
(1-a) b
Imports from ins
Imports from outs

Figure 1

The employment-inflation tradeoff of the outsiders

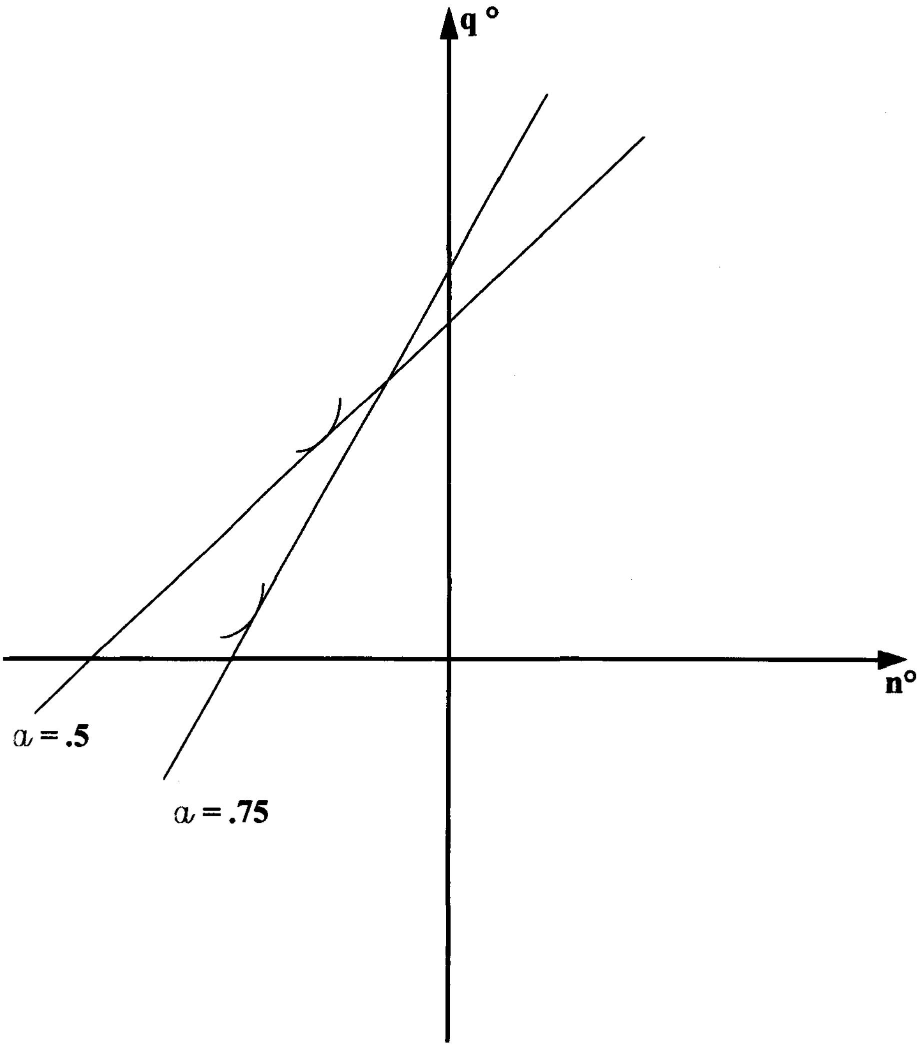

Figure 2

Employment-Inflation Tradeoffs, Symmetric Regime in Europe

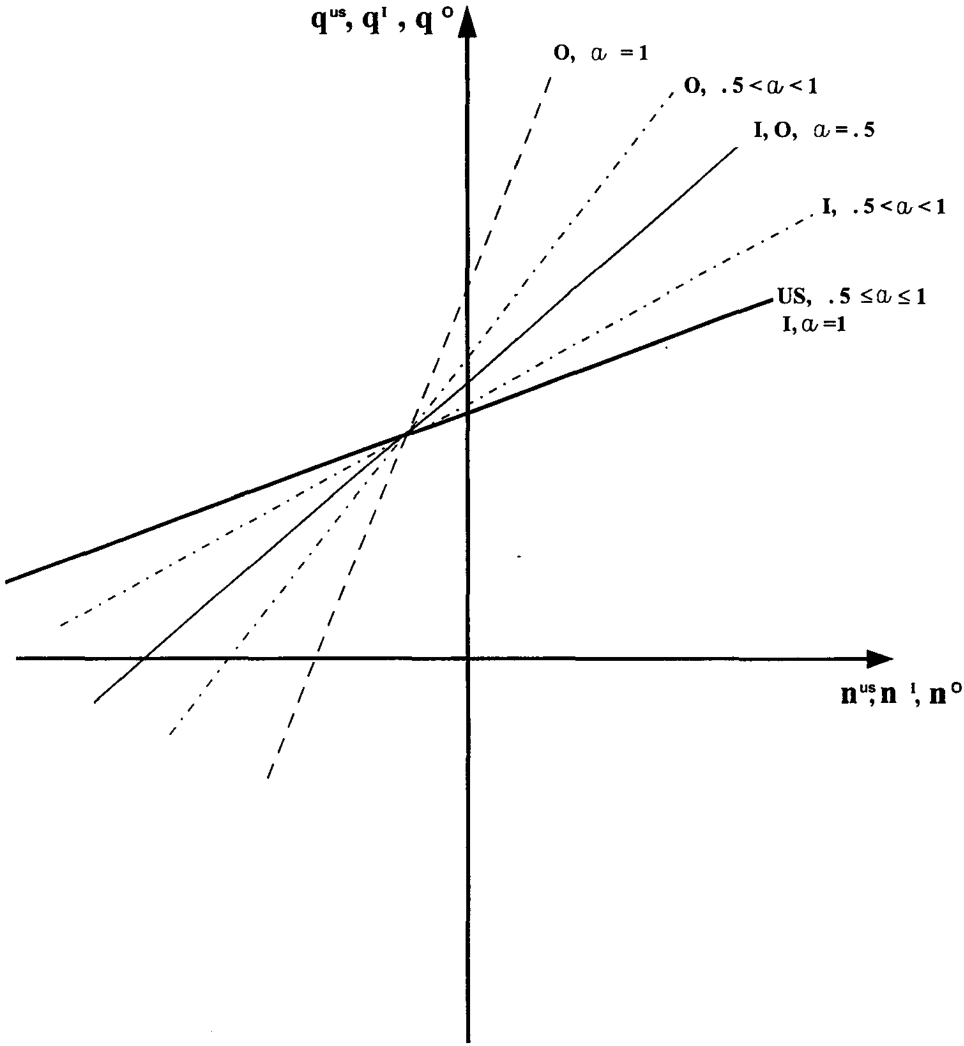

Figure 3

Employment-Inflation Tradeoffs, Asymmetric Regime in Europe

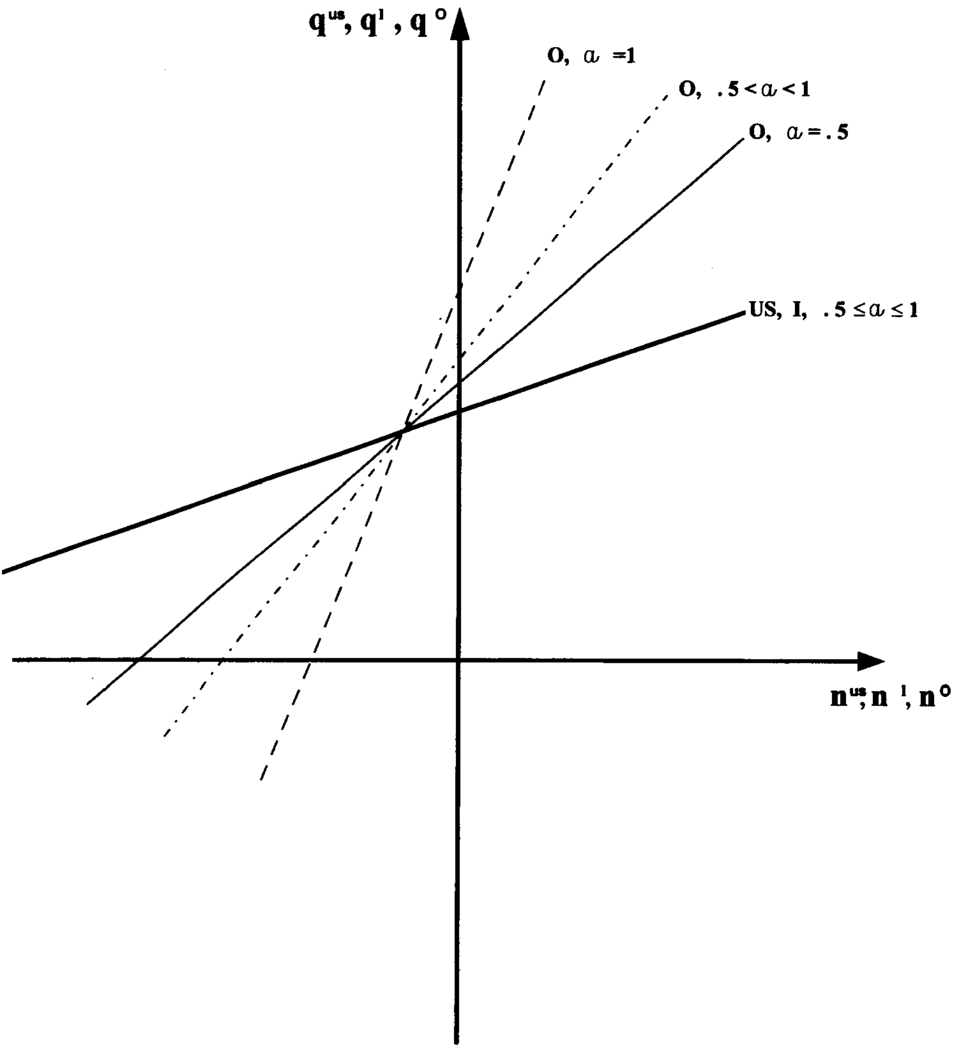

Figure 4