"PRICE AND TRADE EFFECTS OF EXCHANGE RATES FLUCTUATIONS AND THE DESIGN OF POLICY COORDINATION"

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Summary

We analyze a two-country zone facing a joint inflationary shock and responding with coordinated and uncoordinated monetary and fiscal policies.We show that the standard presumption that the absence of coordination results in an excessive exchange rate appreciation of the zone with respect to the rest of the world hinges on a specific assumption: *within* the two countries considered, the price effect of exchange rate fluctuations dominates the trade effects *relatively* to the corresponding effects vis a vis the rest of the world. If the relative hierarchy goes the other way around (as we argue is likely for EC countries), the standard conclusion is reversed, resulting of insufficiently active monetary and fiscal policies. The paper also considers asymmetric shocks as well as monetary policy coordination.

I -INTRODUCTION

The literature on policy coordination usually emphasizes one important externality of the exchange rate: the exchange rate between two currencies exerts opposite inflationary effects on the two countries under consideration. Building on this externality, Sachs (1983) and Miller and Salmon (1985) have shown that two integrated countries hit by a joint supply-side shock will (vainly) try to reduce their domestic inflation rates by attempting to appreciate their currency one against the other. This has led to the now standard presumption that, under such circumstances, uncoordinated monetary policies are too contractionary. An implication is that both countries will over-appreciate their exchange rates vis a vis third countries. (See Canzoneri and Gray (1985) for a more balanced view).

In a previous paper (Cohen and Wyplosz, 1989), we have noted that the other well-known source of beggar-thy-neighbor externalities, that the exchange rate exerts opposite effects on the trade balance and output, may deliver a different presumption on the effect of the lack of policy coordination. In the present paper, we integrate both externalities, and consider both monetary and fiscal policies. We show that the conclusion according to which the exchange rate is unduly appreciated hinges on a specific assumption: it must be that, <u>within</u> the two countries considered, the price effect of exchange rate fluctuations dominates the trade effect <u>relatively</u> to the corresponding forces at work with respect to the rest of the world. If the relative hierarchy goes the other way around (as we argue is often likely) then the standard conclusion is reversed: uncoordinated monetary and fiscal policies will fail to sufficiently appreciate the European exchange rates (with respect to a third party) in response to a joint inflationary shock.

This result can be interpreted as follows. If intra-European trade is closely integrated so that, the law of one price nearly holds

within Europe, no single European policymaker will attempt an appreciation against the others because he foresees that intra-European trade will undermine his efforts. For Europe as a whole this results into too little exchange rate fluctuation with respect to the rest of the world. Coordinating European policies permits a larger appreciation vis-à- vis the rest of the world and (efficiently) lowers European inflationary pressure.

This under-appreciation of the exchange rate (when policies are not coordinated and when trade effects are dominant within Europe) is obtained when a joint inflationary shock hits Europe. When an asymmetric shock occurs Europe countries, then, we show, the conclusion is reversed: the intra-European exchange rate is too volatile. The intuition behind this result is simply the following: when they do not coordinate their, two countries which are hit by an asymmetric shocks fail to internalize the fact that they move in opposite direction: when trade effects dominate,too the outcome is excessive a trade imbalances. In such a case, coordinating policies would yield more inflation in the country hit by an inflationary shock and less trade disequilibria within Europe.

In the last section, we analyze what happens when monetary policy alone is coordinated while fiscal policy is left at the discretion of each European policymaker. We show that, in all cases, monetary policy is looser (in the countries hit by an inflationary shock) than socially desirable. We argue that this result (which relies on a standard second best argument) is likely to be valid in a fairly large number of cases.

II - A FRAMEWORK OF ANALYSIS[1]

We analyze a world composed of three countries which we call France, Germany and the U.S. France and Germany are referred to as "Europe" and the U.S as the "rest of the world". We index with a 1

[1] The following model is an extension of Cohen (1989).

all variables referring to France and with a 2 all variables referring to Germany. France and Germany are two identical countries.

We call e the (log) of the nominal exchange rate of the Franc with respect to the Mark, e_1 the nominal exchange rate of the Franc with respect to the dollar, e_2 the nominal exchange rate of the Mark with the dollar. We have:

$$e = e_1 - e_2 \tag{1}$$

We assume that each country produces one (representative) good. The (log of the) price of the good produced by country i is $p_i(t)$. The price of the US goods is constant and normalized to be 1.

Each consumer in country i consumes a good produced in country i or turned (at a cost) into a product which looks like a country i product.

We can define (in log terms) the corresponding prices as :

$$\begin{cases} z(t) \equiv p_2(t) + e(t) - p_1(t) \\ z_1(t) = e_1(t) - p_1(t) \\ z_2(t) = e_2(t) - p_2(t) \end{cases} \tag{2}$$

z(t) is the Franco-German real exchange rate; $z_i(t)$ the real exchange rate of country i with respect to the rest of the world.

In response to any deviation of $[z(t), z_i(t)]$ from zero, we assume that home or foreign goods are shipped to the least competitive country. The transportation cost includes the cost of turning country i good into country j good. Call $TB_i(t)$ the trade balance which is triggered. We assume a finite response of the following form :

$$(3) \quad \begin{cases} TB_1(t) = h_1 z_1(t) + h\ z(t) \\ TB_2(t) = h_1 z_2(t) - h\ z(t) \end{cases}$$

so that $h_i\ z_i(t)$ represents the trade surplus of country i with the US and h z(t) is the trade surplus of France with Germany.

b - Prices

We assume that prices in each European country are set through a mark-up above labor cost which depends upon the relative prices z(t) and z(t) and upon output.

$$(4a) \qquad p_1(t) = w_1(t) + a_1\ z_1(t) + a\ z(t) + b\ Q_1(t) + \varepsilon_1(t)$$

$$(4b) \qquad p_2(t) = w_2(t) + a_1\ z_2(t) - a\ z(t) + b\ Q_2(t) + \varepsilon_2(t)$$

In both (3) and (4) we assume that France and Germany are identical, with the same response h_1 and a_1 to their exchange rate vis a vis the dollar. $\varepsilon_i(t)$, i=1,2, are two transitory disturbances. We shall examine the two cases $\varepsilon_1(t) = \varepsilon_2(t)$ and $\varepsilon_1(t) = -\ \varepsilon_2(t)$.

Wages for period t are set at the end of period t-1, before $\varepsilon_i(t)$ are known. We assume that wage earners set a nominal wage equal to:

$$w_i(t) = E_{t-1}\ p_i(t)$$

c - Policy objectives

Policymakers in country i are elected so as to minimize the following loss function :

$$L_i = \frac{1}{2} \sum_{0}^{\infty} \frac{1}{(1+r)^t} \left\{ \phi_0 \left[A_i(t) - \bar{A}\right]^2 + \phi_1 \left[Q_i(t) - \bar{Q}\right]^2 + \pi_i(t)^2 \right\}$$

in which $\pi_i(t) = p_i(t) - p_i(t-1)$ is the (current) inflation rate and $A_i(t)$ is domestic absorption. We directly assume that policymakers set directly $\left[\pi_i(t), A_i(t)\right]$. This assumption is less stringent than it seems to the extent that we only deal with transitory disturbances.

We consider that the US financial markets are large with respect to Europe and set a fixed discount factor $\frac{1}{1+r}$ which is the same as the discount factor of the representative policymaker in country i. Furthermore, we assume that the US financial markets agree ex-ante to grant France and Germany lines of credit to finance transitory flows $TB_i(t)$ at the riskless rate r (and diversify away the risk associated with $\varepsilon_i(t)$). With these two assumptions the intertemporal budget constraint faced by country i is simply:

$$E_0 \left[\sum_{0}^{\infty} \frac{1}{(1+r)^t} TB_i(t) \right] = 0 \tag{5}$$

in which $TB_i(t) = Q_i(t) - A_i(t)$ is the difference between output and absorption.

d - Nash Solution

We characterize first the solution to the Nash feed-back equilibrium of the game between the policymakers in country 1 and 2. Other solutions turn out to be particular cases of this case. Each policymaker responds to the stochastic disturbance $\left[\varepsilon_1(t), \varepsilon_2(t)\right]$ through the feed-back policy $\left\{A_i\left[\varepsilon_1(t), \varepsilon_2(t)\right] ; \pi_i\left[\varepsilon_1(t), \varepsilon_2(t)\right]\right\}$ which is best to apply when the other policymaker's response is taken as given and when the expectation of the wage earners are similarly taken a fixed. (This later assumption amounts to choosing a Nash subgame perfect equilibrium

of the game between the government and the wage earners, see Cohen and Michel (1988)).

As we assume that the disturbances $\varepsilon_i(t)$ are transitory, the private sector's expectations of inflation are constant :

$$w_i(t) = p_i(t-1) + \bar{\pi} \qquad i=1,2.$$

Both governments consequently take the price response as:

$$(6) \qquad \begin{cases} \pi_1(t) = \bar{\pi} + a_1\, z_1(t) + a\, z(t) + b\, Q_1(t) + \varepsilon_1(t) \\ \pi_2(t) = \bar{\pi} + a_1\, z_2(t) - a\, z(t) + b\, Q_2(t) + \varepsilon_2(t) \end{cases}$$

Now, consider the government of country 1. As it takes country 2 government's policy $[\pi_2(t),\ A_2(t)]$ as given, it perceives that (3) and (6), together with the identity $z_2(t)=z_1(t)-z(t)$, imply the following interaction between $z_1(t)$ and $z(t)$:

$$(7) \qquad \begin{cases} \pi_2[\varepsilon_1(t), \varepsilon_2(t)] = \bar{\pi} + a_1 z_1(t) - (a+a_1)z(t) + bQ_2+\varepsilon_2(t) \\ Q_2(t) - A_2[\varepsilon_1(t),\ \varepsilon_2(t)] = h_1\, z_1(t) - (h+h_1)\, z(t) \end{cases}$$

which can be rewritten as :

$$(8) \qquad z(t) = \theta\, z_1(t) + h_2[\varepsilon_1(t),\ \varepsilon_2(t)]$$

where $h_2[\varepsilon_1(t),\ \varepsilon_2(t)] = \pi_2[\varepsilon_1(t),\ \varepsilon_2(t)]-\varepsilon_2(t)-bA_2[\varepsilon_1(t),\ \varepsilon_2(t)]$

The parameter

$$(9) \qquad \theta \equiv \frac{a_1 + bh_1}{a+a_1 + b\,(h+h_1)}$$

is our measure of exchange rate interaction. It involves both the price externality parameter a and the trade externality parameter h. Equation (8) shows that whenever the government of country 1 changes its real exchange rate vis a vis the rest of the world z_1, it expects a change in the same direction, but less than proportional since $\theta < 1$, vis-à-vis the currency of country 1.

Substituting equation (8) into the equation describing the domestic economy one can consequently write the policymaker's program as one which minimizes L_1 subject to the following set of equations:

(9-a) $$E_0 \sum_{0}^{\infty} \frac{1}{(1+r)^t} \left[Q_1(t) - A_1(t)\right] = 0$$

(9-b) $$\pi_1(t) = \bar{\pi} + (a_1 + \theta a) z_1(t) + bQ_1(t) + \xi_1\left[\varepsilon_1(t), \varepsilon_2(t)\right]$$

(9-c) $$Q_1(t) - A_1(t) = (h_1 + \theta h)\, z_1(t) + \eta_1\left[\varepsilon_1(t), \varepsilon_2(t)\right]$$

in which ξ_1 and η_1 are the stochastic disturbances which are obtained by substituting (8) into the original law of motion of the economy.

Call ν_0, λ_t and μ_t the shadow prices associated respectively with of the constraints (9-a), (9-b) and (9-c). The first order conditions are:

(10-a) $$\phi_0(A_t - \bar{A}) = \mu_t - \nu_0$$

(10-b) $$\phi_1(Q_t - \bar{Q}) = -b\,\lambda_t - \mu_t + \nu_0$$

(10-c) $$\pi_t = \lambda_t$$

(10-d) $$(a_1 + \theta a)\,\lambda_t - (h_1 + \theta h)\,\mu_t = 0$$

Out of this system of equations, one can readily find that the policy response will set the economy on the hyperplane :

$$\phi_0(A_t - \bar{A}) + \phi_1(Q_t - \bar{Q}) + b\,\pi_t = 0 \tag{11}$$

This allows us to derive the inflation rate which is rationally expected by the private sector as :

$$\bar{\pi} = \frac{1}{b}\,(\phi_0\,\bar{A} + \phi_1\bar{Q}) \tag{12}$$

Obviously an identical set of conditions apply to country 2.

In order to find the equilibrium feed-back policy which arises when the shock $[\varepsilon_1(t),\varepsilon_2(t)]$ hits, we now distinguish the cases when the shocks $\varepsilon_i(t)$ are symmetric or asymmetric[2].

III - SYMMETRIC SHOCKS

We consider here the case when $\varepsilon_1(t) = \varepsilon_2(t) = \varepsilon(t)>0$. The symmetry of the model implies that, at equilibrium, $z(t) = 0$.

a - Nash Solution

We find the Nash solution by substituting the first order conditions (10) into:

$$\begin{cases} \pi_i(t) = \bar{\pi} + a_1\, z_i(t) + b\, Q_i(t) + \varepsilon(t) \\ Q_i(t) - A_i(t) = h_1\, z_i(t) \end{cases} \tag{13}$$

The solution can be shown to be:

$$A_i(t) = \alpha\,\delta_s\,\varepsilon(t) \tag{14}$$

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2 See Cohen and Wyplosz (1989) for an empirical analysis in the case of Europe.

(15) $$Q_i(t) = -\beta\,\delta_s\,\varepsilon(t)$$

(16) $$\pi_i(t) - \bar{\pi} = \delta_s\,\varepsilon(t)$$

where:

$$\alpha = \frac{1}{\phi_0}\,\frac{a_1 + \theta\,a}{h_1 + \theta\,h}, \qquad \beta = \frac{1}{\phi_1}\left(b + \frac{a_1 + \theta\,a}{h_1 + \theta\,h}\right), \text{ and}$$

$$\delta_s = \frac{1}{1 + \frac{a_1}{h_1}(\alpha+\beta) + b\,\beta}$$

For illustrative purposes, consider the case of a joint inflationary shock $\varepsilon_t > 0$. The results show that each country carries an expansionary monetary policy ($\alpha > 0$) and a partially accommodating monetary policy ($\delta < 1$), which brings about a recession, creates a trade deficit and appreciates the exchange rate since:

(17) $$TB_i(t) = Q_i(t) - A_i(t) = h_1\,z_i(t) = -(\alpha+\beta)\,\delta_s\,\varepsilon(t)$$

When h becomes large relatively to the other parameters, the measure of fiscal response α tends towards zero: no European country undertakes a fiscal expansion. The intuition is the following. Fiscal expansion is undertaken because it eases inflationary pressure through the appreciation of the exchange rate, the standard price externality. However, a very large intra-European trade externality h means that intra European trade prevents any substantial deviation from PPP. Put differently, the size of the fiscal action required to obtain a beggar-thy-neighbor real exchange rate appreciation is then so large as to be dissuasive. The failure to internalize the trade externality - and to realize that in equilibrium no change in the exchange rate is possible - prevents both European countries from recognizing that

it is the importance of the trade effect with the US, not within Europe, which is relevant. What is desirable, unless h_1 too is very large, is a joint fiscal expansion and a real appreciation vis a vis the dollar.

b - The Socially Optimal Solution

A European Central Planner who chooses each period $[\pi_1(t),A_1(t);\pi_2(t),A_2(t)]$ in response to a shock $[\varepsilon_1(t),\varepsilon_2(t)]$ in order to minimize the average loss function of Europe would internalize both externalities. We analyze the outcome in the present case of a symmetric shock.

Given the symmetry of the setup, it is straightforward that the European Central Planner will simply have to minimize any one of the two European countries loss function subject to the constraint that $z(t) = 0$. From (8), it is clear that the optimal coordinated policy corresponds to the policy chosen in the non-cooperative game in the case when $\theta = 0$. One can consequently write the European Central Planner's response for each European country i=1,2 as:

(18) $$A_i(t) = \alpha^* \, \delta^*_s \, \varepsilon(t)$$

(19) $$Q_i(t) = - \beta^* \, \delta^*_s \, \varepsilon(t)$$

(20) $$\pi_i(t) - \bar{\pi} = \delta^*_s \, \varepsilon(t)$$

(21) $$TB_i(t) = h_1 \, z_i(t) = - (\alpha^* + \beta^*) \, \delta^* \, \varepsilon(t)$$

where:

$$\alpha^*_s = \frac{1}{\phi_0} \frac{a_1}{h_1}, \quad \beta^*_s = \frac{1}{\phi_1}(b + \frac{a_1}{h_1}), \quad \delta^*_s = \frac{1}{1 + \frac{a_1}{h_1}(\alpha^*+\beta^*)+b \, \beta^*}$$

The comparison between the non-cooperative (NC) and the socially optimal (SOS) solutions turns out to hinge on the comparison

between $\frac{a_1 + \theta a}{h_1 + \theta h}$ and $\frac{a_1}{h_1}$. Two cases arise.

(A) $$\frac{a}{h} < \frac{a_1}{h_1} \quad \left(\text{so } \frac{a_1 + \theta a}{h_1 + \theta h} < \frac{a_1}{h_1}\right)$$

When inequality (A) is satisfied, the intra-European price effect a is less important than the trade effect h <u>relatively</u> to the corresponding <u>relative</u> hierarchy vis a vis the rest of the world. The question is <u>not</u> whether price or trade effect are important, but rather whether intra-European trade flows are <u>relatively</u> more sensitive to exchange rate changes than prices. In practice, we believe that this is likely to be the case. Indeed, dollar changes have a strong effect on European prices (through oil and other key commodities) while changes in the DM should have a (relatively) stronger effect on French trade than on price. We intend to explore in a forthcoming empirical paper whether this conjecture is verified.

At any rate inequality (A) implies the following:

(A') $$\alpha^*_s > \alpha \qquad \beta^*_s > \beta \qquad \delta^*_s < \delta$$

$$\alpha^*_s\delta^*_s > \alpha\delta \qquad \beta^*_s\delta^*_s \lessgtr \beta\delta \qquad (\alpha^*_s + \beta^*_s)\delta^*_s > (\alpha + \beta)\delta$$

A comparison of (14)-(17) and (18)-(21) shows that, in comparison with the SOS response to a joint inflationary shock, the NC response produces a <u>less</u> contractionary monetary policy, a <u>less</u> expansionary fiscal policy, resulting in a weaker real appreciation vis a vis the rest of the world.

The intuition behind this result was already apparent in the analysis of the NC equilibrium. Each non-cooperating European policymaker fails to internalize the fact that no net intra-European trade will take place at equilibrium. Given the relative strength of the trade externality, each of them (sub-optimally) restricts policy actions which would lead to a real appreciation vis a vis the other European country.

In contrast, the European central planner only takes into account the trade and price effects with respect to the rest of the world. In the present case of a relatively weak trade effect vis a vis the US, the European central planner aims at the standard beggar-thy-neighbor real appreciation: thus, when inequality (A) is satisfied, pan-European expansionary fiscal and tight monetary policies (a la Reagan-Volcker) provides a disinflation which is perceived as less effective (in trade effect terms) by the individual (non-cooperating) policymakers. In that case, the proposal of the Delors Report to restrict fiscal policy would not be a good idea.

Let us now turn to the opposite case, when the price effect dominates the trade effect:

$$\text{(B)} \quad \frac{a_1}{h_1} < \frac{a}{h} \qquad \left(\text{so } \frac{a_1 + \theta a}{h_1 + \theta h} > \frac{a}{h}\right)$$

In that case, the inequalities in (A') are reversed and the previous results are turned around. Non-cooperative policies yield an over-appreciated exchange rate with respect to the socially optimum outcome. Thus we find the traditional beggar-thy-neighbor result initially uncovered by Sachs (1983) and by Miller and Salmon (1985): each policymaker vainly attempts to appreciate its currency against the other so as to buy imported disinflation. The outcome is a tighter monetary policy and a more expansionary fiscal policy in the NC case relatively to the SOS solution (which translates here in a larger real exchange rate appreciation vis a vis the rest of the world). In the models of Sachs and Miller and Salmon the trade effect is ignored so that inequality (B) trivially applies.

c - Monetary Cooperation

A more limited - and more likely - form of policy coordination arises when monetary policy alone is coordinated while fiscal policies are left at the discretion of national authorities. It is

important to emphasize that we do not analyze here the case of monetary integration, i.e. when the money supply (or the average inflation rate) is set for the zone as a whole. Instead a we analyze the equilibrium which arises when a European monetary policy $[\pi_1(t), \pi_2(t)]$ is jointly determined in response to a shock $[\varepsilon_1(t), \varepsilon_2(t)]$ while fiscal policies are non-cooperatively chosen in response to the shock and to the European monetary policy. We postpone the analysis of monetary integration (with a fixed exchange rate and one money supply) to future work.

We first consider how fiscal policies are set in response to the shock $[\varepsilon_1(t), \varepsilon_2(t)]$ and to the European monetary policy $[\pi_1(t),\pi_2(t)]$. National policy-makers still solve the same Nash problem as in section II-d above, except that they do not control $\pi_i(t)$ any more. Accordingly, the first order conditions (10) hold with the exception of (10-c) which is simply canceled. Then, the national authorities choose their fiscal instruments $A_i(t)$ so as to always satisfy:

$$\alpha\, Q_i(t) + \beta\, A_i(t) = 0 \tag{22}$$

where α and β are the same parameters as those found in the no-cooperation Nash game (equations (14)-(16))[3].

European monetary policy now internalizes the constraint that the real exchange rate between the two European currencies is

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[3] Taking first differences with respect to the rest point ($A_i(t) = 0$, $Q_i(t) = 0$), the conditions (10-a, b and d) imply : $A_i(t) = \alpha(\lambda_i(t)-\lambda_i(0))$ and $Q_i(t) = -\beta(\lambda_i(t)-\lambda_i(0))$, where $\lambda_i(t)$ is the shadow price associated to the price equation. Then $\pi_i(t)-\bar{\pi} = -(\frac{a_i}{h_i}(\alpha+\beta) + b\beta)(\lambda_t^i-\lambda_0) + \varepsilon_i(t)$. There is a negative correlation $\pi_i(t)$ and $\lambda_i(t)$. If European monetary policy is less inflationary than in the non-coordinated case, (in response to $\varepsilon_i(t) > 0$), the response of country i's fiscal policymaker will necessarily be more active.

unchanged at equilibrium (because the two countries are identical and the shocks are symmetric), so that the price and trade balance equations are taken to be:

(23a) $$\pi_i(t) = \bar{\pi} + a_1 \; z_i(t) + b \; Q_i(t) + \varepsilon(t)$$

(23b) $$Q_i(t) - A_i(t) = h_1 z_i(t)$$

Accordingly, monetary policy is determined so as to minimize the average loss function of each country subject to the above constraints and to constraint (22) which is imposed by the fiscal response in each country.

The first order conditions of the European monetary authority can be simply characterized as :

(24-a) $$\phi_0 \; A_i(t) = \frac{a_1}{h_1} (\pi_i(t) - \bar{\pi}) + \beta \; \gamma(t)$$

(24-b) $$\phi_1 \; Q_i(t) = - \left(b + \frac{a_1}{h_1} \right) (\pi_i(t) - \bar{\pi}) + \alpha \; \gamma(t)$$

in which $\gamma_i(t)$ is the shadow price associated to equation (22). (When $\gamma_i(t)=0$, one finds the response of the European social planner).

Let $\gamma_i(t) = \hat{\gamma}(\pi_i(t)-\bar{\pi})$. Plugging (24) into (22) and (23), we get:

(25) $$\hat{\gamma} = \frac{b}{\alpha^2 \; \phi_0 + \beta^2 \; \phi_1} \left[\frac{a_1 + \theta \; a}{h_1 + \theta \; h} - \frac{a_1}{h_1} \right]$$

Unsurprisingly, we find that the sign of $\hat{\gamma}$ depends upon the sign of $a_1 \; h - a_1 \; h$. (see the interpretation below). Substituting the value of $\hat{\gamma}$ into (23) and (24), we find the equilibrium which is attained through a coordinated monetary policy and non-coordinated fiscal policies:

$$(26)\quad \begin{cases} A_i(t) = \hat{\alpha}_s\ (\pi(t) - \bar{\pi}) \quad ; \ \hat{\alpha}_s = \dfrac{1}{\phi_0}\left[\dfrac{a_1}{h_1} + \beta\ \hat{\gamma}\right] \\ Q_i(t) = -\hat{\beta}_s\ (\pi(t) - \bar{\pi}) \quad ; \ \hat{\beta}_s = \dfrac{1}{\phi_1}\left[b + \dfrac{a_1}{h_1} - \alpha\ \hat{\gamma}\right] \end{cases}$$

$$(27)\quad \begin{cases} \pi_i(t) - \bar{\pi} = \hat{\delta}_s\ .\ \varepsilon(t) \\ \hat{\delta}_s = \dfrac{1}{1 + \dfrac{a_1}{h_1}(\hat{\alpha}_s + \hat{\beta}_s) + b\ \hat{\beta}_s} \end{cases}$$

This solution can be interpreted by rewriting $\hat{\delta}_s$ as:

$$\hat{\delta}_s = \frac{1}{1 + \dfrac{a_1}{h_1}(\alpha_s^* + \beta_s^*) + b\beta_s^* - \dfrac{b^2}{\Phi_0\Phi_1}(\alpha^2\phi_0 + \beta^2\phi_1)\left[\dfrac{a_1}{h_1} - \dfrac{a_1 + \theta a}{h_1 + \theta h}\right]^2}$$

in which α_s^* and β_s^* are the parameters which characterize the socially optimal policy (see (21) above).

Thus we find that, in response to a joint inflationary shock, <u>monetary coordination without fiscal coordination is always more inflationary than monetary coordination with fiscal coordination</u>, independently of the sign of $a_1h - ah_1$.

The intuition behind this result is illustrated on Figure 1. The lines SOS and UFP correspond to equation (22), with (α^*, β^*) and (α, β), respectively. They represent the fiscal authorities optimal response in the SOS and uncoordinated fiscal policy (i.e. NC and MC) cases. The line π_{SOS} describes equation (23a) when monetary policy is set at the SOS optimal level. The two cases $a_1/h_1 \gtrless a/h$ are shown in the two panels of the figure. When trade effects dominate (figure 1a), fiscal policy is not active enough in the NC case as can be seen by comparing the SOS and NC points. When monetary policy is coordinated we are at point MC: more inflation

than socially desirable is needed to induce each European policymaker to take a more active fiscal stance (eq.(24-a)).On the other hand, when price effects dominate (figure 1b), the recession induced by an excessively appreciated exchange rate (as a result of a too expansionary **fiscal policy**) must be alleviated by a European monetary policy looser than socially desirable (eq.(24-b)).

That in both cases monetary policy is looser than in the SOS outcome is a general result, not limited to the present model. As is shown in the Appendix, it is always the case that, when one instrument is not coordinated, the value (shadow price) of the other (s) increases. With uncoordinated fiscal policies, the value of accommodating the supply-side shock with inflation increases, whatever the direction of the externalities. It is also clear that the MC outcome dominates the NC: along the UFP line common to both institutions, the European monetary authority could always choose the point NC.

In summary, we have the following outcomes:

(A) When $\frac{a}{h} < \frac{a_1}{h_1}$ (trade effects dominate):

$$\pi_{NC} > \pi_{MC} > \pi_{SOS}$$

Non-cooperative monetary policy is more inflationary than monetary coordination alone (MC), which is more inflationary than the social optimum.

Here, fiscal policy is more expansionary than in the fully non-coordinated case.

(B) When $\frac{a}{h} > \frac{a_1}{h}$ (price effects dominate), one has:

$$\pi_{MC} > \pi_{SOS} > \pi_{NC}$$

The socially optimal inflation rate is larger them the non-cooperative rate, but the inflation rate attained with monetary coordination alone <u>overshoots</u> the socially optimal rate.

Fiscal policy is less responsive than in each other instances.

IV - ASYMMETRIC SHOCKS

We consider now the case when France is hit by an adverse supply shock and Germany by a favorable shock of the same magnitude : $\varepsilon_1(t) = -\varepsilon_2(t) = \varepsilon(t) > 0$. The symmetry of the model implies that, at the equilibrium, Europe's overall trade with the U.S will be balanced: $TB_1(t) + TB_2(t) = h_1[z_1(t) + z_2(t)] = 0$. Consequently, we can characterize the equilibrium by the following conditions :

$$\begin{cases} z_1(t) = \frac{1}{2} z(t) \\ z_2(t) = -\frac{1}{2} z(t) \end{cases}$$

France will appreciate its exchange rate (to ease down the inflationary pressure), Germany will symmetrically depreciate its exchange rate (to increase output).

At the equilibrium, we have :

$$(28) \qquad \begin{cases} \pi_1(t) = \bar{\pi} + \left[\frac{a_1}{2} + a\right] z(t) + b\, Q_1(t) + \varepsilon(t) \\ \pi_2(t) = \bar{\pi} - \left[\frac{a_1}{2} + a\right] z(t) + b\, Q_2(t) - \varepsilon(t) \end{cases}$$

The outcome closely resembles (14) to (16):

$$(29) \qquad A_i(t) = \alpha\, \delta_a\, \varepsilon_i(t)$$

$$(30) \qquad Q_i(t) = -\beta\, \delta_a\, \varepsilon_i(t)$$

$$(31) \qquad \pi_i(t) - \bar{\pi} = \delta_a\, \varepsilon_i(t)$$

(32) $$TB_i(t) = h_1\ z_i(t) = -\ (\alpha + \beta)\ \delta\ \varepsilon_i(t)$$

where α and β are unchanged, but δ_a differs from δ_s:

$$\delta_a = \frac{1}{\dfrac{a_1 + 2a}{h + 2h}(\alpha+\beta) + b\beta}$$

As in the symmetric case, when $h = +\infty$, no European policymaker will undertake any active fiscal policy. In general, with an asymmetric shock, this needs not be bad as we shall see.

b - Socially Optimal Solution

The European social planner internalizes the fact that Europe as a whole maintains trade with the rest of the world balanced, so that at equilibrium:

$$\begin{cases} z_1(t) = \frac{1}{2}\ z(t) \\ z_2(t) = -\ \frac{1}{2}\ z(t) \end{cases}$$

The task of the European social planner is now simply to maximize the welfare of any one of the two countries subject to $z_i(t) = \pm\ \frac{1}{2}$ $z(t)$. Given (8), this simply amounts to use the first-order conditions of the non-cooperative case for $\theta = 2$. The SOS can consequently be characterized a follows :

(33) $$A_i(t) = \alpha^*_a\ \ \delta^*_a\ \varepsilon_i(t)$$

(34) $$Q_i(t) = -\ \beta^*_a\ \ \delta^*_a\ \varepsilon_i(t)$$

(35) $$\pi_i(t) - \pi = \delta^*_a\ \varepsilon_i(t)$$

(36) $$TB_i(t) = h_1\ z_i(t) = -\ (\alpha^* + \beta^*)\ \delta^*\ \varepsilon_i(t)$$

where: $\alpha_a^* = \frac{1}{\phi_0} \frac{a + 2a}{h_1 + 2h}$, $\beta_a^* = \frac{1}{\phi_1} \left[b + \frac{a_1 + 2a}{h_1 + 2h} \right]$, and

$$\delta_a^* = \frac{1}{1 + \frac{a_1 + 2a}{h + 2h} (\alpha_a^* + \beta_a^*) + b\, \beta_a^*} .$$

As usual, the comparison between the SOS and NC equilibria hinges on the comparison between $\frac{a_1}{h_1}$ and $\frac{a}{h}$. However, as we now show, the conclusions are exactly <u>opposite</u> to those which were obtained in the symmetric case.

(A) $\frac{a}{h} < \frac{a_1}{h_1}$

In that case, we have:

$$\alpha_a^* < \alpha \qquad \beta_a^* < \beta \qquad \delta_a^* > \delta$$

$$\alpha_a^* \delta_a^* < \alpha\delta \qquad \beta_a^* \delta_a^* \lesseqgtr \beta\delta \qquad (\alpha_a^* + \beta_a^*)\delta_a^* < (\alpha + \beta)\delta$$

In the absence of coordination, the country hit by an inflationary shock accepts a <u>more</u> expansionary fiscal policy and a tighter monetary policy, and the real exchange rate appreciates by more than with full coordination . The result is the opposite of the case of a symmetric shock. A non-cooperative policymaker fails to internalize the fact that the other policymaker will undertake the opposite policy and consequently underestimates the trade effect. When inequality (A) holds (trade effects are relatively more important than price effects), this leads non-cooperative policy making to be more active than it should. A European social planner consequently reduces the trade imbalance within Europe and intra-European exchange rate, while volatility generating more inflation than in the non-cooperative case.

(B) $\frac{a}{h} > \frac{a_1}{h_1}$

The results are reversed. In the adversely hit country, the noncooperative equilibrium yields more inflation and less fiscal expansion than is socially desirable. The intra-European trade imbalance is too small as the policymaker fails to internalize the potential disinflationary impact of a real appreciation of the exchange rate. (In the other country, the policymaker fails to internationalize the potential gain for output of a depreciated currency).

c - Monetary Cooperation

The European monetary authority acknowledges that the aggregate trade balance of Europe remains in equilibrium. He minimizes the average loss function of Europe country subject to:

$$z_1(t) = \frac{1}{2} z(t) \; ; \; z_2(t) = - \frac{1}{2} z(t).$$

In the case of a symmetric shock, the monetary authority also takes account of the constraint $\beta A_i(t) + \alpha Q_i(t) = 0$; i=1,2. The first order conditions of the European monetary authority are now:

$$(37) \quad \begin{cases} \phi_0 \; A_t = \dfrac{a_1 + 2\,a}{h_1 + 2\,h} (\pi_t - \bar{\pi}) + \beta \; \gamma_t \\ \\ \phi_0 \; A_t = - \; [b + \dfrac{a_1 + 2\,a}{h_1 + 2\,h}](\pi_t - \bar{\pi}) + \alpha \; \gamma_t \end{cases}$$

in which, as in the symmetric case, one can write:

$$\gamma_t = \hat{\gamma} \; (\pi_t - \bar{\pi}) \text{ with } \hat{\gamma} = \frac{b}{\alpha^2 \phi_0 + \beta^2 \phi_1} \left[\frac{a_1 + \theta\, a}{h_1 + \theta\, h} - \frac{a_1}{h_1} \right]$$

so that the equilibrium can now be characterized as:

$$(38)\quad \begin{cases} A_i(t) = \hat{\alpha}_a\,(\pi_i(t)-\bar{\pi})\ ; \quad \hat{\alpha}_a = \dfrac{1}{\phi_0}\left(\dfrac{a_1 + 2\,a}{h_1 + 2\,h} + \beta\,\hat{\gamma}\right) \\ Q_i(t) = -\hat{\beta}_a(\pi_t(t)-\bar{\pi});\ \hat{\beta}_a = \dfrac{1}{\phi_0}\left(b + \dfrac{a_1 + 2\,a}{h_1 + 2\,h} - \beta\,\hat{\gamma}\right) \end{cases}$$

$$(39)\quad \begin{cases} \pi_i(t) - \bar{\pi} = \hat{\delta}_a \,.\, \varepsilon_i(t) \\ \text{with} \\ \hat{\delta}_a = \dfrac{1}{1 + \dfrac{a_1 + 2\,a}{h_1 + 2\,h}\,(\hat{\alpha}_a + \hat{\beta}_a) + b\,\hat{\beta}_a} \end{cases}$$

Here again, in response to an inflationary shock, the inflation rate which is reached by coordinating monetary policy alone is always superior to the socially desirable level. However, depending upon the sign of $\frac{a}{h} - \frac{a_1}{h_1}$ the MC inflation rate overshoots or undershoots the socially desirable level with a hierarchy which is opposite to that which prevailed in the case of a symmetric shock. Specifically, we have the following two cases:

(A) $\frac{a}{h} < \frac{a_1}{h_1}$

The socially desirable inflation rate is larger (in response to an inflationary shock) than the non-cooperative rate; coordinating monetary policy alone tends to overshoot that rate. Fiscal policy, here, is less responsive than in both other instances.

(B) $\frac{a}{h} > \frac{a_1}{h_1}$

The socially desirable response is less inflationary than the non-coordinated one; coordinating monetary policy alone sets the

inflation rate in between the two. Fiscal policy is more active than in the non-coordinated case, but less active than under full cooperation.

V - CONCLUSION

The results are summarized in the following table :

	Trade effects dominate within Europe ($a/h_1 > a\ h$)	Price effects dominate within Europe ($a_1/h_1 < a/h$)
Symmetric shocks	$\pi_{NC} > \pi_{MC} > \pi_{SOS}$ $A_{NC} < A_{MC} < A_{SOS}$ $\lvert z_1 \rvert_{NC} < \lvert z_1 \rvert_{MC} < \lvert z_1 \rvert_{SOS}$	$\pi_{NC} < \pi_{SOS} < \pi_{MC}$ $A_{NC} > A_{SOS} > A_{MC}$ $\lvert z_1 \rvert_{NC} > \lvert z_1 \rvert_{SOS}$
Asymmetric shocks	$\pi_{NC} < \pi_{SOS} < \pi_{MC}$ $A_{NC} > A_{SOS} > A_{MC}$ $\lvert z_1 \rvert_{NC} > \lvert z_1 \rvert_{SOS}$	$\pi_{NC} > \pi_{MC} > \pi_{SOS}$ $A_{NC} < A_{MC} < A_{SOS}$ $\lvert z_1 \rvert_{NC} < \lvert z_1 \rvert_{MC} < \lvert z_1 \rvert_{SOS}$

The combination of trade and price externalities seriously undermines the conventional view that the lack of policy coordination leads to an over-appreciation of the exchange rate as the result of overly active monetary and fiscal policies. The opposite case of an underappreciation (vis a vis the rest of the world) occurs, in our examples, when: a) the trade effect dominates the price effect within Europe (relatively to the rest of the world) <u>and</u> when the shocks hit symmetrically all European country; b) when price effects dominate <u>and</u> when the shocks hit asymmetrically the European countries. In each instance, when economic policy is fully coordinated, fiscal policy is more expansionary, and monetary policy less accommodative, than when it

is set non-cooperatively.

The results carry important policy implications. If trade effects dominate within Europe[4], symmetric supply-side shocks are likely to be met with relatively inactive monetary and fiscal policies. This could explain the contrast between the US and Europe in the early 1980s. In contrast, when the shocks are asymmetric, both policies may be used excessively and pull apart the European countries away from each other, an outcome reminiscent of the early 1970s. Further empirical work will be needed to confirm these presumptions.

A natural question concerns the implications of European monetary coordination alone[5]. It is quite striking to find that, when fiscal policies remain uncoordinated, monetary policy coordination always produces more accommodation than is socially desirable. The European social planner compensates for mistaken fiscal policies by using more generously the only coordinated instrument. A related question is whether fiscal policy is then biased towards excessive interventionism, a view shared by the Delors Committee. In the preferred case where trade effects dominate within Europe, the contrary occurs for both types of shocks.

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[4] In Cohen and Wyplosz (1990) we explore the relative size of effects for France and Germany. We find that b and a_1 are indeed significant and correctly signed, while a and b_1 are either wrongly signed or not statistically significant.

[5] The model is not well suited to study the effects of monetary unification. Such an analysis will be carried in subsequent work.

APPENDIX

In this appendix we explain why monetary policy is always looser when fiscal policy is not coordinated. The problem which is solved by the European policy makers is simply equivalent to the static problem of minimizing $\Phi_0 A^2 + \Phi Q^2 + (\pi - \bar{\pi})^2$. Rewrite the loss function as:

$$L = \pi^2 + H \qquad \text{where } H = \Phi_0 A^2 + \Phi_1 Q^2$$

It is always true that π, A and Q are linked by:

$$\text{(A1)} \qquad \pi - \bar{\pi} - \varepsilon = (a_1/h_1 + b)Q - (a_1/h_1)A$$

Under full coordination, the monetary authorities freely determine π, A, and Q via (A1). The resulting optimal value of H is:

$$H_1 = \theta_1(\pi - \bar{\pi} - \varepsilon)^2$$

In the absence of fiscal policy coordination, the fiscal authorities use A to minimize H, subject to the misperceived constraint (9). The solution is the relationship (22) between A and Q in the text and:

$$H_2 = \theta_2(\pi - \bar{\pi} - \varepsilon)^2$$

Clearly, the coordinated solution is superior so that we have $\theta_2 > \theta_1$.

When the monetary authorities choose π so as to minimize $L = (\pi - \bar{\pi})_i^2 + \theta(\pi - \bar{\pi} - \varepsilon)^2$, it is clear that $\theta_2 > \theta_1$ implies that π is higher (when $\varepsilon > 0$) in the absence of fiscal policy coordination.

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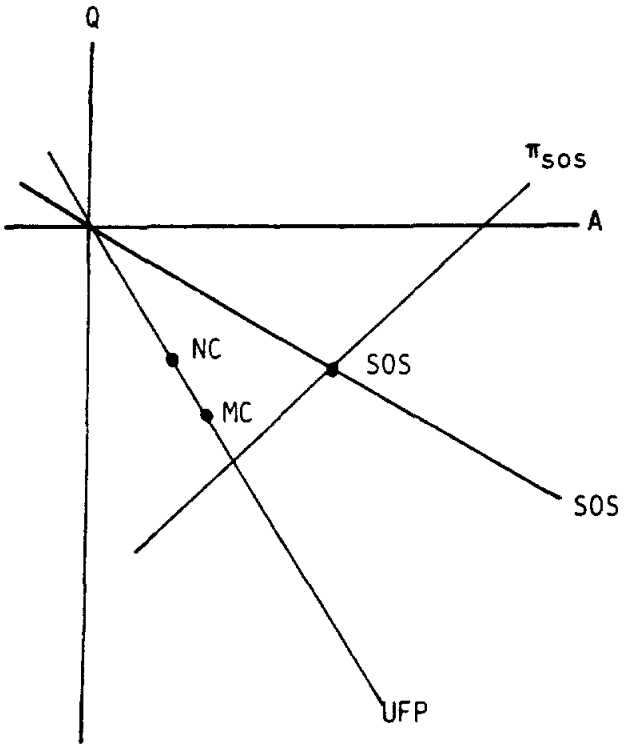

Figure 1.a
($a_1/h_1 > a/h$)

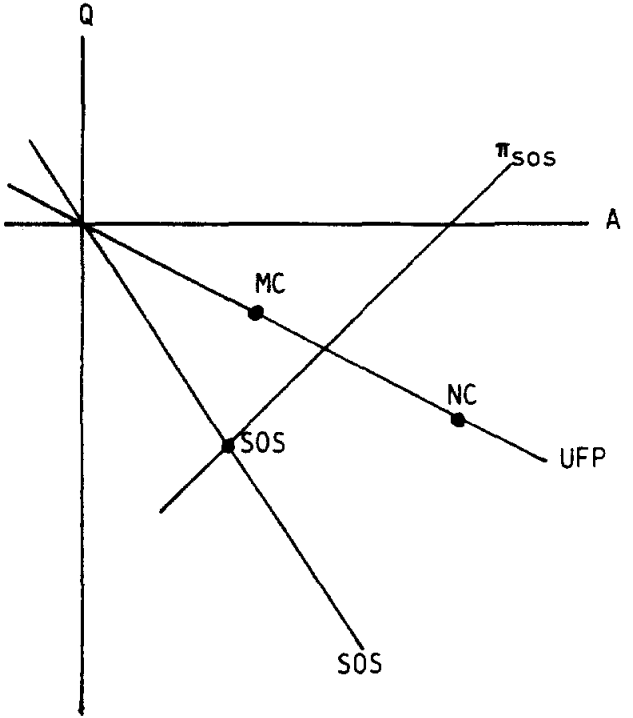

Figure 1.b
($a_1/h_1 < a/h$)

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