How to manage speculative shocks : intra-european vs. international monetary coordination

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The literature on currency crisis has generally not answered to the following question: which economic policies may reduce the contagion effects of a speculative shock? We use a dynamic Mundell-Fleming model extended to four countries and compute three time-consistent equilibria: a Nash equilibrium, and Nash-bargaining equilibria, first between the central banks of the G3 (a target zone equilibrium) and, second between European governments and the ECB. The best equilibrium for the Fed, European and Japanese policymakers is intra-European coordination. It induces a very expansionary fiscal policy in the USA whose government hence rejects it. Extensions to the case of a Stability Pact in European countries do not alter our results. Introducing a Fed less conservative than the ECB or the BoJ provokes a change in US preferences: both authorities give priority to the monetary equilibrium and the US government is no longer isolationist.

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The financial and economic crisis in East-Asia occurred two years ago, and yet not only do the countries involved show some signs of recovery, but the crisis did not spread as much as it was supposed to. A rich literature has been devoted to this subject, focusing on the causes of the crisis, on the role, stabilising or not, played by the I.M.F., and on the lessons one can draw from the episode[1], but little has been said about the macroeconomic impact of the shock on the non-Asian countries. It seems as if only the "target zone between the G3 currencies" controversy had caught the attention of economists[2].

This paper aims at comparing two international policy options when countries are confronted to a speculative asymmetric shock, such as the one that hit the Asian area[3]. Taking into account the practical difficulty to achieve coordination between every monetary and fiscal authority in every country, we restrict ourselves to evaluating the impact of a coordination among US, European and Japanese central banks (monetary equilibrium), and a coordination among French and German governments and the E.C.B (European equilibrium), that is to say an intra–European

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[1] See the exhaustive papers by Corsetti *et al*.. (1998a,b).

[2] The French and German proposition to impose limits on the fluctuations of the dollar, yen, and Euro exchange rates had its 'pros' (see Bergsten, 1998), and its 'cons' (Dornbusch, 1999).

[3] We suppose that the Asian crisis implies a sudden and permanent decrease of the exogenous part of asset demands in yen. We do not discuss the causes of such a situation, and focus on the consequences instead.

coordination.

International monetary coordination consists in central banks limiting interest rate and exchange rate fluctuations so as to minimise a loss function. We do not impose *ad hoc* limits to these fluctuations: limits are endogenous[4]. As the economic policies we define are time consistent, the problem of the lack of credibility of exchange rate bands of fluctuations vanishes. In the target zone theory, policymakers have to enforce the credibility of pre-determined bands of fluctuations. Here, we rather determine credible and consistent policies of reduction of the exchange rates fluctuations. This could be viewed as a *soft* target zone system, without governments involved in the process.

Our objective is to answer the following questions: should European authorities favour a coordination among themselves, compared to a soft target zone system, when confronted to a speculative crisis? Do E.U. partners agree with this point of view?

In the first section, we describe the model. In section two, we discuss the impact of an asymmetric speculative shock. In section three, we assess the advantages and drawbacks of the two kinds of coordination schemes. We go further by introducing a balanced budget rule in France and Germany, in order to study the macroeconomic impact of a tightening of fiscal conditions in Europe. Last, we introduce an asymmetry in the respective loss functions of the Fed, on the one hand, and the ECB and the BoJ, on the other: the Fed is supposed to be less conservative than the other central banks. Section five concludes.

1. The model

We use Capoen-Villa's model (1997) (CV in the rest of the paper) extended to four countries to tackle the issue of a speculative shock. This model is developed into a dynamic Mundell-Fleming framework and contains portfolio and wealth

[4] Our 'soft target zones' will resemble those of Hughes Hallett (1993, 1998), except that we do not introduce nominal exchange rates in authorities' loss functions. Central banks limit interest rate swings ; in a portfolio-type model (see Branson, 1979), variations in interest rates impinge on exchange rate expectations and due to risk

effects. We introduce the United States, Japan (representing the Asian economies), Germany and France. The last two countries are in a monetary union and their size is twice smaller as the one of the large countries, so that the United States, Europe and Japan have the same size.

We introduce three modifications to the CV model. First of all, as was already said, we add two countries and heterogeneous sizes. Then, as we focus on wealth effects in aggregate demand, we simplify the latter by not using the Hicksian definition of the private agents' wealth; we assume instead that households neither consume the returns on their financial assets, nor the capital gains on foreign assets net of exchange rate variations. Last, we rule out the balanced budget rule, as it is not required to stabilise the model in the long run. The introduction of the public debt on GDP ratio in the governments' loss functions is enough to stabilise its path[5].

The model is dynamic[6]: public debt accumulation is taken into account; economic policy decisions are taken in an intertemporal framework and are time consistent. Expectations on the exchange rates and the economic policy strategies are rational. As far as inflation is concerned, expectations are myopic, but the outcome is the same as when price expectations are rational. It is in part due to the fact that wages are only partially indexed on prices in the short and medium term, and that prices and wages adjust slowly (see CV, pp. 19-20).

There are 12 equations for each country in the model, and 6 equations describing the demand for foreign assets from private agents[7]. The *real bloc* consists in an aggregate demand and a supply bloc. Variables have a subscript for time, a superscript for the country, with $i = F, G, J \text{ or } U$ representing respectively France, Germany, Japan and the United States. Their definitions are given in the appendix. Except for assets F, all variables are expressed as deviations from the baseline.

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aversion, on net foreign holdings by domestic agents.

[5] We hence focus on *active* policies. We relax this assumption for France and Germany in section 4.

[6] Long term and stability conditions can be found in CV.

[7] Equations are shown in the appendix.

Aggregate demand (equation 1) depends on the households' income net of taxes (y-T), the real interest rate (r), the public spending (g), the trade balance (b), and a wealth effect. Household's income does not include the interests perceived on assets (public debt (d) and net foreign assets (ϕ)), which are saved and contribute to wealth accumulation. They have an indirect impact on aggregate demand through the wealth effect. Households are assumed to have some desired level for wealth W_0; their consumption-savings trade-off makes their effective wealth (the sum of public debt and net foreign assets) tend toward this desired level.

(1) $y_t^i = c(y_t^i - T_t^i) - \sigma r_t^i + g_t^i + b_t^i + \mu(\phi_{t-1}^i + d_{t-1}^i - W_0)$

The trade balance for country i depends on the cyclical gap with each other country j (with $j \neq i$) and on the respective real exchange rate between country i and countries j:

(2) $b_t^i = \sum_{j \neq i} [n^{ij}(y_t^j - y_t^i) + n^{ij}\delta_x x_t^{ij}]$, where n^{ij} is the degree of openness between country i and country j, x^{ij} the real exchange rate between country i and country j, and δ a positive parameter which satisfies the Marshall-Lerner-Robinson condition.

The supply bloc consists in a wage-price loop: prices follow an expectations augmented Phillips curve. Desired production prices (p^d) depend on wages, the GDP, and financial costs, approximated by the real interest rate (equation 3). An interest rate growth increases inflation *ceteris paribus*, because firms pass the development costs on prices, and substitute work to capital, which puts pressure on wages. Production prices depend on past prices and current desired prices (equation 4). The desired wage depends on consumer prices (q) and the GDP (equation 5). Consumer prices depend on current production prices and foreign prices (equation 7).

(3) $p_t^{id} = w_t^i + v_1 y_t^i + \theta r_t^i$

(4) $p_t^i = l_1 p_{t-1}^i + (1 - l_1) p_t^{id}$

(5) $w_t^{id} = \lambda q_t^i + v_2 y_t^i + w_{0t}^i$

(6) $w_t^i = l_2 w_{t-1}^i + (1-l_2) w_t^{id}$

(7) $q_t^i = p_t^i + \sum_{j \neq i} n^{ij} x_t^{ij}$

The financial bloc includes an equation for the real interest rate, equal to the nominal interest rate minus expected inflation; an equation for the dynamics of public debt accumulation, which depends on interest burden and public primary deficit (equation 8); equations for the net foreign assets desired by private agents; the balance of payments, which depends on the valuation of foreign-currency denominated foreign assets (the terms with x in equation 9)[8]. This last point is crucial as far as the Asian crisis is in question, because the substantial amount of debt denominated in foreign currency in the Asian countries contributed to the turmoil. Following CV, we assume that assets denominated in the domestic and foreign currencies are not perfectly substitutable: because of exchange risk, private agents want to hold only a share of their wealth or external debt in foreign currency; this share depends on the anticipated return differential[9].

(8) $d_t^i = d_{t-1}^i + r_{t-1}^i (d/100) + r_0 (d_{t-1}^i - \tilde{d}) + g_t^i - T_t^i$

(9) $\phi_t^{ij} = F_t^{ij} - F_t^{ji} = \phi_{t-1}^{ij} + 2(x_t^{ij} - x_{t-1}^{ij}) F_0 + (r_{t-1}^j - r_{t-1}^i + y_t^j - y_{t-1}^j - y_t^i + y_{t-1}^i) F_0 + r_0 \phi_{t-1}^{ij} + b_t^{ij}$

(10) $\phi_t^i = \sum_{j \neq i} \phi_t^{ij}$

where $\tilde{d}$ stands for the government public debt target, F^{ij} for assets of country j owned by agents of country i denominated in country i currency, in real terms, and ϕ^{ij} for net external assets of country i *vis-à-vis* country j.

Economic policies are described through reaction functions, which are obtained by the minimisation of loss functions. Each authority controls one instrument. Governments use public spending in order to minimise the following intertemporal loss function:

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[8] For a theoretical justification, see Bénassy and Sterdyniak (1992).
[9] See Branson (1979) and Bleuze and Sterdyniak (1988).

$$(11)\ L_g(0) = \frac{1}{2}\sum_{t=0}^{\infty}\rho^t\left\{\alpha_g y_t^2 + \beta_g q_t^2 + \gamma_g \phi_t^2 + \delta_g (d_t - \tilde{d})^2 + \varepsilon_g g_t^2 + \eta_g i_t^2\right\};$$

while central banks choose the interest rate so as to minimise the intertemporal loss function[10]:

$$(12)\ L_b(0) = \frac{1}{2}\sum_{t=0}^{\infty}\rho^t\left\{\alpha_b y_t^2 + \beta_b q_t^2 + \gamma_b \phi_t^2 + \delta_b (d_t - \tilde{d})^2 + \varepsilon_b g_t^2 + \eta_b i_t^2\right\},$$

where y is and q are in log, ϕ, d, and g are in percentage of GDP, and i the nominal interest rate in percentage. ρ is the time preference, assumed to be constant, and $\tilde{d}$ is the government *ex ante* desired public debt target. We put ρ equal to 0.75.

Each authority has four main targets: to stabilise the GDP at its potential level (we suppose it is satisfied at the baseline), to stabilise inflation, to meet the external constraint so that fluctuations in the exchange rate are stabilised, and to meet the intertemporal budget constraint of the government, taking into account the fact that public debt accumulation reduces the rooms for manœuvre of economic policies[11]. In addition, policymakers wish to minimise the expensive use of the instruments[12]. Table 1 gives the weights of the different targets in the loss functions. They are taken from CV's model. In a first stage, we have assumed that monetary and fiscal authorities had the same weights and targets all over the world. We relax this assumption in section 4.b.

1. Loss functions' parameters

	α	β	γ	δ	ε	η
Government	0.9	0.5	4.0	0.9	0.9	0.5
Central Bank	0.1	2.5	1.0	0.1	0.1	0.5

Source : CV (1996).

[10] The ECB loss function is half the sum of the French and German central banks loss functions.

[11] The qualitative results remain the same when one makes the assumption that central banks do not care about the state's budget balance ($\varepsilon_b = 0$ and $\varepsilon_g = 1$).

[12] Fiscal policy is costly because of the time it takes to implement, and because it may be irreversible; monetary policy affects future growth through its impact on investment.

The weights in the numerical simulations show that governments are more concerned with real variables, as opposed to central banks. Central banks have a "conservative" behaviour.

We compute the equilibria as in Oudiz and Sachs (1985): policymakers follow time consistent economic policy rules in a rational expectations framework ('closed loops'). These rules can be either cooperative or not. The non-cooperative equilibrium is a Nash equilibrium. The coordinated equilibrium is attained through a Nash-bargaining procedure: it consists in maximising the net gains of coordination, that is to say the produce of the differences between the Nash equilibrium and the coordinated one[13].

The exchange rate regimes are as follows. France and Germany are in monetary union in the Euro zone: they share the same central bank (the ECB), and have the same nominal interest rate (a stability pact is introduced in the fourth section). The dollar, the Yen and the Euro fluctuate freely against one another. Central banks are independent, and do not abide by the rules of a fixed exchange rate regime.

Multipliers confirm that the two small countries and the three large ones (the United States, Japan, and the European Union) are symmetric respectively. A permanent increase in public spending gives the same results in France and Germany. A shock in the E.U. has a different impact in France and Germany depending on whether it is symmetric or not. A permanent increase in the nominal interest rate has always the same impact in the countries hit by the shock. The multiplier effects have no relevance in the long run since the model is only stable when active endogenous policies are implemented. Otherwise, an increase in public spending results in a never-ending accumulation of public debt, in a permanent excess in demand through the wealth effect, and in hyperinflation.

2. Short term multipliers

	$g_f = +1$	$g_j = +1$	$i_E = +1$	$i_j = +1$

[13] The appendix in Oudiz and Sachs (1985) is enlightening.

y_f	2.1	-0.1	-1.5	0.2
y_g	0.9	-0.1	-1.5	0.2
y_j	0	3.0	0.2	-1.5
y_u	0	-0.1	0.2	0.2
p_f	0.3	0	-0.2	0.1
p_g	0.2	0	-0.2	0.1
p_j	0	0.5	0.1	-0.2
p_u	0	0	0.1	0.1
e_{Ej}	1.6	-3.2	-2.2	2.2

N.B.: f: France; g: Germany; j: Japan; u: United States; E: European Union.

A 1% increase in public spending in France gives rise to a 2% increase in French GDP and 0.3% increase in French prices; the Euro exchange rate depreciates, which results in a 1% increase of the German GDP. As these two countries are more open than Japan and the United States, the Euro depreciation is smaller than the one of the Yen in case of a fiscal shock in Japan[14].

A 1 point increase in the European nominal interest rate reduces the German and French GDPs by 1.5% each and prices decrease by 0.2%. The Euro appreciation has a positive impact on Japan and the United States whose GDPs grow by 0.2% each.

Our model has at least four main drawbacks. First, parameters are not estimated. Second, we assume that governments and central banks share the same vision of the economy. Third, we cannot compute regime changes because of the limitations imposed by the calculation of time consistent equilibria: price indexation remains partial in the long run[15]. Finally, in order to appraise the impact of the Asian crisis, we mingle the Asian countries (Thailand, South Korea, …) with Japan and do as if the Southeast Asian currencies were pegged on the Yen; this is not the case since they are mainly pegged on the Dollar.

Anyhow, the model allows us to study the impact of an asymmetric speculative

[14] The reason why the exchange rate depreciates in the country whose public spending is increased is linked to the computation process in the framework of time-consistent equilibrium. The equilibrium is computed 'forward', as Sargent advises for unstable roots (see Sargent, 1987, pp.182-83). In the long run, the trade balance will be in deficit if public spending increased (output effect) so that the nominal exchange rate will depreciate in the long run. With rational expectations, the exchange rate depreciates immediately.

[15] We get the same qualitative results with a full indexation. They are available from the authors upon request.

shock, while introducing time consistent, hence credible policies. Turner (1998) believes that the fact that policies were not credible in the countries hit by the Asian shock contributed to worsening the crisis. We characterise cooperative and non-cooperative credible policies that could have stabilised these economies more quickly. We depart from recent works by Fair (1999) and McKibbin and Martin (1998). Fair estimates the impact of a 30% depreciation of the Asian currencies without policy response. Furthermore, he assumes that exchange rates' variations have no impact on the demand for foreign assets, which is not relevant in the case of Asia. McKibbin and Martin consider the impact of the shock on the Asian economies, without considering the international response.

Corsetti *et al.*. (1999) also use a macroeconomic model to study the impact of the Asian crisis. But they have a different objective in mind which is to assess the consequences of moral hazard on public debt, seignorage and inflation[16]. This is too specific a view according to us; we rather suppose that inflation comes first of all as a result of the devaluation. In Southeast Asia, inflation has been more important after and not before the crisis, except in Thailand. Last, Stiglitz (1999) also favours economic policies in response to a speculative shock, but he gives no indication about the kind of policy that could have been implemented and its external impact.

2. An asymmetric speculative shock

Among the problems besetting the Asian economies, the accumulation of foreign-currency denominated external debt (see table 3) played a predominant role. In the years before the crisis the Asian countries resorted to the massive use of external debt, mainly taking the form of short term unhedged foreign-currency denominated liabilities, whose amount, between 1993 and 1997, doubled in South Korea, Indonesia and Thailand, was multiplied by seven in Philippines, and grew by 20 billion dollars in Malaysia (still net creditor in 1993). This source of financing is very destabilising, and makes the economy vulnerable to external shocks, for

[16] The foreign capital withdrawal must be compensated with a fiscal policy; after the growth of public debt, agents expect an increase in prices which in turn provokes the depreciation of the currency and a financial

instance depreciations that make the debt burden increase.

collapse.

3. Net external debts (billion US dollars)

	1993	1994	1995	1996	1997	deviation 1993-97	97/96 (in %)
Korea	30.0	40.4	58.2	80.1	62.5	32.5	-22.0
Indonesia	24.6	31.2	37.4	44.2	51.2	26.6	15.8
Malaysia	-3.2	4.2	5.7	8.4	16.1	19.3	91.7
Philippines	0.8	-0.2	0.7	5.7	6.9	6.1	21.1
Singapore	78.4	94.6	111.8	109.4	81.2	2.8	-25.8
Thailand	29.7	47.4	80.4	90.3	69.8	40.1	-22.7
Hong Kong	123.0	148.8	183.3	185.6	174.8	51.8	-5.8
Taiwan	-3.2	4.2	5.7	8.4	16.1	19.3	91.7

Source : BIS (from Corsetti *et alii*, 1998a), computations by the authors.

The shock consists in an expected and permanent reduction in the *exogenous* part of the European and US households' desire to hold assets denominated in Yen[17]. This shock translates into an exogenous fall of one point of GDP of Japanese net external position.

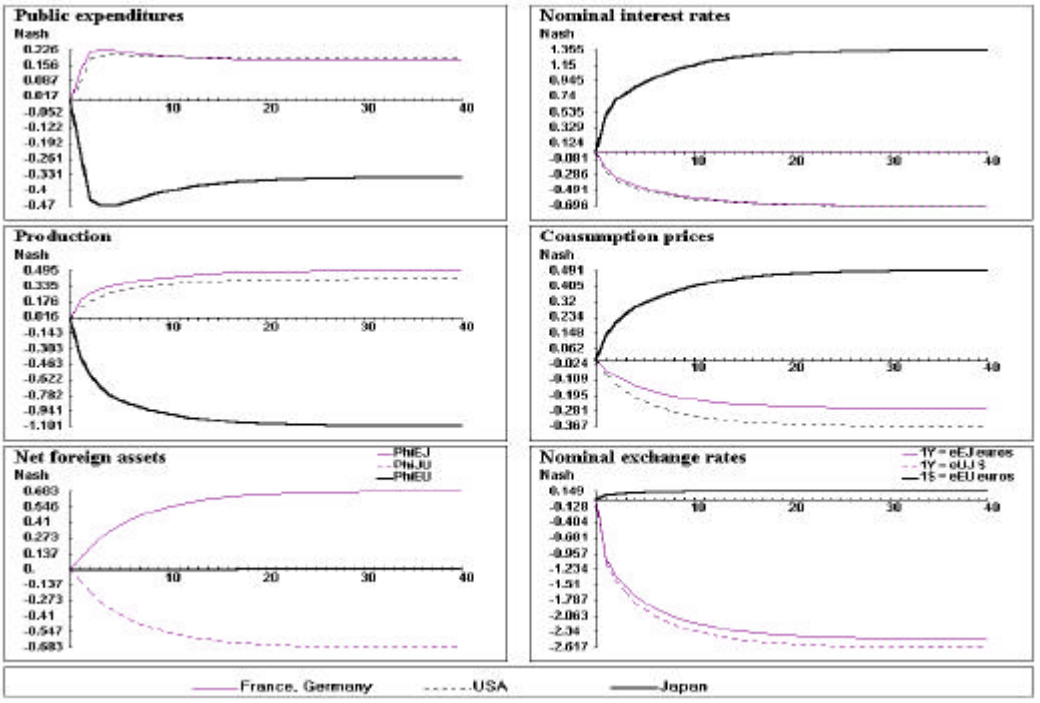
At the Nash equilibrium between all authorities, the shock implies a drop in the Japanese output, in spite of the immediate depreciation of the Yen against the Dollar and the Euro. The income effect has a negative impact on aggregate demand: Japanese households feel poorer after the shock even if the value of their foreign-currency denominated assets increases owing to the appreciation of the Dollar and the Euro[18]. But the fall in output is, above all, the result of a tightening of the monetary policy. Higher nominal Japanese interest rates (+0.5 point in the short term) induce higher real rates despite higher inflation. Private investment and hence demand for goods are decreasing. The increase in nominal interest rate (1.4 point in the long term), aims at offsetting the drop in the net external position by attracting capital via higher yields on the assets denominated in Yen. As a result of inflationary pressures due to the increase in the real interest rate (it increases with desired production prices), and furthermore, because of the Yen depreciation, the fiscal policy is restrictive: public spending decreases by 0.3 point of GDP in the long run,

[17] The endogenous part of Japanese capital flows might well be superior to its exogenous part; in short, the shock does not prevent the capacity of Japan from attracting *net* capital flows.

[18] Remember that in this version of the CV model, agents do not consume the capital gains on their assets.

and public debt diminishes by more than 2.5 points of GDP.

Figure 1: Nash equilibrium



Conflicts between fiscal and monetary authorities are avoided thanks to the time consistent property of the policies implemented in Asia. At the inconsistent equilibrium, the government would have begun with an expansionary policy in order to alleviate the recession and the central bank would have answered by an even higher nominal interest rate. But this policy mix would have implied an explosion of public debt in the long run, and monetary policy would have prevailed over fiscal policy: public spending would have been drastically reduced in order to curb inflation and slacken the dramatic increase in public debt, and monetary policy would have still been restrictive in order to attract foreign capital. When policies are time-consistent, the instruments' assignment to the objectives does not change over time: monetary policy is assigned to the balanced asset situation, fiscal policy to inflation.

The impacts of the shock on the United States and the E.U. are as expected, which shows that the model and its resolution with consistent equilibria are relevant. The

Yen depreciation induces a decrease in production prices, immediate for the United States, almost immediate for the E.U[19]. Consumer prices are decreasing in the three countries. It follows that the Western economic policies are expansionary: public spending increases by 0.2 point of GDP in the medium and long term. Nominal interest rates fall by 0.7 point in the long run. Despite the easing of monetary policy, public debts raise by 1.2 point of GDP in the long run in the E.U., on account of primary deficits, and by 0.8 point in the United States.

Taking into account the negative impact of the external crisis, the policy mix chosen in the E.U. seems appropriate. The economic policies prevent the demand for goods from dropping while sustaining growth. The resulting growth of French, German, and US GDPs is modest, only half the decrease of the Japanese GDP. The wealth effect also helps in improving the Western countries' economic situation: the net external positions of these countries instantly benefit from the interest rate differential with Japan, despite the deterioration of the trade balances, and the capital losses occurring after the Yen depreciation. Public debts also increase. In the long run, the European and US households' wealths increase on average by nearly 2 points of GDP.

The model provides a realistic assessment of the impacts of the speculative crisis which occurred in East-Asian countries: a reversal of private capital inflows in Asia (a sudden decrease in the Yen denominated asset demand in the model); a depreciation of the Asian currencies; an increase in the nominal interest rate and a recession in Asia; a decrease in the nominal interest rate in the short term and GDP growth in the Western countries quite unaffected by the shock. We note that the consistent fiscal policy implemented in Japan is similar to the one advocated by the I.M.F. at the beginning of the crisis: tightening the budget in order to preserve credibility. But this has a drawback: it amplifies the negative impacts of the crisis.

[19] This slight difference in the impact of the shock comes from the fact that the pattern of the policy mix is different in the United States and the E.U.: in the E.U., the E.C.B. is facing two governments, each of them acting as if the policies of the other one and of the E.C.B. were given. So it does not take into account the positive spillover its partners' policies generate on its output and on prices. Then each government runs a too expansionary policy (and more expansionary one than the US government), and the E.C.B. monetary policy is more expansionary than the Fed's.

3. Coordinating economic policies

Is there a way to improve the efficiency of economic policies when confronted to a speculative crisis? We assume the following alternative: either the three central banks coordinate their policies in order to reduce exchange rate fluctuations which have 'beggar-thy-neighbour' effects and therefore favour the contagion of the shock. Or, taking into account the reluctance of monetary and fiscal US policymakers, the European countries decide to organise an internal coordination between the governments and the E.C.B. in order to cut the interest rate and public spending in the E.U.

The coordination of central banks (see figure 2) enables a decrease in exchange rate volatility between the three currencies, owing to the reduction in the interest rates differential between the United States and the E.U.. It nevertheless remains wider than at the Nash equilibrium between Japan and the other countries, which allows to compensate for the growing US and European trade deficits towards Japanese goods: anyway, this results in less volatile exchange rates.

Coordination implies a less restrictive monetary policy in Japan and more expansionary ones in the Western countries. However, the decline in output intensifies in Japan, and at the same time, the deviation of GDP from the baseline increases in the United States and the E.U., compared to the Nash equilibrium. The fall of the Japanese output is due to an internal coordination failure: fiscal policy becomes more restrictive than at the Nash equilibrium. But in the U.E. and the United States, fiscal policies are more expansionary, which also contributes to an improvement in these countries' economic outlook.

Nevertheless, the situation looks better in terms of consumer prices: they increase less in Japan, and decrease less in the other countries, because the Yen depreciation is less important. Less volatile exchange rates moderate prices variations. With a more stable economic environment, trade between Japan and its partners expands in the long run (trade balances are more important in absolute value than at the Nash equilibrium).

The European equilibrium (see figure 3), on its part, is definitely more favourable to the countries involved: when compared to the Nash equilibrium, GDP in each country keeps closer to its potential value in the medium and the long term. The fall in desired consumers‘ prices is less substantial. The trade imbalance towards Japan is less substantial. Monetary and fiscal policies are less expansionary. In accordance with these findings, it seems as if the public deficits were too important at the Nash equilibrium. But this conclusion must be tempered: in fact, public expenditures in the two equilibria are almost the same.

The interest rate differential grows when going from the Nash to the European equilibrium, because the US policy remains nearly the same. It implies an appreciation of the Euro against the Dollar in the short run which decreases the value of the net external French and German Dollar-denominated assets, hence, in return, a slowdown of the GDP. Despite less expansionary policies in Europe, public debt on GDP ratios increase in France and Germany when compared to the Nash equilibrium.

Figure 2: Monetary Equilibrium

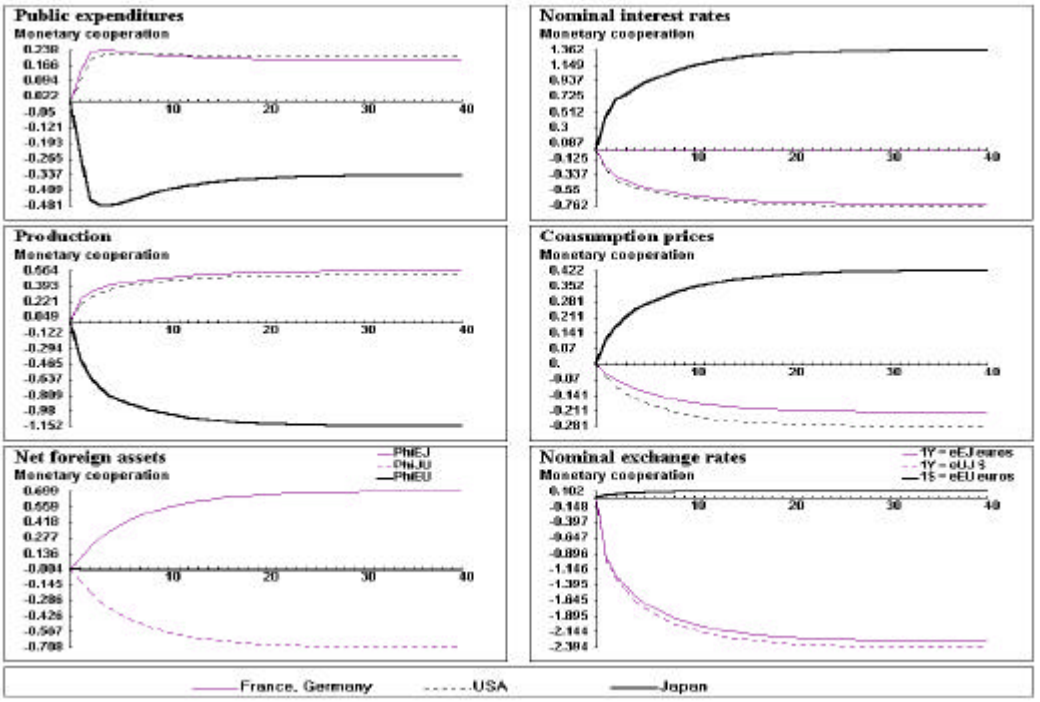
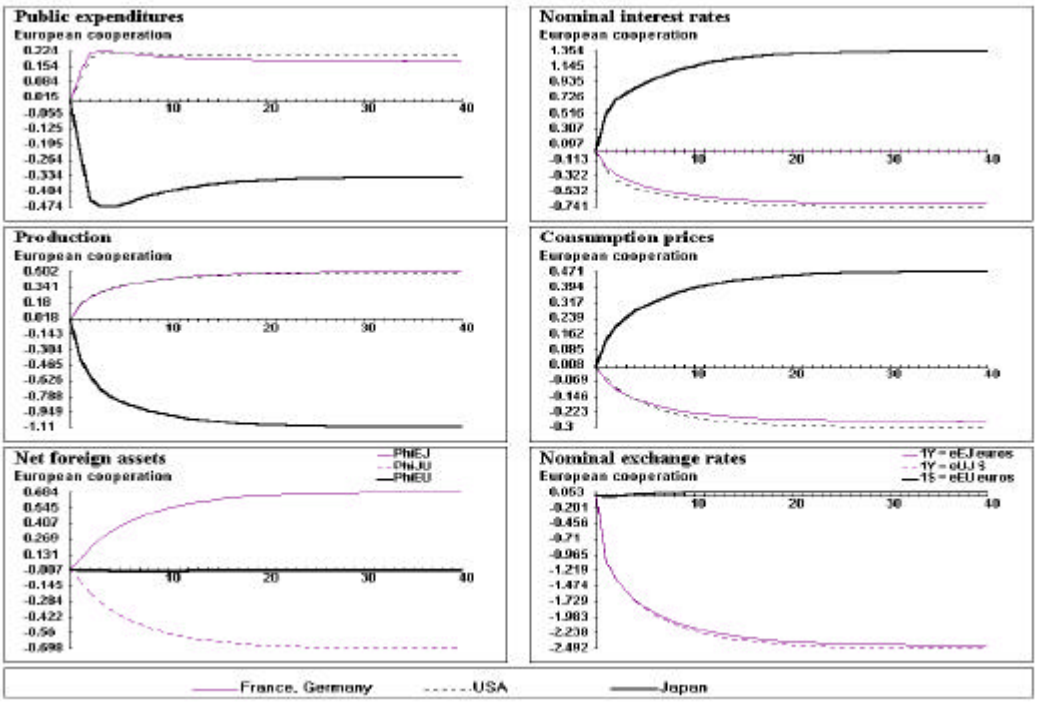


Figure 3: European Equilibrium



The coordination of European policies benefits somewhat to the Japanese economy: prices deviations from the baseline are lower than at the Nash equilibrium (but higher than at the Monetary one). Unfortunately, recession is deeper than at the Nash equilibrium (but less pronounced than at the Monetary one). Time-consistent policies do not differ much from the ones implemented at the Nash equilibrium. Japanese policymakers are no more activist than at the Nash equilibrium, and come to better results in terms of welfare (the central bank and government loss functions are at their minimal value, see table 4), because Japan takes advantage from the weaker depreciation of the Yen against the Euro.

In the United States, government must be more active in the short term in order to make up for the European authorities being less active: the US deficit and public debt tend to grow. It follows that the US monetary policy is less expansionary in the short and medium term.

Table 4 draws up a summary of the present discounted value of the fiscal and monetary authorities' losses in the four countries. We are now ready to answer more precisely the questions put forwrad in the introduction.

4. Present discounted value of the losses of each authority without a Pact

	Central banks			Governments			
	ECB	Fed	BoJ	Ger.	Fra.	USA	Japan
Nash	0.407	0.490	2.470	1.238	1.238	1.281*	8.495
Monet	0.406	0.489	2.469	1.336	1.336	1.305	8.953
Europ.	0.402*	0.487*	2.443*	1.222*	1.222*	1.319	8.465*

* Optimal situation for each authority.

According to these results, the European governments and the ECB are better off at the European equilibrium. So the ECB finds no interest in introducing target zones for the exchange rates when it is possible to implement an intra-European coordination of the economic policies. When it is not, the ECB does not care whether monetary or Nash equilibrium is chosen.

It is interesting to point out that no authority enjoys a net gain when moving to the monetary equilibrium whatever the starting equilibrium. As far as the Fed is concerned, it prefers to let the European authorities implement a coordination of their policies. But this situation would induce an internal conflict between the US policymakers, as the US government would favour the Nash equilibrium. According to this government, the European equilibrium is the least favourable: the accumulation of public debt prevents it from using freely the fiscal regulation and increases its losses. So the US government is the intra-European coordination's only opponent; it follows an isolationist path.

Indeed, the Japanese policymakers, directly concerned by the shock, approve the best policy choice of the European authorities and the Fed. The intra-European coordination is less inflationary for the Japanese economy because of the smaller depreciation of the Yen against the Euro. Yet, this equilibrium aggravates the recession in Japan.

The present discounted values of gains from coordination are nonetheless very small, as Oudiz and Sachs (1985) first recorded. This is all the more the case at the monetary equilibrium. The European one is more efficient in improving the

economic situation. The present discounted value of loss decrease is never higher than 1.3% when going from a Nash equilibrium to a coordinated one, and the average decrease amounts to 1%.

Note that we use a particular definition of the Nash equilibrium in the sense that the policymakers do not pay attention to the policy spillovers, but take the long term outcomes of their own policies into account, through the time-consistent equilibrium (closed loop). It could imply that the kind of Nash equilibrium studied here overestimates the efficiency of the policy response to the asymmetric shock. In a more realistic way, an authority which does not care about the present consequences of its policy on its partners, would not care about the long-term consequences either, and hence behave inconsistently. So the gains of coordination, whether monetary or European, certainly tend to be underestimated. To make sure, we would have to assess the difference between gains at the time inconsistent Nash equilibrium and the time consistent coordinated one. But we cannot compute inconsistent equilibria with the solving algorithm of the model.

However, there is a strong case for implementing an intra-European coordination. The current design of monetary and fiscal policies in the E.U. would have to be clarified. Is the pragmatism the ECB showed in the beginning of 1999 (a cut in nominal interest rates in April in order to fight an increase in unemployment in the large countries of the Euro zone, and the ECB standing by this decision until November despite the Euro depreciation) the sign of a better assignment of instruments to targets in the E.U.? Will fiscal policy succeed in curbing inflation in case the ECB decides to boost the economy ? One can regret the coordination of fiscal and monetary policy is not enclosed in a treaty, as are the ECB's statutes, the convergence criteria and the procedure in case of excessive deficits. At present, the ECB is not compelled to coordinate its policy with those of EU governments. In case of an economic upheaval, there remains large uncertainty on ECB's reactions: will the ECB refuse to cut its interest rate while governments resume increasing their spending, hence favouring excessive real interest rates and public deficits as in the early nineties ?

4. Two extensions.

a) The European Stability Pact.

We now consider the case in which European fiscal policies are constrained by the provisions of the "Growth and Stability Pact" (GSP). We assume that the two governments have no room for manoeuvre: as the impact of the crisis on GDP is too small (the decrease in the European GDPs is less than 0.75%), they cannot call upon the "deep recession argument". The two governments abide by a balanced budget rule: every increase in public spending is offset by an increase in taxes of the same amount. Public debt in percentage of GDP remains constant.

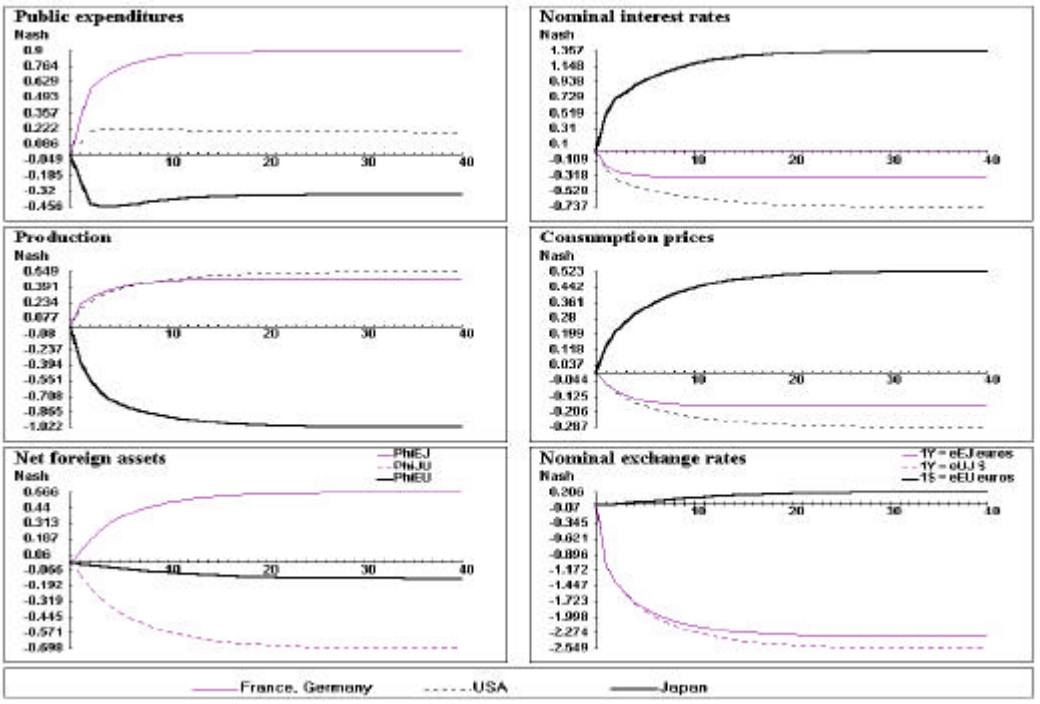
This balanced budget rule follows:

(13) $T_t^i = v^i T_{t-1}^i + (1-v^i)[g_t^i + r_{t-1}^i(d_{t-1}^i/100) + (1+r_0)(d_{t-1}^i - d_{t-1}^i)]$, with $i = F,G$ and $v^i = 0.2$.

Together with the government budget constraint, it ensures that the debt to GDP ratio reaches its *ex ante* desired target $\tilde{d}$.

The impacts of a balanced budget rule in Europe at the Nash equilibrium are as follows (see figure 4): public spending, offset by an increase in taxes, is more important, but gives the same result in terms of GDP, which attests that the European fiscal policy is less effective. But the constraint on monetary policy is alleviated, so it is less expansionary. As the cut in the European interest rate is smaller, the Japanese central bank has to be more activist in order to draw foreign capital: the Japanese interest rate increases more. The more restrictive monetary policy by the BoJ entitles the government to implement a less restrictive fiscal policy in the short and medium term. But in the long run, it involves an increase in public debt, and the Japanese government has to tight its spending more than at the equilibrium without balanced budget rules.

Figure 4: Nash equilibrium with GSP



Whatever the kind of equilibrium considered, the introduction of a stability pact in Europe worries the US policymakers (see table 5 and compare US results in tables 4 and 6). For instance, at the Nash equilibrium, the US government is forced into a more expansionary fiscal policy in the short and medium term. It comes from the fact that the consequences of the external shock are now mitigated: the European countries are less affected, so their GDPs are lower, and their demand for US goods is weaker. Together with a less expansionary monetary policy, the US government's more activist policy implies an appreciation of the dollar against the Euro four times more important than without the stability pact.

5. Present discounted value of losses of the different authorities at the Nash equilibrium

	Central banks			Governments			
	ECB	Fed	BoJ	Ger.	Fra.	USA	Japan
Without GSP*	0.407	0.490	2.470	1.238	1.238	1.281	8.495
GSP**	0.290	0.545	2.344	1.165	1.165	1.641	7.573

* Without balanced budget rule.
** With balanced budget rule in France and Germany.

6. Present discounted value of the losses of each authority with the GSP

	Central banks			Governments			
	ECB	Fed	BoJ	Ger.	Fra.	USA	Japan
Nash	0.290	0.545	2.344	1.165	1.165	1.641*	7.573
Monet	0.289	0.541*	2.342	1.240	1.240	1.691	7.970
Europ.	0.277*	0.567	2.266*	1.082*	1.082*	1.887	7.166*

* Optimal situation for each authority.

When the impacts of the speculative shock are considered, the simulations show that the results obtained in sections 2 and 3 are not substantially altered by the introduction of the balanced budget rule. An intra-European coordination is still the equilibrium favoured by the European and Japanese authorities. Only the Fed has a different point of view: from now on, it prefers the monetary equilibrium (rather than intra-European coordination without the GSP), while the US government remains favourable to the Nash equilibrium. When there is no active fiscal policy in Europe, the US fiscal policy is less effective: debt to GDP ratio increases more than at the Nash equilibrium and monetary policy has to become less expansionary.

Should we infer from these results that the GSP has Pareto-superior properties as far as European countries are concerned, in comparison with the ones obtained without the Pact? Indeed, ECB's and German and French governments' losses have been reduced after the provisions of the Pact have been introduced. At first sight, there no doubt are advantages with this Pact. Looking at these results more acutely

however, at Nash equilibrium for instance, we find that their Pareto-superiority is due to a large extent to a less active monetary policy (the European nominal interest rate varies less), to the reduction in EU public debts' fluctuations, and to the decrease in net financial assets between European countries and Japan.

As a counterpart, the Euro-Yen exchange rate volatility is more substantial; but this kind of variability has not been assumed to incur a peculiar cost to governments or central bankers in our model. Moreover, the adoption of the GSP gives rise to a trade-off between consumption prices and output which is more favourable to the former. Price deviations from the baseline in France and Germany are reduced from the short to the long run when these countries abide by the GSP ; the price fall in the long run is up to 0.2 point, whereas it was up to -0.3 point without a Pact. As for GDP deviations from the baseline, they are superior in the situation with the GSP than without. This trade-off confirms the explanations economists put forward in order to justify the GSP in economic terms (see Artis and Winkler, 1997, Eichengreen and Wyplosz, 1998): limitations over public deficits would resolve coordination failures with the ECB, failures whose occurrence would generate too large variations in the interest rates; these limitations would hence reduce the inflationary pressures which are commonly attributed to public debt rollover. Such a policy mix however faces a drawback: larger fluctuations of the GDPs (in relation to the situation without a GSP) might well occur in the European countries.

b) What happens if the Fed is less conservative than the ECB?[20]

We finally turn to a situation with heterogeneous loss functions between the Fed, on the one hand, and the ECB and BoJ, on the other. In equations (11) and (12), for US authorities, we give the following values to α: $\alpha_G = 0.6$ and $\alpha_B = 0.3$, for government and the central bank respectively. Hence, the relative aversion of the US government towards output in comparison with inflation falls from 1.8 to 1.2, whereas that of the Fed increases from 0.04 to 0.12. Weights' values in European and Japanese loss

[20] We thank Giorgio Basevi for suggesting this extension.

functions remain constant.

In this framework, the asymmetric speculative shock in Japan gives rise to less active fiscal and monetary policies in the US since their aversion towards price deviations is less pronounced than in the preceding sections. Hence, the Yen depreciation which provokes price falls in the US and EU does not exacerbate a large US nominal interest rate decrease.

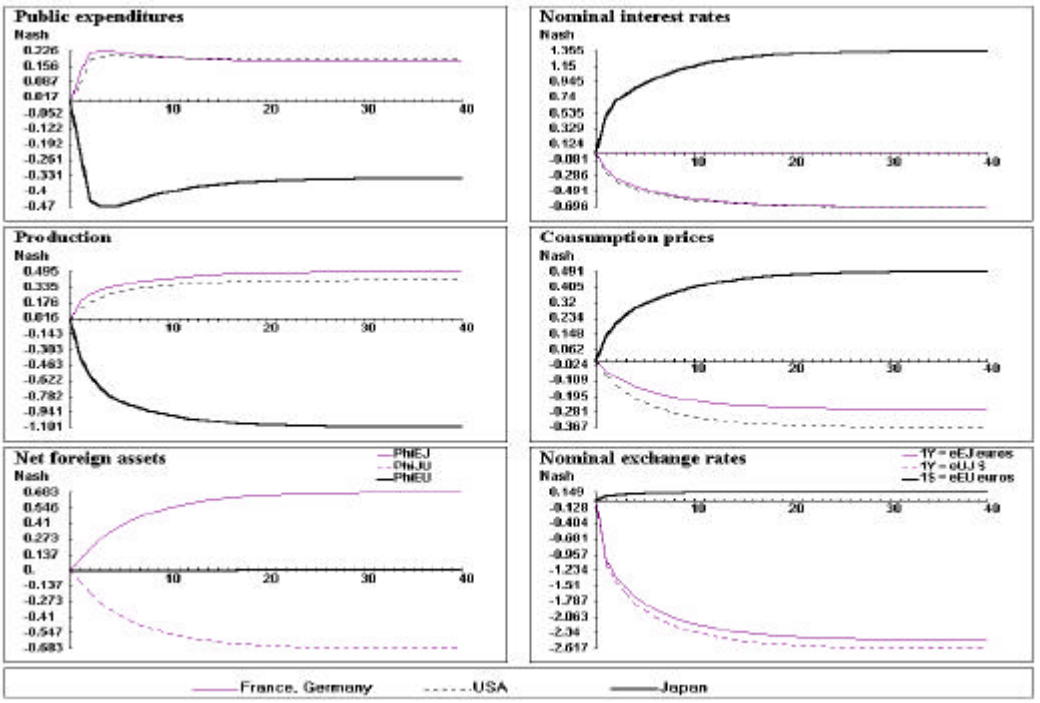
Results in terms of output and prices are better for the US with a less conservative central bank; loss functions for government and the Fed are reduced in relation to their values with homogeneous loss functions[21]. One might conclude that US fiscal policies are more efficient than in preceding sections.

Since US policies are less active, Japanese ones are more: the fall in public spending increases from the situation with homogeneous loss functions to the case with heterogeneous ones and monetary policy is also more restrictive. Finally, despite a higher deviation of Japanese GDP from its baseline level, Japanese policymakers can reduce their loss functions: debt to GDP decreases and deviations of trade balances from the baseline are lower.

The macroeconomic consequences of this heterogeneity for European countries are favourable for GDP and prices deviations, which are reduced thanks to less expansionary fiscal and monetary policies. However, with higher debt to GDP ratios than in the situation with homogeneous loss functions, European governments incur larger losses; as for the ECB, it is better off when the Fed is less conservative than it (the ECB) is.

[21] Remember that US loss functions in the present section do differ from that used in previous ones. Comparisons between these different situations, as far as the US policies are concerned, might therefore be used with caution.

Figure 5: Nash equilibrium with heterogeneous loss functions



7. Present discounted value of the losses of each authority with heterogeneous loss functions

	Central banks			Governments			
	ECB	Fed	BoJ	Ger.	Fra.	USA	Japan
Nash	0.403	0.506	2.460	1.269	1.269	1.114	8.396
Monet	0.400	0.500*	2.455	1.392	1.392	1.043*	8.727
Europ.	0.398*	0.503	2.438*	1.263*	1.263*	1.140	8.390*

* Optimal situation for each authority.

European and Japanese policymakers still give priority to intra-European coordination since they minimise their respective losses. Conclusions differ for the US. The fact that the Fed has less reluctance towards inflation in relation to output deviations is a good device because it resolves the internal coordination default with the government. In the present situation indeed, both US authorities prefer the monetary equilibrium. The fact that the Fed reacts less to the Yen depreciation and its price consequences limits the reaction of the government which is reluctant to increasing its debt to GDP ratio. Hence, it is not compelled to implement 'excessive'

fiscal policies which push its welfare loss up, as it was the case with a more conservative Fed.

In this situation, with a pragmatic Fed and a price-stability-oriented ECB, the US government is no longer isolationist and therefore tends to contradict Dornbusch's point of view on target zones: if these zones were applied endogenously, limiting exchange rate fluctuations with the Yen would minimise its losses as well as those of the Fed.

5. Conclusion

These computations of a four-country dynamic Mundell-Fleming model show that when confronted to an asymmetric speculative shock, European authorities, via the coordination of their economic policies, can succeed in reducing some macroeconomic imbalances not only in their economies, but in the country directly hit by the shock. The coordination of policies in the E.U. generates net gains for the Japanese economy. But the design of this policy mix does not suit the US government, not because it induces more variability of inflation and GDP than the other equilibria, but because it implies a more active fiscal policy, which is expensive.

An international monetary coordination, that is to say the implementation of target zones between the three main currencies, is not an optimal answer to macroeconomic imbalances in the countries concerned here, except for the USA when the Fed is less conservative than the ECB and the BoJ. The decrease in the central banks present discounted value of losses due to less volatility of the exchange rates is very small, which is not surprising within the G3. France and Germany together in the Euro zone are much less open to international trade than they were before January, 1st, 1999. A policy of "benign neglect" can henceforth be implemented in the E.U.; it follows that the European countries feel less concerned by exchange rate agreements such as target zones than before the creation of the EU.

Last, we must underline the main advantage of the kind of model used here: the equilibria are time consistent. Implemented policies are credible, and short-term

policy dilemmas between government and the central bank concerning the assignment of instruments to objectives do vanish. Although the method of computation of time consistent equilibria is complex, our next step will be to justify the model's calibration. We intend to simulate the model using the Monte Carlo method, as Söderlind (1999) recently did with a simpler model. We leave this for future research.

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7. Appendix : The model

F stands for France, G for Germany, J for Japan, U for the United States et E for the EMU

$i, j = F, G, J, U$.

a) Equations

(1) $y_t^i = cR_t^i - \sigma r_t^i + g_t^i + b_t^i + \mu(\phi_{t-1}^i + d_{t-1}^i - W_0)$

(2) $R_t^i = y_t^i - T_t^i$

(3) $T_t^i = T_{t-1}^i$

(4) $b_t^i = \sum_{j \neq i} [n^{ij}(y_t^j - y_t^i) + n^{ij}\delta_x x_t^{ij}]$

(5) $p_t^{id} = w_t^i + v_1 y_t^i + \theta r_t^i$

(6) $p_t^i = l_1 p_{t-1}^i + (1-l_1)p_t^{id}$

(7) $w_t^{id} = \lambda q_t^i + v_2 y_t^i + w_{0t}^i$

(8) $w_t^i = l_2 w_{t-1}^i + (1-l_2)w_t^{id}$

(9) $q_t^i = p_t^i + \sum_{j \neq i} n^{ij} x_t^{ij}$

(10) $d_t^i = d_{t-1}^i + r_{t-1}^i(d^{\%}/100) + r_0(d_{t-1}^i - d^{\%}) + g_t^i - T_t^i$

(11a) $r_t^i = i_t^E - \pi_{t+1}^{ia}$ for $i = F, G$

(11b) $r_t^i = i_t^i - \pi_{t+1}^{ia}$ for $i = J, U$

(12) $\pi_{t+1}^{ia} = p_t^i - p_{t-1}^i$

(13a) $x_t^{FG} = p_t^G - p_t^F$

(13b) $x_t^{ij} = p_t^j - p_t^i + e_t^{Ej}$ for $i = F, G$ and $j = J, U$

(13c) $x_t^{UJ} = p_t^J - p_t^U + e_t^{UJ}$

(14a) $e_{t+1}^{Eja} = e_t^{Ej} + (i_t^j - i_t^E) + k(\phi_t^{Fj} + \phi_t^{Gj})$ for $j = J, U$

(14b) $e_{t+1}^{UJ} = e_t^{UJ} + (i_t^U - i_t^J) + k\phi_t^{UJ}$

(15a) $F_t^{ij} = F_0 + \frac{1}{6k}(e_{t+1}^{ija} - e_t^{ij} + i_t^j - i_t^E)$ for $i = F, G$ and $j = J, U$

(15b) $F_t^{ji} = F_0 - \frac{1}{6k}(e_{t+1}^{ija} - e_t^{ij} + i_t^j - i_t^E)$ for $i = F, G$ and $j = J, U$

(15c) $F_t^{UJ} = F_0 + \frac{1}{6k}(e_{t+1}^{UJa} - e_t^{UJ} + i_t^J - i_t^U)$

(15d) $F_t^{JU} = F_0 - \frac{1}{6k}(e_{t+1}^{UJa} - e_t^{UJ} + i_t^J - i_t^U)$

(16) $\phi_t^{ij} = \phi_{t-1}^{ij} + 2(x_t^{ij} - x_{t-1}^{ij})F_0 + (r_{t-1}^j - r_{t-1}^i + y_t^j - y_{t-1}^j - y_t^i + y_{t-1}^i)F_0 + r_0\phi_{t-1}^{ij} + b_t^{ij}$

(17) $\phi_t^{ij} = F_t^{ij} - F_t^{ji}$

(18) $\phi_t^i = \sum_{j \neq i} \phi_t^{ij}$

(19) $W_t^i = d_t^i + \phi_t^i$

(20) $\tilde{W}_t^i = W_0 + ar_t^i$

b) Parameters' values and baseline calibrations for the variables

$c = 0,6$; $\sigma = 0,4$; $\mu = 0,1$; $\lambda = 0,5$; $\theta = 0,1$; $\rho = 0,75$; $k = 1$; $l_1 = 0,5$; $l_2 = 0,5$; $v_1 = 0,15$; $v_2 = 0,2$; $\delta_x = 1,2$; $\tilde{d} = 30\,\%$; $d_0 = 30\,\%$; $W_0 = 0,03$; $\phi_0 = 0$; $r_0 = 0,025$; $F_0 = 0,05$;

$n^{FG} = n^{GF} = n^{FU} = n^{GU} = n^{FK} = n^{GK} = n^{UK} = n^{KU} = 0,1$; $n^{KF} = n^{KG} = n^{UF} = n^{UG} = 0,05$.

c) Definitions of the variables

(N.B. : except for F, all the variables are expressed as deviations from the baseline.)

y , output (Log)

p^d , desired production price (Log)

p , current production price (Log)

w^d , desired wages (Log)

w , current wages (Log)

q , consumer price (Log)

b^{ij} , trade balance of country towards country j denominated in money i (% of PIB)

e^{ij} , nominal exchange rate (Log, a monetary unit of country j is worth e^{ij} monetary units of country i)

x , real exchange rate (Log)

F^{ij} , assets of country j owned by agents of country i denominated in country i currency, in real terms (% of GDP)

ϕ^{ij} , net external assets of country i towards country j (% of GDP)

i , nominal interest rate (%)

r , real interest rate (%)

T , taxes (% de PIB)

d , public debt (% de PIB)

π^a , anticipated inflation rate of production price (Log)

g , public spending (% de PIB)

R , consumers' revenue (Log)

$\tilde{d}$, government public debt target (% de PIB)

$\tilde{W}$, desired consumers' wealth (% de PIB).