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Internal and External Policy Coordination: a Dynamic Analysis

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SUMMARY

We study in a dynamic framework the conflict between government and the central bank with respect to the exchange rate regime, the nature of the expectations of prices and exchange rate regimes (flexible, fixed, EMU), convergence criteria such as the public debt/GDP ratio. The method consists in calculating Perfect Nash Equilibria between authorities and then modelling « internal and external co-ordination » by a Dynamic Nash-Bargaining procedure.

This technical article, which uses all the contemporary methods of macroeconomic dynamic modelling, can be read in two different ways. The first is linked to the political economy and history of thought; the second is linked to a normative proposition for the political economy. According to the first reading, one can be surprised by the fact that, since German Reunification in 1990, Europe has been in a Keynesian depression and at the same time, macroeconomic theorists have been opposed to Keynesian solutions of the crisis. At the same time, they developed Ricardian explanations of the ending of the crisis in the small countries as Denmark and Ireland.

Would there be an "irrationality" in the diagnosis of economists ? We do not think so. In fact two problems are intertwined : the observation of facts and the normative development of theory. Theorists as empirists do not criticise facts but have another target. They think that a strong signal must be given for the EMU, in which stabilisation policies would play a secondary role and whereby policies would be more free-market oriented because the State is said to have prejudicial effects on the private sector.

The model developed in this text is in the opposite spirit. We think that the organisation of the EMU cannot avoid coordination problems and cannot avoid justifying the use of budgetary prudential ratios. The contribution of this article is thus normative and methodological. The aim is to study the management of macropolicies by using original modelling. But in this framework, the world "rationality" of economic policy as a whole is probably not the most appropriate one. The sense of this word should be discussed in further work.

Results are not qualitatively different whether wages are fully indexed on prices or not, whether expectations of inflation are myopic or rational and whether private agents are Keynesian or Ricardian : (1) central bank independence leads to big « internal » co-ordination » costs; (2) « internal and external co-ordination » depend little on the exchange rate regime; (3) the public debt/GDP ratio, by subjugating budgetary policy to monetary policy, reduces the conflict between central bank and the State, but it reduces also co-ordination gains; (4) budgetary policy can block external coordination because of output and fiscal costs; on the other hand, monetary policy never leads to such a behaviour, even in the asymmetric regimes, because it is then subordinated to the dominant one; (5) to manage public debt in order to obtain a debt/GDP target raises an intertemporal problem of economic policy : to reduce public debt means a restrictive policy-mix in the short term and a reduction of the real interest rate in the long term, in order to be accepted by private agents : but there is no « natural » mechanism to allow for this adjustment.

Keywords : internal and external co-ordination, Perfect Nash Equilibrium, Nash-Bargaining, Time Consistency.

J. E. L. CLASSIFICATION NUMBERS : E1, E4, E5.

RÉSUMÉ

Nous étudions dans un cadre dynamique le conflit entre l'Etat et la banque centrale selon le régime de change et les critères de convergence tel le ratio dette publique/PIB. La méthode consiste à calculer des équilibres de Nash parfaits et à modéliser les coordinations internes et externes par des procédures Nash-Bargaining dynamiques.

Cet article technique, parce qu'il utilise toutes les méthodes actuelles de la modélisation macroéconomique dynamique est susceptible d'être lu de deux manières : la première renvoie à la politique économique et à l'histoire de la pensée, la seconde renvoie à une proposition normative de politique économique.

Selon la première lecture, on peut être surpris par le fait que depuis la réunification allemande de 1990, l'Europe a été plongée dans une dépression keynésienne alors que les théoriciens de la macroéconomie se sont refusés à proposer des solutions keynésiennes à la crise et au contraire ont développé des explications ricardiennes de la sortie de crise en s'inspirant des observations faites dans les petits pays comme l'Irlande ou le Danemark. Y aurait-il une absurdité du diagnostic des macroéconomistes ? Nous ne le pensons pas. En fait se mélangent deux problèmes : l'observation des faits et le caractère normatif du développement de la théorie. Les théoriciens comme les praticiens ne critiquent pas l'observation des faits mais ont un autre projet. Ils pensent peut-être qu'il faut donner un signal fort pour l'unification européenne, où les politiques de stabilisation joueraient un rôle secondaire et où il faudrait s'orienter vers une doctrine plus libérale parce que la hausse de la part de l'Etat aurait des effets de long terme préjudiciables au développement du secteur privé.

Le modèle développé dans ce texte s'inscrit en contrepoint de cette thèse. L'organisation de la politique économique européenne ne peut se dispenser d'étudier les problèmes de coordination et de justifier du point de vue de l'équilibre macroéconomique les critères prudentiels budgétaires.

L'apport de cet article est donc à la fois normatif et méthodologique. Il vise à étudier les problèmes de la gestion macroéconomique en proposant des modélisations originales. Mais dans ce contexte le mot "rationalité" de la politique économique dans son ensemble n'est peut-être pas approprié et il faudrait dans des travaux ultérieurs discuter le sens même de ce terme.

Les résultats ne dépendent pas qualitativement du fait que les salaires soient indexés, que les anticipations soient myopes ou rationnelles ou que les agents soient ricardiens ou keynésiens : (1) l'indépendance de la banque centrale conduit à des coûts de coordination interne importants ; (2) les gains de coordination interne et externe dépendent peu du régime de change (3) le ratio dette publique/PIB, en subordonnant la politique budgétaire à la politique monétaire réduit le conflit entre la banque centrale et l'état, mais aussi les gains de coordination (4) la politique budgétaire peut bloquer la coordination en raison des coûts de production et de fiscalité (5) gérer la dette publique pour obtenir un ratio dette publique/PIB soulève un problème intertemporel de politique économique : réduire la dette publique signifie mettre en oeuvre une politique mixte restrictive à court terme et réduire le taux d'intérêt à long terme pour qu'elle soit acceptée par les agents privés. Mais il n'existe aucun mécanisme naturel qui permette cet ajustement.

Internal and External Policy Coordination : a Dynamic Analysis

Fabrice Capoën[1] *and Pierre Villa*[2]

1. THE ISSUE

The organisation of EMU is based on several principles : the independence of the central bank to which the main target of controlling inflation is assigned, the lack of external co-ordination between budgetary policies and the common monetary policy, and finally the framing of budgetary policies by prudential ratios. This type of organisation is also proposed during the transitory period of the EMS. This institutional framework is problematic because it does not define external and internal co-ordination and neither raises the consistency question between economic policies, even though it implicitly suggests (which is contradictory with these two requirements) a restrictive number of targets : the unemployment-inflation trade-off is assigned to the central bank and the public debt-real interest rate trade-off is assigned to the government.

Some articles, like those of Douven-Engwerda (1995) and Douven-Plasmans (1995) show however that there is a contradiction between convergence criteria (inflation and the long term interest rate) and co-ordination. In fact co-ordination implies, for instance, that, when there is a negative idiosyncratic shock to demand in one country, the latter implements an expansionist policy while the others implement a restrictive policy in order to fight against the overheating of this policy. Economic policy must thus be « free » in a cooperative framework. This is no more the case for convergence. Let us define convergence as the minimisation of a quadratic criterium measured by the sum of squared divergences of variables (that we want to converge) from the European mean. Then Douven and Plasmans show (p10-12) that the convergence (which implies minimising this European criteria) does not lead to a better outcome than the Nash non-co-operative equilibrium obtained without the convergence criterium. The intuitive reason behind this result is simple : after an idiosyncratic shock, the non-cooperative policy consists in pegging the instruments in order to minimise the loss function. The cooperative policy consists then in observing that, because of positive or negative external effects, the policy-

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mix is over or under-reacting at the European level. Then cooperation consists in reevaluating these policies according to a Nash-bargaining procedure. Using a common convergence criterium implies that « policy differences » are imposed by these criteria. There is only room for the inefficient part of these policies (their sum) to implement coordination. So coordination is not efficient. An increase of European expenditures is obviously favourable to a country whose output-inflation trade-off is « lower » than the mean and unfavourable to a country whose output-inflation trade-off is « higher » than the mean. In other terms the Pareto optimal « feasible frontier » with convergence includes the point of non-cooperative policies without convergence. The coordination is not relevant because the instruments are assigned to convergence : so the convergence situation is not better than the uncoordinated equilibrium without convergence. In this article we want to assess this proposition in the case of fiscal prudential ratios.

In a preceding article (Capoën, Sterdyniak, Villa (1994)), we criticised this organisation in a static framework. Our main conclusions were the following :

- when production is equal to its NAIRU level, there is a « consistency relation » between fiscal and monetary policies, which cannot be independent,

- the independence of the central bank and the State introduces a target conflict when - as it is the case in the short term - the two authorities are in charge of the short term stabilisation policies. This conflict takes two forms. In the case of Keynesian unemployment, the central bank implements a restrictive monetary policy in order to fight against inflation and the government implements an expansionist policy in order to fight against the restrictive policy of the central bank. In the case of full neo-classical employment, the conflict is expressed by the inability of the two authorities to agree upon a common rule and thus allowing the private sector to formulate clear and unequivocal expectations to make plans.

- Several solutions can be proposed to solve this organisational problem. In the first case, one of the authorities submits to the other : the government for instance must give up the stabilisation policy. This is the case when it must fulfil budgetary and public debt ratios against which it runs up. The second solution consists in rebuilding the unicity of government through co-ordination. The latter will be the result of a Nash-bargaining negotiation procedure. Then the authority which is the closer to optimum will impose its choice because its negotiating power is the bigger, unlike the case of centralised policy where the weights of the two authorities are equal. So, if the central bank attributes a heavy weight to inflation, it discourages the government from implementives an expansionist policy after an inflationary shock. The third solution (not exclusive to the preceding ones) consists in increasing the number of targets : cost of variation of instruments, trade balance (or foreign assets), public debt, growth (i.e. real interest rate). But the choice of the weight of the targets is implicitly an assignment rule of instruments. Moreover growth, public debt and foreign assets are long term targets, while demand, prices and public deficits are short term targets. So it is necessary to analyse the organisation of economic policy in a dynamic framework. This begs at least four questions : the assignment rules, the wealth structures, stability and the nature of the long run, and finally the dynamic consistency.

(i) Concerning the assignment rules, when the monetary policy is geared to the « short run stabilisation », for instance after a positive demand shock, an increase of the real interest rate has a negative effect on growth, on the long term supply of goods, and a positive effect on public debt, such that the possibly induced divergent path of debt may mean a constraint on the fiscal policy in the long run. It seems to be more judicious to assign the budgetary policy to the short run stabilisation because it has *a priori* no effect upon growth contrary, to the monetary policy. But this prescription, which is not verified in practice (this is not a proof of wrong-doing), is not compatible with the speed of transmission of policies. When financial markets have rational expectations of exchange rates (and/or of inflation), monetary policy has instantaneous effects : an expected appreciation of the exchange rate (and/or of an increase in prices) leads by backward induction to an effective appreciation of the exchange rate (and/or an increase in prices) in the short run. On the other hand, budgetary impacts are slower and can be opposite in the long run and the short run. For instance, in a Keynesian situation, fiscal policy is more efficient for the home country than for the others in the short run. On the other hand in the long run, it is more efficient for the partners than for the home country. This reversing according to the term is due to three reasons : the increase of the interest rate in the home country, the loss of competitiveness and the decrease of wealth in the home country in the long term.

(ii) Secondly, wealth effects must be considered. *A priori* no norm of public debt can be justified economically. In an open economy, public debt is a matter of accounting : it is equal to the desired wealth of households less the desired debt of firms and less the desired net foreign assets of households. In the short run, the interest rate being fixed, public debt is determined by public deficits, the wealth of households through their consumption behaviour, firms' debt by investment and foreign assets by the expected yield difference between home and foreign assets. The variations in production and in the expected rate of inflation as well as exchange rate change constitute the adjustment. In the long run, the real interest rate allow the demand for assets to equalise the demand for debts. In the flexible and fixed exchange rate regimes, the ratio between foreign assets and public debt is determined by the risk on foreign assets and risk aversion. In an EMU regime the risk disappears : the ratio between home public assets and foreign assets is thus indeterminable and the real interest rates are equal in all countries. So there is place for pegging the public debt in each country. Moreover the public debt target is theoretically a parameter of freedom for each country and can be adapted to the desired wealth of the home households. But the Maastricht ratios are a more strict constraint than that. In all regimes, two choices are available at the European level :

-if it is chosen to peg the European real interest rate (because of its influence on growth), the long term European public debt is a result of the long term equilibrium,

-if it is chosen to peg the public debt, the European long term real interest rate (and growth) is a result of the long term equilibrium.

So the question is : what is the good choice ? But the answer, which is political, is beyond the scope of this text.

(iii) Thirdly, dynamics raises the question of stability. This problem can be formulated in a closed economy model. Usually, macro-economists tell a story in which the short run is Keynesian and the long run is classical. So equilibrium is determined in the short run by adjustment of production and prices such that supply equals demand. In the long run, equilibrium is classical such that real interest rate makes aggregate demand equals aggregate supply. But in this case, we are confronted with two contradictions. First, central bank fight inflation by increasing the nominal interest rate in the short term. So, because of the rigidity of prices and wages, the real interest rate increases such that output and inflation decrease. But, in the long term, the real interest rate being fixed by macro-economic equilibrium, the increase of the nominal interest rate must induce an increase of inflation by the Fisher relation. So there is no procedure which allows for going from the short term temporary equilibrium to the long term equilibrium. This is the interest rate version of the unpleasant monetarist arithmetic of Sargent and Wallace (1981). Secondly, in the case of fiscal policy, the problem is the same. If government wants to lower the public debt ratio in the long run, it must decrease the real interest rate in order to diminish the desired wealth of households. But this target is usually obtained by an increase of taxes (or a decrease of public expenditures) such that demand falls and the real interest rate rises in the short term because the inflation rate decreases, the nominal interest rate being fixed by the central bank. The question of stability is thus raised whether private agents are Keynesian or Ricardian, whether there is perfect expectations of inflation or not. In our model, this question is resolved because we assume that there are lags in prices and wages. So it is possible to extent production in the long run by increasing inflation. Thus a permanent increase in nominal interest rate or a permanent decrease in public expenditures lead to a decrease in production in the short as in the long term. In the first case, the desired wealth by households increases, in the second case it decreases. But in both cases, the short run and the long run evolutions are of the same nature. We describe thus a mixed of Keynesian-classical regime all over the trajectories.

(iv) Quarterly, dynamic consistency leads to three recurrent types of results :

- monetary policy consists in appreciating the exchange rate in the short run to fight inflation and in depreciating it in the long run because of losses of competitiveness,

- budgetary policy is expansionist in the short run to fight unemployment and is contrationnary in the long run to stabilise public debt or to fight inflation,

- with independence of the central bank, if there is a conflict in the short term between central bank and government, the policy-mix consists in increasing nominal interest rate and increasing public expenditures. In the long run, when inflation has turned into depression, it consists in decreasing interest rate to boost growth and in decreasing public expenditures to fulfil the debt ratio. Short and long term policies are thus reversed.

In these three examples (which are not exhaustive), dynamic consistency is exacerbated because of the reversal of policies in the short and the long run. Whether centralised or not, government should revise its policy, the greater the actualisation rate is, the more incited it is to postpone stabilisation policies and the more private agents change their expectations after the short run policies are known. That's why we consider only dynamic consistent policies, considering that inconsistent policies are the result of a wrong calculation or of a change of the target function which is beyond the scope of this article.

In the next part, modelling principles are discussed (but algorithms are to be found in Capoën (1996) and Capoën, Villa (1996). Finally we discuss the consequences of policies' organisation through simulations of a supply shock and a change in the public debt ratio target of the government.

2. PRINCIPLES OF DYNAMIC MODELING

In order to study coordination and the assignment of instruments, it is necessary to define four kinds of principles concerning dynamic modelling : the regimes of policy, the wealth behaviour, the expectations' rules and the dynamic consistency of economic policy. These points will be reviewed in this paragraph while the model is described in appendices I and II. The model is a dynamic Mundell-Fleming model with two countries of same size, same behaviour and same initial conditions.

2.1. Economic policy and exchange rate regimes

a) Economic policy design

In our framework monetary policy consists in pegging the nominal interest rate. This choice comes from the observation that the development of financial markets blurs the definition of money and makes the demand for money unstable. It is thus impossible to control the money supply : the money supply multiplier is unstable. This choice is also justified by the fact that saving and investment are not equalised in the short run by the interest rate. Investment creates saving and the later adjusts to the former by variations of output and prices[3].

Moreover budgetary authorities have two instruments : public expenditures and taxes. They use these instruments in order to manage final targets : production, prices and external wealth, but also to stabilise intermediate targets such as public debt (i.e. the wealth choice of private agents between wealth in national currency and in foreign currency), the

[3] The reader could be astonished by this way of modelisation, because it seems to be no money in the model. It is not true. Money is everywhere in this model, even though it does not appear because of Walras law. In fact, if we want to connect this model with old Keynesian features, we must think about a « credit economy » in the sense of Hicks. Credit to the private sector is of the same nature as credit to the government. Three facts allows us to make this hypothesis : first, there is no more pure monetary financing of the government : the central bank lends to the State directly or through buying treasury bonds at a nominal interest rate, which is the rate of the market and depends on its discount rate. Secondly, there is no more a distinction between money and bonds : households can buy a whole range of assets with a continuum of yields which are indexed on the leading interest rate of the central bank (the IS-LM distinction between money and bonds is blurred). Thirdly, the central bank does peg actually the « nominal » interest rate, which is a way of controlling money supply through its objective function.

nominal interest rate (which influences growth) and finally public expenditures and taxation which influence demand and thus the level of activity.

The behaviour of monetary and fiscal authorities is thus not determined by a target of money stock and a public debt/GDP ratio. In the first case this would mean that monetary authorities would manage the unemployment-inflation trade-off only according to the parameters of money demand which is not stable and does not reflect the social choice. In the second case this would mean that budgetary authorities would peg a trade-off between the level of demand and growth only according to a public debt/GDP ratio which does not reflect the desired wealth of households. It is thus closer to reality to assume that monetary and budgetary authorities have a loss function depending on different intermediate and final targets.

The loss function of authorities is thus :

$$L = \sum_{t=0}^{\infty} \rho^t (\alpha y_t^2 + \beta q_t^2 + \gamma \Phi_t^2 + \delta (d_t - \tilde{d})^2 + \varepsilon T^2 + \eta i_t^2)$$

where ρ is the time preference, y_t is output, q_t is the consumption price index, Φ_t external wealth of the country, $d_t - \tilde{d}$ is the discrepancy between the effective ratio of public debt to GDP and the target ratio, T_t is the ratio of taxes over GDP and et i_t the nominal interest rate.

It must be noted that the introduction of taxes in the loss function is not contradictory with its variation in order to adjust the public debt to its target as we shall see in the next paragraph. In effect the fiscal dynamics takes into account the adjustment costs which are considered as a characteristic of fiscal policy. On the other hand the ratio of taxes in the loss function represents the cost for authorities of a gap between actual taxes and the target. This cost represents the distortion effects in the resources' allocation associated with taxes.

In this framework a centralised government has two discretionary instruments : public expenditures and the nominal interest rate. The minimisation of the loss function leads to a linear reaction function because the loss function is quadratique and the model is linear :

$$g_t = f(z_{t-1})$$

$$i_t = h(z_{t-1})$$

where z_t is the state variable of the system :

$$z_t = (y_t, w_t, p_t, d_t, T_t, \Phi_t, i_t - \dot{p}_t^a)$$

y_t is output, $\dot{p}_t^a$ is expected inflation, w_t is the level of wages, p_t the price level of output, d_t is the public debt, T_t is the apparent rate of taxes, Φ_t is the net external wealth divided by GDP and $i_t - \dot{p}_t^a$ the expected real interest rate.

With central bank independence the government must be divided into two authorities characterised by their targets and their instruments : the government manages public expenditures and the central bank the nominal interest rate. Two players with their own different loss functions must be distinguished :

$$L_e = \sum_{t=0}^{\infty} \rho^t (\alpha_e y_t^2 + \beta_e q_t^2 + \gamma_e \Phi_t^2 + \delta_e (d_t - \tilde{d})^2 + \varepsilon_e T^2 + \eta_e i_t^2)$$

$$L_b = \sum_{t=0}^{\infty} \rho^t (\alpha_b y_t^2 + \beta_b q_t^2 + \gamma_b \Phi_t^2 + \delta_b (d_t - \tilde{d})^2 + \varepsilon_b T^2 + \eta_b i_t^2)$$

$$L = L_e + L_b$$

The government minimises its loss function by using public expenditures as the control variable and the central bank does the same by using the nominal interest rate. In numerical applications, the following weights have been used :

Table 1 : parameters of the loss functions.

Parameters	a	b	g	d	e	h
Centralised Policy	1	3	5.0	1	1	1
Decentralised Policy : Government	0.9	0.5	4.0	0.9	0.9	0.5
Decentralised Policy : central bank	0.1	2.5	1.0	0.1	0.1	0.5

This representation of monetary authorities leads us to consider three regimes :

- the centralised regime where the central bank is not independent and where the government chooses the optimal policy-mix (interest rate and public expenditures) in order to minimise the centralised loss function according to the shocks and the exchange rate regime. In that case the weight of government and central bank are equal.

- The decentralised regime where the central bank is independent. Two cases are possible :

a) In the first case, there is no cooperation between government and central bank. This case is modelled by a non-cooperative Nash equilibrium in which each player considers the policy of the other as given when it minimises its loss function.

b) In the second case, there is coordination between the two authorities. This case can be modelled by a Nash bargaining solution starting from a non-cooperative equilibrium modelled by a Nash equilibrium. The cooperative solution depends thus on the initial non-cooperative equilibrium and on the weight of each authority. This weight is inversely proportional to the expected gains i.e. to the difference between optimal utility obtained

with cooperation and the utility obtained in the non-cooperative equilibrium. One authority can thus freeze cooperation if its utility in the non-cooperative case is close the utility it can obtain by cooperation.

The parameters in table 1 signify that government is more concerned with real variables like production, trade balance, taxes and public debt, while central bank is more concerned with inflation. It can be said that central bank is « conservative » and that antagonistic loss functions generate a conflict in targets. Two other types of weights could be considered. In the first case the state and the central bank would have completely distinct targets and the conflict between the two authorities would be maximum. In the second case the government loss function represents the social utility function and the central bank utility function is « included » in the loss function of the government. For instance the central bank is « obtuse » and is interested only in inflation. In this case government would be discouraged to implement an antagonistic policy against the central bank and would implement a restrictive policy like it (see Villa (1995) for a discussion of these two cases).

b) Taxation and public debt

Concerning public debt, it has been assumed that government had two instruments : public expenditures (as a share of GDP) and the apparent rate of taxes *T* (as a share of GDP). It is supposed to manage lump sum taxes T_t in order to make the public debt converge to the target over GDP ratio $\tilde{d}$ (see Sachs-Wyplosz (1984)) :

$$T_t = \nu_3 T_{t-1} + (1-\nu_3)\left[(i_{t-1} - (p_t - p_{t-1}))d_{t-1} + g_t + d_{t-1} - \tilde{d}\right] \quad 0 < \nu_3 < 1$$

where i_{t-1} is the interest rate of national debt, p_t is the GDP price level, g_t is public expenditures as a share of GDP, $\tilde{d}$ is the debt target as a share of GDP, d_{t-1} is the public debt as a share of GDP and T_t is taxes over GDP[4].

Moreover the dynamics of the public debt is given by :

$$d_t - d_{t-1} = (i_{t-1} - (p_t - p_{t-1}))d_{t-1} + g_t - T_t$$

So at long term equilibrium :

$$\tilde{T} = g + (i - \dot{p})\tilde{d} \text{ et } d = \tilde{d}$$

[4] In the model, taxes are « lump-sum », because the apparent rate of taxation is computed according to the baseline : $T_t = TAX / Y_{0,t}$ such that TAX is an instrument of government. This framework allows us to model Ricardian consumers and equivalence. It is not the case in pure Keynesian frameworks, like in Creel, Lerais, Sterdyniak (1995), where the instrument is the tax rate : $t_t = TAX_t / Y_t$. For instance a change of GDP may induce a change of the tax level, even with a passive policy, and there are few chances that Ricardian equivalence may hold.

Equations (10) and (11) in the appendix I are a linearised form of these three preceding equations.

It is necessary to introduce this behaviour because of two reasons. First, it allows to define in all exchange rate regimes, in the long term equilibrium, the share between public debt and external debt held by households. For instance in the EMU regime where the risk on the value of external debt disappears and where risk aversion does not hold because the exchange rate is definitely fixed, the ratio between internal public debt and external assets would be undetermined. Second, from the government point of view, this behaviour corresponds to a gradual adjustment of taxes to their desired level because of adjustment costs of taxes (a quadratic adjustment cost leads to an autoregressive exponential adjustment).

c) Exchange rate regimes

Three exchange rate regimes are considered. With flexible exchange rates, each monetary authority is in control of its policy and can use its nominal interest rate in order to minimise its loss function. On the contrary, in a fixed exchange rate regime, there always exists a « dominating country » according to which the other countries (the dominated countries) must peg their exchange rate, that is subordinate their monetary policy. This type of game appears because the « dominating country » does not want to manage its monetary policy according to an « external target » like the exchange rate. In particular, in Europe, the Bundesbank systematically refused to manage its monetary policy according to an external target. This was a mean to safeguard its independence because it had not to negotiate its policy with an other central bank. In this case, the « dominated country » has no autonomous monetary policy. Its interest rate is fixed according to the interest rate of the « dominating country » and according to its net external wealth in foreign currency, when there is imperfect substitutability between national and foreign assets because of the exchange rate risk aversion of private agents. The risk premium on the interest rate corresponds to the risk of depreciation of the exchange rate and depends on the level of risk aversion. Finally, in a monetary union, foreign assets are equivalent to internal assets, because exchange rate risk vanishes. In this case the interest rates of the two countries are equal and monetary policy is not independent for one country.

That is why, monetary policy is modelled, according to the three exchange rate regimes, in the following form :

In the flexible exchange rate regime, each country fixes its interest rate such that :

$$\begin{cases} \underset{i_t}{\text{Min}}\ L_b\ (.) \\ \underset{i_t^*}{\text{Min}}\ L_b^*\ (.) \end{cases}$$

The exchange rate is a result of equilibrium such that :

$$\dot{e}_t^a = i_t - i_t^* + k\Phi_t$$

i_t is the nominal interest rate, i_t^* is the foreign nominal interest rate, Φ_t is the external wealth of the first country and $\dot{e}_t^a$ is the expectation of the variation of the exchange rate.

In the fixed exchange rate regime with German dominance (the * country), the dominating country fixes its nominal interest rate i_t^* by :

$$\underset{i_t^*}{\text{Min}}\ L_b^*(.)$$

The exchange rate is fixed and assets flows determine the interest rate of the dominated country (France for instance) :

$$i_t = i_t^* - k\Phi_t$$
$$e_t = 0 \text{ et } e_t^a = 0$$

In a monetary union (EMU), the interest rate is determined by the ECB (European Central Bank) :

$$\underset{i_t = i_t^*}{\text{Min}}\ L_b(.) + L_b^*(.) \text{ avec } e_t = e_t^a = 0 \text{ et } i_t = i_t^*$$

It is no more possible to determine the share between external debt and public debt. The public debt ratio and the wealth effect determine the real interest rate at equilibrium. The real interest rate being fixed, the wealth effect determines the total wealth of private agents and the public debt ratio the share between internal and external wealth. This shows why the wealth effect is necessary to determine the long term equilibrium in the EMU and why the Maastricht ratio has only for consequences to determine the real interest rate and the level of public debt in the long run. This shows also that an alternative to this ratio could be to fix a real interest rate target. In this latter case the public debt ratio at long term equilibrium would be a result of economic policy and not a target. We can thus say that choosing a public debt ratio is the same as choosing an implicit rate of growth. But what is better : to choose the public debt ratio or the rate of growth ?

d) Internal and external coordination

The exchange rate regime has an influence on the organisation of economic policy. In fact the independence of economic policy of the different countries and their coordination depend on the exchange rate regime. In a flexible exchange rate regime, independence and coordination of separated fiscal and monetary authorities can be considered, according to the following scheme :

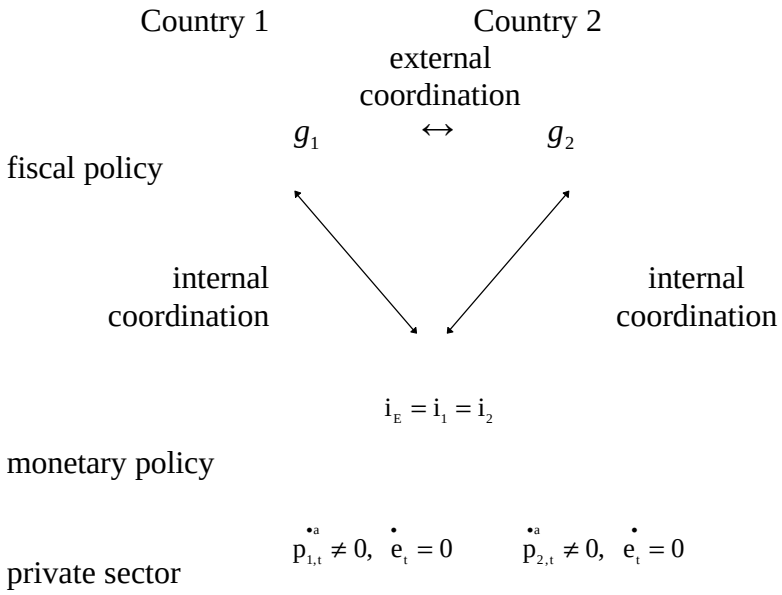
	Country 1		Country 2	
		external coordination		
fiscal policy	g_1	$\leftrightarrow$	g_2	
	$\updownarrow$	external coordination	$\updownarrow$	internal coordination
monetary policy	i_1	$\leftrightarrow$	i_2	
		flexible exchange rate regime		
private sector	$\dot{p}^{a}_{1,t}$, $\dot{e}^{a}_{t} \neq 0$		$\dot{p}^{a}_{2,t}$, $\dot{e}^{a}_{t} \neq 0$	

With fixed exchange rates, with domination of one country, the scheme is the following :

	Country 1		Country 2	
		external coordination		
fiscal policy	g_1	$\leftrightarrow$	g_2	
			$\updownarrow$	internal coordination
monetary policy	i_1	$\leftarrow$	i_2	
		fixed exchange rate regime		
private sector	$\dot{p}^{a}_{1,t} \neq 0$, $\dot{e}_{t} = 0$		$\dot{p}^{a}_{2,t} \neq 0$, $\dot{e}_{t} = 0$	

The dominated country has no monetary policy and the internal coordination of its authorities is impossible : it is fixed by the dominating country.

In EMU the internal coordination is not relevant : only budgetary policies coordination matters (« internal Nash ») versus (« internal-Pareto ») or simultaneous monetary and budgetary policies coordination (« internal-Pareto ») versus (« external-Pareto »).



2.2. Wealth dynamics

Wealth behaviour of the private sector must be split up into external wealth demand and total wealth demand. These two behaviours lead to an aggregate demand function which can be Keynesian or Ricardian.

First concerning the balance of payments, the model is drawn from Bleuze-Sterdyniak (1988) and Benassy-Sterdyniak (1992). The two countries hold each other assets in foreign currency. Let be F_t the German assets denominated in Francs held by the French and F_t^* the French assets denominated in Marks held by the Germans. The variables F_t and F_t^* are computed as a share of the French and the German GDP, which are supposed to be equal in the baseline. Let be : $\Phi_t = F_t - F_t^*$ the net external wealth of France as a share of the baseline GDP. The balance of payments of France can be written :

$$\Phi_t = \Phi_{t-1} + (i^*_{t-1} + \dot{e}_t - \dot{p}_t)F_{t-1} - (i_{t-1} - \dot{e}_t - \dot{p}^*_t)F^*_{t-1} + b_t$$

where i_{t-1} and i^*_{t-1} are French and German nominal interest rates, $\dot{e}_t$ is the variation of the nominal exchange rate of the Mark denominated in Francs, $\dot{p}_t$ and $\dot{p}^*_t$ are the French and the German inflation rates, and finally b_t is the French trade balance as a share of GDP.

Let be r_{t-1} and r^*_{t-1} real interest rates, we have :

$$r_{t-1} = i_{t-1} - \dot{p}_t \text{ et } r^*_{t-1} = i^*_{t-1} - \dot{p}^*_t$$

Thus :

$$\Phi_t = \Phi_{t-1} + r^*_{t-1}F_{t-1} - r_{t-1}F^*_{t-1} + \dot{x}_t(F_{t-1} + F^*_{t-1}) + b_t$$

where x_t is the real exchange rate in logarithm : $x_t = p^*_t + e_t - p_t$.

The linearisation of this equation near the baseline ($F_{0,t}, r_{0,t}$) gives the following equation :

$$\Phi_t = \Phi_{t-1} + (r^*_{t-1} - r_{t-1})F_{0,t} + 2\dot{x}_t F_{0,t} + r_{0,t}\Phi_{t-1} + b_t$$

with the initial values : $F_{0,t} = F^*_{0,t}$ and $r_{0,t} = r^*_{0,t}$

The double impact of the appreciation of the exchange rate comes from the fact that, when the yield of German assets increases, the French hold more wealth in German assets, while the Germans borrow more of the same quantity in Francs. Indeed the demand for assets is given by the portfolio model (Branson (1979)) :

$$F^d_t = F_t = F_{0,t} + \frac{1}{2k}(\dot{e}^a_t + i^*_t - i_t)$$

$$F_t + F^*_t = 2F_{0,t} = 2F^*_{0,t}$$

$$\Phi_t = F_t - F^*_t = \frac{1}{k}(\dot{e}^a_t + i^*_t - i_t)$$ with k=0 in the EMU regime.

So the demand for foreign assets is always satisfied. The balance of payments is equilibrated by the exchange rate in the flexible exchange rate regime, by the interest rate of the dominated country in the fixed exchange rate regime and by capital flows in the EMU because there is then perfect mobility.

Second, concerning the total wealth behaviour, we assume that households have a desired wealth (as a share of the base line GDP) which is an increasing function of the real interest rate :

$$W^d_t = W_0 + ar_t$$

In the long run we have the equality :

$W^d_t = \tilde{d} + \tilde{\Phi}_t$ which determines the real interest rates and the net foreign assets hold by households; and in the short run we have :

$$W_t = d_t + \Phi_t$$

where d_t is the public debt resulting from the public expenditures and fiscal behaviour of the government and Φ_t is the net foreign assets that the households want to hold.

In the base line, we have obviously the equality :

$$W_0 = d_0 + \Phi_0$$

where d_0 is the initial debt of the government and Φ_0 is the initial external wealth of the first country.

From these hypotheses it follows an aggregate demand of the following shape :

$$y^d = g_t + cR_t - s'r_t + m(\Phi_{t-1} + d_{t-1} - W_0 - ar_t)$$

where $r_t = i_t - (p_t^a - p_t)$ is the expected real interest rate.

R_t is households income, g_t is public expenditures as a share of GDP, $\sigma' r_t$ is the impact of real interest rate on investment and consumption while the last term expresses the wealth behaviour of households.

At this point there are two possible definitions of households income. In a Keynesian framework, income is computed according to the « Hicksian » definition, i.e. it is the maximum possible consumption to be as rich at the end of the period as at the beginning. So income is defined as the sum of GDP, of interest income from the government less taxes, and of the interest income and appreciation of the exchange rate income from abroad :

$$R_t = y_t - T_t + r_{t-1}d_{t-1} + r^*_{t-1}F_{t-1} - r_{t-1}F^*_{t-1} + \dot{x}_t(F_{t-1} + F^*_{t-1})$$

By using the budgetary constraint of the government and the balance of payments equilibrium, the following aggregate demand is obtained :

$$y^d_t = c\left[y_t + d_t - d_{t-1} + \Phi_t - \Phi_{t-1}\right] + (1-c)(g_t + b_t) - sr_t + m(\Phi_{t-1} + d_{t-1} - W_0)$$

with : $\sigma = \sigma' + a\mu$

In a Ricardian framework, public debt is not considered as a private wealth, such that an increase of public expenditures is considered to be financed by a future increase of taxes. In this framework, the real income is not determined by the « Hicksian » definition but by the « Barroan » definition :

$$R_t = y_t - g_t + r^*_{t-1}F_{t-1} - r_{t-1}F^*_{t-1} + \dot{x}_t(F_{t-1} + F^*_{t-1})$$

In that case, by using the balance of payments equilibrium, the following aggregate demand is obtained :

$$y^d_t = c[y_t + \Phi_t - \Phi_{t-1}] + (1-c)(g_t + b_t) - \sigma r_t + \mu(\Phi_{t-1} + d_{t-1} - W_0)$$

As we shall see in the following, the wealth effect is necessary if we want to obtain stability of the model in a EMU framework. If there were no wealth effect, one country could accumulate indefinitely external assets or debt towards the other. But this effect is not contradictory with the Barro-Ricardo effect because, even though households do not consider public debt as wealth, they must hold it. Moreover the desired wealth is independent of desired public debt in this model.

2.3. Prices expectations and stability

The question in macroeconomics is how can we obtain the long run by chaining temporary short run equilibria. In an international model stability conditions divide in two : absolute stability concerning the world sum of outputs and differential stability concerning the differences of outputs.

Equations (2) to (6) in the appendix I present a wage-price loop in level with a slow adjustment of prices and wages and partial or full indexation of wages ($0 \leq \lambda \leq 1$). These equations are the supply curve of the model. The effect of the expected real interest rate in the desired price equation of firms (equation 2) means that firms fix their prices according to « development costs » including the relative user cost of capital represented here by the real interest rate. Dynamics raises the question of stability of the model. First of all, it should be remarked that, with partial indexation of wages, « world stability », concerning the two countries, is always obtained. We thus only discuss the case of full indexation, which is more interesting in the long run. Then there can be two sorts of price expectations modelling. In the first one, prices expectations are adaptive ; we shall speak of a Keynesian model. In the second one, prices expectations are rational ; we shall speak of a classical model. But, it is important to note that, in both cases, the stability conditions near the long term equilibrium are the same. They depend, at the world equilibrium, on the wage and price adjustment lags (the parameter *h* in the II.2 appendix). If they are long enough the model is stable. The point is that it is possible, because of lags, to extent production by increasing inflation in the long run. When these stability conditions are fulfilled, an increase in the nominal world interest rate induces in the long term a decrease in production and inflation and thus an increase in the real interest rate. So households, who want to hold a greater share of wealth out of GDP are fulfilled in their desire by a decrease of income. When there are rational expectations of prices and full indexation of wages, the short run and the long run are neither Keynesian nor Classical, they are a mixed regime (see appendix II.2.).

Secondly, according to the exchange rate regimes, the differential stability conditions (see appendices II.3, II.4, II.5) bear on the wealth effect. In the flexible exchange rate regime, the wealth effect must be lower than a maximum value. If it is greater than this specific value, an increase in the nominal interest rate will induce a reduction of production

and an increase in the desired wealth of households which are non-stabilising. The country had to accumulate foreign wealth and the real exchange rate had to depreciate indefinitely in order to increase the trade balance and because of rational expectations of the exchange rate. So there can be no equilibrium. In this case, real wealth effect must not be too important such that the flexible exchange rate regime be stabilising (appendix II.3.).

In the fixed exchange rate regime, it is the reverse, because the real interest rate of the dominated country makes the adjustment. After an increase in the nominal interest rate of the dominating country, demand decreases in the dominated country, its current account deteriorates and its external wealth diminishes. So there must be an external trade surplus to offset the interest burden. This surplus can only be obtained by a decrease in demand because the exchange rate is fixed, i.e. by the wealth effect, which is stabilising. So the long run equilibrium can only be obtained from the short run equilibria when the wealth effect is greater than a minimum value (appendix II.4.).

In the EMU, external wealth is a perfect substitute of internal wealth. In the long run, a decrease in wealth must be offset by a surplus of the trade balance. Because there is no real exchange rate adjustment, this can only be obtained by a decrease of internal demand. So stability is only obtained when the wealth effect is greater than the real interest rate, that is when it can offset the external interest rate burden of the debt (appendix II.5.).

In conclusion, when wages are fully indexed on prices, we do not describe a dynamics where short term is Keynesian and long term classical. Instead we have a mix of Keynesian-classical regime with wealth effect.

2.4. Dynamic consistency of political economy

In a dynamical model, the dynamic consistency of political economy, which has been raised for the first time by Kydland et Prescott (1977), must be assessed.

The first case of dynamic inconsistency appears when one country wants to fight against inflation and when there is a contradiction between short term and long term monetary policies. A restrictive policy increasing interest rate leads in the short run to an appreciation of the real exchange rate, a deflation, a negative effect on demand and also a loss of competitiveness, which requires a devaluation in the long run. After an inflationary shock, monetary authorities, which have a high value of time preference, are lead to propose an optimal policy from their point of view, restrictive in the short run (increase of the interest rate) and expansionist in the long run (decrease of the interest rate and of the real exchange rate). This hiatus generates dynamic inconsistency. In effect, private agents expect an expansionist policy in the future. Three effects results in the short run. First, demand decreases less than the monetary authorities expected because of future expected income. Next, the expected depreciation of the exchange rate in the long run leads, by rational expectations and backward induction, to a depreciation (or a smaller appreciation) in the short run. Finally, expected inflation in the short run is greater, by rational expectations, which increases short term actual inflation and demand. Monetary policy is thus less efficient in the short run : deflation is smaller, production is greater and the exchange rate appreciates less than expected by monetary authorities. So monetary authorities have advantage to implement more restrictive a policy in the long run than the policy to which they committed themselves. This is the incitation to cheat. The dynamic consistent policy consists in taking into account the expectations of the private sector and to

implement a more restrictive policy in the short run and a more expansionist policy in the long run. But this policy is less efficient (in term of the loss function) for the authorities because they must take into account for expectations of prices and exchange rate of private agents, which is an additional constraint.

A second case of dynamic inefficiency is raised by fiscal policy. After a negative shock of demand, budgetary authorities must implement an expansionist policy in the short term in order to compensate the depressive effect on demand. This has three consequences. First inflation increases. Next, public debt is accumulated because of interest burden. Finally the external wealth of private agents diminishes. This third effect has two consequences in the long term. First, if the total private wealth is constant, the public debt must increase. Second, the trade balance must compensate the external interest burden : this can be obtained by a depreciation of the exchange rate (in a flexible exchange rate regime) or a reduction in demand through an increase of the real interest rate (in a fixed exchange rate regime) or through a wealth effect (in EMU). If budgetary authorities have a public debt target in the long run, and/or are inflation averse, and/or have a great time preference, they will implement an optimal policy, from their point of view, expansionist in the short run and restrictive in the long run. This hiatus is at the origin of the dynamic consistency problem. The mechanism is the following. Private agents expect a restrictive policy in the future, for instance an increase of taxes. This has three possible impacts in the short run. First, private agents reduces their consumption in the short run (Barro effect). Next, they expect a lower depreciation of the exchange rate in the long run, which leads by rational expectations and backward induction to a smaller depreciation in the short run. Finally, for the same reason, inflation is smaller in the long and the short term. So fiscal policy is less efficient in the short and long run, that is production, inflation and depreciation of the exchange rate are smaller than expected. Fiscal authorities are thus incited to implement more expansionist a policy in the long run than they committed themselves. On the other hand, a consistent policy would consist in taking into account private agents' exchange rate and inflation expectations and implementing a less expansionist policy in the short run and a less restrictive policy in the long run. But this policy is less efficient because authorities must optimise policy under the constraint of private agents' expectations.

A third case of dynamic inefficiency is raised when there is independence of the central bank. The policy-mix, when there is no internal coordination, in the short run, can lead, after a supply shock (for instance, an inflationary shock with a reduction of production) to implement a restrictive monetary policy in order to fight inflation and an expansionist budgetary policy in order to fight against the restrictive effect of monetary policy. Several features can be imagined in the long run according to the weights with which the different authorities weight their targets and according to their time preferences. In the first case, monetary policy is too restrictive, such that interests on the public debt accumulate and the government must implement a restrictive policy in the long run. In a second case, the conflict between the government and the central bank is smooth such that budgetary policy will be able to be implemented on a long term basis in opposition to the monetary policy. In the first case, budgetary policy will be restrictive in the long term and monetary policy will be expansionist in order to maintain a low inflation rate. In the second case, monetary restrictive policy and expansionist budgetary policy will remain antagonistic in the long run. Private agents response will then be about the credibility of the policy-mix in the short run, which depends on the parameters of the loss functions of the two

authorities. If the conflict between authorities remains the same in the short and the long term, this conflict adds nothing about the dynamic consistency problem.

The dynamic inconsistency comes from the fact that, in an open economy and with flexible exchange rates, the exchange rate is in the short term determined by speculative behaviour and in the long term by wealth effect. Because of rational expectations and backward induction, the long term expected exchange rate level is effective in the short term already. From the internal point of view, dynamic inconsistency is the consequence of the conflict between government targets and central bank targets. If central bank is more conservative than government, it is optimal to generate in the short term an expansionist budgetary policy and a restrictive monetary policy. But, in the long term, because of the public budget constraint and because the government has a stationary public debt target, the conflict induces a subordinated budgetary policy according to public debt constraint and a monetary policy devoted to the management of the production-inflation trade-off. This inversion of assignment rules - in the short run budgetary policy is assigned to activity and monetary policy to inflation, in the long run budgetary policy is assigned to public debt and monetary policy to demand - is a source of dynamic inefficiency of economic policy.

Internal and external coordinations increase or decrease the constraint of dynamic efficiency according to the parameters of economy and the loss functions. With internal coordination, the conflict between the central bank and the government vanishes. In the case of an inflationary shock, this induces a less restrictive monetary policy and a less expansionist budgetary policy in the short term. This reduces the burden of the public debt in the long term and thus reduces the constraints on the dynamic consistent the policy-mix.

The computation of dynamic efficient policies has been developed by Oudiz-Sachs (1985), Currie, Levine, Vidalis (1987) et in a continuous framework by Cohen-Michel (1988). As it is said in Bernhard (1976 pp. 23-24 and 288 and sq.) optimal control cannot be used. So we computed dynamic programming (see Faurre and Depeyrot (1974 pp. 138-140)) in two stages. First stage, we have calculated the reaction functions with rational expectations. And second stage, we used these functions to simulate the dynamic model. The algorithms and the computing of dynamic consistent policies with internal and external coordinations by a Nash-bargaining procedures are presented in Capoën-Villa (1996) in the case of quadratic loss functions and a linear model.

3. INDEPENDENCE OF THE CENTRAL BANKS AND EXCHANGE RATE REGIMES CONSIDERED THROUGH THE SIMULATION OF THE MODEL

In this section, we compare the simulations of the economic policy, when there is partial and full indexation of wages, when expectations of inflation are Keynesian or rational, and when consumers are Keynesian or Ricardian. With an idiosyncratic supply shock on nominal wages in one country, results are given in Tables 1, 2, 3 and 4. These results allows the following statements to be made :

(i) The hierarchy of results does not depend on indexation, on the shape of inflation expectations (Keynesian or rational) and on the nature of household behaviour (Keynesian or Ricardian). This important result follows from three hypotheses :

- first, lags in wage and price functions are more important than wage indexation : they allow production to be extended through inflation, in the long term,

- second, the target utility functions of authorities contains the price level and not the inflation level : this allows the unpleasant monetarist arithmetic of Sargent and Wallace to be solved and it is necessary to do so,

- third, Ricardian or Keynesian consumer behaviour (whether the short term income includes public debt or not) and adaptive or rational inflation expectations are just a matter of dynamics (in the short run) and do not influence the stationary long term equilibrium.

(ii) In the case of centralised economic policy, and in the flexible or fixed exchange rate regimes, external coordination brings little improvement for the two countries because economic interaction between them is rather limited : first budgetary policy spillovers are positive and monetary spillovers are negative, so that the combined policy-mix spillovers are small. After a supply shock, the world's optimal policy consists in reducing public expenditure and increasing interest rates less than in the non-cooperative case.

(iii) Costs associated with central bank independence are very big. After an inflationary shock, budgetary policy is expansionist and monetary policy restrictive in the short run, and both policies are restrictive in the long run. This dynamic policy-mix reversing is more important when indexation is greater, when agents are Ricardian and when expectations of inflation are rational. Cooperation gains do not depend heavily on the exchange rate regime.

(iv) In most cases, when there is independence of the central bank, when external coordination (in the flexible and the fixed exchange rate regimes) is blocked by the budgetary policy of the two countries. If there is a supply shock, external coordination consists in implementing a more restrictive budgetary policy in the country which is hit by the inflationary supply shock and more an expansionist budgetary policy in the other country. But, because of the debt constraint and of the cost, the two budgetary authorities prefer not to change their policy, even though their targets are not fulfilled. So the monetary authorities should foster all the coordination and the budgetary authorities block cooperation.

(v) In the case of central bank independence, internal plus external coordination is (approximately) equivalent to the optimum Paretian policy-mix regime, whatever the exchange rate regime.

(vi) Under EMU, the gain from internal and external coordination is important because the budgetary policy takes into account the idiosyncratic shock and the monetary policy the common shock.

(vii) The budgetary policy is less in conflict with the monetary policy (when there is central bank independence) than in a static framework (compared to Capoën, Sterdyniak, Villa (1994)), because budgetary policy internalises the intertemporal budgetary constraint. This does not mean that central bank independence does not conflict with the budgetary policy. But it means that budgetary policy is cornered by the intertemporal constraint and is thus subordinated to monetary policy. The cost, relying on policies, is thus increased, even though the gains from coordination are lowered.

4. A DECREASE IN THE TARGET OF PUBLIC DEBT

In this paragraph we study the consequences of a decrease of the public debt/GDP ratio. The government is assumed to have to diminish its public debt/GDP target ratio by 3 points below (27%) the desired debt of households (30%). By convention, the shock occurs in France (the dominated country), but EMS asymmetry will lead us to study the impact of a similar shock in Germany (the dominating country). Simulations are made with full indexation, rational expectations and Keynesian behaviour by consumers (the most interesting case).

In order to understand the consequences of a voluntary decrease of public debt, the EMS regime must be distinguished from the symmetrical, flexible exchange rate and EMU regimes, because, in the former, the real interest rate of the dominated country is endogeneously determined, contrary to the case of the latter regimes.

In the flexible exchange rate regime and in EMU, the government of the country which wants to reduce its desired public debt, within the framework of a passive policy (public expenditure and the nominal interest rate remaining constant) must increase taxes in the short term. This induces a Keynesian recession in the short term in this country and subsequently a « disinflation ». As the nominal interest rate is unchanged and private agents have rational expectations of prices (and nominal exchange rates), the real interest rate increases, which accentuates the recession and « disinflation ». But, above all, the increase in the real interest rate raises the « desired wealth » of the private sector, at a time when the State wants to diminish the long run public debt. Now this decrease cannot be compensated by an increase of net external wealth.

Of course, in EMU (Graph 3), a recession induces an external trade surplus for the country which lowers its public debt. But at the Union level, the increase in the real interest boosts the desired wealth of the private sector, while the total public debt of the Union diminishes. The whole process is thus not convergent.

In the flexible exchange rate regime (Graph 1), the real interest rate and the real exchange rate of the country, which decreases its public debt, appreciates. This leads to an external trade deficit and a decrease of net foreign wealth. As a result there is a

contradiction between the increase in the desired wealth of the private sector and the decrease in public debt and external wealth. The process is not convergent.

Reducing the public debt may be compatible in the short term with a restrictive monetary policy, but in the long term it must correspond to a decrease of the real interest rate in order to equilibrate wealth. But there is no « natural » mechanism to allow for this « change ». This is the « nominal interest rate version » of the « unpleasant monetarist arithmetic » of Sargent and Wallace.

Thus, only an « active » policy is significant (internal Nash and external Nash, for instance, see Graphs 2 and 4) which consists of reducing public expenditure in the short term, expanding them in the long run, when the public debt has reached its target, and above all in implementing an expansionist monetary policy in the short and the long run in order to reduce the real interest rate. This policy allows to be stabilised the price level. It does not depend whether the central bank(s) is (are) independent or not and whether budgetary policies are cooperative in Europe. Internal and external cooperation gains are thus very small. This two reasons occurs for : (1) the debt constraint freezes coordination and (2) independence of the central bank is not relevant for the debt problem.

In the EMS, the situation is different because there is no monetary policy in the dominated country and its real interest rate is endogeneously determined by the dominant country and the « external asset balance ».

Imagine that the dominated country (for instance France) wants to diminish its public debt, it must implement a restrictive fiscal policy in the short term, when public expenditure is held constant in the case of a « passive policy ». This induces a Keynesian recession in the short run, even though price expectations are rational (« disinflation »). But, because of external trade surplus and the accumulation of « net external assets », the nominal and the real interest diminishes in this country. Thus « external foreign currency assets » increase, and the two interest rates compensate for the decrease of the public debt. So there is no contradiction between the wealth households want to hold and the decrease of the public debt target. In the case when the restrictive shock on public debt occurs in the dominant country (Germany for instance), there are no more problems however, when the dominant country holds its nominal interest rate and its public expenditure constant. The restrictive fiscal policy in Germany induces an external trade surplus and a deficit in the dominated country. So the nominal and the real interest rates increase in the dominated country, and therefore the asset equilibrium cannot be reached in the dominated country : there is a permanent recession (in output) and « disinflation », which are transmitted to the « dominating country ». In the non-cooperative equilibria (i.e. a Nash-Nash response, Graph 5 and 6), when the dominated country wants to decrease its public debt, it increase taxes and increases public expenditure to fight against recession. But the main fact is that the dominating country implements an expansionist monetary policy which decreases the real interest rate and allows the common public debt of the whole area to be reduced. If, on the other hand, it is the dominating country (Germany for instance), which wants to decrease its debt, the process is the same but more obvious : it has to implement an expansionist policy, which decreases the nominal and real interest of the EMS (as a whole) in order to obtain the wealth equilibrium of the area. This shows that, even though the real interest rate is partly endogenous in an EMS system, monetary policy must be, in the short

run as in the long run, expansionist, to decrease the public debt, while the budgetary policy must adjust the target, when expectations are rational.

Nevertheless, the budgetary authorities in the dominated country can block international cooperation when the dominating country wants to decrease its debt because, optimally, they will seek to avoid the recession.

5. CONCLUSION

The organisation of the macro-economic policy in a dynamic and multi-country framework raises five organisational points :

(1) The independence of the central bank leads to high internal coordination costs ;

(2) The coordination gains vary little according to the exchange rate regime ;

(3) The public debt constraint, by subjugating budgetary to monetary policy, reduces the conflict between the independent central bank and the fiscal authorities, but freezes cooperation ;

(4) Fiscal policy can block external cooperation because of costs in output and taxation, on the other hand monetary policy never leads to the same outcome ;

(5) To manage public debt in order to obtain a public debt/GDP ratio leads to an intertemporal problem : to reduce the public debt in the short term, it is necessary to implement a restrictive policy-mix; whereas in the long term, there must be a reduction of the real interest rate. But there is no « natural » mechanism to such a transition.

So, the question is open : should the European Central Bank not to introduce a long term « real » interest rate target (i. e. growth) into its behaviour ?

Moreover, in this article we have incidentally proposed in this article a general framework to analyse dynamic policies, with wealth behaviour, whether agents are Ricardian or Keynesian, whether wages are indexed or not and whether expectations are rational or Keynesian. Nevertheless our framework raises two questions. First, it would be better to endogenous fiscal policy as budgetary policy, by introducing the instrument in the target functions. Second, the model could be transformed into a « growth » model with taxes and expenditure proportional to GDP. It would be more interesting to study the link between policy and growth, but more difficult to study Ricardian behaviour (a lump-sum tax should be added).

Table 1 : Positive idiosyncratic shock to wages : absolute present value losses of each country : partial indexation, Keynesian expectations, Keynesian consumers.

	Without independence				Independence of the central bank							
Exchange rate regime	Without external coordination		With external coordination		Without internal and external coordination		Without internal coord./ with external coord.		With internal coord./ without external coord.		With internal and external coordination	
	F	G	F	G	F	G	F	G	F	G	F	G
Flexible exchange rates	3.71	0.12	3.69	0.11	6.91	2.56	5.36	1.80	3.73	0.14	3.77	0.16
Fixed exchange rates 1	3.72	0.20	3.70	0.13	3.98	0.52	(1)	(1)	3.98	0.49	3.68	0.28
Fixed exchange rates 2	0.25	3.67	0.21	3.66	2.19	6.35	3.72	0.44	0.17	3.73	0.07	3.95
EMU	-	-	-	-	4.64	1.65	4.41	1.62	-	-	3.71	0.17

-1 : idiosyncratic shock in France -2 : idiosyncratic shock in Germany

(1) : coordination between fiscal authorities cannot produce a better situation than the Nash equilibrium.

Table 2 : Positive idiosyncratic shock to wages : absolute present value losses of each country : total indexation, Keynesian expectations, Keynesian consumers.

	Without independence				Independence of the central bank							
Exchange rate regime	Without external coordination		With external coordination		Without internal and external coordination		Without internal coord./ with external coord.		With internal coord./ without external coord.		With internal and external coordination	
	F	G	F	G	F	G	F	G	F	G	F	G
Flexible exchange rates	6.88	0.93	6.77	0.84	10.35	3.77	(1)	(1)	7.10	0.93	7.09	0.77
Fixed exchange rates 1	7.80	0.41	7.71	0.35	8.29	1.64	(1)	(1)	8.23	1.15	8.04	0.64
Fixed exchange rates 2	0.78	7.53	0.60	7.46	7.82	13.48	(1)	(1)	1.51	7.98	0.65	7.84
EMU	-	-	-	-	10.18	5.30	7.71	0.35	-	-	8.29	1.64

-1 : idiosyncratic shock in France -2 : idiosyncratic shock in Germany

(1) : coordination between fiscal authorities cannot produce a better situation than the Nash equilibrium.

Table 3 : Positive idiosyncratic shock to wages : absolute present value losses of each country: full indexation, classical expectations, Keynesian consumers.

	Without independence				Independence of the central bank							
Exchange rate regime	Without external coordination		With external coordination		Without internal and external coordination		Without internal coord./ with external coord.		With internal coord./ without external coord.		With internal and external coordination	
	F	G	F	G	F	G	F	G	F	G	F	G
Flexible exchange rates	7.59	0.96	6.72	0.87	9.43	3.26	(1)	(1)	7.17	0.82	7.01	0.99
Fixed exchange rates 1	9.11	0.52	8.79	0.40	9.51	1.52	(1)	(1)	9.64	1.16	9.61	0.77
Fixed exchange rates 2	0.77	8.59	0.60	8.52	6.54	12.62	(1)	(1)	1.42	8.50	0.73	8.43
EMU	-	-	-	-	10.38	4.44	10.31	4.36	-	-	8.58	0.56

-1 : idiosyncratic shock in France -2 : idiosyncratic shock in Germany

(1) : coordination between fiscal authorities cannot produce a better situation than the Nash equilibrium.

Table 4 : Positive idiosyncratic shock to wages : absolute present value losses of each country : full indexation, classical expectations, Ricardian consumers.

	Without independence				Independence of the central bank							
Exchange rate regime	Without external coordination		With external coordination		Without internal and external coordination		Without internal coord./ with external coord.		With internal coord./ without external coord.		With internal and external coordination	
	F	G	F	G	F	G	F	G	F	G	F	G
Flexible exchange rates	6.88	0.85	6.79	0.78	9.38	3.21	(1)	(1)	7.04	0.87	7.01	0.77
Fixed exchange rates 1	9.12	0.52	8.80	0.40	9.49	1.52	(1)	(1)	9.63	1.16	9.59	0.77
Fixed exchange rates 2	0.77	8.60	0.60	8.54	6.57	12.59	(1)	(1)	1.36	8.52	0.80	8.38
EMU	-	-	-	-	10.37	4.46	(1)	(1)	-	-	8.59	0.57

-1 : idiosyncratic shock in France -2 : idiosyncratic shock in Germany

(1) : coordination between fiscal authorities cannot produce a better situation than the Nash equilibrium.

Table 5 : Idiosyncratic shock to public debt : absolute present value losses of each country : full indexation, classical expectations, Keynesian consumers.

	Without independence				Independence of the central bank							
Exchange rate regime	Without external coordination		With external coordination		Without internal and external coordination		Without internal coord./ with external coord.		With internal coord./ without external coord.		With internal and external coordination	
	F	G	F	G	F	G	F	G	F	G	F	G
Flexible exchange rates	18.47	0.91	18.43	0.85	18.86	1.18	18.67	1.05	18.51	0.78	18.52	0.72
Fixed exchange rates 1	18.98	1.04	18.73	0.86	19.24	1.26	19.04	1.13	19.17	1.23	18.84	0.92
Fixed exchange rates 2	1.79	18.43	1.47	18.32	1.35	18.77	1.24	18.63	1.26	18.51	(1)	(1)
EMU	-	-	-	-	19.10	1.74	19.05	1.25	-	-	18.85	1.14

-1 : idiosyncratic shock in France
-2 : idiosyncratic shock in Germany
(1) : cooperation cannot produce a better outcome than the Nash equilibrium.

Graph 1 : Idiosyncratic debt shock in FRANCE : flexible exchange rate. Passive policy.

Graph 2 : Idiosyncratic debt shock in FRANCE : flexible exchange rate.Nash-Nash policy.

Graph 3 : Idiosyncratic debt shock in FRANCE : EMU.Passive policy.

Graph 4 : Idiosyncratic debt shock in FRANCE : EMU.Nash-Nash policy.

Graph 5 : Fixed exchange rate. Idiosyncratic debt shock in GERMANY : NASH-NASH

Graph 6 :Fixed exchange rate. Idiosyncratic debt shock in FRANCE : NASH-NASH

APPENDIX 1 : THE EQUATIONS OF THE LINEARISED MODEL

(1) $y_t = c(R_t + \Phi_t - \Phi_{t-1}) + g_t + (1-c)b_t - \sigma . r_t + \mu(\Phi_{t-1} + d_{t-1} - W_0)$

(2) $pd_t = w_t + \nu_1 y_t + \varphi . r_t$

(3) $p_t = (1-l_1)p_{t-1} + l_1 pd_t$

(4) $wd_t = \lambda\ q_t + \nu_2 y_t + w0_t$

(5) $w_t = (1-l_2)w_{t-1} + l_2 wd_1$

(6) $q_t = (1-m)p_t + m(p_t^* + e_t)$

(7) $b_t = m(y_t^* - y_t) + m.\delta_x . x_t \qquad b_t^* = -b_t$

(8) $x_t = p_t^* + e_t - p_t$

(9) $r_t = i_t - \Pi_{t+1}^a$

(10) $d_t = d_{t-1} + r_{t-1}\dfrac{\tilde{d}}{100} + r_0.(d_{t-1} - \tilde{d}) + g_t - T_t$

(11) $T_t = \theta_3 T_{t-1} + (1-\theta_3)[g_t + r_{t-1}.\dfrac{\tilde{d}}{100} + (1+r_0)(d_{t-1} - \tilde{d})]$

(12) $\Phi_t = \Phi_{t-1} + 2(x_t - x_{t-1})F_0 + (r_{t-1}^* - r_{t-1})F_0 + r_0\Phi_{t-1} + b_t$

(13) $\Phi_t = -\Phi_t^* = F_t - F_t^*$

(14) $F_t = F_0 + \dfrac{1}{2k}(e_{t+1}^a - e_t + i_t^* - i_t)$

(15) $F_t^* = F_0^* - \dfrac{1}{2k}(e_{t+1}^a - e_t + i_t^* - i_t)$

(16) $\tilde{W}_t = W_0 + ar_t$ with $W_0 = d_0 + \Phi_0$

(17) $W_t = d_t + \Phi_t$

Private sector regimes.

-. Keynesian consumers.

(18a) $R_t = y_t - T_t + r_0 d_{t-1} + (r_t / 100 - r_0)\tilde{d}$

-. Ricardian consumers.

(18b) $R_t = y_t - g_t$

In the short term, the private demand elasticity according to the real interest rate is the following :

-if private agents are Keynesian :

$\frac{\partial y_t^d}{\partial r_t} = c\eta_3 d_{t-1} - \sigma = 0.4 * 0.2 * 0.3 - 0.4 < 0$ in this model, but not always.

-if private agents are Ricardian :

$$\frac{\partial y_t^d}{\partial r_t} = -\sigma < 0$$

In the long term, the real interest rate elasticity of private demand is the same whether private agents are Keynesian or Ricardian :

$$\frac{\partial y_t^d}{\partial r_t} = -\sigma + \mu \frac{\partial \Phi_t}{\partial r_t} = -\frac{\sigma}{1-c} - \frac{\mu}{1-c}\frac{1}{k} < 0$$

Inflation expectation regimes.

- myopic expectations : Keynesian model.

(19a) $\Pi^a_{t+1} = p_t - p_{t-1}$

- Rational expectations : classical model.

(19b) $\Pi^a_{t+1} = p_{t+1} - p_t$

Exchange rate regimes.

- flexible exchange rate.

(20a) $e^a_{t+1} = e_t - i^*_t + i_t + k\Phi_t$

- fixed exchange rate with German dominance (the star country).

(20b) $e_t = 0$ et $i_t = i^*_t - k\Phi_t$

- Economic and Monetary Union.

(20c) $e_t = 0$ et $i_t = i^*_t$

Parameters and initial values (indexed by 0).

$c = 0.6$; $s = 1$; $m = 0.1$; $l_1 = 0.5$; $l_2 = 0.5$; $v_1 = 0.15$; $v_2 = 0.2$; $v_3 = 0.2$; $d_x = 1.2$; $m = 0.2$
$\tilde{d} = 30\%$; $d_0 = 30\%$; $W_0 = 0.03$; $\Phi_0 = 0$; $r_0 = 0.03$; $F_0 = F_0^* = 0.05$; $r = 0.75$; $q = 0.1$
$k = 1$ (0 in EMU) ; $l = 0.5$ (partial indexation) and $l = 1$ (full indexation) ; $s' = 0.3$; $a = 1$.

Inter-temporal loss functions.

- For each country : $\alpha = 1 \quad \beta = 3 \quad \gamma = 5 \quad \delta = 1 \quad \varepsilon = 1 \quad \eta = 1$

$$L(0) = \frac{1}{2}\sum_{t=0}^{\infty}\rho^t\left\{\alpha y_t^2 + \beta q_t^2 + \gamma \Phi_t^2 + \delta (d_t - \tilde{d})^2 + \varepsilon T_t^2 + \eta i_t^2\right\}$$

- For each government :
$\alpha_e = 0.9 \quad \beta_e = 0.5 \quad \gamma_e = 4 \quad \delta_e = 0.9 \quad \varepsilon_e = 0.9 \quad \eta_e = 0.5$

$$L_e(0) = \frac{1}{2}\sum_{t=0}^{\infty}\rho^t\left\{\alpha_e y_t^2 + \beta_e q_t^2 + \gamma_e \Phi_t^2 + \delta_e (d_t - \tilde{d})^2 + \varepsilon_e T_t^2 + \eta_e i_t^2\right\}$$

- For each central bank :
$\alpha_b = 0.1 \quad \beta_b = 2.5 \quad \gamma_b = 1 \quad \delta_b = 0.1 \quad \varepsilon_b = 0.1 \quad \eta_b = 0.5$

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

Denominations of variables.

y, y^* productions (Log)

p_d, p_d^* desired production prices (Log)

p, p^* actual production prices (Log)

w_d, w_d^* desired wages (Log)

w, w^* actual nominal wages (Log)

q, q^* consumption prices (Log)

b, b^* trade balances (% GDP)

e, x nominal and real exchange rates (Log)

r, r^* real interest rates (%)

d, d^* public debt (% GDP)

T, T^* (lump sum) taxes (% GDP)

F, F^* net real assets in foreign currencies (% GDP)

Π^a, Π^{a*} expected inflation rate of producers prices (%)

g, g^* public expenditure (% GDP)

i, i^* nominal interest rates (%)

w_0, w_0^* supply shocks (%)

R, R^* incomes of households (Log)

$\tilde{W}, \tilde{W}^*$ desired wealth by households (% of GDP).

W_0, W_0^* initial wealth of households and desired wealth in the baseline (% of GDP).

d_0, d_0^* initial (baseline) public wealth held by households (% of GDP).

Φ_0, Φ_0^* initial (baseline) external wealth held by households (% of GDP).

F_0, F_0^* initial (baseline) net real assets in foreign currencies (% of GDP).

r_0, r_0^* initial (baseline) real interest rates (real level).

r time preference of governments and central banks.

$\tilde{d}$ desired public wealth by governments (% of GDP).

APPENDIX 2 : LONG TERM AND STABILITY CONDITIONS

This appendix is devoted to study the existence, the singularity and the stability of long term equilibria, i. e. the way they can be obtained by linking short term Keynesian temporary equilibria. First, long term equilibria are described, then stability is studied according to the exchange rate regime, wage indexation and expectations.

I. Stationary long term equilibria.

If the long term equilibrium exists, it verifies :

aggregate demand :

(21) $y = g - s/(1-c)r + b + m(\Phi - W_0)$

trade balance :

(22) $b = m(y^* - y) + m d_x x$

current account balance :

(23) $(r - r^*)F_0 - r_0\Phi - b = 0$

aggregate supply :

with partial indexation : $l < 1$

(24) $(1-l)p = l(mx + vy + q)r + w_0$

(25) $\dot{p} = 0$

with full indexation : $l = 1$

(26) $h\dot{p} = mx + vy + q)r + w_0$

with : $v = v_1 + v_2$, $h = \dfrac{\Lambda_1 + \Lambda_2}{\Lambda_1\Lambda_2}$, $\Lambda_1 = \dfrac{l_1}{1-l_1}$, $\Lambda_2 = \dfrac{l_2}{1-l_2}$.

real interest rate (Fisher equation) :

(27) $r = i - \dot{p}$

foreign asset demand :

(28) $$\Phi = \frac{1}{2k}(r^* - r)$$

with *k=1* if flexible or fixed exchange rate regimes and *k=0* if EMU.

If there is partial indexation, the long run is Keynesian and the supply curve determines the level of prices. There is no inflation in the long run. The real interest rate is equal to the nominal one : it is determined monetarily. If indexation is full, the long run is classical : the real interest rate is determined by the goods equilibrium. The nominal interest rate is fixed by monetary policy and the rate of inflation is determined by the Fisher relation.

II. World equilibrium stability

It is independent of the exchange rate regime. This is obvious with partial indexation. The problem appears with full indexation. The world demand is written as :

$$y + y^* = g + g^* - \frac{s}{1-c}(r + r^*) - 2m W_0$$

The world supply :

$$\dot{p} + \dot{p}^* = \frac{v(y + y^*) + q(i + i^*) + w_0 + w_0^*}{h + q}$$

At the equilibrium :

$$\Delta(y + y^*) = g + g^* - 2m W_0 - \frac{s\ h}{(1-c)(h+q)}(i + i^*) + \frac{s}{(1-c)(h+q)}(w_0 + w_0^*)$$

with : $\Delta = 1 - \frac{s}{1-c}\frac{v}{h+q}$

The stability condition is : $\frac{s}{1-c}\frac{v}{h+q} < 1$

This condition is fulfilled in our numerical applications because : $s = 0.4$, $c = 0.6$, $n = 0.35$, $h = 2.0$, $q = 0.1$.

Firstly, an increase in world public expenditure raises production and inflation. Secondly, an increase in the nominal interest rate decreases output but has an ambiguous impact on inflation : the increase of the interest burden upon firms increases inflation, but the decrease of investment and the increase of desired wealth by households both reduce demand. Lastly a supply shock induces an increase of expected inflation and thus reduces the real interest rate. This has an expansionary impact, even though there are full indexation of salaries and rational expectations.

III. Stability with a flexible exchange rate

Stability is always obtained under partial indexation, but with the full indexation of salaries there is a condition. Let us assume that $\lambda = 1$.

The difference between demand in the two countries is the following :

$$y - y^* = g - g^* - \frac{\sigma}{1-c}(r - r^*) + 2b + 2m\Phi$$

with :
$$\Phi = (1/k)(r^* - r)$$
$$b = (F_0 + r_0/k)(r - r^*) = m(y^* - y) + m\delta_x x$$

The difference in supply is :

$$(\dot{p} - \dot{p}^*) = \frac{v(y - y^*) + 2mx + \theta(i - i^*) + w_0 - w_0^*}{h + \theta}$$

where x is the real exchange rate determined by the current account equilibrium.

Stability is obtained for $(\partial (y - y^*)/\partial (\dot{p} - \dot{p}^*)_S > (\partial (y - y^*)/\partial (\dot{p} - \dot{p}^*)_D$, that is when the inflation elasticity of supply is <u>greater</u> than the elasticity of demand, in other words when :

$$\frac{2\mu}{k} + \frac{\sigma}{1-c} - 2(F_0 + \frac{r_0}{k}) < \frac{h + \theta + 2/\delta(F_0 + r_0/k)}{v + 2m/\delta}$$

By noting this equation : $A < B$, the equilibrium can be written :

$$(1 - \frac{A}{B})(y - y^*) = g - g^* + A\frac{-h(i - i^*) + w_0 - w_0^*}{h + \theta + 2/\delta_x(F_0 + r_0/k)}$$

$$\dot{p} - \dot{p}^* = A_1(g - g^*) - A_2(i - i^*) + A_3(w_0 - w_0^*)$$

$$A_1 = \frac{1}{B - A} > 0 \ , \ A_3 = \frac{1}{(B - A)(v + 2m/\delta_x)} > 0 \ , \ A_2 = 1 - \eta BA_3 \text{ ambiguous}$$

Our numerical application gives the following results :

$$h = 2 \ ; \ A = 1.04 \ ; \ B = 2.20 \ ; \ A_1 = 0.86 \ ; \ A_3 = 1.26 \ ; \ A_2 = -4.55$$

The effect of the interest rate on inflation is ambiguous because of its negative effect on demand and direct positive effect on prices.

IV. Stability with a fixed exchange rate and a dominant country

The dominant country will be the country with the asterisk. In this regime the stability condition is the same with partial and full indexation. Indeed, whatever the indexation, this exchange rate regime is characterised by :

$$\dot{p} = \dot{p}^* = 0 \text{ if } \lambda < 1 \text{ and } \dot{p} = \dot{p}^* \neq 0 \text{ if } \lambda = 1$$

Thus : $i - i^* = r - r^*$ in all cases.

At the stationary equilibrium, the discrepancy between the interest rates in the two countries adjusts the external wealth and the demand for goods to the supply. The demand for goods can be written :

$$y - y^* = g - g^* - \left[\frac{2\mu}{k} + \frac{\sigma}{1-c} - 2(F_0 + \frac{r_0}{k})\right](i - i^*)$$

The supply of goods is :

$$(1-\lambda)(p - p^*) = v(y - y^*) + \varphi(i - i^*) + 2mx + w_0 - w_0^*$$

The current account :

$$m(y^* - y) + m\delta_x x = (F_0 + r_0 / k)(i - i^*) \text{ with } x = p^* - p$$

By equalising the supply of and the demand for goods, the following is obtained :

$$(i - i^*)\left[\frac{\sigma}{1-c} + \frac{2\mu}{k} - 2(F_0 + \frac{r_0}{k}) - \frac{m\delta_x \varphi}{\Delta} - \frac{(1-\lambda+2\lambda m)(F_0 + r_0/k)}{\Delta}\right]$$
$$= g - g^* + \frac{m\delta_x}{\Delta}(w_0 - w_0^*)$$

with : $\Delta = m(1-\lambda+2m\lambda+\delta_x v)$ and $v = v_1 + v_2$

The stability condition consists in writing that the left hand side of the inequality in square brackets is positive. In the case of our numerical application, this condition yields, with $\lambda = 1$:

$$\sigma / 0.4 + 2\mu \geq 1{,}463\varphi + 4.44 \quad (F_0 + \frac{r_0}{k})$$

An increase in public expenditures lead to an increase of real interest rates in order that demand adjusts to the supply of goods : the model is classical. The stability condition is more easily obtained when there is a wealth effect $(\mu > 0)$, but it is essential that the elasticity of demand to the interest rate be greater than a positive value which depends on the initial external wealth (F_0). The economic mechanism is twofold. An increase in aggregate demand for goods leads to a trade deficit and an increase of the external debt. In the long run, the equilibrium of the current account balance is obtained by an increase of the trade balance surplus, in order to finance the debt burden. This surplus cannot be obtained by an exchange rate depreciation but only by a decrease of output.

a) First external debt induces an increase in the interest rate because of the wealth behaviour of risk-averse private agents. The interest rate of the dominated country must increase in order that private agents borrow in foreign currency. This reduces demand by the wealth effect, and is stabilising. The increase of the user cost of capital reduces competitiveness which is stabilising for demand and destabilising for external trade. This last effect is of second order of size if the coefficient of direct impact of the interest on prices is small.

b) The external wealth effect on consumption is stabilising.

With fixed exchange rates, the model is stable only if :

- the interest rate elasticity of demand is large (σ large).

- the initial external debt is small (F_0 small).

- the impact of the interest rate on supply is small (θ small et v large).

V. Stability in the EMU

In the EMU, the stability condition is nearly the same because in the long run we have :

$$\dot{p} = \dot{p}^* = 0 \text{ if } \mathsf{l} < 1 \text{ and } \dot{p} = \dot{p}^* \neq 0 \text{ if } \mathsf{l} = 1 \text{ , with } e = 0$$

But the adjustment by the interest rate of the dominated country is impossible because there is an equivalence according to risk between foreign assets and home assets. Thus :

$i - i^* = r - r^* = 0$ whether there is partial or full indexation.

The differential between the demand of the two countries is the following :

$$(y - y^*)^d = g - g^* - \frac{\mathsf{s}}{1-c}(i - i^*) + 2\frac{\mathsf{m}}{1-c}\Phi + 2\frac{b}{1-c}$$

with : $i = i^*$

Because the nominal exchange rate is fixed forever $(e = 0 \text{ and } p - p^* = -x)$, aggregate supply can be written :

$$m(1 - \lambda + 2\lambda m + \delta_x v)(y - y^*)^o = -m\delta_x (w_0 - w_0^*)$$

At equilibrium, the trade balance equalises the interest burden :

$$r_0 \Phi = -b$$

The equilibrium of aggregate supply and demand is thus the following :

$$2\frac{m - r_0}{1 - c}\Phi = -(g - g^*) - \frac{\delta_x (w_0 - w_0^*)}{1 - \lambda + 2\lambda m + \delta_x v}$$

Stability is obtained by the sufficient condition : $\mu \geq r_0$.

Stability in the EMU is thus obtained when the wealth effect is greater than the real interest rate, that is when it is more important than the Ponzi effect of the interest rate. When demand increases in one country, this country must borrow abroad. It is necessary that in the long run the interest on this debt be lower than the trade surplus obtained by a decrease of demand following the impoverishment of the country. It is important to note that stability does not rely on the public debt criterion, because public debt is (in the EMU) a perfect substitute of the external debt.

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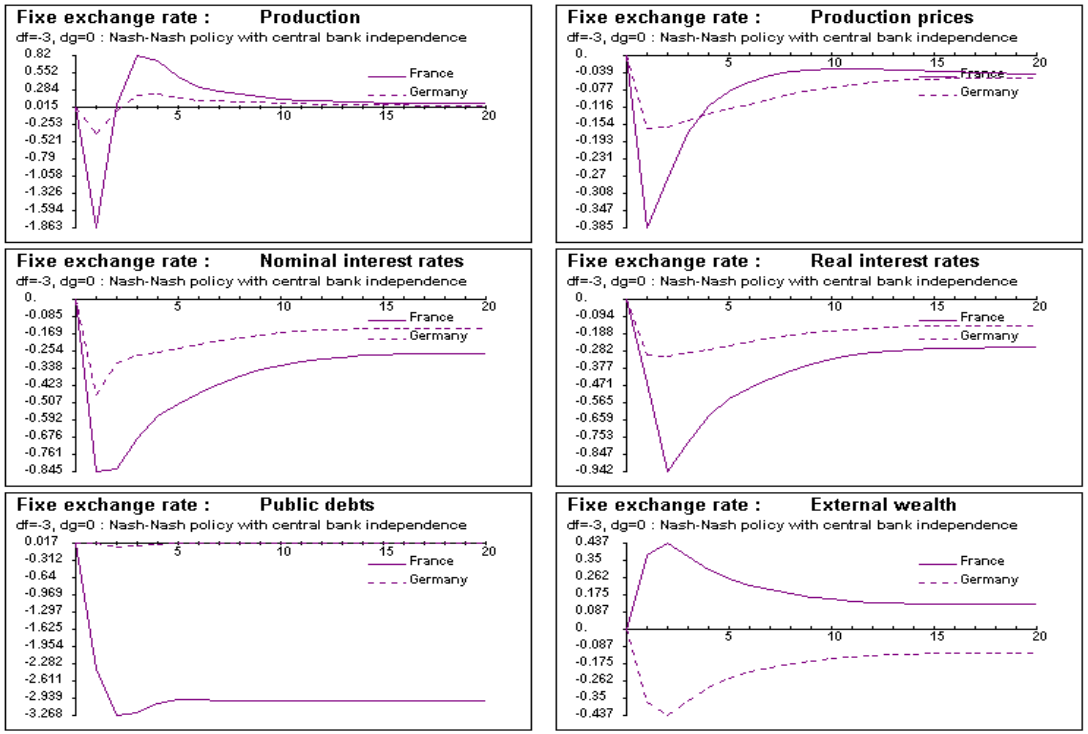
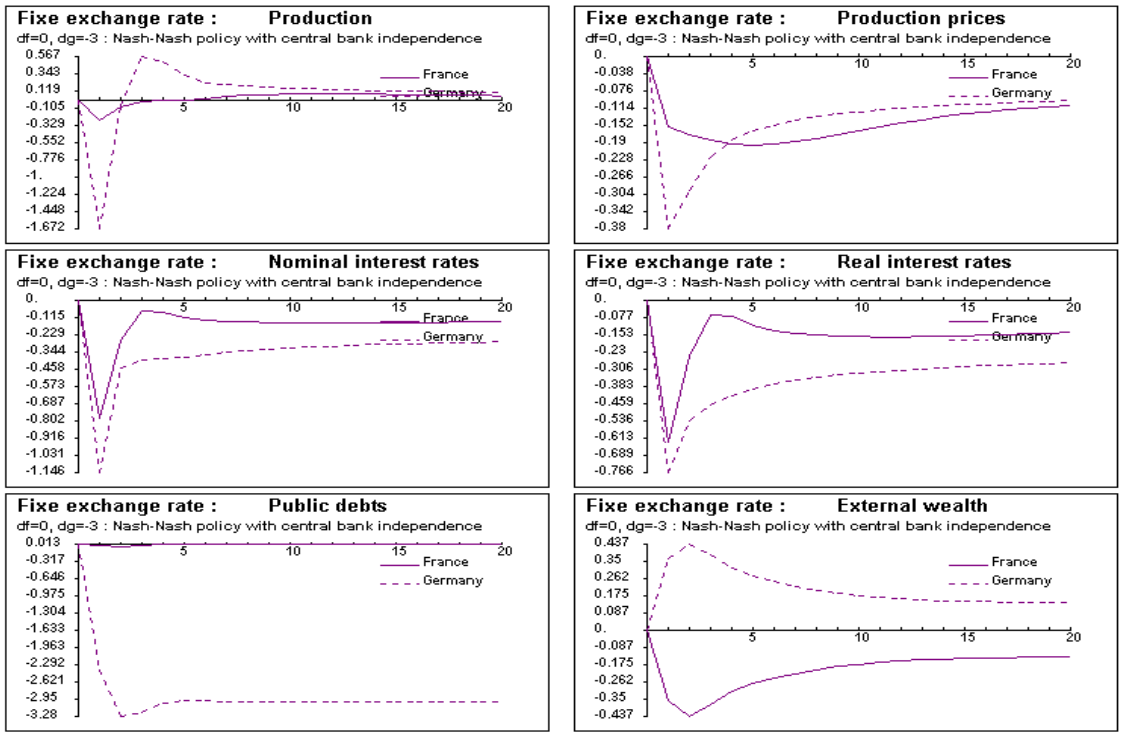
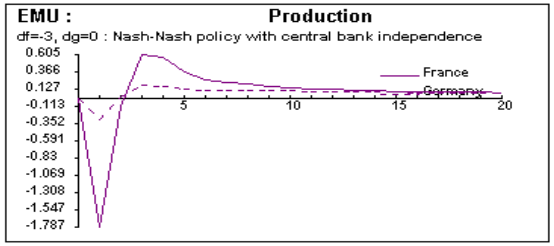
graph 6

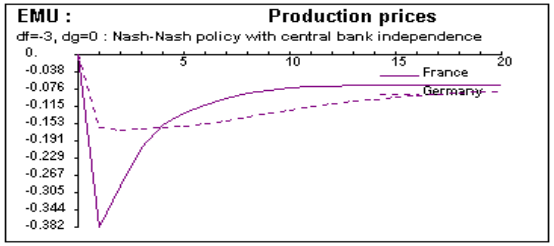

Fixe exchange rate : Production
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.82
0.552
0.284
0.015
-0.253
-0.521
-0.79
-1.058
-1.326
-1.594
-1.863
5
10
15
20
France
Germany
Fixe exchange rate : Production prices
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.039
-0.077
-0.116
-0.154
-0.193
-0.231
-0.27
-0.308
-0.347
-0.385
5
10
15
20
France
Germany
Fixe exchange rate : Nominal interest rates
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.085
-0.169
-0.254
-0.338
-0.423
-0.507
-0.592
-0.676
-0.761
-0.845
5
10
15
20
France
Germany
Fixe exchange rate : Real interest rates
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.094
-0.188
-0.282
-0.377
-0.471
-0.565
-0.659
-0.753
-0.847
-0.942
5
10
15
20
France
Germany
Fixe exchange rate : Public debts
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.017
-0.312
-0.64
-0.969
-1.297
-1.625
-1.954
-2.282
-2.611
-2.939
-3.268
5
10
15
20
France
Germany
Fixe exchange rate : External wealth
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.437
0.35
0.262
0.175
0.087
0.
-0.087
-0.175
-0.262
-0.35
-0.437
5
10
15
20
France
Germany

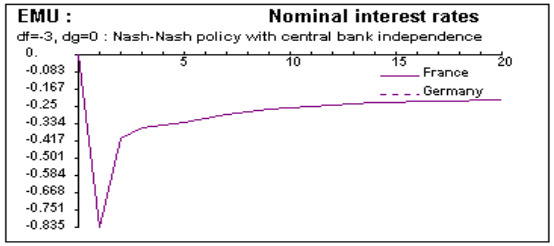
graph 5

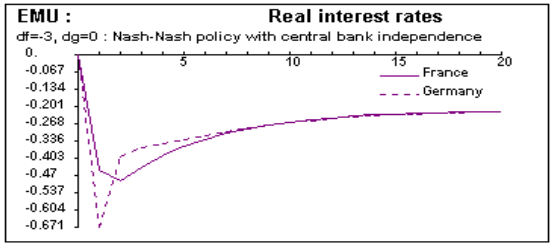


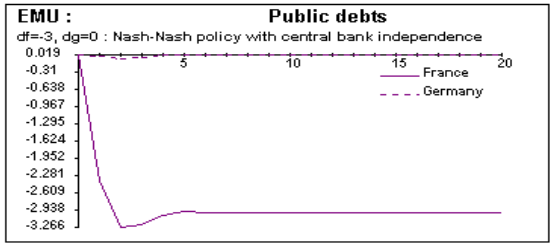
graph 4

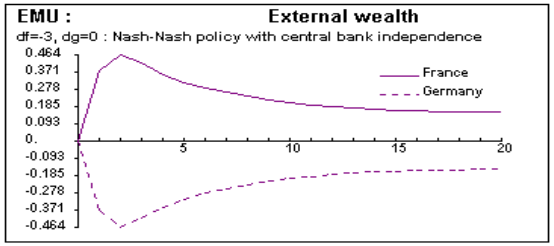

EMU : Production
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.605
0.366
0.127
-0.113
-0.352
-0.591
-0.83
-1.069
-1.308
-1.547
-1.787
5
10
15
20
France
Germany


EMU : Production prices
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.038
-0.076
-0.115
-0.153
-0.191
-0.229
-0.267
-0.305
-0.344
-0.382
5
10
15
20
France
Germany

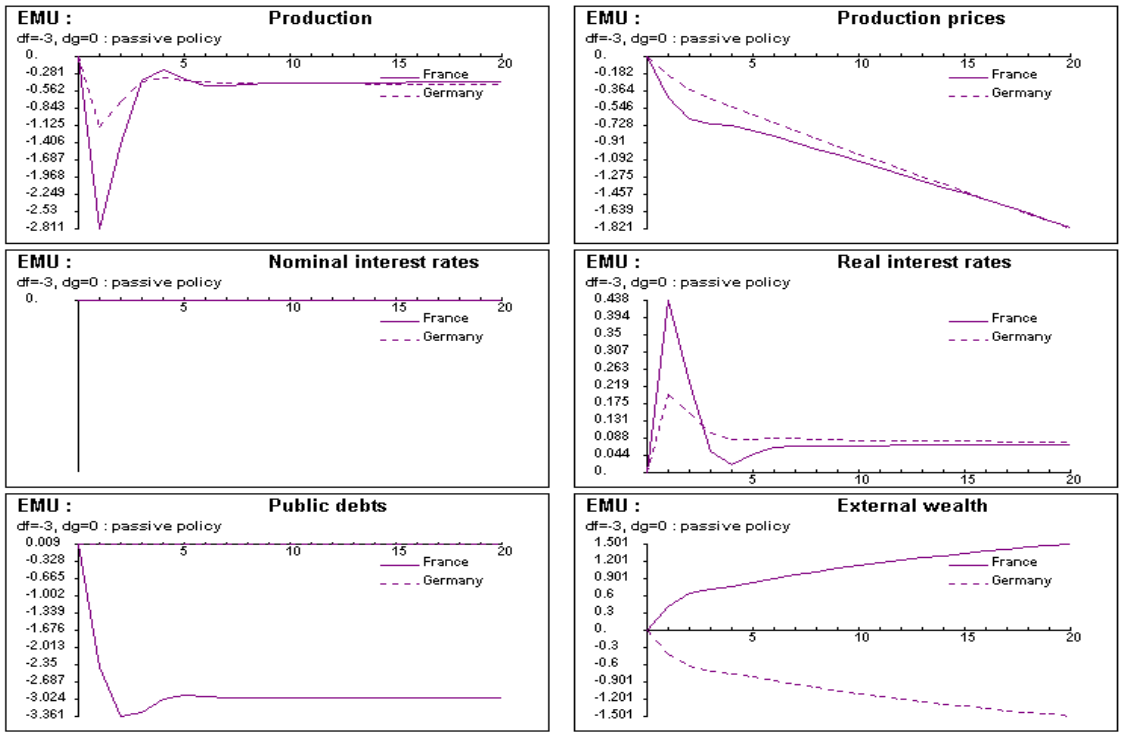

EMU : Nominal interest rates
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.083
-0.167
-0.25
-0.334
-0.417
-0.501
-0.584
-0.668
-0.751
-0.835
5
10
15
20
France
Germany


EMU : Real interest rates
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.067
-0.134
-0.201
-0.268
-0.336
-0.403
-0.47
-0.537
-0.604
-0.671
5
10
15
20
France
Germany

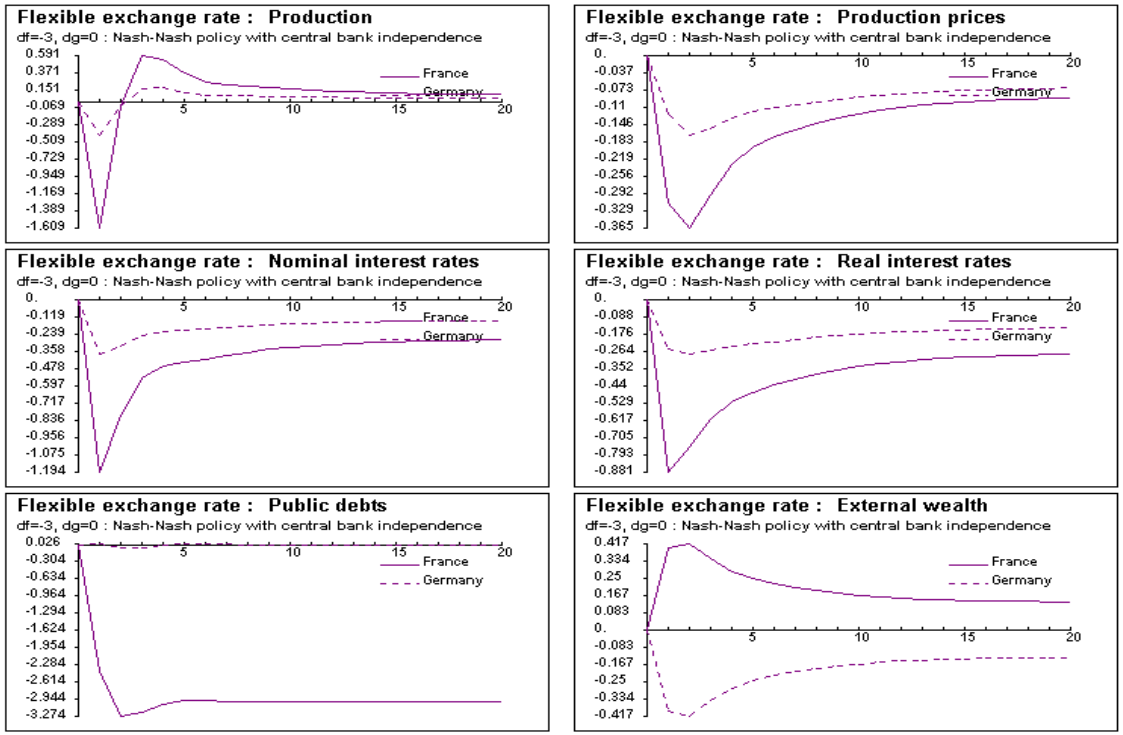

EMU : Public debts
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.019
-0.31
-0.638
-0.967
-1.295
-1.624
-1.952
-2.281
-2.609
-2.938
-3.266
5
10
15
20
France
Germany


EMU : External wealth
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.464
0.371
0.278
0.185
0.093
0.
-0.093
-0.185
-0.278
-0.371
-0.464
5
10
15
20
France
Germany

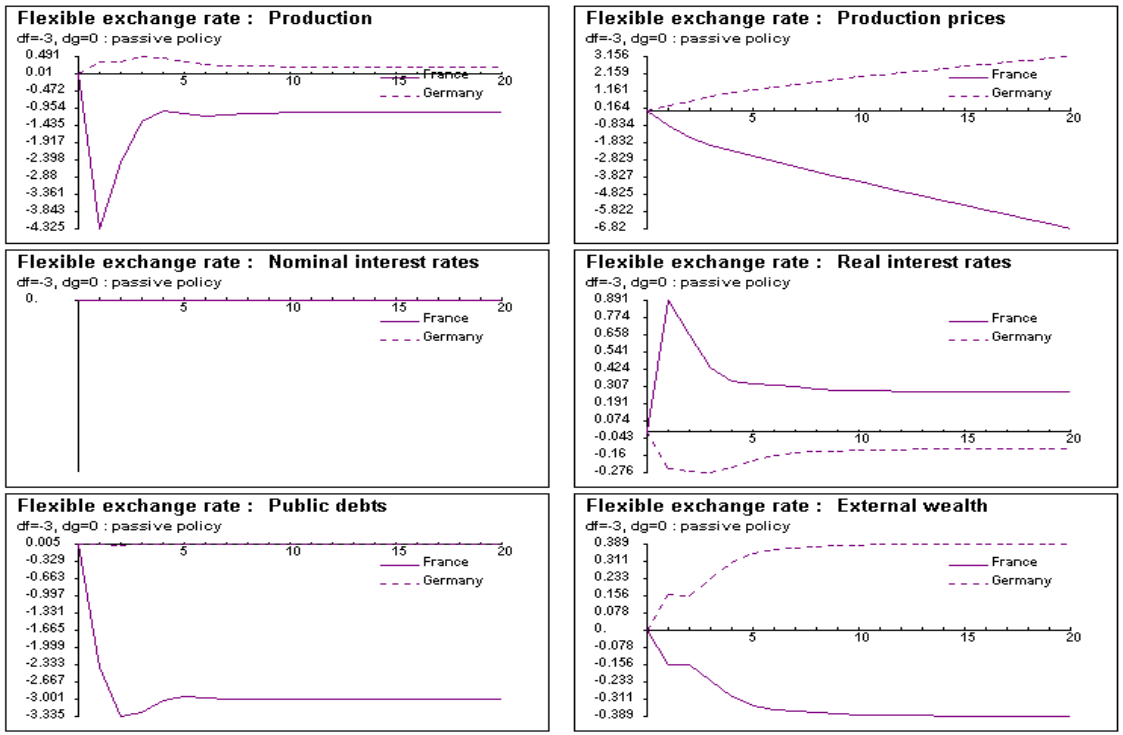
graph 3


EMU : Production
df=-3, dg=0 : passive policy
0.
-0.281
-0.562
-0.843
-1.125
-1.406
-1.687
-1.968
-2.249
-2.53
-2.811
5
10
15
20
France
Germany
EMU : Production prices
df=-3, dg=0 : passive policy
0.
-0.182
-0.364
-0.546
-0.728
-0.91
-1.092
-1.275
-1.457
-1.639
-1.821
5
10
15
20
France
Germany
EMU : Nominal interest rates
df=-3, dg=0 : passive policy
0.
5
10
15
20
France
Germany
EMU : Real interest rates
df=-3, dg=0 : passive policy
0.438
0.394
0.35
0.307
0.263
0.219
0.175
0.131
0.088
0.044
0.
5
10
15
20
France
Germany
EMU : Public debts
df=-3, dg=0 : passive policy
0.009
-0.328
-0.665
-1.002
-1.339
-1.676
-2.013
-2.35
-2.687
-3.024
-3.361
5
10
15
20
France
Germany
EMU : External wealth
df=-3, dg=0 : passive policy
1.501
1.201
0.901
0.6
0.3
0.
-0.3
-0.6
-0.901
-1.201
-1.501
5
10
15
20
France
Germany

graph 2


Flexible exchange rate : Production
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.591
0.371
0.151
-0.069
-0.289
-0.509
-0.729
-0.949
-1.169
-1.389
-1.609
5
10
15
20
France
Germany
Flexible exchange rate : Production prices
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.037
-0.073
-0.11
-0.146
-0.183
-0.219
-0.256
-0.292
-0.329
-0.365
5
10
15
20
France
Germany
Flexible exchange rate : Nominal interest rates
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.119
-0.239
-0.358
-0.478
-0.597
-0.717
-0.836
-0.956
-1.075
-1.194
5
10
15
20
France
Germany
Flexible exchange rate : Real interest rates
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.
-0.088
-0.176
-0.264
-0.352
-0.44
-0.529
-0.617
-0.705
-0.793
-0.881
5
10
15
20
France
Germany
Flexible exchange rate : Public debts
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.026
-0.304
-0.634
-0.964
-1.294
-1.624
-1.954
-2.284
-2.614
-2.944
-3.274
5
10
15
20
France
Germany
Flexible exchange rate : External wealth
df=-3, dg=0 : Nash-Nash policy with central bank independence
0.417
0.334
0.25
0.167
0.083
0.
-0.083
-0.167
-0.25
-0.334
-0.417
5
10
15
20
France
Germany

graph 1


Flexible exchange rate : Production
df=-3, dg=0 : passive policy
0.491
0.01
-0.472
-0.954
-1.435
-1.917
-2.398
-2.88
-3.361
-3.843
-4.325
5
10
15
20
France
Germany
Flexible exchange rate : Production prices
df=-3, dg=0 : passive policy
3.156
2.159
1.161
0.164
-0.834
-1.832
-2.829
-3.827
-4.825
-5.822
-6.82
5
10
15
20
France
Germany
Flexible exchange rate : Nominal interest rates
df=-3, dg=0 : passive policy
0.
5
10
15
20
France
Germany
Flexible exchange rate : Real interest rates
df=-3, dg=0 : passive policy
0.891
0.774
0.658
0.541
0.424
0.307
0.191
0.074
-0.043
-0.16
-0.276
5
10
15
20
France
Germany
Flexible exchange rate : Public debts
df=-3, dg=0 : passive policy
0.005
-0.329
-0.663
-0.997
-1.331
-1.665
-1.999
-2.333
-2.667
-3.001
-3.335
5
10
15
20
France
Germany
Flexible exchange rate : External wealth
df=-3, dg=0 : passive policy
0.389
0.311
0.233
0.156
0.078
0.
-0.078
-0.156
-0.233
-0.311
-0.389
5
10
15
20
France
Germany