THE STABILITY PACT

AND FEEDBACK POLICY EFFECTS

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Abstract: We use a two-country dynamic model in a monetary union in which we introduce a wealth private behaviour. We study the implications of public debt on monetary and fiscal policies in the short and the long run. We analyse the effects of asymmetric fiscal policies in Euroland: the first country has fiscal room for manoeuvre whereas the second country is fettered by the Stability Pact. We show that such a situation creates two feedback effects which reduce the efficiency of economic policies. First, because of the inability of one government to implement an expansionist fiscal policy, the other government has to substitute for it in order to stabilise inflation and production. Second, the ECB's involvement in macroeconomic stabilisation will also be exacerbated. The more substantial these effects, the more co-operation is needed between European governments and the ECB.

Résumé : Nous nous inscrivons dans le cadre d'un modèle dynamique à deux pays formant une union monétaire, avec introduction de comportements patrimoniaux de la part des agents privés. Nous étudions ainsi spécifiquement les implications de l'accumulation de la dette publique sur les politiques monétaire et budgétaires à court et à long terme. Nous analysons les effets du caractère dissymétrique de la politique budgétaire dans la zone euro, c'est-à-dire le fait qu'un pays puisse bénéficier de marges de manœuvre tandis que l'autre est contraint par les dispositions du Pacte de stabilité. On montre alors que cette situation provoque deux types d'externalité qui réduisent le degré d'efficacité des politiques économiques. D'une part, l'incapacité d'un pays à mener une politique budgétaire oblige les autres ; d'autre part, la BCE devra s'impliquer davantage dans une politique de stabilisation de l'inflation et de la production à son potentiel. Une coordination entre les gouvernements et la BCE est d'autant plus souhaitable que ces externalités sont importantes.

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The treaties of Maastricht and Amsterdam did not either resolve the old problem regarding economic policies' co-operation in the EU, nor organise fiscal federalism. If co-operation has been tackled, it has been in a quite questionable way. First, the so-called co-operation is asymmetric: in order to prevent any drift in public finances, any temptation or risk to monetise public debts, any loss of credibility by the independent Central bank[1], fiscal policy has been compelled during the convergence stage to stick to the absolute norm of a public deficit inferior to 3% of GDP. The Stability (and Growth) Pact has moreover reinforced the convergence process for public finances in the EU: it will limit public deficits after the arrival of the euro. Second, the Council (Euro 11) is not a European government. The future should eventually demonstrate its efficiency.

Two macroeconomic implications of the Pact are already clear. On the one hand, it will be more difficult or maybe impossible for European governments to provide an optimal regulation for economic fluctuations. In the present situation, though the Maastricht's norm on public debt has been wiped out as regards the entry of some countries in the Euroland, we nonetheless think that the public finances in these countries (Belgium, Italy) will be carefully supervised by the Commission or the European Central Bank (ECB). Any deviation in the way to fiscal contraction will be penalised by financial markets operators (according to the discrimination principle developed by Buiter & Kletzer, 1991), households (Ricardian equivalence along Barro's, 1974, or Giavazzi & Pagano's, 1990, analyses), the Commission or the ECB (in order to preserve its credibility). In this sense, fiscal policies in these countries will be pro-cyclical.

On the other hand, the ECB will strategically dominate governments in the short run: it will set its policy in line with its goal of price stability and if fiscal policies are judged too expansionist, it will further increase the nominal European interest rate. Governments will have to choose between reducing their spending, i.e. a domination by the ECB; increasing them to compensate the restrictive impact of monetary policy (see Capoen et al., 1994); last, trying to co-operate with the ECB. Based on the circumstances during the convergence stage, governments might well choose the first solution.

Two other consequences of the Pact have been neglected so far, as far as we know. First, the inability of a government to implement a fiscal policy after a shock has occurred may impinge largely on its EU partners: these governments should be compelled to use their own fiscal expenditures to offset the shock. This situation resembles that of the free rider. If expansionist fiscal policies can produce favourable effects which spill over among EU's countries, they also have costs to the country which has increased the deficit: implementation costs, sunk costs, financial costs through the interest charges which impede the future capacities of governments to implement fiscal policies.

[1] Cf. Eichengreen & Wyplosz (1998).

Second, the ECB will also suffer from the constraints of the Pact. It will have to substitute for the absence of fiscal policy in a country under the rule of the Pact. In the long run, if we oppose to the Barro-Ricardian equivalence between tax and public borrowing a theory of wealth effects linked to public debt holding by households, along the lines of Patinkin's (1965), the ECB will have to adjust households' private wealth projects to actual public debt and net foreign assets levels: if, for example, public debt increases in relation to GDP after a negative private demand shock, the ECB will have to choose between reducing the interest rate to curb debt's accumulation or increasing it to make private wealth grow faster. Depending on its reaction in the long run, the ECB will be more or less fettered in its policy choices and its ability to smooth economic fluctuations[2].

As an illustration of these two feedback effects, we use a two-country model in the EMU with dynamic behaviours. We assume that one of the two countries has no fiscal room for manoeuvre because it has already reached the deficit ceiling of the Stability Pact. Its government must strictly meet its budget constraint. We further assume that the other government and the ECB implement economic policies which are consistent with the minimisation of their own loss functions. Policies are not exogenous; rather, they respond to a private demand shock.

This policy framework differs from that found usually in two-country models dealing with the EMU: it is necessary, as far as the stability of wealth accumulation is concerned, that public debt over GDP be stable in the long run, but not in the short run. Hence, fiscal policies in our framework may well reveal macroeconomic stabilisation properties which are absent from other models (see Jensen and Jensen, 1995, for example).

The shock in the economy (or economies) is supposed to be permanent. We study Nash equilibria between the three autonomous policymakers and then compare them to co-operative equilibria which we compute according to the Nash-bargaining procedure[3].

The theoretical model

Despite the Stability Pact, it is not at all sure that countries in the Euroland will be fettered by its provisions after a supply or demand shock. This will be all the more true if they have already recovered fiscal room for manoeuvre. However, some countries will surely have to spare any additional increase in their public debt over GDP ratio in the following years. These countries will have to pursue balanced fiscal policies in the best case, or to keep on reducing their deficits, in the worst.

Aggregate demand and wealth effect

Our model is dynamic and can be characterised by the wealth behaviour of private agents in the economy[4]. It has Keynesian features in the short run (output is driven by

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[2] Note that in the multi-country Multimod model (see Masson et al., 1990, for more details), there is no distinction between effective and desired wealth in the short run. Nothing therefore explains why households want to hold net foreign and public assets. Furthermore, it is not easy to understand how assets accumulation gets to an end. We compare our consumption function to that used by Masson et al. in appendix 2.

[3] Computations are described in appendix 4.

the level of demand, prices adjust slowly to their steady state levels) but Wicksellian features in the long run: output is determined according to the real equilibrium interest rate, which depends on the effects of monetary and fiscal policies on the inflation rate[5]. Aggregate demand is similar to that used in Mundell-Fleming models, except that we introduce a wealth effect. Aggregate supply follows a Phillips curve.

We study a polar case in the EMU: two countries, identical as far as private behaviours are concerned, form a monetary union[6]. Households in both countries hold wealth which is the sum of public debt and net foreign assets. We assume that private agents form wealth plans which positively depend on the real interest rate (ρ) and disposable income ($(1-\tau)y$)[7]. This wealth effect is introduced according to the following channels. In the short run, an increase in the real interest rate has two opposite effects on consumption in theory: substitution and wealth effects. We suppose that the former dominates the latter: private savings increases, i.e. the part of disposable income which is devoted to the accumulation of wealth $w/[(1-\tau)y]$ increases, and consumption decreases. Aggregate demand thus has to satisfy:

$$\partial y / \partial \rho = w - \mu\beta(1-\tau)y < 0 \, .$$

In the long run, wealth increases with the real interest rate and consumption is higher (see equation 1). If actual wealth (w) differs from desired (or planned) wealth, private agents help it to reach its desired level[8] at speed μ. This wealth effect thus resembles the Pigouvian or real balance effect: if actual wealth is beneath its desired level, because of an increase in the real interest rate, private consumption will be reduced until savings has reached the desired equilibrium level. In the long run, households will use this savings in order to boost their own consumption.

In short, aggregate demand (equation 1) depends on the gap between actual and planned wealth, but also on disposable income, interests on wealth (ρw)[9], trade balance (bc), public expenditures (g) and a private demand shock (x). Aggregate supply (equation 3) is derived according to a Phillips curve with a cost effect due to the real interest rate. π represents the inflation rate, z a supply shock. We assume that there is a delay in the adjustment of prices because of staggered contracts in the economy. Wealth (equation 4) is the sum of public debt and net foreign assets which grow after a trade deficit. Equations 5 and 6 describe the growth of these two assets. The model is supposed to be quarterly. Shocks occur in the first quarter of 1999 and are permanent.

$$(1) \quad y = (1-\tau)y + \rho w + bc + g + \mu[w - (\alpha + \beta\rho)(1-\tau)y] + x$$

$$(2) \quad bc = \eta(y^* - y) + \eta\delta(\pi^* - \pi)$$

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[4] For a first approach in the EMU, see Creel, Lerais & Sterdyniak (1995). See also notes 2 and 8.

[5] For more details on the fiscal theory of inflation, see Woodford (1998).

[6] Equations in country 2 are obtained by circular permutation; this country's variables are starred.

[7] The consumption function is detailed in appendix 2.

[8] The introduction of a wealth effect with a slow adjustment to the long term desired level comes from a Creel & Sterdyniak (1995) model. Fair (1997), for example, also takes wealth into account in a multi-country model. Unlike him however, we do not introduce stocks in households and firms behaviours.

[9] In case of perfect substitutability between domestic and foreign assets, we assume that interests on wealth are not taxed.

$$\pi = \pi_{-1} + \lambda \log y + (1+\theta)\rho + \eta(\pi^* - \pi) + z \quad (3)$$

$$w = b + f \quad (4)$$

$$b = (1+\rho)b_{-1} + g - \tau y \quad (5)$$

$$f = (1+\rho)f_{-1} + bc \quad (6)$$

Governments and the ECB

In the EMU, i.e. in the absence of any exchange rate risk, a target for public debt is needed in order to determine the division of wealth between net foreign assets and public debt. Without this target, private wealth could be balanced with unstable and symmetric levels of public debt and external assets[10].

In country 1, this target is such that the government is stabilising public debt over GDP in the long run; this long term steady state level for debt is unknown in the short run. Government 1 thus controls public spending and debt with no limitations in the short run. This is not the case in country 2. In this country, the government must stabilise its debt over GDP at a pre-determined level and must do it in the short run since it has already reached the ceiling of the Stability Pact. This government must thus follow a fiscal balance rule in each period.

We analyse the reactions of the two governments and the ECB in these conditions after a negative private demand shock of 1% of GDP. The shock is either symmetric or asymmetric. Since countries are heterogeneous in terms of government policies, an asymmetric shock in country 1 does not give the same results as an asymmetric shock in country 2.

We consider in this model that the macroeconomic behaviour of private agents is represented by equations 1 (wealth and disposable income effects) and 3 (wage-price loop); they do not have any strategic behaviour. This is not the case for policymakers: they are represented by their reaction functions[11]. For example, government 1 uses its expenditures in order to minimise its loss function each quarter:

$$LG = a_0 y^2 + a_1 \pi^2 + a_2 (g/y)^2 + a_3 (b/y)^2 . \quad (7)$$

This government is assumed to have targets for output and inflation. Variables in equations 7 to 10 represent deviations from the initial steady state. Government 1 incurs losses when it uses its spending.

Government 2 is fettered by the Stability Pact: it is using its tax rate τ to minimise its loss function but has to pursue meanwhile a strict balanced-budget rule[12]:

$$LG^* = a_0 y^{*2} + a_1 \pi^{*2} + a'_2 \tau^{*2} \quad (8)$$

[10] In a flexible exchange rate regime or in the EMS, the uncertainty regarding the future value of external assets denominated in foreign currencies or risk aversion by households are sufficient conditions for determining the division between domestic and foreign assets.

[11] See appendix 4 for more details.

[12] See Barrel & Sefton (1997), Capoen & Villa (1997), Jensen & Jensen (1995), van der Ploeg (1995) for a similar framework. Public expenditures are used to stabilise debt, rather than tax rates, since it is now well known that fiscal adjustments are more efficient when expenditures are reduced.

(9) $g^* = (1-\chi)g_{-1}^* + \chi[\tau^* y^* - \rho b^* + \mu_g(\Phi - b^*)]$

The Φ letter represents the public debt target of government 2; it is exogenous and has the same form as the public debt norm introduced in the Maastricht treaty. The $\mu_g\chi$ parameter represents the speed of adjustment of the public deficit to the level required to reach Φ. In order for stability conditions of the model to hold, this speed has to be high (see appendix 1).

The EMU can be characterised by the uniqueness of the nominal short run interest rate (i) and the independence of the ECB. We will assume that the ECB sets this rate to implement its monetary policy[13]. We avoid the difficulties regarding the definition and level of money supply in the EU and the complications due to the instability of money demand in financial economies. The ECB minimises its loss function:

(10) $LM = k_0(\frac{y+y^*}{2})^2 + k_1(\frac{\pi+\pi^*}{2})^2 + k_2\rho_M{}^2$, where $\rho_M = i - \frac{\pi+\pi^*}{2}$.

The ECB disregards the ratio of public debt over GDP and has henceforth no specific target regarding it.

Three remarks on monetary and fiscal policies are worth mentioning. First, if the ECB had controlled a monetary aggregate, the long term inflation rate would have been unchanged after a shock, following the so-called 'quantitative theory of money'. Output would have also been unchanged. If the interest rate is determined through a reaction function, this time, the long run inflation and real interest rates are not constant, and the output level can reach a new steady state.

Second, macroeconomic models usually give the priority to inflation in the central bank's loss function, according to the credibility argument: the government inflation bias needs a tough reaction by Central bankers. With no costs for the use of fiscal or monetary instruments, k_1 should therefore be superior to k_0 and (k_1/k_0) should be superior to (a_1/a_0). In our formulation with costs, this latter condition can be rewritten:

(11) $(k_1 - k_2)/k_0 > a_1/(a_0 - a_2 - a_3)$, since the cost of using the interest rate reduces the capacity of the ECB to curb inflation, and the cost of using public expenditures (or the tax rate) and the cost of increasing public debt reduce the capacity of governments to stabilise output. We will consider that the weights for output and public debt are similar in government 1 loss function: condition (11) will then obviously hold.

Last, the behaviours of monetary and fiscal authorities are such that policies cannot be considered as exogenous shocks to the economy. In our model, the rationale of policymakers through the minimisation of loss functions make these policies be endogenous reactions to private demand shocks.

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13 There is no monetary targeting in the sense that the Central bank sets monetary aggregates to a certain level or controls that they reach the appropriate level. On this topic, see Svensson (1999).

Calibrations

Parameter values are presented in table 1. Two considerations intervened in their choice[14]: first, their realism which means either that they fit available data (the degree of openness, for example) or econometric results; second, the necessity that the model be stable.

Stability conditions are discussed in appendix 1, and the robustness of results to changing parameters is evaluated in appendix 3. We only concentrate on some important parameters: those affecting the wealth effect; the speeds of adjustment of wealth to its desired level and of public spending to the level required to reach a balanced budget; and the influence of the interest rate on inflation. We check that simulation results are weakly sensitive to the three latter parameters. As could be expected, the model is more sensitive to the β parameter: output results can be reversed if the wealth effect is reduced. We justify the β value we used for our simulations in appendix 2.

Table 1: Parameters and initial steady state values

Parameters	α	β	χ	δ	λ	η	μ	μ_g	θ
	0,3	2,5	0,85	0,2	8	0,2	0,3	0,3	0,05
Loss functions	a_0	a_1	a_2	a_3	a'_2	k_0	k_1	k_2	
	0,5	1,5	0,16	0,5	0,16	1,5	3	0,5	
Initial values	b/y	f/y	w/y	ρ	τ	Φ/y			
	0,25	0	0,25	0,01	0,2	0,25			

Demand shocks

The effects of demand shocks and reactions by the different policymakers are considered next. Above all, we are interested in the variations of the public debt over GDP ratio in country 1 since we think these have been widely ignored when establishing a fiscal asymmetry in the provisions of the Stability Pact. The demand shock can be characterised as an increase in the planned wealth to GDP ratio. It is a negative shock since consumption is reduced in the short run.

[14] See the advice of Cooley (1997) on calibrated models.

Symmetric shock

After a negative symmetric private demand shock, at Nash equilibrium between the three policymakers, the nominal interest rate decreases in the Union and government 1 implements an expansionist fiscal policy. Output is kept slightly over its initial steady state level and deflation is curbed (table 2). In country 2, the tax rate, which is reduced to comply with the smoothing of fluctuations, sees its effects on output partly cancelled because public expenditures have also been decreased. The output and inflation gaps between country 1 and country 2 create an external deficit in country 1 (hence, an external surplus in country 2). The external indebtedness of country 1 will gradually dampen its output increase.

In the medium run, output in country 2 is lower than in the initial steady state and the fall in the inflation rate is more pronounced than in country 1. Since government 2 is fettered by the Stability Pact, government 1 has to implement a more expansionist policy[15]; in the long run, public debt increases by 2 points of GDP in country 1. Still, the improvement in the output in country 1 also crowds in to country 2. The game between monetary and fiscal authorities prevent key variables (output, inflation rates) from converging to their initial steady state levels: the real long run interest rate has been decreased. However, the rise of public debt impinges on monetary policy: it has to be less expansionist in order to commit governments to more restrictive fiscal policies.

Co-operative policies, in the Nash-bargaining framework[16], give the following results: monetary policy in the medium and long run is more expansionist whereas fiscal policy in country 1 is less in the medium run in comparison with Nash equilibrium. Loss functions for the three policymakers are reduced and this equilibrium is Pareto-optimal. In the long run, the fall in the interest rate reduces public debt over GDP growth; to cope with the negative shock, government 1 does increase its spending more than in a Nash equilibrium. Note that policy co-operation, may it be Pareto-optimal, does not mean that public spending should be lessened.

[15] Government 1 implements a less expansionist policy when it has to bear alone the burden of the shock (table 3).

[16] The co-operative equilibrium is reached after the product of the game earnings for the three players has been maximised.

Table 2: Effects of a symmetric private demand shock

	Nash equilibrium				Co-operation			
	Ctry 1		Ctry 2		Ctry 1		Ctry 2	
	2000	2010	2000	2010	2000	2010	2000	2010
Output (%)	0.118	0.223	-0.128	0.261	0.230	0.332	0.048	0.355
Inflation (points)	-0.502	-1.283	-0.631	-1.261	-0.372	-0.817	-0.474	-0.803
Public expenditures (points of GDP)	0.269	0.100	-0.047	-0.128	0.255	0.154	0.033	-0.027
Tax rate (points)	0.000	0.000	-0.225	-0.244	0.000	0.000	-0.156	-0.191
Public debt (points of GDP)	0.535	1.768	0.006	0.000	0.435	0.995	0.001	0.000
Losses	0.540	4.059	0.614	2.427	0.339	1.555	0.342	1.035
	2000	2010			2000	2010		
ECB's losses	1.214	5.049			0.845	2.358		
Real interest rate (points)	-0.707	-0.465			-0.747	-0.655		

N.B.1: results are deviations from initial values.
N.B.2: country 2 is fettered by the Stability Pact.

Asymmetric shocks

After an asymmetric negative private demand shock, the economic situation in each country not only depends on the fact that it has been hit by the shock, but also on its ability to react to it.

If the shock occurs in country 1 (table 3), the relatively large use of public expenditures by government 1 at Nash equilibrium is such that the ECB is encouraged to implement a very weak expansionist policy; output falls in country 1 and its public debt soars. Country 2 is isolated from the effects of the shock in the short run since monetary policy is not tough. In the medium run, the accumulation of an external surplus in country 1 (the income and price effects on the trade balance go in the same direction) increases its external wealth and is favourable to output growth in this country. In the long run, effects of fiscal and monetary policies cancel each other: with the small reduction of the interest rate, government 1 just slightly increases its spending; there is therefore a large fall in prices which spreads over country 2.

At co-operative equilibrium, monetary and fiscal policies are more expansionist in the short run to keep outputs nearest to their steady state levels; this provokes a larger increase of the public debt over GDP ratio than at Nash equilibrium. In the medium run, this substantial debt leads the ECB to keep its interest rate at a higher level than at Nash equilibrium; as a consequence, public spending in country 1 is dampened. Output levels in both countries are kept near to their initial levels and the fall in prices is slowed down.

Table 3: Effects of an asymmetric private demand shock in country 1

	Nash equilibrium				Co-operation			
	Ctry 1		Ctry 2		Ctry 1		Ctry 2	
	2000	2010	2000	2010	2000	2010	2000	2010
Output (%)	-0.149	0.139	0.088	0.115	-0.086	0.113	0.130	0.098
Inflation (points)	-0.214	-0.651	-0.093	-0.667	-0.169	-0.339	-0.049	-0.349
Public expenditures (points of GDP)	0.095	0.055	0.064	-0.076	0.104	0.040	-0.065	-0.235
Tax rate (points)	0.000	0.000	0.009	-0.138	0.000	0.000	-0.121	-0.285
Public debt (points of GDP)	0.773	0.825	-0.003	0.000	0.757	1.060	0.006	0.000
Losses	0.380	0.987	0.017	0.677	0.334	0.741	0.014	0.200
(Losses*)	(0.42)	(0.50)	(0.02)	(0.63)	(0.35)	(0.25)	(0.03)	(0.31)
	2000	2010			2000	2010		
ECB's losses	0.094	1.358			0.060	0.392		
(ECB's losses*)	(0.10)	(0.61)			(0.03)	(0.10)		
Real interest rate (points)	-0.212	-0.248			-0.217	-0.201		
(Real interest rate*)	(-0.17)	(-0.09)			(-0.13)	(-0.11)		

N.B.1: results are deviations from initial values.
N.B.2: country 2 is fettered by the Stability Pact.
*: simulations with the same model, except that both countries can implement fiscal policies with no constraint in the short-medium run[17].

If the shock occurs in country 2 (table 4), the large price decrease in this country is such that the ECB has to reduce its interest rate more toughly than in the preceding case since government 2 is unable to react to the shock. Government 1 increases its spending to compensate the deflationary shock; this can be implemented more easily than in the preceding case because public debt has dropped with interest charges. In the medium and long run, the decrease in country 2 output will be dampened by the growth of external wealth.

In the medium run, the economic situation in country 1, as described by government losses, is more favourable in this case than in the preceding one. Government 1 is however more involved in this shock than government 2 was when the shock occurred in country 1: government 1 losses in the present case are superior to government 2's in the preceding. In the long run, government 1 losses are superior to its own losses after country 1 had faced the shock. This can be explained by the fact that the sharp fall in the real interest rate after the shock has hit country 2 has given government 1 the opportunity to implement a more and more expansionist policy in order to curb deflation. *In fine*, public debt has soared because the ECB has decided to reduce the drop in the

[17] Both governments have a loss function of the form given in equation (7). Only government 1 and the ECB situations in our two variants can be compared since their loss functions are similar from one variant to the other.

interest rate after public expenditures have been kept on increasing. Co-operative equilibrium does not reverse the feedback effect: the country which manages its fiscal policy without restraint suffers from the fiscal policy burden on its partner.

Table 4: Effects of an asymmetric private demand shock in country 2

	Nash equilibrium				Co-operation			
	Ctry 1		Ctry 2		Ctry 1		Ctry 2	
	2000	2010	2000	2010	2000	2010	2000	2010
Output (%)	0.267	0.084	-0.215	0.146	0.336	0.143	-0.187	0.195
Inflation (points)	-0.289	-0.632	-0.538	-0.594	-0.152	-0.408	-0.439	-0.376
Public expenditures (points of GDP)	0.175	0.045	-0.111	-0.051	0.169	0.075	-0.061	-0.005
Tax rate (points)	0.000	0.000	-0.235	-0.106	0.000	0.000	-0.168	-0.086
Public debt (points of GDP)	-0.238	0.942	0.009	0.000	-0.050	0.518	0.006	0.000
Losses	0.194	1.047	0.467	0.541	0.097	0.396	0.311	0.232
(Losses*)	(0.02)	(0.63)	(0.42)	(0.50)	(0.03)	(0.31)	(0.35)	(0.25)
	2000	2010			2000	2010		
ECB's losses	0.637	1.170			0.363	0.556		
(ECB's losses*)	(0.10)	(0.61)			(0.03)	(0.10)		
Real interest rate (points)	-0.495	-0.217			-0.431	-0.322		
(Real interest rate*)	(-0.17)	(-0.09)			(-0.13)	(-0.11)		

N.B.1: results are deviations from initial values.
N.B.2: country 2 is fettered by the Stability Pact.
*: simulations with the same model, except that both countries can implement fiscal policies with no restraint in the short-medium run

As a conclusion, co-operation is always favourable for the three policymakers and it does not automatically lead to a reduction in public deficits and debts (see the case of a symmetric or asymmetric shock in country 1). We can also check that the Stability Pact places a heavy weight on government 1 and the ECB. In tables 3 and 4, results for the simulations of asymmetric shocks are presented in the same model as that used before except that the two countries control their fiscal instruments (they can implement whatever fiscal policy they want); hence, both countries are in the situation of country 1 in the previous model.

Country 1, whose government can implement fiscal policies in the two models, is largely burdened when government 2 is fettered by the Pact. If the shock occurs in country 2, the loss of government 1 is divided by ten if government 2 is free to choose its policy, in comparison with the situation with the Pact. Government 2 would also prefer to use its spending without restraint: macroeconomic stabilisation would not depend to a large extent on a "medium" monetary policy and the slow spillover effects of foreign policies. As for the ECB, its policy is always less expansionist when it does not have to substitute for a government as far as stabilisation policies in the EU are concerned. Its losses are reduced. This result is not the consequence of the reduced costs for the use of the monetary instrument (see equation 10). If we do not take these costs into account, ECB's losses when both governments implement policies (countries are symmetric) will always be equal or inferior to losses when one of them falls under the rules of the Pact (countries are asymmetric) (table 5).

Table 5: ECB's losses at Nash equilibrium*

	Shock on country 1				Shock on country 2			
	Asymmetric countries		Symmetric countries		Asymmetric countries		Symmetric countries	
	2000	2010	2000	2010	2000	2010	2000	2010
ECB's losses	0.07	1.33	0.08	0.61	0.51	1.15	0.08	0.61

*: losses are computed with $k_2 = 0$ in equation 10.

Conclusion

Since the Amsterdam treaty in 1997, the compelling respect of the public deficit criterion has been dictated to countries willing to enter the Euroland. The so-called norm of 3% of GDP has been confirmed by the Stability Pact and will force countries either to implement pro-cyclical fiscal policies if this limit has already been reached or exceeded, or to have a very weak structural deficit in order to gain rooms for manoeuvre.

In this paper, we have dealt with the feedback effects of the Stability Pact on the ECB and the country which is not directly subject to the provisions of the Pact. The three policymakers in the model see their stabilisation capacities reduced by the existence of the Pact. With our dynamic and patrimonial model, we have been able to distinguish between the short-run and long-run effects of economic policies. Hence, we have shed light on the constraints falling on indebted countries. Debt implications are substantial: they change the temporal feature of monetary policy which, by way of consequence, modify fiscal policies. Note also that in this model, countries do not have to follow fiscal balance rules. The change in fiscal policy in the long run, in order to limit debt growth in percentage of GDP, is a sufficient condition to reach a new steady state.

We show that a stringent application of the provisions of the Stability Pact will substantially fetter the framework for economic policies in the whole EU. More noteworthy, the Stability Pact impinges negatively on fiscally 'virtuous' policymakers, as well as on the ECB. A softer respect of the fiscal norm would be more appropriate: the 3% of GDP would be considered as a nominal anchor; countries would be free to stabilise their economies after a downturn and they would have to take benefit of economic expansions to recover rooms for manoeuvre for future crises[18]. One condition

[18] Buiter et al. (1993) have proposed that the 3% norm be applied to the *structural public deficit*, in order to satisfy to the so-called *golden rule for public finances*. Eichengreen (1997) insists however on

should also be met: governments in the Euroland would rather co-operate with each others and co-operate with the ECB.

the risks with the norm promoted by Buiter et al. (no credibility, possible drift…). He prefers that the *structural public deficit be zero*.

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Appendix 1: Stability conditions

To make understanding easier, we present the model dynamics in the closed economy and assume that there is just one asset: public assets. We consider two cases in the model.

First, the government is able to implement any policy, whether expansionist or restrictive, in the short or in the long run: the government controls its instruments. The model dynamics if we do not make fiscal policies explicit is of the following form:

(A1) $\dot{\pi} = \lambda \log y + (1+\theta)\rho + z$;

(A2) $\dot{w} = \rho w + g - \tau y$.

Under a matrix form, we get:

$$\text{(A3)}\quad \begin{bmatrix} \dot{\pi} \\ \dot{w} \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & \rho \end{bmatrix} \begin{bmatrix} \pi - \pi^* \\ w - w^* \end{bmatrix} + X$$

The model is intrinsically unstable if a fiscal or monetary policy is not implemented. The economy has to be stabilised by a government, which sets public expenditures, and/or a Central banker, which sets the nominal interest rate. These two policies impinge on long term inflation and the wealth dynamics. Hence, fiscal and monetary policies have symmetric influences on inflation. Our model differs obviously and voluntarily from a monetarist model and give henceforth the priority to a realist[19] and patrimonial view of monetary policy.

In the second case, the government follows a fiscal-balance rule. The model dynamics if we do not make monetary policy explicit becomes:

(A1) $\dot{\pi} = \lambda \log y + (1+\theta)\rho + z$;

(A2) $\dot{w} = \rho w + g - \tau y$;

(A4) $\dot{g} = -\chi g - \chi(\rho + \mu_g) w + \chi\tau y + \chi\mu_g \Phi$.

Under a matrix form, we get:

$$\text{(A5)}\quad \begin{bmatrix} \dot{\pi} \\ \dot{w} \\ \dot{g} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & \rho & 1 \\ 0 & -\chi(\rho+\mu_g) & -\chi \end{bmatrix} \begin{bmatrix} \pi - \pi^* \\ w - w^* \\ g - g^* \end{bmatrix} + Y, \text{ or } V = AU + Y.$$

The determinant of matrix A is always positive since $\chi\mu_g > 0$. The trace of matrix A is negative if and only if: $\rho < \chi$. The stability of the model, without any macroeconomic stabilisation policies, thus necessitates that public expenditures be highly sensitive to public deficit variations. The introduction of a policy, even a fiscal-balance one, is a

[19] See Svensson (1999).

sufficient stability condition for this model. It is nonetheless crucial that this fiscal rule be stringent. After any increase in public debt or decrease in taxes, the government has to reduce its spending to make debt converge to its stable arbitrarily chosen level, Φ.

Appendix 2: Wealth effect

Our specification for private consumption can be compared with the one used in the Multimod model of the IMF (see Masson et al., 1990). In this model, real private wealth W is the sum of human wealth, capital, money, public debt and net financial assets. Recall that in our model, wealth is the sum of public debt and net foreign assets only.

The consumption function in the short run in Multimod is written:

$$\text{(A6)}\quad \Delta \log C = C_0 + C_1 \log(\frac{W_{-1}}{C_{-1}}) + C_2\rho + C_3\Delta \log[(1-\tau)y] + C_4 DEM + C_5 DUM80$$

where C is private consumption, DEM the dependency ratio which takes into account the link between young and old generations, DUM80 a dummy variable for 1980, and Δ the first difference operator. Equation (A6) has been tested and results are :

$$C_0 = -0.4;\ C_1 = 0.09;\ C_2 = -0.59;\ C_3 = 0.35;\ C_4 = 0.19;\ C_5 = 0.02.$$

Consumption growth increases with wealth and disposable income's growth but decreases with the real interest rate.

In the long run, consumption takes the following form:

$$\text{(A7)}\quad \log C = \frac{C_0}{0.09} + \log W - 6.2\rho + 2DEM.$$

These results do not explain much on the reasons why households want to accumulate wealth for their consumption. Moreover, is long term consumption increasing or decreasing with the interest rate? This question is unanswerable so long as wealth accumulation is not taken into account in equation (A7). This is the reason why we introduced the real wealth effect and supposed planned or desired wealth $\tilde{W}$ would be growing with the real interest rate and disposable income. Further, we considered that the propensity to save (or increase wealth) from disposable income would be growing with the real interest rate, so that we gave the priority to the following formulation:

$$\text{(A8)}\quad \tilde{W} = (\alpha + \beta\rho)(1-\tau)y.$$

For a zero real interest rate, the wealth over disposable income ratio is supposed to be positive ($\alpha = 30\%$). At the initial steady state, we assumed debt over GDP was equal to 25% and net foreign assets were zero. With an initial real interest rate equal to 1%, β equals 2.5. With these parameter values, our consumption formulation does not differ much from that in Masson et al., except in the long run.

In the short run, consumption in our model follows:

$$\text{(A9)}\quad C = (1-\tau)y + \rho W + \mu(W - \tilde{W}).$$

Wealth has two effects on consumption: households consume interests and there exists a real wealth effect.

Using equations (A8) and (A9) in first difference, we obtain:

(A10) $\Delta C = [1-\mu(\alpha+\beta\rho_0)](1-\tau_0)\Delta y + (\rho_0+\mu)\Delta W + [W_0 - \mu\beta(1-\tau_0)y_0]\Delta\rho$;

where variables with subscript 0 are initial values (see table 1).

With the chosen values, private consumption in the short run is such that:

(A11) $\Delta C = 0.9(1-\tau_0)\Delta y + 0.31\rho W_{-1} - 0.35\Delta\rho$.

This formulation differs slightly from Masson et al.'s since in our model, variations and not only the level of the real interest rate impinge on consumption growth. In the long run, differences are more substantial since wealth can be replaced by its value in equation (A8). We thus get:

(A12) $\Delta C = (1-\tau_0)\Delta y + 0.27\Delta\rho$.

Consumption growth hence depends positively on the real interest rate growth. Inflation hence reduces private consumption in the long run whereas a restrictive monetary policy increases it. Therefore, the government has to implement a fiscal contraction to reduce aggregate demand.

Appendix 3: Model robustness to some parameters

In simulated models, and more importantly in dynamic models, results can depend on parameter values. We present in this section the time path of the output level at Nash equilibrium in the country which faces the demand shock, using three different values for each parameter we study. These values meet the stability conditions of the model.

In our model, four parameters deserve peculiar attention; the two firsts are related to the private wealth effect: the sensitivity to the interest rate, β, and the speed of adjustment to the desired wealth level, μ. Next, because of the introduction of a fiscal balance rule, the sensitivity of public spending to public deficit variations, χ, becomes a crucial parameter. Last, inflation dynamics depends on the effect of the interest rate whose sensitivity on prices is measured by $(1+\theta)$.

The β parameter

A low level for the sensitivity of private wealth to the interest rate means that this wealth effect is weakened: if the negative demand shock has led to a public debt increase, the interest rate has to rise substantially (or be lessened to a smaller extent) to maintain the long run patrimonial balance. The output impact is therefore more restrictive than with larger values of β (see figures A1 to A3). More precisely, with a weak wealth effect, fiscal policy is very active in the short run (in comparison with a situation with a higher β) because public debt has no substantial effect on aggregate demand. In the medium and long run, however, this higher debt modifies monetary and fiscal policies: monetary policy, which was expansionist, and fiscal policy become very tight. The ECB moves first; afterwards, the long-lasting effect on debt of the rise in the interest rate compels the government to reduce spending; the falls in output and prices are very tough in the long run.

Figure A1: Output sensitivity in country 1 to beta, symmetric shock

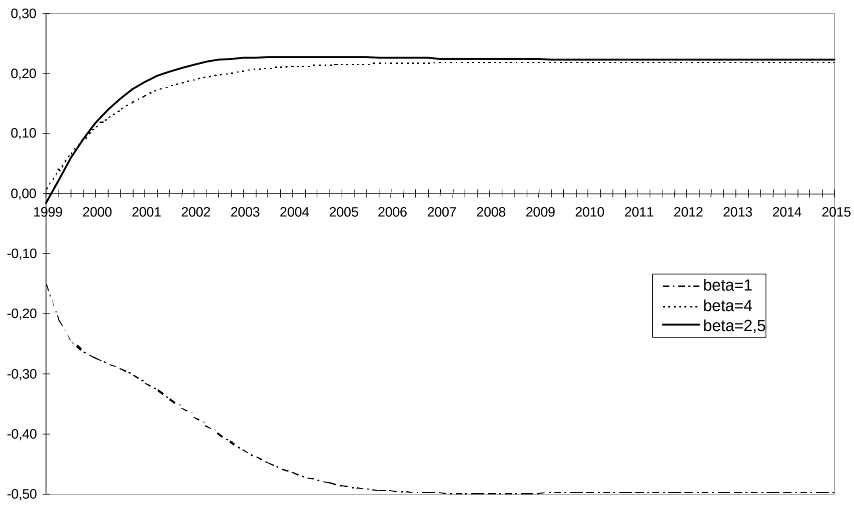


Figure A2: Output sensitivity in country 1 to beta, asymmetric shock in country 1

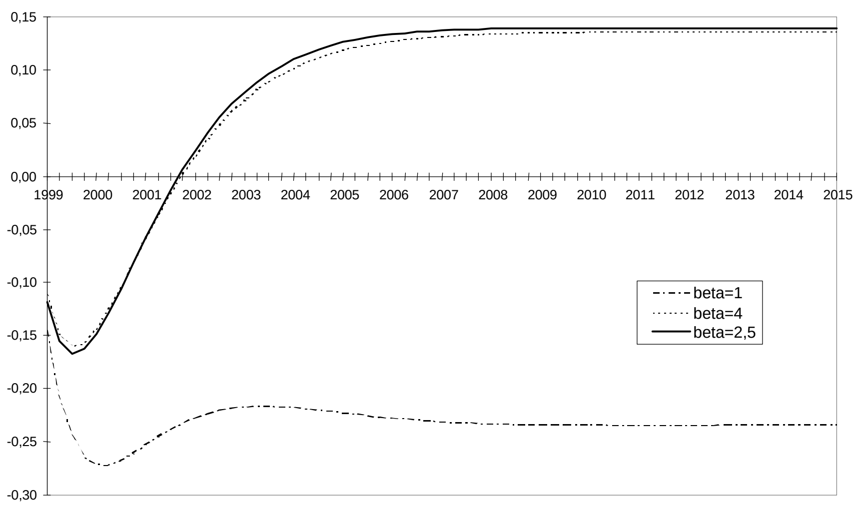
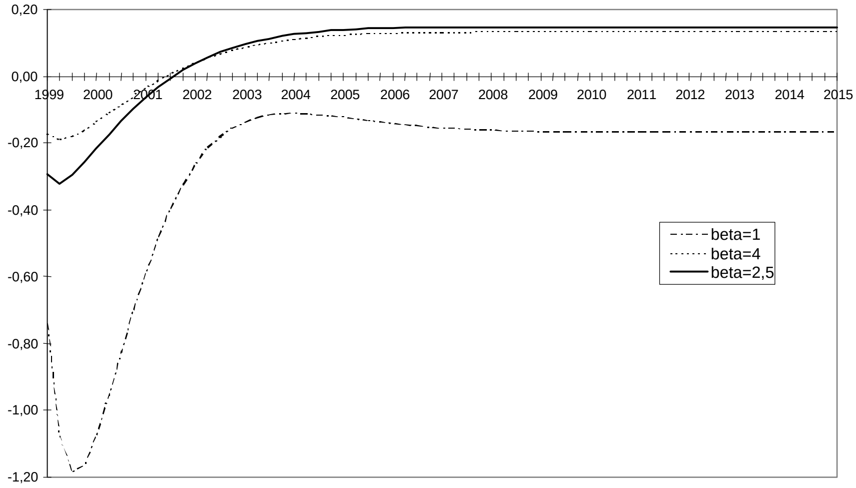


Figure A3: Output sensitivity in country 2 to beta, asymmetric shock in country 2



The χ parameter

This parameter is of crucial importance as far as the model stability is concerned. It has no implication on the values of steady state variables. As figures A4 to A6 show, small values for this parameter slow down the time path to the new steady state.

Figure A4: Output sensitivity in country 1 to χ, symmetric shock

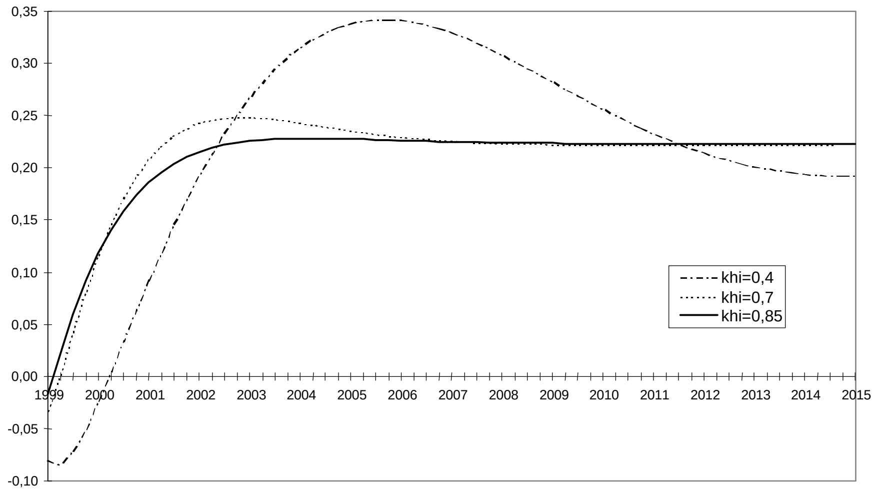


Figure A5: Output sensitivity in country 1 to χ, asymmetric shock in country 1

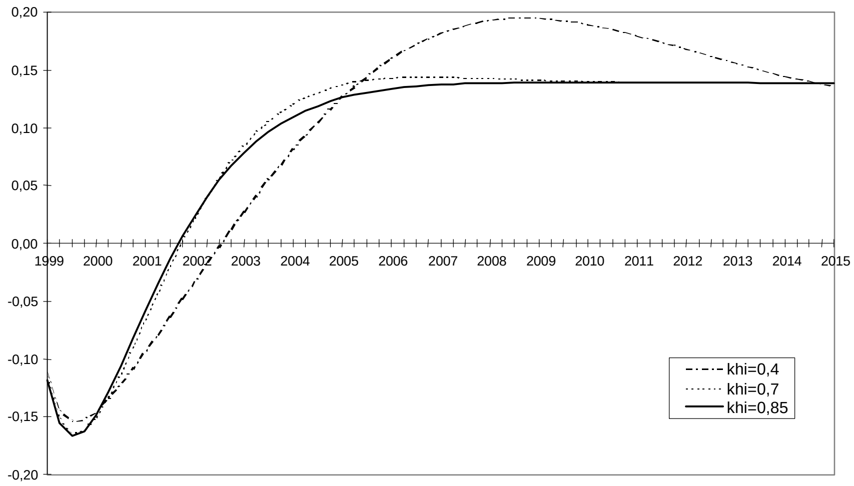
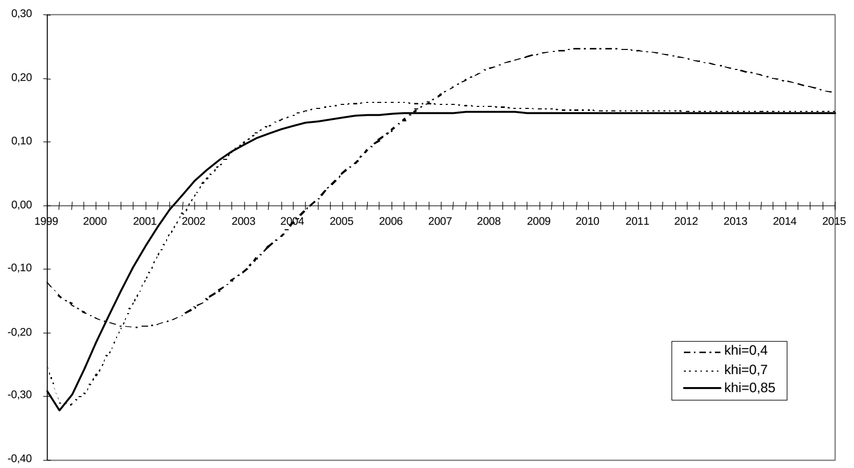


Figure A6: Output sensitivity in country 2 to χ, asymmetric shock in country 2



The μ parameter

The higher the speed of adjustment of actual to planned wealth, the speeder economies reach their new steady states. In the short run, a higher speed of adjustment has more substantial stabilisation effects: the gap between actual and planned wealth has more impact on aggregate demand if μ is large. Output deviations from the initial steady state are smaller. The forms of the time path between initial and final steady states are not radically changed if values of this parameter are modified (see figures A7 to A9).

Figure A7: Output sensitivity in country 1 to μ, symmetric shock

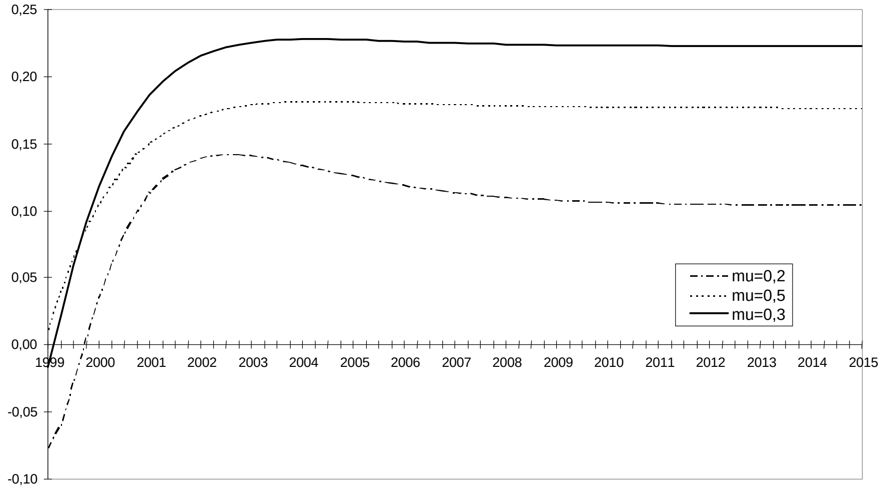


Figure A8: Output sensitivity in country 1 to μ, asymmetric shock in country 1

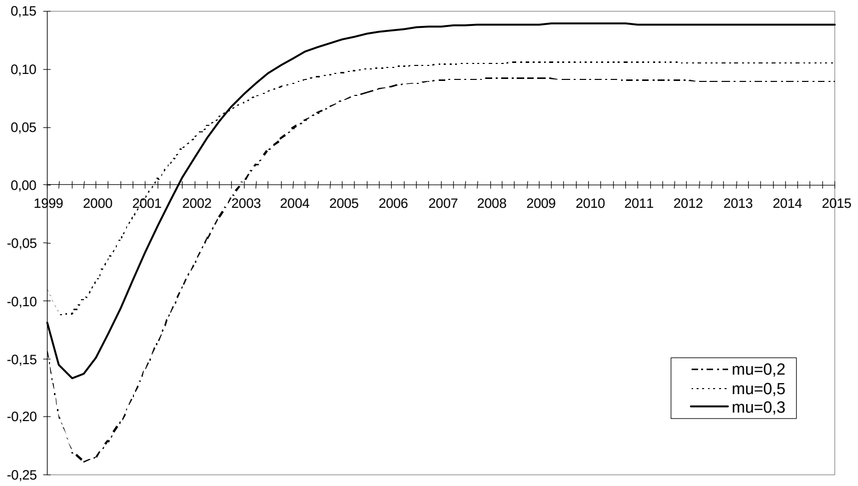
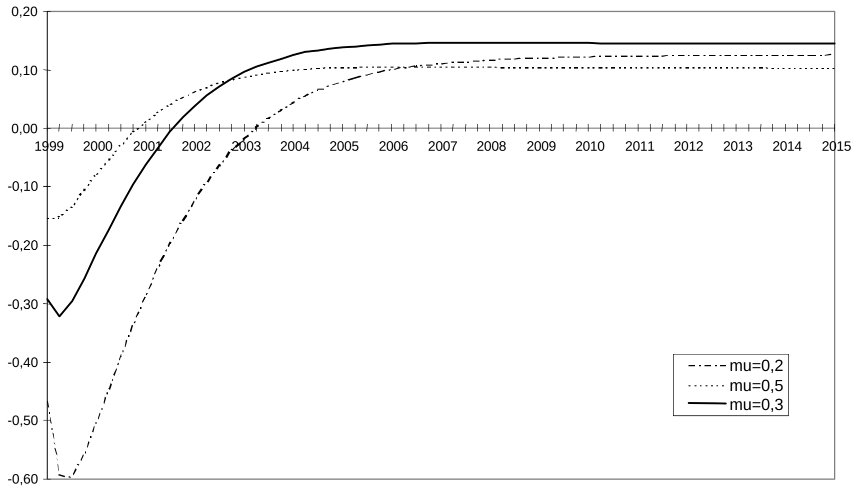


Figure A9: Output sensitivity in country 2 to μ, asymmetric shock in country 2



The θ parameter

The different values for parameter θ do not have any influence on the output steady state path. The model is therefore not sensitive to this parameter (see figures A10 to A12).

Figure A10: Output sensitivity in country 1 to θ, symmetric shock

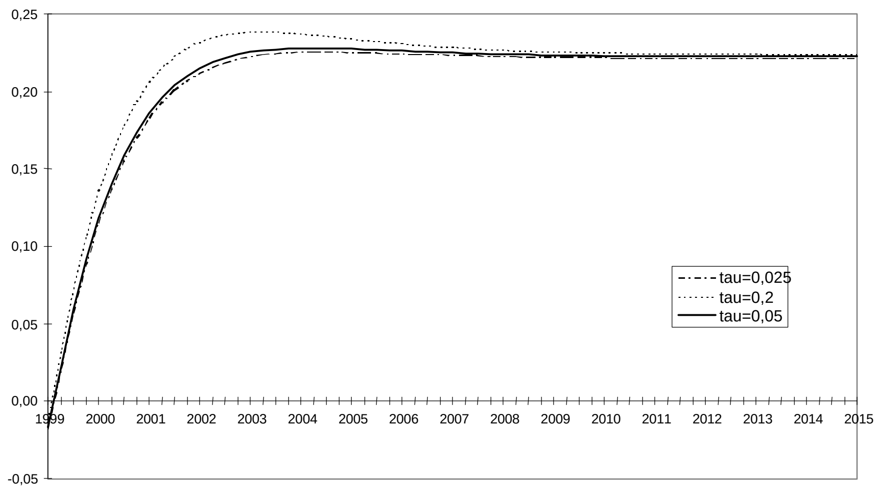


Figure A11: Output sensitivity in country 1 to θ, asymmetric shock in country 1

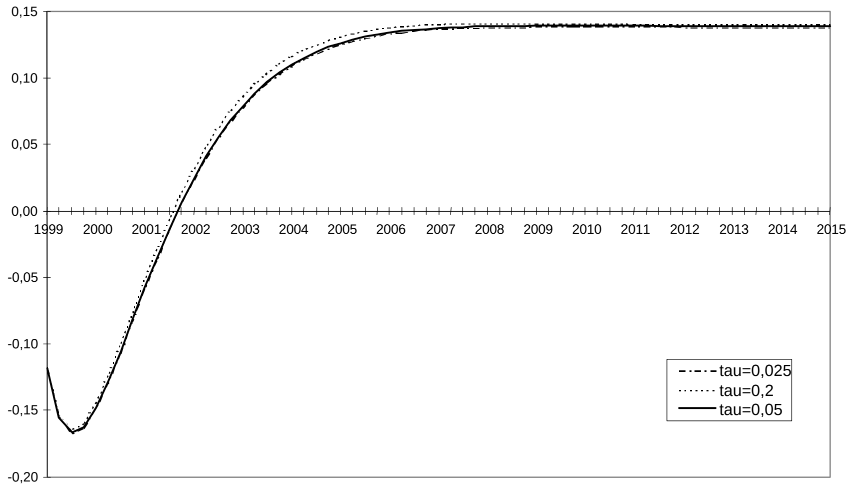
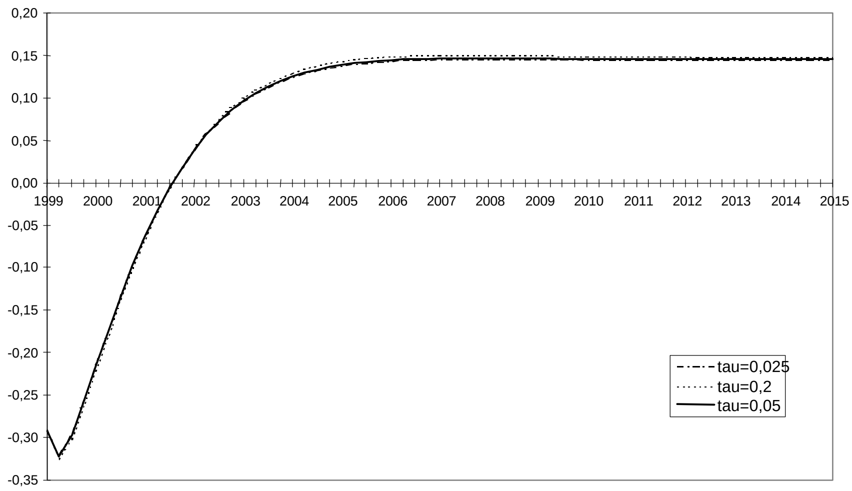


Figure A12: Output sensitivity in country 2 to θ, asymmetric shock in country 2



Appendix 4: Nash and Nash-bargaining equilibria

Assume L_{NG} et L_{NM} are respectively a government and a central bank loss function at Nash equilibrium:

$$L_{NG} = \alpha_G y^2 + \beta_G \pi^2 + \gamma_G \tau^2$$
$$L_{NM} = \alpha_M y^2 + \beta_M \pi^2 + \gamma_M \rho^2$$

At Nash equilibrium, one gets:

$$\begin{array}{lcl} \underset{\tau}{\mathrm{Min}}\, L_{NG} \Leftrightarrow \dfrac{\partial L_{NG}}{\partial \tau} = 0 & & \tau_N = -\dfrac{1}{\gamma_G}(\alpha_G \dfrac{\partial y}{\partial \tau} y + \beta_G \dfrac{\partial \pi}{\partial \tau}\pi) \\ & \text{; hence,} & \\ \underset{\rho}{\mathrm{Min}}\, L_{NM} \Leftrightarrow \dfrac{\partial L_{NM}}{\partial \rho} = 0 & & \rho_N = -\dfrac{1}{\gamma_M}(\alpha_M \dfrac{\partial y}{\partial \rho} y + \beta_M \dfrac{\partial \pi}{\partial \rho}\pi) \end{array}.$$

To determine a co-operative equilibrium, one usually distinguishes between two methods: first, the Nash-bargaining equilibrium which consists in the maximisation of the product of earnings due to co-operation, i.e. the product of the differences between losses at Nash equilibrium and at the co-operative equilibrium for each player; the resulting bargaining equilibrium is henceforth Pareto-optimal. We have, with L_{CG} et L_{CM} the government and central bank loss functions at the co-operative equilibrium respectively:

$\underset{\tau,\rho}{\mathrm{Max}}\,(L_{NG} - L_{CG})(L_{NM} - L_{CM})$, hence:

$$(L_{NM} - L_{CM})(\frac{\partial L_{NG}}{\partial \tau} - \frac{\partial L_{CG}}{\partial \tau}) + (L_{NG} - L_{CG})(\frac{\partial L_{NM}}{\partial \tau} - \frac{\partial L_{CM}}{\partial \tau}) = 0$$
$$(L_{NM} - L_{CM})(\frac{\partial L_{NG}}{\partial \rho} - \frac{\partial L_{CG}}{\partial \rho}) + (L_{NG} - L_{CG})(\frac{\partial L_{NM}}{\partial \rho} - \frac{\partial L_{CM}}{\partial \rho}) = 0$$

Since both policymakers have already reached Nash equilibrium which means, by definition, that each authority has assumed that the policy of the other authority is constant, we also have:

$$\frac{\partial L_{NG}}{\partial \tau} = 0\,; \frac{\partial L_{NM}}{\partial \tau} = 0\,; \frac{\partial L_{NG}}{\partial \rho} = 0\,; \frac{\partial L_{NM}}{\partial \rho} = 0.$$

It comes that:

$$(E1): (L_{NM} - L_{CM})\frac{\partial L_{CG}}{\partial \tau} + (L_{NG} - L_{CG})\frac{\partial L_{CM}}{\partial \tau} = 0$$
$$(E2): (L_{NM} - L_{CM})\frac{\partial L_{CG}}{\partial \rho} + (L_{NG} - L_{CG})\frac{\partial L_{CM}}{\partial \rho} = 0$$

The second method follows a negotiation framework. Co-operative equilibrium is reached after a weighted average of both policymakers' loss functions has been minimised. With the negotiation parameter λ, where $0 < \lambda < 1$, the computations follow:

$\underset{\tau,\rho}{\mathrm{Min}}\left\{\lambda L_{CG} + (1-\lambda)L_{CM}\right\}$, hence:

$$(E1'): \lambda \frac{\partial L_{CG}}{\partial \tau} + (1-\lambda)\frac{\partial L_{CM}}{\partial \tau} = 0$$

$$(E2'): \lambda \frac{\partial L_{CG}}{\partial \rho} + (1-\lambda)\frac{\partial L_{CM}}{\partial \rho} = 0$$

The negotiation framework will be Pareto-optimal if the following condition is met:

$$(E3): \frac{L_{NM} - L_{CM}}{L_{NG} - L_{CG}} = \frac{\lambda}{1-\lambda}.$$

Thus, the Nash-bargaining equilibrium can be described as the search for the value of λ which maximises the product of earnings due to the co-operation. It is therefore impossible that the negotiation comes up to a counter-productive (or sub-optimal) equilibrium. Moreover, the condition (E3) ensures that if one player is in a more favourable situation than at the Nash equilibrium, it is also the case for the second player since $\lambda/(1-\lambda) > 0$: equilibrium is Pareto-optimal.

Values for the economic instruments at the co-operative equilibrium are resulting from equations (E1') and (E2'):

$$\tau_C = -\frac{1}{\lambda\gamma_G}((\lambda\alpha_G + (1-\lambda)\alpha_M)\frac{\partial y}{\partial \tau}y + (\lambda\beta_G + (1-\lambda)\beta_M)\frac{\partial \pi}{\partial \tau}\pi)$$

$$\rho_C = -\frac{1}{(1-\lambda)\gamma_M}((\lambda\alpha_G + (1-\lambda)\alpha_M)\frac{\partial y}{\partial \rho}y + (\lambda\beta_G + (1-\lambda)\beta_M)\frac{\partial \pi}{\partial \rho}\pi).$$

After a small variation in one of the two instruments, the government loss function varies in the sense:

$dL_G = (\partial L_G / \partial \tau)dt$. If we take equation (E1') into account and assume that loss functions are of a quadratic form:

$dL_G = -[(1-\lambda)/\lambda](\partial L_M / \partial \tau)dt = -[(1-\lambda)/\lambda]dL_M$.

After any deviation of one instrument from its value at the co-operative equilibrium, loss functions of the two policymakers vary in opposite directions: the co-operative equilibrium is then Pareto-optimal.