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MONETARY AND FISCAL POLICY DESIGN UNDER EMU: A DYNAMIC GAME APPROACH

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Abstract

This paper analyzes the problem of designing macroeconomic stabilization policies within the European Monetary Union (EMU) as a dynamic game between a centralized monetary authority, the European Central Bank (ECB), and national fiscal policy makers. Non-cooperative feedback Nash equilibrium and cooperative Nash bargaining solutions are determined under various assumptions about rationing regimes in goods and labor markets and structural characteristics of the economies involved.

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Introduction

The European Union (EU) countries have started the Economic and Monetary Union (EMU) on January 1, 1999. With the EMU, the EU countries replaced their national currencies and national monetary policy autonomy by a common currency, the Euro, and a common monetary policy that is designed and implemented by the European Central Bank (ECB). A common currency was considered to form the completion of the Single Market Program: in fully liberalized internal goods, labor and capital markets, a common currency is a natural counterpart and expected to deliver substantial efficiency gains. The distinguishing feature of the EMU is that of a full monetary union without being accompanied by a political and fiscal union.

The ECB sets the monetary policy for the Euro area. In ECB (1998) the institutional framework and monetary policy objectives and instruments (and procedures) of the ECB are proposed. The primary objective is to secure price stability. As long as it does not interfere with price stability, the ECB also targets real macroeconomic activity in the Euro area (which generally will be macroeconomic stabilization). The monetary policy strategy will combine a monetary targeting and an inflation targeting strategy for the Euro area and is likely to be implemented in a pragmatic way, reflecting actual practice. At the end of 1998, reference growth rates for inflation and broad money, M3, in the area were set at 2 percent and 4.5 percent, respectively. In order to achieve its objectives it has at its disposal a set of instruments that can be used. The fact that the ECB conducts monetary policy for a composite of 11 sovereign countries implies that the transmission of monetary policy is much more complicated than that in case of a monetary policy conducted by a national monetary authority. The transmission in the various countries is likely to differ considerably due to variation in factors such as openness, levels and composition of household wealth, flexibility and institutional features of labor and product markets. These factors themselves are also often assumed to change under the new regime, increasing -at least in the short run- further the uncertainty about monetary policy transmission.

Due to the EMU the participating countries loose their monetary policy instruments in the design of macroeconomic stabilization policies. With monetary policy transferred to the ECB and directed at EMU-wide economic conditions, individual countries are more restricted to adopt national macroeconomic stabilization policies and only fiscal policy is left as macroeconomic policy instrument. If business cycles in the EU evolve with asymmetric patterns (due e.g. to asymmetric shocks or symmetric shocks that hit asymmetric countries) and if countries differ in their institutional characteristics, in particular regarding labor market institutions, it would be

natural to allow for a large degree of flexibility in national fiscal policies (including labor market policies). Especially if the EMU remains a very decentralized fiscal federation with limited centralized fiscal spending and revenue collection competencies.

Fiscal management in the EMU remains predominantly a national competence as it is not foreseen that the EMU will develop into a true fiscal federation. On the contrary, the Maastricht Treaty prescribes subsidiarity as the leading principle in fiscal policy design under EMU. Moreover, the Maastricht Treaty and the recent 'Stability and Growth Pact' that was drafted with the Treaty of Amsterdam in July 1997 advocate fiscal stringency. To prevent excessive fiscal deficits, the Stability and Growth Pact introduces financial sanctions in case countries do not comply with its rules. A fiscal deficit of three percent of GDP or higher is considered to be excessive and subject to budgetary sanctions. The fiscal target is a balanced budget in the long run. The compliance with these stringency requirements was considered necessary for economic and monetary stability in the EMU as excessive deficits in an EMU country create the risk that the ECB, the EU or the fiscal authorities of other countries are in the end forced to bail out insolvent countries. In addition, sustained excessive deficits may impose a serious externality upon the other countries through an upward pressure on interest rates and a downward pressure on the Euro exchange rate. In all, these excessive deficits in a member state are likely to impose negative externalities on the other countries which would be forced to share the adjustment burden associated with undisciplined fiscal policies.

Hence, under the EMU, situations may easily arise where the need for flexibility and the requirement of fiscal stringency are in conflict with each other. In addition, in a highly integrated economic area like the EMU, the various spillovers of national fiscal policies and the monetary policies of the ECB may generate additional inefficiencies if the macroeconomic policymakers implement their policies in a non-cooperative manner.

Given these implications of EMU on monetary and fiscal policy design in the EU, an important issue is the design and transmission of monetary and fiscal stabilization policies under EMU and the degree to which they are coordinated. With the aid of a stylized macroeconomic model that features a completely worked out adjustment in the goods and labor markets, this paper analyzes the design, the interaction and the effects of monetary and fiscal stabilization policies in the EMU using a dynamic game approach. We analyze the effects of monetary and fiscal policy coordination in the EMU and analyze the effects of fiscal stringency requirements on the interaction of monetary and fiscal policy in the EMU. We consider the effects of asymmetries in initial conditions and economic structures where we focus in particular on asymmetries in the labor market conditions.

A complete modeling of the goods and labor markets is considered which features the possibility of disequilibria and rigidities in the short run and dynamic adjustment over time. These disequilibria result in rationing in the goods and labor markets. In this way our analysis provides more insight into the importance of goods and labor market adjustments, rigidities and institutions in the EMU. Two alternative disequilibrium regimes are studied: in the Classical regime output in the goods market is determined by the supply side. Too high initial real wages in this regime result in a situation of Classical unemployment in the labor market. In the Keynesian regime, output in the goods market is determined by the demand side of the market. Low demand in this regime causes Keynesian unemployment in the labor market that can be counteracted by active stabilization policies in the EMU.

Our analysis extends and complements the existing literature that models macroeconomic policy design in the EMU. This literature has focused on (i) macroeconomic adjustment and policy design in the transition towards EMU[1], with an emphasis on the effects of the monetary and fiscal convergence criteria of the Maastricht Treaty, and (ii) the comparison between adjustment in the pre-EMU and the EMU regime[2], with an emphasis on the likely costs and benefits of a common currency. Our paper, on the other hand, takes the EMU as a starting point and ignores the issue of convergence and a comparison with the pre-EMU regime. It elaborates further the analysis of macroeconomic policy design in the EMU by Engwerda *et al*. (1998) and (1999) and van Aarle *et al.* (1999), who extend the dynamic game theoretic framework of monetary and fiscal policy interaction developed by Turnovsky *et al*. (1988) and Neck and Dockner (1995) to the case of a monetary union. Moreover, cross-country preferences are allowed[3].

Here, we consider feedback information patterns in a differential game on macroeconomic stabilization between the fiscal authorities and the ECB. In Engwerda *et al*. (1998) and (1999), open loop strategies were assumed which are computationally more accessible but admittedly less realistic than feedback strategies as a characterization of macroeconomic policy design. The non-cooperative feedback Nash strategy is strongly time-consistent, so that the players have no reason at any future state of the game to deviate from the adopted policy, even if there have been deviations in the past. Also, we consider effects of coordination of monetary and fiscal policies in

[1] Von Hagen and Lutz (1995), Jensen and Jensen (1995) and Barrell and Sefton (1997) are insightful examples that address this convergence issue.

[2] This issue is, amongst others, addressed by Currie *et al*. (1992), Hughes Hallett and Vines (1993), Lane and Gros (1994) and Fair (1998).

[3] Note that, e.g., fiscal instruments in one country (may) have a direct impact on output in the other country. Therefore, if the fiscal authority in country 1 is concerned about its own output, it is (in)directly also concerned about the fiscal policy pursued in the other country.

the EMU[4]. A comparison of the outcomes under non-cooperative and cooperative macroeconomic policies is made. In the set of cooperative solutions, we concentrate on the Nash Bargaining case because it looks for the largest coordination gains. Therefore, the Nash Bargaining case appears to be the most realistic characterization of the bargaining problem connected with cooperation as it is the outcome of an axiomatic scheme. Cooperation enables to internalize the externalities and spillovers associated with macroeconomic policy design in the EMU. These spillovers and externalities acerbate outcomes in the non-cooperative feedback Nash case as the players try to shift the adjustment burden to the other players.

The outline of the paper is as follows. Section 2 introduces a simple dynamic macroeconomic model of the EMU. The interaction and transmission of national fiscal policies and the common monetary policy implemented by the ECB are studied to illustrate the most important aspects of the model. The roles of labor market institutions and of fiscal stringency requirements are considered. Section 3 studies numerical simulations with the model and section 4 concludes.

[4] In a three player game (two fiscal authorities, the countries, and one monetary authority, the ECB) this type of coordination implies overall coordination. Coordination in the form of a cooperation between the fiscal authorities (countries) and a competitive situation between the group of these fiscal authorities and the monetary authority (the ECB) will be studied as a special form of a dynamic coalition game in a subsequent paper.

2. A Dynamic EMU Model

This section provides a dynamic two-country model of the EMU. It considers the combination of a common monetary policy and national fiscal policies. Monetary and fiscal stringency criteria are introduced that condition monetary and fiscal policy under EMU. Labor market adjustment and institutions play a crucial role in the model. The various interdependencies between both countries imply that the common monetary policy and the national fiscal policies produce various spillovers between the two countries. This raises our interest to distinguish between a regime in which the monetary and fiscal policies in the EMU are (i) coordinated and (ii) non-coordinated.

It is assumed that the EMU consists of two countries, country 1 and country 2. We allow countries to differ in their macroeconomic structures, which implies that we can study both (i) symmetric and (ii) asymmetric cases. In the EMU, national currencies have been replaced by a common currency and national central banks by the ECB. Capital markets are fully integrated. On the other hand, we assume that there is no labor mobility between both EMU parts and that prices and wages in the goods and labor markets adjust sluggishly. We also ignore here the interaction of the EMU countries with the non-EMU world. The economic structure of the two-country EMU is given by the following equations:

Table 1 A Two-Country EMU

(1*a*) $y_1^d(t) = d_1 s(t) - g_1 r_1(t) + r_1 y_2(t) + h_1 f_1(t)$	(1*b*) $y_2^d(t) = -d_2 s(t) - g_2 r_2(t) + r_2 y_1(t) + h_2 f_2(t)$
(2*a*) $y_1^s(t) = f_1 n_1(t)$	(2b) $y_2^s(t) = f_2 n_2(t)$
(3*a*) $y_1(t) = \min(y_1^d(t), y_1^s(t))$	(3*b*) $y_2(t) = \min(y_2^d(t), y_2^s(t))$
(4) $s(t) = p_2(t) - p_1(t)$	
(5*a*) $r_1(t) = i_E(t) - \dot{p}_1(t)$	(5*b*) $r_2(t) = i_E(t) - \dot{p}_2(t)$
(6) $m_E(t) - p_E(t) = k y_E(t) - l i_E(t)$	
(7*a*) $\dot{p}_1(t) = x_1(y_1^d(t) - y_1^s(t)) + n_1 \dot{w}_1(t) + z_1 \dot{p}_2(t)$	(7*b*) $\dot{p}_2(t) = x_2(y_2^d(t) - y_2^s(t)) + n_2 \dot{w}_2(t) + z_2 \dot{p}_1(t)$
(8*a*) $\dot{w}_1(t) = m_1 \dot{p}_1(t) - s_1 u_1(t)$	(8*b*) $\dot{w}_2(t) = m_2 \dot{p}_2(t) - s_2 u_2(t)$
(9*a*) $n_1^d(t) = -p_1(w_1(t) - p_1(t))$	(9*b*) $n_2^d(t) = -p_2(w_2(t) - p_2(t))$
(10*b*) $n_1^s(t) = t_1(w_1(t) - p_1(t))$	(10*b*) $n_2^s(t) = t_2(w_2(t) - p_2(t))$
(11*b*) $n_1(t) = \min(n_1^d(t), n_1^s(t))$	(11*b*) $n_2(t) = \min(n_2^d(t), n_2^s(t))$
(12*a*) $u_1(t) = n_1^s(t) - n_1^d(t)$	(12*b*) $u_2(t) = n_2^s(t) - n_2^d(t)$

where y_i denotes real output of country i with i={1,2}, p_i the output price level, r_i the real interest rate, f_i the real fiscal deficit that the fiscal authority of country i chooses, w_i the nominal wage rate, n_i employment and u_i the unemployment rate. Moreover, s measures competitiveness of country 1 vis-à-vis country 2 as it is defined as the output price differential. m_E denotes the amount of nominal balances of the common currency that the public holds and i_E the common nominal interest rate. Except for the interest rates and the unemployment rate, all the variables are in logarithms and expressed as deviations from their long run non-inflationary equilibrium. A dot above a variable indicates its time derivative. In the long run the EU countries converge to a long run non-inflationary equilibrium where output is equal to its long run equilibrium level (which is normalized to, zero for simplicity) that is unaffected by monetary and fiscal policies. All the parameters are assumed to be nonnegative.

Equation (1) gives the aggregate demand for goods as a function of intra-EMU competitiveness, the real interest rate, foreign output and the real fiscal deficit. Equation (2) expresses the aggregate supply of goods as a function of the amount of labor employed in the production process where it has been assumed in the model that the amount of capital remains at its equilibrium level in the short run. According to (3) actual output is rationed by the short side of the goods market. The role of rationing is also present in (7) according to which output prices adjust to some extent to any excess demand or supply in the goods market. In addition, cost push factors such as wage increases and increases of foreign prices may affect domestic output prices. Equation (4) defines the competitiveness of the EMU countries relative to each other. The definition of real interest rates is given in (5). The demand for the common currency is given by (6) and depends on output in the currency union and the common interest rate. The money market is cleared by the common interest rate such that money demand equals the supply of Euro base money, m_E, which is set by the ECB. The average price level and average output are weighted averages of output prices and output of the two countries, i.e. $p_E(t) := \omega p_1(t)+(1-\omega)p_2(t)$ and $y_E(t) := \omega y_1(t)+(1-\omega)y_2(t)$, in which ω and $1-\omega$ denote the relative sizes of the economies of country 1 and country 2 in the total EMU economy. The Phillips mechanism is reflected in (8), which relates wage inflation to price changes and the unemployment rate u. The first component reflects the price compensation in wage formation, whereas the second component reflects the moderating effect of unemployment on wage increases. Labor demand, n^d, according to (9), is assumed to be negatively related to the real wage. Labor supply, n^s, according to (10) is a positive function of the real wage. Employment in

(11) is determined by a similar rationing scheme as in the goods market.[5] The rate of unemployment (12), finally, equals the difference between labor supply and labor demand.

Both economies are connected by a number of channels through which output and price fluctuations in one part transmit themselves to the other part of the EMU. Output fluctuations in both economies transmit themselves partly to the other EMU part through the import channel. Therefore, the relative openness to each other of both economies, as measured by ρ_i, creates an important interdependency between both economies. Price differences between the foreign and domestic economy affect the relative competitiveness of both EMU parts, as measured by $s(t)$, and therefore production in both economies. Output and price fluctuations in the domestic economy have also repercussions on the foreign economy through their effect on the demand for the common currency in the common money market. Moreover, domestic price fluctuations are caused by both domestic components, domestic excess demand and wage changes, and by foreign prices. The common monetary policy implemented by the ECB and the fiscal policies implemented by the national fiscal authorities affect real (output and employment) and nominal (prices and wages) adjustment in both economies through these various macroeconomic interdependencies. These interdependencies imply that the fiscal authority of country 1, the fiscal authority of country 2 and the ECB are involved in a dynamic game on macroeconomic stabilization in the EMU.

We assume that the players have quadratic objective functions. Fiscal authorities are assumed to care about stabilization of inflation, output, unemployment and fiscal deficits, i.e.,

$$(13a) \qquad J_{F1} = \frac{1}{2}\int_0^\infty \{\dot{p}_1^{\,2}(t) + a_1 y_1^2(t) + b_1 u_1^2(t) + c_1 f_1^2(t)\} e^{-qt}\, dt,$$

$$(13b) \qquad J_{F2} = \frac{1}{2}\int_0^\infty \{\dot{p}_2^{\,2}(t) + a_2 y_2^2(t) + b_2 u_2^2(t) + c_2 f_2^2(t)\} e^{-qt}\, dt.$$

Inflation, output and unemployment stabilization are standard arguments in the objective functions of macroeconomic policy makers. The assumption that the fiscal authorities value budget balance can reflect the notion that high deficits, while beneficial to stimulate output, are not without costs: these, to some extent, crowd out private investment and lead to debt accumulation that has to be serviced in the future by lower government spending and higher taxes. Deficits in the loss function also reflect the possibility that excessive deficits in the EMU will be subject to sanctions, as proposed in the 'Excessive Deficits Procedure' of the Treaty of Maastricht on the European Union (art. 104c) and its more recent extension into the Stability and Growth Pact. Therefore, countries

[5] These rationing schemes in the goods and labor markets are taken from the New Keynesian disequilibrium theory, initiated by Drèze (1975), Bénassy (1975) and Malinvaud (1977). See e.g. German (1985) and Picard (1993) for a detailed overview of disequilibrium theory and dynamics.

will prefer, ceteris paribus, low fiscal deficits to high deficits. α_i, β_i and χ_i denote the weights that the fiscal authorities attach to these policy objectives; θ measures the rate of time preference.

The ECB also features inflation and output objectives. More in particular we assume that it cares about average inflation, average output, average unemployment and money in the EMU,

$$(14) \qquad J_E = \frac{1}{2}\int_0^\infty \{\dot{p}_E^2(t) + a_E y_E^2(t) + b_E u_E^2(t) + c_E m_E^2(t)\} e^{-qt} dt.$$

Notice that if the preferential parameters α_E and β_E are in the neighborhood of zero, the primary ECB objective of price stability will be attained.[6]

Also in the case of monetary policy, we assume that policy activism is not without costs and therefore disliked by the ECB: in case $\chi_E>0$, higher monetary policy activism, while beneficial in stabilizing output and price fluctuations, entails welfare losses in itself.

Combining (1)-(12) yields after some rewriting, a first-order linear differential equation system with output prices, $p_i(t)$, and wages, $w_i(t)$, in both countries as state variables, and as control variables the policy instrument of the ECB, $m_E(t)$, and of the fiscal authorities in both countries, $f_1(t)$ and $f_2(t)$,

$$(15) \qquad \dot{x}(t) = Ax(t) + B_1 v_1(t) + B_2 v_2(t) + B_3 v_3(t), \quad x(0) = x_0$$

where $x := \begin{bmatrix} p_1 \\ p_2 \\ w_1 \\ w_2 \end{bmatrix}, v_1 := f_1, v_2 := f_2, v_3 := m_E.$

The linear dynamics of (15) combined with the quadratic objectives in (13)-(14) imply that the dynamic game is of the linear quadratic (LQ) type. Differential game theory typically concentrates on this LQ class since only in that case analytical and numerical tools are readily available. We want to consider the dynamic stabilization game in the context of a situation where the European countries are in a recession. This implies a negative output gap and unemployment. Hence, we need to analyze how policy instruments, output and prices adjust over time as a result of the dynamic interaction between macroeconomic policymakers in the EMU. It will also be of interest to consider how the degree of fiscal stringency and asymmetric settings of both economies will affect macroeconomic stabilization policies and adjustment.

In this dynamic interaction one can consider a number of different strategic and informational concepts. In the set of non-cooperative equilibria we concentrate ourselves here to the Nash strategy where players act non-cooperatively and implement their equilibrium strategy

simultaneously and use feedback strategies, where the information available to the individual players consists of the initial state and the current state of the game. As already mentioned before, this feedback Nash equilibrium has the desirable property that it is strongly time-consistent and is therefore often considered among the most relevant non-cooperative equilibria.

Out of the cooperative equilibria we focus on the cooperative Nash Bargaining solution as it rests on a solid axiomatic bargaining scheme in which the non-cooperative Nash equilibrium features as the strategic fallback position (or better threat point), d_i, to which players return in case cooperation breaks down. In the Nash bargaining case, the gains from cooperation, as measured by the distance between losses under cooperation and the strategic fallback positions, are maximized. More particular, in the Nash bargaining case the bargaining weights, ψ_i^{NB} , are determined by the individual players' losses, J_i^{NB}, and the threat-point, d with components d_i, in the following way,

$$(16) \qquad y_j^{NB} = \frac{\prod_{i \neq j} (J_i^{NB} - d_i)}{\sum_{i=1}^{3} \prod_{k \neq i} (J_k^{NB} - d_k)}$$

i.e. player i has a stronger bargaining position in cooperative policymaking in case the other players benefit more from policy coordination, with $\{i,j,k\} \varepsilon \{F_1,F_2,E\}$. In van Aarle *et al*. (1999) we have analyzed in detail the analytical and computational characteristics of the feedback Nash and the Nash bargaining equilibria associated with this dynamic game between the monetary and fiscal authorities in the EMU. Readers interested in these aspects are referred to this paper.

[6] This is the mathematical representation of the secondary objective of the ECB, as mentioned in the introduction: "as long as it does not interfere with price stability, the ECB also targets real macroeconomic stabilization", in our model.

3. Numerical Simulations with the Model

In this section, we concentrate on numerical simulations of a specific example. While this implies that the exact numerical outcomes are specific to the numerical values of the model parameters that are chosen, we are interested in the general adjustment patterns that are generated. The theoretical framework of section 2 gives rise to a number of macroeconomic (policy) regimes in the EMU: (i) cooperative vs. non-cooperative macroeconomic policies, (ii) Keynesian vs. Classical unemployment disequilibria, (iii) symmetric vs. asymmetric economic structures and (iv) restricted vs. unrestricted national fiscal policies. In this simulation exercise we will confront the outcomes in these various cases.

We use the following values for the structural model parameters in the symmetric case that will serve as our basic reference point: γ_i=0.2, δ_i=0.3, ρ_i=0.3, η_i=1, κ =1, λ=0.1, ξ_i=0.25, ν_i=0.7, ζ_i=0.8, μ_i=0.9, σ_i=0.2, π_i=0.7, τ_i=0, ϕ_i=0.75, ω=0.5 and θ=0.1. Concerning the preference weights in the objective functions of the players, the following values have been assumed: $\alpha_1=\alpha_2$=1.5, α_E=0.6, $\beta_1=\beta_2$=3, β_E=0, $\chi_1=\chi_2$=0.8, χ_E=0.5. Of crucial importance for the dynamic adjustment in the EMU are the initial values of the state variables of the model which determine the initial type of disequilibrium that countries face. We assume as a starting point that both countries are confronted with the following (initial) disequilibrium in wages and prices: $w_i(0)$=0.01 and $p_i(0)$=0.005, initially yielding Classical unemployment which implies an initial excess supply in the labor market and an initial excess demand in the goods market.

Figure 1 displays the adjustment of output, prices, wages, unemployment, competitiveness, fiscal deficits and the common money supply that results in this base case scenario.

[Insert Figure 1 here]

Adjustment in the feedback Nash case is indicated by solid lines while adjustment in the cooperative Nash bargaining equilibrium is given by dotted lines. The initial disequilibrium level of nominal wages depresses output and employment in both economies. With aggregate demand deviating from aggregate supply in the goods and labor markets, the rationing schemes of the model are activated and wages and prices start to adjust towards their equilibrium values.

Under the Classical unemployment regime, monetary and fiscal policies have only direct effects on output and employment via price and wage adjustments. Expansionary monetary and fiscal policies increase the excess demand and thereby price adjustment. Real wages decrease over

time if price compensation is imperfect, which fosters output and employment adjustment towards equilibrium. In the non-cooperative case, fiscal deficits are contracted slightly as the fiscal players try to shift the adjustment burden to the monetary authority. In the cooperative case, the common money supply and the fiscal deficits are expanded.

In the first (I) row of Table 2 we tabulate the welfare losses that result under non-cooperative and cooperative policy design in the EMU and the bargaining weights in the cooperative decision making between monetary and fiscal authorities.

Table 2

Non-cooperative and cooperative costs (times 10^{-3}) and relative bargaining power in the Nash Bargaining solutions

Case		Country 1	Country 2	ECB
I	J^{Nash}	0.1121	0.1121	0.0119
	J^{NB}	0.1097	0.1097	0.0107
	y^{NB}	0.2399	0.2399	0.5202
II	J^{Nash}	0.1156	0.1988	0.0092
	J^{NB}	0.1113	0.1634	0.0069
	y^{NB}	0.3376	0.0405	0.6218
III	J^{Nash}	0.8580	0.8580	0.7133
	J^{NB}	0.7195	0.7195	0.7000
	y^{NB}	0.0810	0.0810	0.8380
IV	J^{Nash}	0.7050	0.7050	0.1824
	J^{NB}	0.2874	0.2874	0.1157
	y^{NB}	0.1211	0.1211	0.7579

By definition, policy coordination reduces the welfare losses as externalities from individual policies are internalized in the cooperative case and not ignored as in the non-cooperative case. Obviously, in this symmetric case the bargaining weights in the individual countries are equal. The ECB's bargaining weight turns out to be slightly higher than double the bargaining weight of an individual country, implying an approximately equal splitting of bargaining power between the monetary and both the fiscal authorities together. The initial adjustment for the real variables

(output and employment) is (slightly) higher in the cooperative case than in the non-cooperative case. The reverse is true for the nominal variables (prices and wages).

In the Classical unemployment regime, strong effects result from a change in the labor market parameters. Figure 2 gives the adjustment patterns that result in an asymmetric case where $\mu_1 = 0.9$ and $\mu_2 = 0.1$, implying that prices and wages adjust quicker in country 1 than in country 2.

[Insert Figure 2 here]

A higher degree of price compensation in the wage rate increases the adjustment capacity of the economies. In case of country 2, wages, unemployment and output adjust slower than in the base case of Figure 1 because of the increased wage and price stickiness. The adjustment in country 1 is approximately the same as before. According to the second (II) line of Table 2, this lower labor market flexibility entails for country 2 considerable welfare losses compared to the base case (I), both under non-cooperative and cooperative macroeconomic policy design. In this perspective, it is interesting to note that currently in various countries in the EU attempts to reform labor markets and institutions are undertaken that aim at increasing the flexibility of the labor market. The asymmetric setting implies asymmetric adjustment patterns, asymmetries in the transmission of monetary and fiscal policies and different bargaining positions in the cooperative case. The intra-EMU competitiveness variable *s* is also affected and features as an adjustment channel to disequilibria[7].

A different and potentially stronger role for macroeconomic policies results if output is demand determined. In that case, policies can directly influence output and employment.[8] In the demand regime, monetary and fiscal authorities have a stronger impact on the adjustment as they directly control aggregate demand for goods and thereby employment. In that case the issue of policy coordination becomes increasingly important. Figure 3 gives the adjustment pattern in the base case, when the economies do not start in the Classical regime but in the Keynesian regime. The initial values of $w_i(0)$=-0.005 and $p_i(0)$=-0.01 induce such a regime switch to a demand regime.

[7] In van Aarle *et al.* (1999), pp. 18 and 19, an experiment is conducted in which the labor market of country 2 is assumed to be considerably more flexible than that of country 1. This time a greater flexibility is obtained by considering σ_1=0.2 and σ_2=0.8, so that the labor market of country 2 reacts much stronger to unemployment than in country 1 (stronger Phillips mechanism). Then wages, unemployment, prices and output adjust much more slowly in country 1 than in country 2 entailing large welfare losses and competitiveness of country 1 remains negative over the entire adjustment cycle.

[8] This traditional role of monetary and fiscal policies as demand management policies and in the context of the EMU is the focus of Engwerda *et al*. (1998).

[Insert Figure 3 here]

Figure 4 gives adjustment in the case the fiscal and monetary flexibility parameters are changed. χ_1 and χ_2 are decreased from 0.8 to 0.25, implying that fiscal policy activism is much less restricted by fiscal stringency requirements and less costly for the authorities. χ_E is increased from 0.5 to 3.5 making monetary policy activism more costly for the ECB.

[Insert Figure 4 here]

As indicated in section 2, we view the fiscal flexibility parameter as a stylized representation of the Stability and Growth Pact. A lower value of $\chi_{1,2}$ in this interpretation implies a less strict interpretation of the Stability and Growth Pact. The higher degree of fiscal flexibility enables the fiscal authorities to exercise more fiscal policy activism. Accordingly, fiscal deficits are expanded more in the feedback Nash case and, to a somewhat lesser extent, in the Nash bargaining case. The lower monetary flexibility implies here that the ECB implements a less restrictive monetary policy as before. This reduces the adjustment burden for the fiscal policymakers. Welfare losses are lower both for the fiscal authorities who face a smaller adjustment effort and also for the ECB who has less instrument costs as it is more costly to implement a sharp monetary contraction. The new bargaining weights imply that the more flexible fiscal players gain influence in the cooperative decision making problem.

Conclusion

EMU combines a centralized monetary policy with decentralized fiscal policies. Fiscal stringency requirements are introduced to reduce negative spillovers that result from excessive deficits. In such a setting many complications are likely to arise when designing macroeconomic stabilization policies. This paper characterized the problem of macroeconomic stabilization under EMU as a dynamic game between the ECB and national fiscal authorities. It was analyzed how monetary policy of the ECB and national fiscal policies are interacting and are transmitted using a dynamic game approach. We focused on the non-cooperative feedback Nash and the cooperative Nash Bargaining equilibria of this dynamic game. Moreover, it was analyzed how the monetary and fiscal stringency requirements of the Maastricht Treaty affect macroeconomic outcomes in the EMU. The analysis also provided insights into the effects of labor market conditions on macroeconomic outcomes under EMU. In particular, the type of rationing regime in the goods and labor markets, Classical or Keynesian unemployment, plays a crucial role in macroeconomic policy design and transmission. It was also shown that structural asymmetries may have important implications for monetary and fiscal policies under EMU.

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Figure 1 - *Base Case Classical Regime*

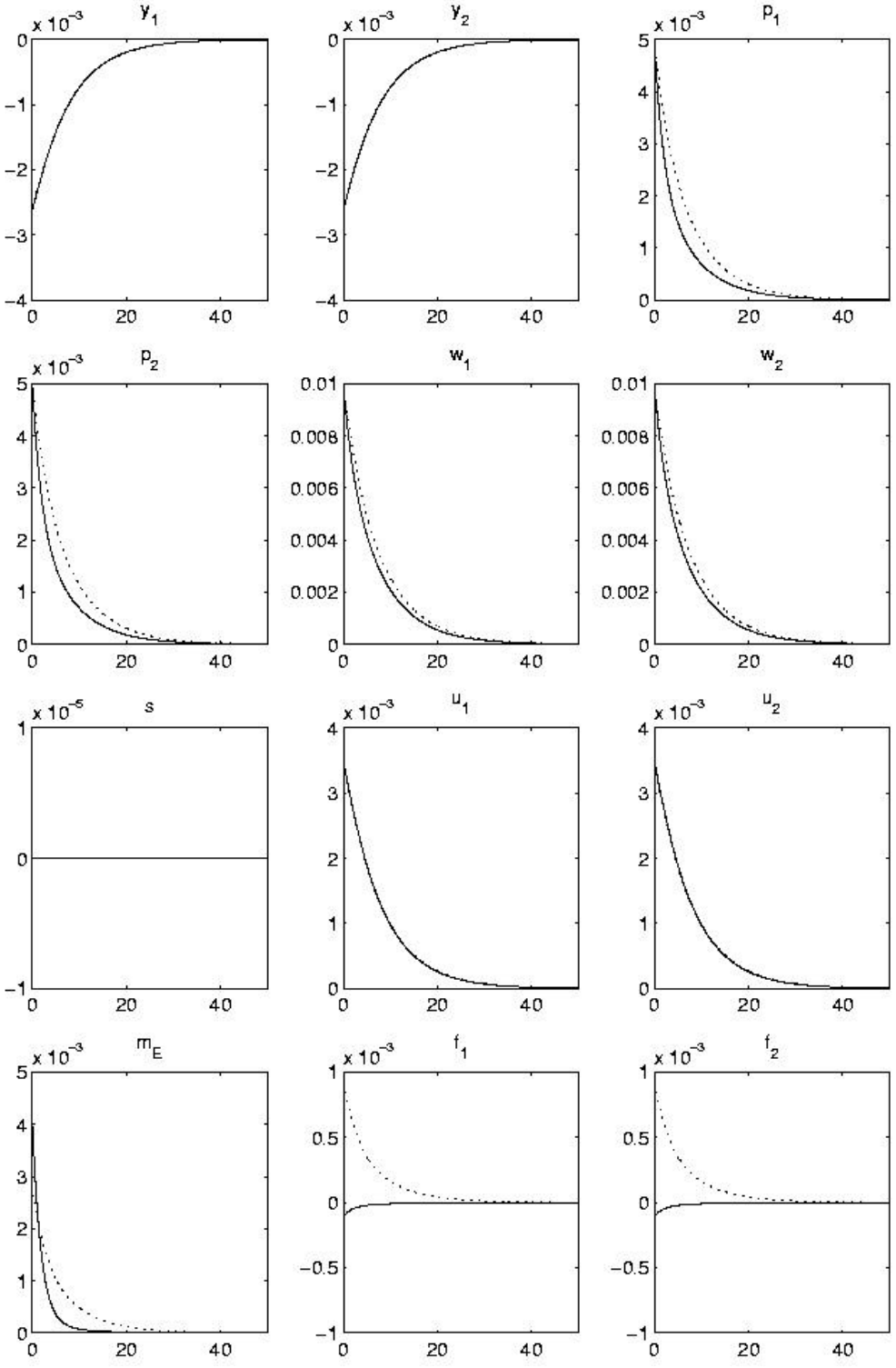
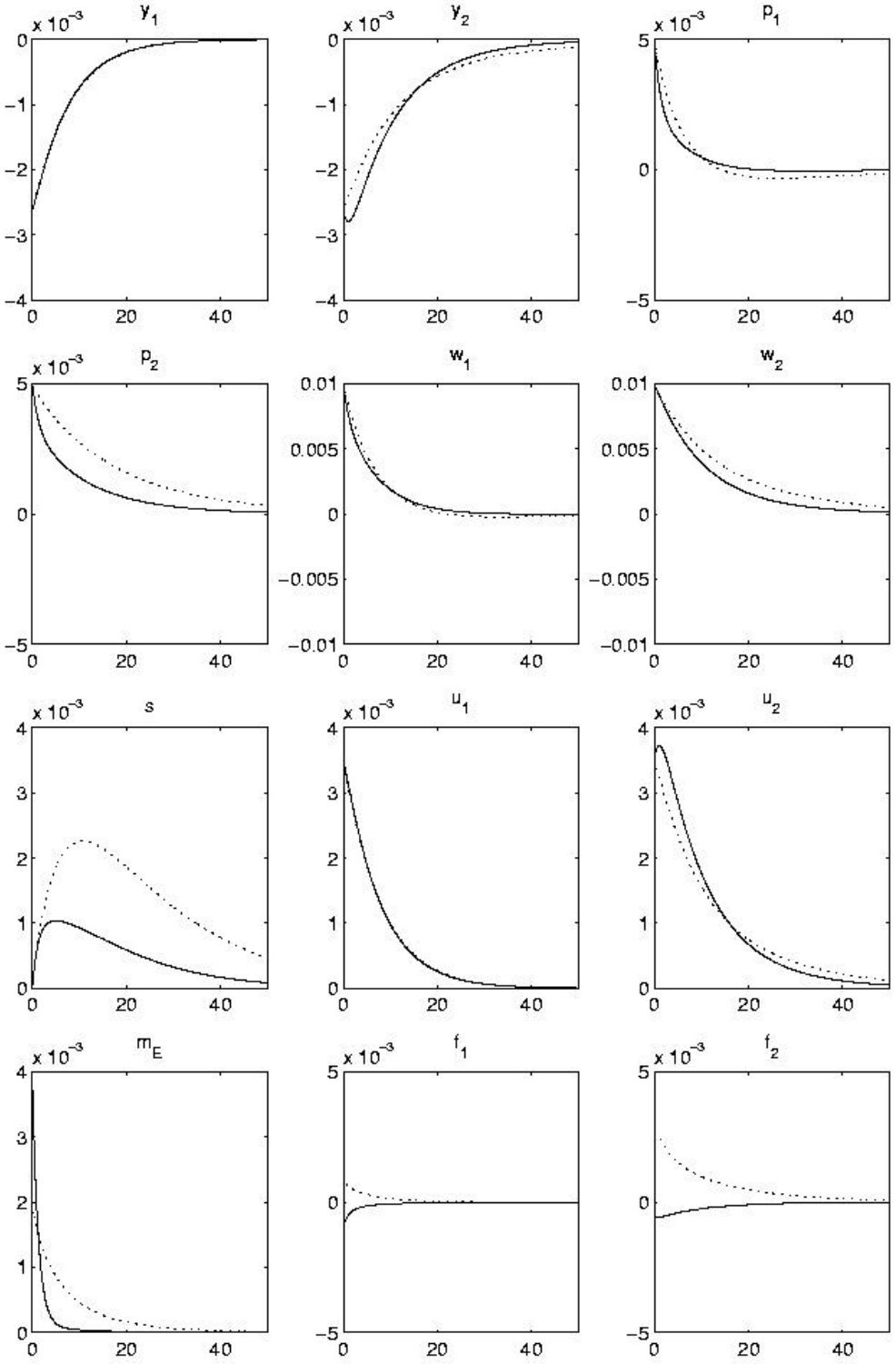


Figure 2 - *An Asymmetric Labour Market Regime*



____ Feedback Nash ------ Nash Bargaining

Figure 3 – *Base Case Keynesian Regime*

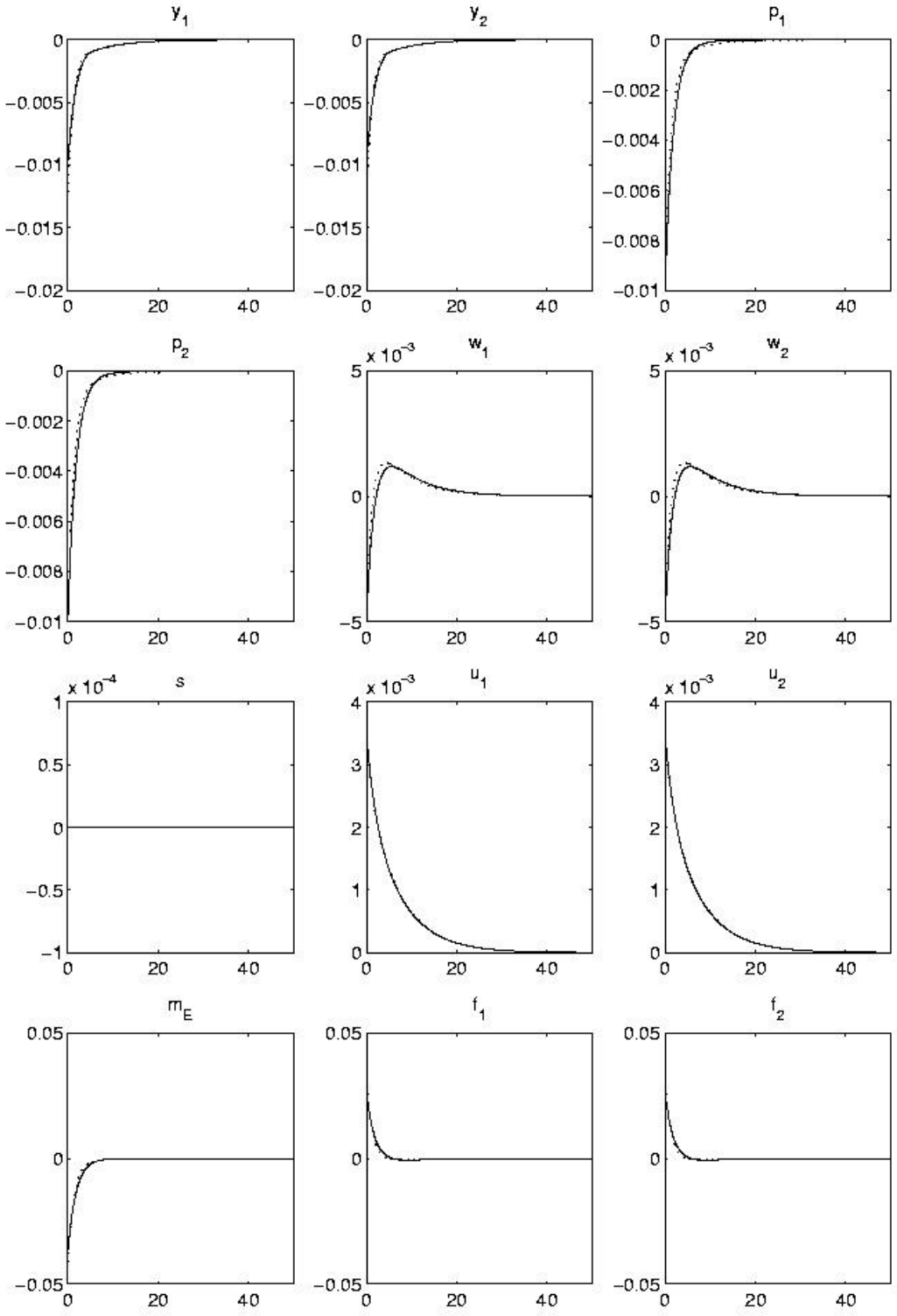
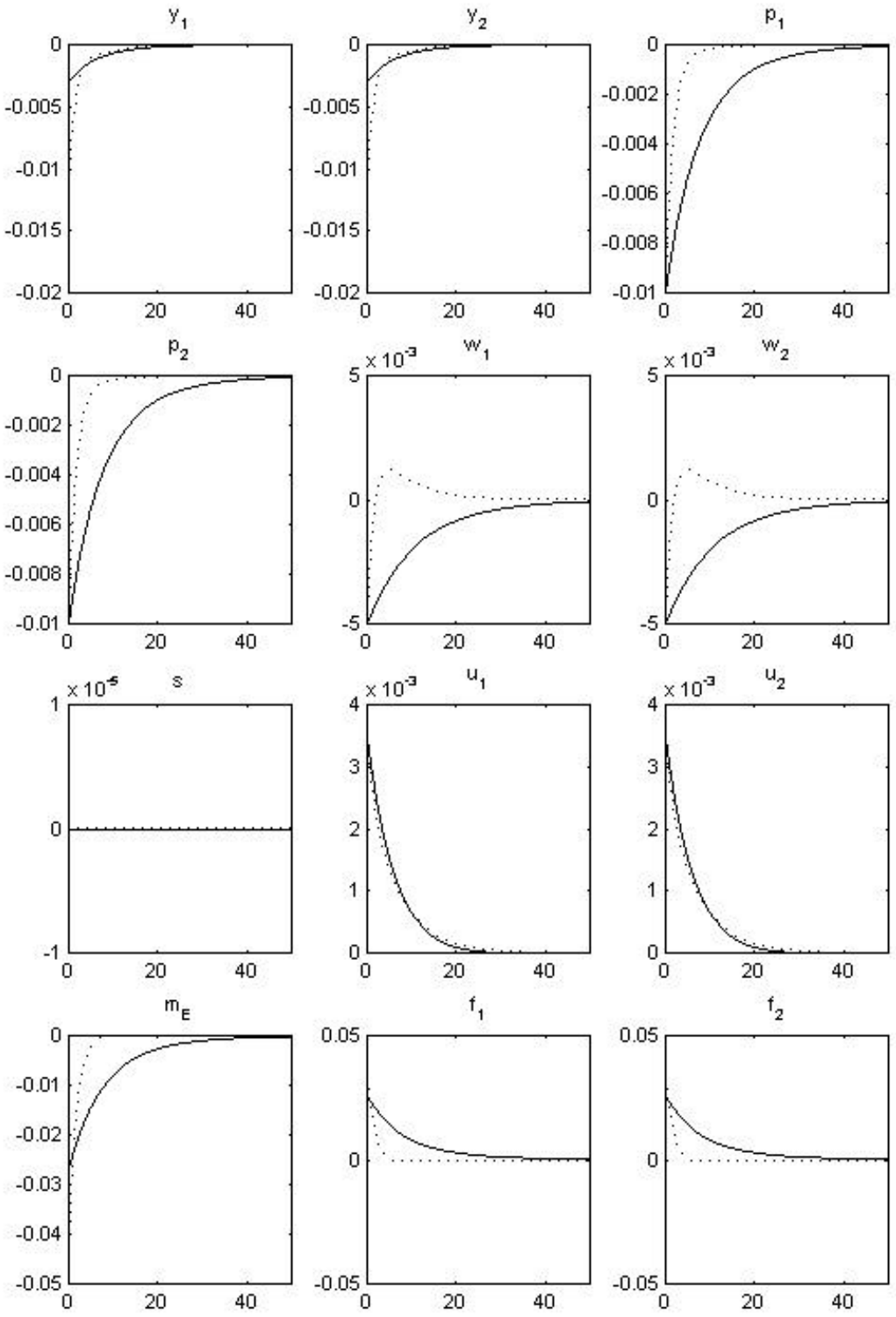


Figure 4 – *More Fiscal and Less Monetary Flexibility*



____ Feedback Nash ------ Nash Bargaining