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Global Implications of Monetary and Fiscal Policy Rules in the EMU

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Abstract

In order to analyze successful strategies for economic policy in a global environment both international interdependencies and the strategic behavior of "global players" must be considered. We use a global model of the world economy (the MSG2 Model) to show the effects of dynamic policy optimization in the presence of various supply and demand shocks to different world regions. We show that fixed rules are generally superior for supply shocks, while demand shocks call for more active or discretionary policies.

It is critical to most economic policy-makers to learn about policies whose domestic effects they consider "optimal." On the other hand, those policy-makers might also be concerned about the global implications of national or international policy measures, in particular those effects that are felt at home. Especially since the start of Stage Three of the European Economic and Monetary Union (EMU) on January 1st, 1999, a large body of literature has dealt with the arguments in favor of and against this institutional change and its possible consequences for European economies (Kenen, 1995; Gros and Thygesen, 1998; Begg et al., 1998; Allsopp and Vines, 1998; De Grauwe, 2000; Eijffinger and de Haan, 2000). Some articles also address the question as to what the loss of monetary sovereignty implies for the design of stabilization policies in Europe.

Both supply side and demand side shocks of different magnitudes are evaluated in Neck, Haber, and McKibbin (1999) and Haber, Neck, and McKibbin (2001). The results suggest that optimal macroeconomic policies should follow fixed rules for supply side shocks, but should be conducted in a more active (discretionary) way for demand side shocks to the economy. Moreover, these studies show that cooperation between fiscal policy-makers and the European

Central Bank (ECB) in the EMU is superior to scenarios resembling the European Monetary System I (EMS I) and noncooperative EMU scenarios. With respect to different alternatives for European monetary policy design and given the ultimate target of price stability as set in the Maastricht Treaty, it is not easy to recommend an intermediate target for the ECB, as this again depends crucially on the nature of the shock. In contrast to some literature on monetary policy design, we do not find evidence that nominal income targeting is preferable to other strategies. If an "all purpose" strategy has to be selected, the results may be cautiously interpreted as supporting cooperative inflation rate targeting.

The results summarized previously were obtained for static strategies implemented by policy-makers outside Europe, i.e. without the reactions of or interactions with other policy-makers in the world economy. Of course, the policy actions of the ECB and the national fiscal policy-makers inside the EMU are likely to have significant effects on other world regions as well. In order to take these considerations into account, the analysis presented here extends the previous literature on European economic policy by assessing the welfare implications of several alternative ECB objective functions, both of a cooperative and noncooperative nature. It also considers passive and active policy reactions in the United States and Japan, with the main focus resting on the welfare effects for Europe and the United States.

Section 1 presents some theoretical issues concerning the design of macroeconomic policy. The McKibbin-Sachs Global (MSG2) Model used in the calculations is briefly described in Section 2. Section 3 explains the simulation and optimization experiments conducted and discusses how they were implemented. In Section 4, a systematic overview of the results is given. Section 5 summarizes and concludes.

1. Policy rule design

Both from a theoretical point of view and for practical applications, one of the most challenging questions in economics is how to design macroeconomic policies and policy rules. In the context of stabilization policies for Europe and the world economy, this question may be divided into three more elementary issues: (1) Are rules better than discretion? (2) Does it make sense for policy-makers to cooperate, or is there something like an "invisible hand" in international economic relations with strategic noncooperative policy-makers? (3) Which policy rule should a country choose? This last question, in turn, can be considered from different points of view: from a European perspective, a U.S. perspective, or a global perspective.

In a Keynesian framework, optimal discretionary policies are never worse and usually considerably better than the best fixed rule (e.g. a constant growth rate of the money supply). In addition, cooperative policy outcomes are always at least as good as noncooperative ones. In contrast, these results do not necessarily hold in a neoclassical framework with forward-looking or rational expectations because of the non-causal structure of the dynamic system.[1] Here, the problem of time-inconsistency can arise, with its attendant strong incentives for decision-makers to deviate from optimal (discretionary) time paths. Under special assumptions, international policy coordination may lead to higher welfare losses when rational policy-makers find it easier to engage in an inflationary monetary expansion (Rogoff, 1985). This result can be interpreted as policy-makers coalescing strategically against private economic agents.[2] Thus, economic theory does not imply a priori preference for either rules or discretion, especially if time-consistent policies are required.

It follows that cooperative strategies need not be Pareto-superior to noncooperative strategies in a global context. As in Rogoff (1985), our previous simulation exercises for Europe (Neck et al., 1999; Haber et al., 2001) have shown that cooperation might even be counterproductive relative to noncooperation. But the debate has not yet been settled. For instance, Allsopp et al. (1999) stress the importance of fiscal policy coordination in the case of fiscal consolidation to reduce output losses. On the other hand, De Grauwe (1999) is rather critical of this recommendation, stressing instead the importance of monetary policy applied in conjunction with fiscal policies.[3]

As far as the third question of the "correct" design of policies and policy rules is concerned, it makes sense to distinguish between different kinds of strategies: fixed rules, which determine the values of the policy instrument variables a priori without taking into account current values of target variables; flexible or contingent rules, which determine the values of the policy instrument variables as feedback to current values of target variables according to an a priori feedback relation; and completely discretionary policies, which determine the values of the policy instrument variables at each point in time without any a priori commitment. The theoretical literature is mostly concerned with the first two types of policy rules or rule-based strategies, referring to flexible rules as a sophisticated form of discretionary policies.

For monetary policies, the literature has proposed a variety of rule-based strategies: a money supply target, a price level target, an inflation rate target, a nominal income target, or an exchange rate target. The first two have been discussed more than the others in the literature (Svensson, 1999, 2000; von Hagen, 1999; Mishkin, 1999). There is no consensus whether it is more desirable to track money supply than a price variable; the latter, in turn, can be either the actual level or its rate of change. Bean (1998), for example, argues in favor of inflation targets, but allows the central bank to respond to adverse supply shocks.[4] Inflation targeting mostly outperforms price level targeting in terms of welfare effects; Bernanke et al. (1999), among others, recommend it as a strategy for the ECB.

Clarida, Gali, and Gertler (1998) stress the advantages of targeting inflation over the exchange rate. For Europe, this is compatible with our findings, although the United States may prefer that the ECB target the exchange rate in response to a world shock. On the other hand, Hall and Mankiw (1994) argue that nominal income targeting is a reasonably good rule for the conduct of monetary policy, which is in line with the main recommendations derived from the well-known Taylor rule or the Henderson-McKibbin rule (Taylor, 1993; Henderson and McKibbin, 1993). Bryant, Hooper, and Mann (1993) provide evidence in favor of nominal income targeting but their results do not necessarily hold in the presence of supply side shocks. In the simulations performed here and in Haber et al. (2001), nominal income targeting by the ECB turns out to be problematic due to inherent instabilities in the objective and instrument time paths (especially in the presence of strategic reactions of other global decision-makers). Therefore, the income target is not included in this paper.

2. The McKibbin-Sachs Global Model

In this paper, we use the McKibbin-Sachs Global Model (MSG2 Model), a dynamic, intertemporal, general-equilibrium model of a multi-region world economy. The model assumes that economic agents maximize intertemporal objective functions and exhibits a mixture of classical and Keynesian properties. Partly rational expectations, in combination with various rigidities, allow for deviations from fully optimizing behavior. In particular, nominal wages are assumed to adjust slowly in the major industrial economies (except for Japan). In spite of that, the model solves for a full intertemporal equilibrium in which agents have rational expectations of key variables. As a model with theoretically constrained long-run properties, it can display how the short-run adjustment of the world economy to exogenous shocks depends upon the long-run adjustment. This is especially useful when transitory shocks are simulated.

McKibbin and Sachs (1991) describe the original version of the model in full detail; additional information is available on the Internet Web site (http://www.msgpl.com.au/). Here, we emphasize those elements of the model that make it particularly well suited for analyzing global economic policy design. The long-run solution of the world economy is driven by a neoclassical growth model, with exogenous technical progress and population growth. Keynesian rigidities in the goods and labor markets in the short run and optimal decisions, conditional on expected future paths of the world economy, drive the short run of the model. Thus, the model captures long-run effects of shocks and short-run dynamics towards these long-run outcomes based on historical experience, with expectations formation providing a link between the long-run outcome and the short-run adjustment.

The MSG2 Model is a fully specified dynamic general-equilibrium model and incorporates both the demand and the supply sides of the major industrial economies. The model pays attention to stock-flow relations and imposes intertemporal budget constraints. The underlying growth of Harrod-neutral productivity plus growth in the labor force is assumed to be 2.5 percent for each region. Asset prices are determined by intertemporal arbitrage conditions and rational expectations. The long-run solution is characterized by stock equilibrium: asset prices stabilize in real terms, once the desired ratios of asset stocks to GDP are reached. In the short run, the model behaves similarly to the Mundell-Fleming model under flexible exchange rates and high capital mobility; however, there is forward-looking behavior in asset and goods markets. The assumptions of rational expectations in financial markets and of partially forward-looking behavior in real spending decisions allow for feedback effects from anticipated policy changes. As for the supply side of the model, factor input decisions are based in part on intertemporal profit maximization by firms. Labor and intermediate inputs are obtained from short-run profit maximization, given a stock of capital that is fixed in each period and adjusted according to a Tobin's q-model of investment, where Tobin's q evolves according to a rational-expectations forecast of future after-tax profitability.

The version of the MSG2 Model used in this paper, called MSGR44A, consists of models of the following countries and regions: the United States, Japan, Germany, the United Kingdom, France, Italy, Austria, the rest of the former European Monetary System (REMS), the rest of the OECD (ROECD), Central and Eastern European economies (CEE), non-oil developing countries, oil-exporting countries, and the former Soviet Union. For the last three regions, only foreign trade and external financial aspects are modeled, whereas the industrial countries and regions are fully modeled with an internal macroeconomic structure. Although the basic theoretical structure for all industrial regions is the same, institutional differences are taken into account, especially when modeling labor markets.

The MSG2 Model is fitted to empirical data by a mix of calibration techniques for computable general equilibrium (CGE) models and econometric time-series estimates. Behavioral parameters taken from econometric studies and data for macro aggregates were combined with steady-state relations in the model to generate other data. The reference year, 1997, represents a point on the stable adjustment path towards the steady state of the model; hence not all steady-state relations are assumed to hold for that year. The model is solved in linearized form, with the linearization taking place at a point in time.

For the simulations and optimizations described in this paper, several modifications of the original MSG2 Model were implemented. Apart from changes in global exchange rate mechanisms due to the introduction of the EMU, the European System of Central Banks (ESCB) is the most important update to the structure of the model. In this respect, we follow the approach described in Haber et al. (2001): money supply in all EMU member countries is not available as an instrument any more; instead, monetary policy is conducted by the ECB, which acts independently of national fiscal policy-makers. Therefore, we have a single monetary authority in Europe (the ECB) and several national fiscal policy-makers within the EMU. This is in line with the current institutional setup in Europe.

3. Simulation layout

3.1. Design of the optimization runs and scenario sets

The paper compares the effects of different strategies adopted by the ECB within different global frameworks regarding policy reactions and forms of co-operation (or lack thereof) in Europe. To accomplish this, a single measure of the economic outcomes of different simulation (or optimization) runs is required. For this purpose, we calculate economic welfare losses caused by various transitory shocks. For computational ease, an additively separable quadratic welfare loss function has been chosen. The welfare losses in each period are equal to the sums of the weighted quadratic differences between the actual values and the optimal values for each of the target variables. The welfare losses in each period are then discounted to their present values (using the rate of time preference of the policy-makers, which is assumed to be 10 percent) and summed up over the time horizon (100 years in the simulations, from 2001 to 2100) to obtain the total welfare loss.

We consider Germany, France, Italy, Austria, the REMS, the United States, and Japan as countries pursuing “active” policies according to an explicit welfare loss function. The arguments of the welfare loss are the rate of inflation, real GDP, the current account and the budget deficit, all equally weighted. These four variables are generally regarded as the most important macroeconomic goals (apart from employment, which is closely linked to real GDP and cannot easily be influenced by demand-side policies in the MSG2 Model), especially in Europe. The rate of inflation and the budget deficit are included as part of the Maastricht convergence criteria. As a reference, the baseline values (simulated values without any shocks) of the target variables are considered as their desired values. This makes sense because the reference (baseline) simulation represents a stable path towards a long-run equilibrium of the model. Note that the welfare losses in the baseline scenario are zero by definition.

The values of the welfare loss function should be interpreted ordinally rather than cardinally. There is no way to compare the absolute values of the objective function under different shocks: it would be like adding apples and oranges. It is legitimate, however—and this is one of the main tasks of this paper—to compare the welfare effects of different ECB strategies under alternative assumptions about European and global policy reactions and coordination to a given set of shocks. By identifying the preference ordering of the various strategies, we obtain a ranking of performances across different shocks.

In addition to the countries’ loss functions, we define another one for Europe.[5] The values of the European loss function are the weighted averages of the respective country-specific values. Although it can be shown that the results of the simulations and optimizations do not strongly depend on the choice of the weights, we have chosen weights in accordance with relative values of GDP at market prices for the countries involved. The weight for the REMS region

Table 1. Weights for European aggregates in the objective function.

Country/Region	GDP 1998 at market prices [millions ECU]	Weight
EMU (EU-11)	5,863,995	
Germany	1,921,764	0.3277
Austria	188,435	0.0322
France	1,297,401	0.2212
Italy	1,058,697	0.1805
REMS	1,397,680	0.2384

of the models is calculated as the residual of the EMU aggregate GDP after subtracting the values of GDP for the other four countries (Germany, Austria, France, Italy) that are modeled individually. The exact weights are shown in Table 1.

For the simulation runs, we make different assumptions with respect to the policy framework. A country is assumed to pursue an "active" or optimizing economic policy when it has a loss function and all the arguments in the loss function *are* active. The policy instruments are a fiscal instrument (real government consumption) for all "active" countries and also money supply for "active" non-EMU countries (U.S. and Japan). European monetary policy is determined independently by the ECB according to the implied intermediate target. Thus, the United States and Japan have two instruments to minimize their loss functions with their four objectives, while EMU countries have only one instrument for their four objective variables. This also implies that monetary and fiscal policy in the United States is always cooperative (the same is true for Japan), whereas this may not be the case in Europe; this introduces policy asymmetry in the world economy.

We consider three sets of scenarios (see Table 2). The first, denoted ncE, envisions different ECB strategies without any policy reactions from the rest of the world. The United States and Japan do not implement active economic policies; Germany, France, Italy, Austria, and the REMS, on the other hand, pursue

Table 2. Overview of the policy scenarios.

	Policy-makers Cooperation	EMU countries and ECB (E) Noncooperative (nc)	EMU countries and ECB (E) Cooperative (c)	EMU countries, ECB, U.S., Japan (G) Noncooperative (nc)
	No Policy (NOP)	NOP-ncE	NOP-cE	NOP-ncG
ECB Policy	Money Supply (MON)	MON-ncE	MON-cE	MON-ncG
	Inflation (INF)	INF-ncE	INF-cE	INF-ncG
	Exchange Rate (EXR)	EXR-ncE	EXR-cE	EXR-ncG
	Price Level (PRL)	PRL-ncE	PRL-cE	PRL-ncG

noncooperative fiscal policies, optimizing their respective objective functions individually. In this scenario, there is no cooperation between the ECB and the other policy-makers. Thus, the ECB acts as an independent player in the European game.

Five strategies for the ECB are considered here. The first is the "no (active) policy" (NOP) scenario in which the monetary instrument is set at its baseline values; also, by assumption, there is no active European fiscal policy either. When the ECB targets money supply (MON), money supply is again set to remain on the baseline path, but fiscal policies are determined in an "active" way. Thus, the NOP scenario and the MON scenario are characterized by the same ECB strategy (monetary targeting) and differ only with respect to fiscal policy strategies. The money supply "target" can be reached in any case in the MSG2 Model, thus we have a strict assignment of the monetary instrument to the monetary target for all NOP and MON scenarios (this is also true for the cooperative set). Inflation targeting (INF), exchange rate targeting (EXR, a unilateral peg to the USD), and price level targeting (PRL), on the other hand, are implemented by modeling the ECB as a player in the respective dynamic game with an assigned objective function containing just one argument; thus, the ECB is always able to reach this target exactly in the noncooperative cases.

In the second set of scenarios, denoted cE, there is policy coordination between all fiscal policy-makers in Europe and the ECB, but no policy reaction from the rest of the world. In this case, the ECB (for the "positive" analysis of the game) gets a cooperative weight in the overall European objective function that is equal to the sum of the cooperative weights of all European (EMU) countries, which implies a strong Central Bank. Note that scenario NOP-ncE is equal to scenario NOP-cE, and that in scenario MON-cE the ECB targets the money supply while full cooperation takes place among all European fiscal policy-makers.

In the last set of scenarios, denoted ncG, both the ECB and the monetary authorities of the rest of the world minimize their loss functions, but do not cooperate with one another. Fiscal policy-makers in Europe are assumed to follow noncooperative strategies. For the United States and Japan, we assume that their fiscal and monetary policy-makers behave as if they were one single decision-maker for each country (perfect cooperation at the national level) but do not cooperate with fiscal or monetary policy-makers of the other countries. Of the three scenarios, this is probably the most realistic one and best suited for an overall assessment of welfare effects in Europe and the rest of the world.

In the noncooperative scenarios, the players minimize their respective loss functions subject to the dynamic model and given the optimizing behavior of the other players. This leads to a Nash-Cournot equilibrium of the dynamic game. In the cooperative scenarios, a joint loss function—a weighted sum of the individual objective functions—is minimized: it can be interpreted as the result of an agreement among the policy-makers of the five countries.[6]

Time inconsistency arises when a policy-maker reoptimizes along a given time horizon, yielding equilibria that differ from the (open-loop) equilibrium obtained at the beginning of the planning horizon. To avoid time inconsistency, closed-loop policy feedback rules were computed for all optimizations. Note that the NOP scenarios might only be carried out if strong self-commitment is enforced. The MSG2 Model is solved with the DYNGAME algorithm which computes time-consistent, closed-loop policy rules. Time-consistent, and thus credible, optimal policies may be inferior to unconstrained, but time-inconsistent, optimal policies.

Due to the large number of scenarios involving different objective functions and several players, comparing aggregated welfare losses and interpreting the resulting ranking in a normative sense is rather problematic. Here, we follow a "two-layer" approach. In calculating the results of the dynamic games ("positive" analysis), the loss functions are used exactly as stated above. For the normative analysis of the welfare effects, however, we use a single objective function for each of the countries or regions under consideration, which contains the four targets as mentioned before, equal weights, a 10 percent discount rate, and GDP weights for the European aggregation. This assumes a "true" normative objective (welfare loss) function which can be used as a benchmark regardless of the behavioral assumptions in the different policy scenarios. This procedure is necessary because while the ECB is a player in the dynamic game, it would not make much sense to attach some welfare loss contributions to ECB activities (e.g. deviations of the exchange rate from the desired value or other intermediate targets). By so doing we make sure that only politically relevant variables are aggregated in determining the value of the overall welfare loss.

3.2. Shocks

Various shocks were imposed on the model but lack of space precludes a detailed discussion of all results. Therefore, we confine ourselves to a temporary negative supply (total factor productivity) shock and a temporary negative demand (autonomous consumption) shock. See Table 3 for a systematic overview.

The productivity shock can be interpreted as a temporary inward shift of the production possibility frontier, caused, for example, by a destructive event like a war or the World Trade Center tragedy of September 11th, 2001, or by an environmental catastrophe resulting in a reduction of the supply of intermediate goods required for producing industrial goods. For the simulations considered here, total factor productivity is assumed to fall by 2 percent the first year (2001, in our simulation), 1.5 percent in the second year (2002), 1 percent in the third

Table 3. Overview of the shock scenarios.

	Scope of shock	Europe	U.S.	World
Type of Shock	Supply (Productivity)	SE	SU	SX
	Demand (Consumption)	CE	CU	CX

year (2003), and 0.5 percent in the fourth year (2004) relative to the baseline solution of the model.

A negative demand shock, on the other hand, reduces aggregate demand. We simulate this shock through a temporary and exogenous decrease in real private consumption, sparked off, for example, by pessimistic expectations about future consumption or changed preferences. More precisely, autonomous real private consumption is assumed to fall by 6 percent in the first year (2001), 4.5 percent in the second, 3 percent in the third, and 1.5 percent in the fourth year relative to the baseline solution of the model.

For both types of shocks, we consider a European shock (affecting the five EMU countries/regions in the model), a U.S. shock (affecting only the United States), and a world shock affecting all fully modeled regions of the world. The first two permit an assessment of how the system reacts to asymmetric shocks, and the third to a symmetric global shock.

4. Results

4.1. General effects of the shocks

As expected, a negative supply shock brings about a stagflation outcome, that is a declining real GDP and a rising price level. Policy-makers are trapped in the horns of a dilemma: expansionary policy measures would further raise inflation, while restrictive ones would further reduce real output. A negative demand shock lowers output or output growth and the price level or the inflation rate in the baseline case where policy is not active. Policy-makers can counteract the effects of the shocks with different degrees of success. For this paper, we conducted 84 optimization runs and report their welfare effects rather than the exact values of the instrument and target paths.[7]

4.2. Welfare effects of optimal European economic policies

We start with the set of noncooperative European policies; the values of the European and U.S. welfare loss functions for the different ECB strategies and shocks are given in Table 4. In parentheses we rank the different ECB strategies, where 1 means best and 5 worst in terms of welfare outcomes. Comparisons should be restricted to a given column, and we concentrate on the regional impact of different ECB strategies.

Here are the salient findings. The no policy scenario (NOP) always produces the best results for Europe in the presence of a supply shock, regardless of whether it is asymmetric or symmetric. On the other hand, there is no clear winning strategy in the presence of demand shocks: if the shock originates in the United States, NOP is best for Europe; but if the shock originates in Europe, the monetary targeting (MON) strategy is best; and if the shock is global, the exchange rate strategy (EXR) is best. But MON is the worst strategy for Europe

Table 4. Welfare results European noncooperative scenario (ncE).

		Supply			Demand		
		Europe (SE)	U.S. (SU)	World (SX)	Europe (CE)	U.S. (CU)	World (CX)
	Europe						
	No Policy (NOP)	⇑ 4.23 (1)	⇑ 0.40 (1)	⇑ 5.40 (1)	7.62 (4)	⇑ 0.11 (1)	9.73 (4)
ECB	Money (MON)	6.84 (3)	0.60 (4)	9.36 (3)	⇑ 5.41 (1)	0.15 (3)	⇓ 9.80 (5)
	Inflation (INF)	8.28 (4)	0.41 (2)	10.71 (4)	5.61 (2)	0.14 (2)	7.14 (2)
	Ex. Rate (EXR)	6.57 (2)	⇓ 3.01 (5)	7.60 (2)	⇓ 14.96 (5)	⇓ 1.38 (5)	⇑ 3.54 (1)
	Price Level (PRL)	⇓ 8.73 (5)	0.47 (3)	⇓ 11.49 (5)	6.03 (3)	0.15 (3)	7.57 (3)
	U.S.						
	No Policy (NOP)	0.03 (2)	34.83 (2)	5.14 (3)	⇓ 0.57 (5)	1.05 (4)	11.27 (3)
ECB	Money (MON)	0.04 (3)	⇑ 34.42 (1)	⇑ 4.59 (1)	0.24 (2)	⇓ 1.07 (5)	10.32 (2)
	Inflation (INF)	0.13 (4)	35.22 (3)	6.00 (4)	0.44 (4)	1.03 (2)	11.94 (4)
	Ex. Rate (EXR)	⇑ 0.01 (1)	⇓ 36.94 (5)	4.76 (2)	⇑ 0.00 (1)	⇑ 0.96 (1)	⇑ 10.25 (1)
	Price Level (PRL)	⇓ 0.16 (5)	35.37 (4)	⇓ 6.19 (5)	0.40 (3)	1.03 (2)	⇓ 12.04 (5)

when the shock is symmetric, and EXR is the worst strategy when the shocks are asymmetric. Inflation targeting (INF) consistently yields second-best results for both asymmetric and symmetric demand shocks and dominates price level targeting (PRL) for Europe. It follows that INF may be an acceptable overall ECB strategy for demand side disturbances.

The economic mechanisms behind these results can be sketched as follows. In the no policy scenario (NOP), European GDP and (less) the price level are below baseline values for two years which account for most of the welfare loss. This tends to raise exports, lower imports and hence create a surplus in the current account (all relative to the baseline). Falling demand lowers interest rates and, with no policy reaction, the Euro depreciates strongly against the U.S. dollar. In the medium run (after two years), lower interest rates compensate for reduced demand by raising real wealth in the EMU economies. If the ECB pursues the monetary targeting strategy (or, for that matter, the similar inflation or price level targeting strategies) but fiscal policies react actively, government consumption is raised in EMU (again relative to baseline values), dampening the fall of GDP and of the exchange rate. Although these scenarios result in higher budget deficits, they are preferable under the assumed welfare loss function because of the higher real GDP path during the first two years.

The fixed exchange rate scenario (EXR) implies quite a different policy mix: strong increases of government consumption and mild decreases of the money supply in the EMU (all during the first years and relative to baseline values). This avoids the depreciation of the Euro resulting from all other strategies, but at a high price (under the assumed loss function): GDP falls less during the first years but remains below baseline values for a longer period of time, and the budget deficit in the European countries contributes strongly to the welfare loss. Wealth effects are weaker than in the other scenarios, preventing a quick return of the EMU economies to their baseline paths.

The United States does best when the ECB targets exchange rates in the presence of demand shocks, apparently reducing the negative transmission and spillover effects from Europe to the United States. INF, the robust strategy for Europe against demand shocks, does not work well for the United States. This can be explained as follows. In the NOP scenario, a negative demand shock in Europe causes an appreciation of the dollar against the Euro. This reduces exports and deteriorates the current account. Although this effect is reversed after some years, and the effect of slightly lower interest rates prevents U.S. GDP from falling below baseline values, the short-run negative effect on the current account renders this scenario undesirable under the assumed U.S. welfare loss function. This is also true for the MON and INF strategies of the ECB. If, on the other hand, the ECB, by a combination of highly expansionary fiscal policies and restrictive monetary policies, shifts the aggregate demand curve back to its baseline position, the U.S. economy will be virtually insulated from the shock, keeping its welfare loss very low. Of course, this result depends on the assumption of an exogenous demand shock acting upon a global economy moving along an equilibrium path in the baseline solution of the model.

For supply shocks, the worst strategies are the same for Europe and for the United States: PRL when the shock originates in Europe or is global, and EXR when the shock originates in the United States. In general, asymmetric European shocks carry low transmission power to the United States; generally this is also true for the transmission of asymmetric U.S. shocks to Europe. In either case, European policy-makers react in a mild way. U.S. welfare losses tend to be similar across different ECB strategies, suggesting small transmission power of ECB actions to the United States. The main transmission channels for shocks (either exogenous or policy ones) run through the exchange rates in the MSG2 Model, and the cross-country multipliers are considerably lower than the domestic ones.

The small subset of results described here gives some initial hints on cautious conclusions at this stage: if we observe supply side shocks, simple and credible fixed policy rules (NOP) prove to be best for Europe, while this does not hold for demand side shocks, especially if they affect Europe directly. In the presence of the latter, the active policy rule of inflation rate targeting (INF) by the ECB might be a more useful strategy for European monetary policy. Thus, at a general level we may conjecture that active policies are superior in the face of demand side shocks, while fixed rules might be better in the face of supply side shocks. Monetary and fiscal policies affect primarily demand-side objective variables, hence their effectiveness with respect to demand shocks. In the presence of a supply shock, expansionary demand-side policies worsen the inflationary impacts of the shock, while restrictive demand-side policies worsen the negative impacts on real GDP (and employment). Therefore, Keynesian policy recommendations, while working reasonably well under demand shocks, do not cope well with supply shocks.

Unfortunately, real shocks very often contain both demand and supply components. From the discussion above, we cannot make a clear recommendation on an all-purpose strategy that is insensitive to the exact type of shock. In particular, the distribution of the "burden" of the shock between Europe and the United States differs considerably across the policy scenarios. It is worth noting that exchange rate targeting is an ambivalent strategy for Europe, but preferable for the United States most of the time. This implies, however, that the ECB would not be well advised to introduce an exchange rate target, except in the face of global shocks.

We now turn to the results of the European cooperation scenario (Table 5). For supply shocks, NOP is the best European strategy when the shock originates in Europe or is global, while INF is the best strategy if the shock originates in the United States. Also, welfare losses tend to be lower than the corresponding losses in the noncooperative scenario; this is particularly so for the inflation targeting strategy. For demand shocks, the price level strategy is unambiguously the best European strategy, closely followed by inflation targeting.

ECB inflation targeting does not work well for the United States; exchange rate targeting produces better results in most cases, the most notable exception being an asymmetric U.S. supply shock. Again, the differences for the United States are rather small for all simulations in this set. EXR, however, shows unstable optimal time paths, leading to quantitatively high policy reactions of both

Table 5. Welfare results European cooperative scenario (cE).

		Supply			Demand		
		Europe (SE)	U.S. (SU)	World (SX)	Europe (CE)	U.S. (CU)	World (CX)
	Europe						
	No Policy (NOP)	⇑ 4.23 (1)	0.40 (3)	⇑ 5.40 (1)	7.62 (4)	0.11 (3)	9.73 (4)
ECB	Money (MON)	⇓ 6.81 (5)	0.59 (4)	⇓ 9.27 (5)	5.70 (3)	0.17 (4)	⇓ 11.94 (5)
	Inflation (INF)	6.27 (2)	⇑ 0.37 (1)	8.03 (3)	4.52 (2)	⇑ 0.10 (1)	2.88 (2)
	Ex. Rate (EXR)	6.57 (4)	⇓ 3.06 (5)	7.56 (2)	⇓ 14.88 (5)	⇓ 1.40 (5)	3.25 (3)
	Price Level (PRL)	6.45 (3)	⇑ 0.37 (1)	8.27 (4)	⇑ 4.37 (1)	⇑ 0.10 (1)	⇑ 2.79 (1)
	U.S.						
	No Policy (NOP)	⇓ 0.03 (5)	34.83 (2)	5.14 (3)	⇓ 0.57 (5)	1.05 (4)	⇓ 11.27 (5)
ECB	Money (MON)	0.02 (2)	⇑ 34.53 (1)	⇑ 4.61 (1)	0.18 (2)	⇓ 1.06 (5)	⇑ 9.87 (1)
	Inflation (INF)	0.02 (2)	35.08 (4)	⇓ 5.18 (5)	0.40 (4)	1.04 (2)	10.66 (4)
	Ex. Rate (EXR)	⇑ 0.01 (1)	⇓ 36.96 (5)	4.75 (2)	⇑ 0.00 (1)	⇑ 0.96 (1)	10.18 (2)
	Price Level (PRL)	0.02 (2)	35.07 (3)	5.16 (4)	0.38 (3)	1.04 (2)	10.60 (3)

the ECB and European fiscal policy-makers; these reactions, in turn, produce high welfare losses in Europe.[8]

The most significant insight from Table 5 is that fully cooperative inflation rate targeting by the ECB seems to be a robust choice. Nevertheless, this strategy creates (small) negative spillovers to the United States.

4.3. Welfare effects with active global economic policies

We have assumed, so far, that policy-makers outside Europe do not react to shocks and to the European policy reactions. Now, we relax this assumption and let the United States and Japan also conduct optimizing fiscal and monetary policies. Policy-makers minimize their loss functions without any attempt to cooperate at the global level; the results of this exercise are shown in Table 6, again from the viewpoint of Europe and the United States.

For Europe, NOP remains the best choice in the presence of supply shocks and of a demand shock originating in the United States. With a modal and a median ranking of 1, one would be tempted to regard this strategy as superior. But taking into account the values of the welfare loss and the importance of European and world demand shocks, both inflation targeting and monetary targeting appear robust, with MON having a slight advantage over INF. Again, exchange rate targeting performs very poorly for Europe.

On the other hand, unilateral European exchange rate pegging is a very desirable strategy from the U.S. perspective, although monetary targeting now also

Table 6. Welfare results global noncooperative scenario (ncG).

		Supply			Demand		
		Europe (SE)	U.S. (SU)	World (SX)	Europe (CE)	U.S. (CU)	World (CX)
	Europe						
	No Policy (NOP)	⇑ 4.24 (1)	⇑ 0.06 (1)	⇑ 5.50 (1)	7.52 (4)	⇑ 0.07 (1)	9.18 (4)
ECB	Money (MON)	6.79 (3)	0.07 (3)	9.25 (2)	⇑ 5.32 (1)	0.09 (2)	8.56 (3)
	Inflation (INF)	8.43 (4)	0.07 (3)	11.24 (3)	5.51 (2)	0.09 (2)	⇑ 6.49 (1)
	Ex. Rate (EXR)	6.60 (2)	⇓ 30.65 (5)	⇓ 13.07 (5)	⇓ 14.56 (5)	⇓ 1.98 (5)	⇓ 11.19 (5)
	Price Level (PRL)	⇓ 8.91 (5)	⇑ 0.06 (1)	11.93 (4)	5.95 (3)	0.10 (4)	⇑ 6.49 (1)
	U.S.						
	No Policy (NOP)	0.02 (2)	27.28 (2)	4.33 (3)	⇓ 0.48 (5)	0.55 (4)	3.55 (2)
ECB	Money (MON)	0.02 (2)	⇑ 27.16 (1)	4.02 (2)	0.21 (2)	⇓ 0.57 (5)	3.90 (3)
	Inflation (INF)	0.11 (4)	27.43 (3)	5.17 (4)	0.40 (4)	0.52 (2)	4.08 (4)
	Ex. Rate (EXR)	⇑ 0.00 (1)	⇓ 27.65 (5)	⇑ 3.77 (1)	⇑ 0.01 (1)	⇑ 0.38 (1)	⇑ 2.68 (1)
	Price Level (PRL)	⇓ 0.13 (5)	27.44 (4)	⇓ 5.31 (5)	0.38 (3)	0.52 (2)	⇓ 4.31 (5)

becomes an acceptable alternative. An active U.S. policy, furthermore, reduces welfare losses considerably with respect to the results of Tables 4 and 5. Desirable and robust strategies are second-best solutions; in fact, there is no single strategy that is best for Europe and the United States across all shocks.

5. Conclusion

In this paper, three main questions were raised: rules vs. discretion, cooperation vs. noncooperation, and the selection of the policy rule. The main results can be summarized as follows. Depending on the nature of the shocks, fixed rules seem to be superior to contingent rules in the face of supply side shocks, while demand side shocks call for more active or discretionary policies. These intuitive findings represent the dividing line between monetarists and supply-siders, on the one hand, and advocates of demand side policies, on the other. But even if we take our findings as conclusive evidence (which is not the case), there remains the problem of how to implement this simple policy prescription. It is quite unrealistic to assume that institutions can switch from one policy regime to another in response to different shocks. This is the reason why in the paper we have emphasized robust strategies across different shocks as opposed to best strategies conditional on a shock. Unfortunately, we did not find an overall robust strategy for the ECB. In a global context with active global players, ECB monetary targeting or ECB inflation targeting work well for Europe for a wide range of shocks. ECB exchange rate targeting, on the other hand, works well for the United States but not for Europe. Moreover, European scenarios show that cooperation dominates noncooperation in a large number of cases in terms of welfare effects.

The single most important policy implication of this paper relates to the robustness of the ECB inflation and monetary targeting, the two pillars of the current ECB strategy. While further refinements may come from future research, at the moment the ECB appears to be on track.

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Notes

1. In particular, neoclassical macroeconomic models with rational expectations imply that expected future paths of policy variables have influence on present actions of economic agents (households and firms). This, in turn, affects the design of economic policies.

2. More generally, according to a public choice view, policy cooperation can imply more effective implementation of selfish politicians' objectives against those of the countries' citizens (see Vaubel and Willett 1991). Another reason why cooperation may be inferior to noncooperation emerges when policy-makers have different views of the economic system, i.e. the underlying model (Frankel and Rockett 1988).
3. Further contributions on policy coordination within the EMU can be found in Hughes Hallett and Mooslechner (1999) and Allsopp and Vines (1998), among others. They contain a wide variety of conclusions with respect to the desirability of policy cooperation for Europe.
4. The inclusion of an output variable for supply side shocks in Bean (1998) is in contrast to the results described in the present paper, as we find that supply side shocks can be treated better by totally fixed rules ("no policy").
5. It should be emphasized that this "European welfare loss function" is mainly regarded as a normative concept. For a normative analysis such as the comparison of outcomes of different scenarios, no welfare loss function is assigned to the ECB (the only "truly European" policy-maker in our model). When the ECB (in the "positive" analysis of a noncooperative or a cooperative policy game) is assumed to follow a rule derived from the minimization of a loss function (usually with one argument only), this loss does not enter the welfare calculations used for the ranking of alternative policy scenarios.
6. This corresponds to the collusive solution in game theory, because all players have equal weights in the joint objective function. Variations of these weights were tried, but gave qualitatively similar results. The same is true for variations of the weights of the arguments in the countries' loss functions.
7. More detailed results about the time paths of instrument and target paths are available from the authors upon request.
8. In this case, some of the key economic variables do not return quickly to their baseline values after the end of the transitory shocks. We interpret this as an argument against ECB exchange rate targeting (EXR) due to inherent possibilities of instability.

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