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Monetary and Fiscal Policy-Makers in the European Economic and Monetary Union: Allies or Adversaries?

REINHARD NECK and GOTTFRIED HABER
Department of Economics, University of Klagenfurt, Universitätsstrasse 65-67, A-9020 Klagenfurt, Austria
E-mail: reinhard.neck@uni-klu.ac.at

WARWICK J. MCKIBBIN*
Australian National University, Australia and The Brookings Institution, Washington, DC, USA

Abstract. Optimal monetary and fiscal policies within the European Economic and Monetary Union (EMU) are determined by simulating a global model under alternative assumptions about the objective function of the European Central Bank (ECB) and about cooperation vs. non-cooperation between monetary and fiscal policy-makers and among the latter. The results show the high effectiveness of fixed rules in the presence of supply-side shocks and the usefulness of cooperative discretionary measures against demand-side shocks. More generally, cooperation among fiscal policy-makers in the EMU is nearly always superior to non-cooperative equilibrium solutions, yielding a strong case for the coordination of fiscal policies.

Key words: European Economic and Monetary Union, monetary policy, fiscal policy, European integration, dynamic game, cooperative solution, non-cooperative equilibrium solution

JEL codes: E5, E6, C5, C7

I. Introduction

It is a major concern of most economic policy-makers to better understand the nature of 'optimal' policies in the face of a range of possible shocks (both domestic and global) and considering a number of alternative assumptions about the interaction with other policy-makers. In particular, the questions of how monetary and fiscal policy-makers should interact and whether their actions should be coordinated have received a lot of attention in the theoretical and empirical open-economy macroeconomics literature (for surveys, see Hamada and Kawai, 1997; McKibbin,

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1997). Dynamic game theory has been a major analytical tool for shedding light on these problems.

The question of whether the coordination of fiscal and monetary policies is advantageous is especially relevant in the institutional setting of the European Economic and Monetary Union (EMU), which has been in effect since January 1, 1999, between eleven (since 2001: twelve) member countries of the European Union (EU). The national currencies have been replaced by the euro, which is now the only legal tender within the EMU. A large body of literature is already available on the arguments in favor of and against this institutional change and on its possible consequences for European economies (e.g., Kenen, 1995; De Grauwe, 1997; Gros and Thygesen, 1998; Begg et al., 1998; Allsopp and Vines, 1998; Breuss, 2000). Some articles also address the question as to what the loss of monetary sovereignty implies for the design of stabilization policies in Europe.

In Neck et al. (1999), both supply side and demand side shocks of different magnitudes were evaluated, and the results suggested that optimal economic policy should consist of fixed rules for supply-side shocks, but should be conducted in a more active (discretionary) way for demand-side shocks to the economy. Moreover, it was shown that cooperative policy-making within the EMU yielded better solutions than scenarios resembling the European Monetary System I (EMS I) and also dominated non-cooperative EMU scenarios. Thus, after having identified these indications in favor of the EMU and given the historical fact of the existence of the EMU, the next step was to investigate alternative monetary and fiscal policy designs within the EMU, which is the subject of this paper.

Section II presents some theoretical issues concerning the design of macroeconomic policy. The model which is used in this analysis, the McKibbin-Sachs Global Model (MSG2 Model), is briefly described in Section III. Section IV explains the simulation and optimization experiments which were conducted and discusses how they were implemented. In Section V, selected results from these alternative scenarios are presented and the results are compared in terms of their implications for normative evaluations of different forms of policy design and interaction. Some concluding remarks are given in Section VI.

II. On the Design of Policy Rules

One of the most challenging questions in the theory of economic policy is how to design macroeconomic policies and policy rules. This question may be divided into three more elementary issues: Are rules better than discretion? Does it make sense for policy-makers to cooperate, or is there something like the 'invisible hand' in international economics with strategic policy-makers? If rules are superior to discretion under specific circumstances, which rule should be chosen?

If we neglect the possibility of completely arbitrary discretionary behavior by policy-makers, which obviously cannot give good results under a normative point of view, policy-makers can choose between contingent or flexible rules (sometimes

also identified with discretionary behavior) and fixed rules. The former determine the values of the policy instrument variables as feedback (reaction) to current values of target (and possibly other) variables according to an a priori determined feedback relation. By contrast, fixed rules determine the values of instrument variables a priori without taking current values of target or other variables into account. Friedman's famous constant money growth rate rule or an annually balanced budget rule are prominent examples of fixed rules.

The choice between flexible rules (as models of discretionary policy-making) and fixed rules becomes obvious if the underlying model is of the Keynesian type and policy-makers are assumed to determine the values of the instrument variables by optimizing an intertemporal objective function in a benevolent way. In such a framework, optimal discretionary policies or flexible rules (obtained by optimum control methods) are never worse and are usually considerably better than the best fixed rule. Moreover, under these conditions, cooperative policy outcomes are always at least as good as non-cooperative policy results.

If, however, the underlying macroeconomic model is of the New Classical Macroeconomics type, things become less clear, due to the non-causal structure of the dynamic system (forward-looking or rational expectations). The optimum control solution may then no longer be time-consistent, which implies that there are strong incentives for policy-makers to depart from the optimal (discretionary) time path, which is time-inconsistent. Time-consistent flexible policy rules, on the other hand, may be dominated by fixed rules. Moreover, under specific assumptions, international policy coordination can lead to higher welfare losses when rational policy-makers find it easier under policy coordination to engage in an inflationary monetary expansion. This may be interpreted as a coalition of strategically acting policy-makers against private economic agents (Rogoff, 1985). Hence, we have to conclude that there is no a priori preference for fixed rules versus flexible rules (or discretion) to be derived from theory, especially if we confine ourselves to time-consistent solutions of the model used.

These considerations are important for the question as to whether cooperation between fiscal and monetary policy-makers in the EMU is advantageous or not. Here this question is of particular interest, because in the EMU one single monetary policy-maker, the European Central Bank (ECB), is confronted with several (now twelve) more or less independent fiscal policy-makers (the governments of the EMU member countries). Given the results of Rogoff (1985), cooperation between governments and the ECB and in particular between governments only (excluding the ECB from their agreement) can be counterproductive compared to the non-cooperative case. Given the complexity of the interactions between policy-makers in the EMU, no general answer is to be expected from a theoretical analysis alone.

There is also much dissent in the policy literature about these questions. For example, Allsopp et al. (1999) stress the importance of fiscal policy coordination in the case of fiscal consolidation to reduce output losses (which is a reasonable scenario for the EMU at present). However, De Grauwe (1999) is rather critical of this

recommendation, stressing instead the importance of monetary policy applied in conjunction with fiscal policies. More recent contributions on policy coordination within the EMU can be found in Hughes Hallett et al. (2001).

Similar ambiguities relate to the third question about the 'correct' design of policies and policy rules. As a starting point, a simple alternative to more complex policy rules would be not to react to shocks to the economy at all. This 'no active policy' strategy can be interpreted as the prototype of a tightly fixed and strict rule. It will be credible only if there are extremely strong legal obligations or other commitments for the ECB or the fiscal policy-makers which cannot be altered. Other types of strategies proposed in the literature are monetary targeting (a money supply target, which is close to a fixed rule), inflation targeting (an inflation rate target, sometimes a price level target), a nominal income target, or an exchange rate target.

Some comparisons between different monetary policy rules have been made in the literature. For example, Bernanke et al. (1999) find empirical evidence for the superiority of inflation targeting and recommend this goal as a strategy for the ECB. Clarida et al. (1998) stress the advantages of inflation targeting as opposed to fixing exchange rates. On the other hand, Hall and Mankiw (1994) argue that nominal income targeting is a reasonably good rule for the conduct of monetary policy, in line with the main recommendations derived from the well-known Taylor rule or the Henderson-McKibbin rule. Bryant et al. (1993) obtain similar results in favor of nominal income targeting using simulation techniques, but report that these results do not necessarily hold for supply-side shocks.

As can be seen from these remarks on the large body of literature on this topic, there is still no consensus on what policy design to choose in general, and on what the ECB and the fiscal policy-makers of the EMU member countries should choose in particular. Given the theoretical ambiguities, we examine some of these issues by means of simulation analysis with a multi-country model, concentrating on the question of possible advantages of coordination between monetary policy (the ECB) and fiscal policy (the governments) in the EMU.

III. The McKibbin-Sachs Global Model

The McKibbin-Sachs Global Model (MSG2 Model) is a dynamic, intertemporal, general-equilibrium model of a multi-region world economy. The model exhibits a mixture of classical and Keynesian properties: expectations are assumed to be formed in a rational way, but various rigidities are taken into account by allowing for deviations from fully optimizing behavior. In particular, nominal wages are assumed to adjust slowly in the major industrial economies (except for Japan); due to this wage stickiness, extended periods of unemployment can be present in these economies. Nevertheless, the model solves for a full intertemporal equilibrium in which agents have rational expectations of future 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.

The theoretical structure of the model and a listing of its equations are given in McKibbin and Sachs (1991) and additional documentation can be found on the Internet at http://www.msgpl.com.au/; only some theoretical features are summarized here. The long run of the world economy is driven by a neoclassical growth model, with exogenous technical progress and population growth. In the short run, on the other hand, the dynamics of the global economy towards this growth path is determined both by Keynesian rigidities in the goods and labor markets and by optimal decisions, conditional on expected future paths of the world economy.

The MSG2 Model is a fully specified dynamic general-equilibrium model incorporating both the demand and the supply sides of the major industrial economies. Intertemporal budget constraints and forward-looking expectations require that all outstanding stocks of assets must be ultimately serviced. The underlying growth of Harrod-neutral productivity plus growth in the labor force is assumed to be 2.5 percent for each region. Given the long-run properties of the model, the world economy settles down to the 2.5 percent steady-state growth path after any set of initial disturbances.

Asset markets are efficient as asset prices are determined by intertemporal arbitrage conditions and rational expectations. The long-run behavior of the model depends on stock equilibrium rather than flow equilibrium. Asset prices stabilize in real terms, once the desired ratios of asset stocks to GDP are reached. The short run of the model behaves in a similar way to the basic Mundell-Fleming model under flexible exchange rates and high capital mobility; however, the future paths of the world economy are important in the short run because of the forward-looking behavior in asset and goods markets.

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 determined to maximize short-run profits, given a stock of capital that is fixed within 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 wage-price dynamics, on the other hand, is specified on the basis of empirical evidence concerning differences in the wage-price processes in the United States and Europe on the one hand and Japan on the other, resulting in different degrees of wage and price stickiness in these regions.

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 European Monetary Union (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.

The MSG2 Model is fitted to macroeconomic data by a mix of calibration techniques for computable general-equilibrium models and econometric time-series estimates. Behavioral parameters taken from econometric studies and data (for 1992) for macro aggregates were combined with steady-state relations in the model to generate other data. The year 1992, for which actual data were replicated, is regarded as representing a point on the stable adjustment path towards the steady state. The model is solved in linearized form, with the linearization taking place at a point in time (1992, in our case) instead of along some reference path.

For the simulations and optimizations described in this paper, several modifications of the original MSG2 Model became necessary. Because only scenarios within the framework of the EMU are analyzed, the United Kingdom was eliminated from the previous European Monetary System I (EMS I) group of countries, allowing for a considerable amount of exchange rate floating between the British Pound and the Euro.

As the main focus lies on optimal policies within the EMU, the implementation of the European System of Central Banks (ESCB) is the most important update of the model structure. As there is no joint monetary aggregate for the Euro zone in the MSG2 Model, the EMU has been modeled by implementing exact exchange rate pegging for all EMU member countries to the German mark which is considered the anchor currency of the EMU (which is equivalent to assuming a fixed DM-euro exchange rate). Note that this assumption does not involve any loss of generality and that any other currency might have been chosen as well without altering the simulation and optimization results. No EMU country is able to influence its domestic money supply; this instrument is controlled by the ECB as a proxy for the whole ESCB. Thus, monetary policy is conducted by the ECB, acting independently of the instruments and goals of national fiscal policies.

IV. Simulation Layout

In this section, the simulation layout is described in detail. In the simulation experiments, some exogenous shocks are imposed under different assumptions regarding economic policy arrangements in Europe. The aim is to analyze the reactions of the European economies to these shocks. Here, we describe the assumptions made about the baseline solution of the model, the objective function used to evaluate different outcomes, assumptions and solution concepts used in the analysis, the European policy scenarios analyzed, and the shocks acting upon the model economies.

1. BASELINE SOLUTION

First, a baseline solution of the dynamic model has to be calculated. This baseline solution can be seen as a stable adjustment path towards the long-run growth path of the model. Therefore, there are good reasons for interpreting this baseline solution

as an optimal path for the economy. When calculating this baseline solution, the exogenous variables (including the instrument variables) are kept at constant values or constant growth rates. This projection serves as a benchmark for the economic performance of each policy-maker and for the world economy as a whole. The next step is to simulate different shocks to the exogenous variables and to analyze the time paths of selected key variables.

2. OBJECTIVE FUNCTION

To compare the welfare effects of different policy actions for one or several countries, a single measure of economic performance is needed for each of these countries. For this purpose, an intertemporal objective function (a loss function to be minimized) was specified. For computational ease, we chose an additively separable quadratic loss function. The losses in each period are assumed to be equal to the sums of the weighted quadratic differences between the actual values and the optimal values for each of the target variables. These losses in each period are discounted to their present values (using the rate of time preference of the government, which is assumed to be 10 percent) and summed up over the time horizon (100 years in the simulations) to obtain the total loss (the value of the objective function).

For the countries for which an objective function is specified (Germany, France, Italy, Austria, and the REMS), the target variables in the following simulations are inflation, real GDP, the current account (as a share of GDP) and the budget deficit (as a share of GDP). For the present purpose, all four target weights are set equal to 0.25 in the base simulations. As mentioned above, the baseline values of the target variables are considered as their optimal values. Note that this implies that the losses in the baseline scenario are normalized to zero.

3. BASIC ASSUMPTIONS AND SOLUTION CONCEPTS

For the scenarios without active macroeconomic policy, it is assumed that the instrument variables of the policy-makers in all countries are set at the same values as in the baseline solution ('no-policy' simulations). In this case, calculating the values of the objective function is straightforward: First, the dynamic model is solved subject to the exogenous shock; then the values of the objective functions are calculated.

In the simulations with dynamic optimization, the fiscal policy-makers of the member countries of the EMU, namely Germany, France, Italy, Austria and REMS (which is considered as a single country block), are considered as players in a dynamic game. The players set the values of their own instrument variables in each period. In the 'non-cooperative' cases, they do so by minimizing their individual objective 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' cases, a joint objective function, which is a weighted sum of the individual objective functions, is minimized subject to the dynamic model. This is equivalent to assuming a European dictator or arbitrator who minimizes the overall losses of the players involved; it can be interpreted as the result of an agreement between the policy-makers of the five countries. It corresponds to the collusive solution in game theory, because all players have equal weights in the joint objective function.

In order to study interactions between fiscal and monetary policy-makers in Europe, the ECB is modeled as a separate player in the dynamic game. In some simulations, the ECB is assumed to follow a strategy directed at a single target such as European inflation (inflation targeting). In other simulations, the money supply target is fixed as an exogenous variable (monetary targeting), or the exchange rate of the euro to the US Dollar is fixed by inverting some model equations (exchange rate targeting). Note that for the last two targets, the ECB is always able to reach its objectives exactly, as the monetary policy reaction is 'hard-coded' in the model equations. Finally, the ECB is regarded as a player with an objective function similar to the fiscal policy-makers in some simulations, with European (EMU-wide) aggregates as arguments.

For determining cooperative solutions to scenarios modeled as dynamic games with an explicit objective function of the ECB, the ECB receives the same weight in the joint objective function as the five other players (the governments of Germany, France, Italy, Austria and REMS) together. In these cooperative solutions, not only the national fiscal policy-makers cooperate, but the ECB also has an objective function containing EMU-wide target variables and ECB and fiscal policy-makers minimize their joint objective function. On the other hand, in the non-cooperative scenarios there is neither cooperation among the national fiscal policy-makers nor between the ECB and the fiscal policy-makers of the member countries. Cooperative scenarios with the ECB following a single-target strategy can be regarded as intermediate cases of partial cooperation (between fiscal policy-makers of different countries, but not between fiscal and monetary policy-makers), because in these scenarios the fiscal policy-makers cooperate among themselves, and the ECB follows (and, due to the assignment of just one target to its instrument, fully implements) its strategy directed towards one (instrument or intermediate target) variable. Breuss and Weber (2001) have shown that results of partial cooperation may differ considerably from those of full cooperation in the EMU, hence this distinction is important.

All European objective variables are calculated as 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 selection of the weights, we have chosen weights in accordance with the relative values of GDP at market prices. The weight for the REMS region in the model is calculated as the remainder of the EMU aggregate GDP after subtracting the values of GDP for the other four countries that are modeled individually.

The MSG2 Model assumes rational expectations for private-sector agents; hence, some complications due to the possibility of time-inconsistent solutions could arise for the resulting dynamic games. However, the solution algorithm DYNGAME, which is used to solve the MSG2 Model, calculates strongly time-consistent, closed-loop policy rules; hence its solutions do not suffer from the time-inconsistency problem. This has to be kept in mind when interpreting the results of the dynamic simulations involving strategic policy optimization: when optimization by one or more players is assumed, time-consistent (credible) optimal policies are calculated, which may be inferior to unconstrained (but time-inconsistent) optimal policies.

In order to explore the effects of alternative monetary regimes and fiscal policy arrangements, it is necessary to model the monetary and fiscal policy interactions in Europe explicitly. Because of the focus of this paper on European policies, the other countries contained in the MSG2 Model are not regarded as strategic players. In particular, it is assumed that the USA, Japan, ROECD, the UK (which is assumed to remain outside the EMS and EMU), and CEE keep the values of their instrument variables (money supply and government expenditures) at their baseline values in all simulations. This means that they do not react to either the exogenous shocks or the policy response of European countries to these shocks. It is not pretended that this assumption is a realistic forecast of what might be done by the policy-makers of these countries; instead, it is assumed in the present context in order to isolate the effects of alternative European policies on macroeconomic variables. For a related analysis taking strategic reactions of U.S. and Japanese policy-makers into account, see Haber et al. (2002).

4. POLICY SCENARIOS

For all exogenous shocks investigated, fifteen scenarios were simulated. With respect to fiscal policies, we distinguish three groups of scenarios or fiscal-policy strategies: 'no-policy' (NOP), non-cooperative (NC) and cooperative (C). In the NOP scenarios, the fiscal policy-makers of the five countries (more precisely: four countries and one region) keep the values of their instrument variable (real government consumption) at baseline values, i.e., they do not react to the shocks at all (possibly because of a commitment to the fixed rule of an annually balanced budget, which might have been implemented in a very strong version of a 'Stability Pact'). In NC scenarios, fiscal policy-makers play (closed-loop, feedback or Markov-perfect) Nash equilibrium strategies among themselves (and, in the case of an ECB with its own objective function, against the ECB). C scenarios are characterized by cooperation among fiscal policy-makers and, in the cases where the ECB has its own objective function, between fiscal policy-makers and the ECB.

For the ECB as the European monetary policy-maker, we explore five groups of scenarios or monetary-policy strategies: monetary targeting (MON), inflation targeting (INF), exchange rate targeting (EXR), and optimization of two different objective functions (ETF1 and ETF2). In scenarios MON, INF and EXR, the ECB

keeps one intermediate target variable (money supply, European inflation and the euro-dollar exchange rate, respectively) at its baseline values. Under ETF1 and ETF2, the ECB is assumed to minimize an objective function with the EMU-wide rate of inflation, real GDP, current account and budget deficit as arguments; for ETF1, the four variables are given the same weight (0.25, as for the objective functions of the fiscal policy-makers), while for ETF2, the rate of inflation is given the weight of 0.7 and the other variables 0.1 each.

Combining the three fiscal policy and the five monetary policy strategies gives a total of 15 scenarios for each shock. Some of these scenarios can be briefly interpreted as follows. The combination of monetary targeting by the ECB and NOP by the fiscal policy-makers determines a 'no-policy' solution, where the values of all instruments (European money supply and national public consumption in the EMU member countries) are kept at baseline values. This corresponds to completely fixed rules, which may have to be completely credible to private economic agents and the other policy-makers in order to be implemented.

In the other MON scenarios, a fixed monetary rule for the ECB (constant growth of the European money supply by 2.5 percent per year) is combined with active (optimal discretionary) fiscal policy (public consumption) by the EMU member countries. This ECB strategy can be regarded as similar to the monetary policy conducted by the German Bundesbank in the past (and by some other European central banks, such as the Swiss central bank) with a strong emphasis on constant and moderate growth of money supply. According to official statements of the ECB, this strategy may be considered as part of its 'two-pillar strategy'.

In the INF scenarios, the ECB minimizes fluctuations in the European inflation rate. Here we use GDP shares of the individual member countries as weights for calculating the overall inflation rate within the Euro zone. This is nearly equivalent to fixing the inflation rate deviations from the baseline run of the model to zero, even in the cooperative simulations. The regional (national) inflation rates do not show much divergence among the EMU member countries in the simulations. This inflation-targeting policy paradigm is well known from central banks of Sweden and the United Kingdom, and it is also part of the announced 'two-pillar strategy' of the ECB. It is also natural to regard inflation as the main target variable of the ECB, because this is laid down in the Maastricht Treaty and the statute of the ESCB.

The objective function under the ETF2 scenarios comes close to the inflation targeting strategy, but here the ECB is assumed to also take other European aggregates into account. It does so more strongly under the objective function assumed in ETF1 scenarios. Another possibility would be nominal income targeting, where the ECB, instead of targeting core monetary indicators, considers weighted European (EMU) nominal income as its single objective variable. Such a strategy contains both monetary and real objectives of the ECB and resembles the main elements of the Taylor rule or the Henderson-McKibbin rule. Introducing a nominal income targeting strategy of the ECB in the MSG2 Model tends to produce unstable solu-

Table I. Policy scenarios

	Fiscal policy setup		
	No policy (NOP)	Non-cooperative (NC)	Cooperative (C)
Monetary policy (ECB)			
Monetary targeting (MON)	MON/NOP	MON/NC	MON/C
Inflation targeting (INF)	INF/NOP	INF/NC	INF/C
Exchange rate targeting (EXR)	EXR/NOP	EXR/NC	EXR/C
Objective function (ETF1)	ETF1/NOP	ETF1/NC	ETF1/C
Objective function (ETF2)	ETF2/NOP	ETF2/NC	ETF2/C

tions and/or very high losses, hence this is not done here (see Haber et al., 2001, for details).

In the EXR scenarios, the ECB fixes the euro exchange rate against the US dollar by unilateral pegging. Of course, a managed floating implementation could be used for this scenario as well, but the differences are quantitatively negligible. Moreover, the problem of specifying the bandwidth of the managed float and the speed and 'smoothness' of reaction would introduce additional arbitrary elements into the simulations. The exchange rate targeting strategy has been occasionally postulated by some European politicians (e.g., the former German Minister of Finance, Lafontaine) in the light of the depreciation of the euro since the beginning of the EMU; at present, it is not a realistic option for the ECB.

An overview of the different policy scenarios simulated is given in Table I.

5. SHOCKS

Several exogenous shocks were imposed on the model. Here in particular, temporary negative productivity shocks and temporary negative consumption shocks are considered, which may be country-specific (affecting only Germany in the present case), regional (affecting the EMU countries), or global (affecting all countries modeled explicitly).

A productivity shock can be interpreted as a temporary inward shift of the production possibility frontiers of the countries affected. It may be caused, for example, by an environmental catastrophe resulting in a reduced supply of intermediate goods required for producing industrial goods, or by another exogenous reduction in total factor productivity. In particular, total factor productivity is assumed to fall by 4 percent in the first year, 3 percent in the second year, 2 percent in the third year, and 1 percent in the fourth year compared to the baseline of the model.

It is well known that supply shocks and demand shocks have different effects on output, the price level and other aggregate variables. Therefore, in addition to negative productivity shocks shifting the aggregate supply curve to the left, we also consider negative demand shocks shifting the aggregate demand curve to the left. In particular, we simulate the consequences of a temporary exogenous decrease in real private consumption, which might be due to pessimistic expectations or changed preferences, for example. In these simulations, autonomous real private consumption is assumed to fall by 6 percent in the first year, 4.5 percent in the second, 3 percent in the third, and 1.5 percent in the fourth year compared to the baseline of the model. Again, the country-specific (Germany), regional (EMU) and global variants of this shock are simulated for all 15 policy scenarios.

V. Results

1. EFFECTS OF SUPPLY (PRODUCTIVITY) AND DEMAND (CONSUMPTION) SHOCKS

The response of the German, European and global economies to a Germany-specific, European-wide or global negative temporary productivity shock, respectively, is generally characterized by the typical effects of a negative supply shock: the aggregate supply curve shifts to the left (upwards), implying lower real GDP and a higher price level in a static context or lower real GDP growth and higher inflation in a dynamic context. This pattern prevails in all scenarios considered. Moreover, international spillovers from country-specific or region-specific shocks are mostly weak. Different macroeconomic policy arrangements can lead to different outcomes in terms of output versus inflation losses and in terms of the intertemporal as well as the international distribution of the stagflationary burden.

Let us consider some results for the European supply shock. For example, in the scenario MON/NOP with 'no-policy' rules, i.e., fixed rules for monetary and fiscal policies, real GDP falls by about 2 percent in the European countries directly affected during the first two years of the shock and returns to its baseline level after five years. Inflation increases by about 2 percentage points in the first year and returns more quickly to its baseline values. Spillovers to the UK are greater than to the US and to Japan and are small in general (less than 0.5 percent of GDP and the price level). Losses (values of the objective functions as described in the previous section) are distributed approximately equally between the five European countries/regions considered; over time, they fall from the first period to near zero from period seven onward. Inflation and GDP losses contribute in approximately equal amounts to the welfare losses in all countries affected.

The MON/NC scenario (monetary targeting, non-cooperative fiscal policies) implies restrictive fiscal policies in the countries directly affected by the shock, especially in the first period, directed at reducing inflation. In later years, fiscal policies become more expansionary. Real GDP falls by 3 to 6 percent in the first year, but returns to baseline levels faster than in the MON/NOP scenario. The rise in

inflation is distinctly weaker (less than 1 percentage point) than in the MON/NOP scenario. Welfare losses are higher than in the MON/NOP scenario in all countries. The results can be interpreted to mean that under the objective function specified for the European countries, the target of price stability has priority over the output target; the price stability target calls for restrictive demand management, as do the current account and the budget deficit targets. However, in the MON/NC scenario only fiscal policies are available to combat inflation, which might be considered to be an inefficient assignment of instruments to targets. Fiscal cooperation combined with monetary targeting (MON/C scenario) looks very similar to MON/NC, but avoids some inefficient conflicts between the governments that are present in the non-cooperative case.

In the INF/NC scenario, the ECB acts in a restrictive way and brings European inflation exactly to its baseline values. Inflation rates in different EMU countries are not exactly equal to their baseline values, but very close to them. Government expenditures, on the other hand, are more expansionary than in the previous scenarios, resulting in an inefficient game of fiscal policy-makers against the ECB (and against each others). GDP behaves in a similar way to before. In the INF/C scenario, the ECB targets European inflation, and fiscal policy-makers behave in a cooperative discretionary way. Now the ECB acts in a slightly less restrictive way than in the INF/NC scenario; nevertheless, it brings European inflation close to its baseline values. Government expenditures are now lower than in the baseline solution, hence fiscal policies support the restrictive monetary policy of the ECB. The rates of inflation fluctuate a little bit more than in the non-cooperative case, especially in Germany, but always by less than 0.2 percentage points. Losses are significantly lower than in the INF/NC scenario, and considerable gains from cooperation are realized. Nevertheless, this scenario is also outperformed by a scenario with fixed rules for fiscal policies (INF/NOP).

A similar picture as for the inflation-targeting scenarios arises from the ETF1 and ETF2 scenarios, with inefficiencies in the non-cooperative cases, especially in ETF2, where expansionary fiscal policies once again counteract restrictive monetary policies. In the exchange rate targeting scenarios (EXR), both money supply and government expenditures are reduced relative to the baseline solution. Here again 'inactive' fiscal policy-makers provide the best solution in terms of overall losses, and the resulting EXR/NOP scenario is similar to the MON/NOP scenario except for avoiding the nominal appreciation of the euro present in MON/NOP.

For the negative demand shock (exogenous reduction of private consumption), effects on GDP are comparable to those of the productivity shock, while inflation is reduced by the drop in private consumption. Fiscal policies and, to some extent, monetary policies as well mostly react to this in an expansionary way, but again there is a variety of policy reaction patterns depending on the nature of the shock and on the scenario assumptions. Lack of space precludes a more detailed presentation of the results, and we confine ourselves to a description of the rankings (in

Table II. Evaluation of different policy scenarios: supply shock, Germany

		Fiscal policy setup		
		NOP	NC	C
Monetary policy (ECB)				
MON	OF	4.48	5.87	5.61
	Rank	**2/1/2**	**2/3/10**	**2/2/8**
INF	OF	5.19	18.07	6.57
	Rank	**5/1/6**	**5/3/15**	**5/2/12**
EXR	OF	3.95	5.57	4.95
	Rank	**1/1/1**	**1/3/7**	**1/2/4**
ETF1	OF	4.61	11.85	5.79
	Rank	**3/1/3**	**3/3/13**	**3/2/9**
ETF2	OF	5.09	16.85	6.38
	Rank	**4/1/5**	**4/3/14**	**4/2/11**

terms of the overall objective function) of the monetary/fiscal policy combinations considered under the various shocks, which will be discussed next.

2. RANKINGS OF DIFFERENT SCENARIOS

Tables II to VII summarize the results, in terms of the overall objective function, of all 90 simulations performed for this paper. In the first line of each (monetary policy scenario) row, the sum of the values of the objective functions (OF) for Germany, France, Italy, Austria and the REMS region is given for each scenario. These numbers may be interpreted as overall 'welfare' loss for these countries taken together. The value of the objective function of the ECB (where there is any) is not included, as no specific welfare interpretation can be given to this institution in a normative analysis. Comparisons of values of the overall objective function in general only make sense within each table (for each particular shock).

In the second line of each row, three rankings are given for each 'cell' (monetary/fiscal policy combination or scenario). For each of the six different shocks (in each of the Tables II to VII), a ranking of the 15 scenarios can be seen from the last numbers (1 is best, 15 is worst). The first numbers compare different ECB strategies for given fiscal policies and have to be read within each column (1 is best, 5 is worst). The second numbers compare fiscal policy strategies for given ECB strategies and have to be read within each row (1 is best, 3 is worst).

The following main results can be seen. Under the asymmetric supply shock to Germany (Table II), the ECB strategies can always be ranked as EXR better than MON better than ETF1 better than ETF2 better than INF. Cooperative fiscal

Table III. Evaluation of different policy scenarios: supply shock, Europe

		Fiscal policy setup		
		NOP	NC	C
Monetary policy (ECB)				
MON	OF	21.12	34.14	34.00
	Rank	**1/1/1**	**3/3/13**	**5/2/12**
INF	OF	33.64	41.35	31.36
	Rank	**5/2/11**	**5/3/15**	**3/1/7**
EXR	OF	23.32	32.83	32.86
	Rank	**2/1/2**	**2/2/8**	**4/3/9**
ETF1	OF	28.72	30.11	29.55
	Rank	**3/1/3**	**1/3/5**	**1/2/4**
ETF2	OF	32.86	38.17	30.92
	Rank	**4/2/9**	**4/3/14**	**2/1/6**

Table IV. Evaluation of different policy scenarios: supply shock, World

		Fiscal policy setup		
		NOP	NC	C
Monetary policy (ECB)				
MON	OF	27.01	46.76	46.35
	Rank	**2/1/2**	**3/3/13**	**5/2/12**
INF	OF	43.03	53.52	40.16
	Rank	**5/2/11**	**5/3/15**	**4/1/9**
EXR	OF	25.95	37.98	37.77
	Rank	**1/1/1**	**1/3/6**	**2/2/5**
ETF1	OF	36.77	38.29	37.76
	Rank	**3/1/3**	**2/3/7**	**1/2/4**
ETF2	OF	42.01	49.26	39.52
	Rank	**4/2/10**	**4/3/14**	**3/1/8**

policies are always better than non-cooperative ones, but NOP strategies ('inactive' fiscal policy) are always still better than cooperative solutions.

The European supply shock (Table III) yields ETF1 twice and MON once as the best ECB strategy, but MON also appears once as the worst ECB strategy, and INF does so twice. Under exchange rate targeting of the ECB, non-cooperative fiscal policies are marginally better than cooperative ones; otherwise (four times), C is

Table V. Evaluation of different policy scenarios: demand shock, Germany

		Fiscal policy setup		
		NOP	NC	C
Monetary policy (ECB)				
MON	OF	32.06	25.06	12.38
	Rank	**5/3/15**	**5/2/13**	**2/1/2**
INF	OF	15.46	20.78	12.28
	Rank	**3/2/9**	**2/3/10**	**1/1/1**
EXR	OF	30.72	13.79	13.04
	Rank	**4/3/14**	**1/2/6**	**4/1/4**
ETF1	OF	15.43	24.24	13.26
	Rank	**1/2/7**	**4/3/12**	**5/1/5**
ETF2	OF	15.44	21.19	12.7
	Rank	**2/2/8**	**3/3/11**	**3/1/3**

Table VI. Evaluation of different policy scenarios: demand shock, Europe

		Fiscal policy setup		
		NOP	NC	C
Monetary policy (ECB)				
MON	OF	38.21	27.07	28.50
	Rank	**4/3/12**	**2/1/8**	**4/2/11**
INF	OF	26.25	28.11	22.69
	Rank	**3/2/7**	**4/3/10**	**1/1/1**
EXR	OF	240.23	74.68	74.31
	Rank	**5/3/15**	**5/2/14**	**5/1/13**
ETF1	OF	24.75	24.59	22.89
	Rank	**1/3/5**	**1/2/4**	**3/1/3**
ETF2	OF	25.89	27.10	22.76
	Rank	**2/2/6**	**3/3/9**	**2/1/2**

better than NC. NC gives the worst fiscal policy result four times and never the best one.

For the global (symmetric) supply shock (Table IV), EXR appears twice as the best strategy for the ECB, and ETF1 does so once. INF gives the worst results twice; this is true for MON once. Under this shock, fiscal policy cooperation again dominates non-cooperation. NOP strategies appear first three times, C solutions do so twice, and NC solutions are always the worst fiscal policy option.

Table VII. Evaluation of different policy scenarios: demand shock, World

		Fiscal policy setup		
		NOP	NC	C
Monetary policy (ECB)				
MON	OF	48.68	49.03	59.97
	Rank	**5/1/13**	**5/2/14**	**5/3/15**
INF	OF	16.61	35.57	14.45
	Rank	**3/2/7**	**4/3/11**	**1/1/1**
EXR	OF	41.74	17.58	16.18
	Rank	**4/3/12**	**1/2/8**	**4/1/5**
ETF1	OF	15.86	23.48	15.19
	Rank	**1/2/4**	**2/3/9**	**3/1/3**
ETF2	OF	16.47	32.43	14.52
	Rank	**2/2/6**	**3/3/10**	**2/1/2**

If we look at all the results for the supply shocks (Tables II to IV), we can see that either EXR/NOP or MON/NOP come out in the first or second place for each of them, with ETF1/NOP always being third. INF/NC and ETF2/NC always occupy the last and second-to-last place, respectively. In other words, especially for fiscal policy design, a fixed rule seems to be the best solution and a non-cooperative discretionary policy the worst.

The results are more varied for the Germany-specific demand shock (Table V). ETF1, EXR and INF each appears as the best ECB strategy once, but ETF1 is also worst once, with MON occupying this place twice. For fiscal policies, the ranking is less ambiguous: C (cooperation) is always best, with NOP being second three times and NC twice.

The rankings are again different for the European demand shock (Table VI): ETF1 wins twice, INF once, and EXR is always in last position. Under monetary targeting, non-cooperative equilibrium fiscal policies give better results than co-operative ones, with NOP coming in last. In four cases, C gives the best results, with NC and NOP each coming out second twice.

Finally, the global demand shock (Table VII) again gives ETF1, EXR and INF the first place once each and MON always the last one. C fiscal policy is best four times, NOP is so once, and NC never, but in one case (under monetary targeting of the ECB) NC beats C. NOP is preferable to NC four times, and NC is never the best fiscal policy.

Considering all the consumption shocks (Tables V to VII), we find that INF/C is always the best policy reaction. Good results are also obtained for ETF2/C (two second places and one third) and (less so) for MON/C (one second place) and

ETF1/C (two third places). MON and EXR appear as worst monetary strategies under a shock to private consumption.

Summarizing all the results, it turns out that fiscal policy cooperation dominates non-cooperative fiscal policies in 87 out of 90 cases (the exceptions are two cases with monetary targeting by the ECB under demand shocks and one case with exchange rate targeting under a supply shock). More specific recommendations cannot be given without regard to the specific shock acting upon the economies involved. Monetary policy strategies exchange rate targeting and monetary targeting give good results under a supply shock, but bad ones under a demand shock; the reverse is true for inflation targeting. The fixed rules of 'no-policy' fiscal policy give the best results in most cases of supply shocks, the (highly activist and elaborate) cooperative fiscal policies do so in most cases of supply shocks. Noncooperative discretionary fiscal policies usually do not fare well under either type of shock.

VI. Concluding Remarks

In this paper, we investigated how fiscal and monetary policies should be designed within the context of the EMU. The main questions were whether stabilization policies should be conducted according to flexible or fixed rules and whether cooperation among fiscal policy-makers and/or the ECB will give better outcomes than a non-cooperative framework.

The fixed versus flexible rules (or rules versus discretion) question has to be answered as follows: the choice depends strongly on the type of shock the policy-maker is faced with. In the case of a supply-side shock (e.g., the productivity shock used in this paper), credible fixed rules ('no [active] policy solutions') may be a better response than active time-consistent policies. Exactly the opposite is true for a negative demand shock, where fixed rules generally produce undesirable results. This supports results obtained in previous simulations (Neck et al., 1999; Haber et al., 2001, 2002) and should be further evaluated using alternative models of the world economy. If these findings can be confirmed under more general conditions, the long-lasting controversy between advocates of demand-side and supply-side policies may be given an intuitive (though not easily testable) solution: if shocks arise from the demand side, activist interventions are preferable; if they occur on the supply side, rule-based policies might dominate even cooperative discretionary policy strategies.

On the other hand, we find strong evidence in favor of cooperation vs. non-cooperative institutional arrangements, even if we place strong emphasis on the objective variable of the ECB, and therefore assign higher priority to the common monetary target than to the individual national fiscal targets of the EMU member countries. While it is difficult to recommend a single intermediate target or a certain strategy to the ECB for all possible shocks, cooperative fiscal policies seem to be fairly robust under different shocks, although they may be dominated by fixed

rules under some circumstances (especially for supply shocks). In any case, non-cooperative discretionary fiscal policies cannot be recommended.

From the point of view of actual policy-making in the real world of the EMU, we are left with a dilemma: policy-makers would have to know the type of shocks the economies are faced with in order to design the 'best' macroeconomic policies. Clearly, this is not possible except for very special conditions. In fact, real shocks nearly always contain supply-side and demand-side elements (although to a varying degree), and even if this were not true, institutional arrangements (such as the degree of coordination between governments and the ECB) could not easily be changed within a short time period as would be required if different reactions to different shocks were to be implemented. If an advice for actual policy-making and its institutional environment is desired, a recommendation of very cautious coordination between the governments (the fiscal policy-makers, which are restricted by the Stability and Growth Pact anyway) and between the governments and a stability-oriented ECB seems to be a safe strategy, given the results of the present paper.

Further research concerning the robustness of these conclusions (including other types of models) is desirable in order to corroborate (or perhaps falsify) our findings. This will be subject to future analyses.

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