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INTERNATIONAL MACROECONOMIC POLICY COORDINATION WHEN POLICY-MAKERS DISAGREE ON THE MODEL

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Abstract

We relax the assumption of the literature on international coordination that policy-makers know the true model. Two countries will still be able to agree on a cooperative policy package that each believes will improve the objective function relative to the Nash non-cooperative solution. However, the bargaining solution may move the target variables in the wrong direction. These points are illustrated with monetary and fiscal multipliers taken from simulations of ten leading econometric models. Out of 1000 possible combinations of models that could represent U.S. beliefs, non-U.S. beliefs and the true model, monetary coordination improves U.S. welfare in only 546 cases.

JEL Classification: 431, 432

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International policy coordination is the fastest-growing research topic in the field of open-economy macroeconomics.[1] The topic owes its success to the happy marriage of the mathematical techniques of game theory and the practical problem of coordination that has in the mid-1980s become of central concern to international policy-makers. Virtually all of the previous coordination literature has made the automatic assumption that policy-makers agree on the true model of how the world macroeconomoy behaves.[2] As a consequence, it has reached a very strong conclusion: in general, countries will be better off if they coordinate policies than they would be in the Nash noncooperative equilibrium in which each government sets its policies while taking those of the others as given.[3] The empirical literature is as yet less fully developed than the theoretical literature; but it too has claimed gains from coordination that, though small, are necessarily positive.[4]

The assumption that policy-makers agree on the true model has little, if any, empirical basis. Different governments subscribe to different economic philosophies. If one wishes to think of actors as perpetually processing new information in a Bayesian manner, so that their models over time would converge on any given reality in the limit, then one must admit that the speed of convergence is sufficiently slow, or else that reality is changing sufficiently rapidly, that policy-makers have not been able to reach agreement on the true model. Nor is there much prospect of their doing so in the foreseeable future.

Professional economists are not much more able to agree on the correct macroeconomic model than are policy-makers. A concrete

illustration was offered by a recent exercise in which a group of economists working under the auspices of the Brookings Institution asked those responsible for twelve leading econometric models of the world economy to simulate the effects of some carefully-specified policy changes.[5] The predictions of the models varied widely as to both the magnitude and the sign of the effects on output, inflation, exchange rates and current account balances, among trading partners and even in the country carrying out the policy change. (See Tables 1 and 8 below.) At best, no more than one of the models can be right, and it seems unlikely that even one of them is exactly right.

Lack of knowledge as to the true model helps explain a troublesome fact. While support for the proposition that coordination would improve welfare is widespread, proponents do not generally agree on the nature of the Pareto-improving package of policy changes that is called for in any particular set of circumstances. Some call for coordinated expansion, some for coordinated discipline, some for coordinated shifts in the mix between monetary and fiscal policy, and so forth.[6] Disagreement, even within one country, as to where the economy currently sits relative to the desired values of the target variables is responsible for some of the disagreement on the desirable coordinated policy changes, but disagreement as to the correct model is also a significant factor. As William Branson (1986, p. 176) says, "With this range of disagreement on economic analysis, how are the negotiators to reach agreement? The topic is one for the National Science Foundation, not a new Bretton Woods."

One implication of the lack of agreement on the true model is, of course, that "more research needs to be done." But the implications for

any policy coordination that might take place in the meantime are considerably more interesting. This paper demonstrates two propositions that hold when policy-makers disagree on the model. First, such policy-makers will in general be able to find a package of coordinated policy changes that each believes will improve its country's welfare relative to the sub-optimal Nash noncooperative equilibrium.[7] Second, and in striking contrast to the standard result when policy-makers agree on the model, the package of coordinated policy changes often turns out to reduce welfare, as judged by some true model of reality, rather than to raise it. For example, using ten models from the Brookings simulations as models which could represent the views of the U.S. government, the views of other industrialized countries, or the true world macroeconomy, we find that out of 1000 possible combinations, monetary coordination perceptibly improves U.S. welfare in only 546 cases, and improves the welfare of the other industrialized countries in only 539 cases.

The first two sections of the paper analyze a very simple game where two countries, the United States and "Europe" (shorthand for the non-U.S. OECD), must decide how to set their money supplies so as to come as close as possible to their desired levels of two target variables: income and the current account (internal balance and external balance). Section I makes the two points theoretically, that the two central banks will in general be able to agree on a coordinated policy package that each thinks leaves its country in a better position, and that the package might in fact leave them in a worse position. Section II uses the multipliers from the ten models in the Brookings simulation to provide a dramatic illustration of the points.

In section III each government is given a second policy instrument, government expenditure, to use in addition to monetary policy, and a third target variable, inflation, to pursue in addition to income and the current account. Again we see that the governments will in general find a coordinated policy package that they expect to improve welfare, but that it often has the opposite effect in reality. The Appendix considers extensions of the framework to deal with the policy-maker's uncertainty regarding the true model, or the other player's model, or both.

Section I: The Theory of Monetary Coordination with Disagreement

Here we assume that each country is interested in two target variables: its own output, denoted y for the United States and y^* for Europe (expressed relative to their optimum values and in log form), and its current account balance, denoted x and x^* respectively (expressed as a percentage of GNP and again relative to their optima). Each government seeks to minimize a quadratic loss function.

(1) $$W = y^2 + \omega x^2$$

(2) $$W^* = y^{*2} + \omega^* x^{*2}$$

where ω and ω^* denote the relative weights placed on external balance versus internal balance.

We assume a general framework in which the targets are linearly related to the available policy instruments, which in this section are limited to the countries' money supplies, m and m^* respectively (in log form). We denote the parameters as perceived by the U.S. authorities by a "us" subscript.

(3) $y = A_{us} + C_{us}\, m + E_{us}\, m^*$

(4) $x = B_{us} + D_{us}\, m + F_{us}\, m^*$.

We denote the parameters perceived by the European government by an "e" subscript.

(5) $y^* = G_e + I_e m + K_e m^*$

(6) $x^* = H_e + J_e m + L_e\, m^*$.

Since each country has only a single instrument but two targets, it cannot unilaterally achieve its targets. We begin by considering the Nash noncooperative equilibrium. To ascertain U.S. behavior we differentiate (1) with respect to m, using (3) and (4) and holding m^* constant. It follows that the U.S. reaction function is:

(7) $m = M + N\, m^*$,

where $M = -\dfrac{A_{us}\, C_{us} + \omega\, B_{us}\, D_{us}}{C_{us}^{\,2} + \omega\, D_{us}^{\,2}}$

and $N = -\dfrac{E_{us}\, C_{us} + \omega\, F_{us}\, D_{us}}{C_{us}^{\,2} + \omega\, D_{us}^{\,2}}$.

To ascertain European behavior we differentiate (2) with respect to m^*, using (5) and (6) and holding m constant. The European reaction function is:

(8) $m^* = Q + Rm$,

where $Q = -\dfrac{G_e K_e + \omega^* H_e L_e}{K_e^{\,2} + \omega^* + L_e^{\,2}}$

and $R = -\dfrac{I_e K_e + \omega^* J_e L_e}{K_e^{\,2} + \omega^* L_e^{\,2}}$.

We solve equations (7) and (8) for the Nash equilibrium.

$$(9) \qquad m^n = \frac{M + NQ}{1 - NR}$$

$$(10) \qquad m^{*n} = \frac{Q + MR}{1 - NR}$$

Figure 1 shows the two policy-makers' reaction functions, equations (7) and (8). The optimum point as perceived by the U.S. policy-makers is a point O_{us} on its reaction function. Concentric indifference curves radiate from O_{us}. These curves are vertical wherever they intersect the reaction function, because m is chosen so that its marginal benefit given m^* is zero. Similarly the optimum point as perceived by the European policy-maker is a point P_e, and its concentric indifference curves are horizontal wherever they intersect its reaction function.

We have drawn the European reaction curve as steeper than the U.S. curve. One might expect the effects that are largest in absolute value to be the positive effects of money on domestic output: C in equations (3)-(4) for the United States and K in equations (5)-(6) for the non-U.S. OECD.[8] It follows that, unless the welfare weight ω on the current account is large, the absolute value of the slope of the U.S. reaction function is less than one when the U.S. money supply is on the vertical axis, and vice versa for the European reaction function.

The possibilities for the sign of the slope are more diverse. If monetary expansion is thought to be transmitted negatively to trading partners ($E < 0$), presumably via a depreciation of the currency and improvement in the trade balance of the expanding country as in the Mundell-Fleming model, then the slope is positive: $N > 0$. If monetary transmission is thought to be positive on the other hand ($E > 0$), then

the slope is ambiguous: when the welfare weight ω on the current account is small, the slope is negative, but when ω is large, or when the transmission multiplier E is small (relative not only to the own multiplier C, but also to the current account multipliers D and F), the slope is again positive. (We are assuming that D and F, the effects of m and m^* on the domestic current account, are of opposite signs by symmetry.)

The same analysis holds for the foreign reaction function (e.g., $I < 0 \Rightarrow R > 0$), though it must be remembered that even if any given model is symmetric, the two reaction functions could easily have opposite slopes. For example one country might believe that transmission is negative and the other that it is positive. In Figure 1 we have drawn the functions downward-sloping: a foreign expansion is transmitted positively to the domestic country and so the domestic government reacts by contracting.

The Nash equilibrium N is determined as the intersection of the two reaction functions. At N the indifference curves cannot be tangent, but must intersect, since their respective slopes are infinity and zero. It follows that the Nash equilibrium is perceived as Pareto-inefficient. Both policy-makers think they would be better off if they could agree to move to a point within the "lens" determined by the intersection of the two indifference curves.

As we have drawn the graph, each country would like to expand but is afraid to do so on its own, presumably because of adverse implications for the current account. But they can agree to expand simultaneously, moving northeastward in the graph to higher levels of perceived welfare. Such joint reflation is the kind of international coordination that has been

urged on Germany and Japan by the United States under two different Administrations: in 1977-78, in the form of the "locomotive theory," and in 1986 in the form of coordinated discount rate cuts.[9]

If an efficient mechanism of coordination exists, the countries will move, not just northeastward, but specifically to one of the points on the contract curve, where the two countries' indifference curves are tangent. There is no strong reason to choose any particular point. Nor, for that matter, is there reason to think that any Pareto-improving solution can necessarily be enforced. But we follow much of the literature in considering the Nash bargaining solution, defined as the point where the product of the two countries' perceived welfare gains, compared to the perceived welfare at the Nash noncooperative solution, is maximized:

$$(11) \quad \text{Max} \ \left(W_{us}(m, m^*) - W_{us}(m^n, m^{*n})\right)\left(W_e^*(m, m^*) - W_e(m^n, m^{*n})\right)$$

subject to equations (1)-(6).

One would differentiate with respect to m and m^* to find the bargaining solution (m^b, m^{*b}), a point such as B in Figure 2.

Once we recognize that the two policy-makers have different models of the world, we must recognize that one, or both, will be wrong. To evaluate whether the bargaining solution B is superior to the non-cooperative solution (m^n, m^{*n}) not just in perception but also in reality, we would have to know the true parameter values, the output and current account functions (3)-(6) without the subscripts:

$$(12) \quad y = A + c\,m + E\,m^*$$

$$(13) \quad x = B + D\,m + F\,m^*$$

$$(14) \qquad y^* = G + I\,m + K\,m^*$$

$$(15) \qquad x^* = H + J\,m + L\,m^* .$$

We would then plug m^b and m^{*b} into (12)-(15), and in turn plug the target variables into the loss functions (1) and (2), to see whether the bargaining solution in fact improves welfare.

In the standard case where the policy-makers agree on the correct model, coordination must necessarily improve welfare for each country, or else its government would not have agreed to go along. In our case, coordination may improve welfare. For example if the true model is very close to that believed by the U.S. authorities, then the true iso-welfare map will be very similar to the perceived indifference curves shown in Figure 1, and U.S. welfare will indeed be higher at B than N. But this need not be the case.

The true optimum policy combination to maximize U.S. welfare is given by differentiating (1) with respect to m (as in the derivation of (7) but without the subscripts), and with respect to m^*, and solving simultaneously:

$$(16) \qquad m^o = \frac{M\,(E^2 + \omega F^2) - N\,(AE + \omega BF)}{(E^2 + \omega F^2) + N\,(CE + \omega DF)}$$

$$(17) \qquad m^{*o} = -\frac{AE + \omega BF}{E^2 + WF^2} - \frac{CE + \omega DF}{E^2 + \omega F^2}\, m^o .$$

If the true optimum point O is not at O_{us} but rather is as shown in Figure 2, with the new set of true iso-welfare curves drawn, then the move from N to B could very well be in the wrong direction, resulting in a reduction in U.S. welfare. Similarly if the true optimum policy combina-

tion from the viewpoint of European interests is not at P_e but rather at P as shown in Figure 2, then coordination could reduce European welfare as well.

It is worth considering momentarily the case when the two policy-makers are seeking to maximize the identical objective function, and disagree only about the proper model. For example they might be the monetary and fiscal authority within the same country. Our two propositions would still hold: (1) the two policy-makers will in general be able to agree on a package of coordinated policy changes that each thinks will improve the (same) country's welfare relative to the Nash noncooperative solution, and (2) the package agreed to in bargaining could in fact worsen welfare as easily as improve it. This is the case considered in Frankel (1986b).[10] While in that paper coordination arises solely from different perceptions, and in the conventional literature it arises solely from different objectives, in the present paper both factors are present.

Section II: Coordination with Ten International Econometric Models

How important for coordination is the issue of conflicting models likely to be in practice? Is the case where bargaining reduces welfare as judged by the true model merely a pathological counterexample, or is it a likely occurrence? In what follows we use the international simulation results of the macro-econometric models that participated in the Brookings exercise to get an idea of what might actually happen if governments coordinate.

The models were asked to show the effects of four experiments, among others: an increase in the U.S. money supply, an increase in the non-U.S.

OECD money supply, an increase in U.S. government expenditure and an increase in non-U.S. OECD government expenditure. In each case the instructions were to hold the other policy instruments constant. Though twelve models participated, some did not report effects on current account balances, which we need along with effects on output levels. The ten that we can use here are the Federal Reserve Board's Multi-Country Model (MCM), Patrick Minford's Liverpool Model (LIVPL), the Sims-Litterman Vector Auto-Regression Model (VAR), the OECD's Interlink Model (OECD), the Project Link Model (LINK), the McKibbon-Sachs Global Model (MSG), the EEC Commissions' Compact Model (EEC), the Haas-Masson smaller approximation of the MCM model (MINIMOD), the Economic Planning Agency model (EPA), and the Wharton model (Wharton). These models are quite representative of the range of econometric models actually in use, including as they do models both large and small in size, structural and nonstructural in approach, Keynesian and neoclassical in philosophy, backward-looking and forward-looking in expectations formation, non-American and American in authorship, and public-sector and private-sector in function.

Table 1 reports the effects of monetary expansion on several macroeconomic variables according to each of the 12 models. The simulations showed effects over six years, but ours is a static framework; we use only the effect in the second year. (Two years is intended to be just long enough to get past the negative part of the "J-curve effect" of the exchange rate on the trade balance.) The models all agree that a monetary expansion raises domestic output, but they agree on little else. There is a surprising amount of disagreement, in particular, on whether a monetary expansion improves or worsens the current account and, in turn, on whether

it is transmitted negatively or positively to the rest of the world. The reasons for this and other disagreements in the simulations are examined elsewhere.[11] It suffices to repeat that disagreements with respect to both the sign and magnitude of effects are common among honorable economists, and are common even within subsets of models that are supposedly similar in orientation, let alone among policy-makers.

The first half of Table 2 reports the multipliers for output and the current account calculated in the form that we need: as a percentage of GNP per one percent change in the money supply. To save space in this and other tables below, we report numbers for only four of the models: MCM, VAR, OECD and LINK. Numbers are reported for six models, including also the LIVPL and MSG models, in the tables in the NBER Working paper version of this study. The qualitative outcome of calculations will be reported here for all ten models, including also the EEC, MINIMOD, Wharton, and EPA models.

Computing the policy-makers' reactions requires knowing not only the perceived policy multipliers, but also the target optima and the welfare weights. We adopt the same target values as Oudiz and Sachs (1984): current accounts of zero for the United States and two percent of GNP for the non-U.S. OECD, and GNP gaps of zero for both regions. The baseline values of both variables, specified as part of the Brookings simulation exercise, were below target as of 1985. Thus policy-makers will seek to increase both output and the current account. The targets, together with the baseline values for the variables and any set of policy multipliers from Table 2, imply corresponding values for the constant terms A, B, G and H in equations (3)-(6).

The choice of welfare weights ω and ω^* is necessarily more arbitrary, even, than the choice of target optima. Oudiz and Sachs chose the values that the weights would have had to have held for countries to have produced the values of output, inflation and the current account actually observed in the 1980s, assuming a Nash noncooperative equilibrium. For lack of a better alternative, we adopt the set of weights calculated by Oudiz and Sachs for the EPA model, and apply it uniformly regardless of model. It would be of questionable benefit to replicate their methodology separately with each model; our welfare comparisons require a common objective function. On the other hand, setting a common set of weights for all models has the drawback that the Nash solution may lie very far from the baseline for certain combinations of models. Often, in our simulations, such large moves to the Nash point resulted in a loss in welfare which was recovered in a similarly large move to the coordination point. In general, our methodology may bias our results towards gains from coordination because often all the models agreed on move from the remote noncooperative point. In order to test the sensitivity of our results to the chosen weights, we repeated the experiment two more times, using different weights. The alternate weights were obtained by using Oudiz and Sachs' methodology, pegging the Nash equilibrium to the baseline, for two models: the OECD and LIVPL models, respectively. The qualitative findings did not change.[12]

If the U.S. policy-maker can believe any of the ten models and the non-U.S. (henceforth "European") policy-maker can believe any of the ten models, then there are $10 \times 10 = 100$ possible combinations, each implying a different Nash noncooperative equilibrium. For each combination we

computed the values of the two countries' variables of interest in the Nash noncooperative equilibrium: the money supply, the perceived output and current account and the perceived welfare function.[13] All but one of the 16 cases we report called for expansion from the baseline by one country or the other.

Our main interest lies in the move from the noncooperative to the bargaining equilibrium, shown in Table 3. To take one example, if the U.S. policy-maker believes in the MCM model and the European policy-maker believes in the OECD model, then they can agree to expand further their money supplies simultaneously (0.37 percent and 1.59 percent, respectively). They each believe that this policy package will result in higher output with little adverse effect on their current accounts. This is the often-mentioned case in which the Nash equilibrium is too contractionary. But besides the case of simultaneous expansion (6 combinations of models in this table), every other case is possible, as well: European expansion with U.S. contraction (7 combinations), U.S. expansion with European contraction (2 combinations), and simultaneous contraction (1 combination).

Without knowing the true model, we can not determine whether any given policy package actually improves welfare. But we can get a good idea of the possibilities by trying out each of the models as a candidate for the true model. The 16 cells in Tables 4 and 5 correspond to the same 16 combinations as Table 3. But within each cell we report the effect that the corresponding coordination package of Table 3 would have under each of the 4 models; thus there are $4^3 = 64$ combinations in all.[14] Table 4 shows the actual effect of coordination on U.S. welfare and Table 5 the effect on European welfare. Whenever one or the other policy-maker turns out

to have had the right model, his country does gain from coordination. Otherwise he would not have agreed to the package. For example the joint monetary expansion that they agree on when the U.S. policy-maker believes the MCM model and the European policy-maker believes the OECD model is seen to raise U.S. welfare if the MCM model is the true one (Table 4) and to raise European welfare if the OECD model is the true one (Table 5). It also turns out to raise both countries' welfare if the LINK model is the true one. But it turns out to reduce welfare if the VAR model is the correct one (also the LIVPL and MSG models). The reader who does not believe in one of the latter three models might not be concerned with that result. But such a reader should instead be concerned with the result that when the U.S. policy-maker, for example, believes in the LIVPL model and the European policy-maker in the VAR model, coordination will reduce welfare according to each of the other models.[15]

Altogether there are $10^3 = 1000$ combinations counting those not shown in the tables. Coordination turns out to result in gains for the United States in 546 cases, as against losses in 321 cases and no perceptible effect (to four decimal places) in 133 cases. For Europe there are gains in 539 cases, as against losses in 327 cases and no effect in 134 cases. These figures in a sense overstate the odds in favor of successful coordination, in that by construction each country's welfare is improved (or at least not worsened) in 1/10 of the combinations, those in which the policy-maker has the same model as the true one. If we take only the $10 \times 9 \times 9 = 810$ combinations where neither country is correct, the proportion of losses is higher. For the United States there are gains in 419 cases, as against losses in 286 cases and no effect in 105. For Europe

there are gains in 408 cases, losses in 298 and no effect in 104.

The results thus suggest that the danger that coordination will worsen welfare rather than improve it is more than just a pathological counterexample. One cannot, under conditions where policy-makers subscribe to different models, make the blanket pronouncement that coordination as it has been defined in this paper must improve welfare.

It would be helpful to know whether the incidence of gains vs. losses from coordination can be associated with any particular pattern in the perceptions of the policy-makers. Such knowledge might allow us to devise alternative concepts of cooperation that would be more likely to improve welfare.

In our framework, losses may occur because countries make errors on the sign of the multipliers (so they adjust their instruments in the wrong direction from the true utility-improving direction). On the other hand, losses may also occur if countries are correct about the sign of the multipliers, but perceive monetary policy to be less effective than it is in reality. In this case, they may adjust their instruments in the direction of the true coordination point, but adjust the instruments too much. This may result in a loss in welfare if "overshooting" is severe. A simple remedy for the second type of loss would be to make smaller moves to reduce losses due to the incorrect magnitude effect, leaving only sign errors. In our simulations, overshooting turns out to be the cause of the losses from coordination in only 25 out of the 189 cases in which coordination results in losses for both countries. The primary reason for losses in our simulations is, then, moves in the wrong direction. Given the diversity of signs in the models we included in our simulations, this is not surpris-

ing. Based on our simulations, smaller policy moves would not much improve the case for coordination.

Another modification might be to allow the countries to agree on the model they wish to use before coordination. In our framework, even assuming such agreement is possible, there is no reason why it should necessarily improve the incidence of gains from coordination, since agreeing on the model does not necessarily improve the chances that the chosen model is correct. However, for the subset of cases where the two countries do agree on a single model, the incidence of gains does happen to be somewhat higher for our simulations. The U.S. gains in 65% of the cases, while Europe gains in 59% of the cases.

While our results indicate that coordination may frequently result in losses, we have said nothing of the magnitude of the losses or gains to cooperation. Specifically, it would be interesting to know whether there is an argument for cooperation based on the magnitude of the potential gains even in the best case when countries cooperate using the correct model. Oudiz and Sachs (1985), Hughes Hallett (1985) and others who have estimated the gains from coordination have described them as small, even when positive as they must be in the conventional framework. But how small is "small"?

In order to obtain a sense of how large or small the gain or loss to cooperation might be, we need a standard by which to judge these changes in welfare. We choose as a standard the gain to a single policy-maker, who may previously have believed an incorrect model, of discovering the true model and unilaterally adjusting his policies accordingly while staying within the Nash noncooperative equilibrium.

Table 6 shows the gains to the United States from a unilateral switch to the correct model by the United States. If the United States already has the correct model, the gains are zero. Otherwise, the gains are substantial. There is no guaranteed gain in utility to the U.S. when it switches to the correct model, as is illustrated by the occasional negative gains to the U.S. of a unilateral switch to the correct model. For example, if Europe were to believe the OECD model, the U.S. would do better if it could play the OECD model as well even if it knew that the LINK model were correct. In these cases, the U.S. could be thought to lose bargaining power to Europe if it switches to the true model. But the gains are usually positive.

The numbers in parentheses in the left-hand column of the table are the gains to cooperation assuming that all countries believe the same, correct model, to bias the case in favor of coordination. If all countries believe the VAR model, the gains are substantial. In the majority of cases, however, the gains to cooperation as shown are quite small compared to the gains to the unilateral switch to the correct model. As can be seen from Table 7, this is true of European gains when Europe makes the unilateral switch to the correct model as well.

Section III: International Coordination of Monetary and Fiscal Policy Together

In this section we give each country a second tool, government expenditure — g for the United States and g^* for Europe. We must add a third target variable for each country; otherwise each will be able to attain its optimal point regardless what the other country does. We choose the inflation rate. Now 24 multipliers are relevant from each model: the

effects of m, m^*, g and g^* on U.S. output, current account and inflation and European output, current account and inflation.

Table 8 reports the effects of fiscal expansion according to all 12 models. Table 2 reports the 24 multipliers for each of the four models. There is not as much disagreement regarding fiscal policy as monetary policy. A domestic fiscal expansion in most of the models is transmitted positively to the other country, via a domestic current account deficit. But a few models have fiscal or monetary expansion reducing the domestic price level rather than raising it.

We again assume that each country seeks to minimize a quadratic loss function. Rather than repeating our earlier points in algebraic form, we turn directly to the simulation results. As before, the weights and target optima are taken from Oudiz and Sachs (1984). The inflation target is zero for both the United States and Europe. Thus policy-makers will seek to reduce inflation, as well as to increase output and the current account.

Table 9 reports the Nash bargaining solution. For one example, when the United States subscribes to the LIVPL model and Europe to the EPA model, the resulting package of coordinated policy changes takes exactly the form urged by many economists in the 1980s: a U.S. fiscal contraction, accompanied by a fiscal expansion in the rest of the OECD and monetary expansion all around.[16] This package is considered desirable because it would depreciate the dollar and reduce the U.S. current account deficit (and European and Japanese surplus) without causing a large world recession.[17] But most other possible kinds of policy packages occur as well, as can be seen in the table.

Tables 10 and 11 show the true gains from coordination for the U.S. and Europe, respectively. Again we find that coordination necessarily improves U.S. welfare if the U.S. model turns out to be the correct one, and European welfare if the European model turns out to be the correct one, but that otherwise welfare can go down. Of the total 1000 combinations of all ten models, the United States has gains in 494 cases, losses in 398, and no perceptible effect in 108. Europe has gains in 477 cases, losses in 418, and no effect in 105. If we take only the 810 combinations where neither country is correct, bargaining results in U.S. gains in 432 cases and losses in 357, and for Europe gains in 408 cases and losses in 376. Thus the odds for successful coordination appear to be no better when policy-makers can take advantage of the monetary-fiscal mix than when the degree of monetary ease is alone at stake.

The results for the two-instrument case generally confirm those of the one-instrument case. As mentioned in Section II, however, modifications of the coordination concept may improve the case for coordination. The Appendix explores other possible definitions of coordination and the resulting gains. The Appendix allows each policy-maker to take into account explicitly the uncertainty he faces regarding the true model, or uncertainty regarding the model believed by the other country. First, there are sometimes gains simply from each country's telling the other what model it believes, as compared to a noncooperative equilibrium in which each must guess the other's model. Second, there are often gains from countries' pooling estimates as to the correct models. The Appendix reports results on these two definitions only, but more definitions should be investigated, including exchange of information over time to allow learning

of the correct model. This would be an important extension of our work. Thus, the scope for useful international cooperation remains wide, provided it is defined more broadly than in the sense explored in the first sections of this paper.

Appendix

This paper has made the simplest assumptions to examine the topic at hand. Some readers of earlier versions have suggested that, in a world in which different models abound, it is not sensible to assume that each policy-maker acts as if he knew with certainty to which model his opponent subscribes or even which model he himself considers to be correct. We now consider extensions in each of these two directions in turn.

To begin with, we retain the assumption that each policy-maker believes in his own model with certainty, but we allow for uncertainty regarding the other's model. A reason for such uncertainty regarding the other's model might be that several models might be believed by different policy-makers within the other country's government. The model which will actually be used in setting policy is the unknown outcome of a political process within the other country. The policy-maker will set his policies so as to maximize expected welfare, a weighted average of the economic consequences of each of the policy settings that the foreign government would choose under each of the possible models to which it might subscribe. The foreign government's policy settings in turn will depend, not just on its model, but also on its beliefs about what the first country's model, and therefore its actions, might be.

The U.S. central bank chooses m_j to minimize

$$\sum_{i=1}^{10} \pi_{ij}^{*} W_i(m_j, m_i^{*})$$

where π_{ij}^{*} is the U.S. estimate of the probability that Europe believes in model i given that the U.S. believes model j and m_i^{*} is the money supply Europe will pick if it believes in model i. If the U.S. central

bank believes in, for example, model 1, then the first order condition is similar to equation (7), but with the foreign money supply replaced by a weighted average of the possibilities.

$$(7') \qquad m_1 = M_1 + N_1 \sum_{i=1}^{10} \pi_{i1}^* m_i^*$$

or

$$m_1 = M_1 + N_1(\underline{\pi_1^{*'} m^*})$$

where $\underline{\pi_1^{*'}}$ is the row vector of π_{i1}^* and $\underline{m^*}$ is the column vector of m_i^* (each for $i=1,10$ assuming ten possible models).

Similarly the European central bank choses m_k^* to minimize

$$\sum_{i=1}^{10} \pi_{ik} W_i^*(m_i, m_k^*)$$

where π_{ik} is the European estimate of the probability that the United States believes in model i given that Europe believes model k,[19] and m_i is the money supply the United States will pick if it believes in model i. If the European central bank believes in, for example, model 2, then the first order condition is

$$(8') \qquad m_2^* = Q_2 + R_2(\underline{\pi_k' m})$$

where $\underline{\pi_k'}$ is the row vector of π_{ik} and $\underline{m}$ is the column vector of m_i. We have one version of equation (7') for each of the ten models in which the U.S. central bank might believe, giving

$$(7'') \qquad \underline{m} = \underline{M} + \underline{N}(\underline{\pi^* m^*})$$

and similarly for Europe,

$$(8'') \qquad \underline{m^*} = \underline{Q} + \underline{R}(\underline{\pi m})$$

where $\underline{\pi}^*$ is the (10x10) matrix of the $\underline{\pi}_j^*$,

$\underline{\pi}$ is the (10x10) matrix of the $\underline{\pi}_k$,

$\underline{M}$ and $\underline{Q}$ are the (10x1) vector forms of M_i and Q_i,

and $\underline{N}$ and $\underline{R}$ are (10x10) diagonal matrices with the N_i and R_i on the diagonal.

Substituting and solving,

$$(9') \qquad \underline{m} = [\underline{I} - \underline{N\pi^* R\pi}]^{-1} [\underline{M} + \underline{N\pi^* Q}] \ .$$

$$(10') \qquad \underline{m^*} = [\underline{I} - \underline{R\pi N\pi^*}]^{-1} [\underline{Q} + \underline{R\pi M}] \ .$$

where $\underline{I}$ is the (10x10) identity matrix.

Equations (9')-(10') represent the 10x10 computable noncooperative solutions for the 10x10 combinations of models in which the two policy-makers could believe. As a concrete example we try putting equal weight on each of our ten Brookings models: $\pi_i = \pi_i^* = 1/10$ (i=1,10). The bargaining solution remains the same as before, assuming that an enforcement mechanism is designed such that each policy-maker must reveal his model as part of the cooperative bargain. As before we calculate in each case the gain or loss in welfare entailed in the move from one equilibrium to the other, where the true effect of any given pair of money supplies is judged by each of the ten models in turn.

The simulations indicate that the noncooperative point when each country believes its own model with certainty but averages over the possible models followed by the foreign country, is quite similar to the noncooperative point under certainty, as discussed in Section II. If the own effects on income — the multipliers of the largest magnitude — play a large role in determining the position of the noncooperative point, then

one would expect little change since there is comparative agreement over these multipliers. This argument is supported by a larger discrepancy between the noncooperative points under averaging and certainty when the own effects on income are small relative to cross effects or relative to the current account multipliers.

As in the earlier sections, the interesting question, under the assumption that each player averages to estimate the other's model, is the effect of coordination. Table 12 reports how money supplies change, and with them the perceived values of the target variable and welfare, in the movement from the noncooperative point under averaging to the Nash bargaining point under certainty. Since it is assumed that one feature of cooperation is that each reveals his model to the other, one country or the other may lose bargaining power by having both their models revealed. For this reason, the "perceived gain" reported in the last two lines of each cell in Table 12 is sometimes negative, even though the perceived gain from coordination with no change in information must necessarily be positive.

The actual effect of coordination depends on the true model, as usual. Tables 13 and 14 report the change in welfare for the United States and Europe under each of the four alternative candidates for the true model. If we include all ten models, coordination under averaging improves U.S. welfare in 600 cases out of the total of 1000 combinations, against 398 losses and 2 cases with no significant change in welfare. For Europe, welfare improves in 643 cases, falls in 355 cases and has no significant change in 2 cases. The frequency of losses and gains is slightly higher than in the case where each knows the other's model with certainty, but there are fewer incidences of no significant change in welfare. This may

be because the move from noncooperative to cooperative points now involves moving from uncertainty to certainty about the other country's model. This change in information results in a slightly larger move than in the case when there was no change in information, and thereby eliminates many of the cases of no significant change in welfare.

The second extension relaxes the assumption that each policy-maker acts as if he were certain as to the correct model. We assume rather that policy-makers assign weight to the possibility that each of the ten models may be true, and choose their policies so as to maximize expected welfare.[20] To preserve some disagreement about models, we could assume that each puts primary weight on a favorite model of his own, but also puts some weight on the other models (perhaps with larger weight on the favorite model of the other player, on the theory that he must have access to some independent information). Here we consider, instead, the simple case of uniform weights. As a result, each will be playing by the same "compromise" model. As before, if heavier weight were placed on particular models, the solution would lie between the results shown here and solution under certainty.

The noncooperative solution under averaging by both policy-makers over the possible correct models lies farther from the noncooperative solution under certainty (as in Section II) than does the noncooperative solution when each policy-maker averages over the other's model (as in the first extension). In this case, all the multipliers change, not just the foreign multipliers, so a larger move would be expected.

As before, the main interest is in characterizing the move to the cooperative point, but two types of cooperation are possible. In the first

case, the cooperative point is the Nash bargaining solution given that each country follows the "compromise" model. If this type of cooperation is compared to the noncooperative averaging solution (see Tables 15 and 16) there is a true gain for Europe in more than half the cases, but a loss for the U.S. in the majority of cases: The United States gains in 200 cases, but loses in 800 cases, while Europe gains in 600 cases and loses in 400 cases. This seems to be because the cooperative solution involves an increase in European money supply, but a larger decrease in U.S. money supply. For many models, the U.S. contraction results in a loss in U.S. income, while the European expansion results in an increase in European income. This represents a welfare loss for the U.S., but not for Europe, since the noncooperative point is, in general, too contractionary. Even though the frequency of losses for the U.S. is large, the magnitude of the losses is small compared to the European gains. Since Europe gains while the U.S. loses under this type of cooperation, this introduces the possibility that cooperation under averaging might result in gains to both Europe and the U.S., if side payments are allowed between the two countries.

The second type of coordination would suppose that, under noncooperation, the two countries stubbornly believe their own favorite models, while under cooperation, the two countries agree simply to average over the possible correct models and play either noncooperatively or cooperatively. If this concept of cooperation is used, both countries gain in more cases than they lose. If the noncooperative averaging point is compared to the noncooperative point under certainty, (see Tables 17 and 18) the move results in gains for the U.S. in 568 cases and losses in 432

cases, while the move results in gains for Europe in 513 cases and losses in 487 cases. The probable reason that averaging usually raises welfare is the statistical principle that the average of ten numbers is closer to the individual numbers, on average, than the individual numbers are to each other. The principle does not apply directly, because each policy-maker's having a better estimate of the "true" parameters does not necessarily imply that the noncooperative equilibrium will be better, but it seems to work here.

A third extension would be to assume both uncertainty about the true model (as in the second extension) and uncertainty about what probabilities the other policy-maker assigns to the models (as in the first extension). Here it would be possible to assume that the policy-makers originally shared the same priors, but that they have observed different sets of data and have come to different conclusions for that reason. Let A_1 be the set of data from which U.S. economists obtained the maximum likelihood point estimates of the parameters that we have been calling model 1. Such estimates come with standard errors that imply (in terms of classical statistics) the probabilities that one could have observed Z_1 conditional on each of the other models in fact being true, or (in terms of Bayesian statistics) the probabilities that each of the models could in fact be true conditional on the known fact that A_1 has been observed. Similarly if A_2 is the set of data from which European economists obtained a maximuim likelihood estimate that we have been calling model 2, then Bayesian methods will give us (conditional on Z_2 and a set of priors, which may be the same as the U.S. set of priors) European probabilities that each of the models is true. Then each policy-maker will choose his money supply so as

to maximize expected welfare, taking into account all the different data sets that the other central bank could have drawn and the money supplies that it would consequently set, and also taking into account the different possible true models and the consequent effects on the macroeconomy. The interesting application of Bayesian principles comes in the realization that the two kinds of uncertainty are not independent. The probability that a given action by the foreign central bank will have the consequences implied by model 2 is greater if that action is the one that would be optimally chosen based on the observation of the data set A_2, i.e., that data set that would imply model 2 as the maximium likelihood estimate. In terms of the simulations, this extension would lead to a combination of the outcomes of the first two extensions. If the probabilities are chosen to be independent and equal, the solution is the same as that of the second extension. If both countries have a very strong belief in a single model which also affects their beliefs about the truth, the solution is very much like that of the first extension.

These three extensions are more elaborate models of the Nash noncooperative equilibrium, but none offers an evident reason for altering our conclusion that the bargaining solution is as likely to reduce welfare as to improve it. For those interested in making coordination work, it is natural to ask whether there might not be some other cooperative solution concept not discussed here (that is, mapping from the players' beliefs and welfare functions to their policy settings) that would turn out to improve welfare by light of the true model more often than does the Nash bargaining equilibrium in Tables 4-5 and 10-11.

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Footnotes

1. Hamada (1976) is generally credited with the birth of the topic in its modern analytic form (though under the assumption of fixed exchange rates). More recent contributions include Canzoneri and Gray (1983), Miller and Salmon (1985), Rogoff (1985) and Buiter and Marston (1985). For good introductions to the literature and further references, see Oudiz and Sachs (1984), Cooper (1985), or Fischer (1987).

2. We have become aware very recently of some new papers on coordination that do allow for policy-makers to be uncertain as to the true model: Ghosh (1986), Ghosh and Ghosh (1986), Roubini (1986) and Holtham (1986).

3. There are two important qualifications to the generality of the proposition that coordination improves welfare under the standard assumption that policy-makers know the true model. The first is that if policy-makers have enough independent instruments to reach their optimum target goals regardless of each others' actions, then coordination is moot. The second is that Rogoff (1985) and Kehoe (1986) have shown that if coordination reduces governments' ability to precommit to anti-inflationary policies credibly to their own peoples, then it can reduce welfare. The present paper is a counterexample along very different lines.

4. Oudiz and Sachs (1984), Ishii, McKibbin and Sachs (1985) and Hughes Hallett (1985).

5. The project was entitled "Empirical Macroeconomics for Interdependent Economies," and is forthcoming as Bryant, et al (1987). Frankel (1986a) discusses the disagreements among the 12 models.

6. Many of the authors in the coordination literature decline to take any position at all on whether the problem with the Nash noncooperative equilibrium is that it is too contractionary or too expansionary, etc. They leave it for econometricians to fill in the correct parameter values at some later date.

7. One's intuition is that players who disagree about the model will find it harder to agree on a package of joint policy changes. The correct way to interpret this intuition is probably that, even if there exists a bargaining solution that is believed to be Pareto-superior to the noncooperative solution, it will be harder for the players to agree on a mechanism to enforce the bargaining solution if they do not share a common view of the world. In an interesting account that he believes may carry lessons for macroeconomic coordination, Cooper (1986) describes the history of international cooperation in the sphere of public health; cooperation was first proposed early in the 19th century, but because there were conflicting schools of thought on whether diseases were carried internationally by travelers, actual cooperation did not take place until a consensus was achieved around 1900 as to the correct model of the transmission of disease. If there are positive costs to an enforcement mechanism and some parties believe the gains from coordination are small, then it will not take place.

8. This holds in the ten econometric models considered in the following section except the LIVPL and MSG models for the U.S. and LIVPL, MSG, Wharton and EPA models for Europe.

9. More often, it has been private economists, and the governments of smaller countries, who have urged such coordinated expansion; e.g., Bergsten, et al (1982). The 1981-84 Reagan Administration opposed coordination.

10. In equations (3) and (4), one could simply redefine m^* as fiscal policy, and let $y^* \equiv y$, $x^* \equiv x$, and $\omega^* \equiv \omega$. As long as the two policy-makers have different parameter estimates, there will still be scope for coordination. One difference is that in Figure 2 the true optimal points P and O would coincide.

11. The positive effect of a monetary expansion on the current account via currency depreciation is offset by a negative effect via higher income. In the Mundell-Fleming model the positive effect on the current account must dominate, to match the net capital outflow that results from lower interest rates, giving negative transmission abroad. But in more modern models the net capital flow may be reversed, in response to perceived overshooting of the exchange rate. The theoretical literature contains many other ways of reversing the Mundell-Fleming transmission results as well. (See Mussa (1979) or, for an optimizing approach, Svensson and van Wijnbergen (1986)). On the models used in the Brookings simulations, see Frankel (1986a), or other papers in Bryant and Henderson.

12. After testing for sensitivity to the choice of weights, we also tested for sensitivity to the choice of targets. The total count for true gains and losses for the two countries were:

		U.S.	Europe
OECD weights	gains	507	479
$\omega = 1/11.8$	losses	322	349
$\omega^* = 1/244.0$	zeroes	171	172
LIVPL weights	gains	421	471
$\omega = 1/.26$	losses	302	267
$\omega^* = 1/2.4$	zeroes	277	262
original weights,	gains	538	537
target level of U.S. GNP =	losses	338	340
95% of baseline	zeroes	124	123
original weights,	gains	484	465
target level of European	losses	272	291
GNP = 95% of baseline	zeroes	244	244

13. The numbers for $6 \times 6 = 36$ combinations are reported in the NBER paper.

14. The diagonal entries of the three-dimensional matrix are the cases where both policy-makers have the correct model. The calculations correspond conceptually to those in Oudiz and Sachs (1984) for the MCM and EPA models.

15. The most bizarre combination occurs when the U.S. believes the LIVPL model and Europe believes the OECD model (not shown). Under this combination, the Nash noncooperative equilibrium entails a mutually

destructive increase in the European money supply of almost 100 percent and decrease in the U.S. money supply of over 100 percent (!). Evidently the problem is that the LIVPL model shows European monetary expansion raising U.S. output much more than does U.S. monetary expansion, as can be seen in Table 1. There is no reason why the Nash solution for the money supply specified in equations (9) and (10) need be positive. One need only plug in the multiplier values from Table 2 to see how negative money supplies are possible. Presumably, in practice, U.S. policy-makers would begin to doubt the LIVPL model and its prediction that European monetary expansion would have such a powerful expansionary effect on U.S. output, long before they relied on it to the extent of reducing the U.S. money supply to zero.

16. Examples include Blanchard and Dornbusch (1984), Layard, et al (1984) and Marris (1985).

17. Table 8 in the NBER paper shows that according to the MSG model this change in the monetary/fiscal mix, though increasing non-U.S. output 0.1 percent and having the desired effect on the current accounts, would in fact reduce U.S. output 0.7 percent. There are several other combinations in the table where this same change in mix results from coordination, all of them involving the LIVPL model; but none of them shows quite the expected effe s on the target variables.

18. As in the case of ordination of monetary policy alone, there are a few cases of absurdly large changes, in particular the two combinations with the MSG and MCM models. The explanation, again, is that these changes offset absurdly large changes implied by the move from

the baseline to the Nash equilibrium in Table 7.

19. The probabilities, $\underset{\sim}{\pi}_j^*$ and $\underset{\sim}{\pi}_k$ are conditional probabilities, given the beliefs of the U.S. (j) or Europe (k). These conditional probabilities are formed using Bayes rule from some underlying probability distribution over models which is known by both countries' policy-makers.

20. Brainard assumed a continuous probability distribution for the parameters (rather than assigning discrete probabilities to 12 models, as suggested here). Roubini (1986) applies this assumption to international coordination.

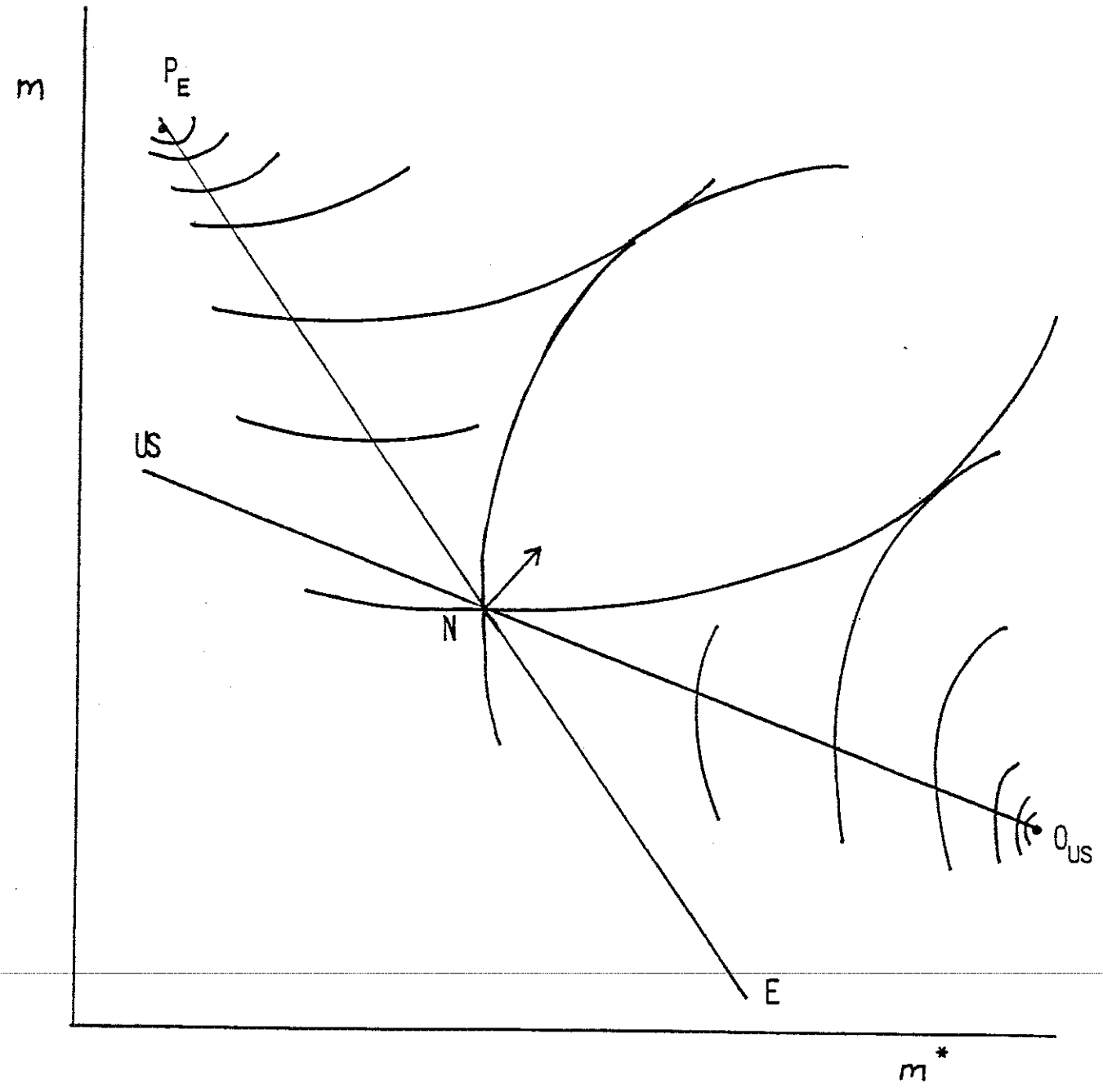

FIGURE 1

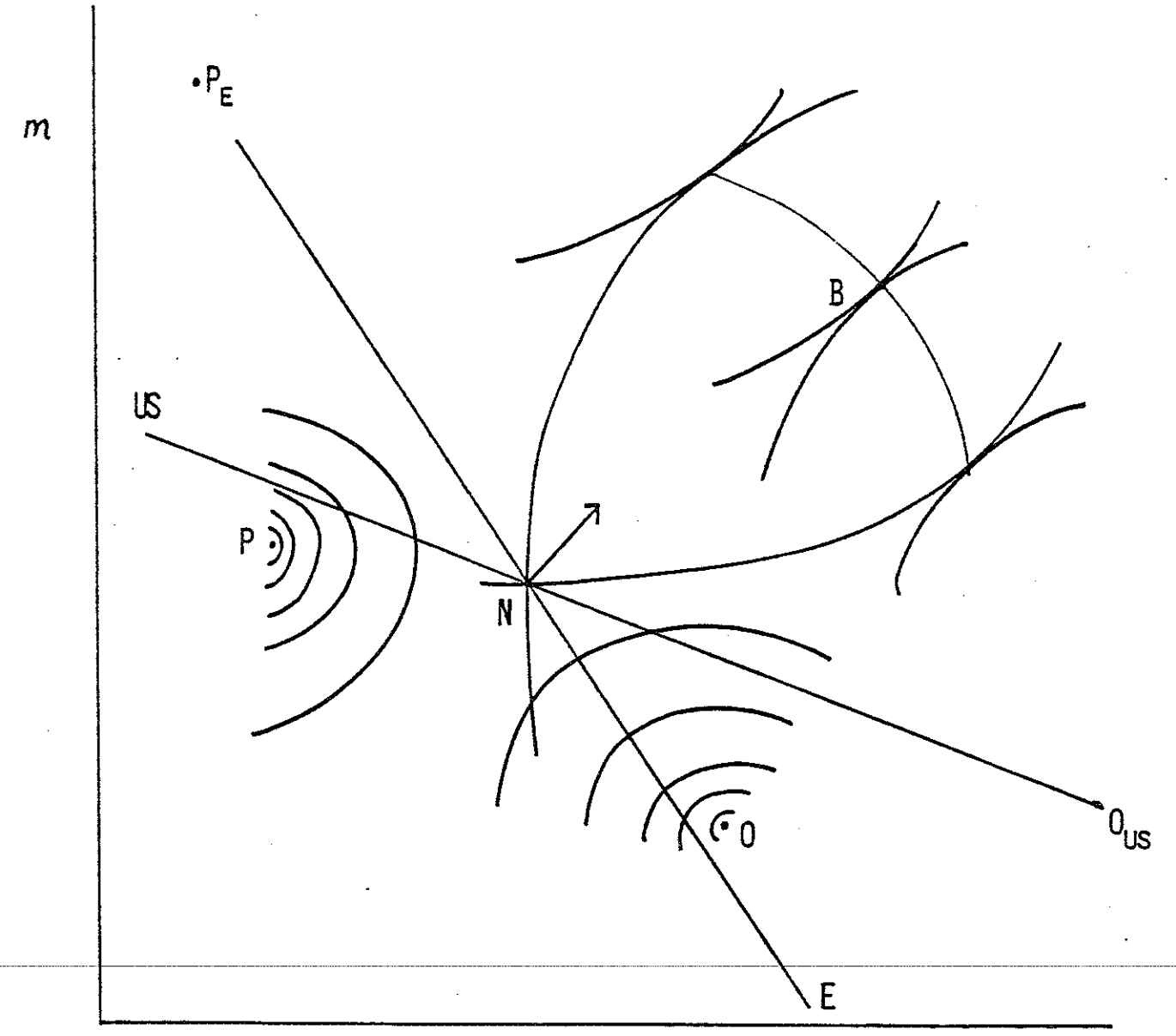

FIGURE 2

TABLE 1: MONETARY POLICY

Simulation Effect in Second Year of Increase in Money Supply (4 Percent)[a,b]

	Y	CPI	i (pts.)	Currency Value	CA ($b)	CA* ($b)	i* (pts.)	CPI*	Y*
Monetary Expansion In U.S. (Sim. D)	Effect in U.S.					Effect in Non. U.S.			
MCM	+1.5%	+0.4%	-2.2	-6.0%	- 3.1	-3.5	-0.5	-0.6%	-0.7%
EEC[c]	+1.0%	+0.8%	-2.4	-4.0%	-2.8	+1.2	-0.5	-0.4%	+0.2%
EPA[d]	+1.2%	+1.0%	-2.2	-6.4%	-1.6	-10.1	-0.6	-0.5%	-0.4%
LINK	+1.0%	-0.4%	-1.4	-2.3%	- 5.9	+1.5	NA	-0.1%	-0.1%
LIVERPOOL	+0.1%	+3.7%	-0.3	-3.9%	-13.0	+0.1	-0.1	-0.0%	-0.0%
MSG	+0.3%	+1.5%	-0.8	-2.0%	+2.6	-4.4	-1.2	-0.7%	+0.4%
MINIMOD	+1.0%	+0.8%	-1.8	-5.7%	+2.8	-4.7	-0.1	-0.2%	-0.2%
VAR[e]	+3.0%	+0.4%	-1.9	-22.9%	+4.9	+5.1	+0.3	+0.1%	+0.4%
OECD	+1.6%	+0.7%	-0.8	-2.6%	-8.4	+3.1	-0.1	-0.1%	+0.3%
TAYLOR[e]	+0.6%	+1.2%	-0.4	-4.9%	NA	NA	-0.1	-0.2%	-0.2%
WHARTON	+0.7%	+0.0%	-2.1	-1.0%	-5.1	+5.3	-1.3	-0.1	+0.4%
DRI	+1.8%	+0.4%	-2.3	-14.6%	-1.4	+14.5	-1.1	-1.3%	-0.6%
Monetary Expansion in Non U.S. OECD (Sim. H)	Effect in Non U.S.					Effect in U.S.			
MCM	+1.5	+0.6	-2.1	-5.4%	+3.5	+0.1	-0.2	-0.2%	-0.0%
EEC[c]	+0.8%	+1.0%	-1.0	-2.3%	-5.2	+1.9	+0.0	+0.1%	+0.1%
EPA[d]	+0.0%	+0.0%	-0.1	-0.1%	-0.1	+0.1	-0.0	-0.0	+0.0%
LINK[f]	+0.8%	-0.6%	NA	-2.3%	-1.4	+3.5	+0.0	-0.0%	+0.1%
LIVERPOOL	+0.4%	+2.8%	-0.9	-8.4%	+7.1	-8.2	-1.1	-3.4%	+1.6%
MSG	+0.2%	+1.5%	-0.7	-1.4%	-15.9	+12.0	-1.2	-0.6%	+0.3%
MINIMOD	+0.8%	+0.2%	-1.8	-4.8%	+3.6	-1.4	-0.6	-0.5%	-0.3%
VAR[e]	+0.7%	-0.5%	-3.0	-5.5%	+5.2	-10.0	+0.6	-0.7%	+1.2%
OECD	+0.8%	+0.3%	-1.3	-2.1%	-1.6	+2.3	-0.2	-0.1%	+0.1%
TAYLOR[e]	+0.8%	+0.7%	-0.3	-3.5%	NA	NA	-0.2	-0.5%	-0.1%
WHARTON	+0.2%	-0.1%	-0.8	+0.2%	+2.6	+0.5	+0.0	+0.0%	+0.0%
DRI	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a]The increase in the money supply is phased in over four quarters.

[b]Source: Frankel (1986a)

[c]Non-U.S. short-term interest rate NA; long-term reported instead.

[d]Non-U.S. current account is Japan, Germany, United Kingdom and Canada.

[e]CPI NA. GNP deflator reported instead.

[f]Appreciation of non-U.S. currency NA; depreciation of dollar reported instead.

TABLE 2: MONEY AND FISCAL MULTIPLIERS

(For three targets in each country)

	Percentage Effect on Income		Effect on Current Account (As Percentage of GNP):		Effect on Percentage Inflation Rate	
From a (1 percent) increase in:	U.S. m	Eur. m	U.S. m	Eur. m	U.S. m	Eur. m
Effect on U.S.						
MCM	0.3750	0.0000	-0.0198	0.0006	0.1000	-0.0500
VAR	0.7500	0.3000	0.0311	-0.0634	0.1000	-0.1750
OECD	0.4000	0.0250	-0.0537	0.0147	0.1750	-0.0250
LINK	0.2500	0.0250	-0.0380	0.0225	-0.1000	0.0000
Effect on "Europe"						
MCM	-0.1750	0.3750	-0.0090	0.0090	-0.1500	0.1500
VAR	0.1000	0.1750	0.1169	0.1192	0.0250	-0.1250
OECD	0.0750	0.2000	0.0178	-0.0091	-0.0250	0.0750
LINK	-0.0250	0.2000	0.0083	-0.0077	-0.0250	-0.1500
From an increase (equal to 1% of GNP):	U.S. g	Eur. g	U.S. g	Eur. g	U.S. g	Eur. g
Effect on U.S.						
MCM	1.8000	0.5000	-0.4217	0.2019	0.4000	0.2000
VAR	0.4000	0.3000	-0.0127	-0.0659	-0.9000	-0.1000
OECD	1.1000	0.1000	-0.3628	0.0843	0.6000	0.2000
LINK	1.2000	0.2000	-0.1647	-0.1621	0.5000	0.0000
Effect on "Europe"						
MCM	0.7000	1.4000	0.0912	-0.0737	0.4000	0.3000
VAR	-0.0000	0.5000	-0.0183	0.1559	0.0000	-0.3000
OECD	0.4000	1.5000	0.2583	-0.1564	0.3000	0.7000
LINK	0.1000	1.2000	0.0420	-0.1349	0.0000	0.1000

TABLE 3: THE COOPERATIVE BARGAIN[a.]

MODEL SUBSCRIBED TO BY THE UNITED STATES		MODEL SUBSCRIBED TO BY EUROPE: MCM	VAR	OECD	LINK
MCM					
BARGAINING CHANGE IN POLICY					
θ_{eur}[b.]		0.240	2.020	1.590	0.710
θ_{us}		-0.137	-0.441	0.367	0.253
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	0.114	0.309	0.346	0.136
	CA	0.003	0.189	-0.008	-0.003
US	Y	-0.051	-0.165	0.138	0.095
	CA	0.003	0.010	-0.006	-0.005
PERCEIVED GAIN FOR:					
EUROPE		0.0001	0.0066	0.0011	0.0002
US		0.0000	0.0002	0.0002	0.0001
VAR					
BARGAINING CHANGE IN POLICY					
θ_{eur}		-5.199	25.185	-32.772	-4.129
θ_{us}		-8.652	-17.173	32.898	8.394
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-0.436	2.690	-4.087	-1.036
	CA	0.031	0.995	0.875	0.102
US	Y	-8.049	-5.325	14.842	5.057
	CA	0.061	-2.130	3.099	0.522
PERCEIVED GAIN FOR:					
EUROPE		0.0092	0.3216	0.2415	0.0090
US		0.3333	0.4323	3.2174	0.4100
OECD					
BARGAINING CHANGE IN POLICY					
θ_{eur}		0.389	14.490	3.837	2.142
θ_{us}		-0.533	-8.940	2.356	1.820
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	0.239	1.642	0.944	0.383
	CA	0.008	0.682	0.007	-0.001
US	Y	-0.204	-3.214	1.038	0.782
	CA	0.034	0.693	-0.070	-0.066
PERCEIVED GAIN FOR:					
EUROPE		0.0004	0.1611	0.0078	0.0015
US		0.0010	0.0933	0.0128	0.0064
LINK					
BARGAINING CHANGE IN POLICY					
θ_{eur}		0.388	35.304	4.975	3.479
θ_{us}		-0.851	-29.058	5.112	4.525
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	0.294	3.272	1.378	0.583
	CA	0.011	0.811	0.045	0.011
US	Y	-0.203	-6.382	1.402	1.218
	CA	0.041	1.898	-0.082	-0.093
PERCEIVED GAIN FOR:					
EUROPE		0.0006	0.6101	0.0161	0.0038
US		0.0010	0.3590	0.0251	0.0141

a. FOR THIS AND ALL SUBSEQUENT TABLES, CHANGES IN INSTRUMENTS AND TARGETS ARE EXPRESSED IN PERCENT, AND CHANGES IN UTILITY ARE EXPRESSED IN PERCENT SQUARED GNP.

b. FOR THIS AND ALL SUBSEQUENT TABLES, $_{eur}$ SUBSCRIPT REFERS TO EUROPEAN VARIABLES, AND $_{us}$ SUBSCRIPT REFERS TO UNITED STATES VARIABLES.

TABLE 4: TRUE GAINS FROM COORDINATION FOR THE UNITED STATES

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE: MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	0.0000	0.0002	0.0002	0.0001
VAR	0.0001	0.1068	-1.0427	-0.5630
OECD	0.0047	0.0313	0.0004	-0.0024
LINK	0.0019	0.0596	0.0119	0.0041
VAR				
MODEL REPRESENTING REALITY:				
MCM	-2.1398	1.0677	6.0012	1.5986
VAR	0.3333	0.4323	3.2174	0.4100
OECD	-2.5239	1.6538	6.3684	1.7626
LINK	-1.0564	1.3516	2.4973	0.7067
OECD				
MODEL REPRESENTING REALITY:				
MCM	-0.0127	-0.1063	0.0362	0.0301
VAR	0.2994	-0.6632	-3.5351	-2.4221
OECD	0.0010	0.0933	0.0128	0.0064
LINK	-0.0008	0.3912	0.0357	0.0203
LINK				
MODEL REPRESENTING REALITY:				
MCM	-0.0138	-1.4439	0.0337	0.0341
VAR	0.6384	-5.2320	-6.3935	-5.3937
OECD	0.0088	-1.1929	-0.0491	-0.0470
LINK	0.0010	0.3590	0.0251	0.0141

TABLE 5: TRUE GAINS FROM COORDINATION FOR EUROPE

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE: MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	0.0001	1.9596	0.2717	0.0974
VAR	-0.1516	0.0066	-2.0826	-1.0593
OECD	-0.0120	0.3715	0.0011	-0.0050
LINK	-0.0127	0.4272	0.0119	0.0002
VAR				
MODEL REPRESENTING REALITY:				
MCM	0.0092	31.7840	-4.1226	-0.9188
VAR	11.2505	0.3216	1.2862	-3.0464
OECD	-0.1383	4.0254	0.2415	0.0886
LINK	0.0729	6.0950	0.3258	0.0090
OECD				
MODEL REPRESENTING REALITY:				
MCM	0.0004	16.0344	0.4762	0.2004
VAR	0.1519	0.1611	-6.4749	-4.2203
OECD	-0.0153	2.2176	0.0078	-0.0054
LINK	-0.0222	3.1398	0.0185	0.0015
LINK				
MODEL REPRESENTING REALITY:				
MCM	0.0006	39.3135	0.4532	0.2078
VAR	0.5566	0.6101	-10.6004	-8.6072
OECD	-0.0124	4.6683	0.0161	-0.0104
LINK	-0.0252	7.3543	0.0271	0.0038

TABLE 6:GAINS TO UNILATERAL SWITCH TO TRUE MODEL FOR US UNDER NASH

MODEL SUBSCRIBED TO BY THE UNITED STATES		MODEL SUBSCRIBED TO BY EUROPE MCM	VAR	OECD	LINK
MCM					
MODEL REPRESENTING REALITY:					
MCM	(0.0000)[a]	0.0000	0.0000	0.0000	0.0000
VAR	(0.4323)	60.6895	1.3907	24.1198	33.2773
OECD	(0.0128)	0.1062	-0.0026	0.0849	0.0728
LINK	(0.0141)	0.0108	0.0828	0.0300	0.0110
VAR					
MODEL REPRESENTING REALITY:					
MCM	(0.0000)	9.6365	1.3087	9.2023	7.1613
VAR	(0.4323)	0.0000	0.0000	0.0000	0.0000
OECD	(0.0128)	10.1937	1.9825	9.4612	7.4815
LINK	(0.0141)	4.4706	1.6852	3.8909	3.2211
OECD					
MODEL REPRESENTING REALITY:					
MCM	(0.0000)	0.0947	0.0001	0.0583	0.0624
VAR	(0.4323)	49.9502	1.3675	20.0785	27.5047
OECD	(0.0128)	0.0000	0.0000	0.0000	0.0000
LINK	(0.0141)	0.0110	0.0883	-0.0027	0.0044
LINK					
MODEL REPRESENTING REALITY:					
MCM	(0.0000)	0.0404	0.0114	0.0322	0.0336
VAR	(0.4323)	53.5756	1.7903	21.0747	28.9926
OECD	(0.0128)	0.0096	-0.0286	0.0079	0.0041
LINK	(0.0141)	0.0000	0.0000	0.0000	0.0000

a. GAINS TO COORDINATION TO THE US ASSUMING THAT ALL COUNTRIES BELIEVE THE SAME, CORRECT MODEL.

TABLE 7:GAINS TO UNILATERAL SWITCH TO TRUE MODEL FOR EUROPE UNDER NASH

MODEL SUBSCRIBED TO BY THE UNITED STATES		MODEL SUBSCRIBED TO BY EUROPE MCM	VAR	OECD	LINK
MCM					
MODEL REPRESENTING REALITY:					
MCM	(0.0001)[a]	0.0000	137.4000	6.6543	4.8828
VAR	(0.3216)	213.7836	0.0000	130.0439	140.7793
OECD	(0.0078)	1.9315	24.2636	0.0000	0.0397
LINK	(0.0038)	1.4064	26.0626	0.0394	0.0000
VAR					
MODEL REPRESENTING REALITY:					
MCM	(0.0001)	0.0000	177.1554	0.0480	1.8082
VAR	(0.3216)	82.8104	0.0000	80.1164	66.6677
OECD	(0.0078)	0.0356	27.0565	0.0000	0.0657
LINK	(0.0038)	0.4441	32.9331	0.3174	0.0000
OECD					
MODEL REPRESENTING REALITY:					
MCM	(0.0001)	0.0000	137.6360	5.7179	4.5334
VAR	(0.3216)	198.3542	0.0000	125.7127	132.8703
OECD	(0.0078)	1.6026	24.2412	0.0000	0.0204
LINK	(0.0038)	1.2849	26.0915	0.0191	0.0000
LINK					
MODEL REPRESENTING REALITY:					
MCM	(0.0001)	0.0000	133.8589	5.9487	4.6242
VAR	(0.3216)	203.7523	0.0000	126.8954	135.0451
OECD	(0.0078)	1.7090	23.8987	0.0000	0.0243
LINK	(0.0038)	1.3257	25.4251	0.0238	0.0000

a. GAINS TO COORDINATION TO THE EUROPE ASSUMING THAT ALL COUNTRIES BELIEVE THE SAME, CORRECT MODEL.

TABLE 8: FISCAL POLICY

Simulation Effect in Second Year of Increase in Government Expenditure (1 Percent of GNP)

	Y	CPI	i (Pts.)	Currency Value	CA ($b)	CA* ($b)	i* (Pts.)	CPI*	Y*
Fiscal Expansion In U.S. (-Sim. B)			U.S.				Non. U.S.		
MCM	+1.8%	+0.4%	+1.7	+2.8%	-16.5	+8.9	+0.4	+0.4%	+0.7%
EEC[a]	+1.2%	+0.6%	+1.5	+0.6%	-11.6	+6.6	+0.3	+0.2%	+0.3%
EPA[b]	+1.7%	+0.9%	+2.2	+1.9%	-20.5	+9.3	+0.5	+0.3%	+0.9%
LINK	+1.2%	+0.5%	+0.2	-0.1%	-6.4	+1.9	NA	-0.0%	+0.1%
LIVERPOOL	+0.6%	+0.2%	+0.4	+1.0%	-7.0	+3.4	+0.1	+0.6%	-0.0%
MSG	+0.9%	-0.1%	+0.9	+3.2%	-21.6	+22.7	+1.0	+0.5%	+0.3%
MINIMOD	+1.0%	+0.3%	+1.1	+1.0%	-8.5	+5.5	+0.2	+0.1%	+0.3%
VAR[c]	+0.4%	-0.9%	+0.1	+1.2%	-0.5	-0.2	-0.0	-0.0%	-0.0%
OECD	+1.1%	+0.6%	+1.7	+0.4%	-14.2	+11.4	+0.7	+0.3%	+0.4%
TAYLOR[c]	+0.6%	+0.5%	+0.3	+4.0%	NA	NA	+0.2	+0.4%	+0.4%
WHARTON	+1.4%	+0.3%	+1.1	-2.1%	-15.4	+5.3	+0.6	-0.1%	+0.2%
DRI	+2.1%	+0.4%	+1.6	+3.2%	-22.0	+0.8	+0.4	+0.3%	+0.7%
Fiscal Expansion in Non U.S. OECD (Sim. G)			Non U.S.				U.S.		
MCM	+1.4%	+0.3%	+0.6	+0.3%	-7.2	+7.9	+0.5	+0.2%	+0.5%
EEC[a]	+1.3%	+0.8%	+0.4	-0.6%	-9.3	+3.0	+0.0	+0.1%	+0.2%
EPA[b]	+2.3%	+0.7%	+0.3	-0.7%	-13.1	+4.7	+0.6	+0.3%	+0.3%
LINK	+1.2%	+0.1%	NA	-0.1%	-6.1	+6.3	+0.0	+0.0%	+0.2%
LIVERPOOL	+0.3%	+0.8%	+0.0	+3.3%	-17.2	+11.9	+0.8	+3.1%	-0.5%
MSG	+1.1%	+0.1%	+1.4	+2.9%	-5.3	+10.5	+1.3	+0.6%	+0.4%
MINIMOD	+1.6%	+0.2%	+0.9	+0.6%	-2.2	+3.2	+0.3	+0.2%	+0.1%
VAR[c]	+0.5%	-0.3%	-0.2	-2.4%	+1.7	-2.6	+0.2	-0.1%	+0.3%
OECD	+1.5%	+0.7%	+1.9	+0.9%	-6.9	+3.3	+0.3	+0.2%	+0.1%
TAYLOR[c]	+1.6%	+1.2%	+0.6	+2.7%	NA	NA	+0.4	+0.9%	+0.6%
WHARTON	+3.2%	-0.8%	+0.8	-2.4%	-5.5	+4.7	+0.1	-0.0%	+0.0%
DRI	NA	NA	NA	NA	NA	NA	NA	NA	NA

[a]Non-U.S. short-term interest rate NA; long-term reported instead.

[b]Non-U.S. current account is Japan, Germany, United Kingdom, and Canada.

[c]CPI NA. GNP deflator reported instead.

TABLE 9: THE COOPERATIVE BARGAIN (MONETARY AND FISCAL POLICIES)

MODEL SUBSCRIBED TO BY THE UNITED STATES		MODEL SUBSCRIBED TO BY EUROPE: MCM	VAR	OECD	LINK
MCM					
BARGAINING CHANGE IN POLICY					
Meur		-0.177	9.980	-55.755	0.869
Mus		1.259	4.010	-41.170	3.330
Geur		0.061	-2.892	0.052	-0.217
Gus		-0.157	-3.969	5.845	-0.955
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-0.311	0.712	-11.830	-0.265
	CA	-0.032	1.292	1.285	0.010
	P	-0.260	-0.277	-1.365	-0.235
US	Y	0.220	-7.048	-4.891	-0.579
	CA	0.053	1.015	-1.675	0.294
	P	0.084	-2.254	1.021	-0.136
PERCEIVED GAIN FOR:					
EUROPE		0.0001	0.0326	0.0002	0.0059
US		0.0002	0.0001	0.0001	0.0001
VAR					
BARGAINING CHANGE IN POLICY [a.]					
Meur		-258.885	43.693	207.547	-1.779
Mus		18.120	-17.723	-82.630	-7.732
Geur		39.164	-13.529	-27.962	-1.911
Gus		63.959	-11.088	-46.589	3.121
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-0.652	-0.890	-25.266	-2.144
	CA	0.460	1.231	-10.996	0.339
	P	-4.218	-1.846	-15.918	0.269
US	Y	-26.743	-8.678	-26.732	-5.658
	CA	13.579	-2.287	-13.287	-0.041
	P	-14.363	2.014	0.143	-3.079
PERCEIVED GAIN FOR:					
EUROPE		0.0001	0.0002	0.0000	0.0002
US		0.0000	0.0001	0.0001	0.0003
OECD					
BARGAINING CHANGE IN POLICY					
Meur		213.120	47.154	-90.252	1.746
Mus		95.318	-20.088	22.653	11.040
Geur		-38.388	-20.510	11.924	1.035
Gus		-23.054	-4.444	-19.374	-3.387
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-6.642	-4.012	-6.215	0.976
	CA	1.785	0.157	-5.653	-0.204
	P	-3.068	-0.244	-4.800	-0.434
US	Y	14.257	-13.796	-13.314	0.838
	CA	3.144	1.654	5.493	0.749
	P	-10.157	-11.463	-3.019	0.063
PERCEIVED GAIN FOR:					
EUROPE		0.0333	0.0000	0.0002	0.0001
US		0.0001	0.0001	0.0000	0.0000
LINK					
BARGAINING CHANGE IN POLICY					
Meur		7.556	147.227	257.973	1.516
Mus		1.262	-53.522	-3.350	-1.796
Geur		-2.858	-55.997	-28.432	1.206
Gus		-0.219	-6.757	-3.605	-1.704
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-1.542	-7.586	7.253	1.630
	CA	0.247	2.688	1.117	-0.263
	P	-0.001	-2.942	-1.552	-0.057
US	Y	-0.331	-29.008	-4.400	-2.264
	CA	-0.305	-2.619	1.920	0.586
	P	-0.236	1.974	-1.467	-0.652
PERCEIVED GAIN FOR:					
EUROPE		0.0003	0.0004	0.0001	0.0002
US		0.0001	0.0001	0.0001	0.0001

a. SEE FOOTNOTE 15.

TABLE 10: TRUE GAINS FROM COORDINATION FOR THE UNITED STATES

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	0.0002	0.0001	0.0001	0.0001
VAR	-2.6394	10.6400	236.3649	-5.8930
OECD	-0.4994	-2.3167	14.8283	-0.0695
LINK	-0.5952	6.3941	25.8278	-1.7681
VAR				
MODEL REPRESENTING REALITY:				
MCM	-74.7859	198.0402	402.5238	13.1769
VAR	0.0000	0.0001	0.0001	0.0003
OECD	-25.1592	158.5107	373.6036	5.5733
LINK	-21.5520	39.1031	122.9517	10.4207
OECD				
MODEL REPRESENTING REALITY:				
MCM	-11.3838	29.9578	0.9014	0.0322
VAR	-268.2709	12.5137	347.2785	3.0793
OECD	0.0001	0.0001	0.0000	0.0000
LINK	-23.2350	-8.0046	-5.7921	-0.0567
LINK				
MODEL REPRESENTING REALITY:				
MCM	1.5302	233.1126	-125.2759	-1.2435
VAR	-6.7995	122.1154	-942.2249	8.2880
OECD	0.9647	119.0264	-43.4986	0.2318
LINK	0.0001	0.0001	0.0001	0.0001

TABLE 11: TRUE GAINS FROM COORDINATION FOR EUROPE

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	0.0001	-3.3306	-5.6736	-3.1598
VAR	-2.5132	0.0326	333.6467	-8.2613
OECD	0.1306	13.3216	0.0002	0.7635
LINK	0.0093	43.8440	44.4689	0.0059
VAR				
MODEL REPRESENTING REALITY:				
MCM	0.0001	6.2655	270.6773	-4.8492
VAR	217.4242	0.0002	209.1031	25.7900
OECD	-367.2546	327.4278	0.0000	1.2868
LINK	-973.6363	327.6573	980.1376	0.0002
OECD				
MODEL REPRESENTING REALITY:				
MCM	0.0333	17.3204	176.5559	12.6783
VAR	-549.5166	0.0000	241.4204	-29.8594
OECD	142.8152	199.9979	0.0002	1.4537
LINK	289.0842	313.7216	119.2115	0.0001
LINK				
MODEL REPRESENTING REALITY:				
MCM	0.0003	141.2746	-696.8871	-0.7884
VAR	-7.2841	0.0004	-1276.6437	-10.8551
OECD	16.4437	828.7074	0.0001	-1.7457
LINK	16.7499	1143.2227	-1016.8853	0.0002

TABLE 12

EFFECT OF COORDINATION, WHILE AVERAGING TO ESTIMATE OPPONENT'S MODEL

MODEL SUBSCRIBED TO BY THE UNITED STATES		MODEL SUBSCRIBED TO BY EUROPE: MCM	VAR	OECD	LINK
MCM					
BARGAINING CHANGE IN POLICY					
Meur		-2.755	8.075	3.594	-0.215
Mus		-0.021	-0.510	0.443	0.334
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-1.029	1.362	0.752	-0.051
	CA	-0.027	0.903	-0.025	0.003
US	Y	-0.008	-0.191	0.166	0.125
	CA	0.000	0.017	-0.005	-0.005
PERCEIVED GAIN FOR:					
EUROPE		0.0125	0.0872	0.0033	0.0009
US		0.0001	0.0026	0.0013	0.0001
VAR					
BARGAINING CHANGE IN POLICY					
Meur		-46.791	3.411	-5.647	-15.201
Mus		-66.265	37.151	-22.917	-37.952
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-5.950	4.312	-2.849	-2.091
	CA	0.173	4.751	-0.352	-0.198
US	Y	-63.735	28.887	-18.881	-33.024
	CA	0.902	0.931	-0.360	-0.221
PERCEIVED GAIN FOR:					
EUROPE		0.3905	0.5650	-0.4098	-0.0844
US		39.2270	11.8864	10.3586	16.7692
OECD					
BARGAINING CHANGE IN POLICY					
Meur		-6.416	20.379	7.848	0.271
Mus		-5.527	-5.847	-0.990	-1.706
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-1.438	2.981	1.495	0.097
	CA	-0.010	1.746	-0.089	-0.017
US	Y	-2.371	-1.829	-0.200	-0.676
	CA	0.196	0.607	0.163	0.090
PERCEIVED GAIN FOR:					
EUROPE		0.0361	0.2435	-0.0123	-0.0041
US		0.0228	0.2009	0.0553	0.0162
LINK					
BARGAINING CHANGE IN POLICY					
Meur		-5.089	44.038	8.474	1.861
Mus		-2.217	-28.237	4.207	3.565
PERCEIVED CHANGE IN TARGETS					
EUR.	Y	-1.520	4.882	2.010	0.284
	CA	-0.028	1.948	-0.004	0.014
US	Y	-0.682	-5.958	1.263	0.938
	CA	-0.032	2.062	0.029	-0.096
PERCEIVED GAIN FOR:					
EUROPE		0.0357	0.7861	0.0138	0.0033
US		-0.0184	0.6110	0.0576	0.0006

TABLE 13

EFFECT OF COORDINATION, COMPARED TO NON-COOPERATIVE SOLUTION WITH AVERAGING: TRUE GAINS FROM COORDINATION FOR THE UNITED STATES

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	0.0001	0.0026	0.0013	0.0001
VAR	1.7426	0.7576	-2.0435	-0.1914
OECD	-0.0081	0.1229	0.0078	-0.0108
LINK	-0.0094	0.2345	0.0287	-0.0047
VAR				
MODEL REPRESENTING REALITY:				
MCM	-10.9240	0.6002	-2.3508	-4.7125
VAR	39.2270	11.8864	10.3586	16.7692
OECD	-12.2776	0.8405	-2.4845	-5.1682
LINK	-5.2851	0.2468	-1.0846	-2.2542
OECD				
MODEL REPRESENTING REALITY:				
MCM	-0.0941	-0.0923	-0.0073	-0.0184
VAR	9.5277	0.8061	-2.8193	1.2366
OECD	0.0228	0.2009	0.0553	0.0162
LINK	-0.0283	0.5544	0.0720	0.0042
LINK				
MODEL REPRESENTING REALITY:				
MCM	-0.0320	-1.4327	0.0237	0.0226
VAR	5.3773	-3.9521	-7.2862	-3.8789
OECD	0.0070	-1.0465	-0.0229	-0.0500
LINK	-0.0184	0.6110	0.0576	0.0006

TABLE 14

EFFECT OF COORDINATION, COMPARED TO NON-COOPERATIVE SOLUTION WITH AVERAGING: TRUE GAINS FROM COORDINATION FOR EUROPE

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	0.0125	7.3801	0.6581	-0.0630
VAR	3.8204	0.0872	-4.2978	-0.1175
OECD	0.1584	1.5901	0.0033	0.0029
LINK	0.1347	1.6933	0.0296	0.0009
VAR				
MODEL REPRESENTING REALITY:				
MCM	0.3905	-12.5586	0.8582	0.3970
VAR	114.7240	0.5650	24.7853	46.5345
OECD	0.8155	3.3431	-0.4098	-0.6620
LINK	1.2612	-0.3424	-0.0650	-0.0844
OECD				
MODEL REPRESENTING REALITY:				
MCM	0.0361	19.9676	1.5301	0.1717
VAR	15.6662	0.2435	-7.3530	1.4815
OECD	0.4063	3.6273	-0.0123	-0.0095
LINK	0.2629	4.2805	0.0461	-0.0041
LINK				
MODEL REPRESENTING REALITY:				
MCM	0.0357	46.6779	1.1965	0.0218
VAR	9.7144	0.7861	-13.3783	-5.8397
OECD	0.3041	6.4888	0.0138	-0.0040
LINK	0.2291	9.1414	0.0533	0.0033

TABLE 15

FFECT OF COORDINATION, COMPARED TO NON-COOPERATIVE SOLUTION WITH

VERAGING OVER OWN MODEL: TRUE GAINS FROM COORDINATION FOR UNITED STATES

ODEL SUBSCRIBED TO Y THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
CM				
MODEL REPRESENTING REALITY:				
MCM	-0.1221	-0.1221	-0.1221	-0.1221
VAR	-0.1104	-0.1104	-0.1104	-0.1104
OECD	-0.1095	-0.1095	-0.1095	-0.1095
LINK	-0.0146	-0.0146	-0.0146	-0.0146
AR				
MODEL REPRESENTING REALITY:				
MCM	-0.1221	-0.1221	-0.1221	-0.1221
VAR	-0.1104	-0.1104	-0.1104	-0.1104
OECD	-0.1095	-0.1095	-0.1095	-0.1095
LINK	-0.0146	-0.0146	-0.0146	-0.0146
ECD				
MODEL REPRESENTING REALITY:				
MCM	-0.1221	-0.1221	-0.1221	-0.1221
VAR	-0.1104	-0.1104	-0.1104	-0.1104
OECD	-0.1095	-0.1095	-0.1095	-0.1095
LINK	-0.0146	-0.0146	-0.0146	-0.0146
INK				
MODEL REPRESENTING REALITY:				
MCM	-0.1221	-0.1221	-0.1221	-0.1221
VAR	-0.1104	-0.1104	-0.1104	-0.1104
OECD	-0.1095	-0.1095	-0.1095	-0.1095
LINK	-0.0146	-0.0146	-0.0146	-0.0146

TABLE 16

EFFECT OF COORDINATION, COMPARED TO NON-COOPERATIVE SOLUTION WITH

AVERAGING OVER OWN MODEL: TRUE GAINS FROM COORDINATION FOR EUROPE

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	2.0912	2.0912	2.0912	2.0912
VAR	0.9814	0.9814	0.9814	0.9814
OECD	-0.0722	-0.0722	-0.0722	-0.0722
LINK	0.2419	0.2419	0.2419	0.2419
VAR				
MODEL REPRESENTING REALITY:				
MCM	2.0912	2.0912	2.0912	2.0912
VAR	0.9814	0.9814	0.9814	0.9814
OECD	-0.0722	-0.0722	-0.0722	-0.0722
LINK	0.2419	0.2419	0.2419	0.2419
OECD				
MODEL REPRESENTING REALITY:				
MCM	2.0912	2.0912	2.0912	2.0912
VAR	0.9814	0.9814	0.9814	0.9814
OECD	-0.0722	-0.0722	-0.0722	-0.0722
LINK	0.2419	0.2419	0.2419	0.2419
LINK				
MODEL REPRESENTING REALITY:				
MCM	2.0912	2.0912	2.0912	2.0912
VAR	0.9814	0.9814	0.9814	0.9814
OECD	-0.0722	-0.0722	-0.0722	-0.0722
LINK	0.2419	0.2419	0.2419	0.2419

TABLE 17

EFFECT OF AVERAGING TO ESTIMATE OWN MODEL, WHILE UNDER NON-COOPERATIVE SOLUTION: TRUE GAINS FOR THE UNITED STATES.

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	-0.1405	-0.0614	-0.1235	-0.1260
VAR	83.1202	1.5495	45.6511	50.3466
OECD	-1.8933	1.0077	-1.6010	-1.6549
LINK	-3.1293	1.9124	-2.6906	-2.7768
VAR				
MODEL REPRESENTING REALITY:				
MCM	9.4959	1.2475	9.0786	7.0351
VAR	22.4318	0.1611	21.5290	17.0695
OECD	8.1975	2.9908	7.7790	5.7568
LINK	1.3311	3.5149	1.1711	0.4338
OECD				
MODEL REPRESENTING REALITY:				
MCM	-0.0458	-0.0613	-0.0653	-0.0636
VAR	72.3810	1.5264	41.6093	44.5739
OECD	-1.9992	1.0102	-1.6856	-1.7275
LINK	-3.1290	1.9180	-2.7234	-2.7834
LINK				
MODEL REPRESENTING REALITY:				
MCM	-0.1001	-0.0500	-0.0913	-0.0924
VAR	76.0063	1.9489	42.6057	46.0620
OECD	-1.9896	0.9818	-1.6778	-1.7235
LINK	-3.1400	1.8297	-2.7206	-2.7878

TABLE 18

EFFECT OF AVERAGING TO ESTIMATE OWN MODEL, WHILE UNDER NONCOOPERATIVE SOLUTION: TRUE GAINS FOR EUROPE.

MODEL SUBSCRIBED TO BY THE UNITED STATES	MODEL SUBSCRIBED TO BY EUROPE			
	MCM	VAR	OECD	LINK
MCM				
MODEL REPRESENTING REALITY:				
MCM	-77.2052	60.1925	-70.5512	-72.3227
VAR	203.9442	-9.8339	120.2067	130.9411
OECD	-10.1212	12.2112	-12.0524	-12.0128
LINK	-11.4224	13.2347	-12.7891	-12.8286
VAR				
MODEL REPRESENTING REALITY:				
MCM	-77.3318	99.8204	-77.2838	-75.5238
VAR	73.8551	-8.9516	71.1615	57.7137
OECD	-11.1399	15.8816	-11.1755	-11.1096
LINK	-12.2419	20.2481	-12.3686	-12.6859
OECD				
MODEL REPRESENTING REALITY:				
MCM	-77.2195	60.4137	-71.5020	-72.6865
VAR	188.5202	-9.8289	115.8803	123.0370
OECD	-10.4069	12.2321	-12.0093	-11.9889
LINK	-11.5336	13.2740	-12.7991	-12.8182
LINK				
MODEL REPRESENTING REALITY:				
MCM	-77.2146	56.6418	-71.2662	-72.5907
VAR	193.8318	-9.9146	116.9776	125.1267
OECD	-10.3120	11.8780	-12.0207	-11.9965
LINK	-11.4956	12.6047	-12.7972	-12.8211