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14 Economic Cooperation and Confrontation between Europe and the U.S.A.: A Game-Theoretic Approach to the Analysis of International Monetary and Trade Policies

Giorgio Basevi, Paolo Kind, and Giorgio Poli

14.1 Introduction

The theory of international economic policy has taken on a new dimension in the last few years with the application of game theory to the analysis of standard problems of international coordination of monetary and fiscal policies. Research in this field has evolved from the assumption of rather simple types of strategic interaction in a static framework to more sophisticated applications of dynamic game theory.[1]

The authors who follow this approach in analyzing problems of international economic coordination have always assumed—at least to our knowledge—that the policy authorities either cooperate completely in the process of optimizing their objective functions or do not cooperate at all. In the real world, however, countries cooperate in some fields or for certain purposes while they go their own ways in other fields or for other purposes. A recent and striking example of this was the new wave of cooperation that was expected to emerge and did, at least initially, in international monetary affairs after the meeting of the Group of Five in September 1985. While this movement toward mon-

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etary cooperation was taking place, countries continued to wage war in the area of trade.

Countries involved in international cooperation do not appear to have consistent views on who should reflate demand, and how it should be done, in order to eliminate trade imbalances and avoid an international recession. This confrontation in the *real* field, if allowed to continue, might halt the process of international cooperation in the *monetary* field. Actually, there are signs that this may already be the case.

More intriguing, yet alarming, is the related possibility that monetary cooperation that is not accompanied by cooperation in other fields may strengthen the forces that push for confrontation in the real field. In other words, uncooperative solutions may be superior to partially cooperative ones.

Clearly, economic analysis of these possibilities requires the abandonment of a dichotomous approach to the theory of international economic policy—that is, complete cooperation versus no cooperation at all—in favor of the identification of different levels of economic objectives and the possibility of the coexistence of cooperation at one level with conflict at another.

In section 14.2, we present a model built around this idea that accounts for the coexistence of cooperation and confrontation between groups of countries. We deal mainly with two groups of countries: the "U.S." on one side, and the "EC" on the other. The EC is assumed to consist of two ideal countries, "Germany" and "Italy." They generally cooperate between themselves at all levels, except when monetary cooperation takes place only between Germany and the U.S. In contrast, even when all three countries cooperate at the monetary level, the U.S. and the EC are assumed to be in conflict at the real level.

In section 14.3, we identify a number of strategies and resulting games that the two blocs and the three countries may play in response to an exogenous shock, represented by a negative supply shift in all countries. We then compute the resulting effects on the endogenous variables and on the loss functions of the three countries. We identify gains and losses that result both from the coexistence of cooperation and confrontation and from the different trade and monetary arrangements that constrain the various solutions.

The trade constraints that we concentrate on are caused by the use of the most-favored-nation principle, under which a tariff levied by a country on its imports does not discriminate between exporting countries. However, an exception to this principle is introduced in some of the games, with the European countries applying a zero tariff to their reciprocal trade. In these games, the two European countries are constrained to use a joint tariff vis-à-vis the United States. In other words, they form a customs union like the EC, not just a free trade area.

Monetary constraints result from the decision of the three countries to stabilize the main exchange rate in the system: the DM/$ rate. In addition, the three countries, particularly the European ones, wish to stabilize the intra-European exchange rate, the lira/DM rate. This is similar to the European Monetary System (EMS) in diluted form. Alternatively, the fact that all three countries care in different ways about both exchange rates is an expression of their aim to stabilize their individual effective exchange rate.[2]

In the model, the decision to manage the main exchange rate (the DM/$) may be undertaken cooperatively by all three countries, or by the United States and Germany only. Thus, we attempt to reproduce at a simplified level the recent tensions and problems that have arisen over the question of how large the group of countries involved in monetary consultation and coordination should be.

After the initial meeting of the Group of Five (G-5) countries in New York in September 1985, some major industrialized countries, in particular, Canada and Italy, complained about their exclusion from that group. As a result, the G-5 was enlarged to the G-7, at least for some purposes and at the official level. In this paper, we attempt to model this situation and its possible consequences by having games played cooperatively at the monetary level, either by two (the G-2) or all three countries (the G-3), while maintaining different cooperative or uncooperative aggregations or disaggregations of countries at the real level.

In section 14.4, we draw conclusions from our analysis and point out directions for additional research.

14.2 The Model

Our three ideal countries[3] are labeled the U.S. (country 1), Germany (country 2), and Italy (country 3). Their economic structure is specified with a static system of log linear equations. All variables are expressed as differences from their equilibrium values. Each country is assumed to produce a homogeneous product, q, according to the following supply functions:

$$(1) \qquad q_i = -\eta_i(w_i - p_i) + v_{si} \qquad \text{for } i = 1,2,3$$

where w_i and p_i are the nominal wage and the deflator of domestic product in each country i, while the terms v_{si} represent possible exogenous shocks to the supply functions.

Supplies of labor are assumed to be perfectly elastic with respect to nominal wages up to the equilibrium level of employment, which corresponds to full employment. Nominal wages are rigid downward under unemployment conditions, but they react through explicit or implicit

indexation to the consumer price index, which is a weighted average of the prices of domestic and foreign products:

$$(2) \qquad \begin{aligned} w_i &= \xi_i \left[\gamma_{ii} p_i + \sum_{j \neq i} \gamma_{ij}(p_j + e_{ij} + t_{ij})\right] + v_{li} \\ &= \xi_i p_{ci} \qquad \text{for } i,j = 1,2,3 \end{aligned}$$

where e_{ij} is the exchange rate between currencies i and j, and t_{ij} is the tariff rate applied by country i on imports from country j. The weights γ_{ij} add up to unity over all j. The parameters ξ_i are the only source of monetary nonneutrality in the model; monetary policies affect real variables only insofar as the values of the parameters ξ_i are smaller than unity.

Aggregate demand for the product of a country is a function[4] of each country's output, relative net prices, tariff rates, and the real rate of interest (equal to the nominal one in this static model):

$$(3) \qquad \begin{aligned} q_i = &\sum_j \delta_{ij} q_j + \sum_{j \neq i} \alpha_{ij} \theta_{ij} + \sum_{j \neq i} \alpha'_{ij} t_{ij} \\ &- \sum_{j \neq i} \alpha''_{ij} t_{ji} - \beta_i i_i + v_{di} \qquad \text{for } i,j = 1,2,3 \end{aligned}$$

where the i_i are rates of interest (not in logarithms), the v_{di} are possible exogenous shocks on demand (such as changes in fiscal policy), while θ_{ij} are real bilateral exchange rates defined as:

$$(4) \qquad \theta_{ij} = p_j + e_{ij} - p_i.$$

Assuming static expectations and perfect substitutability of financial assets issued by different countries and in different currencies, interest rates stay at parity. Thus:

$$(5) \qquad i_1 = i_2 = i_3.$$

The money markets always clear, with demands for money assumed to be standard functions of the real product, its price level,[5] and the rate of interest, plus a possible exogenous shock:

$$(6) \qquad m_i = p_i + \mu_i q_i - \lambda i_i + v_{mi} \qquad \text{for } i = 1,2,3.$$

The system is closed by the objective functions that the authorities of the three countries try to optimize.

In the first set of games, used as standards of reference for the games in the second set, these functions are attributed to a unique policymaking authority within each country. In the second set of games, the objective functions, which are additive in logarithms, are split into two separate functions (corresponding to the two subsets of target and instrument variables) that are aimed at, or controlled by, the two different policymaking authorities within each country.

At the "monetary" level, the authorities aim at minimizing deviations of the consumer price index from its equilibrium value. They also manage the DM/$ rate, trying to minimize deviations from its equilibrium value, possibly because of some international agreement similar to the G-5 cooperation. Similarly, they monitor the lira/DM rate because this makes up—directly or indirectly, through cross rates—their effective (weighted) exchange rate, or because—in the case of Germany and Italy—they are specifically committed to closer management of the intra-European exchange rate, or for both reasons. Their instrument of control is the money supply.

At the "real" value, the authorities aim at minimizing deviations of real product from its equilibrium value. They use tariffs on trade to optimize the real objective function.

We assume the following basic objective functions:

$$(7) \quad L_i = -[w_{pi}p_{ci}^2 + w_{qi}q_i^2 + w_{DMi}e_{21}^2 + w_{Li}e_{32}^2] \qquad \text{for } i = 1,2,3$$

which can be split into pairs of monetary and real objective functions:

$$(8) \quad M_i = -[w_{pi}p_{ci}^2 + w_{DMi}e_{21}^2 + w_{Li}e_{32}^2]$$

$$(9) \quad R_i = -[w_{qi}q_i^2] \qquad \text{for } i = 1,2,3.$$

The M-functions may be the object of cross-Atlantic cooperation, while the R-functions are more likely to be an area of Euro-American conflict, but of cooperation within the EC.

Splitting the objective functions into two additive components[6] lays the groundwork for analyzing the consequences of limiting cooperation to monetary and exchange-rate matters or enlarging cooperation to real areas. In fact, movement toward closer cooperation among the major industrialized countries in money and exchange rates seemed to have occurred after the 1980–85 period of strong appreciation of the dollar and highly differing inflation rates.[7] However, while these countries—or, more precisely, certain authorities among the countries' decision makers, such as central bankers and treasury ministers—were still trying to cooperate on money and exchange rates, they were threatening each other with protectionist moves and various types of commercial warfare in the real field. This can happen because nonmonetary government authorities, or parliaments, do not play the cooperative game in the real field that the monetary authorities in those same countries are trying to arrange in the monetary field. It can also happen because the countries that should cooperate in the real field are a larger or different set from those countries that cooperate in the monetary field.

14.3 Policy Reactions to an Exogenous Shock

To analyze the reaction of the three countries' policy authorities under alternative strategies, and to study the consequences of partial international cooperation—in other words, cooperation limited either to a subset of targets or to a subset of countries, or both—we compute numerical solutions of the model under the assumption that all three countries are hit by an exogenous 10 percent fall in the level of supply. This shock is designed to represent a type of deviation from full employment that the authorities should try to offset, and could result from an exogenous increase in the price of oil or other raw materials.

The authorities in the three countries are assumed to respond to this shock according to policy strategies, and may be under bonds of international economic alliances that give rise to a number of alternative games. Of the numerous games that result, even under the simple assumption that strategies are either cooperative or Cournot-Nash uncooperative, we choose those that seem most interesting from the point of view of this paper, and list them in table 14.1.

The first two sets of games in table 14.1 (games 1 and 2) are a standard of reference for the sets of games 4 through 6. Games 1 and 2 are characterized by optimization of a single objective function in each country; in other words, there is full cooperation among policy authorities within every country, and countries may cooperate internationally. Games 3 are an intermediate step toward splitting the objective function into two layers, monetary and real. Cooperation or confrontation is limited to the monetary level, but countries have no objectives other than monetary ones. In contrast, games 4 through 6 are characterized by the existence within each country of two centers of economic policy, monetary and real. For reasons already explained, they do not cooperate internally. These two policy authorities may cooperate internationally with the corresponding authorities of one or both remaining countries.

When the two European countries cooperate at both levels, we refer to them as the EC. When they do so at the real level only, we refer to them as the EEC. When they only cooperate on the monetary level, we label them the EMS.

We are mainly interested in games 4 through 6. In games 4 there is confrontation between Europe and the U.S. in both fields, monetary and real. Games 5 and 6 are designed to analyze the possible consequences of monetary cooperation, unmatched by real cooperation. The monetary agreements are obtained either within a restricted group of countries (here two, standing for the G-5) that does not coincide with the group where cooperation in the real field is discussed and possibly enforced (games 6); or, monetary cooperation is negotiated within a

Table 14.1 Alternative Games Played by the U.S., Germany, and Italy

1. A single objective function in each country.
   —active instruments: money supplies only
   1.1. All three countries cooperate
   1.2. No country cooperates: overall Nash game
   1.3. European countries cooperate: Nash game EC vs. U.S.

2. A single objective function in each country.
   — active instruments: money supplies and tariff rates
   — cross-Atlantic confrontation
   2.1. No country cooperates: overall Nash game
   2.2. European countries cooperate: Nash game EC vs. U.S.

3. Two objective functions in each country.
   — only the monetary objective functions are optimized
   — active instruments: money supplies only
   3.1. All three countries cooperate
   3.2. No country cooperates: overall Nash game
   3.3. European countries cooperate, Nash game EMS vs. U.S.

4. Two objective functions in each country.
   —monetary and real objective functions optimized separately
   —active instruments: money supplies for M-functions
   tariff rates for R-functions
   — cross-Atlantic monetary and real confrontation
   4.1. No country cooperates, either at the M- or the R-level
   4.2. European countries cooperate at the R-level: EEC vs. U.S.
   4.3. European countries cooperate at the M-level: EMS vs. U.S.
   4.4. European countries cooperate at M- and R-levels: EEC = EMS vs. U.S.

5. Two objective functions in each country.
   — monetary and real objective functions optimized separately
   — active instruments: money supplies for M-functions
   tariff rates for R-functions
   — cross-Atlantic monetary cooperation: G-3
   — cross-Atlantic real confrontation
   5.1. All countries cooperate at M-level, none at R-level
   5.2. All countries cooperate at M-level, EEC vs. U.S. at R-level

6. Two objective functions in each country.
   — monetary and real objective functions optimized separately
   — active instruments: money supplies for M-functions
   tariff rates for R-functions
   — cross-Atlantic monetary cooperation: G-2
   — cross-Atlantic real confrontation
   6.1. U.S.-German cooperation at M-level, no cooperation at R-level
   6.2. U.S.-German cooperation at M-level, EEC vs. U.S. at R-level

larger group of countries (here three, standing for the G-7) than those involved in real cooperation (games 5).

Trade-offs between objectives may have to be accepted by the different countries and in the different games because of the inadequacy of instruments of economic policy. For example, if exchange rates were not arguments of the objective functions nor policy instruments, then in game 1.3 the U.S. would have two objectives, price and output level, and one instrument, money supply. The EC countries would have four objectives, their price and output levels, and two instruments, their two money supplies. Thus, no country or bloc of countries could fully reach the best situation in terms of their objective functions.

Assume now that the DM/$ rate is also an argument of the objective functions. Then in game 5.2, none of the three countries could reduce its loss to zero in terms of the *M*-function. There are four objectives, three consumer price indexes and the DM/$ exchange rate, that are pursued in cooperation. But there are only three instruments, the three money supplies. All three countries must carry a loss in some degree. However, in terms of the *R*-functions, the U.S. theoretically could reach zero loss: it has one instrument, the tariff rate vis-à-vis the EC for one objective, the level of its own real product. The optimum can be reached, unless the instrument also enters the U.S. loss function.[8]

Germany and Italy, in contrast, could not reach their bliss points on the *R*-functions because of their commitment to use a common external tariff in order to aim cooperatively at two objectives: their respective real products. In other words, even though Germany and Italy cooperate in game 5.2 in their policy against the U.S., they have to pay for their formation of a customs union. Adding another instrument—such as the tax on capital movements analyzed in Basevi, Kind, and Poli (1986)—should allow Germany and Italy to also reach the bliss point, because they then would have two instruments for two objectives (unless these instruments also enter their objective functions).

Before interpreting the results, we should make explicit our assumptions about the parameters of the model that characterize the structures of the three economies. We have used reasonable values based on economic theory and the size and structure of the countries involved. The parameters are reported in table 14.2.

In the second row of table 14.2, we see that Italian wages are more responsive to consumer prices than U.S. and German wages. From the main diagonal in the γ_{ij} matrix, we also see that the U.S. economy is the most closed of the three; Italy's is the most open.

The bottom section of the table presents the weights that the three countries attribute to targets (and to a policy instrument, the tariff rate) in their objective functions. Italy is the least concerned with inflation, Germany the most. For the output target the opposite is true. The

Table 14.2 Parameters of the Model with "Realistic" Values

		U.S.	Germany	Italy	ROW
	η_i	0.75	0.75	0.75	—
	ξ_i	0.5	0.5	0.7	—
U.S.		0.75	0.10	0.02	0.13
Germany	γ_{ij}	0.13	0.65	0.10	0.12
Italy		0.15	0.15	0.55	0.15
U.S.		—	0.065	0.025	—
Germany	α_{ij}	0.20	—	0.05	—
Italy		0.12	0.30	—	—
U.S.		—	0.10	0.02	—
Germany	α'_{ij}	0.13	—	0.10	—
Italy		0.15	0.15	—	—
U.S.		—	0.065	0.025	—
Germany	α''_{ij}	0.20	—	0.05	—
Italy		0.12	0.30	—	—
	β_i	0.5	0.5	0.5	—
U.S.		0.6375	0.0552	0.0212	—
Germany	δ_{ij}	0.17	0.5525	0.0425	—
Italy		0.102	0.255	0.4675	—
	μ_i	1.0	1.0	1.0	—
	λ_i	1.0	1.0	1.0	—
Weights:					
Relative GDP		0.3	0.15	0.05	0.5
	w_{pi}	0.4	0.5	0.25	—
	w_{qi}	0.47	0.29	0.55	—
	w_{ti}	0.02	0.04	0.05	—
	w_{DMi}	0.086	0.136	0.03	—
	w_{Li}	0.024	0.034	0.12	—

Notes: α_{ij}, α'_{ij}, α''_{ij}, and δ_{ij} are combinations of structural parameters as shown in the Appendix and in Kind (1986).
ROW = rest of the world

weights of the tariff rates are roughly proportional to the openness of each economy to foreign trade. As for managing the exchange rates, Germany cares most about the DM/$ rate, while Italy mainly looks to the lira/DM rate. However, by giving weight to the DM/$ rate, Italy also attributes a high implicit weight to the lira/$ rate. In fact, the implicit weights used are proportional to the share of the consumer price index represented by imports from the countries whose currencies are exchanged against the domestic one.

The main results of our numerical simulations are presented in tables 14.3, 14.4, and 14.5. They exclude the set of games 2 shown in table 14.1, since these games give rise to unstable equilibria. They also exclude games 3 in table 14.1 because the results of those games are

Table 14.3 **Responses to a 10 Percent Overall Fall of Aggregate Supply**

Games:		1.1	1.2	1.3
U.S.	$ effective rate	0.73	1.41	1.06
	output deflator	4.72	3.83	3.90
	c.p.i.	4.16	3.42	3.46
	output	−1.81	−3.34	−3.20
	money supply	1.80	−1.40	−1.10
	L-loss function	49.23	58.75	56.44
	M-loss function	40.14	28.32	28.53
	R-loss function	9.09	30.43	27.91
Germany	DM/$ rate	−0.76	−1.50	−1.19
	output deflator	4.35	3.05	3.26
	c.p.i.	3.72	2.41	2.64
	output	−2.26	−4.17	−3.91
	money supply	1.00	−3.00	−2.44
	L-loss function	24.62	23.95	23.64
	M-loss function	20.29	9.42	10.86
	R-loss function	4.33	14.53	12.78
Italy	Lira/DM rate	0.22	0.50	0.79
	output deflator	5.10	3.66	4.13
	c.p.i.	4.02	2.81	3.34
	output	−2.91	−4.68	−4.37
	money supply	1.09	−2.89	−2.02
	L-loss function	8.43	13.52	12.87
	M-loss function	3.91	2.02	2.81
	R-loss function	4.52	11.50	10.06

Rankings (loss functions weighted by countries' (GDP):
L-loss functions
U.S.: 1.1 > 1.3 > 1.2
Ger.: 1.3 > 1.2 > 1.1
Ita.: 1.1 > 1.3 > 1.2

Note: Among these three games
—full cooperation (1.1) with compensation to Germany is first-best
—Nash confrontation between U.S. and EC (1.3) is second-best
—overall Nash confrontation (1.2) is third-best

intermediate between games 1 and games 4–6 in terms of losses. In tables 14.3, 14.4, and 14.5, the values of the loss functions are already weighted by the respective countries' GDP, in order to allow for welfare comparisons.

In table 14.3, we see that keeping both monetary and real objectives under unified control results in a better overall performance in each country, relative to splitting the two layers of objectives as in games 4–6. However, from the point of view of the monetary objectives, the *M*-loss functions have higher values for all countries in games 1 than in all the other games. In other words, if coordination of monetary

Table 14.4 Responses to a 10 Percent Overall Fall of Aggregate Supply

Games:		4.1	4.2	4.3	4.4
U.S.	$ effective rate	−0.39	−0.32	−0.36	−.030
	output deflator	−0.31	−0.32	−0.32	−0.34
	c.p.i.	0.22	0.23	0.21	0.22
	output	−11.38	−11.46	−11.41	−11.49
	money supply	−18.94	−18.93	−19.00	−19.00
	tariff rate	5.81	5.85	5.82	5.86
	L-loss function	331.70	336.08	333.24	337.89
	M-loss function	0.21	0.18	0.17	0.16
	R-loss function	331.49	335.90	333.06	337.73
Germany	DM/$ rate	0.29	0.32	0.28	0.30
	output deflator	−1.36	−1.37	−1.38	−1.39
	c.p.i.	−0.36	−0.43	−0.37	−0.45
	output	−13.94	−13.85	−13.98	−13.89
	money supply	−22.95	−22.74	−23.03	−22.84
	tariff rate	3.42	4.55	3.43	4.57
	L-loss function	149.77	149.01	150.56	149.93
	M-loss function	0.27	0.32	0.26	0.34
	R-loss function	149.50	148.69	150.30	149.59
Italy	Lira/DM rate	0.60	0.04	0.42	0.00
	output deflator	−2.32	−1.60	−2.47	−1.66
	c.p.i.	−0.69	−0.35	−0.86	−0.41
	output	−16.15	−14.54	−16.24	−14.60
	money supply	−26.52	−23.78	−26.82	−23.93
	tariff rate	1.55	4.55	1.56	4.57
	L-loss function	123.54	102.45	124.93	103.20
	M-loss function	0.17	0.03	0.21	0.05
	R-loss function	123.37	102.42	124.73	103.15

Rankings (loss functions weighted by countries' GDP):

M-loss functions

U.S.: 4.4>4.3>4.2>4.1
Ger: 4.3>4.1>4.2>4.4
Ita: 4.2>4.4>4.1>4.3

R-loss functions

U.S.: 4.1>4.2>4.3>4.4
Ger: 4.2>4.1>4.4>4.3
Ita: 4.2>4.4>4.1>4.3

L-loss functions

U.S.: 4.1>4.3>4.2>4.4
Ger.: 4.2>4.1>4.4>4.3
Ita: 4.2>4.4>4.1>4.3

Note: Among these three games, after internal "compensation," and with reference to *L*-functions

— 4.2 is first-best, with compensation to the U.S.
— 4.4 is second-best, with Italy compensating the U.S. and Germany
— 4.1 is third best

Table 14.5 Responses to a 10 Percent Overall Fall of Aggregate Supply

Games:		5.1	5.2	6.1	6.2
U.S.	$ effective rate	−0.29	−0.25	−0.33	−0.27
	output deflator	−0.37	−0.39	−0.22	−0.35
	c.p.i.	0.18	0.19	0.29	0.22
	output	−11.51	−11.60	−11.21	−11.52
	money supply	−19.24	−19.24	−18.55	−19.06
	tariff rate	5.87	5.91	5.72	5.87
	L-loss function	338.92	343.67	322.47	339.19
	M-loss function	0.12	0.11	0.28	0.15
	R-loss function	338.80	343.56	322.19	339.05
Germany	DM/$ rate	0.24	0.25	0.23	0.25
	output deflator	−1.46	−1.48	−1.28	−1.43
	c.p.i.	−0.44	−0.54	−0.31	−0.50
	output	−14.12	−14.04	−13.75	−13.94
	money supply	−23.35	−23.17	−22.54	−22.96
	tariff rate	3.46	4.61	3.38	4.57
	L-loss function	153.57	153.08	145.91	150.97
	M-loss function	0.32	0.45	0.20	0.40
	R-loss function	153.25	152.62	145.71	150.57
Italy	Lira/DM rate	0.35	0.03	0.56	0.08
	output deflator	−2.63	−1.75	−2.24	−1.65
	c.p.i.	−1.01	−0.47	−0.67	−0.38
	output	−16.43	−14.73	−15.94	−14.62
	money supply	−27.30	−24.25	−26.10	−23.96
	tariff rate	1.58	4.61	1.53	4.57
	L-loss function	127.61	104.97	120.60	103.42
	M-loss function	0.27	0.06	0.15	0.04
	R-loss function	127.34	104.91	120.45	103.38

Rankings (loss functions weighted by countries' GDP):

M-loss functions
- U.S.: 5.2>5.1>6.2>6.1
- Ger: 6.1>5.1>6.2>5.2
- Ita: 6.2>5.2>6.1>5.1

R-loss functions
- U.S.: 6.1>5.1>6.2>5.2
- Ger: 6.1>6.2>5.2>5.1
- Ita: 6.2>5.2>6.1>5.1

L-loss functions
- U.S.: 6.1>5.1>6.2>5.2
- Ger.: 6.1>6.2>5.2>5.1
- Ita: 6.2>5.2>6.1>5.1

Note: Among these three games, after internal "compensation," and with reference to *L*-functions
- —4.2 is first-best, with compensation to the U.S.
- —4.4 is second-best, with Italy compensating the U.S. and Germany
- —4.1 is third-best

policy were to be left in the hands of monetary authorities with monetary objectives only, things would improve from their limited point of view but deteriorate in terms of the overall loss functions. This would even occur under games 3, with no active use of tariffs.

Table 14.3 shows that, within games 1, full cooperation is the most efficient policy from the point of view of the three countries together. The bliss point still cannot be reached because there are not enough instruments. However, Germany would fare better under confrontation between the EC and the U.S. The U.S. and Italy together get enough advantage from the cooperative situation to be able to compensate Germany for its relative loss. Also, confrontation between the U.S. and the EC (game 1.3) is preferable to a fully uncooperative situation (game 1.2) for all three countries.

In table 14.4, we report the results of game 4.3. This seems an unlikely game because to assume that the European countries cooperate at the monetary level and not at the real level is not in accordance with the institutional predominance of the EEC over the EMS. In practice, however, this may have turned out to have been the case often because of the stricter and easier links between monetary authorities relative to other economic authorities, even within the EC. In any case, game 4.3 does not change the important rankings of the outcomes.

Table 14.4 shows that European cooperation at the real level is the best game in this set, provided that the European countries compensate the U.S. for accepting such a game. Monetary and real cooperation by the European countries is the second-best game, and is preferred to a super-Nash game where all countries go their own way at the real and monetary levels (game 4.1). But Italy must compensate in order to induce the U.S. and Germany to stay out of such a fully uncooperative game.

In table 14.4, the U.S. tariff level does not depend very much on whether the European countries cooperate at the monetary and/or the real level. In all cases, the tariff level is about 5.8 percent. On the other hand, European cooperation, when applied at the real level and possibly at the monetary level (games 4.2 and 4.4), increases the tariff rate that Germany and Italy jointly impose on U.S. exports. This result depends both on the fact that the higher EEC tariff in these games has to offset the zero tariff on intra-European trade, and on the lower weight that Germany attaches to this instrument relative to Italy. In fact, when European cooperation is only monetary (game 4.3), the German and Italian duties fall back to the level of game 4.1 where there is no European cooperation at all.

Table 14.5 focuses on the level of cooperation and how many countries are involved: two, the U.S. and Germany, or all three. First we compare the rankings for the M-loss functions only. When policy is left

to the monetary authorities in games 5 (the G-3 games), European cooperation at the real level (the EEC) is preserved mainly by Italy compensating Germany to make it accept game 5.2. The U.S. also prefers this game to game 5.1.

If all authorities within a country negotiate (in other words, if we also consider the ranking of the *L*-function), it is mainly Italy that must pay to have game 5.2 rather than 5.1. But now the U.S. must be convinced to accept the game. In games 6 (the G-2 games) with policy-making left to the monetary authorities, Germany gains enough in the absence of European cooperation to induce the U.S. to accept 6.1 instead of 6.2. If Italy and the U.S. join, they can compensate Germany for accepting the reverse choice. If all authorities are at the bargaining table (ranking of the *L*-functions), then game 6.1 prevails. In other words, a U.S.-German agreement is formed at the monetary level, with no cooperation at all at the real level.

It turns out that game 6.1 is preferred even when we compare the sets of G-2 and G-3 games together (games 5 and 6 together). Thus, we may conclude, splitting the problem of cooperation at the monetary and real levels can cause European cooperation to fall apart because the two main countries reap advantages from belonging to the exclusive G-2 club.

For Italy, a U.S.-German monetary club accompanied by EC cooperation at the real level (game 6.2) is preferable to a G-3 club on monetary matters (game 5.2). The same conclusion holds in the absence of EC real cooperation (that is, game 6.1 is preferred to game 5.1). This result may explain the lack of interest that Italian economic authorities, and particularly monetary authorities, showed initially toward enlarging the G-5 to G-7 soon after the September 1985 meeting. It was only after a higher political point of view was assumed that the Italians expressed their strong opposition to being left out, and there was some criticism inside the government of the initial coolness shown by the Italian minister of the treasury.

Comparing tables 14.3, 14.4, and 14.5, we see that when centralized control of economic policy is enforced within all three countries (games 1), the shock and the policy response produce relatively small changes in output but large fluctuations in exchange rates and prices. This is not altered much by international cooperation instead of confrontation, whether generalized or cross-Atlantic. However, when monetary authorities explicitly shift their policy to stabilization of prices and exchange rates and disregard output, then the stabilization of prices and exchange rates takes place at the expense of output. Output fluctuates relatively more, even when tariff rates are not used to wage a commercial war (games 3). This may induce nonmonetary authorities to step in and use tariffs, and output will be hurt even more than it was

by the original supply shock (games 4–6). Again, cooperative versus noncooperative monetary policy, either across the Atlantic or within Europe, does not substantially alter this result. Therefore, the declared objective of the monetary authorities—to stabilize exchange rates disregarding, or at the expense of, output—may reinforce the temptation of other authorities within each country to engage in protective measures and possibly to wage an outright commercial war.

14.4 Summary and Conclusions

In this paper, we have built a model and performed numerical simulations in order to analyze the outcomes of strategic interplays that result from two important phenomena. The first is that international economic policy is multidimensional and is played on at least two fields: a monetary one, controlling inflation and exchange rates with monetary policy and exchange rate market interventions, and a "real" field, controlling the level of economic activity and trade with fiscal and commercial policies. The monetary and real authorities who act in these two fields may or may not coordinate their policies internationally. Thus, the traditional dichotomy between international cooperation and confrontation is unrealistic; the two approaches may coexist, with countries cooperating in some fields or for certain purposes, while going their separate ways in other fields or for other purposes. Moreover, because of the relative independence of monetary authorities within a country's political body (and the close and frequent relations that exist between central bankers and treasury ministers at the international level), they are likely to be relatively more prone to international cooperation than the real authorities. In fact, the real authorities represent both governments and parliaments, and are slower and generally less consistent in their formulation of national economic policies. In addition, the institutional frameworks for international meetings of the real authorities are less developed than those for monetary authorities. Thus, international cooperation in the real field is more likely to fail and lead to international confrontation, or at least requires more time than cooperation in the monetary field.

The second phenomenon is that in a multicountry world, monetary cooperation may be undertaken by a large group of major countries (such as the major seven industrialized countries, G-7) or by a subset of them with enough economic or financial weight to be responsible for international monetary affairs (such as the G-5). In the real or monetary field, there may be cooperation within a region (for instance, among the EC countries, or the EMS countries). This raises the possibility of confrontation in the real field with another set of countries (such as the United States and Japan). It may also lead to strains within

the European group in the monetary field over complying with the decisions made by a few EC members who also belong to the more exclusive club (such as Germany and France deciding for the EMS, or Canada having to acquiesce in the decisions of the U.S.). Thus, cooperation and confrontation cut across both different levels of economic policy and different sets of countries.

According to our model, monetary cooperation unaccompanied by real cooperation may reinforce, rather than diminish, the forces that press for confrontation in the real field. Thus, it may lead to protectionism in international trade. Therefore, uncooperative solutions may be superior to partially cooperative ones.

Second, if matters were left to the monetary authorities alone, "Germany" would gain enough from its freedom from European cooperation to induce the "U.S." to form a G-2 club at the monetary level with no European cooperation at the "real" level. The EC would then fall apart, unless "Italy" compensated Germany for keeping EC cooperation at the real level.

Third, a G-2 club between the U.S. and Germany with non-EC cooperation at the real level is relatively preferable when based on both monetary and real objectives. Moreover, it is preferable even when we compare the sets of outcomes of G-2 and G-3 (when all three countries cooperate at the monetary level). Thus, dealing separately with the problem of cooperation at the monetary and real levels can cause European cooperation to fall apart because of the advantages that the two main countries reap from belonging to the exclusive G-2 club.

A fourth interesting result is that, for Italy, a U.S.-German monetary club accompanied by EC cooperation at the real level is preferable to a G-3 club on monetary matters, with or without cooperation within the EC at the real level.

Clearly, the results depend on the theoretical model used, the structural parameters assumed, and the set of strategies selected. Further research should be directed at making the model more realistic, and in particular, at introducing dynamics into the model (with the resulting need to design sequential games). In terms of strategies, the analysis should be extended to games of leadership and should look more closely at the formation of clubs and the relative importance of different layers of authorities in different fields of economic policy.

Appendix

The purpose of this appendix is to derive formally the expressions given in the text for the deviations in the levels of aggregate demand from their equilibrium values.

Let the demand for the output of country i be given by

$$Q_i = \gamma_{ii}A_i + \sum_{j \neq i}\gamma_{ji}\frac{E_{ij}P_j}{(1 + t_{ji})P_i}A_j + G_i \tag{10}$$

where A_i denotes the level of private aggregate expenditure in country i measured in terms of domestic output Q_i, γ_{ji} is the share of A_j falling on the products of country i, E_{ij} is the nominal exchange rate between country i and country j (in other words, the units of currency i per unit of currency j), P_i is the domestic currency price of one unit of domestic output Q_i, t_{ji} is the tariff imposed by country j on the imports from country i, and G_i is the sum of all countries' government expenditures on the products of country i.

At the original steady state equilibrium we assume that each country's net asset position, trade balance, government expenditures, and taxes are all zero, and the value of private aggregate expenditures A_i is thus equal to the steady state equilibrium level of output $\bar{Q}_i$. It follows that, at the steady state,

$$\bar{Q}_i = \gamma_{ii}\bar{Q}_i + \sum_{j \neq i}\gamma_{ji}\frac{E_{ij}P_j}{P_i}\bar{Q}_j \tag{11}$$

and, letting $w_{ji} = E_{ij}P_j\bar{Q}_j / (P_i\bar{Q}_i)$ denote the relative size of countries j and i, from the trade-balance equilibrium condition we have for each i

$$1 - \gamma_{ii} = \sum_{j \neq i} w_{ji}\gamma_{ji}. \tag{12}$$

Totally differentiating (10) around its steady state equilibrium (11) and dividing through by $\bar{Q}_i$ we obtain

$$q_i = \gamma_{ii}da_i + \sum_{j \neq i} w_{ji}\gamma_{ji}da_j + d\gamma_{ii} + \sum_{j \neq i} w_{ji}d\gamma_{ji} + \sum_{j \neq i} w_{ji}\gamma_{ji}(\theta_{ij} - t_{ji}) + dG_i/\bar{Q}_i, \tag{13}$$

where q_i, da_i, and θ_{ij}, respectively, represent the percentage deviations of Q_i, A_i, and the real exchange rates net of tariffs (in other words, $E_{ij}\,P_j/P_i$) from their equilibrium values. As to the percentage changes in private expenditures, da_i, one can show from the solution of a representative individual's intertemporal utility-maximization problem[9] that these will in general depend positively on the changes in current and present discounted values of future disposable income, negatively on the changes in the real rate of interest measured in terms of the domestically produced good, and either positively or negatively on the expected rates of change in the relative prices of foreign goods, depending on the concavity of the individual's instantaneous utility function (in other words, on whether the elasticity of intertemporal substitution is greater or less than one). In the present model we assume

static expectations, disregarding the effects of future changes in prices. We then write

$$da_i = c_i y_i - \beta_i i_i, \tag{14}$$

where c_i denotes the marginal propensity to consume out of changes in current disposable income y_i, β_i is the semi-interest-rate elasticity of aggregate consumption, and i_i is the deviation of country i's real rate of interest from the steady-state level $\bar{i}$. Assuming that individuals discount all future tax liabilities, the percentage change in current disposable income will then be given by

$$y_i = q_i - [g_i - \sum_{j \neq i} \gamma_{ij} t_{ij}], \tag{15}$$

where the expression in brackets represents the excess of country i's government spending over tariff revenues as a percentage of domestic income $\bar{Q}_i$.

In order to simplify our final expressions, two assumptions can now be made. First, we will assume that in each country all tariff revenues are spent by the government and all government spending falls entirely on the domestic product. Second, we will assume a unitary elasticity of substitution in the private sector's instantaneous utility function, so that, aside from exogenous shifts in tastes (which may represent another possible source of external shock in the model), all expenditure shares γ_{ij} are independent of relative prices (in other words, $d\gamma_{ij} = 0$).

Under these assumptions, and substituting (14) and (15) into (13), we then obtain:

$$\begin{aligned} q_i = {} & \gamma_{ii} c_i q_i + \sum_{j \neq i} w_{ji} c_j q_j - \gamma_{ii} \beta_i i_i - \sum_{j \neq i} w_{ji} \gamma_{ji} \beta_j i_j \\ & + \sum_{j \neq i} w_{ji} \gamma_{ji} \theta_{ij} + \sum_{j \neq i} \gamma_{ij} t_{ij} - \sum_{j \neq i} w_{ji} \gamma_{ji} t_{ji} \\ & + (1 - \gamma_{ii} c_i) \tilde{g}_i - \sum_{j \neq i} w_{ji} \gamma_{ji} c_j \tilde{g}_j, \end{aligned} \tag{16}$$

where $\tilde{g}_i$ represents the excess of government spending over tariff revenues. Alternatively, assuming, for all countries, (1) static expectations ($i_i = i_j$), (2) $\beta_i = \beta$, and (3) $\tilde{g}_i = 0$, we have, using (12):

$$\begin{aligned} q_i = {} & \gamma_{ii} c_i q_i + \sum_{j \neq i} w_{ji} \gamma_{ji} c_j q_j - \beta i_i \\ & + \sum_{j \neq i} w_{ji} \gamma_{ji} \theta_{ij} + \sum_{j \neq i} \gamma_{ij} t_{ij} - \sum_{j \neq i} w_{ji} \gamma_{ji} t_{ji}, \end{aligned} \tag{16'}$$

which can be written compactly as equation (3) in the text.

Notes

1. Many contributions have appeared in this area after the path-breaking work by Hamada (1976), revisited in Hamada (1985). Except for the most recent ones, these contributions have been surveyed by Cooper (1984). The volume by Buiter and Marston (1985) mainly deals with the dynamic aspects of the theory. The present paper continues in the line of research followed by Canzoneri and Gray (1985), Giavazzi and Giovannini (1985), Melitz (1985), Oudiz (1985), and Canzoneri and Henderson (1986). It is written in the spirit of the criticism that Kenen (1986) addresses to this literature as being too often detached from institutional and policy-oriented problems.

2. In Basevi, Kind, and Poli (1986), we pay more attention to problems of the European Monetary System, particularly with respect to the use of controls (taxes) on capital movements, within and without the EMS, as instruments of economic policy in addition to the monetary and commercial ones discussed here.

3. In the numerical simulations of the model that are the basis of this paper, the set of countries is extended to four, the fourth one being the rest of the world. This "country" enters with the price of its product assumed to be set exogenously but denominated in dollars. Thus, its price changes endogenously in terms of marks or lire when these currencies' exchange rate changes vis-à-vis the dollar. The consumer prices of the three countries depend also on the share spent on the product of the fourth one and on its dollar price converted into domestic currency price. Moreover, the real bilateral exchange rates against the fourth country also affect the demand for the products of the three endogenous countries.

4. For the theoretical derivation of aggregate demand from consumer theory, see the Appendix. As explained in note 3, demands for products are also affected by the real exchange rates vis-à-vis a fourth residual country (the rest of the world).

5. Deflating the nominal quantity of money with the consumer price index does not substantially alter the results of our analysis.

6. In Alesina and Tabellini (1986), there is also a game involving more than one policy authority, but this game remains internal to a country and is played among monetary authorities, fiscal authorities, and wage-setters. In Rogoff and Sibert (1986), the game is between the current and the future government of a country. In contrast, our model is designed to describe situations in which the policy authorities of a country may not cooperate internally, while at the same time each of them may coordinate its actions internationally with the corresponding authorities of another country or set of countries.

7. This closer cooperation has occurred particularly since the G-5 meeting of September 1985 in New York, the G-7 summit of May 1986 in Tokyo, and more recently (October 1986) the informal agreement between the United States and Japan to the effect of limiting further depreciation of the dollar vis-à-vis the yen. Unfortunately, our three-countries model cannot deal more realistically with the problems arising from confrontation or cooperation among at least three blocs of countries, such as the U.S., the EC and Japan, unless we abandon the focus on intra-EC relations. A more extended model in terms of countries would clearly give rise to a much larger set of possible games. Yet, even the simplified three-countries model used here, and the consideration of cooperative or Cournot-Nash uncooperative games only, allows a much larger number of combinations than those presented and analyzed in this paper.

8. In order to get stability of the games played in this model, it must be assumed that the tariff rates enter with enough weight in the objective functions of the countries that use such instruments. The equilibrium solutions obtained with zero-cost tariffs are unstable.

9. See P. Kind (1986).

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