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Monetary Policy Coordination Within the EMS : Is There a Rule ? (*)

by Massimo Russo and Giuseppe Tullio

Internal paper

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(*) A first draft of this paper was written when the authors were, respectively, Director General and Economic Adviser, Directorate General for Economic and Financial Affairs, Commission of the European Communities, Brussels. Mr. Russo is now Director of the European Department at the International Monetary Fund, Washington D.C., and Mr. Tullio is a member of the Research Department of the Bank of Italy, Rome. Appendix II was written by Eric de Souza in collaboration with Giuseppe Tullio.

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I N D E X

I. Introduction (**)

By drawing on the analysis of the role of monetary policy in balance of payments adjustment under different monetary systems and exchange rate arrangements, this paper aims at focussing on the crucial issues involved when attempting to set rules for monetary policy coordination in a system of fixed but adjustable exchange rates such as the EMS. A proper functioning of the balance of payments adjustment mechanism is crucial for the stability of an exchange rate system. In turn, the proper working of the adjustment mechanism can be sought either through "rules" which make the adjustment automatic or through prompt "discretionary" changes in monetary policy, which requires a close degree of cooperation among the central banks of the member currencies (and the political willingness to subordinate, when necessary, internal objectives to the external constraint).

After recalling the main lessons from the gold standard and the Bretton Woods system, the analysis will focus on the EMS as it works at present. These are all systems of fixed but, in different degrees, adjustable exchange rates (1). In Part II the two main lessons from the earlier international monetary regimes are summarized, that is : first, that in a system of fixed exchange rates the money supply of at least n-1 participants must remain endogenous, if the adjustment mechanism is to work smoothly. To put it differently, a fixed monetary rule for the total stock of money (but not for the domestic component of the monetary base) is incompatible with a system of fixed exchange rates, unless such a rule is reserved implicitly or explicitly to a recognized leader of the system. Second, a stable system needs a rule governing "world" inflation or, however measured, the inflation target of the group of countries participating in it as well as a rule governing the reaction of countries' economic policies to deviation of actual inflation from the desired path.

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The authors are indebted for comments to their colleagues in the Commission, the Banca d'Italia, and the International Monetary Fund, in particular to Manuel Guitián, and Stefano Micossi, as well as to the other participants in the conference and the discussant Lucas Papademos; but the conclusions are their own and do not necessarily reflect the views of their previous or current employers. Mr. Nouriel Roubini of Harvard University provided extensive and very useful comments, which significantly affected the conclusions.

Part III of the paper is devoted to an analysis of the degree of monetary policy coordination and convergence of inflation and interest rates reached by EMS countries. In particular, we investigate the role of Germany in the fight against inflation and the balance of payments adjustment mechanism within the EMS. No explicit rule concerning inflation exists at present in the EMS. However, there has been an accepted unwritten rule since 1982/83, that is: Germany decides its domestic inflation rate and all other members adopt policies to adjust gradually their own to it, i.e., the German inflation rate has become the target inflation rate of the system.

Part IV deals with the question of how the working of the EMS could be improved by making the balance of payments adjustment mechanism more symmetrical than has been the case so far. It is found that this will also require a rule guaranteeing low and stable inflation in all member countries. Four possible co-ordination rules for monetary policy are examined: First, the adoption, ex ante, of an aggregate money supply rule for the member countries, an application to the EMS of the proposal McKinnon (1984) made for Japan, the United States and Germany in the context of the reform of the international monetary system. Second, a rule derived from the first involving the expansion of the domestic component of the monetary base (i.e., money of domestic origin) in each member country coupled with the non-sterilization of international reserve flows. Third, a nominal income rule adopted by each member country that should, however, be consistent with both their (independently determined) growth and inflation objectives and the aim of convergence within the system. Fourth, a rule consisting of the adoption of a common inflation target pursued by each country individually and, for each member, a suitable monetary policy designed to achieve it.

II. Lessons from the gold standard and Bretton Woods

II.1. The gold standard

1876 can be considered as the beginning of the classical gold standard in continental Europe. By that year, Germany had completed the transformation of its monetary system from a predominantly silver standard to a gold standard. From 1876 and until 1913 all major industrial powers of the world, including the United States, were operating under the rules of the gold standard with London being the financial centre of the system. During this period, the central exchange rates between the currencies of the major countries were never changed. It follows that expectations that exchange rates would remain fixed were very firmly held. Member countries gave up entirely their monetary policy independence in favour of free trade in most industrial goods, free capital

mobility and fixed exchange rates. (2) Private capital flows are believed to have been relatively large and proved to be generally of an equilibrating nature because expectations that there would be no change in exchange rates were so firmly held. The need for actual gold flows to finance current account disequilibria was therefore relatively limited (Bloomfield, 1959, 1963). Nevertheless, financial crises occurred in 1884, 1890, 1893, and 1907. Fiscal policies were not a source of disturbance, as budget deficits were modest in size, as were government revenues and expenditures relative to GDP.

The gold standard was a unique system characterized by an automatic rule governing the balance of payments adjustment and another governing the determination of the world price level. Thus the latter was outside the control of governments, including Britain which was then issuing the key currency of the system. However, this proved not enough to guarantee perfect world price stability, as insufficient gold production and German purchases of gold led to world deflation until 1896, while large gold discoveries and new processes to extract gold, led to world inflation from about 1896 to 1913. A weighted average index of consumer prices in the United Kingdom, France and the United States fell by about 26 per cent from 1876 to 1896 and increased by about 19 per cent from 1896 to 1913 (an annual rate of 1 percent per year, no mean feat by today's standards). The gold standard in fact possessed an automatic stabilizing mechanism which tended to bring the world price level back to long run equilibrium. (3) However, the equilibrium world price level was not impervious to all types of shocks. In particular a shift in the flow demand for industrial gold or a shift in the flow supply of gold could lead to a permanent change in world prices. Moreover, the stabilization process appears to have been extremely slow, as shown by the long periods of deflation and inflation.

The independence of the equilibrium world price level from the fiscal and monetary policy of the key currency country and the automatic adjustment of world inflation (for at least some types of shocks) were unique features of the gold standard. Neither the Bretton Woods system nor the EMS have these properties.

The balance of payments adjustment mechanism under the gold standard worked as follows: assume an inflow of capital into Germany. The private discount rate in Berlin (the key market interest rate) fell and the differential between this rate and the official discount rate of the Reichsbank widened, making it less advantageous for commercial banks to discount bills at the Reichsbank. This led to a fall of earning assets and liabilities of the Reichsbank. The reduction in the Reichsbank's liabilities in turn led to an increase in its liquidity ratio i.e. the gold or metal cover of notes and other short-term liabilities outstanding (mainly deposits held by banks). Since the liquidity ratio was the main factor influencing the Reichsbank's decisions to change the discount rate, the Reichsbank was promptly led to reduce the discount rate (4).

From 1896 to 1913, the period during which the adjustment mechanism worked most smoothly, there were in Germany 98 changes of the discount rate or 5.4 changes per year, on average. The variability within the year of the level of notes outstanding was also extremely high: the difference between the highest and the lowest level of Reichsbank notes outstanding as a fraction of their average yearly total reached a maximum of 74.6 per cent in 1912 and a minimum of 23.8 per cent in 1877. A similarly high variability of the discount rate and of the amount of notes issued is found for the Bank of England (5). The role of central bank notes outstanding can be compared with that of the monetary base or the money stock in today's industrial countries. As a result of the subordination of the discount rate policy to external objectives and of the possibility of central banks borrowing from each other in times of crises, balance of payments disequilibria and international gold flows were limited.

The conclusion that we wish to draw from this analysis is that the balance of payments adjustment mechanism between the main industrial countries worked well during the gold standard. In the case of Germany and the United Kingdom, both the Reichsbank and the Bank of England were ready to accept a sufficient variability of the discount rate and an even greater one of the relevant monetary aggregate, thus making the adjustment relatively symmetrical. This experience shows that: monetary targeting is incompatible with a smoothly working and symmetric balance of payments adjustment mechanism under fixed exchange rates. The system would have broken down if one major country had attempted to target money.

The gold standard was far from a perfect system. The world price level was too dependent on gold discoveries and its automatic adjustment mechanism very slow to operate. Moreover, there were government interferences with trade and capital flows between the major countries, although on a moderate scale by subsequent standards. In addition, the balance of payments adjustment between the core countries of the system and the developing countries of the periphery was asymmetrical with a disproportionate share of the burden falling on the latter. Nevertheless, in terms of variability of output and inflation, the gold standard compares well with the post World War II Bretton Woods system, at least for the major countries (Eichengreen, 1984, Sommariva and Tullio, 1987a, Chapter I).

What worked well was the balance of payments adjustment mechanism between the major countries. The discretionary policies of their central banks, which aimed predominantly at stabilizing their respective liquidity ratios and maintaining internal convertibility, made this result possible. There was no conflict between the internal (convertibility) objective and the external objective of balance of payments equilibrium. There were some interferences into the free movement of gold on the part of the main central banks, which resulted in changes in transport costs. For instance, the Reichsbank changed at times the location of its gold window from Hamburg to Berlin. Nevertheless, the

effects on gold flows of these forms of capital controls must have been minimal, as suggested by the fact that over 95 percent of the variance of annual German international gold flows from 1878 to 1912 can be explained without the need of dummy variables for "capital controls" (Sommariva and Tullio, 1987b).

The gold standard collapsed in 1914 when the internal convertibility of notes into gold was abolished. The war effort of individual countries led to high budget deficits, inflation and a collapse in world trade. The gold standard which emerged after the First World War can hardly be called a system. Internal convertibility of notes into gold was not reintroduced in most countries. The war had caused large gold flows towards the United States and the United Kingdom or toward countries which had not participated in the war, at the expense of the other continental European countries. As a result, the world distribution of monetary gold became very uneven with the United States and France possessing a very large fraction of it. (6) In addition the balance of payments adjustment mechanism did not work smoothly, as domestic objectives were not subordinated to the external one (Hawtrey, 1947) and free trade and free capital mobility became the exception rather than the rule. There was virtually no attempt at coordinating policies nor was the United States ready to provide the necessary leadership (Kindleberger, 1976). Budget deficits and external indebtedness grew rapidly, especially in Germany in the second half of the 1920's. As a result of the reconstruction, the introduction of flexible exchange rates especially in the early 1920's (7), and the lack of coordination of economic policies, business cycles were less synchronized in this period than before the First World War. Table 1 shows that the United Kingdom, France and Germany were in the same phase of the business cycle in 83.1 per cent of the months from September 1878 to August 1914, while they were in the same phase in only 45.5 percent of the months between June 1919 and July 1932.

Table 1: Percentage of Months During Which Countries Were in the Same Phase of the Business Cycle

Countries	Sept. 1879 - Aug. 1914	June 1919 - July 1932
United Kingdom, France, Germany	83.1	45.2
United Kingdom, France, Germany, United States	53.5	35.6

Source: Morgenstern (1959).

II.2. The Bretton Woods system and the special role of the U.S.

Relative to the gold standard, the Bretton Woods system was characterized by (a) a greater degree of exchange rate flexibility (which entailed a greater variability of expectations of exchange rate changes and consequently at times large destabilizing capital flows), (b) a greater asymmetry in the balance of payments adjustment mechanism, due to the role of the dollar as a reserve currency and the insufficient response of American interest rate policy to the United States balance of payments fluctuations, and (c) a very weak mechanism tending to stabilize the world price level, especially after about 1960 when the United States decided not to make its monetary policy responsive to the continuous fall in the ratio of its gold holdings to its dollar liabilities (8).

Although at times the asymmetry in the balance of payments adjustment mechanism caused tensions in relation to the proper division of the burden of adjustment, the system worked well as long as the reserve currency country followed policies consistent with maintaining world inflation at a low and stable level and did not cause a shortage of reserves or create an excess supply of international liquidity. The strains became severe when the United States embarked upon a fiscal and monetary expansion which was incompatible with world price stability. This led ultimately to the breakdown of the system as other major countries, particularly Germany and Japan, were not prepared to renounce their low inflation objective. This experience underscores the need in a Bretton Woods type system to maintain the price stability of the key currency.

Scholars of international monetary systems are divided as to the degree of responsibility to be attributed to the United States for the 1971 collapse of the Bretton Woods System. Some tend to attribute greater responsibility to policies followed by the United States since 1964-65, while others emphasize the inherent defects of the system, such as the insufficient world gold production and the ensuing need on the part of the reserve currency country to supply the international reserves needed to finance increased world trade and world economic growth, leading to the well-known "Triffin dilemma". By 1975 Harry Johnson concluded: "The fact that the root cause of the disturbance that shocked and finally wrecked the International Monetary System's adjustable peg was a world inflation, originating in President Johnson's failure to accompany the escalation of the war in Vietnam in 1965 with an appropriately large increase in taxes, is by now generally accepted" (Johnson, 1975).

Table 2 shows the huge increase in dollar holdings from 1969 to 1972. Triffin (1978) does not take a clear position as to the United States responsibilities but he considers the increase in dollar holdings resulting from large scale intervention to sustain the exchange rate of

the dollar as the cause of the acceleration of world inflation in the 1970's.

Table 2: The Inflationary Explosion of International Liquidity

(dollar figures in billions)

	End of 1969	End of 1972	End of 1977
Foreign dollar claims	78	146	363
On United States government and banks	49	85	210
On foreign branches of United States banks	29	61	153
International Monetary Reserves	79	159	319
Foreign exchange	33	104	244
Dollars and Eurodollars	20	81	197

Source: Triffin (1978).

Triffin had already foreseen in 1957 the collapse of the Bretton Woods system; he was wrong, however, in forecasting its timing. He explained later that the system had survived longer than he had expected because of United States political pressure on Germany and Japan, bureaucratic routine on the part of central bankers in investing their surpluses in the largest financial market of the world, fears of "rocking the boat" and above all reluctance on the part of other countries to see their currencies appreciate vis-à-vis the U.S. dollar (Triffin, 1978). Robert Heller attributes the large increase in official dollar holdings in those years to a shift in the private demand from U.S. dollars to other currencies. The U.S. liquid liabilities to private non-residents fell from US$28.23 billion at the end of 1969 to US$21.77 billion at the end of 1970 and US$15.09 billion at the end of 1971. During the same period U.S. liabilities to foreign governments increased from US$16 billion at the end of 1969 to US$50.65 billion at the end of 1971 as central banks made large interventions in support of the U.S. dollar (Robert Heller, 1976) (9). Heller also shows that the growth of the U.S. money supply was lower than in other countries and concludes that monetary policy in the United States was not excessively expansionary in those years and hence could not have triggered the shift in private portfolios.

Table 3 below reports the rate of growth of M1 for the U.S. and for the average of 10 industrial countries, excluding the U.S., from 1961 to 1973. In virtually every year the rest of the world's money supply grew faster than that of the U.S. The excess of monetary growth in the rest of the industrialized world with respect to that in the United States is particularly marked in the period 1961-1963 and 1970-1973. A somewhat higher rate of growth of money abroad can be justified for the average of the period by the higher rate of economic growth that the countries of the "periphery" experienced during the period. The difference in real economic growth between Europe and the United States was particularly high in the early 1960's as a result of the creation of the common market and the ensuing productivity gains from increased trade within the community, the still relatively large technological gap, and the scope for shifts in employment from low to high productivity sectors. The differences in money growth in the period 1970-73 appear for the most part to be caused by other factors.

Table 3: Monetary Growth in Domestic Currencies, 11 Industrial Countries

(percentage changes in annual averages)

	United States	10 Other Industrial Countries 1/	Difference 10 - U.S.	Average Difference
1961	2.9	12.7	9.8)	
1962	2.1	11.0	8.9)	9.2
1963	2.8	11.7	8.9)	
1964	4.1	8.6	4.5)	
1965	4.3	9.3	5.0)	
1966	4.6	8.3	3.7)	
1967	3.9	7.4	3.5)	3.7
1968	7.0	8.1	2.1)	
1969	5.9	8.3	2.4)	
1970	3.8	8.2	4.4)	
1971	6.8	16.7	9.9)	
1972	7.1	16.1	9.0)	8.5
1973	7.3	13.9	6.6)	

Source: McKinnon (1986).

1/ The countries are: Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom.

Individual countries' money stocks are not good indicators of the degree of ease or restrictiveness of monetary policy under a fixed exchange rate regime with perfect capital mobility, since they are endogenously determined. As Swoboda and Genberg (1977) have shown, the only truly exogenous monetary variables under Bretton Woods were the domestic component of the U.S. monetary base (the Federal Reserve's claims on the government and commercial banks), what they call "the outside portion" of international reserves--i.e., international reserves not created via balance of payments deficits of the reserve currency country (or countries),--and to some extent the domestic components of the monetary base of the central banks of the rest of the world. The latter in fact becomes partly endogenous if these central banks try to sterilize international reserve flows. It follows that if one wants to say something about the degree of restrictiveness of U.S. monetary policy at the end of the Bretton Woods system, one has to look at the domestic components of the monetary base. This is done in Table 4 which also shows the U.S. balance of payments deficit and the rates of inflation in the U.S. and abroad.

The large U.S. balance of payments deficits of the early 1970s were clearly related to the excessive growth of the domestic component of the U.S. monetary base (reflecting in turn the fiscal imbalance), while the expansionary "European" monetary policy in the period 1968-69 retarded the collapse of the Bretton Woods system. The excess of the growth of the domestic component of the U.S. monetary base over the foreign growth rate was -17.4 per cent in 1968, -9.7 in 1969 and swelled to 13.5 in 1970 and 34.6 in 1971. In the second half of the 60's the favourable relative inflation performance of the U.S. had also ended, which could have caused by itself a downward shift in the private demand for U.S. dollars, as pointed out by R. Heller (1976).

The U.S. balance of payments deficits reached unprecedented levels in 1970-72 swelling the stock of dollars held by foreigners and the world money stock. This inflow of international reserves could only in part be sterilized by surplus countries by reducing the domestic component of the monetary base in 1970 and 1971, which thus became itself partially endogenous. In 1972 and 1973 the surplus countries gave up the attempt to sterilize reserve inflows, as indicated by the large rate of increase of the domestic component of their monetary base, thus speeding up the acceleration of world inflation. Swoboda and Genberg (1977) have shown that because of the special role of the dollar as an international reserve asset in the Bretton Woods system and the rest of the world's practice of holding dollar reserves in the form of U.S. Treasury bills and U.S. or Eurodollar bank deposits (rather than in the form of deposits at the Federal Reserve System), an increase in the domestic component of the monetary base of the U.S. had a comparatively larger effect on the world money stock than an equal dollar increase in the domestic component of the monetary base of the rest of the world. The habit of keeping dollar reserves in this form implied an automatic sterilization of the U.S. balance of payments deficits (10).

Table 4: Changes in Domestic Component of Monetary Base and US Balance of Payments

	Domestic Components of Base Money (percentage changes)		U.S. Balance of Payments (in billions of U.S. dollars)	Excess of U.S. Inflation over the rest of OECD 2/
	U.S.	Rest of OECD 1/		
1960	5.7	10.1	-3.12	0.28
1961	6.0	6.6	-1.35	-1.64
1962	9.3	18.1	-2.41	-3.22
1963	6.2	8.8	-1.99	-3.38
1964	8.5	10.1	-1.27	-2.18
1965	8.5	9.6	-1.17	-2.44
1966	9.9	10.6	-0.10	-2.11
1967	9.7	11.5	-3.34	0.64
1968	6.8	24.2	1.73	0.14
1969	3.4	13.1	2.59	0.73
1970	10.0	-3.5	-10.25	0.82
1971	14.5	-20.1	-28.17	-1.77
1972	0.6	36.0	-10.91	-2.58
1973	10.3	28.5	-4.03	1.63

Source: Tullio (1979).

1/ The countries are: the 10 in Table 5 plus Denmark and Australia.
2/ Inflation is measured by the consumer price index. The countries are the 10 in Table 5 plus Denmark and Australia.

The magnified effect of U.S. domestic credit policies on the world money stock, and therefore on world inflation, also implied that the balance of payments adjustment mechanism worked asymmetrically, with the largest share of the burden of adjustment falling on the countries of the periphery. Also in this respect the Bretton Woods system differed from the classical gold standard. As to the countries of the periphery, the balance of payments adjustment mechanism worked as follows: if say expectations of a sterling crisis developed, capital would flow out of the United Kingdom, putting upward pressure on British interest rates and downward pressure on the British money supply, as the Bank of England was obliged, under the rules, to intervene in the foreign exchange market to support the pound.

The smooth operation of this "automatic" mechanism implied that the Bank of England did not and could not fully sterilize the effect of the losses in reserves on the domestic monetary base, i.e., the Bank of England had to let the British money supply fall. (11) To the extent that capital was flowing to other countries of the periphery, the adjustment mechanism would work symmetrically, as other countries experienced, in the absence of sterilization, a multiple increase in the money stock and a fall in interest rates. To the extent that capital flowed to the U.S., the burden of adjustment would fall mostly on the U.K., since the U.S. money stock and interest rates were largely unaffected because of automatic sterilization, as U.S. banks' liquidity was not altered as a result of the change in the holder of their liabilities (from the U.K. monetary authorities to other monetary authorities or to the private sector).

The preceding analysis of the Bretton Woods system suggests the following conclusions: domestic monetary stocks were not the proper indicators of monetary policy, while domestic credit expansion was, both in the case of the leading country and for countries of the periphery that did not sterilize reserve flows; a major defect of the system, that impeded the smooth and symmetric working of the balance of payments adjustment mechanism, was that the money stocks of the leading country was not allowed to reflect balance of payments deficits and surpluses; finally, a monetary system without a rule guaranteeing stability of the world price level or without a central reserve currency country pursuing a stable inflation target is bound to collapse sooner or later. Michael Parkin (1977) has shown that two rules would be required for the long-term sustainability of a fixed exchange rate system: a rule determining the growth rate of the domestic component of the monetary base in each country and a rule determining the growth of the world money supply. As will be seen below the above analysis has some important implications for the significance of the money supply in Germany as an intermediate target and as an indicator of monetary policy during the EMS period.

III. The working of the EMS: 1979-1987

This section is divided into three parts. The first analyzes the degree of convergence of exchange rates, inflation rates and interest rates achieved so far by EMS members participating in the exchange rate agreement, and discusses whether the establishment of the EMS has contributed to the reduction of inflation in member countries. Existing studies on the degree of convergence will be surveyed and new updated results based on the "principal component analysis" will be presented. In light of these considerations, we then discuss the leading role of Germany within the EMS and analyze the contribution that German monetary policy has made to the reduction of inflation in the system. Finally, the working of the balance of payments adjustment mechanism within the EMS will be described and the problems arising from monetary targeting and from sterilization of international reserve flows dealt with.

III.1. The degree of convergence of exchange rates, inflation and interest rates and the degree of coordination of monetary policy within the EMS

Average inflation in the EMS, as measured by the private consumption deflator, has fallen steadily from a peak of 11.6 per cent in 1980 to 2.3 per cent in 1986 (Table 5). The dispersion of inflation both in relation to the mean and to the lowest level has also declined considerably from its peak in 1980. Measures of dispersion of real GDP growth rates show instead that a downward trend is discernible only after 1982. Measures of dispersion of monetary growth also indicate that the EMS period has to be divided into two subperiods: one of high average monetary growth rates and insufficient convergence of monetary policy lasting until the general realignment of March 1983, and the succeeding years of falling average monetary growth rates and reduced dispersion. The key factor behind the greater convergence of real growth rates and of monetary policy in the second subperiod was the change in France's economic policy. Also the shift in economic policy in Italy since 1981 played an important role, as the authorities accepted to see their exchange rate appreciate in real terms to reduce inflation. In Ireland, a major shift in economic policy occurred also in 1981 resulting in a real appreciation of the Irish punt. As in Italy, progress in improving the budget deficit was slow, but the current external imbalance and inflation were reduced markedly. In Denmark the policy shift occurred in 1982-83.

The fact that inflation has been reduced and inflation, real GDP growth and the growth of money have tended to converge, at least after 1983, does not necessarily imply that they have done so because of the existence of the EMS. De Grauwe (1986) argues, for instance, that in non-EMS European countries inflation fell more sharply during the EMS

period and at a lower cost in terms of foregone growth and investment than in EMS countries. An empirical study by the I.M.F. (Ungerer et al. 1986) finds instead that there is support for the hypothesis that "the EMS has not laid the ground for a looser monetary policy but rather provided a framework in which anti-inflationary policies could be pursued more effectively." In a more recent paper, included in this conference volume, S.M. Collins rejects the hypothesis that the EMS has contributed to reducing inflation in the area. Both studies regress inflation on money growth, output growth, and dummy variables for a set of EMS and non-EMS countries. However, the main effect of the EMS would be on the path of the money stock of countries which felt the constraint; hence regressions of this type cannot be conclusive. In addition, several countries outside the EMS behaved "as if" they belonged to it throughout most of the period while, at least in the early years of the EMS period, some members did not behave as "full" members, as suggested by the principal component analysis presented below and in Appendix 1.

Table 5: Convergence In the EMS 1/

	61/70	71/78	1979	1980	1981	1982	1983	1984	1985	1986
A. Private consumption deflator										
Average increase	3.7	8.8	8.7	11.6	11.4	9.9	8.1	6.2	5.0	2.3
Deviation from mean	.6	3.0	4.0	5.0	4.6	4.3	4.1	3.0	2.4	2.4
Deviation from lowest	1.2	3.5	4.8	5.8	5.4	5.2	5.3	3.7	3.0	2.2
B. Real GDP										
Average growth rate	5.1	3.2	3.8	1.9	.1	.2	.6	2.1	2.1	2.6
Deviation from mean	1.1	.9	.7	1.1	.3	1.2	.6	.6	.5	.4
Deviation from highest	1.9	2.9	1.1	2.0	2.5	2.8	1.4	2.3	1.7	.5
C. Money supply										
Average increase	11.5	14.6	12.9	9.7	8.7	9.5	10.2	8.4	7.7	6.9
Deviation from mean	2.1	3.7	4.0	3.4	2.5	2.3	3.5	3.1	3.2	1.5
Deviation from lowest	4.6	6.0	8.1	4.4	4.4	3.0	4.8	4.4	2.8	1.6

Source: Commission of the European Communities.

1/ The U.K. and Greece are excluded, because they are not part of the exchange rate agreement.

Be that as it may, the conclusion of the I.M.F. study appears more in line with the belief on the part of European monetary officials that the EMS has indeed represented a binding constraint for high inflation countries, which has been reinforced at times by the real appreciation of weak currencies in relation to the deutsche mark. In this respect it can probably be said that the EMS has exerted a deflationary bias, given the objective of monetary stability pursued by Germany. This has occurred, however, with the consent of other members and is not in contradiction with the original objectives of the system. As Giavezzi and Giovannini (1987a), and Roubini (1987a) have shown, by joining a fixed exchange rate regime under German leadership, more inflation prone countries have gained "credibility" in the disinflation process, provided realignments are not frequent and entail political as well as economic costs. More credibility would also imply a reduction of the output costs of a given amount of disinflation (12).

The 1986 I.M.F. study also compares indices of variability of exchange rates, and of their rates of change, of the rate of inflation, the rate of growth of money and domestic credit, and of interest rates in each year before and during the EMS period for the EMS countries and for a group of non-EMS countries. The study concludes that the EMS has brought about a significant increase in convergence and greater exchange rate stability among its members and that "it does not seem that events exogenous to the EMS have led to the decline in exchange rate variability among participating currencies, since no such trend is evident elsewhere". Other studies, including the most recent ones by Artis and Taylor in this conference volume, arrive at the same conclusion (Padoa Schioppa, 1985, Russo, 1986). As to other variables, however, these studies do not reach similarly strong conclusions.

In order to gain more insights into the degree of convergence achieved by EMS countries a "principal component analysis" has been carried out and the results shown in Appendix I. The technique allows the isolation of common elements in a number of time series. It has been applied before to inflation rates in industrial countries under the Bretton Woods system to isolate a common "world inflation" (Genberg 1975, 1977) and to interest rates to analyse to what extent they can be explained by a world interest rate (Fase 1976). It can be thought of as a correlation analysis generalized to a large number of time series.

Table 6 summarizes the fractions of the cumulative variance explained by the first principal component for each of the variables considered. The fraction is standardized for the number of countries in the group for the reason explained in footnote (13).

Table 7 provides the same information but the sample is now limited to the countries participating in the exchange rate mechanism.

Table 6 : Principal Component Analysis:
Fraction of Cumulative Variance Explained by
First Principal Component - 17 Industrial Countries

Variables 1/	Periods		
	1973/3-1979/2	1979/3-1983/2	1983/5-1986/3
Exchange Rate 2/	.56	.70	.83
Consumer price inflation	.18	.19	.24
Nominal short-term interest rate	.34	.70	.59
Nominal long-term interest rate	.28	.44	.31
M1 3/	.12	.11	.20

1/ All variables are expressed in percentage change except the interest rates.
2/ Bilateral exchange rates with the U.S. dollars.
3/ Seasonally adjusted.

Table 7: Principal Component Analysis:
Fraction of Cumulative Variance Explained by
the First Principal Component -
EMS Countries Participating in Exchange Rate Mechanism

Variables 1/	Periods		
	1973/3-1979/2	1979/3-1983/2	1983/5-1986/3
Exchange Rate 2/	.73	.95	.99
Consumer prices	.34	.26	.48
Nominal short-term interest rate	.40	.76	.79
Nominal long-term interest rate	.49	.49	.36
M1 3/	.20	.16	.24

1/ All variables are expressed in percentage changes except the interest rates.
2/ Bilateral exchange rates with the U.S. dollars.
3/ Seasonally adjusted.

Several indications emerge from Table 7. First, the fraction of the variance explained by the first principal component is higher for exchange rates than for any other variable. This is in line with the requirements of the EMS which have exerted a stronger effect with time, but was also the case before the EMS was created. Second, the fraction is higher for all variables in the third period with respect to the first, except for nominal long-term interest rates (14). Third, every number in Table 7 is higher than the corresponding one in Table 6, implying that EMS countries experienced both before and after the EMS greater convergence than the larger group of industrial countries. Furthermore, the increase in convergence of inflation rates in the third period seems to have been more pronounced for the EMS than for the larger group of countries, thus confirming the finding reported above by Ungerer et al.

III.2. The special role of Germany in the EMS, monetary targeting and the inflation objective

There is no explicit rule governing inflation in the EMS. An implicit rule has, however, been followed so far since 1982/83. Under this rule Germany's role in the EMS is similar to the role of the U.S. under Bretton Woods: Germany decides its desired rate of inflation and other member countries converge to it. As a corollary, the asymmetry noted above in the working of the Bretton Woods system is also present in the EMS as it has operated so far, i.e., Germany is also in a position to set its monetary growth target geared to ensure its own desired inflation rate, while the other members adjust their monetary policy (i.e., their interest rates) to it. Bretton Woods survived and the EMS will survive as long as there is agreement on a low and stable inflation target and member countries are willing to subordinate their monetary policy to this objective. This crucial condition has been emphasized also by Matthes (1987) and is implicit in the stance of German economic policymakers. There are, however, several differences between the role that Germany can play in the EMS and that played by the U.S. under Bretton Woods. The most important difference is in the economic size of the two countries in relation to the other members of the system ("raumwirtschaftliches Potential" as Matthes calls it). The U.S. was by far the largest country under Bretton Woods, whilst the economic size of France, Italy, and the United Kingdom is relatively closer to that of Germany. Table 8 shows the share of U.S. exports of goods in world and industrial countries' exports and the share of German exports in EMS exports in selected years. The shares of imports are also reported. U.S. exports were 28.3 percent of industrial countries' exports in 1950, but by 1985 the ratio had fallen to 16.9 percent. The share of German exports in EMS exports (excluding the U.K.) was 19.5 percent in 1950 and 35.8 percent in 1985. Looking only at the share of exports, Germany is therefore more important during the EMS period in relation to EMS members than the U.S. was in relation to industrial countries under Bretton Woods. A similar conclusion is reached by looking at the share

Table 8: Share of U.S. and German Exports and Imports of Goods

(In percent)

	Exports					
	United States				Germany	
	In World Exports	In Ind. count. Exports	In EMS incl. U.K.	In EMS excl. U.K.	In World Exports	In Ind. count. Exports
1950	17.6	28.3	12.1	19.5	3.4	5.4
1955	17.9	26.6	21.7	31.0	7.0	10.4
1960	17.4	24.6	27.0	36.0	9.6	13.6
1965	16.1	21.9	27.6	35.1	10.5	14.2
1970	15.1	19.7	30.4	36.7	11.9	15.6
1975	13.3	19.0	30.3	35.5	10.2	15.6
1980	11.7	17.8	29.2	35.0	10.2	15.6
1984	12.3	17.9	29.6	35.3	9.7	14.1
1985	11.9	16.9	29.9	35.8	10.3	14.6

	Imports					
	United States				Germany	
	In World Imports	In Ind. count. Imports	In EMS incl. U.K.	In EMS excl. U.K.	In World Imports	In Ind. count. Imports
1950	16.0	24.2	13.6	21.6	4.5	6.8
1955	13.6	20.2	18.2	27.6	6.3	9.4
1960	13.2	19.2	22.5	31.7	8.2	11.9
1965	12.9	17.7	25.4	33.1	9.8	13.4
1970	14.2	18.8	25.7	31.6	10.0	13.2
1975	12.8	18.0	24.9	30.2	9.1	12.7
1980	13.3	18.8	26.2	31.2	9.7	13.7
1984	18.4	26.1	25.9	31.5	8.3	11.7
1985	19.2	26.6	25.7	31.3	8.4	11.6

Source: IMF, International Financial Statistics, various issues.

of imports. However, Germany is a much more open economy than the U.S. When GDP-weights are used, the U.S. share in industrial countries was and still is larger than that of Germany in the EMS (Table 9). This makes the German economy much more vulnerable to foreign shocks than the U.S. economy.

Another important factor is the size and sophistication of U.S. financial markets in relation to those of Germany. The deutsche mark will face strong competition from the French franc, if capital liberalization in France is maintained and Paris becomes a major international financial centre and, more importantly, if the pound sterling joins the ERM. Thus also prospectively the deutsche mark cannot play the same role as the U.S. dollar under Bretton Woods.

The third difference is the great importance German monetary authorities attach to price stability. Matthes argues that Germany's leading role in the EMS originates not so much from its economic size but rather from the importance it attributes to price stability, while the U.S. and the dollar played and still play a leading role in the international monetary system, independently of whether the United States pursues a stable inflation objective. He concludes, therefore, that Germany cannot depart from this low and stable inflation objective without endangering the EMS and her leading role in it.

The fourth difference is that while the U.S. had no explicit money supply target during the Bretton Woods period, Germany has one under the EMS. Tables 10 and 11 show Germany's monetary targets and their implementation, as reported by the Bundesbank, as well as EMS interventions in deutsche mark. Except for 1978 and 1986-87, years of rapid appreciation of the deutsche mark vis-à-vis the U.S. dollar and large interventions to stem the speed and extent of this appreciation, the Bundesbank was able to achieve the targets initially set. When compared with total interventions (within and outside the EMS), the liquidity impact of deutsche mark interventions within the EMS was relatively small or negative and temporary (except for 1979 and 1981), as most of the interventions were intramarginal and/or were later reversed (except for 1987, when purchases of deutsche mark after the realignment of January 12, 1987 were considerably smaller than the large sales effected in the months leading to the realignment, see section B of the table). When read in conjunction with Table 12 (as well as with the findings of the principal component analysis mentioned earlier), the data show that domestic credit expansion (defined as the growth of the domestic component of the central bank monetary liabilities) was endogenous in Germany, in the sense that it attempted to sterilize the effects of the change in net foreign assets on the growth of the money stock. This was not the case for the other EMS members, most of which did not even have money supply targets. Throughout the period, inflation in Germany declined sharply in line with the deceleration of money supply growth.

Table 9: Share of U.S. GNP in Industrial Countries' GDP and of German GNP in EMS GDP

	United States		Germany	
	In Ind. count. GDP	In EMS includ. U.K.	In EMS exclud. U.K.	In Ind. count. GDP
1954	45.88	10.19	15.33	6.80
1955	45.79	10.74	15.93	7.14
1960	44.74	13.28	19.11	9.05
1965	43.69	13.83	19.24	9.11
1970	42.04	15.54	20.12	9.82
1975	37.02	18.64	22.48	11.54
1980	35.41	22.74	26.71	14.11
1983	42.82	24.74	29.18	13.55
1984	45.36	25.17	29.63	13.12
1985	46.09	25.27	29.83	13.10

Source: IMF, International Financial Statistics, various issues.

Table 10. Germany: Monetary Targets and Their Implementation

(In percent)

	Target: Growth of the Central Bank Money Stock			Actual Growth (rounded figures)	
	In the course of the year 1/	On an annual average	Qualification of target in the course of the year	In the course of the year 1/	On an annual average
1975	8	--	--	10	...
1976	--	8	--	--	9
1977	--	8	--	--	9
1978	--	8	--	--	11
1979	6-9	--	Lower limit	6	...
1980	5-8	--	Lower limit	5	...
1981	4-7	--	Lower half	4	...
1982	4-7	--	Upper half	6	...
1983	4-7	--	Upper half	7	...
1984	4-6	--	--	5	...
1985	3-5	--	--	5	...
1986	3½-5½	--	--	8	...
1987	3-6	--	--	... 2/	...

Source: Bundesbank, Annual Report, 1983, and Monthly Report, various issues.

1/ Fourth quarter to fourth quarter.
2/ Annualized growth rate through August vis-à-vis the base period for the target was 7.4 percent.

Table 11. Deutsche Mark Interventions in the EMS 1/

(In billions of deutsche mark)

		Obligatory	Intramarginal	Total	Memo item Affecting Liquidity In Germany 2/
A. By calendar years					
1979 3/	Purchases	--	-2.7	-2.7	-2.4
	Sales	+3.6	+8.1	+11.7	+11.7
	Balance	+3.6	+5.4	+9.0	+9.2
1980	Purchases	-5.9	-5.9	-11.8	-11.1
	Sales	--	+1.0	+1.0	+0.6
	Balance	-5.9	-4.9	-10.8	-10.5
1981	Purchases	-2.3	-8.1	-10.4	-10.3
	Sales	+17.3	+12.8	+30.1	+25.3
	Balance	+15.0	+4.7	+19.7	+15.0
1982	Purchases	--	-9.4	-9.4	-2.5
	Sales	+3.0	+12.8	+15.8	+6.1
	Balance	+3.0	+3.4	+6.4	+3.7
1983	Purchases	-16.7	-19.1	-35.8	-20.4
	Sales	+8.3	+12.9	+21.2	+12.6
	Balance	-8.4	-6.2	-14.5	-7.8
1984	Purchases	--	-30.2	-30.2	-0.8
	Sales	+4.7	+7.6	+12.3	+4.4
	Balance	+4.7	-22.7	-17.9	+3.6
1985	Purchases	--	-29.6	-29.6	-0.2
	Sales	+0.4	+30.8	+31.1	--
	Balance	+0.4	+1.2	+1.5	-0.2
1986	Purchases	-19.0	-33.6	-52.6	-12.1
	Sales	+4.1	+76.0	+80.1	+3.8
	Balance	-14.8	+42.4	+27.6	-8.4
B. By selected periods, net					
March 21, 1983 to July 8, 1985 From the first trading day after the realignment of March 21, 1983 to the end of major deutsche mark purchases by partner countries		-11.8	-49.8	-61.6	-16.9
July 11, 1985 to April 4, 1986 From the end of major deutsche mark purchases by partner countries to the last trading day before the realignment of April 6, 1986		+0.7	+33.3	+34.0	+0.0
April 7, 1986 to July 7, 1986 From the first trading day after the realignment of April 6, 1986 to the end of major deutsche mark purchases by partner countries		-19.0	-10.9	-29.9	-10.3
July 8, 1986 to January 9, 1987 From the end of major deutsche mark purchases by partner countries to the last trading day before the realignment of January 12, 1987		+18.9	+44.1	+63.0	+17.4
January 12, 1987 to February 20, 1987 From the first trading day after the realignment of January 12, 1987 to the last trading day before the Paris accord of February 22, 1987		--	-7.3	-7.3	-0.9
February 23, 1987 to March 31, 1987 From the first trading day after the Paris accord of February 22, 1987 to the end of the quarter		--	-16.1	-16.1	-5.7

Source: Bundesbank Report, 1986.

1/ Deutsche mark intervention by other central banks participating in the EMS exchange rate mechanism and EMS interventions by the Bundesbank.

2/ Indicates the extent to which deutsche mark interventions in the EMS and the settlement of creditor and debtor positions in the EMCF affected the net external position of the Bundesbank and thus the banks' provision with central bank money; excluding transactions connected with the winding-up of the "snake", which was succeeded by the EMS.

3/ As from the beginning of the EMS on March 13, 1979. Discrepancies in the totals are due to rounding.

N.B. + equals deutsche mark sales or expansionary impact on liquidity in Germany.
- equals deutsche mark purchases or contractionary impact on liquidity in Germany.

Table 12. Germany: Growth of the Money Stocks, the Bundesbank Net Domestic Assets, and Prices

	Money Supply 1/	Net Domestic Assets 2/	Prices 3/
1978	10.1	22.1	2.7
1979	8.2	23.6	4.1
1980	3.5	47.4	5.4
1981	4.7	16.2	6.3
1982	6.1	5.8	5.3
1983	6.7	13.2	3.3
1984	4.8	8.2	2.4
1985	5.6	5.7	2.2
1986	8.8	-3.6	-0.2

Source: I.M.F., International Financial Statistics.

1/ Average money stock is defined as the annual averages of monthly narrow and quasi-money (lines 34 and 35, respectively).
2/ Domestic component of the monetary base is broadly defined as the domestic credit of the central banks, the sum of the following IFS lines: claims on central government, official entities and deposit money banks (12a, 12b, and 12e).
3/ Inflation rates are based on the consumer price index (line 64).

The exogeneity, or otherwise, of the national money stock in Germany under a system like the EMS, has important implications for the determination of inflation in Germany and for the determination of the deutsche mark/U.S. dollar exchange rate. In order to make the point clearer, let us start by considering a system of perfectly floating exchange rates (no intervention of the central bank in the foreign exchange market). Under such a system the money stock is exogenous. Assuming a stable demand function for money, the rate of inflation in Germany will be determined by the following equation:

$$(1) \qquad \dot{P}_{g\,t} = \sum_{i=o}^{n} W_i (\dot{M}_g - \dot{m}_g)_{t-i}$$

$$(1a) \quad lnm_g = a + b\ lny_g + ci_g + d\ lnS'_g$$

where a dot indicates a percentage change, ln the natural logarithm, P_g the price level, M_g the nominal money stock (= supply of money) and m_g the real demand for money. Equation (1) says that inflation adjusts gradually towards its long run equilibrium level due to the existence of transaction and information costs. Equation (1a) defines the real demand for money as a function of the nominal rate of interest (i_g), the deviation of the effective exchange rate from purchasing power parity (S'_g), reflecting the degree of currency substitution, and real output (y_g). In the long run the price level is determined, according to equation (1) and (1a), by the quantity theory of money.

Under perfectly fixed exchange rates the Bundesbank is obliged to intervene in the foreign exchange market and the German nominal money stock is no longer exogenous. Assuming that the whole world is on fixed exchange rates, German inflation is determined by world inflation and world inflation by world monetary growth and the world demand for real money.

$$(2) \quad \dot{p}_g = \dot{p}_w$$

$$(3) \quad \dot{p}_w = \sum_{i=o}^{n} v_i (\dot{M}_w - \dot{m}_w)_{t-i}$$

$$(3a) \quad lnm_w = a_w + b_w lny_w + c_w i_w$$

where i_w is the world interest rate and y_w the world real output.

The EMS is a regional system and in addition exchange rates between members have been adjusted. Therefore neither equations (1) and (1a), nor equations (2), (3) and (3a), correctly describe how inflation is determined in Germany. While so far inflation in Germany may have been still determined as in equations (1) and (1a), it is likely to be progressively determined according to equations (4) and (5) below, as realignments become less frequent and capital mobility increases:

$$(4) \quad \dot{P}_g = \dot{P}_{EMS} + \dot{S}_{g/EMS}$$

$$(5) \quad \dot{p}EMS = \sum_{i=o}^{n} z_i (\dot{M}_{EMS} - \dot{m}_{EMS})_{t-i}$$

$$(5a) \quad lnm_{EMS} = a_{EMS} + b_{EMS} lny_{EMS} + c_{EMS} i_{EMS} + d_{EMS} lnS'_{EMS/\$}$$

where $S_{g/EMS}$ indicates the rate of change of the effective exchange of the deutsche mark vis-à-vis the other EMS members and $S'_{EMS/\$}$ indicates the deviation of the ECU-dollar exchange rate, excluding sterling, from purchasing power parity and reflects currency substitution between the EMS block and the dollar block.

Demand functions for money specified as in (5a) have been estimated by Bekx and Tullio (1987) for the aggregate of the countries participating in the exchange rate agreement and for the U.S. from the third quarter of 1978 to the last quarter of 1985. The coefficient of the currency substitution term turns out to be significantly different from zero indicating that in periods of dollar weakness the demand for U.S. money tends to fall and the demand for EMS money tends to rise. Bekx and Tullio also show that the deutsche mark/dollar exchange rate and the ECU-dollar exchange rate were explained during the EMS period reasonably well by the disequilibria in the money markets in the EMS (excluding the United Kingdom) and in the U.S., as suggested by the monetary approach to exchange rate determination. The equations performed better when the currency substitution term was included in the demand functions for money in the respective currency blocks.

The disequilibrium in the German money market instead does not contribute significantly to the explanation of the deutsche mark/dollar exchange rate, independently of whether one takes into account currency substitution or not. These results suggest that despite the exchange rate realignments within the system, the monetary policy of France, Italy and other countries participating in the exchange rate agreements had an impact on the deutsche mark/dollar exchange rate. Although intuitive, the finding has strong implications for the working of the system. First, German monetary policy does not have the same effectiveness as under the flexible exchange rate system of the pre-EMS period in influencing the exchange rate of the deutsche mark, at least in the short run, i.e., between realignments. Second, to the extent that the monetary policy of France and Italy influence the deutsche mark/dollar exchange rate they also influence the German inflation rate, at least between realignments. Mastropasqua, Mocossi, and Rinaldi argue, in their recent paper included in this volume, that the German monetary base appears correlated with the lagged values of other EMS members' monetary base. The partial compensation by Germany of contractionary or expansionary monetary impulses originating in other EMS countries seems consistent with a reduced role of German monetary variables in explaining domestic inflation and the deutsche mark/U.S. dollar exchange rate. The finding by Giavazzi and Giovannini, also in a paper in this volume, that German inflation is underpredicted during the EMS period by a largely domestic model of the inflationary process, may further strengthen this argument.

As controls on capital movements are reduced in Europe and currencies of member countries become better substitutes, the effectiveness

of German monetary policy in influencing the German exchange rate and inflation may be reduced even more. Co-ordination of monetary policy between member countries around agreed inflation targets then becomes more important than at present, not only for other member countries but also for Germany.

III.3. The balance of payments adjustment mechanism under the EMS

If under the EMS the "automatic" balance of payments adjustment mechanism is to work smoothly, it should not differ much from that between non-reserve currency countries under the Bretton Woods system. If expectations of a devaluation develop, for instance, capital will tend to flow out of the member countries concerned and this will put its currency under pressure. By intervening in the foreign exchange market to prevent the exchange rate from falling outside the margin, the monetary authorities will lose international reserves; this will reduce the money supply and put upward pressures on domestic short term interest rates. The opposite should occur in the country where capital will flow.

In comparison with the adjustment mechanism under Bretton Woods, the task of the monetary authorities is made, on the one hand, easier by the more frequent possibility to realign and therefore by the fact of not having to defend for too long unrealistic parities. On the other hand, central banks have to deal more frequently with destabilizing speculation, because markets discount the possibility and frequency of these realignments and because capital is more mobile internationally.

Be that as it may, the smooth operation of this "automatic" mechanism implies that, for instance, the Banque de France and the Bundesbank do not sterilize, or at least do not fully sterilize, the effects of changes in their international reserves on the money supply. Full sterilization effectively leads to a breakdown of the automatic adjustment mechanism, if carried out by both the strong and weak currency members. Interventions performed by using reserves accumulated with the banking system of partner countries lead to changes in international reserves of the intervening country but do not change the liquidity of the banking system of the country whose currency is used; this type of intervention is therefore asymmetric and shifts the burden of adjustment on the intervening country, as was the case under Bretton Woods.

The EMS statutes contain a clause that forbids the accumulation of reserves in members' currencies except for working balances. However, this rule is not enforced as especially Italy and France have accumulated large reserves in Deutsche Mark, the main intervention currency. Interventions in U.S. dollars lead to changes in international reserves in the intervening member country without influencing those of other member countries and are therefore also asymmetric in their effects. However, interventions performed by directly borrowing currencies from other member central banks increase the liquidity of the country that

lends while reducing the liquidity of commercial banks of the intervening country, in the same way as interventions performed using working balances of partner currencies held at the issuing central banks and not with the banking systems. These types of intervention would automatically reduce the liquidity of the banking system of the weak currency and increase that of the strong currency, in a symmetric way.

This symmetry, however, is lost if one member country or both adhere to a monetary target. If only one has such a policy, the burden of adjustment is shifted on the countries which do not adhere strictly to a monetary rule. Giavazzi and Giovannini (1987a) present evidence of two types of asymmetries within the EMS. They show first that Germany and the Netherlands intervened very little at the margin in EMS currencies and that they hardly intervened within the margins, while France and Belgium did most of the intervention in EMS currencies. They also show that the EMS period is associated with a reduction in the volatility of interest rates in Germany, and an increase in France, especially of offshore rates (15). The fundamental asymmetry lies in the practice of sterilizing interventions, since this is not possible in a durable manner for countries facing downward pressure on the exchange rate, no matter how the financing of interventions is shared. Mastropasqua, Micossi, and Rinaldi, in the paper cited above, estimate that Germany sterilized foreign reserve flows to a significantly greater extent than other EMS members. The sterilization coefficient that they obtained is not significantly different from -1.0 for Germany, while for France, Italy, and Belgium it falls between -0.30 and -0.40. Roubini (1987b) shows that symmetric intervention rules are a necessary but not sufficient condition for an exchange rate system to be symmetric; central banks must also refrain from sterilizing foreign reserve flows. Asymmetry, however, was--and is--appropriate when inflation still needs to be reduced in the countries that do not have a money supply target, but becomes less appropriate as low inflation levels are reached and commitment to anti-inflation policies is credibly undertaken. It is also appropriate if demand shocks are originating in one country only, but not if all countries are faced with the same external shock.

Why does Germany then insist on adhering to a monetary target? Her reasons are not unfounded and should be clear from the discussion in the previous sections: since the present world monetary system has no built in mechanism to guarantee the stability of the world price level, as the gold standard did, and since the EMS also has neither an explicit low inflation objective nor a built in mechanism to guarantee the return to an acceptable rate of inflation, if an exogenous shock should occur, Germany has made a hybrid compromise between monetary targeting, which should guarantee a stable and low German inflation in the long run, and a fixed but adjustable exchange rate system such as the EMS.

If more symmetry is desired, the European monetary system needs an agreement on the target inflation rate and on a rule subordinating monetary (and fiscal) policies of member countries to the agreed inflation objective.

IV. The balance of payments adjustment mechanism and the inflation objective within the EMS

This section will investigate the implications for the EMS of the adoption of "rules" for the co-ordination of monetary policies to facilitate balance of payments adjustment and to contribute to the objective of reducing inflation and/or keeping it at a low level. By drawing on the existing literature, four possible rules will be examined: an EMS-wide money supply target, a target expressed in terms of expansion of the domestic component of the monetary base in each country with the agreement not to sterilize international reserve flows among members, nominal income targets for each member country and an appropriate inflation target for the area as a whole.

Before going into the details of the analysis, it is useful to state which EMS institutional setting we have assumed for the foreseeable future. It is not assumed that powers are transferred to the FECOM or other central institutions as envisaged in the "second stage" of the EMS (16). We assume, however, an increased degree of capital mobility between the member countries, in line with the declared objective of reducing and eliminating existing capital controls. Greater capital mobility has obvious implications for the degree of monetary cooperation which is consistent with the present exchange rate system: interest rate policy will have to be better co-ordinated and more subordinated to external objectives than has been the case in the past. The analysis developed below would also not change substantially if Italy narrowed its exchange rate band or if the U.K. joined the exchange rate agreement. On the other hand, it is assumed that no individual currency is by design recognized as the reserve currency of the system because this would be politically unacceptable and is contrary to the stated objective of placing the ECU at the centre of the EMS (17).

IV.1. First rule: an EMS-wide ex-ante money supply target

McKinnon has drawn the economic policymakers' attention to the implications of currency substitution between the major currency blocks for domestic monetary targeting and exchange rate developments (18). He suggested that domestic monetary targets be abandoned in favor of a worldwide (U.S. plus Japan plus Germany) monetary target.

His proposal is based on the assumption that each country's inflation depends on the world money supply rather than on its money supply. By regressing U.S. price inflation on U.S. money growth, world money growth and the effective exchange rate of the dollar from 1973 to 1984 he purports to show that world money growth and changes in the effective exchange rate explain U.S. inflation better than domestic

money growth (McKinnon, 1985b). However, Spinelli (1983) performed tests on McKinnon's hypothesis for 10 industrial countries from 1973 to 1980 and concluded that, except for France, domestic money performs better than world money to explain domestic inflation. The addition of world money among the explanatory variables only improves somewhat the explanatory power of the regressions.

Despite the inconclusive outcome of empirical tests of McKinnon's hypothesis for the major currency areas, the discussion of the previous section and in particular the results of Bekx and Tullio on the determination of the deutsche mark/dollar exchange rate during the EMS period, suggest that the hypothesis may become with time plausible at the EMS level, if capital controls within the area are reduced further, realignments become less frequent, and the single market for goods and factors of production is achieved. Bekx and Tullio have already shown that the deutsche mark-dollar exchange rate--and a fortiori the ECU-dollar exchange rate--are better explained by the EMS aggregate; changes in the ECU-dollar exchange rate significantly influence inflation in Europe. Imports of finished goods from the dollar area are important for most EMS-member countries, and, under unchanged intra-EMS parities, inflation in each member country is influenced by inflation in other members via import price effects. Finally, as the stability of intra-EMS exchange rates tends to increase and the ERM tends to become more credible, wage demands by labour unions may also tend to converge and adapt to a common inflation objective (19).

If capital controls among member countries are further reduced, as planned, expectations of realignments will lead to shifts of funds from countries which are likely to depreciate to strong currency countries and currency substitution both on the demand side and on the supply side (via central bank interventions) will render domestic monetary stocks more volatile and less important as determinants of domestic inflation. It may therefore be worthwhile to analyse the implications of an aggregate money supply rule for the EMS.

The first step in the process of fixing a common money supply target (M_{EMS}) would have to be to agree on a common inflation target in the EMS (P_{EMS}) (20). The second step would be to agree on the potential output growth for the EMS area ($\bar{Y}_{EMS}$). Here the average will be arrived at by aggregating individual countries' potential growth rates, not a very easy process since some countries may show the tendency to overestimate their potential output growth to achieve a more relaxed monetary policy while others may have a tendency to do the opposite (21). If these problems can be solved (and this is a big "if"), then the target rate of growth of EMS wide money can be obtained as follows:

$$(6) \qquad \dot{\bar{M}}_{EMS} = \dot{P}_{EMS} + \dot{y}_{EMS}$$

where changes in the velocity of the EMS-wide demand for money are assumed to be zero or to be accommodated by providing a range for the money supply growth target as is done in Germany (22).

The adoption of an aggregate money supply rule for the EMS would, however, present several problems. First, keeping in mind that the ultimate objective of fixing an aggregate monetary target for the EMS would be to stabilize the inflation rate within the EMS, it is crucial to know whether the EMS-wide demand for money would be stable enough to generate the success of this rule. The study by Bekx and Tullio mentioned in the previous section seems to suggest that the EMS-wide demand for money may be better behaved than the German demand for money (23). Even with the inclusion of a term reflecting currency substitution, the degree of autocorrelation of the residuals is significantly lower for the EMS-wide demand function than for the German one, during the EMS period. Formal stability tests of the parameters of the equations have, however, not been performed, nor have demand functions for money for other EMS member countries been estimated. More work is clearly required in this area. In addition, the stability of the demand for EMS-wide money may be reduced by the ongoing rapid pace of financial innovation in many member countries. Financial innovation may even accelerate in the next few years owing to the increased competition injected into national financial systems by the elimination of controls on capital flows and of barriers to the provision of financial services by European firms in any member country. Finally, while the instability due to currency substitution may be smaller for the EMS-wide demand for money than for the demand for money from each member country taken individually, it can still be substantial because the EMS currencies are freely floating as a block against the dollar, the yen and the pound (24).

Assuming that the EMS-wide demand for money can be estimated and predicted with sufficient accuracy, would it be feasible for European central banks to set ex-ante targets and to achieve the desired EMS-wide monetary growth in the absence of an institutional change which creates a European central bank? There do not seem to exist at present the political conditions for the creation of such a central bank. Therefore, following McKinnon, an attempt is made in the next section to suggest operating procedures and rules to share the burden of adjustment among the members, under the present institutional framework.

IV.2. Second rule: an individual domestic credit target for each member country with no sterilization of reserve flows

It will be shown in this section that if member countries fix individually the rate of growth for the domestic component of the monetary base according to a certain formula, and refrain from sterilizing international reserve flows within the system, the balance of payments adjustment mechanism could work smoothly and symmetrically and the

desired inflation target be achieved. The rule prescribed in this section is optimal in the sense that it satisfies the two requirements that a system with decentralized central banks and different monies needs. Assuming, for simplicity, that the monetary base multipliers are equal to one, we start by decomposing equation (6) into the monetary base growth of individual member countries, in the absence of interventions vis-à-vis third currencies, using first differences rather than percentage changes and expressing all monetary variables in a common currency:

$$(7) \qquad \Delta M_{EMS} = \Delta \sum_{i=1}^{7} M_i \ ,$$
$$= \Delta \sum_{i=1}^{7} (DA_i + IR_i) = \sum_{i=1}^{7} (\Delta DA_i + \Delta IR_i)$$

where DA is the domestic component of the monetary base and IR stands for international reserves.

Because interventions in member currencies cancel out, in the absence of interventions in third currencies:

$$(8) \qquad \sum_{i=1}^{7} \Delta\, IR_i = 0$$

equation (7) becomes:

$$(9) \qquad \Delta M_{EMS} = \sum_{i=1}^{7} \Delta DA_i$$

or in percentage changes:

$$(9') \qquad \dot{M}_{EMS} = \sum_{i=1}^{7} d_i \dot{DA}_i$$

where $d_i = \frac{DA_i}{M_{EMS}}$ is the share of domestic assets of the central bank of country i in the total monetary base of the EMS. Assuming that in each member country DA_i grows at the rate given by equation (6') (i.e., the proposed rule):

$$(6') \qquad \dot{DA}_i = \frac{1}{a_i} (\dot{p}_i + \dot{y}_i) \text{ where } a_i = \frac{DA_i}{M_i}$$

Substituting (6') into (9') yields the following equation:

(5)

$$(10) \qquad \dot{M}_{EMS} = \sum_{i=1}^{7} \frac{d_i}{a_i} \dot{p}_i + \sum_{i=1}^{7} \frac{d_i}{a_i} \dot{y}_i$$

which can be rewritten as:

$$(10') \qquad \dot{M}_{EMS} = \dot{p}_{EMS} + \dot{y}_{EMS}$$

which is equivalent to the EMS-wide monetary base rule. The substitution of (6') into (9') shows first that if each country follows rule (6'), this is equivalent to the EMS-wide monetary base rule given by equation (6). However, while there is a mathematical equivalence between equations (10') and (6'), their interpretations are quite different. If member countries follow the rule of equation (6'), equation (10') would hold ex post. If member countries jointly decide instead to follow rule (6), they would do so ex ante. Second, it shows what weights should be used to compute the aggregate EMS-wide inflation rate and GDP growth rate from individual country targets. The weights should be the share of each country's monetary base (money supply) in the EMS-wide monetary base (money supply), since:

$$\frac{d_i}{a_i} = \frac{M_i}{M_{EMS}}$$

In Appendix 2 it is shown in a simplified two country model that, if each country follows a rule like (6'), the exchange rate system is stable. Vice versa if each country sterilizes reserve flows, i.e., it fixes the total monetary base, the exchange rate system is unstable or indeterminate. If only one country fixes the total monetary base, the system is stable. In this case it can be shown, however, that the speed of convergence is slower than in the case in which both countries do not sterilize reserve flows.

Some important assumptions under which rule (6') has been derived, do not hold strictly at present. They are the assumption that exchange rates are perfectly fixed, the assumption that the productivity growth rates in the traded and non-traded goods sectors in each member country do not differ, and the assumption that member countries do not cheat about the sum of $\dot{y}_i$ and $\dot{p}_i$ in setting their target for $\dot{DA}_i$.

The possibility of realignments raises two problems. The first is technical: if in the ratio M_i/M_{EMS}, M_i is expressed in a common currency using central rates, every time a weak currency i is realigned with respect to the common currency, the weight M_i/M_{EMS} is reduced discontinuously. Conversely, if exchange rates for the conversion are

kept constant the weight of high inflation countries will increase through time. This problem can be overcome, however, by using fixed exchange rates for the conversion and by changing the weights every 5 years or so, for instance when the weight of member currencies in the ECU is changed.

The second problem has to do with currency substitution on the demand side: expectations of realignments can influence the demand for money in each country and lead to a higher or lower growth in the nominal demand for money than predicted on the basis of y_i or p_i. This can change the degree of restrictiveness or ease of monetary policy in each country, an occurrence which may lead to unwanted output and unemployment outcomes to the extent that domestic monetary growth will still matter, in addition to the global monetary growth, in the transition toward full monetary union. Capital controls will contribute to keeping the weight of domestic monetary policy higher than it would otherwise be.

Differential productivity growth in the traded and non-traded goods sectors leads to a further technical problem in the long run. If in one member country productivity in the traded goods sector grows faster than in the non-traded goods sector and because of institutional factors and market rigidities nominal wages are equalized across sectors, prices of non-traded goods will have to increase in relation to prices of traded goods. Thus inflation measured by the consumer price index will be higher in the high-productivity countries. It will then become necessary to distinguish between the common inflation rate measured by the prices of traded goods and the different inflation rates measured by the consumer prices or the GDP/GNP deflators. If $\dot{p}_i$ indicates the inflation rate measured by the price index of traded goods, equation (6') will have to be amended by adding a term reflecting differential productivity growth in the two sectors. This is mathematically tractable as shown by Michael Parkin (1977).

A final problem could arise if some countries by design or error forecast wrongly the potential growth of output or the extent of the productivity bias, and hence consumer price inflation. Let us assume that a country desires a more relaxed monetary policy and intentionally overestimates the sum of $\dot{y}_i$ or $\dot{p}_i$. It will eventually incur a balance of payments problem. Unless the country reverses its policy, it will have to realign its exchange rate. Countries that underestimate the sum of $\dot{y}_i$ and $\dot{p}_i$ will be subjected to large international reserve inflows or pressure to revalue the currency. Thus eventually the market will force countries that make errors to fall back in line.

While a common monetary policy based on equation (6) seems unfeasible as long as there is no common European central bank, a rule such as (6') has some appeal. First it allows the money stock in each country to vary in order to accommodate balance of payments fluctuations, thus helping to smooth and make more rapid the balance of payments adjustment process. Second each central bank is attributed a precise responsibil-

ity consistent with its inflation objective and its potential output growth. A co-operative approach could be adopted in fixing the inflation objective for each member country, consistently with the desired degree of convergence. The Committee of Central Bank Governors and/or the Monetary Committee could become the forum for these discussions. Once exchange rates become permanently fixed, then there will be the same inflation objective for each member. If countries feel that more convergence is needed before this rule can be applied, they can in the meantime retain the principle of non-sterilization of international reserve flows among members of the system, which is an important ingredient of the rule implicit in equation (6').

There is no need for a stable relationship between DA_i and output, for the proposed rule to work. All that is needed is a stable relationship between the total monetary base and output and shocks involving symmetric shifts in the demand for money deriving from autonomous portfolio adjustments. Only for this type of shock will the control of DA_i allow stabilization of both nominal output and the balance of payments.

The essential appeal of a rule à la McKinnon within the context of the EMS lies in the symmetry of the balance of payments adjustment and the specificity of the required common inflation target. It is an optimal rule in response to symmetric shifts in the demand for money deriving from autonomous portfolio adjustments; it is not, however, an optimal rule in the case of asymmetric demand or supply shocks, whether originating within or outside the EMS. It is also not optimal in the case of an asymmetric monetary shock (a velocity change) deriving from an autonomous change in money demand (or money supply shock) in one member country only or in the currency area as a whole. In these cases, the appropriate response would have to be a realignment (in case of asymmetric external demand or supply shocks) and/or corrective action in the member country originating the shock, be it monetary or demand related. This in turn will require the resolution of difficult conflicts in identifying the nature of the shock and in deciding on the appropriate asymmetric response (burden sharing).

Countries that have very large and growing public debts may show more reluctance to adopt a rule like (6'). The implications of the rule for real domestic interest rates and the derived constraints for fiscal policy of both the quasi-fixity of exchange rates and the resulting high real interest rates would have to be accepted by the parliament and the government. These constraints may be seen as contributing to the effort to reduce the public debts and deficits in those countries and may therefore be quite useful. The large public debts and deficits in some member countries and the danger, however remote, of monetization of these debts suggest that a monetary policy rule like the one proposed in this section may not be enough to guarantee the long-run stability of the EMS. A rule involving fiscal policy may have to supplement the monetary policy rule.

IV.3. Third rule: nominal income targeting by each member country

James Meade (1984) suggested that the whole panoply of demand management policies for the control of money expenditure should be used to keep total money expenditures on the products of labour (i.e., money GDP or money national income) on a steady and moderate growth path. In an open economy, according to Meade, monetary policy has a comparative advantage on the level of the exchange rate, so that most of the burden to keep money GDP on a stable moderate growth path would have to fall on fiscal policy. The level of real wages and changes in wage differentials should instead be used to guarantee full employment. He calls this policy strategy "New Keynesianism" as opposed to "Orthodox Keynesianism" which is aimed at manipulating money expenditure to control the level of employment. The orthodox Keynesianism led to excessive inflation due to the lack or unfeasibility of an appropriate incomes policy and the existence of labor market rigidities.

Meade's proposal has some appeal for the EMS because it would allow the endogeneity of the money supply necessary for the smooth working of the balance of payments adjustment process within the system. It would thus be consistent with the adoption of the rule described in the previous section. Money GDP targets could be set for each country individually but in a coordinated fashion consistently with a declining inflation rate in the higher inflation countries and a low and stable inflation rate in the low inflation countries. Fiscal policy would be the primary instrument to stabilize nominal GDP, while monetary policy could follow the rule outlined in the previous section or at least follow the rule of non-sterilization of international reserve flows.

Nominal GDP targeting could also be used as a non-contingent rule: as a velocity-adjusted money growth target. This would be particularly appropriate if asymmetric velocity changes are expected (because of financial innovation, liberalization of capital movements etc.). Money growth could then follow the path implied by the announced target for nominal GDP without necessarily implying a feedback to fiscal policy, since this would depend on whether the authorities concerned were prepared to fine tune or not.

Recently, Williamson and Miller (1987) have suggested the following rules for monetary and fiscal policy to manage a system of real effective exchange rates with target zones involving the major currencies of the world. They propose nominal domestic demand and the real effective exchange rate as targets of economic policy. The three rules are:

(a) that national fiscal policies should be designed with a view to achieving national target rates of growth of domestic demand;

(b) that differences in short-term interest rates among countries should be revised to prevent the deviation of currencies from their target ranges;

(c) that the average level of world interest rates should be revised up (or down) if the growth of aggregate nominal demand for the participating countries as a group exceeds (falls short of) the target growth.

These rules could equally well be applied to the management of the ERM. Rule (b) bears close similarities with the domestic component of the monetary base rule outlined in the previous section. The two rules imply the same "reaction" of interest rates in the case of shocks involving the balance of payments. In fact, assume for instance, an asymmetric positive productivity shock in the domestic country which leads to a strengthening of competitiveness and of the exchange rate. In the case of an interest rate rule, the interest rate will have to fall to slow down the appreciation of the exchange rate; in the case of a rule related to the domestic component of the monetary base, the unsterilized inflow of foreign currency will also lead to a reduction in the interest rate and slow down the appreciation.

Rule (c) allows to solve the so-called "n-1 problem". Since in an n- country world there are only n-1 exchange rates, n-1 interest rate differentials are enough to stabilize them. The n^{th} interest rate (and the average interest rate) can be used to stabilize the whole system's aggregate demand. Thus Williamson and Miller's "blueprint" are a reformulation of the rule of the previous section with an aggregate nominal demand rule added to it, to solve the problem of velocity shifts for the area as a whole. It is a truly symmetric rule.

One problem with nominal income targets (or nominal demand) is caused by the fact that the lags of economic policy are variable and often long. If an unexpected fall in money expenditure occurs, it takes time before fiscal measures influence money expenditures. Furthermore there are lags between the recognition that a fiscal stimulus (or contraction) is needed and the time the policies change can be implemented, as fiscal policy cannot normally be changed during a given fiscal year. Keeping money expenditure precisely on a desired path may be easier said than done. However, the setting of annual or bi-annual targets rather than quarterly ones could make the task easier.

Generally, the view behind the nominal income rule is one of more "activism" of fiscal policy. According to the "activist" view, fiscal policy should be actively used to support weak business cycles and dampen excessive aggregate demand growth. This view contrasts with the view behind the monetary rule described by equation (6') in the previous section which is based on "non-activism". While in principle the two rules could coexist, it is important to understand this difference.

The extent to which fiscal policy can be used "actively" to even out the business cycle depends in part on the level of the public debt and budget deficit in the country. If disequilibria accumulated from the past are large, the "room for manoeuvre" is limited. Thus a nominal income rule for each of the member countries would imply severe asymme-

tries between members, as countries like Italy and Belgium should not lose sight of the long term objective of reducing public debts and budget deficits. For them, an announced rule to reduce the ratio of the government deficit to GDP by one or more percentage points per year may be more compatible with the monetary rule implicit in equation (6') than using fiscal policy actively to achieve a given nominal income or demand target.

IV.4. Fourth rule: a common inflation target and a monetary rule for each country individually

The above sections have tried to show: (a) that the symmetric working of any pegged exchange rate system is incompatible with a rigid money supply rule. This is true for the gold standard, for Bretton Woods, as well as for the EMS; (b) that it is important for the system to have some anchor for inflationary expectations and a mechanism tending to stabilize inflation, such as under the gold standard; (c) that there is no precise "rule" which could be optimal in all circumstances. McKinnon (1977) has therefore proposed that member countries should agree upon the final, rather than intermediate target, i.e., a common inflation target, measured by the prices of traded goods, which under fixed exchange rates will be the same for all members. The rate of inflation of traded goods prices on which an agreement is easiest would probably be zero. Wholesale prices are the existing index which best approximates an ideal index of traded goods prices. Consumer price inflation will be different among members if productivity in the traded and non-traded goods sectors grows at differential rates, given existing labor market rigidities. The proposed rule is the following: if the targeted EMS inflation rate accelerates above the intended path, monetary policy should be restricted in a coordinated fashion with countries where it accelerates more, adopting a relatively more restrictive stance, (i.e., reducing more than proportionately the growth in the monetary aggregates). The Monetary Committee may become the inflation forum where the performance of EMS inflation is evaluated and changes in monetary policy suggested to the central banks of member countries.

Fiscal policy could also be restricted in order to assist monetary policy in reducing inflation when it accelerates, and expanded when inflation falls below zero. Because the lags with which monetary and fiscal policy affect inflation may be long, targets may have to be set for periods longer than one year. It would seem preferable to set the inflation targets in terms of "underlying" inflation rates and not actual inflation rates: i.e., exogenous price shocks should be removed from actual inflation (oil shocks, maybe also indirect taxes).

McKinnon's proposal to target a common (and low) rate of inflation based on a common index seems appealing if the difference between productivity growth in the traded and non-traded goods sectors is signifi-

cant. A case could also be made to target consumer prices because the latter are more stable and less influenced by exchange rate developments and also because they represent the politically more sensitive inflation rate. As convergence of real economic performance among member countries proceeds with the creation of the internal market and the ensuing further integration of the real economies, the economic significance of the productivity bias is likely to become smaller, thus strengthening the case for targeting consumer prices rather than wholesale prices.

This proposal presents technical problems which are not easy to solve: the adjustment of consumer prices for the effects of exogenous shocks to arrive at the "underlying inflation rate", and above all the agreement on the relative importance of the various factors affecting inflation: money, wages, fiscal policy, import prices. There are still large theoretical differences among European central banks as to the relative importance of each factor for inflation. In addition there is the problem of the long and variable lags between policy changes and inflation. An analysis of what existing econometric models of the various countries could tell in this respect would take us beyond the scope of this paper. However, if EMS member countries find this rule appealing, then a comparative study of these models should certainly be commissioned.

V. Conclusions

This paper has analysed the working of the gold standard, the Bretton Woods system, and of the EMS so far. The lessons drawn from this analysis are first that in a fixed exchange rate system the money supply cannot be exogenously determined by the monetary authorities of individual countries without interfering with the balance of payments adjustment process. This is the more true the greater the degree of capital mobility in a system. However, in each system and to different degrees, a leader has emerged providing the "anchor" to the system and having a greater degree of monetary autonomy than the other members. The second lesson is that a properly functioning fixed or adjustable exchange rate system needs a rule governing inflation. The gold standard had such a rule, albeit an imperfect one, Bretton Woods and the EMS do not. To the extent that in the latter two systems the n-th country (the "leader") has also provided an acceptable inflation anchor, the system has operated satisfactorily but in an asymmetric manner.

Having established that a properly functioning exchange rate system needs rules governing inflation and rules guaranteeing smooth balance of payments adjustment, in Section IV four rules were discussed that could lead, under a broadly unchanged institutional setting, to an improvement in the functioning of the EMS system. While these rules were proposed in the wider context of the international monetary system, they could be extended to the EMS proper. They are not intended to be proposals for

reform but only working hypotheses to stimulate the discussion. The rules discussed were: a common EMS-wide money supply target à la McKinnon fixed ex-ante, a rule which consists in setting the growth rate of the domestic component of the monetary base in each country on the basis of the inflation target and of potential output growth (coupled with no sterilization of interventions), a nominal demand/income target rule à la Williamson-Miller and the rule to target monetary policy (and fiscal policy?) at a commonly agreed measure of inflation. It was found that no rule could provide an "optimal" response to all shocks, particularly when based on intermediate targets. In particular, while symmetry was a desirable feature, it would not provide, per se, a desirable outcome in all circumstances. Therefore, the need for concentrating on a final target (i.e., inflation) and adapting the policy response to the nature and origin of the shock must prevail in the present institutional context.

The EMS has been since its inception and still is in a transition stage. Initially there was no agreement (not even implicit) on inflation and the system had to undergo several realignments. After 1983 an implicit agreement on inflation emerged, namely to converge towards the German inflation rate and to let Germany determine the "anchor" inflation rate of the system. Discretionary coordination of monetary policy and to a lesser extent of fiscal policies emerged, but given the initial inflation differentials and the different disequilibria accumulated from the past, realignments were still necessary. At present we have substantially greater convergence of inflation, and inflation differentials are smaller than the permitted fluctuation of exchange rates within the band. Roughly since 1986 a new challenge to the system is emerging, the increased degree of capital mobility. Independence of monetary policy, fixed exchange rates and totally free capital mobility are not consistent with each other. In the future, the independence of monetary policy will have to be constrained by more rigid rules, since the major achievements of the EMS, a relative stability of real exchange rates among members, should not be abandoned, and free capital mobility, albeit with safeguard clauses, is a necessary building block of a truly common European market for goods, services and factors of production.

The rule implied by equation (6'), that members expand the domestic component of the monetary base according to the targeted inflation rate and the potential output growth, seems to be the most promising of all those discussed if symmetry is desired and appropriate. Its main implication is the non-sterilization of intra-EMS international reserve flows, but this would be appropriate only in response to symmetric shifts in the demand for money in member countries. Therefore, a degree of asymmetry will remain necessary in response to other shocks, involving the use of fiscal policy in a co-ordinated fashion as well. The recent agreement for the financing of intramarginal interventions by the monetary authorities in an ad-hoc manner goes in this direction. It is to be part of and supplemented by stricter surveillance with a view to identifying the appropriate response to incoming shocks. At the same time central banks could consider putting their credibility more on

achieving final economic policy targets (inflation) rather than domestic monetary growth, as suggested by the fourth rule.

Co-ordination of monetary policies will remain difficult if realignments are large and provide incentives for one-way bets, and therefore destabilizing speculative capital movements. Given the achieved convergence of inflation rates, this problem would be lessened if realignments were infrequent, but nevertheless remained small so that any new agreed band would overlap with the previous one. To maintain the "disciplinary" character of the system, they should also not completely offset inflation differentials, however measured, unless flanked by credible stabilization policies. While such a realignment rule--cum monetary policy co-ordination--would be sufficient in the face of disturbances generated within the system, it may prove too rigid in cases of external shocks, such as the recent sharp depreciation of the U.S. dollar. In this case a temporary widening of the margins of the currency which has so far played the central role may prove the less costly option, waiting for the time when all currencies of the system become better substitutes for each other.

Footnotes

(1) However, only under the gold standard, central exchange rates were perfectly fixed between major currencies.

(2) The system, however, may have been more asymmetric than claimed here, with the United Kingdom playing a central and more dominant role and the Bank of England "conducting the International Orchestra" (Eichengreen, 1987).

(3) This equilibrating property resulted from the fact that, with a fixed nominal gold price, profits in gold production and thus world gold output were raised by a fall in the world price level and reduced by an increase.

(4) See Sommariva and Tullio (1986) for a theoretical model explaining the determinants of the German discount rate under the classical gold standard and for empirical tests showing that changes in the liquidity ratios explain changes in the discount rate.

(5) See Vergleichende Notenbankstatistik (1925) and Charles Goodhart (1972, 1984).

(6) An even more dramatic concentration of gold in U.S. hands occurred during World War II. Valued at 35 dollars an ounce the U.S. gold stock amounted to US$8,500 million in 1931 and US$26,000 million at the end of World War II.

(7) Germany had flexible exchange rates until the monetary reform of 1923. All major industrial countries had returned to fixed exchange rates by 1928. The period of fixed exchange rates was very short and lasted until about 1931, when sterling was devalued.

(8) It must be pointed out, however, that the fall in this ratio was also due to the sharp increase in the demand for dollar reserves which resulted from world economic growth, the growth in world trade and the insufficient world gold production. This indicates that the proviso of adequate international reserves is also an important condition for the smooth functioning of a fixed exchange rate system.

(9) This situation reoccured in the first half of 1987, after the decision to stabilise the dollar exchange rate vis-à-vis other key currencies (the "Louvre" agreement).

(10) A practice which is being repeated with respect to the deutsche mark in the EMS, with similar consequences.

(11) The "follower" country indeed cannot "sterilize" its losses of foreign reserves because any such credit expansion could bring another round of reserve losses equal to the domestic credit expansion (a point noted by Mr. N. Roubini).

(12) It should be noted that the size and duration of a member currencies' real appreciation could be considered as a measure of the extent to which the monetary authorities concerned have not been able to "borrow credibility" from the Bundesbank. Furthermore, as suggested by Melitz in this conference volume, to the extent that credibility is bought at the expense of competitiveness, the gains of credibility have to be weighted against the output loss resulting from the real appreciation of the exchange rate. Thus, for countries like France and Italy, EMS participation may reduce welfare.

(13) The reason for this standardization is that we wish to compare the fraction of the cumulative variance of each variable explained by the first principal component in the analysis relating to the group of 17 industrial countries with that relating to the EMS countries only. This is done in Tables 6 and 7 below.

For instance the first number in Table 6 is obtained from Table A1 in Appendix 1 as follows (for n=16):

$$0.56 = \frac{f - \frac{1}{n}}{1 - \frac{1}{n}} = \frac{0.59 - 0.0625}{1 - 0.0625}$$

where f is the fraction of the variance explained by the first principal component reported in Table A1

(14) The fact that long-term nominal interest rates show less cohension in the third period may be due to inflation differentials, which were still significant and risk premia related to larger differences in budget deficits in relation to domestic savings.

(15) It could be argued, however, that offshore rates of currencies which are subject to capital controls are inherently more volatile because, as the internal and external markets are separated, the external ones bear the brunt of shocks. As they are generally small markets, their volatility is inherently high.

(16) The conclusions of the European Council meeting at Bremen on July 6-7, 1978, state that "not later than two years after the start of the scheme, the existing arrangements and institutions will be consolidated in a European Monetary Fund." The second stage is also mentioned in point 1.4 of the Resolution of the European Council of Bruxelles on December 5, 1978.

(17) Italy and France have, however, accumulated deutsche mark balances which they use for interventions, against the original rules of the system. See also Section III.3 where the issue of interventions under the EMS is discussed.

(18) Under perfectly fixed exchange rates, which are expected to prevail forever, all currencies become perfect substitutes in investors' portfolios (on the demand side). Substitutions on the supply side (via central bank interventions) will then become an important factor in changing the stock of money.

(19) This has been an argument frequently used by the supporters of the entry of sterling into the ERM, especially in 1986, when wages were growing very rapidly in the United Kingdom.

(20) This common inflation target should not be an average, but the lowest possible inflation rate acceptable to every member.

(21) Note that when comparing measures of capacity utilization for Germany, those by the Bundesbank are believed to be on the low side, and its estimates of potential output growth have been higher than those of other German forecasters. The Sachverständigenrat revised its estimate of the ratio of actual to potential output for 1986 from 98.5 percent to 96.1 percent, presumably to adapt its estimate to the one of the Bundesbank.

(22) Switzerland instead announces its target as a point estimate equal to the growth of potential output and assuming zero inflation. Deviations from the target are, however, accepted if other data show no inflationary pressure and the deviation is not too large.

(23) Other estimates, however, show a relatively stable demand for money in Germany.

(24) It is important to bear in mind that we are talking here about currency substitution on the demand side. Currency substitution on the demand side among countries participating in the ERM is likely to be reduced in importance as realignments become less frequent and expectations of exchange rate changes less volatile. At the same time, substitution on the supply side between ERM member currencies via central bank interventions in the foreign exchange market will become more important.

Appendix 1 - Principal Component Analysis of Selected Variables: 17 Industrial Countries

Consider first the monthly rate of change of the bilateral exchange rate with the U.S. dollar. The principal component analysis has been made for the bilateral exchange rates of 16 industrial countries: the 7 countries participating in the EMS Exchange Rate Agreement (Germany, France, Italy, the Netherlands, Belgium, Denmark, Ireland) plus the United Kingdom, Spain, Norway, Sweden, Austria, Switzerland, Canada, Australia and Japan. The analysis has been carried out separately for 3 time periods: March 1973 to February 1979, March 1979 to February 1983, May 1983 to March 1986.

The first period goes from the beginning of floating to the starting of the EMS. The second period goes from the beginning of the EMS up to the general realignment of March 1983. The third period starts in May 1983, after the disturbances caused by the March realignment had settled down and ends with the month preceding the general realignment of April 1986. Thereafter there have been two more realignments in August 1986 and January 1987. It was not possible to update the analysis for lack of data.

The principal component analysis gives some insights into how closely the various currencies in the group fluctuated vis-à-vis the U.S. dollar in the three subperiods. It is also interesting to see whether the data are able to isolate an EMS block of currencies within the larger group and whether some countries which are not formally part of the exchange rate agreements de facto behaved as if they were. Such candidates could be Switzerland, Austria, Norway and at times Sweden, as their currencies followed the Deutsche Mark quite closely. On the other hand, the analysis could indicate that countries which are formally members of the EMS have de facto not behaved as good members due to the use of larger margins of fluctuations, frequent realignments or divergent economic policies. (Italy and France could have been two countries belonging to this sub-group.).

Table A1 summarizes the results of the principal component analysis of bilateral exchange rate changes with the U.S. dollar for the first period (1973 3 - 1979 2). Tables A2 and A3 contain the results for the two EMS-subperiods. Panel A of each table shows the cumulative variance explained by the first principal components and panel B contains the correlation coefficients of each country's variable with the first three principal components. In Table A1 the first principal component is highly correlated with the currencies of the DM area. The bilateral U.S. dollar exchange rates of the following countries have a correlation coefficient higher than 0.90: Belgium, Germany, Denmark, the Netherlands, Austria and Norway. France, Sweden and Switzerland have a

correlation coefficient between 0.80 and 0.90. Ireland, the United Kingdom and Italy between 0.60 and 0.70. The exchange rates of the non-European countries have a much lower correlation coefficient. Thus the first principal component can be identified with the deutsche mark-area.

As to the second sub-period, panel B of Table A2 indicates that the first principal component still represents the deutsche mark-area with France, Italy, Ireland and also Switzerland now moving closer to it (correlation coefficient greater than or equal to 0.90 for all these countries). Spain also moves closer, while during this period Norway and Sweden had a more independent exchange rate policy than before. During the second EMS sub-period panel B of Table A3 indicates that the EMS group showed an even greater cohesion, with Austria, Norway, Sweden, Switzerland and Spain now de facto behaving as if they belonged to the group.

What emerges from the analysis of panel B of Tables A1-A3 is that the original deutsche mark-area of the period of free floating developed into a more cohesive exchange rate system comprising not only the countries which formally joined the exchange rate agreement, but also Austria, Switzerland, Spain, Norway and Sweden. The fraction of the cumulative variance of bilateral exchange rate changes explained by the first principal component increases from 59 percent during the floating rate period to 72 per cent in the first EMS sub-period and 84 per cent in the second.

The same statistical analysis for consumer prices is presented in Tables A4-A6, the U.S. having been added to the group of countries. Even though the fraction of the variance explained by the first principal component is much smaller than for bilateral exchange rates, a European block of countries can be identified in each subperiod. This block widens in time to comprise additional countries and becomes more cohesive in the second EMS sub-period. During this period France, Italy, Germany, Belgium and to a lesser extent Denmark and the Netherlands seem to form a block with high (and growing) cohesion. U.S. inflation also has in this period a much higher correlation with the first principal component than in the previous ones, reflecting the common external shock of the increase in oil prices and the priority given in all industrial countries to the fight against inflation. These findings do not say anything about whether the EMS has led to a faster reduction of inflation in the member countries.

The results of the principal component analysis for the 17 nominal long-term interest rates, are presented in Tables A7-A9. During the first EMS sub-period (i.e. 1979-83), a remarkable degree of convergence of nominal long-term rates seem to emerge between Europe and the North American continent with only British and Japanese interest rates showing greater independent behaviour (Table A7). The very high interest rate policy in the U.S. probably helped to bring about this increased convergence, as European countries tried to contain the depreciation of their currencies with respect to the U.S. dollar. This occurred at a

time of growing financial integration. As to the second EMS sub-period there is also no evidence of an independent EMS block, with Germany and the U.S. being among the countries possessing the highest correlation with the first principal component. Table A7-A9 seem to suggest that no common independent European capital market has emerged yet, not even in the second EMS sub-period. They suggest instead a strong domination of the U.S. capital market on the other countries in the 1980's and a remarkably high and increasing worldwide integration of capital markets. This confirms Micossi and Padoa Schioppa's findings (1984).

As to the principal component analysis of nominal short-term interest rates (not shown here), there is also no evidence of a greater convergence in the EMS group of countries. This is not surprising, however, as a smoothly working balance of payments adjustment mechanism within a fixed exchange rate system requires that movements in the short-term interest rate be subordinated to the achievement of exchange rate stability.

The principal component analysis of the rates of change of the money stocks (also not presented here) shows that the first three principal components explain a very low fraction of the variance of the money stocks. In addition there is no evidence of a cohesive EMS block. Again this is hardly surprising: the data used are monthly; under a system of pegged exchange rates the money stock has to be subordinated to the achievement of exchange rate stability and to balance of payments adjustment. This implies short-run changes of the money stocks of member countries which at times go in opposite directions. Thus, as with short-term interest rates, the inability to find evidence of a common growth rate of the money stock on a monthly basis within the EMS may indicate more rather than less monetary policy coordination. Furthermore a greater monthly variability of the money stocks and less monthly convergence is perfectly compatible with greater convergence of annual monetary growth as shown in Table 5.

Table A1.

A. Rate of Change of Bilateral Exchange Rates with U.S. Dollar
16 Currencies, Period 1973 3 to 1979 2

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.585	9.360
Princ2	0.685	1.600
Princ3	0.757	1.159
Princ4	0.821	1.018
Princ5	0.872	0.809
Princ6	0.906	0.549
Princ7	0.933	0.438
Princ8	0.954	0.337

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.687	-0.491	0.118
United Kingdom	0.687	-0.491	0.119
France	0.853	-0.006	0.015
Italy	0.606	-0.437	0.059
Belgium	0.962	0.156	-0.079
Germany	0.941	0.235	-0.056
Denmark	0.952	0.192	-0.104
Netherlands	0.938	0.164	-0.053
Austria	0.942	0.223	-0.074
Norway	0.908	0.227	-0.041
Sweden	0.864	0.218	-0.162
Switzerland	0.843	0.039	0.052
Australia	0.177	0.074	0.885
Canada	-0.165	0.637	0.447
Spain	0.377	-0.381	0.038
Japan	0.597	-0.276	0.289
Variance	0.585	0.685	0.757
Eigenvalues	9.360	1.600	1.159

Table A2.

A. Rate of Change of Bilateral Exchange Rates with U.S. Dollar
16 Currencies, Period 1979 3 to 1983 2

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.722	11.554
Princ2	0.803	1.297
Princ3	0.860	0.909
Princ4	0.905	0.725
Princ5	0.931	0.405
Princ6	0.952	0.341

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.977	-0.127	0.067
United Kingdom	0.682	-0.057	-0.533
France	0.962	-0.034	0.109
Italy	0.965	-0.025	0.032
Belgium	0.953	-0.024	0.094
Germany	0.965	-0.070	0.021
Denmark	0.956	-0.014	0.175
Netherlands	0.964	-0.103	0.174
Austria	0.960	-0.074	0.220
Norway	0.884	0.162	-0.080
Sweden	0.649	0.231	-0.468
Switzerland	0.900	0.022	0.211
Australia	0.706	0.568	-0.115
Canada	0.518	-0.495	-0.292
Spain	0.692	-0.503	-0.266
Japan	0.646	0.595	-0.103
Variance	0.722	0.803	0.860
Eigenvalues	11.554	1.297	0.909

Table A3.

A. Rate of Change of Bilateral Exchange Rates with U.S. Dollar
16 Currencies, Period 1983 to 1986 3

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.839	13.424
Princ2	0.910	1.129
Princ3	0.951	0.660

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.992	-0.061	0.021
United Kingdom	0.838	0.020	0.413
France	0.992	-0.091	-0.022
Italy	0.970	-0.077	-0.093
Belgium	0.991	-0.079	-0.030
Germany	0.992	-0.074	-0.050
Denmark	0.990	-0.075	-0.021
Netherlands	0.994	-0.066	-0.036
Austria	0.992	-0.073	-0.057
Norway	0.981	-0.017	0.076
Sweden	0.984	-0.032	-0.006
Switzerland	0.975	0.054	0.063
Australia	0.437	0.723	-0.493
Canada	0.462	0.742	0.426
Spain	0.962	-0.072	-0.017
Japan	0.826	-0.029	-0.192
Variance	0.839	0.910	0.951
Eigenvalues	13.424	1.129	0.660

Table A4.

A. Consumer Prices, Rates of Change of 17 Countries, Period 1979 3 to 1983 2

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.227	3.852
Princ2	0.370	2.433
Princ3	0.484	1.947
Princ4	0.571	1.474
Princ5	0.644	1.239
Princ6	0.702	0.997
Princ7	0.757	0.933

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.452	-0.514	0.299
United Kingdom	0.577	-0.338	-0.106
France	0.719	0.008	-0.069
Italy	0.084	-0.033	-0.745
Belgium	0.385	0.362	-0.193
Germany	0.581	0.114	0.222
Denmark	0.314	-0.458	-0.091
Netherlands	0.541	-0.324	-0.347
Austria	0.673	0.416	0.333
Norway	0.610	0.354	0.122
Sweden	0.505	0.409	-0.419
Switzerland	0.144	-0.242	0.567
Australia	-0.237	-0.458	-0.336
Canada	0.288	-0.511	0.374
Spain	0.503	0.531	-0.028
Japan	0.342	-0.386	-0.440
United States	0.551	-0.410	0.015
Variance	0.227	0.370	0.484
Eigenvalues	3.852	2.433	1.947

Table A5.

A. Consumer Prices, Rates of Change of 17 Countries, Period 1973 3 to 1979 2

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.236	4.005
Princ2	0.346	1.883
Princ3	0.450	1.769
Princ4	0.529	1.330
Princ5	0.594	1.119
Princ6	0.656	1.053
Princ7	0.714	0.978
Princ8	0.764	0.858

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.643	-0.161	0.339
United Kingdom	0.588	0.123	0.434
France	0.643	-0.213	-0.298
Italy	0.579	-0.242	-0.196
Belgium	0.699	-0.083	-0.193
Germany	0.602	0.508	0.266
Denmark	0.240	-0.271	-0.186
Netherlands	0.595	-0.278	0.024
Austria	0.452	0.667	0.121
Norway	0.292	0.352	0.235
Sweden	0.227	0.492	-0.060
Switzerland	0.348	0.271	-0.249
Australia	0.535	-0.480	-0.060
Canada	0.049	0.269	-0.703
Spain	-0.010	-0.191	0.081
Japan	0.669	-0.189	0.039
United States	0.194	0.252	-0.744
Variance	0.236	0.346	0.450
Eigenvalues	4.005	1.883	1.769

Table A6.

A. Consumer Prices, Rates of Change of 17 Countries, Period 1983 5 to 1986 3

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.282	4.800
Princ2	0.424	2.410
Princ3	0.523	1.687
Princ4	0.612	1.505
Princ5	0.677	1.109
Princ6	0.739	1.048
Princ7	0.787	0.823

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.454	-0.346	0.435
United Kingdom	0.361	0.294	0.441
France	0.782	0.145	0.233
Italy	0.725	0.198	-0.211
Belgium	0.765	-0.205	0.332
Germany	0.783	-0.179	-0.097
Denmark	0.572	0.542	0.014
Netherlands	0.666	0.458	0.005
Austria	0.461	-0.665	-0.088
Norway	0.332	-0.159	-0.638
Sweden	0.389	-0.197	-0.368
Switzerland	0.495	-0.161	-0.088
Australia	-0.224	0.221	-0.020
Canada	0.100	-0.599	0.236
Spain	0.194	-0.594	-0.402
Japan	0.301	0.515	-0.544
United States	0.672	0.092	0.116
Variance	0.282	0.424	0.523
Eigenvalues	4.800	2.410	1.687

Table A7.

A. Nominal Long-Term Interest Rates of 16 Countries, Period 1973 3 to 1979 2

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.378	6.046
Princ2	0.730	5.627
Princ3	0.856	2.021
Princ4	0.904	0.769
Princ5	0.931	0.427
Princ6	0.954	0.367

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.752	-0.472	0.241
United Kingdom	0.734	-0.538	0.049
France	0.712	-0.354	0.001
Italy	-0.262	-0.858	0.337
Belgium	0.368	-0.833	0.224
Germany	0.767	0.562	-0.219
Denmark	0.046	-0.592	-0.597
Netherlands	0.866	-0.112	-0.221
Austria	0.839	-0.101	-0.112
Norway	-0.363	-0.798	-0.339
Sweden	-0.529	-0.821	0.114
Switzerland	0.877	0.405	-0.152
Australia	0.281	-0.808	0.379
Canada	0.085	-0.832	-0.400
Japan	0.949	0.054	0.149
United States	-0.134	-0.217	-0.924
Variance	0.378	0.730	0.856
Eigenvalues	6.046	5.627	2.021

Table A8.

A. Nominal Long-Term Interest Rates of 16 Countries, Period 1979 3 to 1983 2

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.718	11.481
Princ2	0.859	2.266
Princ3	0.918	0.945
Princ4	0.944	0.416
Princ5	0.960	0.258

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.750	-0.197	0.554
United Kingdom	0.576	-0.690	0.312
France	0.951	0.214	-0.128
Italy	0.889	0.426	0.049
Belgium	0.952	0.177	-0.159
Germany	0.890	-0.323	0.007
Denmark	0.796	0.341	0.022
Netherlands	0.847	-0.463	-0.042
Austria	0.960	-0.103	-0.009
Norway	0.856	0.437	-0.102
Sweden	0.878	0.282	-0.265
Switzerland	0.937	-0.243	-0.102
Australia	0.865	0.434	0.097
Canada	0.965	-0.060	0.056
Japan	0.245	-0.672	-0.617
United States	0.895	-0.273	0.093
Variance	0.718	0.859	0.918
Eigenvalues	11.481	2.266	0.945

Table A9.

A. Nominal Long-Term Interest Rates of 16 Countries, Period 1983 5 to 1986 3

Cumulative Variance and Eigenvalues

	Variance	Eigenvalues
Princ1	0.606	9.696
Princ2	0.762	2.500
Princ3	0.850	1.398
Princ4	0.896	0.747
Princ5	0.935	0.620
Princ6	0.955	0.325

B. Coefficients of Correlation with Principal Components

	Princ1	Princ2	Princ3
Ireland	0.898	-0.238	0.104
United Kingdom	0.580	-0.355	-0.291
France	0.895	0.362	-0.077
Italy	0.669	0.641	-0.016
Belgium	0.941	-0.115	0.083
Germany	0.934	0.258	0.021
Denmark	0.860	-0.164	0.008
Netherlands	0.924	0.346	-0.036
Austria	0.834	0.057	0.105
Norway	-0.768	0.348	-0.398
Sweden	0.085	-0.735	-0.509
Switzerland	0.525	-0.727	-0.342
Australia	0.121	0.507	-0.748
Canada	0.875	-0.103	0.173
Japan	0.876	0.239	-0.352
United States	0.916	-0.176	0.174
Variance	0.606	0.762	0.850
Eigenvalues	9.696	2.500	1.398

Appendix 2 - Stability Analysis of a Two Country Model Under Alternative Monetary Rules and Exchange Rate Regimes (*)

I. Introduction

This appendix is intended to study the stability of an EMS-like agreement under alternative monetary rules. In particular the rule developed in Section IV.2 of the paper will be investigated. The contribution of nonsterilization of international reserve flows to the stability of the EMS will be demonstrated.

Any movement toward less frequent changes of parities and the removal of barriers to capital mobility will fundamentally change the operating conditions of the EMS and require new rules for coordinating monetary policy. Fixed exchange rates and unrestricted capital flows will necessarily be accompanied by a very high degree of currency substitution among the currencies of countries participating in the exchange rate mechanism (ERM), a situation which is already observable to some extent in the present less than perfect state of monetary integration.

The monetary rules considered are two: (i) a rule consisting of controlling the total monetary base, with its implied sterilization of foreign exchange reserve variations; and (ii) a rule consisting of controlling the domestic component of the monetary base.

The implications for stability of the adoption of these two rules will be evaluated both under the assumption of partially variable managed exchange rates and under the assumption of perfectly fixed exchange rates.

II. Stability Analysis of a Managed Exchange Rate Regime

For analytical purposes, the actual exchange rate agreement of the European Monetary System will be modelled as a managed exchange rate regime. The regime is potentially a floating one, but exchange rate movements are damped down through foreign exchange market intervention. We shall examine which monetary rules return the exchange rate to its equilibrium level and the relative speed of convergence.

(*) This appendix has been written by Eric de Souza of the University of Louvain-la-Neuve in collaboration with Giuseppe Tullio.

1. We shall consider two countries that are sufficiently large relative to each other so as to exert significant reciprocal influences. and shall refer to them as Germany and Italy. The analysis will rely on the monetary mechanism of the balance of payments adjustment and exchange rate determination.

In each economy wealth is held in the form of money and goods, so that any excess demand for money must spill over into an excess supply of goods, just as an excess supply of moeny means that there is an excess demand for goods. The demand for money is characterized by a stable relationship which depends on real income. It also depends on the interest rate but we shall ignore this complication as we shall not consider interest rate adjustments. We shall also neglect the role of currency substitution.

In a closed economy, when there is an excess supply of money, the accompanying excess demand for goods will lead to a rise in prices unless increased supplies are forthcoming. In this way real cash balances adapt and equilibrium is reestablished in the goods and money markets. This mechanism is not immediately operative in an open economy. An excess supply of money will lead to an excess demand for goods in general, and in so far as this can be expended on imports, there will be no tendency for prices to rise. Instead a trade deficit will be incurred. If the exchange rate is free to vary, this will result in a depreciation of the domestic currency. In a similar manner, an excess supply of the foreign currency will lead to a trade surplus at home and a consequent appreciation of the exchange rate. The above reasoning is incorporated in the following equation:

$$(1) \quad \dot{S} = \alpha(M - PY) - \beta(M^* - P^*Y^*) \quad \alpha,\beta>0$$

where S is the exchange rate (the price in Italian lire or deutsche mark), M is the Italian monetary base, P the price level in Italy and Y the level of output. Asterisks indicate the corresponding variables for Germany.

Under freely floating exchange rates and instantaneous adjustment of portfolios, the above equation would determine the level of the exchange rate and not its evolution. However, in our context changes in the exchange rate are tempered (or exacerbated) by intervention of the central banks of the two countries in the foreign exchange market. This formulation ignores the existence of a band around the central parities. For the analysis of the stability of the system which concerns us here this neglect is not of very great importance, especially if the banks are sufficiently large as in the case of Italy. Intervention can either lean against the wind or with it. In the simplest case, Italian intervention in the foreign exchanges can be modelled as:

$$(2') \quad \dot{R} = -\gamma(S - S_0)$$

where $\dot{R}$ is the change in the level of international reserves held by the central bank, and S_0 is the central parity of the Italian lira with the deutsche mark, the target exchange rate. γ is a policy parameter: it expresses the attitude of the Italian central bank. When γ is positive, the bank is considered as leaning against the wind; when negative, it reinforces the pressures of the foreign exchange market on the rate of exchange. The larger γ is in absolute value, the stronger the reaction of the central bank.

In equation (2') above, changes in reserves were rigidly guided by the foreign exchange market intervention rule. Remaining balance of payments disequilibria were absorbed by changes in the exchange rate. Consistently with the narrow bands of variation in exchange rates around the central parities in the exchange rate mechanism, we allow, however, disequilibria resulting from excess or deficient private holdings of real cash balances to influence both exchange rates and reserves. Consider Italy once again. Suppose for a moment that the central bank intervenes to keep exchange rates firmly pegged. Then the entire disequilibrium in private holdings of cash balances will spill over into changes of international reserve holdings of the central bank:

$$B = -\delta_1 (M - PY) + \delta_2(M^* - P^*Y^*) \quad \delta_1, \delta_2 > 0$$

where B is the change in reserves held by the Italian central bank as a consequence of private transactions. Now let the central bank relax its rigid stance. If B is negative, the Italian monetary authorities will partially let the lira depreciate, partially absorb the excess supply of Italian lira by selling Deutsche mark. Therefore:

$$\dot{R} = B + \gamma (S - S_0)$$

where $\dot{R}$ represents actual changes in international reserves held by the Italian central bank. In the above illustration, $\gamma < 0$ with the bank reinforcing private market pressures by accepting a larger fall in international reserves. When γ is positive, the Italian central bank buys marks when the Italian lira tends to depreciate. The latter is clearly not the behavior that central banks normally adopt. The two basic equations now are:

$$(1) \quad \dot{S} = \alpha(M - PY) - \beta(M^* - P^*Y^*)$$

$$(2) \quad \dot{R} = \gamma(S - S_0) - \delta_1(M - PY) + \delta_2(M^* - P^*Y^*)$$

The above model is closed by introducing the following identities:

$$(3)\quad M = D + R$$

$$(4)\quad M^* = D^* + R^*$$

where D refers to the domestic credit component of the monetary base. The two equations define the monetary base for Italy and Germany as the sum of domestic credit available from the central bank and its holdings of international reserves.

The final identity links the holdings of international reserves by the two countries with each other. Let R be the total availability of (outside) international reserves measured in marks. Then:

$$(5)\quad SR + R^* = \bar{R}$$

We shall evaluate reserves at the central parity exchange rate level. Moreover, without loss of generality, we shall normalize this level to unity. We thus obtain:

$$S_0R + R^* = R + R^* = \bar{R}$$

Given equation (2), equation (5) determines the change in German holdings of international reserves.

1.A We shall first suppose that neither Italy nor Germany sterilizes the effects of international reserve flows on their monetary bases. The domestic credit component is held constant since output is held fixed as well as prices. The resulting differential system is the following:

$$\begin{pmatrix} \dot{S} \\ \dot{R} \end{pmatrix} = \begin{bmatrix} 0 & \alpha + \beta \\ \gamma - (\delta_1 + \delta_2) & \end{bmatrix} \begin{pmatrix} S \\ R \end{pmatrix} + \begin{pmatrix} \alpha(D - PY) - \beta(D^* + \bar{R} - P^*Y^*) \\ -\gamma - \delta_1 (D - PY) + \delta_2 (D^* + \bar{R} - P^*Y^*) \end{pmatrix}$$

where S_0 has been normalized to unity.

The characteristic equation of the above system is:

$$\lambda^2 + (\delta_1 + \delta_2)\,\lambda - (\alpha + \beta)\gamma$$

the roots of the equation are:

$$-\frac{(\delta_1 + \delta_2)}{2} \pm \frac{((\delta_1 + \delta_2)^2 + 4(\alpha + \beta)\gamma)^{1/2}}{2}$$

Intervention rule (i): $\gamma > 0$

With γ positive, the system has a saddle point behavior. This requires an initial discretionary intervention in order to attain the unique convergent path.

Intervention rule (ii): $\gamma < 0$

With γ negative, the Italian central bank reinforces the movement of reserves initiated by adjustment of private cash balances to desired levels. In this case, the system is asymptotically stable. Any initial point leads to equilibrium either monotonically or with fluctuations depending on the sign of

$$[(\delta_1 + \delta_2)^2 + 4(\alpha + \beta)\,\gamma]$$

Central bank behavior in relation to interventions in the foreign exchange market is generally characterized by a negative γ . Actual behavior leads therefore to a stable system.

1.B Now suppose that Italy intervenes on the foreign exchanges and does not sterilize the effects of reserve flows; whereas Germany does sterilize the effects of reserve changes on its money stock. This form of asymmetric nonsterilized intervention has characterized the European Monetary System so far.

In this case the following equation must be added to the five listed above:

(6) $\dot{D}^* = -\dot{R}^*$, or equivalently, $M^* = \bar{M}^*$

The differential system now becomes:

$$\begin{pmatrix} \dot{S} \\ \dot{R} \end{pmatrix} = \begin{bmatrix} 0 & \alpha \\ \gamma & -\delta_1 \end{bmatrix} \begin{pmatrix} S \\ R \end{pmatrix} + \begin{pmatrix} \alpha(D - PY) - \beta(\bar{M}^* - P^*Y^*) \\ -\gamma - \delta_1(D - PY) + \delta_2(\bar{M}^* - P^*Y^*) \end{pmatrix}$$

The characteristic equation now is:

$$\lambda^2 + \delta_1\lambda - \alpha\gamma$$

with roots:

$$\lambda = -\frac{\delta_1}{2} \pm \frac{(\delta_1^2 + 4\alpha\gamma)^{1/2}}{2}$$

Once again, if $\gamma > 0$, the system is characterized by saddlepoint behavior, whereas if $\gamma < 0$, the system is asymptotically stable.

The sterilization of international reserve flows by Germany affects the relative speed of convergence to equilibrium of the exchange rate and of reserves. When Italy intervenes as it normally does ($\gamma < 0$), then sterilization by Germany slows down the convergence of the system as can be seen by comparing the larger of the two roots in the two cases described above (case 1.A - symmetric nonsterilization by both countries, and case 1.B - Nonsterilization by Italy and sterilization by Germany).

If, moreover, Italy behaves such that $\gamma > 0$ and is on the convergent path, then the speed of convergence if further hampered.

1.C If now Italy intervenes on the foreign exchanges and sterilizes the effects of reserve changes, whereas Germany allows reserve changes to affect its monetary base, conclusions about the stability of the system are like in case 1.B.

1.D The system breaks down if both countries refuse to allow their monetary base to be influenced by the international reserve flows. It provokes the continuous accumulation of reserves by one country and a continuous loss by the other.

III. Stability Analysis of a Fixed Exchange Rate Regime

With the transition to credibly fixed exchange rates between the member countries of the European Monetary System and the removal of barriers to capital mobility, the degree of currency substitution between the member states will become very high indeed.

Under a regime of fixed exchange rates, the entire brunt of disequilibria in private money holdings, that is, the adjustment of actual money holdings to the desired level is borne by changes in international reserves at the central bank:

$$(1)\quad \dot{R} = -\delta_1(M - PY) + \delta_2 (M^* - P^*Y^*)$$

Moreover, in the absence of restrictions to capital flows, national currencies become perfect substitutes and only the total aggregate money stock will reveal stable behavior. Furthermore, prices in the different countries will have to align themselves to each other:

$$(2)\quad P = P^*$$

In such a world, excess supplies of money will be absorbed not only by an international transfer of reserves but also by an adjustment of prices in both countries. Consider a rise of output levels in Italy and the consequent shortage of real cash balances. The resulting movement of reserves toward Italy will provoke a shortage in Germany. Hence, the output shock will ultimately be absorbed by price changes:

$$(3)\quad \dot{P} = \dot{P}^* = (M + M^* - P(Y + Y^*))$$

International reserve changes in both countries are directed toward the maintenance of fixed exchange rates. It remains to determine the behavior of domestic credit. Assume the domestic component of the monetary base is targeted to a permanent zero rate of inflation. Two other alternatives will be considered, namely, the targeting of domestic credit to temporary changes in prices; and the targeting of the total monetary base to the same end.

1. Consider first the case in which the domestic component of the monetary base is kept constant. In Section IV.2 of the paper the rule proposed was that the domestic component of the monetary base should grow at the same rate as the sum of desired inflation and potential output (equation (6')). Since here derived inflation is assumed to be

zero and potential output is assumed to be constant, the case considered here is the dynamic version of rule IV.2. The system reduces to two equations:

$$\begin{pmatrix} \dot{R} \\ \dot{P} \end{pmatrix} = \begin{bmatrix} -(\delta_1+\delta_2) & \delta_1 Y - \delta_2 Y^* \\ 0 & -\eta(Y + Y^*) \end{bmatrix} \begin{pmatrix} R \\ P \end{pmatrix} + \begin{pmatrix} -\delta_1 D + \delta_2 D^* + \delta_2 \bar{R} \\ \eta D + \eta D^* + \eta \bar{R} \end{pmatrix}$$

with characteristic equation:

$$[(\delta_1 + \delta_2) + \lambda] \quad [(Y + Y^*)\eta + \lambda]$$

and roots:

$$\lambda = -(\delta_1 + \delta_2) \text{ and } -\eta (Y + Y^*)$$

Since both roots are negative, the system is asymptotically stable.

2. Now suppose that both countries adapt the domestic component of the monetary base to counteract temporary price movements:

$$\dot{D} = -\alpha \dot{P} \; ; \; \dot{D}^* = -\beta \dot{P}^*$$

An unexpected rise in output in Italy will lead to an increase in Italian reserves and a fall in prices. If α and β are positive, the necessary adaptation of the Italian monetary base will be hastened, whereas the undesired reduction of the German monetary base neutralised. The complete system of differential equations is:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & \alpha & 1 & 0 \\ 0 & \beta & 0 & 1 \end{bmatrix} \begin{pmatrix} \dot{R} \\ \dot{P} \\ \dot{D} \\ \dot{D}^* \end{pmatrix} = \begin{bmatrix} -(\delta_1 + \delta_2) & \delta_1 Y - \delta_2 Y^* & -\delta_1 & \delta_2 \\ 0 & -\eta(Y + Y^*) & \eta & \eta \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{pmatrix} R \\ P \\ D \\ D^* \end{pmatrix} + \begin{pmatrix} \delta_2 \bar{R} \\ \eta \bar{R} \\ 0 \\ 0 \end{pmatrix}$$

with the roots of its characteristic equation equal to:

$$\begin{aligned} \lambda &= 0 \text{ (twice)} \\ &= -(\delta_1 + \delta_2) \\ &= -[(\alpha + \beta) + (Y + Y^*)]\eta \end{aligned}$$

The two zero roots correspond to the collinearity between the dynamics of the price level and domestic credit in the two countries. The other two roots are both negative if α and β are positive. The system is always stable in this case. If, however, α and β are negative, with large values, implying that the central banks accommodate a rise in inflation, then the system will exhibit saddlepoint behavior.

3. Both countries are now supposed to target their total monetary base to inflation:

$$\dot{M} = -\alpha\dot{P} \; ; \; \dot{M}^* = \delta\dot{P}$$

In this case, three roots of the corresponding characteristic equation are zero, whereas the fourth is equal to:

$$-(\alpha + \beta + Y + Y^*)\eta$$

It is, consequently, negative for α and β positive. Under monetary base control, the system is characterized by hysteresis, that is, when subjected to shocks it will not return to its original equilibrium but to another one.

IV. Conclusion

The examination of various monetary rules in the context of the monetary approach to the balance of payments, both under managed and fixed exchange rates has led to a presumption in favor of rules based on control of the domestic credit component of the monetary base. This evaluation has been based on the criteria of stability, speeds of convergence and determinateness. The analysis of this appendix confirms therefore that a rule like the one proposed in Section IV.2 of the paper implies a stable system.

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