

PRINCETON STUDIES IN INTERNATIONAL FINANCE

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INTERPRETING THE ERM CRISIS:
COUNTRY-SPECIFIC AND SYSTEMIC ISSUES

WILLEM H. BUITER

GIANCARLO M. CORSETTI

AND

PAOLO A. PESENTI

INTERNATIONAL FINANCE SECTION

DEPARTMENT OF ECONOMICS
PRINCETON UNIVERSITY
PRINCETON, NEW JERSEY

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The authors of this Study are Willem H. Buiter, Giancarlo M. Corsetti, and Paolo A. Pesenti. Willem Buiter is Professor of International Macroeconomics at the University of Cambridge and a member of the Monetary Policy Committee of the Bank of England. He has previously served at Princeton and Bristol Universities, at the London School of Economics, and at Yale University, where he was Juan T. Trippe Professor of International Economics. Giancarlo Corsetti is Assistant Professor of Economics at the University of Rome III and has also taught at Yale and Columbia Universities. Paolo Pesenti is Assistant Professor of Economics and International Affairs at the Woodrow Wilson School at Princeton University. He is a research fellow of the National Bureau of Economic Research and has served as a consultant to the World Bank. The authors' book *Financial Markets and European Monetary Cooperation: The Lessons of the 1992–93 Exchange Rate Mechanism Crisis* will be released this year by Cambridge University Press.

PETER B. KENEN, *Director*
International Finance Section

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INTERNATIONAL FINANCE SECTION
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1 INTRODUCTION

The crisis of the European exchange-rate mechanism (ERM) in 1992–93 was a critical event in the post-Bretton Woods history of the international monetary system. The disruptive effects of speculative flows exposed the fragility of the European Monetary System (EMS) following the removal of exchange controls, shaking the entire process toward monetary union. Both inside and outside Europe, the events of 1992–93 represented a turning point for intellectual opinion—and policy priorities—regarding use of the exchange rate as an effective nominal anchor in the design of disinflation policies for integrated capital markets.

A full understanding of the causes, origins, and implications of the ERM breakdown can provide policy lessons that are particularly relevant, although by no means confined, to the current debate on the monetary future of Europe. By shedding light on the dynamics of “systemic” crises, the lessons of 1992–93 can help to refine our interpretation of the other two large-scale episodes of international monetary instability occurring in the years after the European crash: the speculative attacks and financial crises following the collapse of the Mexican peso at the end of 1994 and the currency crises in East Asia during the second half of 1997. Against obvious differences in their dynamics and underlying causes, the currency crises of the 1990s are alike in sharing a rapid and “contagious” propagation of speculative waves from the original country or group of countries under attack to an entire region having (perceived) comparable macroeconomic features. For this reason, an analysis of the

For their helpful comments and suggestions, we thank Michael Bordo, Barry Eichengreen, Jeffrey Frankel, Jeffrey Frieden, Peter Garber, Koichi Hamada, Maurice Obstfeld, David Pearce, Guido Rey, Kenneth Rogoff, Chris Sims, Niels Thygesen, and an anonymous referee. We also thank seminar participants at Harvard, Rutgers, Yale, Cambridge, and Koç Universities, the University of California, Berkeley, the University of Rome III, the London School of Economics, the Tinbergen Institute, the Banca d'Italia, the Danmarks Nationalbank, and the European Monetary Institute, and conference participants at the Centre for Economic Policy Research conference on “Speculative Attacks on Foreign Exchange Reserves,” held in Sesimbra, Portugal, in April 1997. Giancarlo Corsetti gratefully acknowledges financial support from the Ministero dell'Università e della Ricerca Scientifica e Tecnologica. We thank Mukul Kumar for excellent research assistance. A previous version of this study has circulated as CEPR Discussion Paper No. 1466.

ERM crisis can enhance our tools for policy evaluation in an interdependent global economy.¹

Most contributions to the recent literature have linked the ERM crisis to the international policy conflict generated by the policy mix adopted by Germany during its process of reunification in the early 1990s. Explanations have also stressed the persistent asymmetric performances of national price or unit-cost levels (reflecting divergent national monetary and fiscal policies), the destabilizing effects of deregulating international financial capital movements under the Single European Act, and the perceived change in the commitment of national policymakers to fixed exchange rates after the results of the first Danish referendum in June 1992. Other contributions have emphasized the possible role of self-fulfilling speculative attacks triggered by sudden, essentially arbitrary, expectations shifts in the financial markets.

Virtually all the interpretive schemes proposed by the literature have focused on the adjustment problems faced by individual European countries and have analyzed the country-specific sources of exchange-rate tension that eventually undermined the ability of individual countries to maintain a stable parity against the deutsche mark after September 1992. In other words, most contributions have represented the ERM as the sum of independent unilateral pegs against the currency of the “center” country, autonomously pursued by a number of “periphery” countries.

The problem with such an approach is that it downplays or ignores altogether the presence of structural policy spillovers in Europe, an omission of no little consequence. Interpretations based on a country-by-country analysis cannot, by their very structure, adequately explain the ERM events as the crisis of an exchange-rate *system*. They are therefore unable to address the issue of contagious speculative attacks or to analyze the effects of coordination (or lack thereof) of monetary and exchange-rate policies. Theories based on country-specific imbalances (including self-fulfilling shifts in expectations) cannot easily

¹ Looking backward, several contributions have also pointed to the remarkable similarities between the ERM crisis and the international crisis of 1971–73, which led to the demise of Bretton Woods. As Peter Kenen (1995, p. 161) writes, “in both cases, the game played between markets and governments had ossified the exchange rate regime, although the architects of both regimes had tried to combine short-term stability with long-term flexibility. Furthermore, the center country in each system was unable to arrange an orderly exchange rate realignment and resorted instead to methods that undermined the system.”

rationalize the simultaneous and unanticipated eruption of financial tensions that occurred in virtually all the countries participating in the ERM. Models that emphasize macroeconomic developments in Germany as the source of global shocks have little to say about why the ERM economies, which shared comparable macroeconomic conditions, responded to the common shock with highly dissimilar policies.

Contagious crises and systemic macroeconomic effects are central to the reading of the 1992–93 events presented in this study. We attempt to explain, within a comprehensive interpretive scheme, both the global loss of credibility of the ERM parities and the subsequent asymmetric policy developments in Europe. Espousing the view that the ERM events derived from a “coordination failure,” we provide a model suitable for analyzing the logic of the crisis and deriving its implications for the behavior of key observable macroeconomic variables in Europe. In Buiter, Corsetti, and Pesenti (1998), we generalized the theory of currency crises so as to encompass policy links and structural spillovers in a multicountry model of monetary coordination and financial instability. Building on those results, we analyze more directly in this study the interplay between country-specific asymmetries and systemic issues in the evolution of the EMS during the 1990s. The main theses discussed in our contribution may be summarized as follows.

During the first three quarters of 1992, the policy mix accompanying the reunification of Germany, as well as sizable asymmetries in the macroeconomic and political conditions in many European countries, generated strong tensions, of increasing severity, in the EMS. The main factor underlying the eruption of the ERM crisis in September 1992 was the unwillingness by European policymakers to agree on a cooperative policy response to these tensions. The fundamental imbalances stemming from German unification were at odds with the German-centered model of the ERM, a model to which European economic policy had previously conformed. Germany could not accept the idea of jeopardizing its internal price objectives, and the other countries in the system viewed a realignment as disruptive of the policy credibility acquired during several years of fixed exchange rates.

When, in September 1992, the existing parity grid became clearly untenable, most European countries tried to “save” their currencies from devaluation and refused to coordinate their exchange-rate policies. Our model predicts that, in a scenario characterized by a demand shock in the center country of a system, a cooperative policy response will lead to a sizable reduction in interest rates through a series of contained devaluations of the periphery countries against the currency

of the center. Conversely, a noncooperative policy response—associated with devaluations by only a subset of periphery countries—will lead to a lower average rate of monetary expansion and to persistently higher interest rates in the system as a whole. For this reason, the observed devaluation rates in the periphery will be large, possibly involving disruptive currency crises.

In 1992, the effect of the perceived policy-coordination failure on financial-market expectations was pervasive. To the extent that the events of September 1992 unequivocally signaled the breakdown of the EMS as a system in which both country-specific and system-wide monetary shocks could be counteracted by joint policy responses, the focus of market expectations shifted away from a coordinated small realignment to large devaluations by a few countries. Such a shift in expectations was not the outcome of self-fulfilling prophecies but, rather, a rational reaction by market participants to the ongoing policy developments.

Between September 1992 and August 1993, Europe was hit by repeated waves of speculative frenzy. Although exports from Italy and the United Kingdom increased rapidly after the eruption of the crisis—contributing to divert trade and employment in other countries—a comprehensive assessment of the empirical evidence cannot overlook two other important, systemic, features of the crisis after September 1992: the effects of the large devaluations on inflation in those countries that had maintained their peg, and, more explicitly, the financial and real effects of the decline in the German interest rates. The German rates had climbed relentlessly during 1991 and 1992, reaching their highest level in the summer of 1992. After September 1992, they fell steadily, although initially at a slow pace, through 1994. To the extent that low inflation in the consumer-price index (CPI) and falling interest rates allowed the nondevaluing European countries to reduce the macroeconomic costs of their peg to the deutsche mark, the breakup of the ERM helped, rather than hampered, the successful exchange-rate policies of these countries. The novelty of our inquiry consists in showing, within a rigorous analytical framework, how the success of some currencies in maintaining their peg to the center currency crucially depends on devaluations by other countries, which absorb the fundamental imbalances in the system. Although this notion runs against the popular model of “beggar-thy-neighbor” exchange-rate policies, it stresses the particular nature of the sign of the intra-European monetary spillovers in 1992–93 relative to the highly contractionary monetary stance of the center country.

This study is organized as follows. Chapter 2 presents a historical reconstruction of the ERM crisis. Chapter 3 describes a multicountry model of currency crises containing several key features that suit the stylized facts of the ERM events, that is, asymmetric macroeconomic conditions at a country level, a global shock in the form of an aggregate demand surge in the country at the center of the system, and structural links involving both trade and financial dimensions. The model builds on the traditional theory of currency collapses, developing its logical core so as to highlight the role of international spillovers. Chapter 4 interprets the 1992–93 crisis in light of the previous chapters’ analyses. Chapter 5 offers conclusions. A detailed, technical analysis of the model is given in the Appendix.

2 THE ERM CRISIS: A RECONSTRUCTION

Country-Specific and System-Wide Tensions in Europe

From its inception in 1979, the ERM system of exchange-rate bands allowed for periodic realignments of the central parities. During the 1980s, member countries gradually developed procedures to ensure strict coordination of exchange-rate policies, making the setting of new central rates a “truly collective decision” (Padoa-Schioppa, 1985, p. 351; see also Giavazzi and Giovannini, 1989, pp. 40–41). Once a country or group of countries proposed a realignment, the modalities of devaluation were subject to collective negotiation in the Monetary Committee meetings, and the final decision on implementation required unanimous approval. The architecture of the ERM thus provided its members with an effective institutional framework through which economic and financial tensions arising in the exchange markets could be absorbed through coordinated policy actions, thus anchoring market expectations of exchange-rate realignments. At the same time, the negotiation process prevented individual member countries from undertaking unilateral realignments.

The eruption of the crisis in 1992, and the shifts in market expectations, coincided with clear evidence that the coordination mechanism had somehow ground to a halt. To analyze the roots of this coordination failure, it is useful to reconstruct the ERM crisis by first focusing on the German reunification shock and the consequent buildup of exchange-rate tensions between the end of 1991 and the summer of 1992 (see Buiters, Corsetti, and Pesenti, 1998).

The unprecedented integration of two national economies, rebuilt after the war under very different systems and divided by a substantial gap in productive capacities as well as standards of living, resulted in the adoption of a highly controversial monetary-fiscal policy mix. In 1991, the net transfer of public funds from west to east Germany was as high as 139 billion deutsche marks.¹ A comparison to west German private savings, which equaled 260 billion deutsche marks that year, illustrates the magnitude of the transfer. The rate of growth of west German

¹ The following year, it reached 180 billion deutsche marks. Here and throughout, “billion” equals a thousand million.

public-sector indebtedness, which had averaged about 5 percent in the second half of the 1980s, rose to 13.4 percent and 11.2 percent in 1990 and 1991, respectively (Bundesbank, 1992). The massive transfer of resources to the east was neither financed by additional taxes nor balanced by significant cuts in other spending items in the budget.

At the same time, with the creation of the Monetary, Economic and Social Union in May 1990, “ost” marks could be converted into deutsche marks on a 1-to-1 or 2-to-1 basis.² The Bundesbank’s more cautious proposals regarding the conversion rate of the ost mark were de facto ignored by Chancellor Kohl. The chosen conversion rates between ost marks and deutsche marks hit east German production hard—dropping the level of industrial production in the first two months after reunification to less than half that of 1989—while the massive budgetary transfers contributed to a sustained high level of consumption demand (see Collier, 1991, and Akerlof et al., 1991).

In addition, the process of restructuring in the aftermath of reunification soon generated a noticeable increase in investment demand. Unless much of the increase in consumer demand from the east could be directed toward foreign goods, the German reunification scenario would lead to domestic overheating and inflationary pressures in the western part of the country.³ In the words of Helmut Schlesinger (1994, pp. 6–7), “the biggest mistake in the transition which has negative consequences to this day began with the wage policy. . . . These maladjustments were costly and they were largely responsible for . . . a relatively restrictive line of monetary policy through the Bundesbank to avoid creating an inflationary spiral” (for a discussion of these theses, see Sinn and Sinn, 1992).

Publicly denouncing what its president Karl Otto Pöhl had called, in March 1991, the “disastrous consequences” of a misguided approach to reunification, the Bundesbank warned the German government that reunification would provoke interest-rate increases unless the government’s budget deficit were drastically reduced. From the date of reunification until the signing of the Maastricht Treaty in December 1991, German key rates were gradually raised, in four steps, and the

² To be precise, all debts were converted at 2 to 1 and all claims at 2 to 1, except for bank deposits, which were converted at 1 to 1 for a limited amount per capita (2,000 marks for children under the age of 15; 4,000 for adults under 60; 6,000 for people over 59). The average rate of conversion, according to Bundesbank estimates (1990, p. 25), was 1.8 to 1. Wage, price, and pension contracts were converted on a 1-to-1 basis.

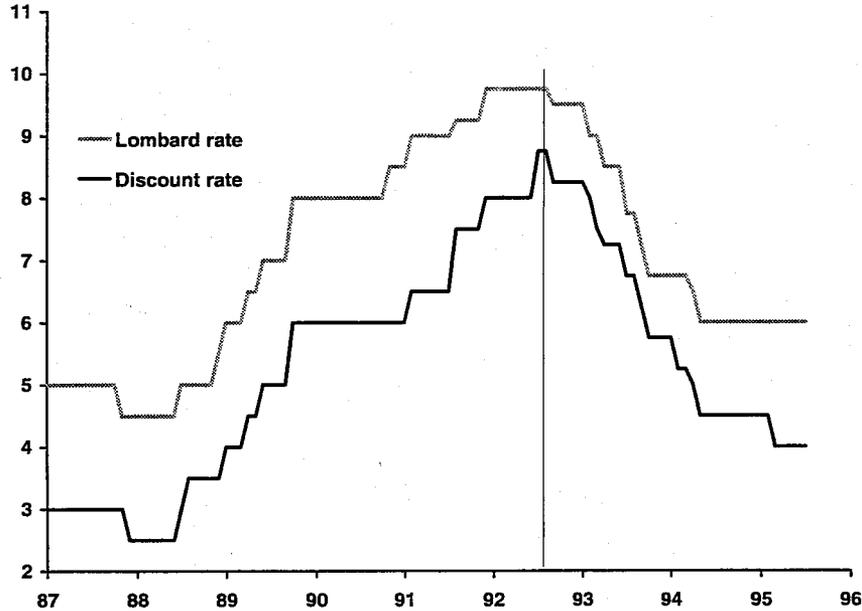
³ Capacity utilization in west Germany reached 90 percent in 1990, and the unemployment rate fell throughout the period, dropping below 7 percent during 1990.

target range for growth of the M3 measure of the money supply was lowered once without changing the intervention rates.

Toward the end of 1991, there was a strong tightening of monetary policy, signaling an absolute unwillingness to accommodate additional wage inflation and loosening of fiscal policy by the government (Commission, 1993). In 1992, it became increasingly clear that, in the absence of a realignment in the ERM, the Bundesbank would pursue the goal of monetary stability by using the interest-rate instruments regardless of the consequences for the domestic real economy and with utter disregard for the international implications of its policies. Figure 1 plots the German key interest rates between 1987 and 1995. The spike in the graph corresponds to September 1992.

There were domestic imbalances in the rest of the system as well. In Italy in the early 1990s, a downturn in the level of economic activity, coupled with notorious fiscal problems, fueled doubts about the desirability of a strenuous defense of the lira (see Froot and Rogoff, 1991). Evidence of a negative trend in the amount of international reserves

FIGURE 1
KEY INTEREST RATES IN GERMANY, 1987-1995



SOURCE: Deutsche Bundesbank.

TABLE 1
DEFICIT AND DEBT RATIOS IN THE EUROPEAN UNION
(in percentages)

	Deficit to GDP					Debt to GDP				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Austria	2.4	2.0	4.1	4.4	5.5	56.6	56.1	63.0	65.2	68.0
Belgium	6.5	6.6	6.6	5.3	4.3	132.6	134.4	141.3	140.1	138.3
Denmark	2.1	2.9	4.5	3.9	2.1	60.9	63.1	66.8	68.7	68.8
Germany	3.3	2.9	3.3	2.5	2.3	42.7	47.3	51.8	54.6	62.5
Finland	1.5	5.8	7.9	5.5	5.0	23.2	42.7	56.2	62.7	69.1
France	2.2	4.0	6.1	6.0	5.0	41.1	45.6	52.9	56.8	59.5
Greece	11.5	12.3	13.2	12.5	11.4	81.7	88.6	117.1	119.8	120.2
Ireland	2.1	2.2	2.3	2.2	2.5	95.3	90.7	92.7	87.9	83.3
Italy	10.2	9.5	9.6	9.0	7.8	103.9	111.4	120.2	122.6	122.1
Luxembourg	1.0	2.5	2.1	2.3	1.4	6.0	7.0	7.0	7.0	8.0
Netherlands	2.8	3.8	3.2	3.0	3.3	76.4	77.1	78.5	79.0	79.4
Portugal	6.5	3.3	7.1	5.7	5.4	62.2	63.2	67.8	70.4	70.8
Spain	4.9	4.2	7.5	6.6	6.2	49.9	53.0	59.4	63.5	66.5
Sweden	1.1	7.5	13.4	10.4	9.2	53.7	69.8	74.6	79.4	84.5
United Kingdom	2.6	6.1	7.9	6.5	4.2	35.5	41.4	47.4	51.6	53.4

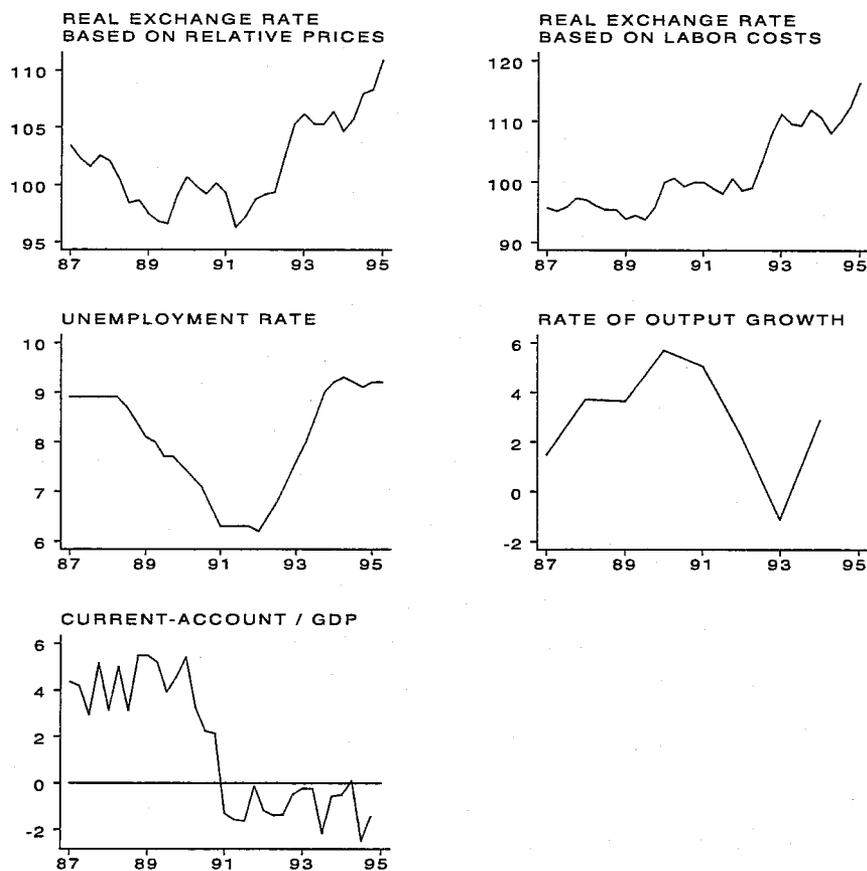
SOURCE: European Commission and OECD (for Austria, Finland, and Sweden in 1991 and 1992).

held by the Banca d'Italia suggests that speculative pressures began as early as the spring of 1992 (Goldstein et al., 1993, p. 53). Spain and Portugal, too, were experiencing a deterioration of competitiveness, and in England, the strength of the pound was being undermined by a severe contraction that generated internal pressures for a relaxation of British monetary policy. These developments are illustrated in Figure 2, which plots the time series of key macroeconomic variables in a number of European countries (inside and outside the ERM) between 1987 and 1995.

For the European Union (EU) as a whole, the gap between actual public-debt and deficit performance and the Maastricht convergence criteria widened.⁴ Table 1 shows how the EU members performed with

⁴ According to the Maastricht protocols, the general government financial deficit should not exceed 3 percent of GDP, and its gross financial liabilities should not exceed 60 percent of annual GDP. On the transition to European economic and monetary union (EMU) according to the Maastricht Treaty, see Fratiami and von Hagen (1992), Gros and

FIGURE 2
TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: GERMANY



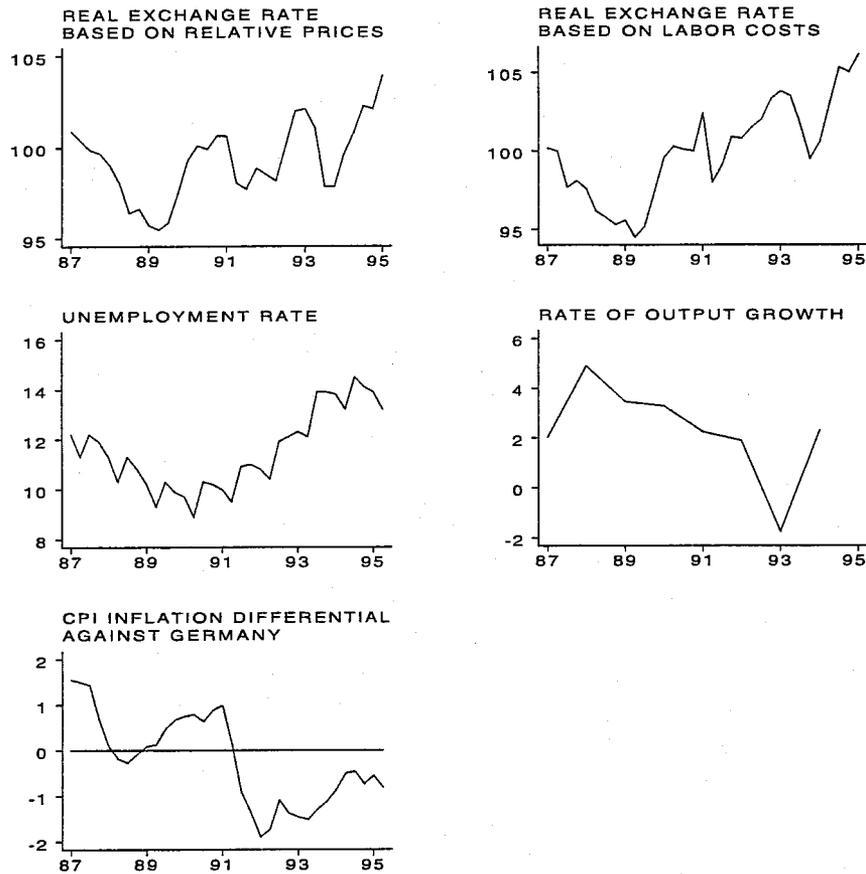
SOURCE: OECD and IMF.

respect to the fiscal criteria. In part, their performance can be attributed to the operation of the automatic fiscal stabilizers during a fiscal downturn, but doubts were also growing regarding the political feasibility of the budgetary tightening required to satisfy the deficit criterion

Thygesen (1992), Buitert, Corsetti, and Roubini (1993), De Grauwe (1994), and Kenen (1995). Bini-Smaghi, Padoa-Schioppa, and Papadia (1994) reconstruct the history of the Maastricht Treaty.

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: BELGIUM

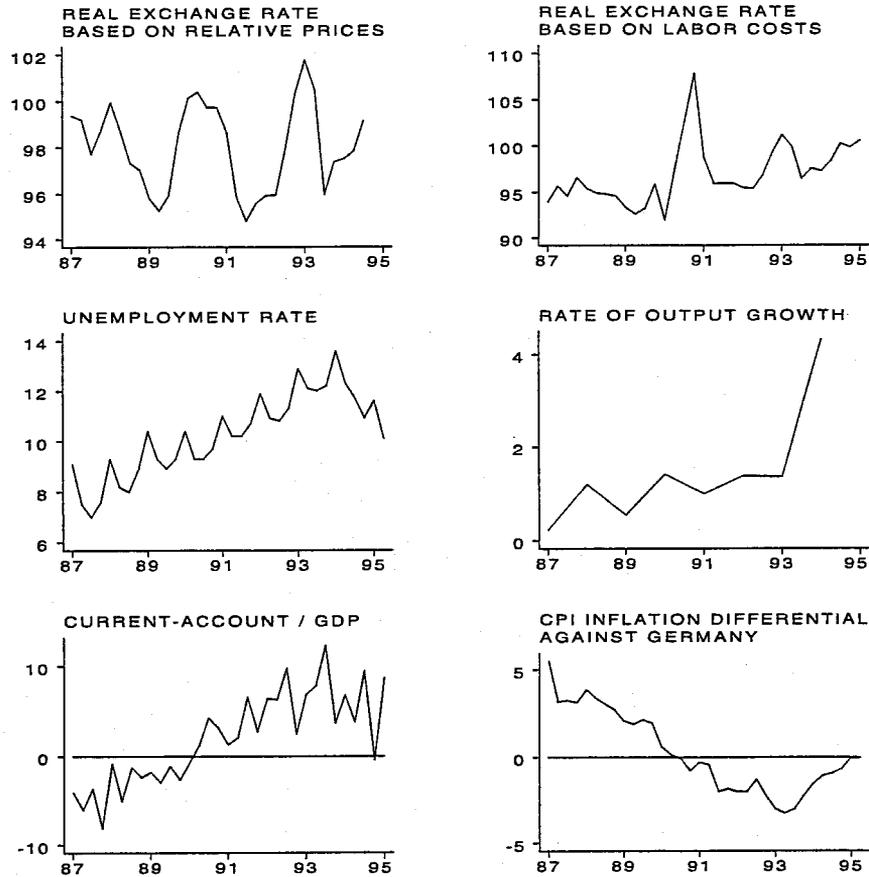


by the critical EMU deadlines. There is little doubt that the results of the first Danish referendum in June 1992 (rejecting the Maastricht Treaty) led to an extensive downward revision of the perceived costs of leaving the "hard" ERM. A shrinking political support for Maastricht was confirmed by the results of the polls in the weeks preceding the French referendum of September 20, 1992.

During the summer of 1992, these elements (reinforced by the dollar crisis in August) halted the trend of improving credibility that had characterized the ERM since the late 1980s. The Committee of Governors of the Central Banks (1993, p. 20) stated that:

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: DENMARK

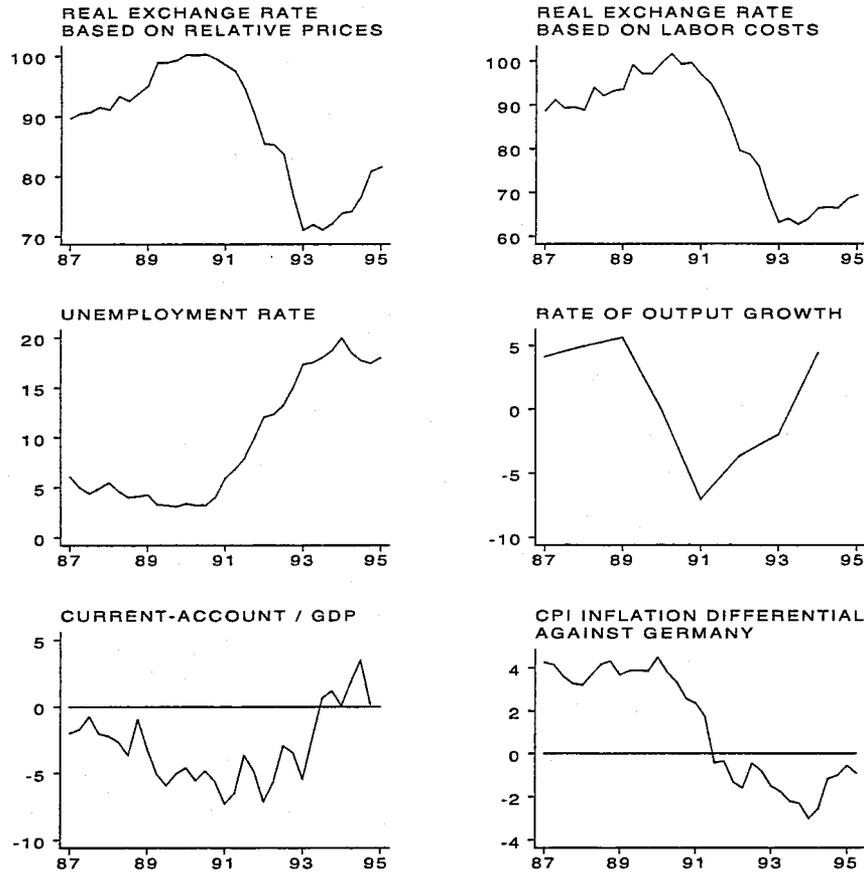


over this period the difficulty in pursuing internal and external policy objectives intensified as market confidence in the preservation of central exchange rate parities diminished. Against the background of broadly unchanged interest rates in Germany, the Netherlands and Belgium, short and long-term market interest rates rose in the other Community countries reflecting the additional currency risk.

To illustrate this point, Figure 3 (see p. 22) plots three-month interest differentials against the deutsche mark for a number of European countries. The two vertical spikes correspond to the Monday following the first Danish referendum and to Black Wednesday (discussed below).

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: FINLAND



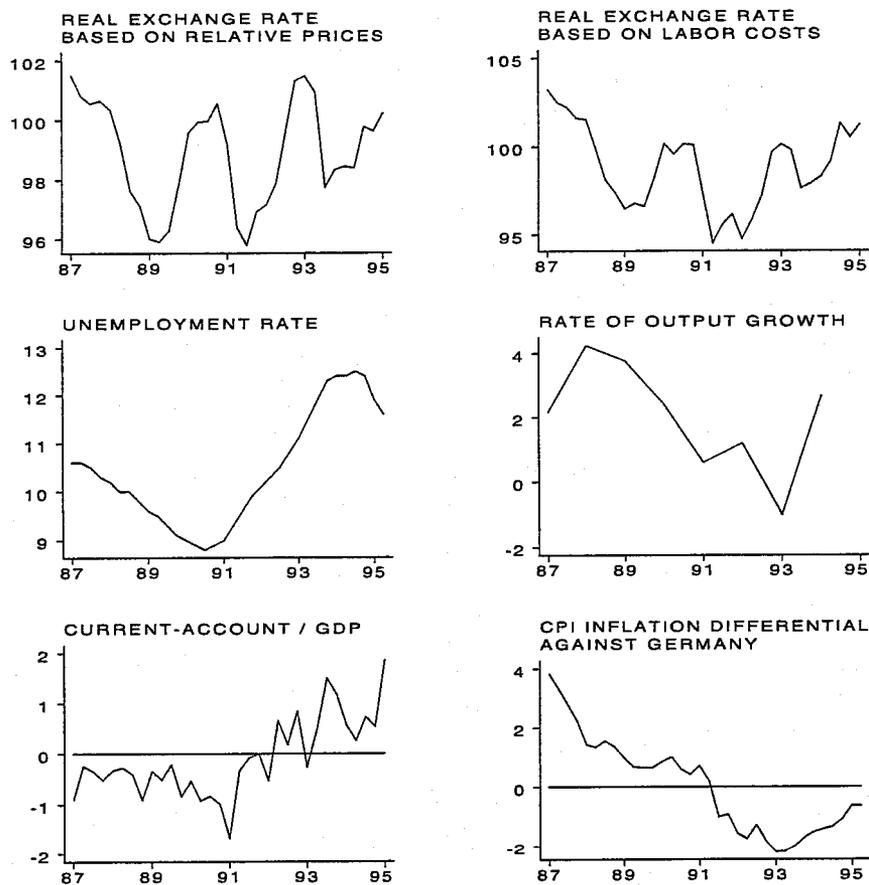
The Speculative Attacks of September 1992

At the beginning of September, a massive speculative attack against the lira occurred. It intensified after the Euromeeting in Bath on September 5 and 6, at which time the conflict on exchange-rate matters among European policymakers was widely reported by the press. As reconstructed by Kevin Muehring (1992, p. 11):

Near the end of the conference in the British spa town of Bath on Saturday, September 5, British Chancellor of the Exchequer Norman Lamont asked Bundesbank president Helmut Schlesinger once more for a commitment to cut German interest rates, which could be included in the post-

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: FRANCE

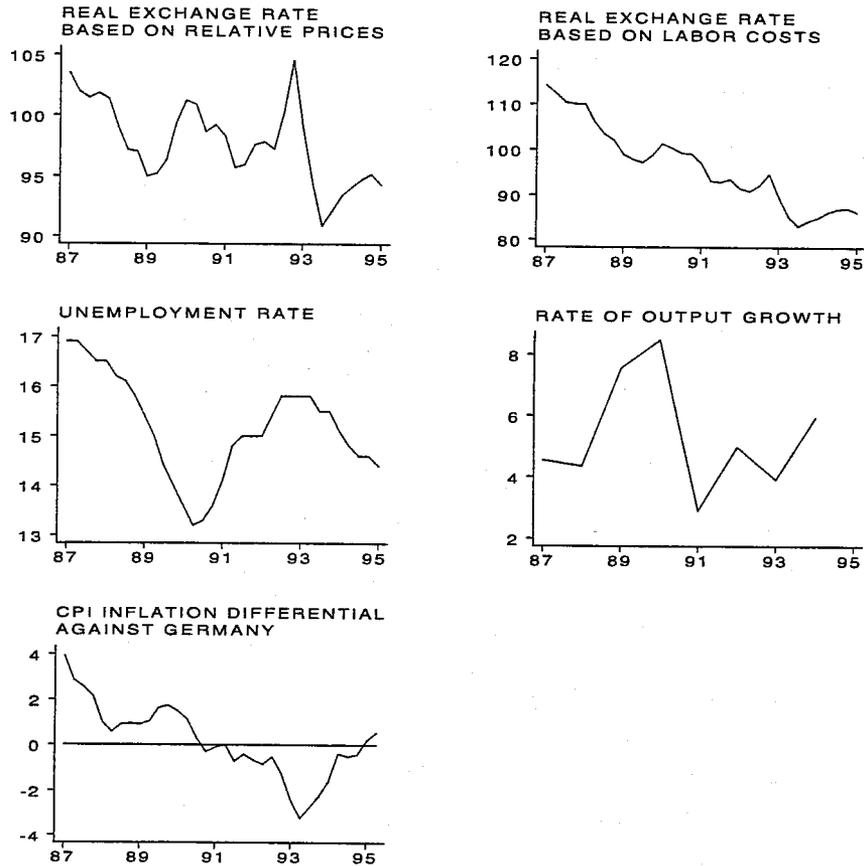


meeting communiqué. Schlesinger, containing his mounting anger, replied that it was impossible. When Lamont continued to press him, the normally unflappable Bundesbank president suddenly stood up to leave, only to be restrained by an almost equally annoyed Theo Waigel, the German finance minister. “My dear Norman”—Waigel snapped—“you have asked us that question four times, and four times we have given you the same answer. We do not see the need for wasting any more time. So if you ask again, I will get our helicopter ready to take us back.”⁵

⁵ In private conversations with the authors of this study, Schlesinger explained in detail his explicit position during the meeting: “The Bundesbank committee decided the

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: IRELAND

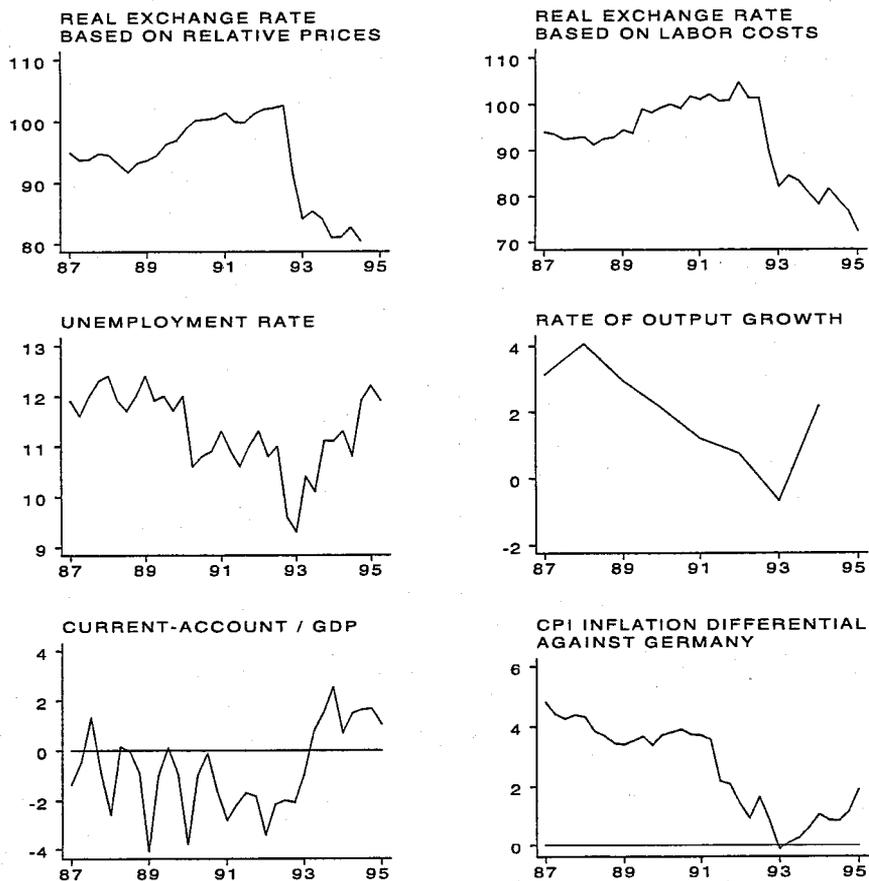


Germany was keen on implementing a generalized ERM realignment, but apparently no country (with the exception of Italy) was willing to discuss the terms of such a realignment. At Bath, "Schlesinger was not so much ignored as scorned," says a participant [to the European meeting], for his apparent willingness to 'so easily put monetary union at risk' with the first ERM realignment since 1987. . . . 'Realignment was a dirty word in Bath,' Schlesinger was later bitterly to complain to a German colleague" (Muehring, 1992, p. 7).

day before not to lower, but authorized me to say that we would not increase."

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: ITALY

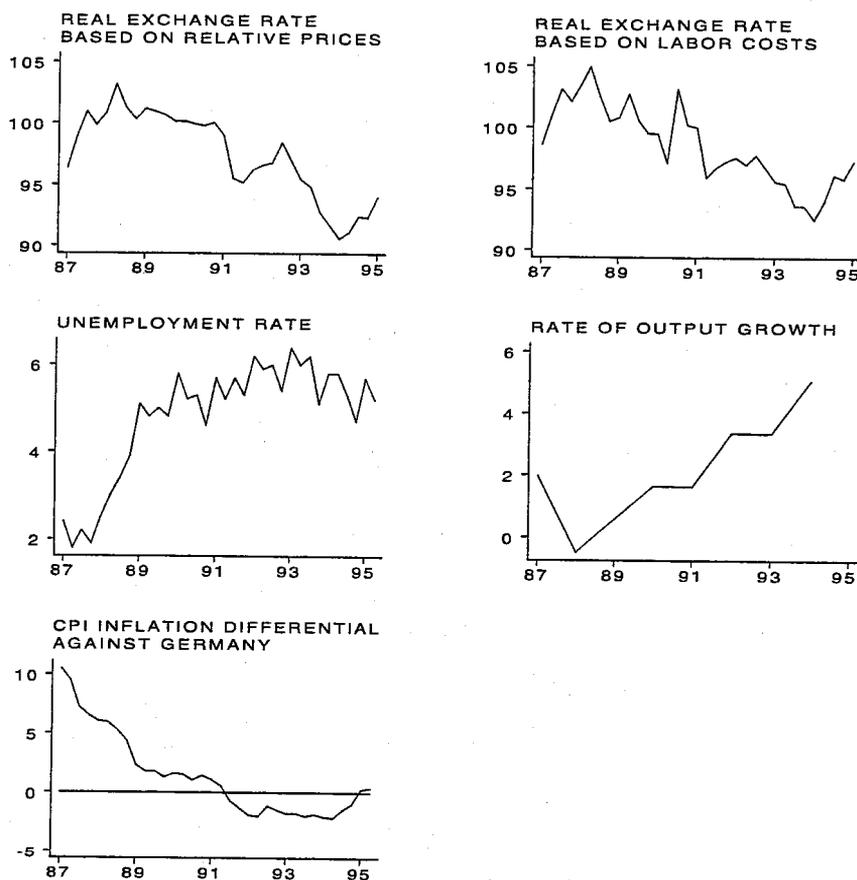


The dress rehearsal for the ERM crisis was staged in Scandinavia. During the 1980s, the Nordic countries had adopted a system of unilateral target zones relative to the ECU. The weakness of the Finnish markka had already led to a devaluation by 12 percent on November 1991. On September 8, the Finnish central bank (Suomen Pankki), out of reserves and unwilling to tolerate an additional rise of short-term rates above their current 14 percent level, was forced to float the markka.

The Swedish reaction to their neighbor's crisis went in the opposite direction. Twice in a few hours, the Riksbank raised the marginal

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: NORWAY

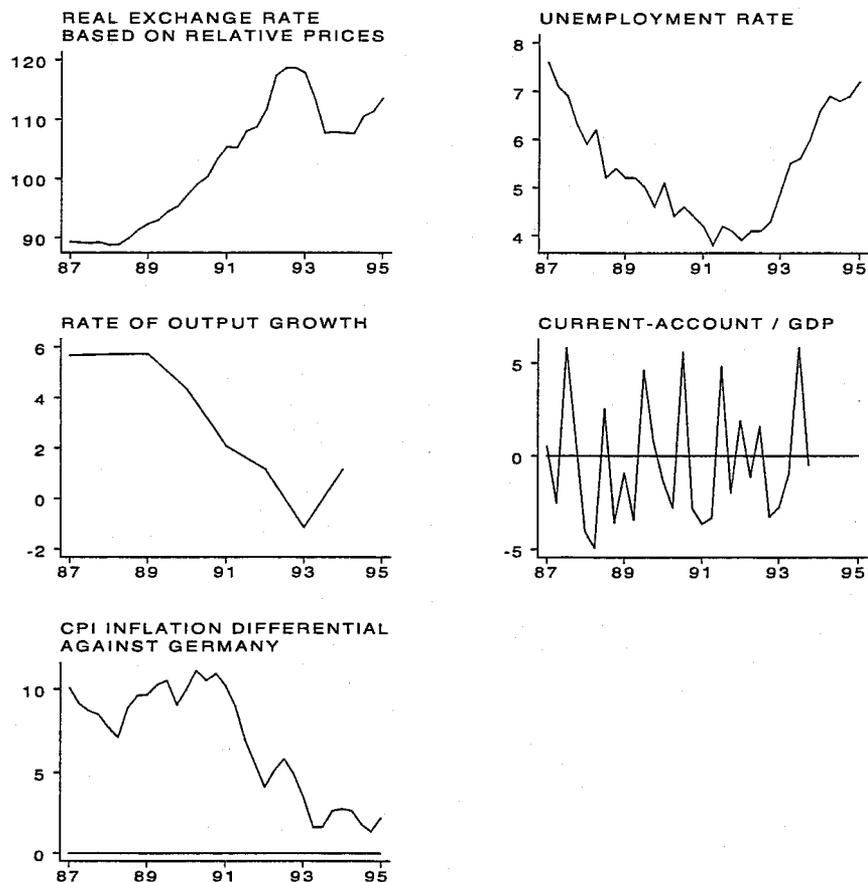


lending rate (charged by the central bank for overnight reserves) to 75 percent (at an annual rate). At the same time, the Riksbank engaged in extensive borrowing from abroad, doubling the stock of official reserves. The speculative wave quickly moved southward and westward. Within the ERM, the pound and the lira approached the floors of their fluctuation zones.

By the end of the second week of September, the Banca d'Italia and the Bundesbank were forced to acknowledge that the current parity of the lira was unsustainable. Apparently, a few days of strenuous defense of the Italian currency had required interventions of 24 billion deutsche

FIGURE 2 *continued*

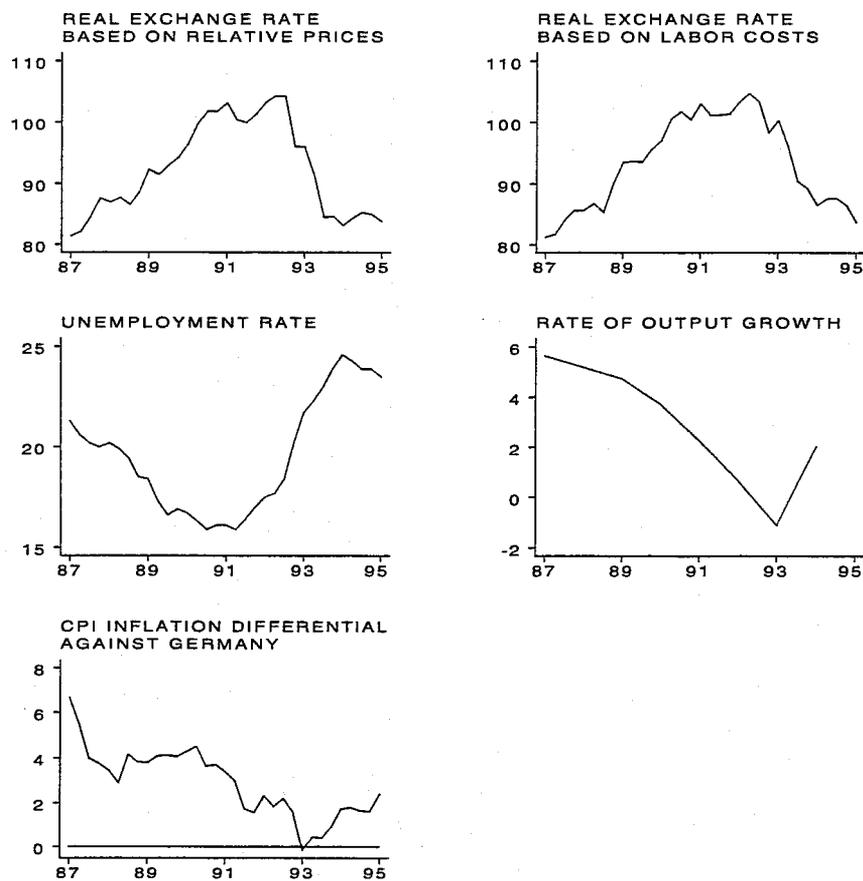
TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987–1995: PORTUGAL



marks in Frankfurt and approximately 60 billion deutsche marks across Europe. According to the obligations of the EMS, the central bank of a strong-currency country was supposed to undertake open-ended intervention (or provide unlimited credit) in support of a weak currency quoted at the floor of the bilateral fluctuation band. The Bundesbank, however, could not accept the risk of undermining internal price stability—its institutional mandate—through protracted intervention in the foreign-exchange market. Already in 1978, considering the risk of future conflict between EMS obligations and the Bundesbank's domestic mandate, bank president Otmar Emminger had made clear—in a letter

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: SPAIN

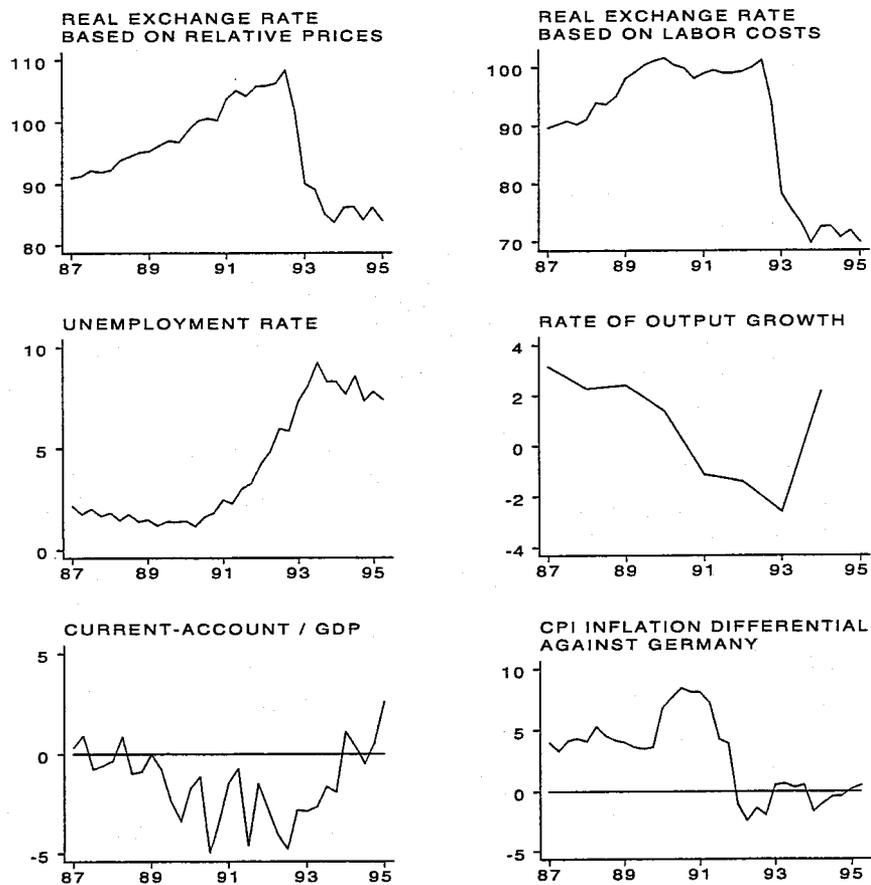


to the federal government—that the Bundesbank was “starting from the premise that, if need be, the Government would safeguard the Bundesbank [from legal obligations toward other members of the EMS], either by a correction of the exchange rate or, if necessary, by discharging the Bundesbank from its intervention obligations” (Emminger, 1986, quoted in Eichengreen and Wyplosz, 1993, p. 109).⁶

⁶ As Kenen (1995, p. 163) writes, “[in September 1992], the Bundesbank invoked the Emminger letter and asked the German government to negotiate a devaluation of the lira.”

FIGURE 2 *continued*

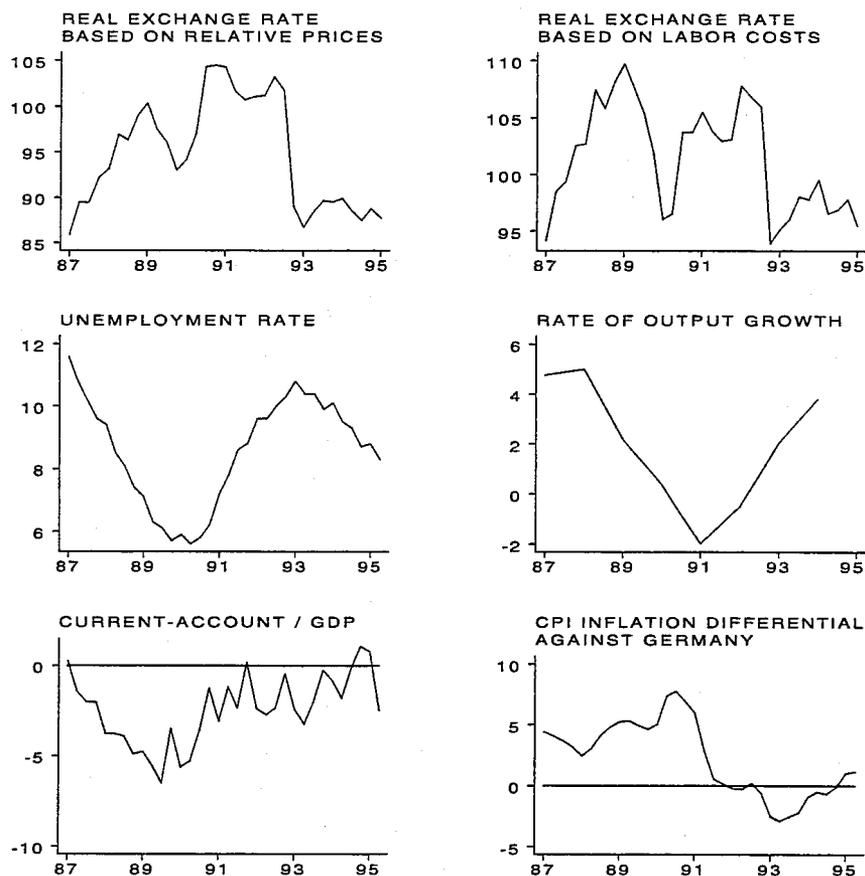
TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: SWEDEN



It is striking that, in such a situation, there was no meeting of either the Monetary Committee or of the ministers and central-bank governors. Nevertheless, in the course of bilateral consultations, Germany and Italy prepared a proposal for a general realignment. The proposal included a 3.5 percent devaluation of the lira and a 3.5 percent revaluation of the deutsche mark against all currencies in the ERM (thus a 7 percent devaluation of the lira against the deutsche mark). The Bundesbank would agree to cut interest rates. Although the precise terms of the arrangement are not known, the magnitude of the cut was clearly meant to be a function of the number of currencies involved in the realignment

FIGURE 2 *continued*

TIME SERIES OF MACROECONOMIC VARIABLES IN EUROPE, 1987-1995: UNITED KINGDOM

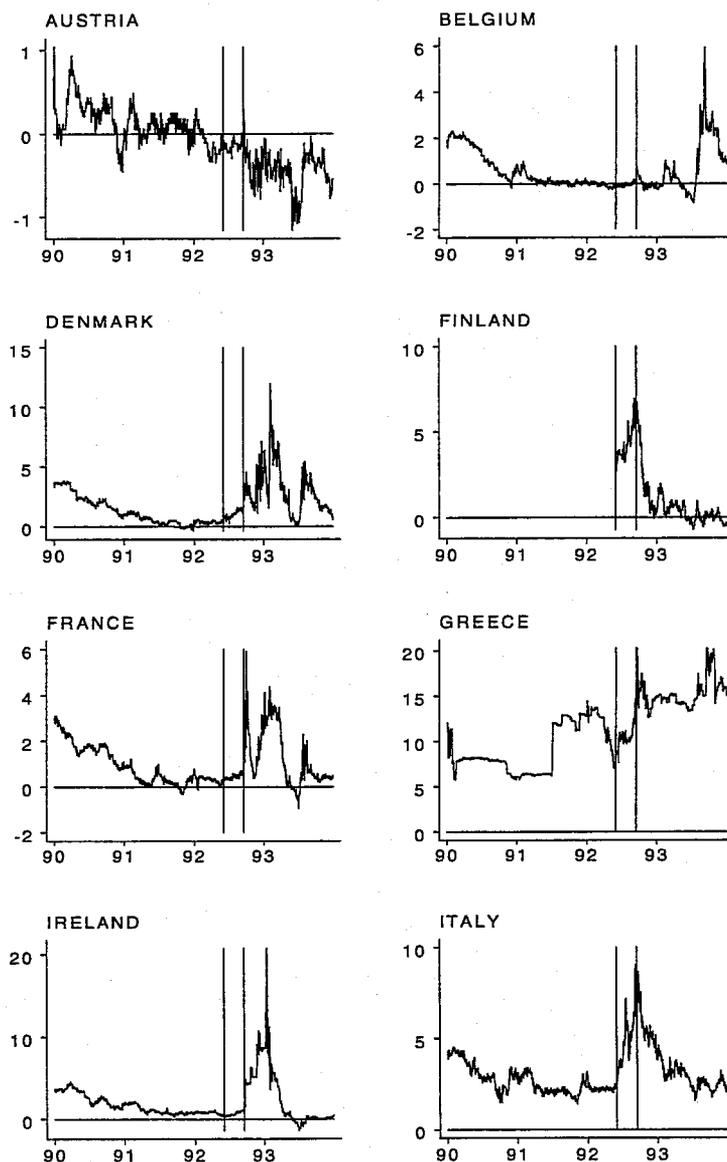


(with special reference to the pound and the peseta), as well as of the magnitude of the realignment.

The scheme was ready on Sunday morning (September 13) and was supposedly communicated to officials in the other ERM countries—although British officials claimed that they were never asked to devalue the pound that day. According to other sources, Lamont refused to include the pound in the realignment, hoping to buy time and to benefit from a hoped-for pro-European result of the French referendum the following week. The Spanish finance minister, who was on an official visit in Germany, also delivered a flat refusal.

FIGURE 3

THREE-MONTH INTEREST DIFFERENTIALS AGAINST GERMANY, 1990-1993

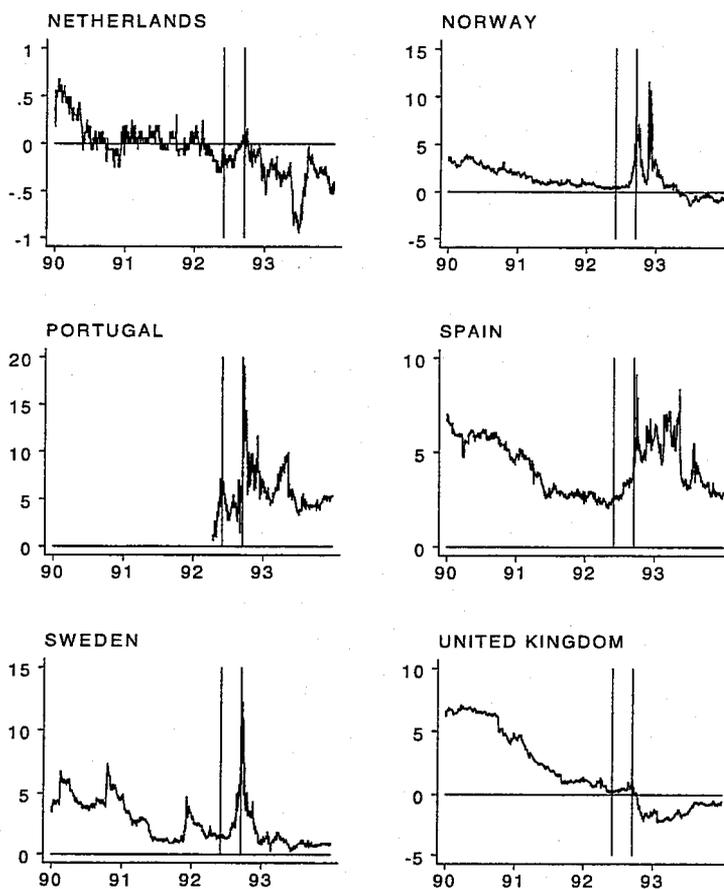


SOURCE: BIS.

NOTE: Interest rates are 3-month euromarket bid-rates, quoted at 10 AM Swiss time.

FIGURE 3 *continued*

THREE-MONTH INTEREST DIFFERENTIALS AGAINST GERMANY, 1990-1993



Ultimately, the Italian lira, which was devalued by 7 percent, was the only currency to be devalued against all other currencies in the ERM. On September 14, the Bundesbank lowered the discount rate by 0.5 percent and the Lombard rate by 0.25 percent (down to 9.5 percent); an ephemeral appreciation of the pound and, within its new band, the lira, followed. Outside the ERM, the Riksbank cut the marginal lending rate from 75 to 20 percent. Less than twenty-four hours later, the lira reached the bottom of its new band, this time joined by the pound. Market sales of sterling intensified, and any residual hesitation within the private financial sector faded away when the German business

newspaper *Handelsblatt* issued a press release that stated: “The president of the Bundesbank, Helmut Schlesinger, does not rule out the possibility that, even after the realignment and the cut in German interest rates, one or two currencies could come under pressure before the French referendum” (quoted in Muehring, 1992, p. 14). The loss of reserves for the Bank of England was reported to be about 15 billion dollars, almost half its entire stock. Only slightly less dramatic was the fall of the peseta below its central ERM rate, the within-the-band target level defended by the Banco de España.

September 16, 1992, has been nicknamed “Black Wednesday” in England, out of respect for the wounded pride of the British monetary authorities.⁷ On Wednesday morning, the Bank of England had raised the minimum lending rate from 10 percent to 12 percent. A few hours later, it announced a new increase to 15 percent (although it did not implement it). At the end of the day, the pound closed in London below its ERM floor, and in the evening, the Bank of England announced the “temporary” withdrawal of the pound from the ERM (a few days later, on September 19, its return to the ERM was postponed indefinitely). Later, Wednesday night, Italy followed Britain out of the ERM, and Spain, although staying in the ERM, devalued the peseta by 5 percent. Outside the ERM, energetically and solitarily leaning against the wind, the Riksbank pushed the marginal lending rate up to the spectacular level of 500 percent (at an annual rate).

The following day, all the currencies that had been under attack but had survived Black Wednesday were quoted near their ERM floors. The Bank of England brought the minimum lending rate back down to 10 percent. The Bank of Ireland followed the Swedish recipe instead; on September 18, it raised overnight rates to 300 percent (at an annual rate).

The French referendum on the Maastricht Treaty was finally decided in favor of the treaty on September 20. The victory of the *oui* was far from overwhelming, however (only 51.1 percent of those voting were in favor), and speculative attacks against the franc (and also the escudo, peseta, and punt) intensified despite the pro-Maastricht result.⁸ The

⁷ In the popular press, “black” Wednesday has recently turned “white,” reflecting the long period of prosperity and high employment that the United Kingdom has enjoyed since its exit from the ERM.

⁸ Greece, the only European Community country never to have joined the ERM, also encountered speculative pressures on the drachma in September 1992. The Bank of Greece raised the official lending rate from 30 to 40 percent, intervened heavily in support of the drachma, and tightened capital controls. This last measure was reversed toward the end of 1992.

two countries that had left the ERM showed no inclination to return to the fold. On September 21, Italy announced that the lira was not bound to rejoin the ERM in the near future, and the following day, England cut its minimum lending rate to 9 percent.

On September 23, an unsuccessful attack was launched against the franc. Through the interventions undertaken to contain the speculative wave, the Banque de France suffered a loss in reserves of about 80 billion francs. The Banque de France raised the French repo rate to 13 percent, and the Bundesbank intervened heavily in support of the franc.⁹ Other less evident strategies may have contributed to the survival of the franc. It was observed, for instance, that throughout the crisis, implicit capital controls (leading to positive offshore-onshore interest differentials) and the implicit control of domestic lending rates by the Banque de France (signaled by sizable differentials between money-market and prime rates) helped mitigate the repercussions of the external financial crisis on the rest of the French economy (Marston, 1995, pp. 133–135). Formal exchange controls were explicitly introduced by Spain on September 23 and by Ireland and Portugal on September 24.¹⁰

Toward the Revamping of the ERM

The subsequent developments of the ERM crisis can be summarized as follows. Between October and November, tensions in the financial markets appeared to ease. This pattern was interrupted in the second half of November by a new financial crisis, once again originating in the North. On November 19, the Riksbank decided to float the krona. The impact on the weaker ERM currencies was immediate, and on November 22, Spain and Portugal announced a devaluation by 6 percent of the central parities of the peseta and the escudo. On December 10, Norway allowed the krone to float.

Tension and relaxation alternated within the ERM during the first quarter of 1993. Two speculative episodes are worth mentioning. On January 4, the French franc was quoted once again near its ERM floor,

⁹ The speculative attack was unsuccessful, and because participants in the attack commonly took positions for one month, most of the reserves lost were back in France by the end of October.

¹⁰ This was not in violation of the letter of the Single Market legislation, which retained the right for member states to impose temporary capital controls in order to deal with disorderly exchange markets. It was, however, an additional blow to the Maastricht timetable. Spain removed its capital controls in November 1992, after the second devaluation of the peseta, and Portugal followed suit soon after.

leading the Bundesbank and the Banque de France to reiterate in a joint statement their willingness to cooperate to defend the French currency. The punt came under pressure in early January and was devalued by 10 percent on January 30, despite the high interest rates maintained throughout the month.

German interest rates were eventually cut on March 18, after the signing of the so-called “solidarity pact,” an agreement between the *Länder* (states) and the federal government about how to share the financial burden of the reconstruction in the east. The drop in the German official discount rate by half a percentage point to 7.5 percent helped avert a possible new currency crisis that might have been triggered by the neo-Gaullist sweep in the French general elections of March 28.

In April, key interest rates fell in Germany, France, and several other countries. These optimistic signals, however, were soon offset by a new outburst of speculative frenzy. On April 27, the peseta was quoted at its lowest level against the deutsche mark since Spain’s entry into the ERM. On May 13, after a new series of heavy attacks against the peseta, the Banco de España abandoned the defense of the ERM band and asked for a new realignment, the third since the beginning of the crisis. The peseta’s devaluation by 6.5 percent was followed rapidly by an equal devaluation of the Portuguese escudo.

Good news for the ERM came from Denmark on May 18, when, in the second national referendum, the supporters of the Maastricht Treaty obtained a sound victory. In the weeks following the Danish *ja*, the stability of the ERM was hastily (and prematurely) interpreted as a return to the golden days of the late 1980s.

Such illusions and flights of fancy were short-lived. No later than mid-July, the ERM was once again under pressure, following a now familiar pattern. The French franc was quoted slightly above its ERM floor, and French money-market rates, for the first time in six weeks, were again above their German counterparts. Tensions had built up in Denmark as well, forcing the Nationalbank to raise a key interest rate. With the Bundesbank refusing to adjust its rates at its council meeting on July 15—the last before summer vacation—the ERM reached the point of no return.

On July 30, all the ERM currencies except the guilder and punt were quoted at the bottom of their bands against the deutsche mark. After an emergency weekend meeting in Brussels, a thorough revamping of the ERM was announced on August 1. Most of the surviving “hard” ERM was replaced by a much weaker scheme for exchange-rate

targeting, almost indistinguishable from a free float. The size of the bands was widened from 4.5 percent to 30 percent (15 percent on either side of the unaltered central parities). The sole exception was the exchange rate between the deutsche mark and guilder, the target zone for which remained unchanged. By the end of 1993, most currencies were close to, or even above, their central rates. Yet, although actually moving their currencies back to the previous narrow bands, the central bankers showed no interest in legally restoring the old system.

3 BUILDING BLOCKS OF A SYSTEMIC MODEL OF CURRENCY CRISES

In light of the reconstruction above, the interpretation of the 1992–93 events is by no means a straightforward task. At a minimum, there are four fundamental questions that should not be ignored: Why did no early warnings of the imminent turmoil emerge in the weeks preceding Black Wednesday? Which event(s) caused the sudden, generalized shift in expectations that triggered the first wave of speculative attacks? Why did the crisis spread among the European economies (both inside and outside the ERM), largely independently of the perceived strength or weakness of their macroeconomic fundamentals? Why did the crisis last for several months, forcing a number of countries periodically to devalue their currencies and eventually causing a de facto demise of the system?

A model suitable for analyzing the unfolding of the EMS collapse and of answering the above queries should be able to encompass a number of complex features, including (1) asymmetries in the conduct of monetary policy and in the inflation performances across countries, (2) a political structure that attaches a credibility cost to a devaluation, and, more crucially, (3) the presence of international externalities and structural spillovers that tie together the policy stances in the system. The theory described in this chapter can be seen as a step toward constructing such a comprehensive model of system-wide currency crises.

The actual model underlying our analysis is presented in the Appendix. We concentrate here on a verbal and intuitive discussion of the model's essential features, briefly relating these features to the existing literature and emphasizing a set of results that will be especially useful in the analysis of the 1992–93 currency collapse.¹

A Disinflation Game in a Center-Periphery Economy

Our interpretive framework considers an exchange-rate system that consists of $N + 1$ countries, the first N of which represents the periphery of

¹ Our model builds on the familiar framework of an international monetary-policy game. The standard references are Hamada (1976), Buiter and Marston (1985), Cooper (1985), and Canzoneri and Henderson (1991). Recent developments are surveyed in Currie and Levine (1993), Ghosh and Masson (1994), and Persson and Tabellini (1995). Among recent models of currency crises, with special reference to the 1992–93 events, see Drazen and Masson (1994), Gerlach and Smets (1994), and Ozkan and Sutherland (1994).

the system, while the last is the center. All countries in the system are symmetric with respect to technology and private-sector decision rules, including those characterizing labor-market behavior. In particular, all countries are characterized by short-run nominal-wage rigidities: current wages are set one period in advance, based on the expected level of the GDP price deflator. The economies are nonetheless heterogeneous in two dimensions: first, wage inflation rates (that is, inflation expectations) differ across countries, and, second, policy preferences vary both within the periphery and between the center and the periphery as a whole.

The center is characterized by its uncompromising attitude toward the goal of domestic price stability, and its economy is not subject to systematic inflationary pressures (of the kind considered in the literature since Kydland and Prescott, 1977, and Barro and Gordon, 1983 [1994]). In contrast to the center, the periphery countries are characterized by different levels of inflationary bias in policymaking. Because such distortions are present, the inflation-prone periphery countries consider fixed exchange rates as an intermediate target on the way to price stability: the periphery countries can choose to “tie their own hands” and reduce the scope for discretion in monetary policy by pegging their exchange rates to the currency of the price-stabilizing center country. Our construction thus conforms to the “consensus” view (at the time of the crisis) of the ERM as a disinflation mechanism, in which the center is the natural candidate to receive the mandate of guaranteeing price stability to the system as a whole, and the exchange rate against the deutsche mark is the nominal anchor for the periphery countries (see Giavazzi and Pagano, 1988 [1994], Giavazzi and Giovannini, 1989, and Begg and Wyplosz, 1993).

The commitment of policymakers in the periphery is only imperfectly credible, however, and market participants perceive the abandonment of the peg as a possible policy option in the presence of sizable cyclical downturns or external shocks. The concept of “imperfect credibility” of a peg is best understood in relation to the loss of political reputation and prestige associated with renegeing on the commitment to maintain the announced exchange-rate target: the lower the perceived political opportunity cost of devaluing or switching to a float, the lower the reliability of the commitment to a fixed-exchange-rate regime and the credibility of the existing parity.

Although technology and preferences underlying the economic structure of the periphery countries are substantially identical,² macroeconomic

² For the sake of simplicity, the model in the Appendix assumes that all countries in the periphery trade real goods and services exclusively with the center, that is, intraperiphery

stances may differ across countries: there may be wage-inflation differentials within the periphery,³ and policymakers may pursue different objectives in terms of inflation and unemployment. Such country-specific asymmetries are one source of exchange-rate tension in the system.

Another source of tension in the system may be a demand shock in the center (as with German unification), generating pressures for an effective real appreciation of the center country's currency. In such a situation, the periphery as a whole would benefit from a monetary expansion by the center, which would absorb at least part of the domestic demand surge and would lower interest rates in the system. The resulting level of internal inflation, however, would be unacceptable to the center country, which would benefit, instead, from a revaluation of its own currency against the periphery, thereby offsetting the "overheating" caused by the original domestic demand shock. Such a realignment, though, would entail high reputational and credibility costs for the policymakers in the periphery countries.

The Theory of Currency Collapses—in a Nutshell

To understand the implications of a realignment by a periphery country, it is useful to follow the literature on exchange-rate crises with optimizing policymakers (sometimes referred to as "second-generation" models of speculative attacks) and to consider a currency crisis as a policy decision based on the rational assessment of social and political costs and benefits. In the Appendix, we show that such choice can be analyzed starting from a simple optimizing condition, expressed in the metric of the exchange rate.

trade is negligible. At first sight, this last assumption may appear unrealistic. After all, concerns about the competitive gap *within* the periphery have been raised frequently by national policymakers and by both import-competing and exporting sectors in Europe since the inception of the ERM and have affected the determination of Community-wide exchange-rate policies. The assumption is inessential, however. A more complex setup would not significantly alter the conclusions reached within our framework. For instance, one of the properties of our model is that a devaluation in a given periphery country shifts global demand toward the country's products and causes a real appreciation in all other periphery countries, the same qualitative result we would obtain in a model encompassing explicitly intraperiphery competitiveness.

³ There are at least two ways in which differences in wage inflation in countries having identical economic structures are consistent with rational-expectations equilibrium in the model. First, if multiple instantaneous equilibria can occur (as discussed below), expectations embodied in nominal-wage contracts may differ across countries. Second, there may be differences in the national policy targets. Countries with a larger gap between public and private output objectives will, other things being equal, exhibit higher expected inflation rates.

This condition is based on the following two elements. First, define as $\Delta\tilde{s}$ the “shadow devaluation rate,” that is, the percentage change in the exchange rate when the policymaker opts for a devaluation, keeping unchanged all other macroeconomic fundamentals. By construction, the shadow devaluation rate coincides with the observed rate of depreciation in a realignment; when the peg is defended, instead, the shadow devaluation rate represents the hypothetical rate of depreciation that would have prevailed, other things being equal, if the monetary authority had decided to realign.

Second, consider the political (or reputational) costs “paid” by the policymaker when reneging on its commitment to defend the existing exchange-rate parity. These costs are better understood as a proxy for the wide array of nonquantifiable political interests underlying the defense of a given exchange-rate target, ranging from naked national chauvinism to fears of loss of political prestige, reputation, and influence. They may also reflect a widespread belief that exchange-rate stability is a public good in its own right, quite apart from its anti-inflationary implications.⁴ We denote these utility costs by c .

Indexing the (logarithm of the) current exchange rate and the current fixed parity with s and \bar{s} , respectively, it will generally be possible to find some increasing function, $g(\cdot)$, such that the equilibrium exchange-rate behavior can be characterized as follows:

$$\bar{s} = \begin{cases} \bar{s} & \text{if and only if } \Delta\tilde{s} < g(c) \\ \bar{s} + \Delta\tilde{s} & \text{if and only if } \Delta\tilde{s} \geq g(c) \end{cases} \quad (1)$$

This condition expresses the optimal choice of a policymaker who carries out a social-welfare arbitrage across monetary-policy regimes: the policymaker will defend the peg as long as the gains from monetary discretion—in terms of higher employment, output, and consumption—are low compared to the reputational or political cost of a devaluation (that is, $\Delta\tilde{s} < g[c]$); it will optimally abandon the peg otherwise.

For a deeper understanding of the implications of the policy rule (equation 1), consider the links between our analysis and the so-called “first-generation” models of speculative attacks subsequent to Salant and Henderson (1978) and Krugman (1979 [1992]).⁵ The concept of a shadow

⁴ In more complex models based on repeated games between private and public agents, these costs would represent the endogenous reputational penalty associated with the policymaker’s deviation from the optimal outcome; see, for example, de Kock and Grilli (1993).

⁵ See the survey by Garber and Svensson (1995). Buitier, Corsetti, and Pesenti (1995, 1998) and Cavallari and Corsetti (1996) generalize the analytical framework to the new generation of models of currency crises allowing for optimizing policymakers.

exchange rate was introduced into the literature by Flood and Garber (1984 [1994]). In the context of these seminal models, monetary policies are exogenous (that is, not explicitly derived in terms of welfare optimization), and a devaluation involves no reputational cost, so that $c = g(c) = 0$.⁶ The mechanism leading to a currency crisis is the maximization of speculative profits by forward-looking private agents, who understand the fundamental inconsistency between a policy of fixed exchange rates and a trend in domestic credit. In such a framework, the shadow devaluation rate is a measure of private profits per unit of foreign reserves.

In our framework, that is, with optimal endogenous policies, the shadow devaluation rate becomes a measure of the opportunity cost, in social-welfare terms, of defending the existing parity. A devaluation occurs when the net welfare benefits associated with the abandonment of the peg, $\Delta\tilde{s}$, outstrip the reputational costs, $g(c)$. Thus, the shadow devaluation rate is both a measure of the welfare gains from switching regimes and the optimal rate of devaluation that the policymaker actually implements when abandoning the peg. The use of the shadow devaluation rate helps simplify the exposition of the analysis, while offering important insights about the basic economic mechanism at work.

In the context of our model (see Appendix), the shadow devaluation rate of each of the N countries in the periphery is a simple linear function of the (logarithms of the) wage rate, the price and employment objectives of the government, and a country-specific shock (to be discussed below). Denote such a shock by u_i , where the subscript i refers to a particular country in the periphery. Also, denote by w the (logarithm of the) wage level in domestic currency, with o being an index of domestic policy goals (for example, price and employment targets), and p^* being the price level of the center country. Then, the shadow depreciation rate in the periphery country i is simply

$$\Delta\tilde{s}_i = \mathcal{A}w_i + \mathcal{B}o_i + \mathcal{C}u_i - p^* \quad (2)$$

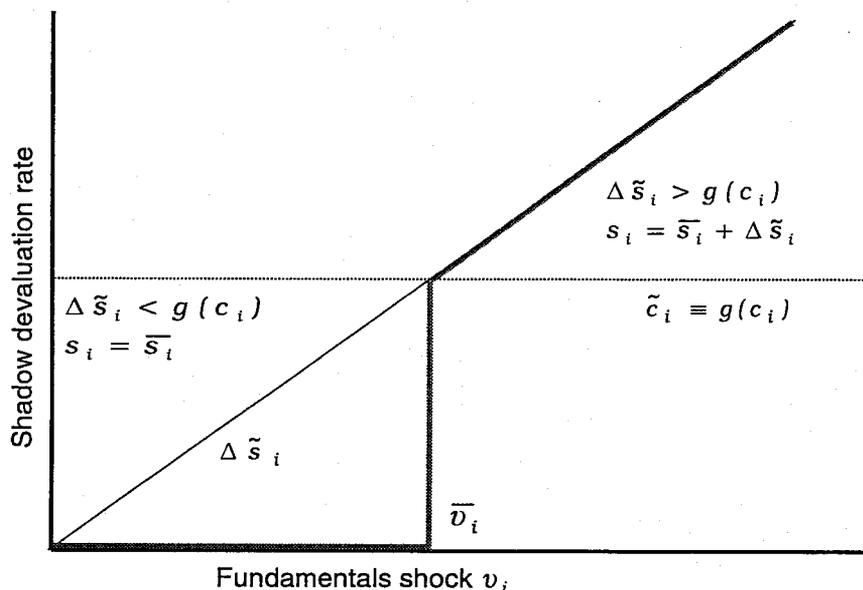
where \mathcal{A} , \mathcal{B} , and \mathcal{C} , are positive constants depending on the parameters of the model. In models with optimizing policymakers, a devaluation is the optimal reaction of the government to the fundamentals faced by the country (indexed by v_i , o_i , and p^* in our model) and to market expectations (indexed by the forward-looking wage rate, w_i , in our model).

A graphical synthesis of our analysis appears in Figure 4. On the x axis, we put the support of the shock u_i . Conditional on given values of w_i , o_i ,

⁶ In principle, a positive c could capture the transactions costs of carrying out financial arbitrage.

and p^* on the y axis, we have the shadow and the actual devaluation rates, as well as the “adjusted” welfare cost of devaluing, $\tilde{c} \equiv g(c)$. The level of the shock, \bar{v} , at which the shadow devaluation rate crosses the cost line, divides the support of the shock into two regions. The domestic policy-makers will find it optimal to maintain the peg if the shock falls in the region to the left and to abandon the peg if the shock falls in the region to the right. By construction, the optimal devaluation rate in a realignment coincides with the shadow devaluation rate to the right of \bar{v} .

FIGURE 4
THE SHADOW DEVALUATION RATE



Market Expectations and Self-Fulfilling Prophecies

For an exogenous specification of the distribution of v_i , one can easily calculate the distribution of the shadow devaluation rate conditional on domestic wage inflation, domestic policy targets, and the inflation rate in the center country. Because the policymaker will (optimally) devalue if and only if $\Delta \tilde{s}$ is above the threshold $g(c)$, the probability of a devaluation and the expected rate of realignment are also easily calculated. Thus, a higher reputational or political cost of devaluing strengthens the currency by increasing the devaluation threshold for any level of the shadow devaluation rate. For a given c , the determinants of the shadow devaluation rate

are also the determinants of the “credibility” of the peg. Focusing, for instance, on the domestic variables that appear in equation (2), high wage-inflation rates or overambitious policy goals (that is, a large level of the index o) increase the likelihood of a crisis by raising the shadow devaluation rate for each level of the shock.

Forward-looking wages, w (and, in general, all macroeconomic variables embodying market expectations), play a complex role in the second-generation models of currency collapses. Market prices are set based on an assessment of the probability of a devaluation; the choice whether to devalue or not, however, depends, *ceteris paribus*, on observed price and wage rates. This circular structure of the expectation game between the private and public sectors may make devaluation expectations self-fulfilling, that is, validated *ex post* by the actual behavior of the monetary authorities.

It follows that, when the political costs of a devaluation are not excessively high, there might be different forecasts of future monetary policies, all consistent with rational expectations. Market participants may coordinate on a “good” equilibrium, expecting stable exchange rates and setting a low level of wage inflation, or on a “bad” equilibrium, expecting a realignment and setting a high level of wage inflation. Many studies have extensively explored the predictions of this class of models, introducing additional elements so as to account for reputation-building devices by the policymaker, as well as for the interplay between fiscal and exchange-rate policies.⁷

In terms of our model, consider two economies facing the same country-specific fundamentals, that is, the same shock v and similar policy targets o . These two economies, which are structurally identical, may display quite different macroeconomic outlooks. One may have low wages, low prices, and high competitiveness; because its shadow devaluation rate is below the devaluation threshold $g(c)$, its currency is strong. The other may have relatively high wages and price inflation, shifting the shadow devaluation rate to the right for any level of the fundamentals v and lowering the credibility of the peg.⁸

⁷ See, for example, the contributions by Obstfeld (1986, 1991, 1994, 1995), Jeanne (1995), and Velasco (1996), and the discussions in Kenen (1996) and Buitier, Corsetti, and Pesenti (1998). Eichengreen, Rose, and Wyplosz (1994) provide an empirical analysis of speculative episodes, with emphasis on the ERM crisis, contrasting the predictions of first- and second-generation models of currency crises. Bordo and Schwartz (1996) survey historical case studies of currency crises in relation to the two alternative interpretive approaches.

⁸ Models based on self-fulfilling prophecies have so far been unable to provide a convincing theory of the coordination of individual expectations on a particular equilibrium.

European Macroeconomic Spillovers: Theory and Empirical Evidence

Relative to the number of analyses that build on the considerations of the previous section, few contributions on the ERM crisis have satisfactorily analyzed the *international* determinants of domestic credibility. A point commonly made is that the stability of the peg in the periphery is enhanced by inflation in the center—in our specification, a high p^* shifts the shadow devaluation rate to the left in Figure 4. The conflict between the center and the periphery as a group, however, is not the only element of policy interaction across countries: a second dimension of strategic links is found in *intraperiphery* spillovers. Because these spillovers play a crucial role in our discussion, this section will analyze their nature and implications in some detail.

Consider a monetary expansion in one periphery country (for instance, Italy), which brings about a real depreciation of its currency against the center (Germany).⁹ The impact of such a monetary expansion on the economy of another (any other) periphery country (say, Belgium) can be split into two components of opposite sign, an *expenditure-switching* effect and an *expenditure-changing* effect.

These effects are best understood starting from the equilibrium condition in the goods market of the center country (Germany), holding constant this country's level of production. The real depreciation of the periphery country's currency (the lira) will appreciate the terms of trade of the center country, and, because output supply in the center is kept constant, equilibrium will require a fall in the center's real interest rate. If all else is equal, the real appreciation of the center's currency will shift demand in the center away from the goods produced in either the center or the rest of the periphery (that is, Belgium) and toward Italian goods. This is the expenditure-switching effect associated with the Italian devaluation, which lowers aggregate demand in the rest of the periphery. The fall in the center's real interest rate, however, will lower the real interest rate in all other periphery countries and will boost demand for Belgian goods. This is the expenditure-changing impact of a monetary expansion in Italy, which increases global demand by lowering the system-wide interest rate.

The relative likelihood of a specific equilibrium is generally modeled by specifying an exogenously given, and essentially arbitrary, distribution function defined over all possible outcomes.

⁹ With predetermined wages, a country's GDP deflator increases with its nominal money stock, but less than proportionally, and its real output expands. The increase in aggregate demand that matches the increase in supply requires a real depreciation and a fall in the real interest rate.

If, following a monetary expansion by any one periphery country, the elasticity of the aggregate demand is large enough with respect to the real exchange rate—that is, if the expenditure-changing effect prevails over the expenditure-switching effect, the real exchange rate will appreciate and the real interest rate will fall in all other countries in the periphery. Arguably, such a scenario describes well the economic links among European countries in the period of the crisis. Nonetheless, it is logically possible that the spillovers associated with a monetary expansion by Italy will have the opposite sign: all else being equal, a nominal devaluation of the lira may shift global demand away from the goods produced in the rest of the periphery, resulting in a real depreciation of all periphery countries, along with Italy, as well as in a generalized rise of the real interest rates in these countries.

Despite the implausibility of such a scenario in 1992, whether expenditure-switching effects prevail over expenditure-changing effects or vice versa is ultimately the kind of question that can only be addressed by using a multicountry econometric model. The problems in carrying out empirical estimates of these effects are well known, and there is considerable disagreement in the empirical literature about the sign and size of international spillovers (see, for instance, Frankel, 1988, and Ghosh and Masson, 1994, chap. 2). In the discussion that follows, we review the findings of several contributions on structural links in Europe.

Both the International Monetary Fund's MULTIMOD model (Masson, Symansky, and Meredith, 1990) and the MSG model (McKibbin and Sachs, 1991)—based on a Mundell-Fleming framework incorporating rational expectations, asset dynamics, and intertemporal budget constraints—provide strong support for our hypothesis that a German monetary expansion increases output and decreases real interest rates in the periphery. The available empirical evidence on the intraperiphery spillovers is less compelling, because few studies in the existing literature provide an evaluation of intra-EU policy multipliers.

Masson, Symansky, and Meredith (1990) simulate the effects of a 10 percent increase in the U.K. money-supply target on France, Italy, and Germany, starting in 1990.¹⁰ They find that the U.K. monetary expansion has a positive effect on French and Italian outputs both on impact and after a one-year lag and that the impact on German output is non-

¹⁰ The authors consider Britain as the only EMS, non-ERM, country, and they do not include France, Italy, and smaller industrial countries in their assessment of monetary multipliers, because "monetary policies in these countries are constrained by the need to limit deviations of their exchange rate vis-à-vis the Deutsche mark" (Masson, Symansky, and Meredith, 1990, p. 23).

negative.¹¹ The effects on short-term interest rates are negligible in the periphery, although German interest rates fall by ten basis points in the two years following the U.K. monetary expansion.

McKibbin and Sachs (1991) consider the effects on the EMS countries of a monetary expansion in the “rest of the OECD” (the OECD countries minus Japan, the United States, and the EMS countries). Assuming that the policy multipliers for the “rest of the OECD” represent an acceptable proxy for the policy multipliers for the subset of ERM countries that adopt an expansionary stance, real interest rates at any maturity are found to be persistently lower, relative to the baseline, in both Germany and the “rest of the EMS” following the increase in the money supply. The effects on output are temporarily negative but become positive after a one-year lag.

More recently, Hughes Hallett and Ma (1995) use an updated version of MULTIMOD to run a number of simulation exercises on costs and benefits from coordination for the period from 1990 to 1996. Particularly interesting from our vantage point is the simulation of a “no realignment” scenario in which the United Kingdom and Italy target, respectively, $DM2.95 \pm 2.5$ percent per pound and $DM1.33 \pm 2.5$ percent per 1,000 lira after 1992. The results are unambiguous. The monetary tightening associated with the defense of the Italian and U.K. currency bands leads to a generalized increase in short-term real interest rates in both Germany and France: “Interest rates have to rise to levels not seen since the late 1970s. Real interest rates are very high therefore. That generates a persistent recession” (Hughes Hallett and Ma, 1995, p. 32; see also tables 3 and 4, pp. 46–47).

We believe that the results of the simulation exercises based on multi-country econometric models can be approached only with necessary and appropriate reservations—perhaps with some degree of skepticism. It is worth noticing, however, that the simulation results discussed above confirm the widely held view that the ERM devaluations in 1992 substantially contributed to the fall of interest rates both in Germany and in the rest of the system (France and the United Kingdom, in particular) between 1992 and 1993 and do not support the presence of substantial negative spillover effects. This conclusion has been reinforced by the 1995 report of the Commission of the European Communities (1995, paras. 9–11, 23) on the impact of currency fluctuations on the Internal Market:

¹¹ The percentage deviations of real GNP from baseline are, for France, 0.4 in 1990 and 0.2 in 1991; for Italy, 0.3 and 0.2; and, for Germany, 0.2 and 0.0 (Masson, Symansky, and Meredith, 1990, table 16, p. 33).

Changes in nominal exchange rates have had differing effects on cost competitiveness, depending on the country in question. In some cases, they have offset the cost-competitiveness gains or losses recorded over the period from 1987 to 1992. In others, they have led to net gains or loss in cost competitiveness compared with the trends over the period. . . . In conclusion, it should be emphasized that there is no strict relationship between variations in nominal exchange rates and variations in cost competitiveness. . . . It transpires that exchange rate fluctuations have not had a significant impact on current account balances. . . . Trade movements measured over the entire period 1987–94 show that the exchange rate fluctuations recorded since 1992 have not hitherto been of major importance at the aggregate level.

In summary, although the size and sign of macroeconomic spillovers in Europe are difficult to measure and are, perhaps, not stable over time, the pattern of prevailing expenditure-changing effects fits well the empirical evidence for the period under consideration. To the extent that the impact of the “swing” of German interest rates on the countries of the European periphery is considered the predominant macroeconomic issue in the unfolding of the ERM events, the *net* effect in the transmission of monetary policies in Europe can be deemed, on balance, to be positive. This assumption does not rule out the possibility of intraperiphery shifts in demand from strong- to weak-currency countries’ goods following a devaluation; it only deemphasizes their relevance for domestic welfare compared to the impact of a system-wide fall in real interest rates.

Currency Crises in a Multicountry Framework

The presence of externalities and policy spillovers posits a clear challenge to analyses of the 1992–93 crisis that implicitly treat the ERM as the sum of independent and inward-looking unilateral pegs against the deutsche mark. The key insight of our approach is that the modalities of a currency crisis in any given country, as well as the characteristics of the new macroeconomic equilibrium on which the country settles after the crisis, cannot be properly assessed without accounting for macroeconomic developments and policy options in the rest of the system. Black Wednesday sheds light on the 1992 attack on the French franc, and the behavior of the franc helps explain the crisis of the peseta.

As seen above, in our discussion of currency collapses, it is the realization of the country-specific shock, v_i , that ultimately drives the decisions of a national policymaker trying to minimize his (or her) country’s own loss function. In the multicountry model presented in the Appendix, the shock v_i includes two components (others allowing for

domestic-productivity shocks and velocity shocks could easily be added). A first disturbance term, indexed by ϵ , depends on current and future anticipated shocks to the aggregate demand of the center country (that is, the IS shock). This affects all periphery countries symmetrically. A second component of the country-specific shock depends, with a negative sign, on the monetary innovations of all the other countries in the system (including the center). By indexing the monetary stances with m^* (for the center country) and m_j (for country j in the periphery), we can write:¹²

$$v_i \equiv \epsilon - \left[\phi(m^* - w^*) + \xi\theta \sum_{j \neq i} (m_j - w_j) \right] \quad \phi > 0, \xi\theta > 0. \quad (3)$$

In equilibrium, an increase in demand for the center's output requires, *ceteris paribus*, a real effective appreciation of the center's currency against the periphery. This can be achieved by (a) domestic inflation in the center, (b) an appreciation of the nominal exchange rate of the center against the periphery, or (c) a generalized deflation in the periphery. Under option (a), the demand boom in the center would be absorbed internally and would have no significant consequence in the periphery: heuristically, the changes in ϵ and m^* would offset each other in equation (3), leaving v_i unaffected everywhere in the periphery. Moreover, as considered before, a monetary expansion in the center would also increase p^* , decreasing the shadow devaluation rate (equation 2) for any level of v_i .

If the center is unwilling to tolerate the inflationary consequences of the internal demand boom, the shock will be transmitted to the periphery. If the periphery consists of one country only, for any given domestic monetary policy (option b), the IS shock in the center will unambiguously lead to CPI inflation in the periphery. The mechanism is well known. As the demand boom raises the interest rates in the center, capital will flow out of the periphery country. Holding the money supply constant, the equilibrium exchange rate of this country will depreciate in both nominal and real terms against the center, and its CPI level will increase. If, instead, the monetary authorities of the periphery react to the fall in the demand for domestic currency and defend the current parity, the corresponding fall in domestic money supply will have a recessionary impact (option c).

In the general case of a multicountry system, equation (3) shows that, from the vantage point of each individual periphery country, the impact of

¹² Note that the country-specific shock depends on money supply in excess of the nominal wage rate. To the extent that wages are set based on monetary expectations, that is, that $w_t = E_{t-1}m_t$, only monetary surprises matter in determining v_i .

the shock originating in the center depends not only on the policy response of the center itself, but also on the monetary behavior of the rest of the system. In other words, although the relevant shock v_i is always country specific, it reflects the behavior of all the other countries in the system. With positive spillovers ($\xi\theta > 0$), the role played by a monetary expansion in the rest of the periphery is somewhat analogous to the role played by a monetary expansion in the center. By bringing the center's effective terms of trade closer to their equilibrium level, an expansion somewhere in the periphery represents a "shock absorber" for the rest of the system.¹³

So, although the domestic shadow devaluation rate completely characterizes the monetary policy of a country, it is not possible to determine an individual country's shadow devaluation rate without knowing the policy stance of the other countries in the system. This implies that the institutional characteristics that affect the *average* monetary stance in the exchange-rate system are a key determinant of the individual currency crises. In the next chapter, we shall turn to the characterization of the system-wide equilibrium and show that, even if the relation between the center and periphery is frozen in noncooperative behavior, the macroeconomic outcome is still dependent on whether and to what extent currency crises are mitigated through cooperative policy actions among the periphery countries themselves.

It should be emphasized that our approach does not rule out the possibility of multiple equilibria for given country-specific fundamentals, but we do not *base* our interpretation of the expectations shifts that trigger a currency crisis on self-fulfilling prophecies. We provide, instead, a coherent framework within which to interpret the ERM demise in terms of fundamentals only, provided that the traditional list of fundamentals is augmented by the rules of the international monetary-policy game, that is, the cooperative or noncooperative design of monetary and exchange-rate policies in the system.

¹³ When we move from the partial-equilibrium approach considered so far to general-equilibrium considerations, it should be clear that the policy stance of every country in the system is jointly determined as a function of the exogenous shock to fundamentals ϵ .

4 THE 1992–93 EVENTS AS A COORDINATION FAILURE

The idea that a policy-coordination failure was at the root of the ERM crisis underlies most interpretations that stress the role of the German unification shock in the 1992–93 events. According to this view, the origins of the crisis must be traced to the international policy conflict between the center country, which was unwilling to bear the inflationary consequences of its internal unification, and the periphery countries, which were unwilling either to sustain the costs of a deflation or to accept the political consequences of a devaluation (see Eichengreen and Wyplosz, 1993). As Tommaso Padoa-Schioppa (1994) emphasizes, this conflict prevented member countries from agreeing on a common objective and a common policy in the course of 1992 and ultimately compromised the normal operating procedures in the ERM system at the time of the crisis:

[The cause of the ERM crisis] was plainly traceable to what in the academic jargon is called a “co-ordination failure.” . . . There was the refusal to accept a general realignment and even to call a meeting of the Monetary Committee or of the ministers and central-bank governors when, in September 1992, a general realignment might have calmed the markets. The general procedure, once embarked on, did not produce a credible new grid. At various times, and in various ways, through unhelpful declarations that excited markets as well as through policy decisions that caused unnecessary friction, the system was destabilized by its very custodians (Padoa-Schioppa, 1994, pp. 14–15).

Although rhetorically suggestive, the notion of a coordination failure among the “very custodians” runs the risk of appearing vague and, perhaps, tautological; almost by definition, a crisis of an exchange-rate system is a symptom of insufficient or ineffective policy coordination. To interpret the ERM crisis in the context of a coordination failure, it is necessary to provide a consistent analysis of the *implications* of a cooperation breakdown for the modalities of a currency crisis. Only within the framework of a multicountry model of currency collapses (such as the one developed above) is it possible to define rigorously the concept of “coordination shock” and to explore in depth the predicted responses of financial and real markets to such an event.

The analysis that follows in this chapter provides the theoretical underpinnings of two theses. First, the eruption of the 1992 crisis was associated with a discrete change in market beliefs about intra-ERM

policy cooperation, prompted by the modalities of the first ERM realignment on September 14. Second, the instability of the European exchange-rate system and the contagious speculative waves in the aftermath of Black Wednesday were to a large extent the outcome of fundamental systemic imbalances, as is predicted by a model of currency crises among noncooperative, interdependent economies. The chapter concludes by discussing the hypothesis that, relative to the difficulties of coordinating monetary policies on anything but a strenuous defense of the current parities, the coordination failure in September 1992 could be interpreted as a rational choice by ERM member countries.

Expectations Shifts in Europe During September 1992

Weathering the crisis through monetary coordination. Recalling our reconstruction in Chapter 2, we note that two important “stylized facts” characterize the period leading up to the 1992–93 crisis. First, the proposal for a coordinated realignment formulated by Germany and Italy during the weekend preceding the crisis included a modest nominal revaluation of the deutsche mark (3.5 percent), to be coupled with an equally modest devaluation of the lira (3.5 percent). Whether or not such a realignment could have “saved” the ERM is an open issue. For our purposes, it is sufficient to point out that the proposal, supposedly designed to serve as a basis for further negotiation among the ERM countries, did not include drastic changes of the existing parities.

Second, although the credibility of the ERM was diminishing in August 1992, all indicators of devaluation expectations—such as interest-rate differentials, forward premiums, and average forecasts based on survey data—were by no means large by historical standards (see Rose and Svensson, 1994). This piece of evidence is typically interpreted in one of two ways, either that irrationality and myopia were affecting market forecasts or that, in September 1992, there was a sudden (and substantially arbitrary) shift in market sentiments consistent with the existence of multiple rational-expectations equilibria.

Our theoretical construction allows us to put forth a different and comprehensive interpretation of the factual evidence. As late as the summer of 1992, both European policymakers and financial markets were still anticipating some cooperative defense of the integrity of the exchange-rate system. Expectations of a coordinated, generalized realignment led market participants to forecast a relatively small adjustment of the ERM parities.

Facing an exogenous demand shock in the center, ϵ , consider the implications of a coordinated realignment that includes a revaluation of the center country’s currency against all other currencies in the system. An

example would be the German-Italian proposal after the Bath meeting, a scheme that, to our knowledge, is the only plan ever brought forward as the basis for the design and implementation of a coordinated realignment. What would be the system-wide macroeconomic outlook after such a revaluation? The answer to this question is rooted in the international spillovers of domestic monetary policies.

From our previous discussion, we know that intra-European externalities are positive, in the sense that a monetary expansion by one country reduces the impact of global shocks and raises social welfare in the rest of the system. A devaluation by one country decreases CPI inflation abroad and contributes to the loosening of the global monetary stance. This decreases real interest rates and therefore boosts aggregate demand in the system as a whole.

With positive externalities, cooperation calls for “doing more” in terms of monetary policy. In other words, the overall monetary stance is more expansionary in an equilibrium with a coordinated realignment than in a noncooperative equilibrium. The very fact that many countries join the realignment scheme implies that there will be a substantial effective devaluation of the periphery against the center.

The main point here is that, from the vantage point of each individual periphery country, the relatively large expansionary stance in a coordinated realignment need not require a large devaluation of the periphery country’s own currency. Because it is the *average* revaluation of the center’s currency that ultimately matters, individual rates of nominal devaluation in the periphery need not be high for purposes of domestic stabilization when interest rates fall everywhere in the system (see Appendix and Buiter, Corsetti, and Pesenti, 1998, chap. 8).

It is worth emphasizing that these results do not require that the center coordinate its monetary policy with the periphery. The presence of externalities and policy spillovers implies that, even though the center is unwilling to act cooperatively, the periphery countries may still increase their total welfare by coordinating monetary policies *among themselves*. Of course, if one allows for center-periphery coordination contingent on the periphery countries accepting a realignment, then the average devaluation by the periphery that is necessary to reestablish equilibrium in the system will be even smaller. In equilibrium, an additional monetary expansion by the center (above the monetary expansion consistent with its noncooperative behavior) reduces devaluation rates for all currencies (see our discussion at the end of Chapter 3).

The implications for our reconstruction are straightforward. To the extent that market participants in the late summer of 1992 based their realignment expectations on the presumption that the ERM would

remain an effective coordination device, they rationally forecast that a new parity grid involving a large number of small realignments would be the most likely policy response to global and country-specific tensions in Europe. The anticipated interest-rate cut in Germany, in parallel with the realignment, reinforced these expectations.

Expectations under a noncooperative scenario. The next step toward understanding the effects of a coordination failure on market expectations is the characterization of an alternative equilibrium—different from the cooperative scenario described above—under the assumption that the proposal for a revaluation of the center is rejected and that each country unilaterally maximizes its own objective function taking monetary policy pursued in the rest of the system as given. Referring the reader to the Appendix for details, we describe below two essential features of such a noncooperative equilibrium.¹

First, when the periphery countries do not coordinate their monetary and exchange-rate policies against the center, the equilibrium response to shocks to the center demand, ϵ , may require that only a subset of countries devalue their currencies. If some countries devalue and therefore help to lower the real interest rates in the system, the other countries will have less incentive to abandon the peg. In a noncooperative equilibrium, some countries may avoid realignment altogether.

All things being equal, the number of countries that optimally choose to devalue will increase in response to both the demand shock to the center and to the cumulative misalignment in the system (as indexed by the average magnitude of $w - \bar{s}$). If the combined effect of these shocks is very large, all countries will devalue in equilibrium. Thus, by focusing on uncoordinated realignments including a subset of countries as equilibrium outcomes, we implicitly rule out scenarios in which the size of the exogenous shocks is excessively large.

Second, because countries ignore the positive externalities associated with their money expansion, the average monetary stance is always less expansionary than in the cooperative scenario. The realignment has therefore only a limited impact on the equilibrium real interest rate. But this result implies that the individual devaluation rates of the countries that abandon the peg may be significantly larger in a noncooperative equilibrium. Facing persistently high system-wide interest rates, countries

¹ In the Appendix, we first characterize the optimal policy of a country that abandons the peg, as opposed to a country that maintains the peg. We then assume a particular size and composition of the set of countries that abandon the peg. Finally, we check whether the conjectured set satisfies a system-wide equilibrium condition.

that realign may find it optimal to engineer sizable devaluations; that is, they may be subject to currency crises.

In light of these considerations, market expectations based on the noncooperative scenario are remarkably dissimilar across countries. Each country is expected to determine whether it is preferable to peg or to devalue, and to determine this independently on the basis of the cost-benefit analysis described in the previous chapter (that is, by comparing the country-specific shadow devaluation rate with the devaluation threshold). Excluding the extreme cases in which the shock to center demand is either too large or too small, a number of periphery countries will be expected to abandon the peg and to devalue dramatically in response to fundamental disturbances while the other periphery countries will be expected to maintain the defense of their exchange-rate parities. In equilibrium, periphery countries facing the same global shock will be expected to pursue asymmetric policies somewhat independently of their domestic macroeconomic positions.

The lira devaluation shock. In September 1992, a sudden shift in devaluation expectations in a number of ERM countries triggered the first wave of speculative attacks. The question is *which* unexpected event led market participants to revise their beliefs. We suggest that it was the realignment of the Italian lira on September 14, 1992.²

The fact that *only* the lira was devalued that day—against expectations of a realignment to restore equilibrium in an interdependent monetary system and amidst rampant rumors and revelations about fundamental disagreements among European policymakers—gave the financial markets a strong signal about the ongoing policy game in Europe. With no substantial concession by the Bundesbank, a new parity grid including a mere 7 percent depreciation by only one currency could not appear credible as the outcome of cooperative policy.³ It should be recalled that the lira devaluation against the deutsche mark on September 14 was identical in size to that proposed two days earlier in the context of a general realignment, which would have had all other countries devaluing their currencies by 3.5 percent against the deutsche mark.

² In support of this interpretation, see BIS (1993, pp. 198–199), quoted in Kenen (1995, pp. 159–160).

³ As Kenen (1995, p. 159) observes, “the 7 percent devaluation of the lira on September 14, 1992, was badly bungled. It may have been large enough to restore Italy’s competitive position, but it was too small to seem decisive. It evoked an inadequate response by the Bundesbank—a 25 basis-point cut in the discount and Lombard rates. And it should have been the occasion for a general realignment—a modest revaluation of the deutsche mark combined with selective devaluations of the lira, peseta, escudo, and pound.”

In describing the noncooperative scenario of our model, we have pointed out that, if the exogenous shocks to fundamentals are not too large, restoring equilibrium will require sizable devaluations by a subset of countries in the system. To the extent that the modalities of the lira's realignment modified market views about the level of cooperation in the system, expectations of exchange-rate devaluation were correspondingly revised. In other words, after the first Italian devaluation, it became apparent that German rates would fall significantly only in response to sharp devaluations by a number of other countries. Ultimately, an analysis of the crisis as a policy-coordination failure can rationalize the dramatic change in the financial markets' assessment of ERM stability in the week of the lira realignment without resorting to "sunspots" and the exogenous uncertainty of the self-fulfilling-prophecies theory.

Systemic Effects in the ERM Crisis

In the new, "uncoordinated" scenario that emerged after the lira shock, the first wave of speculative attacks hit a set of currencies that appeared weak with regard to conventional indicators. These currencies included—in addition to the lira—the escudo, peseta, pound, and punt. Some observers were puzzled by the attack against the French franc on September 23 and asserted that the traditional arguments emphasizing the role of weak fundamentals in triggering a currency crisis did not apply to the French case. The puzzlement grew when the franc came again (and repeatedly) under pressure during the 1992–93 period. These "paradoxical" attacks on the franc have been proposed as a key piece of empirical evidence supporting the view that self-fulfilling prophecies were at the root of the ERM crisis.

The nature of the attacks against the franc is a highly controversial subject in the literature. Taking issue with the "self-fulfilling" view, some observers have pointed out that the empirical evidence at the time of the crisis did not entirely support the contention that the French fundamentals were strong; in particular, the high level of unemployment in 1992 was a clear indicator of the French economic malaise. In the light of our model, we can go beyond the terms of this debate. Even if the French macroeconomic conditions were indeed relatively sound, the overall strength of the French fundamentals could not be assessed independently of the monetary behavior of the other countries in the system.

Disregarding strategic interactions (that is, using a partial-equilibrium perspective), one may be tempted to predict that, in the presence of currency-market tensions generated by a shock in the center, countries with *ex ante* weaker macroeconomic conditions will be the most likely

candidates for a currency devaluation, and the equilibrium devaluation rate will be “proportional” to the magnitude of domestic imbalances. A general-equilibrium analysis, however, shows that such a prediction may be proved wrong. According to the logic of a systemic model, a “strong” domestic performance—as measured by the standard set of macroeconomic indicators—is no guarantee against the possibility of a currency crisis.

Because of international interdependencies, neither the number of countries that devalue nor which countries devalue is uniquely determined in a noncooperative scenario. For a given exogenous shock to center demand, ϵ , equilibria that include more currencies in a realignment tend to be characterized by lower individual devaluation rates. Certain equilibrium outcomes, moreover, cannot be ruled out: countries with relatively high inflation—or out-of-line policy targets such as misaligned exchange-rate parities—may be able to keep their pegs, provided that a sufficiently large group of periphery countries participate in a (noncoordinated) realignment. By the same token, there may exist equilibria in which countries with relatively high cost competitiveness (as measured by unit-labor cost at the current parity) devalue their currencies.⁴ Ultimately, policy spillovers weaken the relation between domestic macroeconomic conditions and exchange-rate stability.

Restoring international equilibrium after a sizable shock to the center requires a sizable fall in the system-wide real interest rate and a sufficiently large real appreciation of the center’s effective exchange rate against the periphery. Both real interest rates and exchange rates are functions of the average size of the realignment in the periphery, that is, of the average monetary stance in the system. Absent cooperation, if not enough countries have already devalued by a sufficient amount to restore system-wide equilibrium, both “weak” currencies (such as the escudo, the peseta, and the pound) and “strong” currencies (as the French franc was perceived to be) may be candidates for a speculative attack.

An important implication of this analysis is that the magnitude of devaluation rates in the ERM was to some extent the mirror of the success of a few countries (notably France) in defending their currencies. The conventional wisdom attributes negative spillover effects (beggar-thy-

⁴ Consider equations (2) and (3) for a country with weak domestic macroeconomic conditions (w_i and o_i). Heuristically, the effects of devaluations by other countries on the country-specific shock v_i may more than compensate for weak domestic levels of w_i and o_i , lowering the shadow devaluation rate below the threshold $g(c)$. Provided enough countries devalue in equilibrium, country I will be able to keep the peg, despite its weak macroeconomic conditions.

neighbor) to a devaluation. According to the logic of the traditional approach, the ERM realignment raised the cost of defending the currencies that did not participate in it and therefore increased the likelihood of speculative attacks against them. This logic downplays the effects of a devaluation by one country on the inflation rates and interest rates of countries that do not devalue.

In our interpretation, the noncoordinated devaluation of a subset of currencies partly reduced the ERM-wide imbalance and therefore helped to defend those currencies that had not been devalued. In the Europe of 1992–93, burdened by sizable real interest rates, the contagion effect from a currency crisis was therefore opposite to the traditional prediction. It was not the prospect of losing employment and trade to the devaluing countries that increased the likelihood of a currency crisis in ERM countries that had not devalued. Rather, it was the adverse effects on interest rates caused by the strenuous defense of the existing parities by the nondevaluing countries.

This proposition clearly implies that the size of devaluation rates in Europe responded to more than domestic imbalances such as inflation-rate differentials, budget deficits, and unemployment rates. On empirical grounds, the prediction of our model is consistent with the results of econometric analyses of the ERM, which, despite the wide variety of model specifications proposed, find no link between these “domestic fundamentals” and the likelihood and magnitude of currency devaluations (see Eichengreen, Rose, and Wyplosz, 1994).

It is worth pointing out that most empirical work on this issue—both econometric studies and noneconometric research agendas such as the analysis of early-warning indicators of currency collapses—typically builds on the logical structure of unilateral-peg or two-country models of currency crises. The findings of our multicountry model offer a simple interpretation of the empirical evidence resulting from a unilateral-peg approach: systemic effects make the link between domestic macroeconomic conditions and the size of currency devaluations, let alone the likelihood of a crisis, tenuous. Because internal and external macroeconomic developments are strictly interwoven, this link may even take the “wrong” sign.

Our claim finds support in recent econometric work focused on the contagious effect of currency crises both inside and outside the EMS. The findings by Eichengreen, Rose, and Wyplosz (1996), for instance, show that, after controlling for a number of fundamental determinants of the exchange rate, the probability of a speculative attack against one currency is significantly affected by currency crises and exchange-rate tensions

elsewhere in the world. This econometric evidence is consistent with the prediction of our “fundamentals” model of systemic exchange-rate crises and reinforces the view that unilateral-peg models focusing exclusively on domestic macroeconomic variables may provide a misleading framework for policy analysis.

Cooperation at a Dead Lock?

At the root of our interpretation of the 1992–93 events is the thesis that European countries were unable to cooperate in defense of the ERM. Understanding why such a failure in coordination occurred may be a more difficult task than analyzing its positive implications. Economic theory suggests a set of stylized reasons why rational agents may fail to coordinate their actions. These include a lack of commitment technologies, disagreement about the distribution of costs and benefits from common actions, and a lack of appropriate policy tools by which to redistribute gains across individuals. The breakdown of ERM cooperation in 1992 can be interpreted in terms of a combination of these three elements, with particular emphasis on the difficulties of reaching an agreement about the distribution of costs and benefits from a policy that might have counteracted the tensions in the system.

The German authorities in 1992 were unwilling to lower interest rates and to reduce the financial pressure on the ERM countries independently of a realignment. But their position “disregarded” the presence of country-specific political costs of a devaluation in the periphery, which hindered the possibility of reaching consensus on the modalities of devaluation. It is worth stressing, in this respect, that, according to the standard procedures regulating the collective decisions on exchange-rate policies in the ERM, a realignment required the unanimous approval of all member countries.

Should national policymakers have devalued simultaneously (that is, should the periphery have accepted a *revaluation* of the center) and tolerated the consequences of a cumulative loss of prestige and credibility? If not, which countries should have paid the reputational cost of a devaluation in the general interest? Should individual devaluation rates have been asymmetric, so as to account for the *ex ante* heterogeneity across countries (different rates of wage inflation)? If so, how large should individual devaluations have been? Should the countries that maintained the peg have been compensated by the devaluing countries for suffering a deterioration of cost competitiveness? Or, rather, should the devaluing countries have been compensated for the loss of anti-inflationary credibility? The (formidably complex) answers to these questions would have

determined how the costs and benefits from periphery-wide policies were to be distributed among the individual periphery countries.

Note that, even if periphery countries could have agreed on a specific distribution of costs and benefits from a selective and (or) asymmetric realignment, they still lacked the tools required to achieve such a distribution. In the interdependent EMS of 1992, these tools should have taken the form of improbable redistributive and compensatory transfers intended to correct the perceived unfairness of particular joint-policy measures.

These considerations suggest that in the presence of a center that pursued a realignment as a way to absorb its internal imbalance (somewhat irrespective of the credibility costs in the rest of the system), the set of politically *feasible* coordination schemes was very small, so small, perhaps, that the only feasible coordination in September 1992 was on the status quo, that is, on a painfully deflationary defense of the existing parities.

Political constraints on coordination thus made it impossible to pursue a cooperative monetary relaxation in the system to compensate for the German policy mix. In such a scenario, it was perhaps both individually and collectively rational to abandon attempts to find a joint response to the existing imbalances. Uncoordinated behavior, through large devaluations by a few periphery countries, was the only way to loosen up the average monetary policy in the system.

For most ERM countries, once the crisis had started, the survival of the parities was clearly linked to individual efforts, with little or no intra-Community support. The difficulty of the task was magnified by a widespread feeling that the strength of the political support for Maastricht had dwindled with the first Danish referendum. From September 1992 until August 1993, the operation of the ERM was characterized by uncoordinated attempts to determine the new equilibrium exchange rates, that is, by the (somewhat messy and staggered implementation of the) Nash scenario of our model.

The two obvious exceptions to this pattern are the Netherlands and France. The Netherlands was substantially a member of the European center—its currency never came under attack and its monetary policies were fully harmonized with Germany. France, although clearly not a member of the “hard” center for the period under discussion, held a special position in the extended center or “soft core” of the system. Several observers have commented on the evidence of a coalition or cooperative arrangement between Germany and France, and unlike the other periphery countries, which were effectively left to fend for themselves, France benefited from massive German support in the defense of its parity.

As mentioned above, the particular position of France had important implications for the dynamics of adjustment in 1993. Although the repeated waves of speculative attacks on the franc can be explained in terms of systemic imbalances in Europe (a devaluation of the franc would have contributed substantially to the appreciation of the effective deutsche mark rate), the successful defense of the French franc implied that the long-term interest rates in Europe remained relatively high, causing other European currencies to experience repeated realignments or sustained depreciations. The analysis applies to ERM currencies such as the escudo, peseta, and punt, as well as to non-ERM currencies. In the period under consideration, high interest rates were creating difficulties for the Scandinavian countries that kept their currencies pegged to the deutsche mark, thereby exacerbating already severe country-specific problems (for Finland, the breakup of its trading arrangements with the former Soviet Union; for Sweden, the collapse of domestic consumption demand).

According to our interpretation, the final act in the ERM crisis—the widening of the fluctuation bands in August 1993—represented explicit recognition that the EMS had lost its ability to be a coordination device for the domestic policies of its members. The width of the bands accurately reflected the weakness of international ties in what remained of the monetary system in Europe, and the end of the “hard ERM” represented the beginning of a new stage in European monetary relations. The *policy coordination* of the past, with its strict and problematic requirements in terms of design, consultation, and implementation, was replaced by the *goal coordination* of the present, that is, the attempt to pursue identical policy targets (the convergence criteria) according to the letter of the Maastricht or Amsterdam Treaty. From this vantage point, any form of monetary cohabitation that will emerge in Europe is bound to reflect—for good or for evil—the implications of the coordination failures of the early 1990s and to represent, ultimately, the persistent inheritance of the ERM crisis.

CONCLUSIONS

Building on a model of intra-European spillovers consistent with the available empirical evidence, this study has developed a coherent interpretation of the two main aspects of the ERM crisis: the sudden change in the regime of expectations in September 1992 and the domino effects of speculative attacks between the fall of 1992 and the summer of 1993. Our model of an integrated EU economy, which allows for both country-specific macroeconomic conditions and global shock, has focused on the systemic forces linking the revision of market expectations and asymmetric policy responses as different dimensions of the same equilibrium outcome.

On methodological grounds, our theoretical framework has analyzed the implications of changes in the degree and modalities of policy coordination on the equilibrium exchange-rate parities in Europe. We have shown how the traditional theory of currency crises can be generalized in a multi-country framework in which the fundamentals are augmented so as to include the rules regulating coordination (or competition) among policymakers. We have explained how, in equilibrium, the interdependence among policymakers weakens the link between domestic macroeconomic conditions and the strength of a currency. The effect of a relatively strong macroeconomic outlook on the stability of a currency may be offset by policy shocks from abroad, reflecting the ongoing policy game among national central-bank and fiscal authorities. By the same token, relatively weak currencies may not be forced to devalue when global shocks disturb the system, if a sufficient fall in the world interest rate absorbs the initial imbalance.

The revamping of the ERM in 1993 has closed an important chapter of European monetary history. The belief, popular throughout the 1980s, that the exchange rate is an effective nominal anchor and that countries can import credibility for their disinflation strategies by pegging their currencies to a price-stabilizing center country, is nowadays met with strong reservations and widespread skepticism (see Svensson, 1994, and Obstfeld and Rogoff, 1995). In particular, since 1993, the academic and policy debate has focused mainly on the idea that a flexible peg—that is, a fixed-exchange-rate regime with escape clauses—may be destabilizing and may contain the seeds of its own disruption.

Although we certainly sympathize with this view of unilateral pegs, we believe that an additional, important lesson can be learned from the

1992–93 ERM crisis. Macroeconomic disturbances and shifts in market sentiments need not be disruptive of international exchange-rate arrangements. The speculative tensions in Europe since 1992 have been to a large extent the reflection of each country's attempt to restore macroeconomic equilibrium within a new EMS suffering from the loss of its systemic structure and nature. The widening of the ERM bands in 1993 represented the de facto institutional sanctioning of such a transformation. Since 1993, the wide-band ERM has been a largely empty shell, in which European countries have pursued noncooperative policies while trying to rebuild a common structure.

In light of this conclusion, the future evolution of EMU depends critically on the ability of the new European institutions to provide effective solutions to the issues that prevented the system from surviving in 1992, that is, their ability to reestablish the conditions for an effective cooperative framework. The ERM collapsed when European policymakers could not agree on the distribution among the member countries of the costs and benefits from policy interventions. Similarly, the case can be made that, regardless of the speed and sustainability of intra-European macroeconomic convergence, monetary cohabitation in Europe will be severely jeopardized by the widespread perception that EMU imposes unfair obligations on, and grants asymmetric benefits to, its members. In this sense, a crisis would revive the as yet unreconciled political faults that were exposed in the system by the 1992–93 crisis.

APPENDIX

This appendix presents the structure of the model underlying our analysis. All variables other than interest rates are in natural logarithms. Variables referring to the center country are starred. Variables referring to the periphery countries are indexed with a subscript i , for $i = 1, 2, \dots, N$. Unless otherwise stated, Greek letters (both lowercase and uppercase) refer to constant, positive parameters.

The Center Country

Output supply in the center, denoted by y^* , is a function of employment, n^* , subject to decreasing returns to scale:

$$y_t^* = (1 - \alpha)n_t^* \quad 0 < \alpha < 1. \quad (\text{A.1})$$

Profit-maximizing competitive firms equate the marginal product of labor to the real wage. The money wage in the center is denoted by w^* , and the center's GDP deflator is denoted by p^* :¹

$$w_t^* - p_t^* = -\alpha n_t^*. \quad (\text{A.2})$$

Real aggregate demand in the center depends on the effective real exchange rate of the periphery relative to the center z (defined below), the center's real interest rate r^* (defined below), and an aggregate demand shock λ^* :

$$y_t^* = \lambda_t^* - \delta z_t - \nu r_t^*. \quad (\text{A.3})$$

The center's real exchange rate is defined as follows. Let s_i be the nominal spot exchange rate of the periphery country i (expressed as country i 's currency per unit of center's currency), and let p_i be the GDP deflator of the periphery country i (in local currency). The real exchange rate of the periphery country i relative to the center is defined as

$$z_{i,t} = s_{i,t} - p_{i,t} + p_t^*. \quad (\text{A.4})$$

Under the assumption of symmetry, the effective real exchange rate of the periphery relative to the center z is then simply given by the arithmetic average of the real exchange rates in the periphery:²

$$z_t \equiv \frac{1}{N} \sum_{i=1}^N z_{i,t}. \quad (\text{A.5})$$

¹Strictly speaking, defining the logarithm of the nominal wage as \widehat{w}^* , the demand for labor is given by $\widehat{w}^* - p^* = \ln(1 - \alpha) - \alpha n^*$. For notational simplicity, we define it in the following discussion as $w^* \equiv \widehat{w}^* - \ln(1 - \alpha)$.

²A simple, albeit algebra-intensive, modification of the model can account for differences in country size or trade shares by modeling the effective exchange rate as a weighted average of the bilateral rates.

Assuming a constant share of imports in consumption, β (which applies to each of the periphery countries as well as to the center), the center's CPI is defined as follows:³

$$q_t^* \equiv (1 - \beta)p_t^* + \beta \frac{1}{N} \sum_{i=1}^N (p_{i,t} - s_{i,t}) = p_t^* - \beta z_t \quad 0 < \beta < \frac{1}{2}. \quad (\text{A.6})$$

The real interest rate in the center is its nominal interest rate, i^* , minus the expected proportional rate of change in its CPI, q^* :

$$r_t^* \equiv i_t^* - E_t q_{t+1}^* + q_t^*, \quad (\text{A.7})$$

where E_t denotes the expectation operator conditional on information available in period t .

Assuming a constant-velocity money-demand function, equilibrium in the money market requires

$$m_t^* = p_t^* + y_t^* = w_t^* + n_t^*, \quad (\text{A.8})$$

where m^* denotes the center's nominal money stock. At the end of period $t - 1$, that is *before* the center money stock m_t^* is determined and observed, wage setters choose the money wage prevailing in period t . Their objective function is to minimize the forecast deviation of employment from the full-employment level (here normalized to zero). Therefore, they solve

$$\min_{w_t^*} E_{t-1} (n_t^*)^2, \quad (\text{A.9})$$

subject to (??). Because $n^* = m^* - w^*$, this implies that nominal wages are equal to the expected money supply, and employment (or output) is a function only of monetary innovations:

$$w_t^* = E_{t-1} m_t^* \quad (\text{A.10})$$

$$n_t^* = m_t^* - E_{t-1} m_t^*. \quad (\text{A.11})$$

The Periphery Countries

Periphery countries have the same technology as the center. Thus, using self-explanatory notation, the *supply-side* equations characterizing the periphery are given as

$$y_{i,t} = (1 - \alpha)n_{i,t} \quad (\text{A.12})$$

³We restrict the propensity to import β to be less than one half. As will become clear later, this assumption rules out the possibility that real interest differentials and real expected depreciation between center and periphery move in opposite directions.

$$w_{i,t} - p_{i,t} = -\alpha n_{i,t} . \quad (\text{A.13})$$

We assume that periphery countries import (export) goods and services exclusively from (to) the center country. This is the reason why only the bilateral real exchange rate of country i relative to the center, z_i , enters into the demand equation for country i 's output:

$$y_{i,t} = \lambda + \delta z_{i,t} - \nu r_{i,t} . \quad (\text{A.14})$$

In contrast to its role in the demand equation in the center country (??), the parameter λ is constant in equation (??). In other words, for the sake of simplicity, we abstract from country-specific and time-specific IS shocks hitting the periphery countries. The other behavioral parameters δ , ν , and β are identical in both the center and the periphery.

Real interest and exchange rates in country i are

$$r_{i,t} = i_{i,t} - E_t q_{i,t+1} + q_{i,t} \quad (\text{A.15})$$

$$q_{i,t} = p_{i,t} + \beta z_{i,t} . \quad (\text{A.16})$$

By analogy with the center, real-money balances, money wages, and employment in the periphery are determined as follows:

$$m_{i,t} - p_{i,t} = y_{i,t} \quad (\text{A.17})$$

$$w_{i,t} = E_{t-1} m_{i,t} \quad (\text{A.18})$$

$$n_{i,t} = m_{i,t} - E_{t-1} m_{i,t} . \quad (\text{A.19})$$

Finally, we assume that assets denominated in different currencies are perfect substitutes in private agents' portfolios, so that the uncovered-interest-parity condition holds:

$$i_{i,t} = i_t^* + E_t s_{i,t+1} - s_{i,t} . \quad (\text{A.20})$$

Note that, given (??), with perfect capital mobility, the uncovered-interest-parity condition must hold for any pair of currencies in the system.

Shocks to Fundamentals, Monetary Innovations, and the Real Exchange Rate

In this section, we present a semi-reduced form of our model, expressing all endogenous variables as functions exclusively of exogenous, predetermined, or control variables. Consider, first, the bilateral real-interest-rate differential between country i and the center country, $r_{i,t} - r_t^*$. By taking the sum over the N periphery countries, the average interest-rate differential between the periphery and the center will be

$$\frac{\sum_i r_{i,t}}{N} = r_t^* + (1 - 2\beta)(E_t z_{t+1} - z_t) . \quad (\text{A.21})$$

According to the previous expression, the real-interest-rate differential and the expected rate of depreciation of the real exchange rate between center and periphery move in the same direction if and only if $\beta < 1/2$, that is, if there is *home bias* in consumption preferences (??).

Using (??) together with the aggregate demand functions (??) and (??) and the resource constraint of the economy as a whole, defined as

$$\frac{\sum_i y_{i,t}}{N} - y_t^* = (1 - \alpha) \left(\frac{\sum_i n_{i,t}}{N} - n_t^* \right), \quad (\text{A.22})$$

we obtain a first-order stochastic-difference equation in z_t :

$$z_t = \gamma E_t z_{t+1} + \phi \left(\frac{\sum_i n_{i,t}}{N} - n_t^* \right) + \frac{\phi}{1 - \alpha} (\lambda_t^* - \lambda), \quad (\text{A.23})$$

for which the parameters γ and ϕ are defined in Box 1.

Because the effective real exchange rate z is a forward-looking variable, we impose a no-bubble terminal condition. Solving (??) with such a boundary condition yields

$$z_t = \phi \left(\frac{\sum_i n_{i,t}}{N} - n_t^* \right) + \epsilon_t, \quad (\text{A.24})$$

where ϵ is defined as

$$\epsilon_t \equiv \frac{\phi}{1 - \alpha} \sum_{s=0}^{\infty} \gamma^s E_t (\lambda_{t+s}^* - \lambda). \quad (\text{A.25})$$

The effective real exchange rate depends both on the difference between the current monetary innovations in the periphery and in the center and, through the variable ϵ , on the present discounted value of current and expected future real-demand shocks in the center relative to the periphery. Thus, a demand (IS) shock in the center larger than in the periphery causes the center's real exchange rate to appreciate, whereas a money-supply shock in the center larger than in the periphery causes the center's real exchange rate to depreciate.

Next, it is straightforward (though algebraically tedious) to show that the bilateral real exchange rate of periphery country i relative to the center is

$$z_{i,t} = \xi (1 - \theta) n_{i,t} + v_{i,t}, \quad (\text{A.26})$$

where θ and ξ are defined in Box 1. Note that the sign of θ is ambiguous. In (??), as well as in (1) in the main text, v denotes the relevant macroeconomic disturbance from the vantage point of country i , which is a function

BOX 1
PARAMETER DEFINITIONS

$\gamma \equiv \frac{v(1-2\beta)}{2\delta+v(1-2\beta)} < 1$	
$\phi \equiv \frac{1-\alpha}{2\delta+v(1-2\beta)}$	
$\theta \equiv \left(\frac{\delta-\nu\beta}{2\delta+\nu(1-2\beta)} \right) \frac{1}{N}$	
$\xi \equiv \frac{1-\alpha}{\delta+\nu(1-\beta)} = \frac{\phi}{1-N\theta} > 0$	
$\rho \equiv \alpha + \beta\xi(1-\theta)$	$\rho^c \equiv \alpha + \beta\phi$
$\kappa \equiv \alpha + \xi(1-\theta)$	$\kappa^c \equiv \alpha + \phi$
$\Sigma \equiv \frac{1+\sigma\rho^2}{\kappa}$	$\Sigma^c \equiv \frac{1+\sigma(\rho^c)^2}{\kappa^c}$
$\Lambda \equiv \sigma\rho$	$\Lambda^c \equiv \sigma\rho^c$
$\mathcal{A} \equiv (\Sigma - \Lambda)/\Sigma$	$\mathcal{A}^c \equiv (\Sigma^c - \Lambda^c)/\Sigma^c$
$\mathcal{B} \equiv 1/\Sigma$	$\mathcal{B}^c \equiv 1/\Sigma^c$
$\mathcal{C} \equiv (\Sigma - \beta\Lambda)/\Sigma$	$\mathcal{C}^c \equiv (\Sigma^c - \beta\Lambda^c)/\Sigma^c$
$\Gamma \equiv \frac{\xi\theta}{\xi\theta + \kappa} \mathcal{C} < 1$	

of the global shock ϵ and the policy stances of all other countries in the system:

$$v_{i,t} \equiv \epsilon_t - \phi n_t^* - \xi \theta \sum_{j \neq i} n_{j,t} = \epsilon_t - \left[\phi (m_t^* - w_t^*) + \xi \theta \sum_{j \neq i} (m_{j,t} - w_{j,t}) \right]. \quad (\text{A.27})$$

Adopting the notational simplifications of Box 1, we can finally write the semi-reduced-form equations for the CPI as

$$q_{i,t} = \rho n_{i,t} + w_{i,t} + \beta v_{i,t}, \quad (\text{A.28})$$

and the bilateral nominal exchange rate relative to the center as

$$s_{i,t} = \kappa n_{i,t} + w_{i,t} - w_t^* - \alpha n_t^* + v_{i,t}. \quad (\text{A.29})$$

Policy Preferences in the Periphery

The policymakers in the periphery country i minimize an intertemporal loss function defined as follows:

$$\sum_{\tau=0}^{\infty} E_t L_{i,t+\tau}, \quad (\text{A.30})$$

where the single-period loss function is

$$L_{i,t} \equiv \ell_{i,t} + c_i I_{i,t} \equiv \frac{1}{2} [(n_{i,t} - \bar{n}_i)^2 + \sigma (q_{i,t} - \bar{q}_{i,t})^2] + c_i I_{i,t} \quad (\text{A.31})$$

$$I_{i,t} = \begin{cases} 0 & \text{if } s_{i,t} = \bar{s}_{i,t} \\ 1 & \text{otherwise} \end{cases}. \quad (\text{A.32})$$

The single-period loss function ℓ_i in (??) is quadratic in the deviation of actual employment and CPI from their current target levels, \bar{n} and \bar{q} , respectively. The target levels for prices and employment, as well as the exchange-rate parity (indexed by \bar{s}) are known at time $t - 1$, before wages are set.⁴

The target level of employment exceeds the rational-expectations equilibrium of “natural” level (normalized to zero in this model): $\bar{n} > 0$. Following the standard conventions, such a parametrization of the model implies

⁴Over time, the CPI target level \bar{q} and the nominal-exchange-rate target \bar{s} may change, but not independently of each other. See the discussion in Buiter, Corsetti, and Pesenti, 1998, chaps. 6-7.

the presence of exogenous (and unremovable) distortions in the periphery labor market, which make the full-employment output level socially sub-optimal. The well-known theoretical implication of the resulting conflict between public preferences and equilibrium constraints is that an equilibrium with full monetary discretion is affected by an inflationary bias.

The positive constant c in (??) denotes the welfare cost of abandoning the peg: country i 's policymakers suffer a welfare loss equal to c when the current exchange rate deviates (no matter by how much) from the announced exchange rate parity. Such cost indexes the “commitment technology” of the monetary authority: the higher the degree of commitment to the defense of the peg, the higher the cost, c , that the policy authority will pay (in terms of reputation and credibility) if it abandons its announced target.

Characterizing the Optimal Monetary Policy: The Shadow Devaluation Rate

In the absence of international policy coordination, the optimal policy rule for a periphery country combines two different monetary regimes. In one, the money stock is consistent with the survival of the peg. In the other, the peg is abandoned and the money supply optimally responds to fundamentals. If the policymaker decides to defend the current parity \bar{s} , the money supply is endogenous and is implicitly determined by (??), where we posit $s = \bar{s}$. For future reference, define the employment level, the CPI, and the loss function implied by $s = \bar{s}$ as n^{FX} , q^{FX} , and ℓ^{FX} , where FX denotes “conditional on defending the peg.”

If, instead, the current exchange-rate parity is no longer a binding target or constraint, the policymaker will choose a monetary policy that minimizes the current loss function, ℓ . By taking the first-order condition as a minimum, it can be easily shown that the optimal devaluation rate (contingent on a realignment) is

$$\Delta\tilde{s}_{i,t} = \mathcal{A}w_{i,t} + (1 - \mathcal{A})\bar{q}_{i,t} + \mathcal{B}\bar{n}_i + \mathcal{C}v_{i,t} - \bar{s}_{i,t} - p_t^* , \quad (\text{A.33})$$

where the parameters \mathcal{A} , \mathcal{B} , and \mathcal{C} are defined in Box 1. Posing $o_i \equiv \bar{n}_i + (1 - \mathcal{A})/\mathcal{B}\bar{q}_i - \bar{s}_i/\mathcal{B}$, we obtain the expression (2) in the main text.

Equation (??) defines the shadow devaluation rate, that is, the percentage difference between the (optimally chosen) value of the exchange rate and the target exchange rate if the peg were abandoned. Note that the shadow devaluation rate is increasing in the predetermined nominal wage, in both the employment and the price targets, as well as in the country-specific shock.

By definition, the prevailing exchange rate conditional on the abandonment of the peg will be $s = \bar{s} + \Delta\tilde{s}$. We define the employment level, the CPI, and the loss function implied by $s = \bar{s} + \Delta\tilde{s}$ as n^{FL} , q^{FL} , and ℓ^{FL} ,

where FL denotes “conditional on abandoning the peg.” Note that the shadow devaluation rate can also be written as

$$\Delta\tilde{s}_{i,t} = \kappa (n_{i,t}^{FL} - n_{i,t}^{FX}) = \frac{\kappa}{\rho} (q_{i,t}^{FL} - q_{i,t}^{FX}) . \quad (\text{A.34})$$

The interpretation of these relationships brings additional insights to the meaning of $\Delta\tilde{s}$. The shadow devaluation rate is proportional to the “employment gap” ($n^{FL} - n^{FX}$), that is, the employment loss caused by defending the existing parity. It is also proportional to the “price level gap” ($q^{FL} - q^{FX}$), that is, the inflation benefit gained by defending the peg. In either case, the shadow devaluation rate provides a measure of the welfare opportunity cost of maintaining the exchange rate as fixed.

To emphasize the relevance of the latter point, consider the policymaker’s choice between the two exchange-rate (and monetary-policy) regimes. The policymaker will opt for abandoning the peg if and only if the loss under a peg is larger than the loss associated with a devaluation (including the lump-sum welfare cost c):

$$\begin{aligned} s_{i,t} &= \bar{s}_{i,t} && \text{if } \ell_{i,t}^{FX} - \ell_{i,t}^{FL} \leq c_i \\ s_{i,t} &= \bar{s}_{i,t} + \Delta\tilde{s}_{i,t} && \text{if } \ell_{i,t}^{FX} - \ell_{i,t}^{FL} \geq c_i . \end{aligned} \quad (\text{A.35})$$

By using (??) and the first-order condition for minimizing ℓ , we can rewrite the condition for an optimal choice of exchange-rate regime (??) exclusively in terms of the shadow devaluation rate:

$$\begin{aligned} s_{i,t} &= \bar{s}_{i,t} && \text{if } \Delta\tilde{s}_{i,t} \leq \tilde{c}_i \\ s_{i,t} &= \bar{s}_{i,t} + \Delta\tilde{s}_{i,t} && \text{if } \Delta\tilde{s}_{i,t} \geq \tilde{c}_i , \end{aligned} \quad (\text{A.36})$$

where \tilde{c} is a constant obtained as a transformation of the original devaluation cost c , that is, $\tilde{c} = g(c)$ for some monotonic function g .⁵ In other words, there exists a threshold value of the shadow devaluation rate that triggers an optimal realignment.⁶ It bears emphasizing that such a threshold \tilde{c} translates the opportunity cost of abandoning the peg from the metric of the welfare function into the metric of the exchange rate.

⁵In our case, the constant can be shown to be equal to the square root of $2c\kappa^2 / (1 + \sigma\rho^2)$.

⁶Note that the escape clause specified in our analysis does not preclude *a priori* the possibility of a revaluation of the central parity. We simplify the analysis by ruling out construction shocks to fundamentals that would correspond to a large negative value of the shadow depreciation rate (so that $\Delta\tilde{s} \geq -\tilde{c}$). The extension to the general case is simply a corollary of the analysis that follows.

Endogenous Wages

To determine the equilibrium wage rate, we proceed as follows. First, because the shadow devaluation rate is monotonic in v , there exists a threshold level for the shock, say \bar{v} , such that $\Delta\tilde{s} \geq \tilde{c}$ if and only if $v \geq \bar{v}$. We shall refer to the event $v \geq \bar{v}$ by the shorthand FL , and to the event $v \leq \bar{v}$ by the shorthand FX .

Second, define the probability of a realignment as

$$\pi_{i,t} \equiv \Pr\{\Delta\tilde{s}_{i,t} \geq \tilde{c}_i\} \equiv \Pr\{v_{i,t} \geq \bar{v}_{i,t}\} . \quad (\text{A.37})$$

Wage-setters' forecasts will be obtained by taking the expectations of m^{FX} and m^{FL} , conditional on, respectively, the defense of the peg (FX) and a devaluation (FL), and combining them according to their respective probabilities:

$$\begin{aligned} w_{i,t} &= E_{t-1}m_{i,t} = (1 - \pi_{i,t}) E_{t-1}(m_{i,t}^{FX}|FX) \\ &\quad + \pi_{i,t} E_{t-1}(m_{i,t}^{FL}|FL) . \end{aligned} \quad (\text{A.38})$$

The wage rate obtained according to this expression will be a decreasing function of the devaluation threshold \bar{v} , so far taken as an exogenous parameter.

Third, we now replace w in the definition of the shadow devaluation rate $\Delta\tilde{s}$ with expression (??). Rearranging the realignment rule (??), it can be shown that country i will devalue its currency if the following condition holds:

$$\begin{aligned} \tilde{c}_i \leq & \mathcal{C}v_{i,t} - p_t^* + \frac{\mathcal{B}\bar{n}_i + (1 - \mathcal{A})(\bar{q}_{i,t} - \bar{s}_{i,t})}{1 - \mathcal{A}\pi_{i,t}} \\ & - \frac{\mathcal{A}[(1 - \pi_{i,t}) E_{t-1}(v_{i,t}|FX) + \pi_{i,t}(1 - \mathcal{C}) E_{t-1}(v_{i,t}|FL)]}{1 - \mathcal{A}\pi_{i,t}} . \end{aligned} \quad (\text{A.39})$$

This expression is critical to the endogenous identification of the devaluation threshold \bar{v} , so far taken as a given parameter. The equilibrium interior value(s) of the devaluation threshold under rational expectations can be found by taking expression (??) to hold with equality and solving for $v = \bar{v}$.

Multicountry Nash Equilibrium

For the sake of simplicity, we shall assume, in what follows, that the devaluation costs c are equal across countries. In addition, the center implements a noncontingent money rule,

$$m_t^* = 0 , \quad (\text{A.40})$$

so as to rule out any strategic interaction between center and periphery as a whole. Although permitting us to avoid a great many analytical complications, such a simplification does not affect the results of our analysis in any substantive way.⁷ It can be easily verified that the center's monetary policy implies

$$n_t^* = m_t^* - E_{t-1}m_t^* = 0, \quad (\text{A.41})$$

as well as $p_t^* = w_t^* = 0$.

To simplify the notation, we drop the time subscripts. In order to determine the Nash equilibrium, we proceed in three steps. First, for any country j , the *realized* rate of exchange-rate depreciation can be written as

$$\Delta s_j \equiv s_j - \bar{s}_j = (\xi\theta + \kappa)n_j + (w_j - \bar{s}_j) + \eta, \quad (\text{A.42})$$

where

$$\eta = \epsilon - \xi\theta \sum_{j=1}^N n_j. \quad (\text{A.43})$$

This second equation is obtained by rearranging (??) as a function of η , that is, the global shock net of the system-wide monetary response (*including* country j response). Note that the level of η will be endogenously determined in equilibrium.

Second, consider the shadow devaluation rate of country i as a function of $\sum_{j \neq i} n_j$. To solve for $\sum_{j \neq i} n_j$, sum (??) across all $j \neq i$ and rearrange. After substituting into (??), we obtain

$$\Delta \tilde{s}_i = H_i + K - \Gamma \sum_{j \neq i} \Delta s_j, \quad (\text{A.44})$$

where Γ is defined in Box 1. The shadow devaluation rate is a function of three elements. The first element is an index of *country-specific* asymmetries (including potential asymmetric wage rates arising from self-fulfilling changes in expectations):

$$H_i = [\mathcal{B}o_i + \mathcal{A}w_i + \Gamma(\bar{s}_i - w_i)]. \quad (\text{A.45})$$

The second element is an index of net *periphery-wide* shocks, labor-cost imbalances, and policy spillovers:

$$K = \mathcal{C}\epsilon + \Gamma \sum_j (w_j - \bar{s}_i) + \Gamma(N-1)\eta. \quad (\text{A.46})$$

⁷Indeed, we obtain comparable results in our analyses of international monetary games allowing for a quadratic loss function in employment and the CPI level for both the center country and the periphery countries; see Buiter, Corsetti, and Pesenti (1995, 1998).

The third element is the aggregate devaluation rate by all other countries in the periphery of the system. Under our assumptions about the sign of the external effects of domestic monetary policy, this term is negatively related to country i 's shadow devaluation rate.

Next, consider a realization of the shock ϵ that is not “too large” and assume the existence of an equilibrium in which F number of countries devalue and $N - F$ countries maintain the peg, with F to be determined endogenously. The set of devaluing countries will be indexed by \mathcal{FL} , which stands for “floater.” After some simple manipulations of the above formulas, we can write two expressions for the equilibrium shadow devaluation rate, one for a representative floater in the set \mathcal{FL} in (indexed i):

$$\begin{aligned}\Delta \tilde{s}_i &= \Delta s_i = \frac{1}{1 - \Gamma} \left[H_i + \frac{(1 - \Gamma)K - \Gamma \sum_{i \in \mathcal{FL}} H_i}{1 + \Gamma(F - 1)} \right] \\ &\geq \tilde{c} \quad \forall i \in \mathcal{FL},\end{aligned}\tag{A.47}$$

the other for a representative “pegger” (indexed z):

$$\Delta \tilde{s}_z = H_z + \frac{(1 - \Gamma)K - \Gamma \sum_{i \in \mathcal{FL}} H_i}{1 + \Gamma(F - 1)} \leq \tilde{c} \quad \forall z \notin \mathcal{FL}.\tag{A.48}$$

For each country in the set \mathcal{FL} , the first expression yields the equilibrium devaluation rate as a function of the number of countries that devalue in equilibrium and the index K , which depends on the global monetary stance of the periphery. Once η is endogenously determined, for a given level of the global shock ϵ , the two expressions jointly determine the number of countries that devalue in equilibrium, F . This number must satisfy the following inequality for all H_i of the floaters and all H_z of the peggers:

$$\tilde{c} - \frac{H_i}{1 - \Gamma} \leq \kappa \frac{\mathcal{C}\epsilon + \Gamma \sum_j (w_j - \bar{s}_j) - \frac{\Gamma F}{\mathcal{A}} \bar{H}_F}{F\Gamma\kappa + (\alpha + \phi)(1 - \Gamma)} \leq \frac{\tilde{c} - H_z}{1 - \Gamma},\tag{A.49}$$

where \bar{H}_F is the average of H_i for all floaters $i \in \mathcal{FL}$.

Note that the number F of countries abandoning the peg in equilibrium increases with the size of the global shock ϵ and with the cumulative labor-cost imbalance $w - \bar{s}$ (an index of exchange-rate misalignment) in the periphery. In equilibrium, each country in the set \mathcal{FL} finds it optimal to abandon the peg, and each country outside the set finds it optimal to maintain the announced exchange-rate parity, provided that the countries in \mathcal{FL} optimally devalue. If countries are *ex ante* identical ($H_i = \bar{H}_F$), it will not be possible to determine *which* particular countries will be part of the set \mathcal{FL} . If the countries are not too heterogeneous, the same result will obtain: if the average devaluation rate in the system is sufficiently high,

countries with relatively weak fundamentals may not devalue in equilibrium, and countries with relatively strong fundamentals may be part of the set \mathcal{FL} .

Note also that, for given ϵ , H_i , and H_z , there can be more than one value of F satisfying the above inequality. In this case, the smaller the value of F that solves (??), the larger will be the corresponding individual devaluation rates.

The range of shocks ϵ for which some countries keep the peg in equilibrium is limited by the fact that F must lie between 0 and N , the total number of periphery countries. The boundaries of this range can thus be determined by setting $F = 0$ and $F = N$ in equation (??) and solving for the corresponding threshold values of ϵ , say ϵ_{min} and ϵ_{max} . These thresholds correspond to the largest H_i for the floaters, and the smallest H_z for the peggers. For shocks larger than ϵ_{max} , all countries in the periphery will devalue by their specific optimal rate $\Delta\bar{s} > \tilde{c}$. For shocks smaller than ϵ_{min} , all periphery countries will maintain the peg.

Cooperative Equilibrium

In the cooperative equilibrium described in the main text, the policymakers in the periphery minimize the joint-loss function,

$$\sum_{i=1}^N \frac{1}{N} \left(\sum_{\tau=0}^{\infty} E_t L_{i,t+\tau} \right), \quad (\text{A.50})$$

with respect to the N monetary stances. The first-order condition with respect to the monetary instrument of country i is

$$n_i - \bar{n}_i + \sigma\rho(q_i - \bar{q}_i) = \sigma\beta\xi\theta \sum_{j \neq i} (q_i - \bar{q}_i). \quad (\text{A.51})$$

Aggregating, the average devaluation rate (as a result of the coordinated realignment) is

$$\frac{\sum_j \Delta s_j}{N} = \mathcal{A}^c \frac{\sum_j w_j}{N} + (1 - \mathcal{A}^c) \frac{\sum_j \bar{q}_j}{N} + \mathcal{B}^c \frac{\sum_j \bar{n}_j}{N} + \mathcal{C}^c \epsilon - \frac{\sum_j \bar{s}_j}{N}, \quad (\text{A.52})$$

where the parameters \mathcal{A}^c , \mathcal{B}^c , and \mathcal{C}^c are defined in Box 1. Comparing this equation with its analog in the absence of cooperation (??), it is straightforward to show that $\mathcal{C}^c > \mathcal{C}$. The average policy response to a global shock is more expansionary under a joint cooperative realignment than in the absence of cooperation, even if all countries find it optimal to devalue in a noncooperative equilibrium.

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