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Characteristics of the Euro, the Demand for Reserves, and Policy Coordination Under EMU

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Abstract

The success of European Economic and Monetary Union (EMU) will depend on the stability of the euro. The monetary policy framework is yet to be decided, but is likely to involve either money or inflation targeting. Stochastic simulations compare the outcomes for major macroeconomic and financial variables pre- and post-EMU under both policy rules, as well as under an inflation targeting rule that includes output. Implications for the euro as a reserve currency are examined in the light of the expected returns and covariances among reserve currencies. The role of the exchange rate as an indicator and incentives for policy coordination with other major countries are also discussed.

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SUMMARY

The euro's economic base, as measured by the combined GDP of the currency area, will rival that of the dollar. Despite a monetary policy oriented toward price stability backed by restrictive fiscal policies, the euro will face considerable initial uncertainties. This paper assesses the prospects for the euro from the perspective of the past behavior of European economies, while recognizing that Economic and Monetary Union (EMU) is likely to bring about structural changes.

Stochastic simulations are used to analyze the effects of replacing European currencies with the euro. They are performed for a monetary aggregate or inflation target, plus a variant of inflation targeting that includes a weight on output. The results suggest, in the absence of structural changes, that macroeconomic variables for the European Union (EU) should be at least as stable after EMU as at present.

The paper then analyzes the potential demand for reserves after EMU in the light of these results, which suggest that the incentives to hold foreign exchange reserves in euro for store of value purposes should be somewhat greater than for the deutsche mark at present and, hence, that there should be incentives to diversify away from the dollar. However, holdings of dollar reserves by EU central banks, though they appear to be too large in the light of EMU, are likely to have a much smaller impact on the euro-U.S. dollar exchange rate than the relative stance of monetary policies and economic conditions.

Uncertainty is likely to make any monetary policy framework problematic in the initial phase of EMU. As a result, the European Central Bank may initially give more weight to other indicators, like the exchange rate. In the light of this increased uncertainty, the paper argues that EMU will not necessarily decrease the incentives for international policy coordination, because coordination may help to contain the overall uncertainty facing Europe.

I. INTRODUCTION

Economic and monetary union (EMU) in Europe will be a major event for the international monetary system. The creation of a new currency, the euro, will provide a potentially serious rival for the U.S. dollar at the center of the international monetary system. The euro will be a currency whose economic base, as measured by the combined GDP of the currency area, will be close to, and perhaps even greater than, that for the dollar, depending on the countries that actually proceed to stage 3 of EMU. It will be a currency in its own right, rather than a basket currency like the ECU. Moreover, the statutes of the European Central Bank (ECB) provide strong guarantees that the new currency will be backed by monetary policies oriented toward price stability. The excessive deficit procedures established by the Maastricht Treaty, reinforced by the recently concluded Stability and Growth Pact, should help to ensure that fiscal policies will not interfere with that monetary policy objective.

However, the euro will face considerable initial uncertainties. First, the set of countries that will proceed to EMU on January 1, 1999, is yet to be determined, and, since not all countries are likely to qualify (or, like Denmark and the United Kingdom, may not choose to join if they do qualify), there will remain uncertainty even after the start of monetary union concerning its ultimate composition. Indeed, the European Union (EU) may admit further members, in particular from Eastern Europe, which would also increase the dimension of EMU in a more distant future. Second, the precise way the ECB will operate will not be clear from the beginning, even though some issues will no doubt be resolved between now and 1999, including its monetary policy operating procedures. One important choice will be that of an intermediate target; the European Monetary Institute considers that monetary or inflation targeting procedures are potential candidates (EMI, 1997). Third, whatever the announced policy objectives and operating procedures, there will be doubts about how closely the ECB will attempt to achieve those objectives. In other words, the *credibility* of the central bank will depend on establishing a track record. The public (including financial markets) will need to see results before fully believing the new institution's stated policy intentions. Finally, there will be considerable uncertainty about the way the economy works after a major regime change like the introduction of unalterably fixed exchange rates and the replacement of national currencies. This will affect the transmission mechanism for monetary policy as well as the private demand for assets in euro. As a result, traditional indicators of the stance of monetary policy will not give the same signals or be interpretable in the same ways. This will both complicate the ECB's task of implementing monetary policy and the public's monitoring of its success, which is important for establishing credibility.

The present paper is an attempt to assess the prospects for the euro from the perspective of the past behavior of European economies, while recognizing that the future will in some respects not look like the past. However, we will not analyze all aspects of this vast, and very speculative, question. Instead, we will focus on a few selected topics. In particular,

we first use stochastic simulations of MULTIMOD[2] to analyze the effects of replacing European currencies by the euro, and replacing an asymmetric monetary policy (mainly influenced by events in Germany) with a symmetric policy that reflects Europe-wide[3] developments. This will affect the inflation and exchange rate stability properties of the euro (relative to the deutsche mark) in a number of ways that depend on the nature of historical shocks to various economic relationships. For instance, shocks to consumption and investment may average out at the European level, and hence aggregate shocks may be less large and variable (relative to the size of the economy) than those for a single country, like Germany. EMU will also eliminate currency risk among member countries relative to each other, which can be expected to help stability. These channels are discussed in some detail in the next section, and the simulated effects on variability of going to EMU are presented for a range of financial variables. The simulations are performed under the two alternative intermediate targets mentioned above, namely a monetary aggregate or inflation target, plus a variant of inflation targeting that includes a weight on output.

The third section proceeds to analyze the potential demand for reserves after EMU in the light of the stochastic simulations of the previous section. The attractiveness of the euro will depend on its expected rate of return and its covariances with other reserve assets, though clearly other factors (such as the extent trade will be denominated in euro, and the depth and liquidity of financial markets) will also be very important. The latter have been discussed by other authors; here, we limit ourselves to considering reserve holdings from an optimal portfolio perspective, where only expected returns and covariances of returns among the major reserve currencies matter. These are calculated on the basis of the stochastic simulations; implications for the attractiveness of the euro relative to the dollar and yen are then derived.

After having considered the international impact of EMU using historical relationships (modified only with respect to the monetary regime), the remaining sections highlight how uncertain a guide those historical relationships may be in the face of a major regime change. Among other effects, this may have important implications for what the ECB chooses to do in the initial years of monetary union. In section 4, it is argued that uncertainty will make both monetary and inflation targeting frameworks problematic, because the transmission mechanism and the demand for money will not conform to historical relationships, and because there will be little quantitative evidence available for updating them. This may induce the ECB initially to give more weight to indicators, like the exchange rate, whose interpretation is less questionable and on which monetary policy may have a more predictable effect. In section 5, the issue of policy coordination between EU members (and the ECB) and other major countries is considered in the light of this increased uncertainty about the effects of monetary policy. Contrary to other authors, it is argued that EMU will not necessarily

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[2]See Masson, Symansky, and Meredith (1990)

[3]That is, for those European countries that are members of EMU.

decrease the incentives for international policy coordination, because coordination may help to contain the overall uncertainty facing Europe.

II. Will the Euro Facilitate Macroeconomic Stability?

We will begin by analyzing whether European monetary policy, when oriented to developments in a wider area than Germany, would be associated with greater or lesser variability of macroeconomic variables, including output, inflation, interest rates, and the exchange rate. A potentially important issue will be the choice of monetary policy framework, an issue discussed in EMI (1997). At present, the Bundesbank puts stress on the value of an intermediate target for the broad money supply (M3) in framing its monetary policy[4] and one of the tasks of the European Monetary Institute has been to harmonize monetary aggregates so as to facilitate the calculation of a European aggregate. How the European Central Bank will frame policy has not been resolved (and may not be decided until it begins its operations), but a target for M3 is one major possibility. The other is inflation targeting, even though it is not practiced by any of the "core-ERM" countries, which are the likeliest ones to proceed to stage 3 of monetary union in 1999. Both alternatives are considered in the MULTIMOD simulations discussed below.

It is of interest to analyze the possible channels by which monetary union could make financial variables more or less variable than in the current operation of the ERM. Take the case where the ECB is assumed to put some weight on hitting money targets, in the same way as the Bundesbank. There are several considerations that would affect the relative stability of interest rates in euro relative to those in deutsche mark. First, if shocks to national money demands in Europe are negatively correlated, for instance because of currency substitution, then going to EMU might lead to lower aggregate variability of money demand and hence of European interest rates. However, it may also be the case that other countries' demands are subject to larger shocks than Germany's, tending to go in the other direction. Second, asymmetry in the behavior of real GDP and prices (the arguments of money demand) across EU countries could also lead to lower variability of European money demand than that of individual countries, leading to the same sorts of effects as under the first point. Alternatively, shocks to Germany could conceivably have amplified effects on other countries, so that EU prices and output could be more variable. Third, our EMU simulations remove the risk premium relative to the deutsche mark affecting other European currencies. This might reduce overall volatility of European variables. Fourth, to the extent that exchange rate movements offset asymmetric aggregate demand or money demand shocks, removing this channel might cause European output to become more variable, other things equal. Finally, and contrary to the previous point, under a single currency the EU will be less vulnerable to fluctuations of the

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[4]Though in fact the Bundesbank seems to act in a way that suggests that it responds to inflation and output developments in a similar fashion to the U.S. Federal Reserve. See Clarida and Gertler (1996).

dollar, which when it is weak has tended to put pressure on the deutsche mark relative to other ERM currencies.

If one compares monetary targeting in Germany with inflation targeting under EMU, then other things enter into the comparison. One could view both policy frameworks as implying feedback rules of real income and prices onto short-term interest rates, the policy instrument. However, the two feedback rules differ in the explicit weight given to output: it is zero for inflation targeting, but typically nonzero for money targeting, since money demand depends positively on output. A second major difference relates to the timing of variables. As discussed in Svensson (1996), implementation of an effective inflation targeting framework involves targeting forecast, not actual, inflation, because the lags involved in influencing inflation using monetary policy are long. This tends to blur the difference concerning the weight given to output, since variations in the latter may influence the forecast for inflation. Indeed, Moutot (1996) argues that differences between the two frameworks should not be exaggerated. In fact, empirical work for several countries, including the United States and Germany, suggests that they follow a Taylor-type rule[5] linking interest rate settings to output gaps and inflation.

Clearly, evaluating the effects of EMU on macroeconomic variability is extremely complicated. The net effect of these and other effects is impossible to gauge without a detailed model, and we therefore use the stochastic simulations of MULTIMOD[6] to examine the implications of EMU for the financial variables of interest. In doing the EMU simulations, we assume that all 15 EU countries go to stage 3, and that the ECB targets a broad money aggregate summed over those 15 countries, a GDP-weighted average 15-country inflation rate, or a combination of the latter with a EU-wide output gap. In our simulations of EMU, we consider both contemporaneous and forward-looking inflation targeting, as well as a (forward-looking) inflation rule with a positive weight on output. We ignore any problems of instability of money demand (beyond the variability captured in the historical residuals), an issue to which we will return in a subsequent section. In addition, we assume that the mean inflation rate, and also mean rate of return on short-term assets, would be the same as what would have occurred in Germany in the absence of monetary union. Hence we do not address in the simulations whether the ECB's anti-inflationary credibility will be the same as that of the Bundesbank.

Table 1 gives a comparison of simulated standard deviations of the short-term interest rate and other macroeconomic variables, on the assumption that both the Bundesbank and the

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[5]Taylor (1993) and Clarida and Gertler (1996).

[6]Using a version of the model in which all 15 countries are included separately (except for Luxembourg, which is aggregated with Belgium).

Table 1. Standard Deviations of Selected Variables
Under ERM and EMU (with M3 Target)
(Variables in percent)

	United States		EU		Japan	
	ERM	EMU	ERM	EMU	ERM	EMU
Short-term rate	2.01	2.14	3.27 1/	2.32	2.59	2.64
Real GDP growth	1.65	1.65	3.23	1.97	4.36	4.34
Inflation rate	1.07	1.08	1.51	1.50	2.36	2.34
Exchange rate	4.21 2/	4.46 2/	5.70 3/	5.80 3/	7.17	7.12

1/ German short-term interest rate for EU under ERM.
2/ Nominal effective exchange rate for United States.
3/ DM/dollar rate under ERM; bilateral dollar exchange rate of the euro under EMU.

ECB target M3, but in the latter case, a European, instead of a German aggregate.[7] The variability of the short-term euro interest rate is considerably lower in the EMU simulation than is the case for the German short rate in the ERM simulation, as is the case for European real GDP. Inflation variability is virtually unchanged but the exchange rate of the euro against the dollar is somewhat more variable than that of the deutsche mark in the ERM. All in all, these simulations, subject to caveats discussed below, suggest that moving to a more symmetric European monetary policy has the result of reducing the variability of European macroeconomic variables, even if the same monetary policy framework is used by the ECB as by the Bundesbank.

Table 2 compares the two major alternative intermediate targets that have been proposed for the ECB, namely M3 and inflation. In implementing inflation targeting, we have specified a feedback rule for the short-term interest rate which makes changes in the latter respond to deviations between observed or expected inflation and its target value.[8] The form of the rules and the values chosen for the parameters are given in the Appendix. The Table suggests that inflation targeting would further improve European macroeconomic stability relative to money targeting. In particular, a contemporaneous inflation targeting procedure (aimed at the current year's outcome) would lower variability of inflation, short-term interest rates, and the exchange rate of the euro against the dollar, without increasing output variability. Note that the feedback rule does not attempt to hit inflation targets exactly, and there are considerable deviations from target; otherwise, instrument instability would no doubt result, and this is also the reason that inflation targeting frameworks are forward looking. Column 3 gives standard deviations of the same variables when expected inflation next year is targeted. Here, the effects of today's shocks on deviations from next year's target are resisted, not effects on this year's inflation. Not surprisingly, interest rates move somewhat less, but also each year's inflation target is hit less accurately (target inflation is constant in these simulations, so that the standard deviations also measure deviations from target). GDP is also somewhat less variable, though not by much, while the exchange rate is somewhat more variable.

Finally, a forward-looking inflation targeting rule is combined with a weight on the EU output gap, as suggested by Taylor (1993) and Clarida and Gertler (1996). The results here further lower output variability, as well as improving the performance relative to *this year's* inflation target, but increase the variability of the other variables.

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[7]The form of the reaction function for the short-term interest rate is assumed to be the same as Germany's (see Masson and Meredith, 1990). Deviations from the center of the range of targeted money growth are resisted, but not eliminated completely, within a year. Also, the parameters of European money demand (income elasticities, lags, etc.) are assumed to be the same as those for Germany.

[8]It is assumed that the target for inflation is the same as that underlying the money target.

Table 2. Standard Deviations of Selected EU Variables
Under EMU with M3 or Inflation Target
(Variables in percent)

	Money target	Inflation Target		Clarida-Gertler-Taylor Rule
		Contemporaneous	Forward looking	
Real GDP growth	1.97	1.94	1.87	1.82
Inflation 1/	1.50	1.27	1.58	1.53
Exchange rate (U.S. dollar/euro)	5.80	4.48	5.02	5.05
Short-term interest rate	2.32	1.78	1.52	1.70

1/ GDP-weighted average for 15 EU countries.

On the face of it then, the above results suggest an optimistic conclusion concerning the stability properties of the euro, which should be enhanced relative to those (already excellent) of the deutsche mark. One needs to recognize however that the simulations are based on various assumptions, none of which is likely to be strictly correct. First, the characterization of actual German monetary policy as based strictly on money targeting (albeit with an element of interest smoothing) is a simplification. Clearly, other factors are also important, and other indicators influence the Bundesbank's monetary policy settings. Second, the choice of parameter values for the feedback rules is somewhat arbitrary, though influenced by rough conformity with historical experience and by the attempt to find reasonably well-behaved specifications. However, it is possible that other parameter values might give a better performance for one or another of the policy rules. Third, and an issue we will discuss in section 4 below, the structural relationships (including the demand for money and the transmission mechanisms for monetary policy) are assumed unchanged in the face of the major regime change the EMU would involve. Finally, issues of credibility are ignored; credibility concerns might well induce additional volatility in domestic financial and foreign exchange markets.

III. Reserve Currency Use After EMU

With the achievement of European monetary union and the creation of the euro, there will be a potentially attractive international currency which may rival the dollar, both for official and private use. There are a number of dimensions to the use of an international currency.[9] These include its use in official foreign currency reserves, as the currency of denomination of goods trade and cross-border claims, and as a vehicle currency in markets for foreign exchange. Several authors have dealt with these issues, first giving estimates of the extent that existing European currencies currently serve these functions, and then speculating on the extent that the euro would either increase or decrease in importance relative to the currencies it replaced. It has been pointed out that the financial role of the dollar exceeds the economic weight of the United States, while the reverse is true for Europe; the discernible trend toward diversification away from the dollar might be expected to be accelerated by EMU. Nevertheless, the scope for major shifts seems limited (European Commission, 1990, pp. 187–8).

As calculated by Bénassy-Quéré, the dollar's share in cross-border banking positions in foreign currencies declined from 75 percent in 1977 to 48 percent in 1995, while the share of the European currencies rose from 16 percent to 30 percent; the dollar's share of international bonds outstanding declined from 62 percent in 1985 to 33 percent in 1995, benefitting mainly the yen. In addition, the share of Latin American countries' external debt denominated in U.S. dollars also declined, by some 15 percentage points from 1983–91 (Bénassy-Quéré, 1996, pp. 13–17). Others have stressed that the development of a deep and liquid government

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[9]A good discussion of these various uses is given in Eichengreen and Frankel (1996).

securities market in Europe, with bonds denominated in euro, as well as an efficient payment system, is likely to be an important stimulant for the international use of the currency after EMU (Thygesen, 1995). Prospects for European financial markets are analyzed by Schinasi and Prati (1997) and White and McCauley (1997).

As for the use in foreign exchange markets, a direct implication of EMU, and of course one of its key objectives, is the elimination of the need for foreign currency transactions by the creation of a single currency (Kenen, 1993). Hartmann (1996), on the basis of 1995 data, estimates that the importance of the U.S. dollar in spot forex trading could increase (from 71 percent to 87 percent[10] for an EMU composed of all EU countries), while at the same time the role of the euro could exceed the current share of the deutsche mark (attaining 61 percent, compared to 54 percent for the latter). Though European currencies would not be traded against each other, the euro would replace existing European currencies (and the ECU) in transactions against third currencies. Moreover network externalities could favor an enhanced vehicle currency role for the euro relative to the present role of the deutsche mark. However, the dollar would remain the dominant currency in Hartmann's scenarios. In addition, a key unanswered question which will affect its attractiveness is the relative volatility of the euro when compared to the U.S. dollar and other potential vehicle currencies, since volatility would be associated with higher transactions costs (Hartmann, 1996). In any case, past experience suggests that international currency use changes gradually.

In this paper, we focus on just one of the international uses of the euro, namely on the official demand for euro in foreign exchange reserves. After surveying the existing literature and examining the overall need for reserves of European countries after EMU, we focus on the currency composition of global reserves. In particular, we examine incentives to hold reserves from the perspective of optimal diversification, to gauge the scope for the use of the euro as a store of value, using the results of the stochastic simulations detailed in the previous section.

A. Current Holdings of Foreign Exchange Reserves

Table 3 gives the holdings of foreign exchange reserves by industrial and developing countries, the totals for which are roughly equal in size. Among countries, however, the distribution is very unequal. Aside from EU countries, most reserve holdings are concentrated in Asia. In fact, eight Asian territorial entities—China, Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan Province of China, and Thailand—held 41.4 percent of world reserves at the end of 1995, and 56.3 percent if the EU is ignored. Moreover, this group (excluding Japan) constitutes 56.2 of the total reserves of developing countries, whose currency composition is detailed in the IMF's annual report (though in fact, the data given there are based on submissions from only some of the central banks, and exclude five of the seven Asian

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[10]Shares sum to 200 percent, since each transaction includes 2 currencies.

Table 3. Foreign Exchange Reserves, End 1995
(In billions of U.S. dollars and in percent)

Industrial Countries			Developing Countries		
	(In US$)	(As a % of total)		(In US$)	(As a % of total)
Total	655.65	100.00	Total	671.24	100.00
USA	49.10	7.49	Asia	368.35	54.88
Japan	172.45	26.30	*Of which*		
European Union	349.80	53.35	China	73.58	10.96
			Hong Kong	54.90	8.18
Other	84.30	12.86	Korea	31.93	4.76
			Malaysia	22.95	3.42
			Singapore	68.35	10.18
			Taiwan	90.30	13.45
			Thailand	35.46	5.28
			Latin America	125.29	18.67
			Of which		
			Argentina	13.75	2.05
			Brazil	49.71	7.41
			Chile	14.14	2.11
			Mexico	15.25	2.27
			Peru	8.22	1.22
			Other	177.60	26.46

countries). As pointed out by Ilzkovitz (1996), the potential for reserve currency use of the euro depends importantly on the portfolio decisions of these countries. Though we do not have individual country data for most of them, what data exist[11] suggest that their reserves are primarily held in U.S. dollars. There are also a few large reserve holders in Latin America, notably Brazil.

Table 4 presents data on the currency composition of foreign exchange reserves, again broken down by industrial and developing countries. It is interesting to note the decline in the share of the U.S. dollar, which occurred mainly between the late 1970s and mid-1980s, and a corresponding increase in the share of the yen and European currencies, in particular of the deutsche mark and ECU. However, it is important to distinguish the reserve holdings of EU countries from those of other central banks, since the former at present have a greater need for holding other ERM currencies for intervention purposes, and because monetary union, by converting EMU member currencies into internal claims, will eliminate them from the reserves of those countries. In addition, the reported rise in the share of the ECU is to some extent spurious, because official ECUs are issued against dollars and gold, and with EMU will be converted back to them.

B. EU Countries' Reserve Holdings Before and After EMU

A number of authors have noted that as a result of monetary union, both the demand for reserves by EMU countries and their holdings of reserves will change. Of course, the extent of these changes will depend on the countries that actually proceed to stage 3; in what follows, we will suppose that all 15 EU members do so. In these circumstances, present reserve holdings of EU currencies by EU central banks will cease to be reserves, and their holdings of reserves will decline. However, demand for reserves will also decline, since much of what was foreign trade will be trade between members of the monetary union, and should therefore not be associated with reserve holdings. There have been various calculations of the net effect of those two factors, with all authors agreeing that existing dollar reserves are greater than will be needed after EMU—see European Commission (1990), Kenen (1993), Leahy (1996), among others. Their calculations have been based only on estimates of current holdings, not actual data, since figures for individual countries are not made public. The following table is however based on actual data reported on a confidential basis to the IMF; the aggregation preserves the confidentiality but gives a more precise picture of current reserve holdings than other authors' estimates.

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[11]See, for instance, Dellas and Yoo (1991), p. 408, for data on Korea, where on average over 1980–87 the proportion of dollar assets in foreign exchange reserves was 86.4 percent.

Table 4. Currency Composition of Foreign Exchange Reserves, End of Year 1977–95
(In percent of total)

	1977	1987	1995
All countries			
U.S. dollar	80.3	56.0	56.4
Pound sterling	1.8	2.2	3.4
Deutsche mark	9.3	13.4	13.7
French franc	1.3	0.8	1.8
Swiss franc	2.3	1.8	0.9
Netherlands guilder	0.9	1.2	0.4
Japanese yen	2.5	7.0	7.1
ECU	--	14.2	6.5
Unspecified currencies	1.6	3.4	9.7
Industrial countries			
U.S. dollar	89.4	54.8	52.8
Pound sterling	0.9	1.0	2.1
Deutsche mark	5.5	14.1	15.7
French franc	0.3	0.3	2.1
Swiss franc	0.8	1.5	0.1
Netherlands guilder	0.6	1.1	0.2
Japanese yen	1.8	6.3	6.9
ECU	--	19.9	12.3
Unspecified currencies	0.7	1.0	7.8
Developing countries			
U.S. dollar	70.9	59.1	60.5
Pound sterling	2.8	5.4	4.9
Deutsche mark	13.3	11.5	11.4
French franc	2.3	2.0	1.5
Swiss franc	3.9	2.7	1.8
Netherlands guilder	1.2	1.3	0.8
Japanese yen	3.2	8.6	7.3
ECU	--	...	...
Unspecified currencies	2.5	9.5	11.8

Source: IMF *Annual Report*, 1986 and 1996, Table I.2.

Table 5. EU Countries' Holdings of Foreign Exchange Reserves 1/

(In billions of U.S. dollars)

	Actual, End 1995	After ECU Conversion 2/	After Elimination of EU Currencies
Total, of which	340.5	295.5	204.7
U.S. dollars	135.9	171.3	171.3
Japanese yen	17.9	17.9	17.9
Swiss francs	0.9	0.9	0.9
ECUs	80.3	–	–
EU currencies	90.7	90.7	–
Deutsche mark	68.8	68.8	–
French franc	11.7	11.7	–
Pound sterling	9.2	9.2	–
Dutch guilder	1.0	1.0	–
Unspecified	14.7	14.7	14.7

1/ Excluding Finland, for which data were not available.
2/ Official ECUs, which are claims against the European Monetary Institute, would be converted back to the dollars and gold that back those ECU claims when stage 3 of EMU starts. The calculation in the table converts ECUs to dollars in the proportion used to calculate the last column of Table I.2, IMF *Annual Report 1996*, p. 164.

With EMU, the holdings of EU currencies will become domestic currencies, though what are labeled ECUs will be swapped back into dollars and gold.[12] Thus, for purely accounting reasons, dollar holdings in reserves would rise. The resulting reserves of EU countries, if they should all proceed to monetary union, would total about 205 billion U.S. dollars. However, their *demand* for reserves would likely fall. As other authors have calculated, the proportion of current trade that would be internal to the union would decrease the need for international reserves, by a large proportion. Using IMF data on the *Direction of Trade* for 1995, imports from other EU countries constitute about 60 percent of total imports of EU countries. If the demand for reserves is proportional to imports, as is often assumed, then the demand for reserves after EMU would fall by 60 percent, and equal about $100 billion on the basis of the above table. Thus, about $105 billion (most of it held in U.S. dollars) would be excess, and might lead to some tendency for depreciation of the U.S. dollar

[12]The data include a certain amount of private ECUs. However, these could not be identified separately.

over time, as EU countries decreased their reserve holdings. This figure is considerably below the range of $200–230 billion excess reserves provided by the Commission (1990, p. 183), based on what Kenen (1993) characterizes as a "shirt-cuff calculation." The European Commission's calculation makes no allowance for the reduction in the holdings of other EU currencies as reserves, and it also includes gold, which is arguably not held for the same reasons as currencies. In contrast, Leahy (1996) cites a figure of a possible decline in dollar holdings to 65 percent of what they were, which using 1992 reserve levels would translate into a decline in dollar holdings of $55 billion.

There are a number of uncertainties involved in such calculations, as detailed by Leahy (1996). First is the issue of whether there are economies of scale that operate as a result of pooling of reserves, allowing the European Central Bank to economize further on reserve holdings relative to the national central banks at present. Indeed, the statutes of the ECB provide for a transfer of up to only 50 billion ECUs (about $60 billion, at current exchange rates)—though national central banks would also want to keep some reserves as working balances. Leahy surveys the empirical literature and provides new tests of scale effects, finding only inconclusive evidence of such effects, however. Second, and related to the use of historical data to gauge scale effects, the past decade has seen a large measure of exchange stability with respect to a subset of European currencies, as well as increased integration (in part due to the Single Market). Hence, it seems arbitrary to include all intra-EU trade before EMU. Third, and going the other way, the exchange rate commitments within the ERM have themselves generated a demand for holding other EU currencies for intervention purposes, and this need would of course disappear after EMU for those countries proceeding to stage 3. Finally, as mentioned above the calculations assume all 15 EU countries join EMU, which is unlikely, at least in the next few years.

Whatever the exact magnitude of the desired reduction of dollar reserve holdings by EU countries, the possible resulting pressures on the dollar are not likely to be the dominant force on exchange rates after EMU. Other factors, like the monetary policy stance and credibility of the ECB and the cyclical position of the EU relative to the United States and Japan will be more important influences on the exchange rate of the euro. First, the amount of excess reserves, though not negligible, is not enormous. The international investment position of the United States involved assets and liabilities of $3.35 trillion and $4.13 trillion, respectively, dwarfing the reserves figure.[13] Even compared to annual balance of payments flows, the estimation of excess reserves is not too large; for instance, the U.S. current account deficit was of the order of $150 billion in 1995. Second, empirical studies have long failed to isolate a consistent effect of changes in foreign exchange reserves on exchange rates of major

[13]IMF, *Balance of Payments Yearbook*, 1996.

currencies.[14] Third, European central banks and the ECB would have no desire to reduce their holdings in a disruptive way, and they would be unlikely to rush to do so, especially in the early years of EMU. Indeed, there might be a desire to hold precautionary reserve levels to smooth out any possible volatility in exchange markets, especially in a period in which the credibility of the euro was yet to be established.

The conclusion that excess reserves in Europe are not likely to lead to significant downward pressure on the dollar after EMU is generally shared by other commentators, with varying emphasis however on the extent that it may be a problem at all. Kenen (1993), for instance, argues that changes in dollar holdings and the use of the euro as reserve currency will both occur gradually, not suddenly as a result of asset switching. He points to the fact that total reserve holdings were not adjusted quickly after the break-down of Bretton Woods in 1973. Because EU central banks may want to resist a depreciation of the dollar, they may be reluctant to reduce their holdings at all; for this reason, it may be desirable to consider establishing a substitution account (Kenen, 1993, note 13). A report of a working group of the ECU Institute argues that "the European authorities may simply choose to hold longer-term dollar assets rather than shift out of the U.S. currency altogether" (Thygesen, 1995, p. 135). Goldman Sachs (1996) and Salomon Brothers (1996) estimate that shifts in central banks' foreign exchange reserves will not cause exchange market upheavals or have a big impact on the euro's external value.

C. Scope for Diversification in Reserve Holdings by Non-EU Countries

The use of the euro as a reserve currency depends, of course, on its potential use by non-EU (or at least non-EMU) countries.[15] There is an extensive literature on the demand for reserves in different currencies by central banks and other monetary authorities, focussing on the various uses for international money, paralleling the domestic store of value, medium of exchange, and unit of account uses. Dooley et al. (1989) have shown that the currency denomination of reserve holdings is strongly influenced by the country's exchange arrangements, the direction of its trade flows, and the currency denomination of its debt. Official use to a large extent reflects private use, and the latter evolves slowly, as witnessed by the use of sterling to denominate trade long after the economic weight of the United Kingdom had declined.

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[14]See Jurgensen (1983). Some recent studies have highlighted effects of intervention when it is coordinated (Catte, Galli, and Rebecchini, 1994) or when it signals future changes in monetary policy (Dominguez and Frankel, 1993). However, neither factor is likely to be relevant here.

[15]EU countries not part of the first group to go to stage 3 would likely participate in the ERM2 mechanism and hold reserves in euro in order to intervene as necessary to prevent their exchange rate from going outside pre-agreed bands.

Several authors in recent articles have turned their attention to the potential of the euro to become an important reserve currency rivaling the dollar, and whether this depends on first developing its *private* international use. The European Commission (1990) argues that private use of the ECU (now euro) as a vehicle currency in trade and for denominating private claims might increase substantially, though the euro would still not rival the dollar. Hartmann (1996) agrees with this assessment, concluding that even with all 15 EU countries participating in EMU, the share of the dollar in trade invoicing would still be over twice that of the euro. Bénassy-Quéré (1996) acknowledges that private use of vehicle currencies might be slow to change, but argues that official use might change more quickly, given the unique nature of the creation of a new international currency. In particular, its greater attractiveness as an anchor currency (for instance, for central and eastern European countries, and those in Africa) than the deutsche mark would lead to an immediate demand for reserve holdings. Kenen (1993) has stressed the potential in the medium to long term of a switch away from dollar reserves toward euros.

Here, the more limited question of the attractiveness of euro reserves held as a store of value by central banks is considered from the perspective of optimal diversification. Though it is not claimed here that central banks are primarily guided by such considerations in their choice of reserve holdings, they cannot be indifferent to them over the longer run. A currency which either does not hold its value in real terms, or fluctuates wildly in real value, will not be as attractive as a stable currency. Thus, it is argued, the risk and return properties of the euro will have some significant impact on whether it eventually becomes as attractive as the dollar as a reserve currency. Using the simulation results discussed above, with alternative assumptions concerning the monetary policy framework of the ECB, the implications for the attractiveness of the euro can be derived from a framework in which central banks are assumed to be influenced by risk and return considerations.

The framework we will use to assess optimal diversification is the standard Capital Asset Pricing Model.[16] In particular, assuming that the objective function takes a simple form,

$$U = m(r) - (b/2)var(r) \qquad (1)$$

where m(r) is the mean (weighted average) return on the portfolio, var(r) is the variance of the portfolio return, and b is the coefficient of relative risk aversion, portfolio shares can be calculated as a simple function of the expected return and the variance-covariance matrix of

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[16]See, for instance, Kouri and Macedo (1978) and Heller and Knight (1978). A recent application to the currency composition of Korea's reserves is given in Dellas and Yoo (1991), who conclude that the model seems to adequately describe the central bank's currency diversification. Bénassy-Quéré et al. (1994) use such a framework to analyze the effect of EMU on global portfolios through reducing the number of European currencies.

returns. In particular, if portfolio shares are given by a vector χ and returns on the various currencies have expected values and covariances given respectively by a vector ρ and a matrix Ω, then

$$m(r) = \chi'\rho \tag{2}$$

and

$$var(r) = \chi'\Omega\chi \tag{3}$$

and optimal shares can be written as a function of these expected returns and covariances:[17]

$$\chi = A(\Omega)\rho \tag{4}$$

We first examine the historical experience of real returns on the major reserve currencies and what it would imply for optimal reserve shares, and then consider how the characteristics of those returns, and hence optimal shares, might change after EMU. Our initial calculation uses annual ex post returns since 1981 on the U.S. dollar, the Japanese yen, and the deutsche mark. Annual returns on each currency are calculated as the previous year's average short-term rate (on treasury bills or comparable instrument), plus the change in the exchange rate from the end of the previous year to the current year-end. In order to take the point of view of a global investor, these calculations use the SDR as numeraire currency, and returns are calculated using SDR exchange rates for each of the 3 currencies. Moreover, we calculate a global price index using the same weights on the price indices of the United States, Japan, Germany, plus France and the United Kingdom, as those used in calculating the value of the SDR.[18] The returns are then converted to real terms by subtracting the ex post change in the global price index from the nominal SDR returns. The choice of a starting year is somewhat arbitrary, but the use of ex post returns makes the use of a long enough period important so as to avoid having the results dominated by particular episodes of currency movement. For instance, the decade of the 1970s was dominated by the decline of the dollar associated with the breakdown of the Bretton Woods system and the 1973–74 oil price shock. Starting in 1980 includes extended periods of dollar strength and weakness.

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[17]The formula used is the same as in Dooley et al. (1989), p. 393.

[18]SDR weights are revised every five years. The weights established in 1996 were the following: United States, 0.39; Japan, 0.18; Germany, 0.21; France, 0.11; and United Kingdom, 0.11.

Table 6. Ex Post Returns and Inflation, 1981-95

	Nominal Returns		Inflation		Real SDR Returns 1/	
Country	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
United States	8.54	4.02	4.20	2.00	3.35	8.75
Japan	5.85	2.20	1.83	1.35	5.21	7.52
Germany	7.08	2.22	2.93	1.81	4.00	7.22

1/ Converted to SDRs and net of the rate of change of a SDR-weighted consumer price index.

The dollar has the highest nominal returns over the period 1981–95, but also the highest average inflation. Moreover, both are more variable than for the other currencies. As a result, the yen and deutsche mark have somewhat higher mean real returns and lower standard deviations for that variable than the dollar, and hence should dominate it, other things equal, in a global portfolio. Associated with the lowest rate of inflation, the yen has the highest return when expressed in SDR terms (in part because of yen appreciation against the SDR), but also a higher standard deviation (due mainly to exchange rate fluctuations) than the deutsche mark, whose real SDR return is intermediate, but its standard deviation is the lowest of the three currencies. The correlation structure of returns is also important when considering optimal portfolios. In particular, an asset with a lower return may still be held in positive proportions if it contributes to lowering the portfolio's standard deviation, for instance because it is negatively correlated with the return on other assets in the portfolio. The correlations among ex post real returns in SDRs over the period 1981–95 are as follows:

Table 7. Historical Correlation of Real SDR Returns, 1981-95

	United States	Japan	Germany
United States	1		
Japan	-.47	1	
Germany	-.76	.14	1

Thus, the fact that currency returns are not perfectly correlated implies that there is some scope for diversification, even when a currency, like the dollar, is dominated in terms of

the mean and standard deviation of returns. In particular, dollar returns are strongly negatively correlated with deutsche mark returns, so that holding both dollars and deutsche mark allows hedging of risks. In contrast, the yen is less negatively correlated with the dollar, and has a weakly positive correlation with the deutsche mark.

Using these mean returns and their covariance structure we proceed to calculate "optimal" portfolio shares from the perspective of a world investor. Here we need to make some assumption concerning the degree of risk aversion. In the limiting case of b=0, only expected returns matter, so that only the currency with the highest return (in the ex post data, the yen) would be held. We restrict ourselves to a range of 1 to 5 for b;[19] it turns out that in this range, shares do not vary much. The following table gives these calculated shares for b=3, and compares them to actual data on currency denomination of global foreign exchange holdings (see Table 4). The three currencies (which accounted for 83 percent of foreign exchange reserves, when ECUs issued against dollars are converted to dollars) are rescaled so that their shares sum to 1:

Table 8. Currency Shares of Global Holdings of Foreign Exchange Reserves
(In percent)

Currency	Calculated Shares	Actual Shares, 1995 1/
U.S. dollar	38	74
Japanese yen	23	9
Deutsche mark	39	17

1/ The three currencies' shares are rescaled to sum to 1.0.

As can be seen from the table, each of the calculated shares is positive, something that was not imposed in the calculation (in principle, optimal shares could have involved borrowing in one currency to invest in another). The calculated shares for the dollar and deutsche mark are almost identical, with the yen's share considerably smaller. However, the calculated shares do not correspond at all closely to actual shares, suggesting that other motives influence reserve holdings, as discussed by Dooley *et al.* (1989). The calculated share for the dollar is half of the actual share—the latter no doubt reflecting the other important roles of the dollar,

[19]A frequently mentioned value for relative risk aversion is b=2.

including its use as a vehicle currency and intervention currency.[20] Therefore, one should not give too much weight to these "optimal" shares, since they do not incorporate all the reasons for holding reserves. What they do suggest is that there may already be some forces leading toward diversification away from the U.S. dollar, and increases in holdings of the deutsche mark and the yen.

We now turn to the issue of how those incentives toward greater reserve currency diversification might change after EMU, when the deutsche mark has been replaced by the euro. To examine this question, we use the results of stochastic simulations of MULTIMOD pre- and post-EMU to calculate effects on the covariance matrix of returns on reserve currencies. We then calculate new optimal reserve shares. In particular, we calculate the change in the covariance matrix of returns in the pre- and post-EMU simulations, and add it to the historical covariance matrix;[21] the mean returns are virtually unaffected and were kept unchanged. The changes relative to pre-EMU simulations (and the deutsche mark) are as follows for the two alternative intermediate targets, money and contemporaneous inflation:[22]

Table 9. Simulated Changes in Returns and Portfolio Shares

Standard Deviation of Returns			Correlation of Returns			Calculated Shares (in percent)		
	M3	inflation		M3	inflation		M3	inflation
$	0.33	-0.01	$/¥	0.08	0.02	$	-1.7	-5.8
¥	-0.08	-0.04	$/euro	-0.06	0.02	¥	-5.0	-5.2
euro	-0.64	-2.17	euro/¥	0.01	0.04	euro	6.7	11.0

[20]A recent article, Garber (1996), explains the small reserve-currency role of the yen by the lack of liquidity of short-term yen instruments. See also Frenkel and Goldstein (1997) for a discussion of the international role of the deutsche mark, which has been discouraged by the German authorities.

[21]Simulated covariances in the pre-EMU case are not identical to historical covariances, principally because the stochastic simulations do not incorporate shocks to all of the exogenous variables.

[22]Forward-looking inflation targeting produced such a large negative correlation between euro and dollar returns that optimal weights could not be calculated since the covariance matrix was not positive definite.

Under M3 targeting the standard deviation of returns on the euro is considerably below that for the deutsche mark, that for the dollar has increased moderately, and that for the yen is slightly lower. Under inflation targeting, the reduction in the standard deviation of returns in euro is considerably larger. There are also changes to the correlation structure; under money targeting, euro returns are even more negatively correlated with dollar returns than were those on the deutsche mark, but the reverse is true for (contemporaneous) inflation targeting. The implications for optimal reserve holdings (with b=3, but as before there is very little difference in the range b=1 to 5) are given in the last two columns of the table. Interestingly enough, the incentives for diversification toward the euro seem to be greater than for the deutsche mark. Under money targeting, this comes about not primarily at the expense of the dollar, but rather at the expense of the yen. Under inflation targeting, the increase in reserve share for the euro is even greater, and results from about equal declines in dollar and yen shares. These results should be taken as illustrative only, as they are sensitive to the assumptions made in doing the simulations, including the rules guiding monetary policy under EMU—as is evidenced by problems doing the calculations for some policy rules. Moreover, small changes in expected return (which are ignored in this calculation) might induce offsetting changes in the calculated shares. In addition, of course, the simulations assume unchanged structure, an issue that is reexamined in the next section.

A tentative conclusion to be drawn from these results is that absent credibility problems and changes in structure, holdings of euro reserves should be more attractive than the deutsche mark for portfolio reasons, leaving aside the other factors affecting reserve use (see Dooley et al., 1989). We have already concluded that there are already some unexploited possibilities of portfolio diversification in favor of the deutsche mark, which our calculations suggest would be amplified under EMU (in favor of the euro). Against this it must be noted, as does Bénassy-Quéré (1996), that the euro is unlikely to serve as exchange rate anchor for the Asian countries that hold the largest reserves (Table 3)—and the anchoring function has been shown to be important in determining the currency composition of reserve holdings.

IV. Uncertainties in the Demand for Euro and the Monetary Transmission Mechanism

The discussion until now has assumed that structural relationships remain unchanged after EMU. In particular, monetary targeting requires for its effectiveness a stable and predictable money demand. For the use of an inflation targeting framework, as it is practiced for instance in Canada, the United Kingdom, and New Zealand, the predictability of the link between monetary policy instruments and inflation 12–18 months in the future is crucial.

There has been some work on the demand for money at the European level (see, for instance, Kremers and Lane, 1990; Artis, Bladen-Hovell, and Zhang, 1993; Monticelli and Strauss-Kahn, 1992, 1993; Cassard, Lane and Masson, 1995, 1997). These studies have typically found that a cross-border aggregate calculated by adding up national money supplies has better stability properties and more sensible parameter values than the typical national

monetary aggregate. It has been pointed out, however, that national monetary aggregates do not capture some of the deposits (deposits of non-residents with domestic banks, or resident deposits in foreign currency) which could vary substantially in response to currency substitution—something that should have become increasingly important with exchange rate stability and moves to monetary union (Angeloni, Cottarelli, and Levy, 1991). Therefore, one may question whether cross-border aggregates calculated on the basis of national money supplies would provide a good measure of money holdings after EMU. One view is that the existing holdings of other EU national currencies by European residents will simply disappear, because they are the result of transactions demands (holding correspondent balances, etc.) or for taking positions in anticipation of exchange rate changes, neither of which will be present after EMU; hence the demand for money will decrease (Kenen, 1993). Of course, if those balances were not captured in existing national aggregates, then the simple aggregation of those aggregates might be an adequate measure. But other uncertainties, related to the potential size of monetary union (if not all countries join at once), the use of euro currency outside the EMU area (for instance, in other EU countries and in central and eastern Europe), will make estimation of the demand for any euro monetary aggregate particularly imprecise. This would clearly complicate the monetary policy of the ECB if it were to use money as its intermediate target.[23]

As concerns an inflation targeting framework, in which monetary policy instruments are varied in response to expected future inflation, it needs to be recognized that the effects of monetary policy on inflation in the medium run will also be very unpredictable in the early years of monetary union. As Moutot (1996) points out, an inflation targeting strategy depends very much on the ability of the central bank to forecast and control future inflation, so that a detailed knowledge of the transmission mechanism is essential. There have been a number of studies of the transmission process in Europe, and these studies have isolated some differences across countries, for instance a greater or lesser role for long-term interest rates and differences in the speed with which output is affected (Moutot, 1996). Such differences have led to concerns that monetary policy changes might have damaging effects in some countries; an optimistic view is that structures would adapt to the common monetary policy, with long-term rates becoming more important in the transmission mechanism (as in Germany).

What is certain is that the existing empirical estimates will not be expected to remain valid after EMU, which is a particularly stark example of a regime change subject to the Lucas critique. Evidence of the domestic effects of monetary policy in individual countries will not translate straightforwardly to an estimate of how monetary policy changes will work when exchange rate changes (and currency risk premia relative to the deutsche mark) have been ruled out and when changes have been made to the implementation of monetary policy as a

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[23]A dissenting view is however that of Ramaswamy (1997), who argues that targeting of an observable and easily monitored variable like the money supply will be important for the ECB to establish credibility, especially if EMU includes a large set of countries, and not just a core group.

result of the creation of the ECB. Moreover, to get the combined effects of a *European* monetary policy, one would need to allow for spillover effects *across countries*, and these will be especially problematic in a currency area with no exchange rate flexibility relative to historical experience.

As a result of these uncertainties affecting intermediate targeting frameworks, it seems likely that the ECB will be forced, at least initially, to practice a reasonably discretionary policy, whether or not it announces an intermediate target, probably even more so than the Bundesbank at present. Such discretionary policy would no doubt rely on various economic indicators of current and future developments with respect to economic activity and inflation. One indicator that might be given prime attention is the exchange market value of the euro. The exchange rate is a particularly visible and publicly recognized indicator. Indeed, since national currencies will remain in circulation during a transition period, EU citizens will be able to compare exchange rates pre- and post-EMU.[24] Unlike newly calculated EMU aggregates (including those for the money supply, output, inflation, and the trade balance) the exchange rate against the dollar or yen will have a clear interpretation for the general public. Indeed, there is much current discussion in Europe of whether the euro will be "as strong as" the deutsche mark. In order to judge this, the public is unlikely to be guided in the first instance by European inflation, which will be an unfamiliar aggregate to them. They will be more sensitive to their own country's inflation figures, but it will not be possible (or desirable) to target any particular country's inflation rate; in a monetary union, only aggregate inflation matters. Of course, if all countries' inflation rates are about the same, this is not an issue, but there is no reason to expect this to be so. Other monetary unions exhibit considerable relative price fluctuations across regions (Poloz, 1993). EMU-wide money growth will also be subject to major problems of measurement and interpretation, and it is a variable that is not likely to be familiar to, or monitored by, the general public, at least initially. Thus the problem of establishing credibility may lead the ECB to pay more attention to the exchange rate than does the Bundesbank at present, not less.

V. Incentives for International Policy Coordination

There has been considerable discussion of whether international policy coordination between Europe and other major countries, in particular the United States and Japan, would be stimulated or hindered by the creation of EMU. The European Commission took a fairly upbeat view of the issue in *One Market, One Money*, namely that the reduction in the number of players through consolidating European monetary policy would have beneficial results, as would the creation of a bloc more clearly comparable to the United States, increasing the incentives on the latter to take the spillovers from Europe seriously (European Commission, 1990, Chapter 7). Others have been less convinced. For one thing, a Europe that is relatively closed will have fewer incentives to coordinate with other countries (Kenen, 1993). Also,

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[24]We are indebted to Michael Mussa for this point.

Goodhart (1993) disputes the implication that the United States has not been seriously engaged in the international coordination process, and points out that fiscal policy coordination will in any case be severely constrained, both by the division of powers within the U.S. system and by the dispersion of fiscal responsibilities across EU national governments, which will not speak with one voice. Alogoskoufis and Portes (1992) and Henning (1996) raise the problem of representation in Europe, since monetary policy is the responsibility of a single ECB, but responsibility for exchange rate policy is shared with the Council, made up of national Ministers of Finance, which will not have an obvious single representative in such meetings as those of the G-7 (or G-3). In these circumstances EMU may increase, not decrease, the number of players.

A factor that has not been sufficiently taken into account is the increase in structural uncertainty facing European monetary policy, as discussed above. As discussed in Ghosh and Masson (1994), uncertainty can provide a powerful inducement to coordination, because it may in some circumstances reduce the risks of particularly bad outcomes. The reasoning is as follows: coordination makes the transmission of monetary policy across countries (in particular, through exchange rate movements) more certain. Thus, coordination around exchange rates might become more likely than at present, at least in a transition period. And that transition period before the structural uncertainty is resolved may be fairly long, not least because EMU is likely to involve a progressive enlargement of the EMU area, rather than a once-and-for-all change affecting all the (current) EU countries. Neither monetary nor inflation targeting will be free from the types of uncertainty discussed in the previous section, namely money demand instability and unpredictable changes in the transmission mechanism, so that the exchange rate may be given considerable weight by the ECB in formulating monetary policy. In these circumstances, coordination with the United States and Japan to limit exchange rate fluctuations may naturally emerge.

To illustrate the potential gains in terms of reduced volatility of attempting to lean "against the wind" of exchange rate fluctuations, we present in Table 10 calculated standard deviations (under both the ERM and EMU) of money targeting with a weight placed in the reaction function on deviations of the nominal effective exchange rate from its "equilibrium" level (see Appendix for details). This policy rule is assumed to be followed by the United States, Japan, as well as the EU. Comparing Table 10 with Table 1, we see that in addition to lower exchange rate variability, short-term interest rates are also less variable in all three regions, while output and inflation variabilities are on balance little changed. If some importance is given to reducing financial market volatility, therefore, there may be benefits from such coordination around exchange rates between the three blocs. Of course, the simulations ignore problems of credibility and uncertainty about actual equilibrium values.

As was already mentioned, there are two counter-arguments against the likelihood that such coordination would emerge. First, it is argued that this would be unrealistic for a large economy like the EU, which will be comparable in size to the United States and not very open, so that the exchange rate will not matter much for EU inflation or output. However,

Table 10. Standard Deviations of Selected Variables
Under ERM and EMU with International Policy Coordination
(Variables in percent)

	United States		EU		Japan	
	ERM	EMU	ERM	EMU	ERM	EMU
Short-term rate	1.80	2.13	2.60 1/	1.98	2.22	2.42
Real GDP growth	1.62	1.61	2.99	2.05	4.14	4.24
Inflation rate	1.26	1.19	1.26	1.40	2.06	2.14
Exchange rate	2.24 2/	1.90 2/	2.07 3/	1.93 3/	4.30	4.29

1/ German short-term interest rate for EMU under ERM.
2/ Nominal effective exchange rate for United States.
3/ DM/dollar rate under ERM; bilateral dollar exchange rate of the euro under EMU.

when the de facto fixing of the currencies of a core group to the deutsche mark is taken into account, Germany is already not very sensitive to exchange rate movements. Moreover, lack of openness does not necessarily mean that the exchange rate is a matter of indifference; after all, both the United States and Japan have at times been the impetus behind G-7 cooperation on exchange rates. Second, it is argued that the ECB will want to establish, and fiercely defend, its independence in the conduct of monetary policy, and hence avoid exchange rate agreements. Exchange rate policy is shared with the Council, which has the possibility of entering into formal agreements as well as suggesting "general orientations" to the ECB. In these circumstances, it could be argued, the ECB would not adventure into an exchange rate policy, which might limit its room for maneuver (Henning, 1996). While these considerations may be important, they argue against a formal target, but do not preclude some use of the exchange rate as an indicator of the tightness or ease of policy, and occasional cooperation with other G-3 central banks to limit movements in the euro's exchange rate against the dollar and yen. Thus, though the problem of representation may remain for fiscal policy, it is not inconceivable that a start at reinforced coordination might be made among central banks. Whether this might continue once the ECB had resolved some of the uncertainty facing intermediate targets of monetary policy would of course remain an open question.

VI. Conclusion

Monetary union will, over time, no doubt bring major changes to the international monetary system that are impossible to envisage with any precision at this time. In this paper, we have tried to analyze some selected topics related to this vast question. Assuming that economic structures are unchanged, results of model simulations suggest that EMU is likely to promote stability of major macroeconomic variables. However, EMU will produce structural changes that are not captured in our models and are hard to forecast, and there will be considerable uncertainty about the interpretation of economic indicators and about monetary transmission mechanisms. This will considerably complicate the task of the ECB, and may suggest that the traditional intermediate targeting procedures, whether of money or inflation, may not be closely followed. A more discretionary policy, in which the exchange value of the euro (among other indicators) is given a certain amount of attention, may instead emerge.

Turning to prospects for reserve currencies, it seems likely that after monetary union holdings of dollar reserves by EU central banks would be somewhat too large. However, there is no reason to think that this would be a major influence on the exchange rate between the euro and the dollar, which is more likely to be influenced by the relative stance of monetary policies, relative cyclical positions, and policy credibility. Simulation results for financial variables suggest that the incentives to hold foreign exchange reserves in euro for store of value purposes would be at least as great as for the deutsche mark at present.

METHODOLOGY

MULTIMOD, the IMF's global macroeconometric model is used for the simulations in Section II. For this exercise, we use the MULTEU version of the model which disaggregates for all EMU countries separately. Except for the alternative monetary policy rules (see below), the original specification and parameter values of the model are maintained. See Masson, Symansky, and Meredith (1990) for a detailed overview of the model.

The methodology of stochastic simulations is well-known and is reviewed only briefly here. The interested reader can consult Frenkel, Goldstein, and Masson (1989) and Bryant and others (1993) for a detailed discussion. Stochastic simulations are designed to quantify the response of the endogenous variables in the model to a large number of shocks taking into account the historical variance-covariance matrix of the residuals. In principle, shocks are drawn for each residual in the model for a long period consistent with their historical joint probability distribution. This experiment is repeated for the different policy regimes and a set of summary statistics is then presented for the endogenous variables of interest.

Several practical difficulties arise when implementing this methodology. First, since it is beyond the scope of this paper to reestimate the model based on the updated dataset, some residuals might not be truly identically and independently distributed; in order to deal with this issue, the residuals were regressed on a constant, a time trend and an autoregressive term before constructing the historical variance-covariance matrix. These equations were then added to the model.

Second, in order to keep the simulations manageable, only the most relevant residuals of the model were used to construct the variance-covariance matrix. For the 15 EU members, the United States, Japan, Canada, and a group of other industrial countries—Australia, New Zealand, Norway and Switzerland grouped together—the residuals included were those for the equations on consumption, investment, oil consumption, exports, imports, the long-term interest rate, the exchange rate, the GDP deflator, price of exports, capacity output, money demand and the tax reaction function. Of these residuals, the residual on the interest rate parity condition is particularly important since it captures the exchange rate risk premium in the model (see below).

Third, the large number of residuals and relatively short time series result in a singular variance-covariance matrix; a small number was added to the diagonal of the matrix to make it non-singular.

The simulations are implemented as follows. Residuals are calculated based on annual data for 1975–95. After making the necessary corrections just mentioned, a 215x215 variance-covariance matrix is constructed and its Cholesky decomposition is calculated. Draws from the standard normal distribution are made and premultiplied by the Cholesky

matrix; the resulting residuals are added to the appropriate equations.[25] This was repeated for each of the monetary policy regimes described in the next section.

MONETARY POLICY RULES

The different monetary policy rules in Tables 1 and 2 were implemented as follows. For the pre-EMU simulations (i.e., ERM regime), the money supply reaction function is the standard MULTIMOD function for targeting a monetary aggregate (M3) for all countries in the model that do not participate in the ERM, and for Germany:

$$\Delta i_t = \frac{0.333}{-0.05402} \log\left(\frac{M_t^T}{M_t}\right) \tag{A1}$$

where i_t is the short-term nominal interest rate, M_t^T is the target level for M3, and M_t is the actual money stock given by money demand. The countries participating in the ERM—except for Germany—leave their interest rates unchanged when their exchange rate is within the band but revert to an exchange rate target at either limit of the band:

$$\Delta i_t = \begin{cases} 1000\{\log\left(\frac{E_t}{\alpha * P_t}\right)\}^3 & \text{if } E_t \leq \alpha * P_t \\ 1000\{\log\left(\frac{E_t}{P_t/\alpha}\right)\}^3 & \text{if } E_t \geq \frac{P_t}{\alpha} \end{cases} \tag{A2}$$

where E_t is the nominal exchange rate expressed as local currency per deutsche mark, P_t is the central parity and α is one minus the width of the band. Austria, Belgium, France, and the Netherlands are assumed to target small bands ($\alpha = 0.9775$) whereas the other ERM participants—Denmark, Finland, Ireland, Italy, Portugal, and Spain—have wide bands ($\alpha = 0.85$).

For the EMU simulations, four alternative monetary policy rules are implemented. The first assumes that the ECB targets a European-wide monetary aggregate and the monetary reaction function is similar to equation (A1). In the second case, the ECB tries to hit a target for contemporaneous inflation:

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[25]The model was simulated 35 times with shocks for 10 years each, yielding 350 trials.

$$\Delta i_t = (\pi_t^{EU} - \pi_t^T) \tag{A3}$$

where π_t^{EU} is European-wide inflation and π_t^T is its target. A forward-looking rule is implemented in the third case; here the ECB targets inflation one year ahead:

$$\Delta i_t = (E_t(\pi_{t+1}^{EU}) - \pi_{t+1}^T) \tag{A4}$$

where $E_t(.)$ is the expectations operator. In the fourth case, we follow Clarida and Gertler (1996) and implement an adaptation of the Taylor rule:

$$\Delta i_t = (E_t(\pi_{t+1}^{EU}) - \pi_{t+1}^T) + \frac{1}{3} * \left(\frac{Y^{EU} - Y_{cap}^{EU}}{Y_{cap}^{EU}} \right) \tag{A5}$$

where Y^{EU} denotes real GDP for the EU and Y_{cap}^{EU} measures European-wide capacity output. The original Taylor specification used quarterly data and lagged inflation, and gave weights of 1.5 and 0.5 to inflation and output. In order to maintain the comparability with our results for the forward-looking inflation-targeting rule, we maintained a unit weight on inflation and added the output gap with the same *relative* weight as in the original Taylor specification.[26]

The results in Table 10 were obtained using the following rule for monetary policy:

$$\Delta i_t = \frac{0.333}{-0.05402} \log\left(\frac{M_t^T}{M_t}\right) + 100 * \log\left(\frac{NEER_t^T}{NEER_t} \right) \tag{A6}$$

[26]This was done to ensure that the comparison with the forward-looking inflation targeting rule only involves the additional output component.

where $NEER_t$ is the nominal effective exchange rate, and $NEER_t^T$ is its target level; the other variables are defined as in equation (A1).[27]

Finally, the exchange rate risk premium—captured by the error term for the open interest rate parity equation in the model—is modeled differently under ERM and EMU. To illustrate this point, consider the following open interest rate parity condition:

$$(1 + \frac{i_t^{US}}{100}) = (1 + \frac{i_t^j}{100}) * (\frac{E_{t+1}^{\$}}{E_t^{\$}}) + \alpha_1 * (\varepsilon_t^j - \varepsilon_t^{common}) + \varepsilon_t^{common} \qquad \text{(A7)}$$

where i_t^j is country j's short-term interest rate, $E_t^{\$}$ is the nominal exchange rate expressed in dollars per local currency, ε_t^j is risk premium against the dollar specific to the exchange rate of country j, and ε_t^{common} is the risk premium common for EMU participants; α_1 is a zero-one parameter. Under ERM, each EU currency faces a different risk premium vis-à-vis the U.S. dollar; hence, the bilateral exchange rates for those countries participating in the ERM are also subject to risk premia. In this case, α_1 is set to unity in equation (A7). In EMU, the bilateral risk premia for EMU participants disappear and only a premium between the Euro and the U.S. dollar remains ($\alpha_1 = 0$).[28] See Masson and Symansky (1992) for a further discussion of this issue.

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[27]The nominal effective exchange rate is constructed with average trade weights (imports plus exports) for 1990–95 as a percent of total trade with the two other trading partners (i.e. German imports plus exports to Japan as a fraction of total imports and exports of Germany with the United States and Japan). Under ERM, German trade weights are used; under EMU, trade weights for the European Union.

[28]The introduction of the Euro is not assumed to affect the risk premium vis-à-vis the U.S. dollar for nonparticipants in EMU.

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