Exchange Market Intervention in Four European Countries

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The major industrialized nations have now had a decade of experience with floating exchange rates. Although many of the concerns about potential instability associated with greater flexibility appear in retrospect to have been exaggerated, so too were some of the optimistic expectations that flexible rates would relax some of the constraints imposed on macroeconomic policy in an open economy. The governments of all the major economies have felt compelled to intervene in exchange markets, in some cases relatively infrequently, and in others more or less constantly.

The resulting system of "managed floating" consequently bears only a limited resemblance to textbook models of flexible rate regimes or even to earlier periods such as the 1920s, when intervention was much less frequent. The recognition that the level of exchange market intervention may be regarded as a policy tool has changed the character of the discussion of appropriate exchange rate policy from the traditional dichotomous fixed-versus-flexible rates choice to that of determining the appropriate degree of official intervention in exchange markets. There is obviously no a priori theoretical presumption that the optimal policy would lie at either extreme of the continuum between full intervention (fixed rates) and zero intervention. Theoretical work on this question (Boyer, 1978; Turnovsky, 1983; Black 1983) has been limited by the stringency of the assumptions necessary to specify solvable models. It does suggest, however, that the optimal degree of intervention will depend on the structure of the economy, the type and source of shocks to which it is exposed, and the particular objectives of policymakers and the amount of information available to them and to other market participants.

In this context empirical investigation of recent experience with intervention may provide us with a better understanding of the choices and constraints policymakers perceive in deciding whether and how much to intervene than would theory alone. The experience of the four major Western European economies, France, West Germany, Italy, and the United Kingdom, is particularly interesting in this respect, since they present a rather wide range of approaches to exchange market policy over time and among each other.

In the first part of this paper I develop a simple framework for the

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examination of potential determinants of exchange market intervention. This approach is then applied in econometric estimates for the four countries for the 1973-1982 period and selected subperiods. Despite a number of difficulties with the definition, specification, and measurement of such a relationship, the results show that exchange rate policy in all four countries appears to have been motivated by resistance to short- to intermediate-run changes in the nominal exchange rate. Given the frequently stated aims of monetary authorities in "countering disorder" and resisting "erratic fluctuations" and exchange rate movements "which bear no relation to the fundamentals,"[1] this result is hardly surprising. A more subtle question is whether there are differing perceptions, both across countries and over time, of what constitute departures from "equilibrium" rates. Although our results suggest this may be the case, they also provide support for the view that central banks usually regard any change in the nominal rate as a move away from equilibrium. Of parallel interest are the variations in the degree to which monetary authorities may have used exchange rate policy for macroeconomic objectives, rather than simply for "smoothing" exchange rate movements. Although the evidence here is far from satisfactory, it does suggest that in several countries, the objectives of price stability, international competitiveness in goods markets, and possibly employment may have also played a role in exchange rate policy, at least in particular periods.

The second part of the paper addresses the questions of why monetary authorities wish to reduce exchange rate instability and whether or not they have succeeded in doing so. Despite widespread official abhorrence of "disorderly markets" and exchange rate volatility, it is not clear that the reduction of exchange rate uncertainty should necessarily be a primary policy objective, particularly if the suppression of uncertainty in the exchange market merely transfers the effects of shocks to other markets, such as the labor market, which may be less suited to handling risks.

Even if we accept greater exchange rate stability as a goal, however, there remains the question of the extent to which monetary authorities have actually attained this goal. The primary difficulty in answering this question is that of defining "instability" in an operational and economically meaningful way. Several approaches, each having specific limitations, are used in Part II. They tend to show mixed results for central banks' interventions in the past decade in terms of their effects in reducing exchange rate uncertainty. It appears difficult, however, to characterize the present situation as a "mismanaged float," as some critics of central bank policy have argued. Our examination of the data suggests that central banks have not had a destabilizing role, with the possible exception of the initial periods of the float, and that their performance may have improved in recent years.

[1]A number of these aims are discussed in the recent Report of the Working Group on Exchange Market Intervention, established at the Versailles summit in June 1982.

I. An Empirical Examination of the Determinants of Intervention

A. Variable definition and model specification

Exchange market intervention by central banks is easier to define in principle than it is to measure in practice. In theory, the purchases or sales of foreign exchange undertaken either by monetary authorities or on their behalf to influence the exchange rate, either in the sense of maintaining it at a given level or moving it toward a level desired by the monetary authorities, could be regarded as the measure of exchange market intervention. In several countries, notably the United States and West Germany, reported changes in official reserves of foreign exchange, net of SDRs and gold, probably come reasonably close to the true level of intervention for most of the period, once allowance is made for the interest earnings on the stock of reserves. In the German case, however, swaps between the Bundesbank and commercial banks after 1979 may produce variations in official reserves which do not reflect direct market intervention.

The situation is considerably more complicated in France, the United Kingdom, and perhaps most of all in Italy. In these countries changes in reserves do not fully reflect intervention for several reasons. Most important is the practice of using government-controlled entities to engage in transactions in exchange markets. In addition, in France and in Italy, the government in effect manages the foreign exchange positions of the commercial banks.[2]

For our purposes, these complications are important in the sense that they create a presumption that the true level of official intervention will be understated when published official reserve data are used. It seems plausible to assume, however, that hidden or "off-the-books" intervention would usually have the same sign as reported reserve changes, so that the latter figure might be regarded as a proxy for the true level of intervention. There is little doubt, however, that it is an imperfect one; the poor fit several of the regressions reported below probably derives primarily from this source.

The approach used in this study does not distinguish between sterilized and unsterilized exchange market intervention, as it does not directly enter the single-equation model explaining intervention used here. The distinction would in principle be relevant, however, to the long-run effects of intervention on the real exchange rate if we were to attempt to explain intervention as part of a larger structural model, since intervention-induced changes in the monetary base could have price level effects. In this case it would appear reasonable to assume that the relation between several of the potential explanatory variables and the intervention decision would be affected by the degree to which the intervention was sterilized.

[2]One of the most extensive investigations made by an academic researcher of various ways in which intervention may be partially obscured in the published data was made by Taylor (1983).

A number of variables might be considered as potential determinants of the level of intervention. If the monetary authorities regard one of their principal objectives as the maintenance of "stability," then both the actual exchange rate and some equilibrium rate from which it is perceived to have departed should affect the intervention level. Although the choice of the former is straightforward, we have no direct observation of the rate which the authorities regard as an "equilibrium" one. A number of alternatives suggest themselves, and in fact one of the interesting results in the estimates reported below is that the authorities' perceptions of departures from the equilibrium rate may differ among countries.

The simplest model is that any departure from the prevailing nominal rate is a disturbance which the authorities resist. In this case the equilibrium rate is simply the current rate lagged one time period. Such an approach is equivalent to static expectations with respect to the nominal exchange rate, and in a world with differential rates of inflation might be regarded as embodying a form of money illusion.

A theoretically more satisfactory approach is suggested by the distinction between "expected" and "unexpected" exchange and interest rate changes used by Isard (1979), Dornbusch (1980) and others. If interest rate differentials between the home and foreign currency correspond to the expected rate of depreciation of the home currency, then "unexpected" exchange rate changes would be equal to observed changes minus the amount embodied in the interest rate differential. This approach has been used by Dornbusch (1980) in explaining German intervention in the dollar/DM market, and would appear appropriate when the degree of capital mobility between the two currencies is high, as would be the case for the dollar/DM rate or the dollar/sterling rate.

An alternative approach, potentially more robust to restrictions on the degree of capital mobility, exploits the idea of long-run purchasing power parity. In this view, expressed in a relative form, changes in the exchange rate over a long period should correspond to differential price level changes in the two currencies, so that the expected depreciation (appreciation) of the home currency would equal the positive (negative) difference between the home and foreign inflation rate. Although this approach does not require a high degree of capital mobility, it has other drawbacks. It is equivalent to assuming static expectations with respect to the real exchange rate. Differential rates of productivity growth, demand changes, and currency portfolio shifts could all compromise the validity of this approach. In addition, it raises the practical question of which price index to use as a measure of inflation. All three of the approaches discussed here were used in the estimates reported or summarized below, since each provides a plausible explanation for monetary authorities' perceptions of departures from an "equilibrium" rate.

As noted earlier, one of the interesting questions which arises in an examination of intervention experience is the degree to which other objectives besides "stability" have affected central bank intervention decisions.

Although we might assemble a rather long list of potential variables, including possible noneconomic ones, the estimates in this paper use only a few.

If the monetary authorities regard their trade balance or current account as responsive to exchange rate changes, then one obvious use of exchange market intervention is to pursue a kind of "beggar-thy-neighbor" policy of real depreciation when unemployment rates rise above politically acceptable levels. This view would argue for the inclusion of the unemployment rate or a related measure of labor and/or factor market pressure in general as one of the determinants of the intervention level. An alternative approach would treat the current account balance or the trade balance as an intermediate target which is positively related to the level of goods market pressure and employment. In this case a deterioration in the current account would lead to intervention to drive down the relative price of the home currency, and hence to purchases of other currencies by the central bank.

From a central bank point of view, one of the major macroeconomic targets is the maintenance of domestic price level stability. In some cases, for example Germany, the central bank is formally charged with this responsibility.[3] In these circumstances, an increase in the domestic price level would induce the monetary authorities to use the exchange maket as a partial "safety valve" by promoting real appreciation to lower the world price component of the domestic price level. In an economy with a relatively greater tolerance for inflation, however, the anti-inflationary effect of real appreciation might be outweighed by concern over the maintenance of international competitiveness in the face of a rising domestic price level.

The preceding discussion may now be summarized in the general form of the intervention equation

$$(1)\ ITV = f[(E/\bar{E}), U, \dot{P}]$$

where ITV is the level of intervention, E the actual nominal exchange rate and $\bar{E}$ the "equilibrium" rate, U the unemployment rate, and $\dot{P}$ the rate of inflation. In the estimates below a log-linear form of (1) was adopted, in the form

$$(1')\ \ln ITV = a + b_1(\dot{e}-\bar{e}) + b_2U + b_3\dot{P}$$

where $\dot{e}$ is the logarithmic change in E.

As noted above $\bar{e}$ may be determined in several different ways. The dependent variable was defined as the percentage change in reported official foreign exchange reserves between periods, minus the increase in reserves due to accrued interest. The latter was calculated by multiplying the lagged reserve stock by the U.S. Treasury bill rate. The exchange rate used was an index of the value of the home currency, so that a rise in E ($\dot{e} > 0$) corresponds to an appreciation of the home currency. Both a dollar-based index and the IMF's multilateral weighted effective exchange rate were

[3]The priority given to price stability is discussed in a recent paper by Hodgman (1983).

used. The unemployment rate was measured as a percentage of the civilian labor force, except in the case of France. Since a published rate was not available in this case, the log of the total number of registered unemployed was used. The inflation variable was calculated from the consumer price index.

B. Estimates for the four countries

Equation (1′) was estimated for the four countries of our study. Quarterly data were used for the most part, with monthly estimates made in a few cases as noted. Data sources are discussed in the appendix.

As noted in the preceding section, our maintained hypothesis is that a rise in the value of the home currency above its "equilibrium" rate ($\dot{e} > \bar{e}$) will be resisted, leading to purchases (sales) of foreign (home) currency. Thus we would expect the exchange rate change coefficient b_1 to be positive. As unemployment increases, a "beggar-thy-neighbor" policy would imply intervention to induce a real depreciation (hence purchases of foreign currency). Thus the unemployment rate coefficient b_2 should be positive if this effect exists. The expected sign of the inflation coefficient (b_3) is ambiguous. If concern with domestic inflation dominates preoccupation with international competitiveness in goods markets, we would expect the central bank to induce a real appreciation, hence selling foreign currency. In this case b_3 would be negative. If competition is relatively more important, and monetary authorities believe that nominal exchange change is lagging behind the inflation differential, then b_3 could be positive.

Initial estimates using ordinary least squares showed a significant level of first order serial correlation, positive in the French and British data and negative in the Italian case. All equations (including the German ones, in which the problem appeared less serious) were therefore reestimated using the Cochrane-Orcutt transformation. The estimates for the entire period run from 1973–III through 1982–II except as noted. Table 1 reports the results for the entire period, using three different measures of $\dot{e}$. In the first case (model A), the authorities are assumed to regard any departure of the rate as a movement from equilibrium, so that the explanatory variable in this case is the total percentage change in the exchange rate. In models B and C, the short-run interest differential and the wholesale price index change are used respectively. The t-statistics for each coefficient are shown in parentheses below the coefficient.

A number of features of the equations should be noted. First, regressions for the entire period can at best explain only about 40 percent of the variation in intervention. In one case (model C for France) the equation is not significant at the 5 percent level. There appear to be several reasons for this, in addition to the data problems mentioned earlier. The model is not explaining the behavior of a large group of decisionmakers like consumers, but the discretionary behavior of a few central bank authorities. It would be naive to expect that a linear rule like (1′) would be anything more than a

Table 1
Estimates of Exchange Market Intervention

	Constant	b_1 $(\dot{e}-\bar{\dot{e}})$	b_2 (U)	b_3 (P)	R^2
France [73:3–82:2]					
(A)	−.16	.50	.04	−.11	
	(.40)	(3.14)	(.54)	(.09)	.32
(B)	−.20	.43	.04	−.05	
	(.46)	(2.73)	(.56)	(.04)	.29
(C)	−.03	.31	.02	−.26	
	(.08)	(1.57)	(.18)	(.10)	.19
Germany [73:3–82:4]					
(A)	.03	.15	−.00	−.94	
	(.78)	(2.59)	(.08)	(1.91)	.32
(B)	.04	.14	.01	−.97	
	(.80)	(2.51)	(.14)	(1.97)	.31
(C)	.05	.15	−.00	−.96	
	(1.34)	(2.73)	(.39)	(1.98)	.33
Italy [73:4–82:2]					
(A)	−.12	.43	−.04	2.31	
	(.35)	(1.73)	(.52)	(2.46)	.34
(B)	−.17	.49	−.03	2.29	
	(.52)	(2.08)	(.41)	(2.54)	.36
(C)	−.10	.60	−.04	2.07	
	(.32)	(2.15)	(.60)	(2.36)	.37
United Kingdom [73:2–82:3]					
(A)	.09	.38	−.01	−.48	
	(1.12)	(3.54)	(.99)	(1.51)	.40
(B)	.08	.36	−.01	−.51	
	(.95)	(3.39)	(.79)	(1.56)	.38
(C)	.10	.37	−.01	−.65	
	(1.23)	(3.74)	(1.11)	(2.07)	.40

rough first approximation. In addition, there is evidence, which I discuss below, that structural changes occurred during the time period of these regressions. When the model is estimated for subperiods, or when potential structural shifts are permitted, the explanatory power of the model improves.

Despite the poor overall quality of many of the estimates, "leaning against the wind" or central bank resistance to market changes in the rate comes through strongly. For the decade as a whole, the unemployment coefficient b_2 is not significant for any of the four countries. Despite record levels of unemployment during part of the period, our estimates suggest that the monetary authorities in the four countries made no attempt to pursue "beggar-thy-neighbor" policies. Given the fear in the early seventies that the breakdown of the Bretton Woods system might lead to competitive devaluations in the presence of flexible rates and high unemployment, this is a reassuring conclusion. As is shown in more detail below, however, the unemployment coefficient may have been significant in certain subperiods

in several countries.

The inflation coefficient, b_3, shows a marked difference among the four countries. It is strongly and significantly negative in Germany. This is consistent with a monetary and exchange market policy which places a high priority on domestic price level stability. In France and the United Kingdom it also has a negative sign, but is not strongly significant in either country. Italy constitutes an interesting exception, showing the opposite pattern from the German one. The positive and significant coefficient in this case must be treated with some caution, due to the poor quality of the Italian intervention data. Nevertheless, it is a plausible result when the potentially greater tolerance of the Italian economy to inflation and its generally weak payments position during much of the past decade are considered.[4]

Comparison of the three alternative specifications for exchange rate change permits us to address the issue of whether central banks differ in their concept of "disequilibrium." In the French case there is a noticeable deterioration in the size and significance of the b_1 coefficient when models B and C are used. In other words, the greatest explanatory power comes from a model which postulates that the French monetary authorities regard any departure of the nominal rate from the preceding period as a movement to be resisted. In this case, the equilibrium rate is simply the rate in the past.

This does not appear to be the case in the other three countries. Differences in b_1 among the three models are small and not significant. In all three cases the price differential model (C) appears slightly superior, suggestive of some attention to inflation differentials in formulating intervention policy, but the data are simply not adequate to discriminate among the alternative models.

A remaining possibility is that monetary authorities use past interest rate or inflation differentials as a guide to changes in the equilibrium rate. Regressions embodying this hypothesis were tested for the four countries, using lagged values of the inflation differential or the interest differential and current exchange rate changes. The results were not significantly different from those reported here.

C. Extensions of the basic model

The regressions reported in Table 1 form part of a larger set which were estimated but for lack of space are only summarized here. Among the issues addressed in different specifications were simultaneity, time lags, and a number of alternative explanatory variables. The basic model was also tested over subperiods of the past decade, corresponding in the French, German, and Italian cases to the periods before and after the establishment

[4]Compared to the other three economies, the degree of inflation indexation in the Italian economy is much higher. Some of the macroeconomic implications have been examined by Modigliani and Padoa-Schioppa (1978).

of the European Monetary System, and in the British case to the periods before and after the recuperation of sterling in late 1976.

Potential simultaneity might compromise single equation estimates of the model (equation 1′) if intervention actions have a contemporaneous effect on private participants in the exchange market. In an attempt to deal with this potential problem, the current account balance and the inflation rate were treated as exogenous variables in two-stage least squares estimates, correcting for first order serial correlation. The exchange rate and the level of intervention were both treated as endogenous variables under this specification. The resulting coefficient estimates for exchange rate change in the determination of the intervention level were not significantly different from those of the single equation estimates. This result should be treated with caution, however, due to the difficulty of finding adequate instruments for such a procedure.

When lagged values of the inflation rate and the unemployment rate were substituted for contemporaneous values, there was a slight deterioration in the explanatory power of the model for Italy, an improvement in the French case, and little change for either the United Kingdom or Germany. This particular issue was not explored further, but it is clear that lags in the collection of data and their processing and interpretation by monetary authorities might justify lagging the macroeconomic variables in equation (1′) It does not seem reasonable, however, to lag the exchange rate variable in a quarterly model, since it is observed by the central bank without a time lag.

The regressions in Table 1 all used an index of the bilateral U.S. dollar/home currency rate in the construction of the exchange rate change variable. In several European countries, particularly France and Italy, more attention may have been given to other bilateral rates, even before the EMS began to operate. All regressions were therefore reestimated using an index of the exchange rate based on the IMF's Multilateral Exchange Rate Model. The results were generally poor, even in the French and Italian cases, although "leaning against the wind" ($b_1 > 0$) continued to be strongly significant in most estimates. A potential explanation for this result is that monetary authorities can much more easily observe a bilateral rate than they can an effective rate like that of the MERM. An alternative approach, not attempted in this study, would be to use more than one bilateral rate as explanatory variables.

As was noted earlier, the current account might be used as an explanatory variable in place of the unemployment rate. This specification was tried for all four countries. Like the unemployment rate, it was not significant in any of them. It is possible that its explanatory power might be enhanced if a distinction were made between expected and unexpected changes in the current account along the lines suggested by Dornbusch (1980). In the Italian case, one further specification change was made, under the assumption that the available quarterly unemployment rate used in the basic model might be a poor indicator of the underlying level of excess demand or supply in factor markets. The rate of utilization of indus-

trial capacity, a series provided by the Banca d'Italia, was substituted for the unemployment rate. Like the latter, its coefficient was not significantly different from zero.

Comparison of the three models for each country suggests that the monetary authorities' perception of the "equilibrium" exchange rate is approximated about as well by the preceding period's rate as it is by a rate based on either interest or inflation differentials. This conclusion was generally borne out in a further test, using a more complex model of equilibrium exchange rate determination, based on a well-known model of J.A. Frankel. If we assume long-run relative purchasing power parity and a stable demand for money, then the equilibrium exchange rate may be expressed in log form as[5]

$$(2)\ \dot{\bar{e}} = \dot{p}^* - \dot{p} = (\dot{m}^* - \dot{m}) - \phi(\dot{y}^* - \dot{y}) + \lambda(\dot{r}^* - \dot{r})$$

Ignoring macroeconomic effects on intervention like inflation or unemployment, this yields an intervention equation of the form

$$(3)\ \ln \mathrm{ITV} = c_1\dot{e} + c_2(\dot{m}^* - \dot{m}) + c_3(\dot{y}^* - \dot{y}) + c_4(\dot{r}^* - \dot{r})$$

If intervention is proportional to the gap between actual E and equilibrium E, or $\Theta(\dot{e} - \dot{\bar{e}})$, then $c_1 = -c_2 = \Theta$ and $c_3 = \Theta\phi$ and $c_4 = -\Theta\lambda$. Equation (3) was estimated with and without the linear restriction $c_1 = -c_2$ for all four countries. Sources of the "rest-of-world" variables $\dot{m}^*$, $\dot{y}^*$, and $\dot{r}^*$ are discussed in the data appendix. Only in the United Kingdom case were the results an improvement over the naive $\dot{\bar{e}} = 0$ model. In the other countries the effects of the monetary growth, income growth, and long-run interest rate differentials were usually of the theoretically correct sign, but not significant.

It was noted earlier that there are good a priori reasons to expect structural changes in the intervention behavior of monetary authorities over the floating rate period from 1973-1982. In France, Germany, and Italy the formal intervention commitments of membership in the European Monetary System, which began operating in March 1979, could be expected to have a marked effect on intervention policies in all three countries.[6] In the United Kingdom, the end of the long decline in the pound in late 1976, following borrowing from the IMF and other monetary authorities, appears to mark a turning point in British exchange rate policy.

Two sets of estimates, corresponding respectively to pre- and post-EMS for the first three countries and to the pre- and post-sterling reversal

[5]As the exchange rate used in this study is an index of the value of the home currency, rather than the domestic price of a unit of foreign currency, as in Frankel's model, the logarithmic change in the equilibrium rate is the difference between the log change in the foreign price level and the domestic one, rather than vice-versa.

[6]The introduction of the intervention commitments under the EMS may have introduced a degree of real exchange rate fixing. For a development of this argument, see Thygesen (1981).

Table 2
Intervention Estimates for Specific Subperiods

	constant	b_1 $(\dot{e}-\bar{\dot{e}})$	b_2 (U)	b_3 $(\dot{P})$	R^2
France					
[73:3–79:1]	−1.65	.43	.31	2.84	
	(2.41)	(2.12)	(2.51)	(1.52)	.43
[79:2–82:2]	3.17	.26	−.59	−1.28	
	(2.02)	(1.27)	(1.98)	(.51)	.56
Germany					
[73:3–79:1]	−.02	.23	.01	−.74	
	(.54)	(3.78)	(1.48)	(1.62)	.56
[79:2–82:4]	.09	−.05	−.01	−1.57	
	(1.05)	(.53)	(1.01)	(1.23)	.16
Italy					
[73:4–79:1]	−1.38	.48	.28	3.42	
	(3.23)	(1.43)	(2.83)	(3.11)	.51
[79:2–82:2]	.29	.23	.06	−.15	
	(.55)	(1.19)	(.67)	(.13)	.17
United Kingdom					
[73:2–76:3]	.08	.41	.00	−.50	
	(.78)	(1.75)	(.00)	(1.37)	.45
[76:4–82:3]	−.04	.32	.01	−.35	
	(.46)	(2.60)	(.60)	(.87)	.48

in late 1976 are summarized in Table 2. The estimates shown in Table 2 are for model (A), in which the exchange rate change variable is not adjusted. Estimates for the other two models were made for the same time periods, but are not reported here, since they differed little from those shown. As can be seen from the first three sets of regressions, there is a noticeable change in the model with the inception of the EMS, with a virtual breakdown in the Italian and German cases. With the exception of Germany in the post-EMS period, however, "leaning against the wind" appears to be well supported by the data.

In none of the four countries, however, does the effect appear as strong as was the case in the earlier part of the floating rate period. The unemployment coefficient, b_2, is significantly positive for France and Italy in the earlier period. In none of the three EMS members do "beggar-thy-neighbor" effects appear in the post-1979 period. The anti-inflationary element of German intervention policy still appears in the latter period, but it is not significant. Among the four countries, only the estimate for the United Kingdom appears stable over the whole period. A Rao-Chow test for equality of the coefficients in this case does not reject the hypothesis of stability.

The generally weaker explanatory power of the exchange rate change variable in the three EMS members after 1978 is consistent with the new EMS intervention rules. As the explanatory variable is the bilateral dollar/

Table 3
Real and Nominal Exchange Rate Change

Real		France	Germany	Italy	United Kingdom
[Jan 71–Mar 73]	m	1.49	3.22	−0.40	−0.01
	sd	3.40	2.49	1.83	5.10
[Apr 73–Dec 76]	m	1.34	2.06	−6.32	−3.31
	sd	7.72	7.42	6.50	6.30
[Jan 77–Feb 79]	m	−0.31	2.23	−0.44	1.08
	sd	4.53	2.35	3.05	5.34
[Mar 79–Dec 82]	m	−2.26	−3.38	0.12	5.98
	sd	5.58	6.55	5.50	9.97
Nominal					
[Jan 71–Mar 73]	m	0.69	2.71	−1.06	−3.07
	sd	2.99	2.46	1.59	4.47
[Apr 73–Dec 76]	m	0.91	6.07	−11.37	−9.11
	sd	8.01	6.55	7.10	5.83
[Jan 77–Feb 79]	m	−1.77	6.66	−7.17	−2.55
	sd	4.11	2.26	3.70	6.27
[Mar 79–Dec 82]	m	−4.77	0.69	−6.97	2.94
	sd	6.50	6.30	5.55	8.51

home currency rate, a reduced emphasis on this rate in central banks' intervention decisions would explain the fall in the size and significance of the b coefficient among the three EMS members.

II. Intervention and Exchange Rate Uncertainty

The results of Part I provide strong support for the view that central bank intervention policy in the four countries during the past decade placed a heavy emphasis on exchange rate stability. What is less clear is whether the goal was stability in the nominal rate or in a real rate, adjusted for inflation differentials among countries. The data does not permit us to discriminate satisfactorily among these possibilities (models A and C above), but it does suggest that French policy may have been more nominally oriented, while in the other countries an inflation-adjusted target rate does a marginally better job explaining intervention. Our estimates suggest, moreover, that although apparently less important than exchange rate variability, macroeconomic considerations like inflation may have influenced intervention policy in several cases.

Under these circumstances, when the objectives of central bank policymakers vary over country and over time, we cannot really pass judgment on their success (or failure), despite a long tradition of such exercises among academics. Given the central role that avoidance of exchange rate volatility appears to have played in intervention policy over the last decade, it is worthwhile examining both nominal and real exchange rate variability in the four countries. Table 3 reports the percentage change in both rates over

12 months, based on monthly data from January 1970 through December 1982. The nominal rate is the IMF's index of the effective exchange rate, while the real rate is the index multiplied by the ratio of the domestic consumer price index to the IMF's aggregate CPI for the industrial countries. The use of these particular variables and time periods rests on several considerations.

The use of bilateral rates would tend to exaggerate rate variability, which could reflect movements in either currency. Although effective rates do not eliminate the problem completely, it is alleviated. The choice of the CPI rather than the WPI is due to the greater coverage of the former index. If exchange rate variability is an important phenomenon at a microeconomic level, then it is desirable to include nontradables, for which the CPI is a better proxy. In this sense we can link changes in the real exchange rate to changes in the relative price of tradables to nontradables.

The choice of a 12-month period is in part arbitrary, but is based on the assumption that in goods and factor markets exchange rate changes of a shorter duration may be less serious for firms and consumers than are longer ones. This is due in part to the fact that forward cover for periods of a year or more is difficult to obtain; in addition, the reduction of exchange risk in trade through leading and lagging and other forms of adjustment of the net foreign currency position may be practical for short periods, but becomes increasingly difficult as the time period lengthens. Mean percentage changes in real and nominal rates, as well as their standard deviations, are shown in the table for four periods, the first corresponding to the period immediately preceding generalized floating in March 1973 and the last since the start of the EMS.

Examination of the table shows that real and nominal variability are rather closely related. Interpreted another way, there is rather meager evidence of much of a purchasing power parity effect at work during the past decade. If it had held even moderately strongly, changes in real rates would have been much smaller in relation to nominal rate changes. Only the Italian case shows a substantial gap between nominal and real change. This situation provides some clue to our results in Part I: if central banks target on past nominal rates (model A) rather than an inflation-adjusted rate (model C), it may simply be due to the rather weak performance of PPP in exchange rate determination, a fact well documented by J.A. Frenkel (1981) and others. Hence intervention policies which were targeted at stabilization of the nominal rate, as appears to have been the case in France, would in fact have partially stabilized the real rate as well, since little of the movement in the nominal rate can be explained be inflation differentials.

If exchange rates moved fairly smoothly at rates corresponding to interest rate differentials or other factors, then the means reported in the table might still have the same magnitudes, but the standard deviations would be small. Their size could be regarded as a measure of exchange rate uncertainty, if we assume that the "fundamentals" behind the trend (mean) are approximately known. As is clear from the table, uncertainty defined in

this way worsened after 1973 and after some decline in the 1977-79 period, appears to have risen once more. With the exception of the United Kingdom in the most recent period, real exchange rate uncertainty appears to have been roughly comparable among the four countries in each period since 1973.

It does not appear possible to construe the data of Table 3 to argue that official intervention had either strong stabilizing or destabilizing effects on exchange rates, either nominal or real. Although the uncertainty attaching to both nominal and real rates clearly increased after 1973, the return to a form of limited fixing under the EMS rules does not appear to have reduced either real or nominal rate uncertainty in the three members in comparison to the preceding period.

One interesting, if somewhat controversial approach to answering the question of whether official intervention has been stabilizing or destabilizing is the "profitability" criterion recently used by Taylor (1982, 1983). In essence, this criterion derives from Friedman's (1953) well-known argument that speculators who make profits by buying low and selling high will tend to stabilize prices, since their purchases will occur in periods of lower prices and sales during higher ones. Using this method Taylor calculated that the central banks of the four countries lost about $8.3 billion in intervention between April 1973 and the end of 1979. He concluded that the net effect of official intervention was thus destabilizing.

The profitability criterion has a number of drawbacks, some of which have been pointed out recently by Mayer and Taguchi (1983). Perhaps the most serious of them is that the criterion is highly sensitive to the choice of exchange rate used to calculate profits or losses if the central bank were actually to liquidate its foreign exchange position. In addition, to be strictly correct, it must take into account the interest differential between the two currencies, which in turn must equal trend appreciation or depreciation of one currency against the other. As this last requirement is unlikely to hold, except in an economy with perfect foresight, the usefulness of the criterion is limited.

Despite these rather severe limitations, application of the criterion may be a useful exercise. Using reported changes in official reserves, average monthly spot rates, and the interest differential between the U.S. Treasury bill rate and comparable local ones, I made a number of sample calculations for the four countries, assuming a zero net foreign currency position at the beginning of the period. As the results are highly sensitive to the end period exchange rate, they do not appear very meaningful in themselves and are not reported here. Several characteristics of the calculations, however, are worth noting. In several cases, most prominently in the United Kingdom and on a smaller scale in Italy, the losses appear attributable to periods when the central bank resisted what in retrospect may have been a change in "fundamentals," rather than the consequence of shorter term "smoothing" operations. One further feature is the extent to which time has healed some old wounds; the recent sharp rise in the dollar turns a

number of losses which were large at the time Taylor made his calculations into substantial profits. It is just as difficult to attribute these profits to central bank success at stabilization, however, as it is to link past losses to destabilizing intervention.

Even if we were to conclude, however, that central banks can provide a greater degree of exchange rate stability through official intervention, there remains the question of how high a priority greater stability should receive among policymakers' goals. A greater degree of exchange rate fixing transfers the disturbance in the exchange rate to one in the money supply. Although sterilization may partially offset this, the composition effects may have real effects, in addition to the problems arising from potential limits to the degree sterilization is possible. Viewed in this larger context, the choice of the level of official intervention in exchange markets is a choice about which markets or sectors of the economy will bear the consequences of a shock.

An adequate answer to this question would require us to specify in considerable detail the links between markets and the ways in which individual participants in these markets bear or avoid risk. The fact that "leaning against the wind" is perhaps the single most important feature of central bank intervention policy suggests that monetary authorities believe exchange rate variability has real costs for participants in the exchange market. Whether or not this is in fact so is essentially an empirical question. In countries in which the combination of high inflation and nominal fixing once created a high degree of real exchange rate uncertainty, as was the case in several Latin American economies, the adoption of a crawling peg and the consequent reduction of real exchange rate uncertainty have had important real effects.[7] Evidence that exchange rate uncertainty matters this much in Europe and the industrialized countries as a whole is harder to come by; in one of the few empirical studies addressing this question Hooper and Kohlhagen (1978) concluded that exchange risk had no significant quantity effect on trade, despite a significant price effect.

Summary and Conclusions

The most prominent common feature of official intervention in the exchange markets in France, Germany, Italy, and the United Kingdom in the past decade of floating is resistance to short- and intermediate-run movements in exchange rates, or "leaning against the wind." Although this implies a judgment that the actual rate has departed from a target or equilibrium rate, an examination of the data does not indicate with any clarity how monetary authorities define this equilibrium rate. Macroeconomic goals such as price stability may have played a role in intervention policy in some cases, but beggar-thy-neighbor use of the exchange market for domes-

[7]The Brazilian experience after its adoption of a crawling peg in 1968 is discussed by Coes (1981).

tic employment purposes does not appear to have been a problem in the past decade.

Despite their clear preference for greater exchange rate stability, the evidence that central banks' intervention policies have actually provided it is not clear. Exchange rate uncertainty, both nominal and real, increased after 1973, and has not diminished noticeably with the advent of the EMS. Attempts to judge the performance of central bank intervention policies on the basis of profitability lead to ambiguous answers, due to the problem of choosing the appropriate end period valuation rate.

Finally, even when intervention may have diminished exchange rate uncertainty, it is not clear that the uncertainty has not simply been displaced to other markets. A fuller answer to this question, which must come from both theoretical modeling and empirical investigation of the way markets bear and allocate exchange risk, is central to any evaluation of official intervention policies.

Data Appendix

The quarterly and monthly data used in this study came primarily from the IMF tape (April 1981) and was updated through 1982 using various issues of the IMF's *International Financial Statistics*. Exchange rate series used were the index of the average rate (ahx) and the effective rate (ahm). Official foreign exchange holdings net of gold, SDRs and the Fund position (series 1dd) were not adjusted for swaps or concealed intervention. Series 63 and 64 were used for wholesale and consumer prices. Interest rate series used were the call rate (60b) and the long-term public authorities rate (61), as well as 60c (U.S. Treasury bill rate). The domestic money supply was the adjusted series (34b) and national product at 1975 prices the series (99ar). The "rest of world" money supply was the money supply for the industrial countries (code 110) of the IMF tape. "World" income was based on an index of industrial countries' exports plus imports deflated by the U.S. WPI. "World" interest rates and wholesale prices were respectively a weighted average of the long-term rates (series 61) and wholesale prices (63) for the United States, Japan, Germany, France, the United Kingdom, and Italy, with the respective weights 0.45, 0.18, 0.13, 0.10, 0.08, and 0.06. The weights were based on 1975 GDP as reported in the World Bank's *World Development Report* (1981). Unemployment rates were taken from various issues of the OECD's *Main Economic Indicators*. For France the total number of registered unemployed was used.

References

Black, S. "The Effects of Alternative Intervention Policies on the Variability of Exchange Rates: The 'Harrod' Effect," Dept. of Economics and Business Administration, Vanderbilt University, *Working Paper 83-Wo6,* 1983.

Boyer, R. "Optimal Foreign Exchange Market Intervention," *Journal of Political Economy,* Dec. 1978.

Coes, D. "The Crawling Peg and Exchange Rate Uncertainty," in J. Williamson, ed., *Exchange Rate Rules.* London: MacMillan, 1981.

Dornbusch, R. "Exchange Rate Economies: Where Do We Stand?" *Brookings Papers on Economic Activity,* 1: 1980; reprinted in J.S. Bhandari and B.H. Putnam, eds., *Economic Interdependence and Flexible Exchange Rates.* Cambridge, Mass.: MIT Press, 1983.

Frankel, J.A. "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials," *American Economic Review,* Sept. 1979.

Frenkel, J.A. "The Collapse of Purchasing Power Parities during the 1970s," *European Economic Review,* 16, 1981.

Friedman, M. "The Case for Flexible Exchange Rates," in *Essays in Positive Economics.* Chicago: University of Chicago Press, 1953.

Hodgman, D. "A Policy Reaction Function for the Deutsche Bundesbank," unpublished working paper, University of Illinois, Feb. 1983.

Hooper, P. and S.W. Kohlhagen. "The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade," *Journal of International Economics,* Nov. 1978.

Isard, P. "Expected and Unexpected Changes in Interest Rates," *International Finance Discussion Paper 145,* Board of Governors of the Federal Reserve System, June 1979.

Mayer, H. and H. Taguchi. "Official Intervention in the Exchange Markets: Stabilising or Destabilising," *Bank for International Settlements Economic Discussion Paper No. 6,* March 1983.

Modigliani, F. and T. Padoa-Schioppa. "The Management of an Open Economy with 100% Plus Wage Indexation," *International Finance Section Essay 130,* Princeton University, Dec. 1978.

Taylor, D. "Official Intervention in the Foreign Exchange Market, or Bet against the Central Bank," *Journal of Political Economy,* April 1982.

———. "The Mismanaged Float: Official Intervention by the Industrialized Countries" in M. Connolly, ed., *The International Monetary System.* New York: Praeger, 1983.

Thygesen, N. "The European Monetary System—An Approximate Implementation of the Crawling Peg," in J. Williamson, ed., *Exchange Rate Rules.* London: Macmillan, 1981.

Turnovsky, S. "Exchange Market Intervention Policies in a Small Open Economy" in J.S. Bhandari and B.H. Putnam, eds., *Economic Interdependence and Flexible Exchange Rates.* Cambridge, Mass.: MIT Press, 1983.

Working Group on Exchange Market Intervention, "Exchange Market Intervention," March 1983.

Discussion

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The always controversial issue of exchange market intervention has become even more controversial because of the relatively high exchange value of the dollar. Controversy over intervention policy at the 1982 Versailles summit induced the seven participating governments to commission a study on their recent experience with intervention, and the resulting report of the study group was released last April.[1] Included in the report is a statement of the objectives that the various countries have sought to attain by means of intervention. The stated objectives run the gamut from "countering disorder" to "buying time for reassessment of economic policy." However, the report does not present any empirical tests which would allow us to rank these objectives in terms of their ability to explain the intervention which has taken place; there is no guidance on the quantitative importance of the various reasons for intervention. This omission points up the need for studies such as the one undertaken by Don Coes.

As Coes recognizes, there is no presumption that a country should choose between the polar extremes of either a fixed or a freely floating exchange rate. On the contrary, the optimal arrangement might entail a different degree of flexibility between every pair of currencies. Traditionally, what is really involved here are differing degrees of monetary union; foreign exchange intervention is simply a form of monetary policy, and a truly fixed exchange rate arrangement is tantamount to a monetary union.[2]

Contrary to this traditional viewpoint, exchange market intervention need not be a form of monetary policy. Of course, definitions are inherently arbitrary, but I think it is useful to propose the following distinction: exchange market intervention is equivalent to monetary policy only if the intervention is allowed to change the monetary base; by contrast, if intervention is sterilized so that it does not affect the monetary base, then intervention is separate and distinct from monetary policy.[3]

This distinction between sterilized and unsterilized intervention is disregarded in much of the empirical research on intervention reaction functions, including the research of Coes. It is to be hoped that monetary

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[1] *Report of the Working Group on Exchange Market Intervention*, March 1983.

[2] Jacob A. Frenkel and Joshua Aizenman, "Aspects of the Optimal Management of Exchange Rates," *Journal of International Economics*, vol. 13 (November 1982), p. 254.

[3] See Michael Dooley, "An Analysis of Exchange Market Intervention of Industrial and Developing Countries," International Monetary Fund, *Staff Papers*, vol. 29 (June 1982), pp. 233-69. As pointed out in the *Report of the Working Group* (p. 6), intervention which does not affect the base may nonetheless affect other monetary aggregates.

authorities know the difference between sterilized and unsterilized intervention. If they do, it is not likely that they will undertake sterilized intervention for the same reasons and to the same degree that they undertake unsterilized intervention, even in the short run. Therefore, the dependent variable in the reaction function should be either sterilized intervention or unsterilized intervention; it should not be a hybrid.

An illustration of this point may be helpful. Suppose the German central bank wanted to retard a depreciation of the mark against the dollar. A sale of dollars in exchange for marks that was allowed to reduce the German monetary base would obviously be more effective in supporting the mark than a sale of dollars whose monetary base effect was offset by something like a central bank purchase of a mark-denominated security. Thus the German central bank presumably would undertake less intervention if it were permitting the monetary base effect, so that the coefficient for the exchange rate in the reaction function would vary depending upon the change to be allowed in the monetary base.

Of course, there are other problems in defining intervention, as Coes points out. Aside from such definitional problems, another major hurdle confronts all those who attempt to discern the nature of intervention reaction functions. This hurdle is the difficulty of modeling the process of exchange rate determination.

There is no dearth of models of the exchange rate. The sizable variation in exchange rates together with the macroeconomic importance of the exchange rate made it inevitable that economists would devote considerable effort to constructing models to explain exchange rate movements. One result is that the number of published exchange rate models, or model variations, must by now exceed the number of currencies in the world. Prior to the breakdown of the Bretton Woods system, no self-respecting international economist would be caught without his own proposal for international monetary reform; now the same economist must have his own model of the exchange rate.

The multiplicity of competing models testifies not merely to our fractiousness but to our failure to explain the process of exchange rate determination. A recent study by Meese and Rogoff concludes that representative exchange rate models forecast no better out of sample than a random walk model.[4] The absence of a reliable exchange rate model makes it difficult for Coes to succeed in explaining why central banks intervene as they do in the foreign exchange markets.

The problem is one of avoiding bias and inconsistency arising from simultaneity, from the fact that intervention not only responds to exchange rate movements but may influence them at the same time. In an effort to deal with this problem, Coes adopts a two-stage least squares technique,

[4] Richard A. Meese and Kenneth Rogoff, "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?," *Journal of International Economics*, vol. 14 (February 1983), pp. 3-24.

but his use of the technique is handicapped by the lack of a reliable model setting forth the exogenous determinants of exchange rate movements.[5] As a result, we cannot be very confident that the estimated response of intervention to exchange rate movements is free from bias or inconsistency.

Some other difficulties also arise from the lack of a reliable model of the exchange rate. Because we cannot model the "long-run" equilibrium exchange rate, it is not possible to test whether the monetary authorities intervene in order to smooth out deviations from that rate. Nor is it easy to determine whether intervention is a response to unexpected changes in the exchange rate, since we cannot estimate what changes were expected. On this matter, Coes follows the lead of Dornbusch in taking the interest differential as an index of expected exchange rate change. This procedure presumes that there is no foreign exchange risk premium, a question on which the jury is still out.

Aside from the modeling of exchange rates, some other questions are raised by Coes's reaction functions. For example, is it reasonable to represent international competitiveness simply by the domestic rate of inflation, or would it be better to use the differential between domestic and foreign inflation? In this connection, Coes's statistical results indicate that before 1979 the Italian authorities typically sold their own currency when the Italian rate of inflation accelerated, and he suggests that the motivation was to remain competitive. Perhaps so, but it does seem a bit out of character for a central banker to take pains to depreciate his currency in the foreign exchanges when internal inflation is rising. One wonders what is the estimated coefficient on inflation lagged one period, since, as Coes points out, inflation data may not be available to the authorities for the period in which intervention occurs.

The chief conclusion which Coes draws from the reaction functions is that the monetary authorities lean against the wind, or intervene so as to resist change in the exchange rate in the short run. This conclusion holds for France, Germany, Italy, and the United Kingdom if all nine years are included in the sample; but if these nine years are broken into subperiods it seems that Italy never leaned against the wind and that France and Germany abandoned the practice after entering the EMS.

Other studies have also found that intervention has resisted exchange rate change (other things equal).[6] International sanction for such interven-

[5] For another effort to cope with this problem, see Peter J. Quirk, "Exchange Rate Policy in Japan: Leaning Against the Wind," International Monetary Fund, *Staff Papers*, Vol. XXIV (November 1977), pp. 653-61.

[6] For example, see: Rudiger Dornbusch, "Exchange Rate Economics: Where Do We Stand?" *Brookings Papers on Economic Activity*, 1:1980, pp. 173-76; David Longworth, "Canadian Intervention in the Foreign Exchange Market: A Note," *The Review of Economics and Statistics*, vol. 62 (May 1980), pp. 284-87; Quirk, "Exchange Rate Policy . . ."; and Jacques R. Artus, "Exchange Rate Stability and Managed Floating: The Experience of the Federal Republic of Germany," International Monetary Fund, *Staff Papers*, vol. XXIII (July 1976), pp. 312-33.

tion policy can be inferred from the following published IMF principle:[7] "A member should intervene in the exchange market if necessary to counter disorderly conditions which may be characterized inter alia by disruptive short-term movements in the exchange value of its currency." On the other hand, leaning hard and long against the wind would run afoul of another IMF principle, to wit: " . . .the Fund shall consider the following developments as among those which might indicate the need for discussion with a member: (i) protracted large-scale intervention in one direction . . . ."

Principles aside, if it is true that monetary authorities commonly resist exchange rate change, the logic for such behavior is not altogether clear. Unless the objective is to maintain a fixed exchange rate and intervention policy is supported by monetary policy, one wonders why officialdom should *persistently* favor what the market did last month over what it is doing this month.

This is not to deny that intervention might be appropriate to resist overshooting or destabilizing speculation when those phenomena could be identified. Given the high variability of exchange rates in recent years, it seems that significant overshooting of long-run equilibrium rates must have occurred on a number of occasions. An overshoot which disappears only over an extended period might impose significant adjustment or unemployment costs on industries most affected by the accompanying shifts in relative prices.

The variability of exchange rates is addressed in the last section of Coes's paper, where measures of 12 month variation are presented for each of the four currencies under consideration. These data are consistent with a growing body of evidence showing that real as well as nominal exchange rates have varied substantially since the advent of widespread managed floating. However, we should bear in mind that much of the period since March 1973 may have been unrepresentative, since the world economy was subjected to two severe oil shocks. Indeed, perusal of Coes's data reveals that during the sub-period when the world was relatively free of oil shock effects, from January 1977 through February 1979, the variation in real exchange rates was not much different from what it had been in the period before widespread floating. The data are also consistent with the view that overshooting can result from real disturbances as well as from monetary disturbances.[8]

In conclusion, Coes recites the interesting point that even when intervention diminishes exchange rate uncertainty, the net effect may be merely to shift the uncertainty to other markets. Let us consider another elementary but sometimes overlooked aspect of intervention. It is commonly be-

[7] Quotations are from Executive Board Decision No. 5392—(77/63), adopted April 29, 1977, *Selected Decisions of the International Monetary Fund and Selected Documents*, Ninth Issue (Washington, 1981), page 10.

[8] See Jagdeep S. Bhandari, "An Alternative Theory of Exchange Rate Dynamics," *The Quarterly Journal of Economics*, vol. 98 (May 1983), pp. 337-48.

lieved that changes in basic monetary policy lead to exchange rate overshooting. The country whose monetary policy had changed could intervene to reduce the overshoot, but unsterilized intervention—the kind sure to be effective—would simply amount to a reversal of the monetary policy change.