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MANAGED EXCHANGE-RATE FLEXIBILITY: The Recent Experience

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MANAGED EXCHANGE-RATE FLEXIBILITY: THE RECENT EXPERIENCE

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Foreword

The papers and comments in this volume were presented at a conference sponsored by the Federal Reserve Bank of Boston. It was the 20th in a series of conferences which began in 1968. The subject of this conference is reminiscent of our second one in 1969 on *The International Adjustment Mechanism.* It was clear at the time of the 1969 Conference that the Bretton Woods system could not survive much longer; it was also clear that there was no consensus as to what should succeed it.

After seven years of the floating rate regime, it is important to begin to assess the experience. We are pleased therefore to make these papers available and hope their publication will contribute to an understanding of the issues involved.

Frank E. Morris
President
Federal Reserve Bank of Boston

The Transmission of Fluctuations in Economic Activity: Some Recent Evidence

Duncan M. Ripley*

I. Introduction

The purpose of this paper is to consider recent evidence on the synchronization of cyclical movements, and the implications of this evidence for the transmission of fluctuations in real economic activity among countries. Greater exchange-rate flexibility affects the channels of transmission. Whether its net effect is to strengthen the impact that is transmitted, weaken it, or leave it unchanged depends on the determinants of capital flows and price movements, on the formation of expectations about exchange rates and prices, and the speed of adjustment in the markets for assets, goods and factors.

A severe recession affecting all industrial and most primary producing countries has characterized the period of managed floating. Even at this time, many countries are experiencing low levels of capacity utilization. The extent of unused capacity is difficult to quantify, and comparisons across countries as to the degree of slack must be viewed as approximate. Recent calculations made at the IMF suggest that for 1977 the degree of slack in the manufacturing sector of the industrial countries ranged from a low of 6 percent in the United States to a high of about 20 percent in Sweden and Japan.[1] Little increase in activity levels in many of the industrial countries is foreseen for 1978 on the basis of data from the first half year; indeed, for a few countries, the gap could even widen in 1978.

Over the last few years there has been a great deal of discussion of the need for policy coordination under the regime of managed floating. The need to avoid large exchange-rate changes and restrictive demand management policies in response to the common oil shock was widely espoused.[2] As the recession's scope and duration increased, the locomotive policy prescription

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The views expressed here are those of the author, and not necessarily those of the International Monetary Fund. The author would like to thank Messrs. J. Artus, W. Day, and E. Spitaeller for helpful comments on earlier drafts, and A.G. Turner for technical assistance.

[1]See Jacques R. Artus and Anthony G. Turner, "Measures of Potential Output in Ten Industrial Countries, 1955-1980". mimeographed.

[2]The arguments for sharing the deficit, and possible patterns for allocation are discussed in Andrew D. Crockett and Duncan M. Ripley, "Sharing the Oil Deficit", *IMF Staff Papers*, July 1975.

merged into the convoy prescription, and has now evolved into the concerted action program according to which an expansion path for each country is geared to its internal situation and its external constraints.[3] The policy prescriptions now recommending deliberate synchronization of cyclical activity through coordinated expansion indicate a continuing awareness of the importance of the transmission mechanism.

Clearly, one of the reasons for the prescriptions for coordinated action is that an expansion in domestic demand in a single country tends to have important implications for the country's trade balance. Rough estimates from using coefficients obtained from the "World Trade Model" suggest that the income effects alone, abstracting from price and exchange-rate effects, resulting from a 1 percent change in domestic demand in the United States cause a deterioration of the U.S. trade balance of more than $1 billion at the scale of 1977 trade flows.[4]

In the absence of stabilizing capital flows, isolated expansionary measures (a lack of synchronization) have important exchange-rate implications which adversely affect domestic price and wage formation and may even adversely affect activity levels through their impact on real balances. Such effects could make expansion in isolation for the more open economies, particularly those with weak external positions, unacceptable.

An abrupt and very widespread decline in activity levels followed the common oil shock and the restrictive demand management policies undertaken in response to rapid inflation. The period since 1975 has been characterized by continuing low levels of activity reflecting the inability or unwillingness of countries to extricate themselves from their current situations because of the price consequences of expansion, and because of external constraints. Coordinated growth could moderate in large part the exchange-rate implications (and price implications) of the desired expansionary stimuli and thus contribute to a transmission mechanism more similar to the one existing under fixed rates.

This paper first reviews briefly the channels of transmission under fixed- and flexible-exchange rates, and considers recent evidence on the degree of synchronization that has evolved. It then tries to evaluate the information these data provide on the evolution of the transmission mechanism under managed floating.

[3]See, for example, "Need for Coordinated Strategy Clearer, Economic Counsellor Says at ECOSOC," *IMF Survey,* July 17, 1978 and "Interim Committee Agrees on Coordinated Strategy," *IMF Survey,* May 8, 1978. Calls for coordinated expansion are discussed in Marina v.N. Whitman, "Coordination and Management of the International Economy: A Search for Organizing Principles," in William Fellner, editor, *Contemporary Economic Problems 1977,* (Washington, D.C.: American Enterprise Institute, 1977) and "The Locomotive Approach to Sustained World Recovery: Has it Run Out of Steam" in William Fellner, editor, *Contemporary Economic Problems 1978,* (Washington, D.C.: American Enterprise Institute, 1978).

[4]See Michael C. Deppler and Duncan M. Ripley, "The World Trade Model: Merchandise Trade," *IMF Staff Papers,* March 1978, for a description of the model.

II. The Transmission Mechanism[5]

The current account provides a major channel for the transmission of fluctuations in real output among countries.[6] Under a system of fixed-exchange rates a downturn in domestic demand in one country tends to dampen the demand for imports of goods and services and consequently to dampen exports of partner countries. At the same time exports of the first country may become more competitive since export orders can be filled more rapidly, and lagging domestic demand may encourage the search for new markets abroad. The strength of this type of transmission channel increases as the openness of the economy increases, so that the strengthening of the transmission process in the sixties and early seventies is to be expected.

In the absence of capital flows and with rapid adjustment in the goods market, flexible rates may insulate countries from external disturbances. This will depend, however, on the relative strength of price and real balance effects. If expenditure levels decline and there is an incipient move of the current account towards surplus, the exchange rate will appreciate; this in itself will increase real balances in the appreciating country (and decrease those held abroad), which in turn will help to sustain domestic demand while dampening demand abroad. Price effects of an appreciation over the short term will also contribute to balance-of-payments equilibrium by reallocating domestic and foreign demand from domestically produced goods to goods produced abroad. The transmission mechanism described above suggests that under flexible rates movements in real balances are like to play an important role. This simple scenario is not very realistic, however, in that it ignores the slow response of demand to changes in relative prices, particularly when these changes are viewed as transitory, and the impact of exchange-rate movements on the price of domestically produced goods, all of which will dampen the relative price effects of exchange-rate changes. It also ignores the capital account which can be expected to play an important role in exchange-rate determination.

To the extent that a depressed expenditure level contributes to a current account surplus that is viewed as temporary by market participants, and there is a high degree of substitutability between domestic and foreign assets, offsetting (stabilizing) capital outflows may respond to very small exchange-rate or interest-rate movements with the result that the transmission mechanism resembles closely the mechanism existing under fixed rates.[7] To the extent that depressed expenditure levels and exchange-rate appreciations affect market participants' expectations about inflation — with depressed levels and

[5]For a more complete discussion of the transmission process see Edward Tower and Thomas D. Willett, "The Theory of Optimum Currency Areas and Exchange Rate Flexibility," *Special Papers in International Economics,* No. 11, International Finance Section, Department of Economics, Princeton, New Jersey, May 1976.

[6]It is assumed here that the effects of an increase in reserves on the money supply are offset by the authorities.

[7]It is assumed here that the effects of capital inflows on the money supply are sterilized by the authorities.

an appreciating exchange rate suggesting a greater probability of a lower underlying rate of inflation — the exchange-rate appreciation may have to be very large (and clearly excessive) to induce equilibrating capital outflows; the needed appreciation will be further magnified by the J-curve effects on the current account which will accompany it. Very large exchange-rate movements may have important implications, even in the short term, for investment decisions in the traded-goods sector to the extent that the competitiveness of this sector is considered to be affected. They also have important domestic and foreign real-balance implications.[8]

It has traditionally been argued that a move to flexible-exchange rates and the elimination of the balance-of-payments constraint enable the authorities to assign monetary and fiscal instruments to the achievement of demand-management targets. Furthermore, control over the nominal money supply is clearly increased by the move to greater flexibility. However, the authorities may not, in fact, have greater control over real balances because of the rapid and important effects of exchange-rate movements on price formation and price expectations. Exchange-rate flexibility may also impair the effectiveness of fiscal-stimulus measures as instruments of demand management.

III. Measurement Techniques

The observed degree of synchronization in cyclical positions among industrial countries and the extent to which the move to greater exchange-rate flexibility has affected the transmission of fluctuations among these countries are explored in this paper. In considering the empirical evidence it is necessary to select a measure of short-term variations in economic activity. An earlier study focused on movements in industrial production indices about their long-term trend.[9] The sharp structural changes that have occurred in recent years make it less appropriate to apply this technique to the period after 1973.

The measures of economic activity used here represent a substantial improvement over those used in the earlier study for 10 of the 14 industrial countries covered in that estimates of potential output for these countries are now based on estimated Cobb-Douglas production functions.[10] These take into account the capital stock, the labor force, variations in the intensity of use of capital and labor, and the effects of the change in energy prices on productive potential. For four industrial countries, namely, Austria, Denmark, Norway, and Switzerland, it was necessary to estimate "potential manufacturing

[8]If, in contrast to the two scenarios above, the capital flows induced by a change in aggregate demand more than offset the effects of the change in demand on the current account, leading to a perverse exchange-rate effect, the propagation of disturbances could be heightened by the introduction of flexible rates. This would depend on the strength of relative price movements, price elasticities and real-balance effects. However, little empirical evidence of such a relationship was found by Tower and Willett, *Optimum Currency Areas,* p. 53.

[9]See Duncan M. Ripley, "Cyclical Fluctuations in Industrial Countries 1952-1975," in *Proceedings of the Second Pacific Basin Central Bank Conference on Econometric Modelling,* Central Bank of Korea, Seoul, Korea, 1976. This study considered 12 industrial countries.

[10]See Jacques R. Artus, "Measures of Potential Output in Manufacturing for Eight Industrial Countries, 1955-1978," *IMF Staff Papers,* March 1977, for a description of the techniques used to estimate potential output. The data used here are based on an expanded sample of ten industrial countries and are given in Jacques R. Artus and Anthony G. Turner, "Measures of Potential Output in Manufacturing for Ten Industrial Countries, 1955-."

output" by fitting log linear trends to observed series. Countries' cyclical positions are represented by semiannual series of the ratio of actual output to potential output in the manufacturing sector. The semiannual frequency was selected so as to eliminate spurious movements that exist in data for shorter frequencies, and to reduce somewhat the problem of lagged relationships.[11] The time period considered is 1961 to 1977.

Several techniques are used to analyze the observed pattern of covariation indicated by the data. First, weights indicating the relative importance of each of the 13 trading partners for economic activity in the country under consideration are obtained from the World Trade Model[12] and used to construct partner-country indexes of cyclical position for the country under consideration. The index of the country's cyclical position and that of its partner countries taken as an aggregate are then plotted over time in Charts 1-4 to indicate visually the degree to which they moved together. The charts are summarized in Table 1 for five sub-periods by the correlation coefficient between changes in a country's cyclical position and that of its major trading partners. Correlation coefficients for 1961-1965, 1966-1970, 1968-1972, 1973-1977, 1975-1977, and 1961-1977, are compared to see whether the degree of covariation changed during the fixed-rate period, how it may have been affected by the large discrete exchange-rate adjustments that characterized the period 1968-1972, and the extent to which covariation may have been affected by the oil shock and the move to greater exchange-rate flexibility.

A second technique that is used to analyze the degree to which countries' cyclical positions moved together is factor analysis.[13] "Factors" — statistical constructs that summarize the principal patterns of shared movement — are derived and given subjective interpretations depending on their movement over time, and on the countries whose cyclical movements are explained largely by the movement of these factors. This technique is applied to semiannual series on changes in manufacturing activity levels for four of the time periods mentioned above.

To attribute the observed change in patterns of synchronization to a change in the transmission mechanism resulting from greater exchange-rate flexibility could be incorrect since a large number of other factors that influence the observed pattern of cyclical activity may have changed also. For example, fiscal and monetary stances may have become more similar across countries during the flexible-rate period in response to common stimuli such as rapid inflation and substantial external constraints despite "increased flexibility." The strength of common external shocks may also have changed.

[11]In Ripley, "Cyclical Fluctuations," lags were introduced in measuring the degree of synchronization of cyclical movements but were not found generally to be significant.

[12]See Michael C. Deppler and Duncan M. Ripley, "The World Trade Model." The model was solved repeatedly for the increase in the net volume of nonagricultural exports of one industrial country that is implied by a 1 percent increase in activity in a second country, and assuming no change in activity levels in other partner countries. These solutions were then used to construct relative weights for the activity levels in the trading partners of the first country.

[13]For a description of factor analysis see M.G. Kendall, "Factor Analysis as a Statistical Technique," *Journal of the Royal Statistical Association*, Series B., Vol. XII, 1950, pp. 60-73 and T.W. Anderson, "The Use of Factor Analysis in the Statistical Analysis of Multipler Times Series," *Psychometrica*, Vol. 28, No. 1, 1963, pp. 1-25.

To correct for these additional influences, reduced form equations are estimated relating changes in output gaps to: changes in fiscal and monetary stances; changes in common external shocks; and changes in activity levels abroad. The equations are estimated on semiannual data over the period 1963-1977 and the coefficient on the foreign impulse variable is tested for stability. The estimated coefficients for fiscal and monetary stances and common shocks are then used to adjust the actual series for these exogenous influences. The degree of covariation among these "whitened" series is again analyzed for further evidence on the strength of the transmission of fluctuations in real economic activity.

IV. Measures of the Synchronization of Cyclical Fluctuations

For purposes of comparing the dispersion of cyclical movements over time, an index of partner-country activity levels is created for each of the industrial countries based on the importance of the partner countries for the activity level of the country under consideration. These indices are presented visually in Charts 1-4. Correlation coefficients comparing the movements of these series for six time periods covering the fixed- and flexible-rate period are presented in Table 1.

The charts suggest an extremely high level of covariation between own activity levels and partner-country activity levels for Canada and the Netherlands for the full period, with a high level of dispersion for the United States, Japan, and Italy. The degree of dispersion has clearly varied over time for a number of countries, and certain extreme observations, for example, the precipitous declines in activity levels in 1974 in many countries, or even the strikes in 1968 in France, dominate statistical measures of covariation for particular time periods. These charts help indicate these extreme observations. The correlation measures are useful, nonetheless, as they summarize the data and facilitate comparisons across countries and time periods.

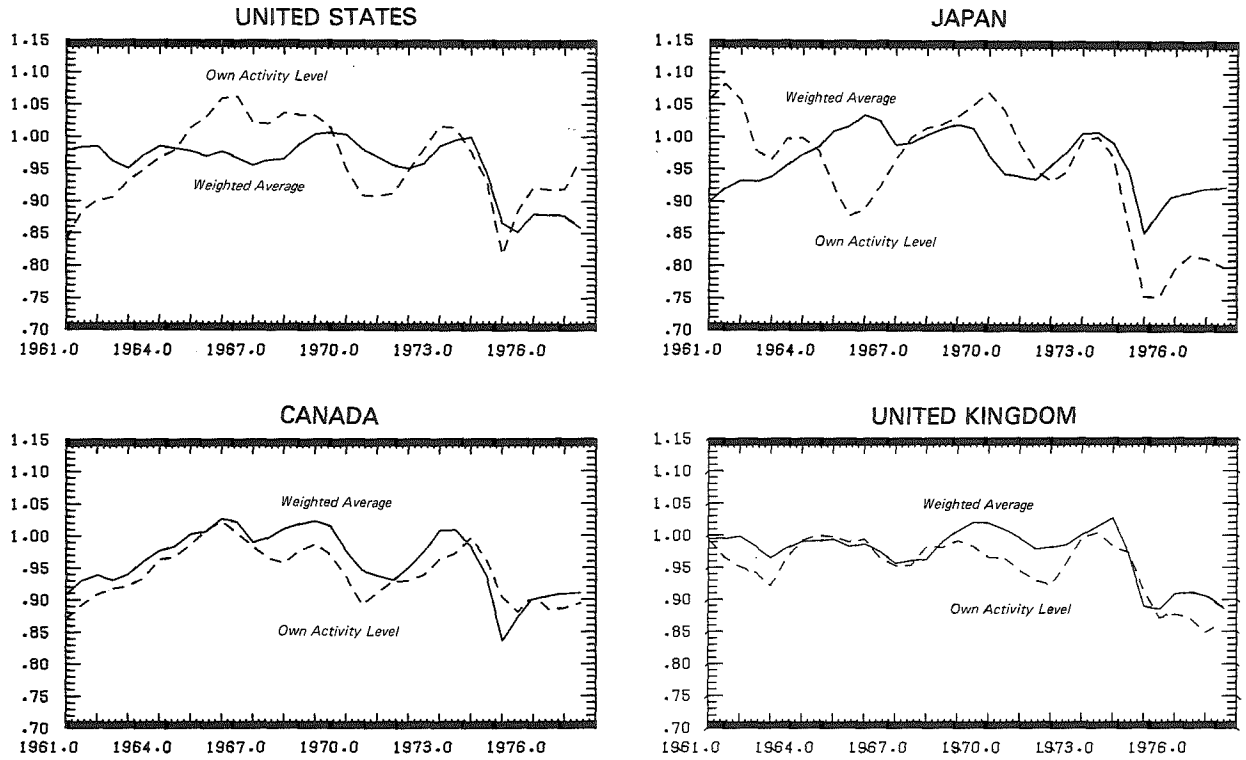
The correlation coefficients between activity levels at home and abroad are presented in Table 1. The high degree of common movement suggested by the charts for Canada and the Netherlands is borne out by the correlation statistics; a high degree of synchronization is also found for Belgium. This seems to reflect the strong Canadian economic linkages with the United States, the strong linkages between Germany, the Netherlands, and Belgium, and the openness of the last two countries. Of the European countries in the sample, only the Nordic countries and Italy do not show an increase in the degree of covariation between 1961-1965 and 1966-1970. For Japan, Norway and Italy there is little synchronization of changes in activity levels with changes in levels in partner countries during the sixties.[14] This outturn probably reflects the relatively small size of the external sector in Japan, the stop-go nature of government growth policies following during the sixties,[15] and the remarkable stability of Norwegian manufacturing activity.

[14]These results are similar to those reported in Duncan Ripley, "Cyclical Fluctuations."

[15]Japanese growth during the sixties was frequently very rapid and resulted in severe balance-of-payments difficulties, restrictive government policies, and very sharp downturns following rapid growth.

CHART 1

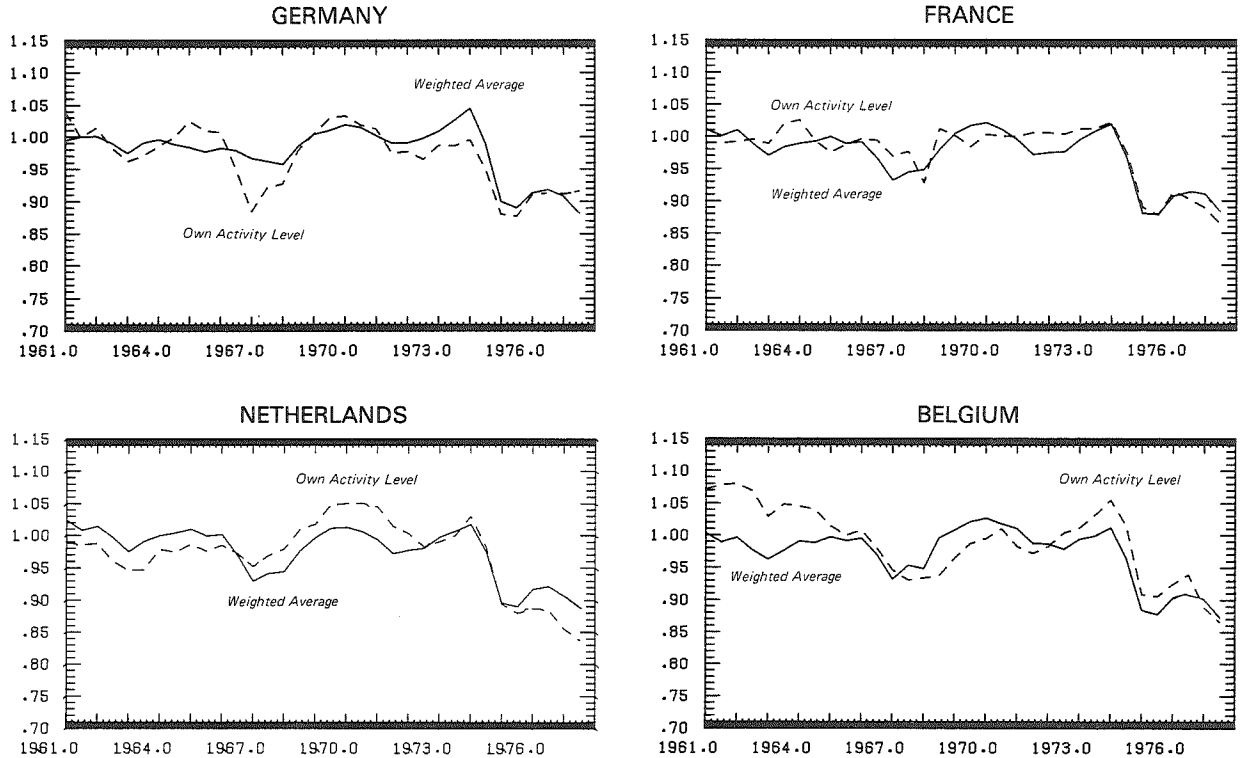
CYCLICAL FLUCTUATIONS IN INDUSTRIAL COUNTRIES, 1961-77*



* Countries' cyclical positions are measured as the ratio of actual to potential output in the manufacturing sector.

CHART 2

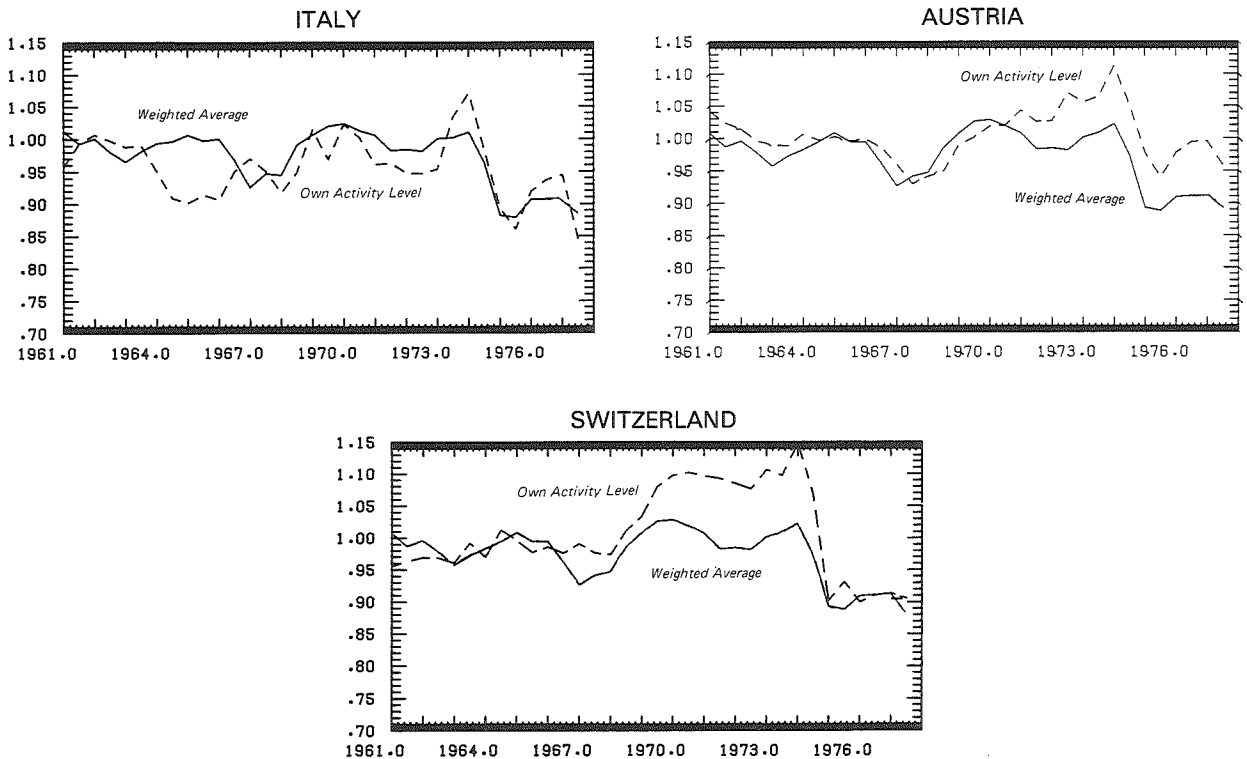
CYCLICAL FLUCTUATIONS IN INDUSTRIAL COUNTRIES, 1961-77*



* Countries' cyclical positions are measured as the ratio of actual to potential output in the manufacturing sector.

CHART 3

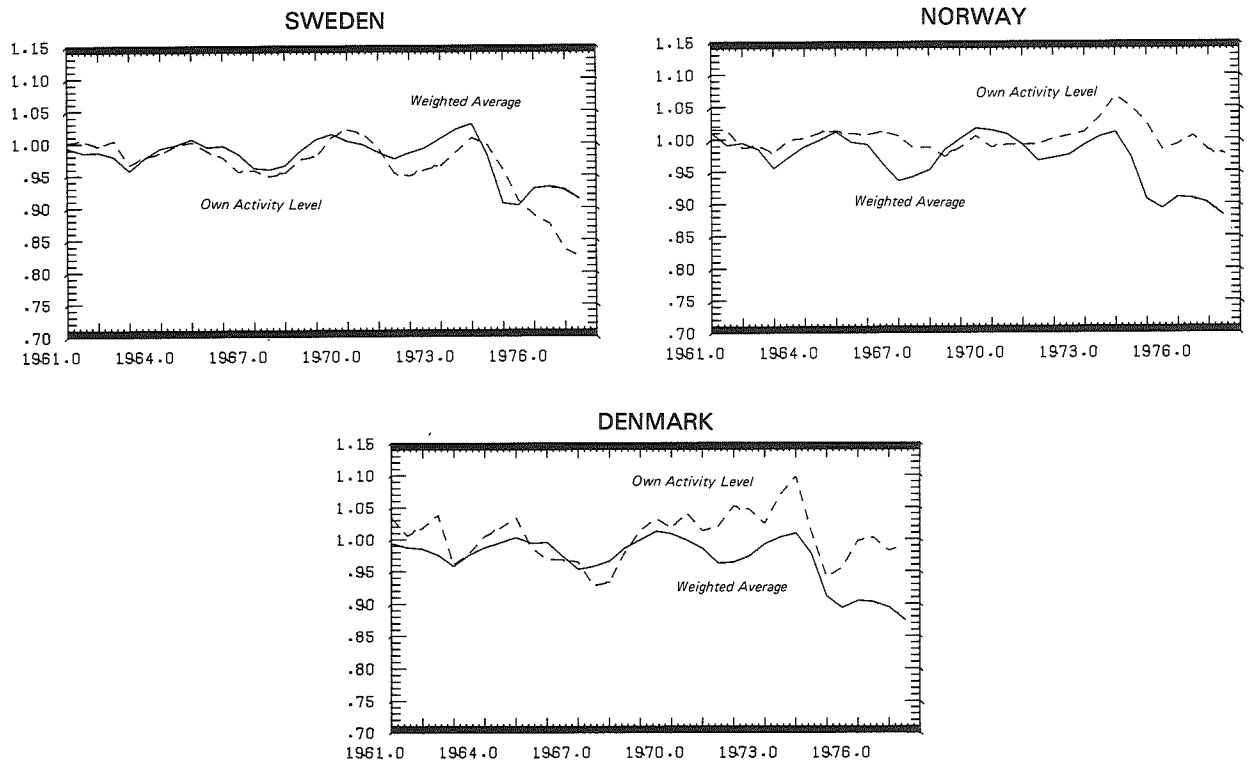
CYCLICAL FLUCTUATIONS IN INDUSTRIAL COUNTRIES, 1961-77*



* Countries' cyclical positions are measured as the ratio of actual to potential output in the manufacturing sector.

CHART 4

CYCLICAL FLUCTUATIONS IN INDUSTRIAL COUNTRIES, 1961-77*



* Countries' cyclical positions are measured as the ratio of actual to potential output in the manufacturing sector.

Table 1

Measures of Synchronization of Cyclical Fluctuations in Industrial Countries and Their Trading Partners

	Correlation Coefficient[1]					
	1961-1965	1966-1970	1968-1972	1973-1977	1975-1977	1961-1977
Austria	.14	.33	.10	.81	.95	.54
Belgium	.15	.79	.39	.79	.85	.70
Canada	.45	.83	.71	.66	.64	.66
Denmark	.76	.41	.50	.72	.88	.61
France	–.07	.41	.37	.89	.87	.44
Germany	.01	.55	.79	.77	.76	.52
Italy	–.06	–.05	.16	.73	.76	.28
Japan	.33	.25	.33	.82	.88	.45
The Netherlands	.02	.86	.76	.82	.74	.70
Norway	.32	.16	–.13	.35	.29	.28
Sweden	.51	.49	.63	.60	.40	.59
Switzerland	–.13	.61	.73	.63	.45	.54
United Kingdom	.50	.16	.32	.73	.63	.59
United States	.00	.56	.20	.59	.61	.46

[1]Correlation between the percentage change in the output gap in manufacturing in a country and a weighted average of percentage changes in output gaps in 13 partner countries. The estimates are based on semiannual data.

For all but five countries there is an increase in the observed level of covariation between changes in activity levels in 1966-1970 and 1973-1977. For Belgium, the Netherlands, the United States, and Switzerland, there is little change in the level of covariation between periods, while for Canada it declines. When the period is shortened to 1975-1977, a similar pattern of relatively high covariation emerges. Although the brevity of this period limits the significance of these results, they are consistent with the view that the system of greater exchange flexibility — even abstracting to some extent from the direct effects of the oil shock — has contributed little towards insulating countries' activity levels.

V. Factor Analysis Applied to Countries' Cyclical Positions

Factor analysis estimates the extent to which the movement in one country's cyclical position is unique to that country, and the extent to which it is shared among all the countries in the sample. It then concentrates on isolating a small number of statistical constructs, factors, that explain the movement that is shared among the countries. The interpretation of individual factors is necessarily subjective, but is suggested by the movement of the factor over time, and by the countries for which a common factor provides substantial explanatory power. Cyclical movements are measured as changes in the ratio of actual to potential output in manufacturing, and the explanation of cyclical movements in each country is given equal importance.[16]

Factor analysis is performed on the series for the following time periods: 1961-1965, 1966-1970, 1968-1972, 1973-1977. Factors are calculated from the data for the 14 industrial countries, and for the group of ten industrial countries for which more reliable estimates of potential output for the manufacturing sector are available. The cumulative percentage of the total movement in the data explained by the first two factors for these four periods is given in Table 2. The factor weights for the first three factors are shown in Table 3.

It seems reasonable to take as an indicator of the synchronization of cyclical movements among countries the extent to which this movement can be captured by the first one or two factors. Table 2 indicates that the generalized variance explained by the first and second factors is remarkably stable from the early sixties to the early seventies with the movement of these factors explaining, on average, one-half of the generalized variance. It increases very sharply during the period 1973-1977, and the role of the first factor becomes much more dominant. These findings are similar to those discussed earlier.

These results for the sixties contrast somewhat with results found in an earlier study on the covariation of cyclical positions among 12 industrial

[16]In other words, factor analysis is performed on the matrix of correlation coefficients rather than on the variance-covariance matrix; thus the explanatory power of the first factor depends on the percentage of the cyclical movement in country one that it captures, regardless of whether country one shows wide or narrow swings in its cyclical position. If the variance-covariance matrix formed the basis of the analysis, the explanatory power of the first factor would be judged not only on the percentage of the cyclical movement in country one that it captures, but also on the variability of country one's position relative to the variability of the positions in the other countries in the sample.

countries in that the earlier study found some slight increase in the level of covariation between the periods 1958-1963 and 1964-1970;[17] the sharp increase in the level of covariation experienced during the mid-seventies is again observed.

The explanatory power of the common "movement," as represented by the first two factors, remains remarkably high and stable for the Netherlands and Sweden, and to a lesser extent, Belgium and Switzerland, over the observation period; for the United Kingdom and Austria the explanatory power of the two factors tends to decrease over time, but for Austria this outturn reflects largely the very high explanatory power of these factors in the first period. France, Italy, Japan, and Norway are characterized by a substantial degree of country specific movement before the early 1970s.

To the extent that there is an important world cycle, or an indistinguishable alternative in this context, a common exogenous shock, the country weights for the first factor should have the same sign, and be highly significant for all of the countries. Table 3 indicates that this is true only for the period 1973-1977; this first factor is very important for all the industrial countries, and can be identified to a large extent with the direct effects of the oil shock which influenced these countries simultaneously. It is of somewhat lesser importance for the United States, the United Kingdom, and Sweden. The downturn in the Scandinavian countries extended beyond that in most of the industrial countries, whereas the U.S. downturn came to an end much more abruptly. Thus, the second factor indicating a more rapid pickup (or downturn, depending on sign) is also important for the United States (to a lesser extent Japan and Germany) indicating some "pickup," and Sweden and Norway indicating a further "downturn."[18]

The factor weights for 1966-70, and 1968-1972 also indicate synchronized movements in many of the European countries; movements in Italy, France, and Norway do not share in the pattern of movement common to most of the European countries. This "European" movement has little relationship to the cyclical movements in the United States and the United Kingdom. For the period 1966-1970 the second factor reflects a pattern of movement that characterizes developments in the United States, and, to a lesser extent, Canada and the United Kingdom.

The first factor for the period 1961-1965 again represents a "European" cycle that is particularly important for the Nordic countries and the United Kingdom. The second factor also relates to movements in European countries indicating that the common pattern of movement in the Netherlands and Aus-

[17]In this study the explanatory power of the first two factors increased from 75 to 80 percent between these two periods. However, quarterly data on the ratio of actual to trend industrial production were used rather than semiannual data on changes in utilization ratios.

[18]Donald S. Kemp, "Economic Activity in Ten Major Industrial Countries: Late 1973 through Mid-1976," *St. Louis Review,* October 1976, and Charles Pigott, Richard Sweeney, and Thomas D. Willett, "Aggregate Economic Fluctuations and the Synchronization of Economic Activity among Industrial Countries," *Rivista Internationale di Scienze Economiche e Commerciali,* Anno XXV, 1975, N. 5, also found a sharp increase in the degree of covariation for the seventies.

Table 2.

Measures of Covariation between Cyclical Positions in Industrial Countries, 1961-1977

	14 Industrial Countries				10 Industrial Countries			
	1961-1965	1966-1970	1968-1972	1973-1977	1961-1965	1966-1970	1968-1972	1973-1977
Percent of generalized variance explained by								
First factor:	32	35	34	68	31	36	38	69
First and second factors:	50	50	52	80	51	52	55	80
Percent of variance explained by the first two factors for								
Austria	91	60	33	78	—	—	—	—
Belgium	56	73	66	87	59	59	59	87
Canada	40	48	07	75	47	63	19	77
Denmark	68	52	26	71	—	—	—	—
France	05	11	42	94	32	14	25	94
Germany	51	71	77	98	59	87	68	98
Italy	21	13	17	67	67	07	14	62
Japan	12	25	77	87	45	23	84	90
The Netherlands	88	75	75	96	54	90	71	95
Norway	45	09	34	93	—	—	—	—
Sweden	76	66	86	80	44	52	88	68
Switzerland	58	78	82	73	—	—	—	—
United Kingdom	75	47	59	40	68	41	62	48
United States	13	71	48	83	31	81	64	80

Table 3

Factor Weights from Semiannual Changes in Output Gaps in Manufacturing

	Factor 1	Factor 2	Factor 3	Commu-nality*	Factor 1	Factor 2	Factor 3	Commu-nality*	Factor 1	Factor 2	Factor 3	Commu-nality*	Factor 1	Factor 2	Factor 3	Commu-nality*
	1961-1965				1966-1970				1968-1972				1973-1977			
14 Countries:																
Austria	-.65	.70	.08	.92	.76	.17	.34	.72	.33	-.47	.03	.33	.86	.21	.36	.91
Belgium	-.57	-.49	-.50	.81	.85	.06	.34	.84	.67	-.46	-.23	.72	.93	.05	-.02	.87
Canada	-.43	.46	-.53	.68	.49	-.49	.29	.56	-.23	-.14	.85	.79	.87	-.02	-.15	.78
Denmark	-.80	-.19	.21	.72	.66	.29	.15	.54	.51	-.01	.33	.37	.84	-.08	.29	.79
France	-.19	-.11	-.53	.32	.29	.16	-.68	.58	.25	.60	.43	.60	.96	-.12	.09	.95
Germany	-.65	.30	.34	.63	.79	-.30	-.38	.86	.87	.13	.37	.90	.95	-.26	-.05	.98
Italy	.44	-.12	-.68	.68	-.09	.35	-.24	.19	.36	.21	.17	.20	.79	.22	.41	.84
Japan	-.33	-.11	-.60	.48	-.47	-.16	-.27	.32	.81	-.34	-.13	.78	.85	-.38	-.01	.87
The Netherlands	-.71	.61	-.20	.92	.82	-.29	-.31	.85	.84	.22	.01	.75	.98	.10	-.01	.96
Norway	-.55	-.39	.02	.45	.30	.04	.67	.54	.00	-.59	-.09	.35	.70	.66	-.04	.93
Sweden	-.76	-.43	.02	.76	.73	.35	-.16	.69	.92	-.14	-.10	.87	.55	.71	-.35	.92
Switzerland	-.22	-.73	.06	.59	.73	.49	-.15	.80	.83	.37	.02	.82	.82	-.21	-.06	.73
United Kingdom	-.86	-.10	.06	.76	.43	-.54	.29	.56	.21	-.74	.06	.59	.64	.03	-.56	.72
United States	.21	.29	-.53	.41	.16	-.83	.05	.71	-.26	-.64	.59	.83	.64	-.65	-.20	.87
Percent of Generalized Variance Explained by Factor																
	32	18	15		35	15	12		34	18	12		68	12	07	
10 Countries:																
Belgium	.67	.38	-.41	.76	.71	.30	.26	.66	-.69	.33	-.31	.68	.92	.15	.08	.88
Canada	.56	.39	.32	.57	.56	-.56	-.40	.79	.31	.31	.79	.81	.88	.05	-.15	.79
France	.31	.47	-.42	.49	.31	.21	-.65	.56	-.16	-.47	.50	.50	.97	-.05	.17	.97
Germany	.58	-.51	.28	.67	.93	.10	-.16	.90	-.81	-.14	.49	.92	.97	-.21	-.01	.98
Italy	-.26	.78	-.05	.68	-.26	.07	-.57	.39	-.33	-.19	.18	.18	.74	.25	.45	.82
Japan	.47	.48	.05	.46	-.38	-.30	-.27	.31	-.87	.31	-.10	.85	.88	-.35	.06	.90
The Netherlands	.74	-.03	.56	.86	.94	.09	-.08	.91	-.80	-.28	.17	.74	.95	.20	.07	.95
Sweden	.65	-.13	-.24	.50	.57	.44	-.05	.52	-.94	.07	-.00	.88	.50	.66	-.23	.74
United Kingdom	.78	-.25	-.23	.73	.54	-.34	.43	.60	-.28	.74	-.06	.62	.69	.08	-.49	.72
United States	-.09	.55	.56	.63	.36	-.83	.02	.82	.26	.75	.43	.82	.69	-.57	-.15	.82
Percent of Generalized Variance Explained by Factor																
	31	20	13		36	16	12		38	17	15		69	10	06	

*This figure indicates the proportion of the variance of the series explained by the factors whose weights are listed.

tria is negatively correlated with the pattern of movement characterizing Swiss activity levels. Movements in French and Italian activity levels are not explained by either of the first two factors.

These factor-analysis results relate only to the observed degree of synchronization in activity levels across countries. They suggest a number of cycles rather than a world cycle characterizing movement in all industrial countries. They suggest similarities in movement between Germany and a number of its European trading partners, and the United States and Canada, although the patterns of similarity in movement have not remained stable. The exceptional outturn is the large first factor for 1973-1977 with important and similar implications for all industrial countries; this factor can clearly be identified with the oil shock. The absence of similar factors for earlier periods suggests either the relatively small role played by such shocks in synchronizing cyclical movements, the ability of countries to offset their influence on real activity, or the limitation of these shocks to small groups of countries.

VI. Application of Reduced-Form Equations to the Explanations of Changes in Countries' Cyclical Positions

The evidence on the transmission process presented above must be viewed as only indirect evidence about the extent to which the transmission process has been affected by the move to flexible rates. As noted above, observed patterns of covariation indicate something about the transmission mechanism — all other things being equal — but other things have not been equal, notably the oil shock affecting all industrial countries, and perhaps even the adoption of fiscal and monetary policies in response to common domestic problems, for example, inflation. An experimental attempt is made here to relate observed changes in countries' activity levels to changes in common shocks, changes in policy stances, and fluctuations in economic activity abroad, and to see whether the impact of the transmission variable has been affected by the move to greater exchange-rate flexibility. The results must be viewed as highly tentative.

An extremely simple reduced-form equation was specified relating changes in a country's cyclical position to changes in activity levels abroad (ΔEI), changes in monetary and fiscal impulses (ΔMI, ΔFI), common external shocks (CS), and dummy variables (Z) reflecting country-specific developments, e.g., strikes. Thus relationships of the following form were specified.[19]

[19]This relationship is a modification of the relationship used by Victor Argy in "The Contribution of Monetary and Fiscal Impulses to Economic Activity," mimeographed, September 1977. He uses a seven equation model of aggregate demand that can be solved to obtain a reduced-form aggregate demand equation. With certain simplifying assumptions, he obtains an estimating relationship of the following form:

$$\dot{Y}_R = \text{fn}(\dot{RB}, \dot{FD}, \dot{FI}, \dot{COMP})$$

where YR is real output; RB represents real balances; FD represents foreign demand; FI represents the fiscal impulse; COMP represents price competitiveness; and the superscript ($\dot{}$) indicates that the variable is expressed in rates of change. No variable was included in the current equation to represent the effects of relative price movements since price effects (in contrast to short-term fluctuations in income) were thought to affect trade flows with a substantial lag. Since the dependent variable used here is the rate of growth of actual manufacturing output above the rate of growth of potential output, each of the explanatory variables was deflated by its "neutral" value.

ΔOutput Gap = fn(ΔMI, ΔFI, ΔEI, CS, Z)

The fiscal impulse, FI, is measured as the difference between the observed budget balance, expenditures minus receipts, and the cyclically neutral budget balance of the central government. It is assumed to be under the control of the central authorities so that changes in the fiscal impulse variable reflect desired changes in fiscal policy. For these calculations the German definition of the neutral balance is used with 1972 as a base year for the calculation of suitable ratios of government expenditure and receipts to GNP.[20] The balance is then deflated by nominal potential GNP. This measure of budget impulse is selected because it is widely used in Fund work, and because it is relatively easy to calculate. This fiscal impulse measure is introduced in level form on the assumption that a sustained expansionary fiscal impulse has a continuing effect on a country's cyclical position. It is also introduced in change form — which is very similar to the Dutch budget impulse measure — reflecting the view that the budget impulse has to increase as a percent of national income from year to year to have an on-going impact on the output gap. The second specification proves superior to the first for all countries other than the United States so that for estimation purposes it is adopted for all countries.

In choosing a measure of monetary stance for inclusion in this relationship it is desirable to select a variable that is under the control of the monetary authorities and clearly indicates the type of monetary policy that the authorities wish to implement. It is difficult to find such variables for the many industrial countries considered here, and the variable selected to represent monetary stance is arrived at by a process of eliminating less desirable alternatives. Further work based on country-specific knowledge of different types of monetary aggregates could substantially improve the representation of monetary stance.

Monetary stance can be represented by real balances, but real balances are not used in the specified relationships because the money supply in many countries was strongly influenced by the transmission process during the historical period. Domestic credit appears to be a more reliable indicator of monetary stance since it is not directly affected by reserve changes, and it is used in calculating the variable representing an exogenous change in monetary stance. The use of this variable is easy to criticize, nonetheless, in that it may have been determined in a number of periods by a reaction function focusing on overall liquidity, and may not be a reliable indicator of monetary policy. Its effectiveness as an indicator is also adversely affected by unanticipated price movements. Monetary policy is represented in the equation by the deviation of the rate of growth of domestic credit from the rate of growth of GNP.[21]

It is very difficult to distinguish between synchronization reflecting com-

[20]The concept and calculation of the cyclically neutral budget balance is explained in Sheetal K. Chand, "Summary Measures of Fiscal Influence," mimeographed, December 27, 1976. The budget figures reflect only the expenditure and receipts of the Federal Government given in *International Financial Statistics*. Data on potential real GNP prior to 1972 were based on the OECD Economic Prospects Division, "The Measurement of Domestic Cyclical Fluctuation," *Occasional Studies*, July 1973; the actual GNP deflator was used to express the real series in nominal terms. More recent figures on the rate of growth of nominal potential GNP are based on Fund Staff estimates. The series on potential GNP are clearly subject to large margins of error.

[21]The figures on domestic credit were taken from *International Financial Statistics*.

mon external shocks which affect activity levels in a similar way in all or a number of industrial countries, even in the absence of transmission, and country-specific fluctuations in activity abroad that induce a sympathetic movement in activity at home. The introduction of current and lagged foreign-impulse variables, with the current value representing "common influences" and the lagged value reflecting the transmission impact, was considered but rejected since the data base is semiannual. While some lag in the transmission process may be expected, the arbitrary imposition of a six-month lag does not seem reasonable and the interpretation of the statistical results would be uncertain at best. Instead, explicit allowance is made for the direct effects of the oil shock by the inclusion of a dummy variable that takes the value 1 for 1974:2 and 1975:1. The first factor for the period 1973-77 clearly attests to the importance of this shock. It is extremely important for all countries, and affects all countries in a similar manner. The factors for other periods, however, are not suggestive of common shocks in that their importance varies widely across countries and they are associated positively with upswings in some countries and downswings in others. Because of these inconclusive factor results, and the difficulty of identifying these shocks, no other "common shock" variable is included in the estimated relationship.

EI is the external impulse variable. It is proxied by the weighted average of output gaps in the other industrial countries described earlier. As noted above, this variable is affected by common shocks. With the inclusion of the oil shock variable it is expected that the coefficient on the foreign demand variable will relate to the transmission process rather than to the strength of common shocks.[22]

It was also necessary to introduce a number of dummy variables, Z, reflecting country-specific developments that are unrelated to changes in policy stances or external impulses. These dummies represent, for example, the French strikes of 1968, and the Italian strikes of 1969.

The relationship given above is estimated using ordinary least squares for 12 of the industrial countries over the periods 1963-1977. It is not estimated for Denmark or Norway because of inadequate data. In a number of instances the data suggest that activity levels respond with a lag to changes in domestic and foreign impulses so lagged values or simple weighted averages of current and preceding-period values are also introduced as explanatory variables. The weighting schemes used are described in the footnotes for Table 4.

Clearly, the measurement errors associated with each explanatory variable are likely to increase the standard error of the parameter estimate and reduce the significance of the coefficients. Also, the importance of excluded variables that are correlated with the explanatory variables may bias the estimated coefficients of the explanatory variables. To the extent that they are independent, they will contribute to the low explanatory power of the equation taken as a whole. One might expect a somewhat weak performance of the monetary impulse variable used here since it constitutes only one part of the money supply, and since it may be manipulated to offset changes in foreign assets.

[22]The coefficient could, to some extent, be affected by reverse causation for the larger industrial countries.

Table 4

Reduced-Form Equations Explaining Changes in Manufacturing Output Gaps

	Austria[1]	Belgium[2]	Canada[3]	France[4]	Germany[5]	Italy[6]	Japan[7]	The Netherlands[8]	Sweden[9]	Switzerland[10]	United Kingdom[11]	United States[12]
Constant	–0.00	–0.00	–0.01	–0.00	–0.01	–0.00	–0.00	–0.00	–0.01	0.00	–0.02	–0.00
	(0.7)	(0.8)	(1.8)	(1.3)	(1.7)	(0.6)	(0.2)	(0.1)	(1.9)	(1.0)	(0.5)	(0.3)
Monetary	0.50	0.39	0.50	0.52	1.00	0.75	0.51	2.29	0.31	0.82	0.36	0.81
Impulse	(1.4)	(1.0)	(2.2)	(1.3)	(2.5)	(2.2)	(2.0)	(1.7)	(1.3)	(1.9)	(2.4)	(1.5)
Fiscal	4.89	0.45	10.9	4.40	0.85	2.37	0.16	0.07	0.75	2.35	0.53	4.84
Impulse	(2.5)	(1.8)	(4.4)	(1.5)	(1.0)	(1.7)	(0.1)	(0.3)	(0.1)	(0.5)	(0.4)	(1.7)
Foreign	0.80	0.70	0.29	0.41	0.70	0.09	0.21	0.78	0.78	0.50	0.68	0.09
Impulse	(4.1)	(3.4)	(2.0)	(2.1)	(2.4)	(0.6)	(1.0)	(5.4)	(3.0)	(1.6)	(2.7)	(0.2)
Oil	–0.007	–0.016	–0.010	–0.019	0.012	–0.036	–0.090	–0.021	0.014	–0.091	0.031	–0.052
	(0.3)	(0.9)	(0.9)	(1.1)	(0.5)	(2.6)	(4.0)	(1.6)	(0.5)	(3.3)	(1.4)	(1.6)
Country	0.026			–0.053		–0.055						
Dummy	(3.3)			(4.4)		(4.4)						
SEE	.017	.019	.012	.015	.020	.018	.028	.013	.017	.023	.017	.027
D.W.	2.19	2.04	2.18	1.92	1.74	1.43	1.09	1.41	.99	2.78	2.13	1.58
$\overline{R}$-squared	.63	.65	.74	.74	.54	.55	.51	.76	.31	.67	.44	.45

[1]For Austria the country dummy took the value +1, –2, and +1 for 1972:2, 1973:1 and 1973:2, respectively, reflecting the temporary effects on the level of output caused by a change in the tax system. The fiscal impulse variable consisted of a lagged average over the current and two preceding periods of the change in the cyclical effect of the budget with weights of .1, .3, and .6.

[2]For Belgium the fiscal variable was the current change in the cyclical effect of the budget.

[3]For Canada the monetary and foreign impulses were simple averages over the current and preceding half years. The fiscal impulse variable was the current value of the change in the cyclical effect of the budget.

[4]For France the fiscal and monetary impulse variables were simple weighted averages over the current and preceding period. The fiscal impulse variable was based on the change in the cyclical effect of the budget.

[5]For Germany the monetary impulse was lagged by one period. The fiscal impulse variable was the change in the cyclical effect of the budget.

[6]For Italy the foreign impulse variable was lagged by one period. The fiscal impulse variable was a weighted average of the current and preceding half-year changes in the cyclical effect of the budget with weights of .4 and .6, respectively. The Italian dummy reflects the effects of strikes in 1969-1970.

[7]For Japan the monetary and foreign impulse variables were lagged one period; the fiscal variable was the change in the cyclical effect of the budget for the current period.

[8]For the Netherlands the monetary impulse variable was lagged one period. The fiscal impulse variable was a simple average over the current and two preceding periods of the change in the cyclical effect of the budget.

[9]For Sweden the monetary and fiscal impulse variables were lagged one period; the fiscal variable was the change in the cyclical effect of the budget.

[10]For Switzerland the monetary impulse variable was lagged one period; the fiscal impulse variable was a simple average over the current and preceding half year of the change in the cyclical effect of the budget.

[11]For the United Kingdom current values were used for both monetary and fiscal impulse variables. The fiscal variable was represented by the change in the cyclical effect of the budget.

[12]For the United States the monetary impulse variable was lagged by one period. The fiscal variable was the current change in the cyclical effect of the budget.

For 5 of the 12 countries the monetary impulse variable is significant at a 99 percent confidence level; at an 80 percent confidence level the coefficient is insignificant only for Belgium. The fiscal impulse variable is highly significant for only 2 of the 12 countries and significant at an 80 percent confidence level for only six countries. This may reflect, in part, the particularly large scope for error in the measurement of the cyclically neutral budget. The foreign impulse variable is introduced with a lag for Canada, Japan, and Italy. It plays a relatively small role in explaining movements in activity in Italy, Japan, and the United States. All of the relationships given in Table 4 must be viewed as subject to large margins of error, and further work is clearly called for.

The implications of these relationships for the transmission process are explored in several ways. Shift dummies are included for the period after 1972 to test for the stability of the coefficients on the foreign-impulse variable after the move to greater exchange-rate flexibility.[23] For 3 of the 12 countries the coefficient on foreign activity increases significantly with the move to managed flexibility. These countries are Belgium, France, and Austria. In as far as this coefficient relates to the transmission process, and not to the strength of common shocks, it suggests a strengthening of this process after 1972.

A second approach is used to explore the development of the transmission process since 1972. It is hypothesized that the foreign-impulse variable does not fully represent the impact of fluctuations in activity abroad and that much of the unexplained movement in the series is attributable to the transmission process. The inclusion of the foreign-demand variable is necessary, nonetheless, to obtain unbiased coefficients for the other exogenous variables. Thus the estimated coefficients for fiscal and monetary impulses and the common shock are used to adjust observed changes in activity levels for the ten larger industrial countries for changes that can be attributed to deviations in fiscal and monetary policy stances from "neutrality," and for the common oil shock.[24]/[25] The "adjusted" series on changes in economic activity are then analyzed by means of factor analysis to see whether the pattern of covariation has changed significantly. The results are given in Table 5.

The adjusted series show a somewhat higher degree of covariation than the unadjusted series for the period prior to 1972, as indicated by the explanatory power of the first and second factors in Table 5, and a lower degree of covariation thereafter. This suggests that the domestic policy stances during the earlier period contributed to a reduction in the observed synchronization of cyclical movements. The degree of synchronization of the adjusted series for the period 1973-1977 fell relative to the unadjusted series.

[23]A shift dummy on the monetary impulse variable after 1972 proved uniformly insignificant.

[24]The impulse measures were defined as deviations from neutrality, that is, deviations of fiscal stance from the cyclically neutral budget using 1972 as a base period and deviations of the rate of growth of real domestic credit from the rate of growth of potential GNP. Thus, the correction was based on setting the "impulse measures" to zero. Although estimated relationships were available for Austria and Switzerland, adjusted series were not calculated for these countries since it was desirable to compare the factor analysis results before and after adjustment for the same group of countries.

[25]Argy, "Monetary and Fiscal Impulses," made similar adjustments for purposes of testing whether monetary and fiscal policy had been stabilizing.

Table 5

Measures of Covariation between Cyclical Positions in Industrial Countries Adjusted for Differences in Policy Stances and the Initial Impact of the Oil Shock, 1966-1977

	1966-1970	1968-1972	1973-1977
Percent of generalized variance explained by			
First factor:	36	40	52
First and second factors:	57	64	67
Percent of variance explained by the first two factors for			
Belgium	89	63	71
Canada	3	49	82
France	75	79	65
Germany	62	70	79
Italy	66	59	71
Japan	40	67	69
The Netherlands	62	74	78
Sweden	68	83	78
United Kingdom	42	19	44
United States	63	77	32

When compared over time, the degree of synchronization of the adjusted series tends to rise gradually. These results are consistent with the view that there has been a strengthening of the transmission process over the last five years. They are also consistent with the view that common exogenous shocks other than the oil shock have become increasingly important, although the first factor obtained from the adjusted data does not support this interpretation.[26]

VII. Summary and Conclusion

Various techniques have been used to analyze the observed degree of synchronization of cyclical fluctuations among industrial countries, and to determine whether the move to greater exchange-rate flexibility has resulted in a weakening of the transmission of real impulses among countries. The observed degree of synchronization increased between the late 1960s and the period of managed floating. When the period immediately following the oil shock was excluded from the managed-rate period, the observed degree of covariation between changes in activity levels remained high.

The pattern of covariation provides only indirect evidence on the

[26]The conclusions suggested here contrast somewhat with those drawn in Pigott, Sweeney, and Willett, "Aggregate Economic Fluctuations," which attributes a large amount of the recently observed covariation to external shocks.

strength of the transmission process since activity levels reflect, among other things, the impacts of policy stances and common exogenous disturbances. An attempt was made to directly estimate the impact of country specific fluctuations in foreign activity levels to see whether this impact had changed with the move to greater flexibility. Further observed activity levels were adjusted for changes in policy stances and even for the direct impact of the oil shock. The adjusted series were analyzed for information on the transmission process. Although all of these results must be viewed with caution because of the scope for error in the calculations and their interpretation, they indicate that the increase in the observed degree of covariation among countries since 1972 cannot be attributed exclusively to a convergence of policy stances or the oil shock. They suggest a continuing or heightened importance of the transmission process under a system of greater exchange-rate flexibility, and underscore the need for coordinated demand management policies in returning to more normal activity levels.

Discussion

Robert E. Baldwin*

It is a pleasure to have the opportunity to comment upon the very interesting and ambitious paper by Duncan Ripley. In her careful study of changes in the degree of synchronization of cyclical movements in real economic activity between 1952-1974 she pointed out most of the possible sensitive parts of the analysis so I can do little more than reemphasize some of these.

The first issue that arises is what difference one would expect a system of flexible versus fixed exchange rates to make in the degree to which real changes in economic activity are transmitted abroad. There are, of course, an almost bewildering set of models to analyze, each with differences in assumptions concerning such factors as the responsiveness of the trade account to real income and relative price changes; the responsiveness of capital flows to changes in interest rates and exchange rates; the flexibility of prices and wages; the nature of expectations about future changes in prices and exchange rates; the nature of various adjustment lags; and the time period under consideration. It might be useful to expand somewhat the second section of the paper by presenting a taxonomy of the different possibilities that emerge from a spectrum of models, such as those surveyed by Rudy Dornbusch in his paper. In her own survey, Ripley does, however, touch on most of the reasonable possibilities. Out of this, the conclusion seems to emerge that the transmission of real economic activity from one country to another under flexible rates runs the range of possibilities from being quite similar to that under fixed rates to being weaker than under this latter system and even to being stronger and more magnified. Thus, the traditional notion that, in the intermediate run, flexible rates tend to weaken the propagation of real disturbances is not something we can be very confident about, given the apparently long lags in the responsiveness of the trade account to relative price changes coupled with the high responsiveness of foreign direct investment to exchange-rate changes.

The system that we have had and that Duncan is investigating is, of course, not a pure flexible-rate versus pure fixed-rate system but a managed float system versus one with a fixed rate that has been subject to occasional adjustments. This tends to blur the distinctions one might expect on theoretical grounds.

We should not forget that it is not the type of exchange-rate system we have that by itself determines the nature of real adjustments but also the

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nature of politically feasible real adjustments that determine the nature of the exchange-rate system. It is not an accident that governments intervene in exchange-rate markets now nor an accident that we did not stick entirely with fixed rates in the so-called fixed-rate period. For example, one now sees the same political pressures in export surplus nations against allowing the extent of appreciation indicated by free market forces that we did in the fixed exchange-rate period. In other words, only a fairly small range of adjustments is politically tolerable in any time period so that the operation of a fixed versus flexible system becomes rather similar as far as their real transmission effects are concerned.

With regard to political pressures exerted on exchange-rate policies, it has always seemed rather puzzling that export interests rather than import-competing industries seem more important both in depreciations and appreciations of countries' currencies in response to periods of trade deficits and trade surpluses. On the other hand, in the field of trade policy, the import-competing industries dominate export industries when it comes to exerting political pressures. It is not clear to me just why this is so.

A second issue concerns how to relate the cyclical activity of one country to that of others. In this regard Duncan relates the ratio of a country's actual-to-potential output to a weighted average of this ratio for its trading partners. As weights for constructing an average of trading partner activity, she uses the effect on the exports of the country under consideration of a 1 percent change in economic activity in each trading partner. In other words, the weights relate to how changes in activity abroad affect the country being considered. I wonder about the relationship in the other direction, namely, the effect of the country under consideration on the other countries. I would think that some sort of average of the trade effects of changes in economic activity in both directions would be more appropriate as weights than just the effect in one direction. The effect of changes in economic activity in one country on economic activity in another is also transmitted through other mechanisms besides income effects in trade, i.e., substitution effects related to relative price changes and effects due to changes in capital flows. By using only the income effects of trade as weights one might be missing some of the transmission effects. A country-by-country comparison would seem to avoid some of these problems.

As she has reported, the results of her initial correlation and factor analyses are that the transmission of economic activity among countries seems just as high — indeed even higher — after flexible rates were introduced as during the fixed-rate period. But, as she notes, one cannot conclude from this that the transmission mechanism is as strong under flexible as fixed rates. Some factor in the later period may simply have been common to all countries and thus made them all move together without having anything to do with the transmission mechanism. Similarly, various domestic policies may have happened to be synchronized and thus to produce a more uniform movement.

To examine this possibility, Duncan runs regressions for each country that make the change in a nation's output gap a function of changes in mone-

tary policy, changes in fiscal policy, changes in external impulses, the oil shock, and a number of dummy variables. Her external variable is still significant in most cases, but, as she again says, one cannot be sure that this does not just represent some common cause affecting all countries' output. The direction of causality between a country's output gap and the gap in other countries also is not clear.

Duncan then takes the coefficients on the monetary and fiscal variables as well as on the oil shock to adjust the observed changes in activities. Hoping to have corrected for factors that did not stay constant over the period, she again performs her factor analysis and finds the degree of synchronization does not decline in the flexible-rate period but actually rises. This time there is a more uniform upward trend throughout the period, however. This is consistent with a point she makes earlier, namely, the gradual increase in the openness of economies during the period.

In conclusion I found the paper most interesting and stimulating. The problem she is dealing with is a formidable one on both theoretical and econometric grounds and she has shown considerable imagination and ingenuity in handling it. I think we can conclude that the data do not support the old notion that the degree of synchronization of real activity under flexible rates is less than under fixed rates.

The International Transmission of Inflation[1]

Norman S. Fieleke*

The world is passing through the third great inflation of the 20th century. As can be seen from Figure 1, which charts an index of "world" market prices of 28 basic commodities, the first two severe inflations of the century were closely associated with the world wars and their aftermath (including the Korean Conflict after World War II), while the current sharp inflation is basically a peacetime phenomenon, beginning well after the 1965-68 escalation of the war in Vietnam.

Figures 2 and 3 testify to the pervasiveness of the inflation. The fact that inflation has accelerated so widely throughout the world raises the question whether one or a few countries are the source, generating and transmitting inflationary pressure to the rest of the world, or whether the geographic sources are virtually as widespread as the manifestation. The primary aim of this paper is to investigate the transmission of inflation between countries and, in particular, whether exchange-rate flexibility insulates a country from external inflationary pressure. It is not our purpose to inquire into the causes of inflation at its geographic sources.[2] By "inflation" is meant a rise of prices generally, not an increase in a particular price or group of prices such as might result from changes in tastes, in techniques, or in availabilities of particular resources.

Interdependence and Inflation

The relatively poor grain harvests of 1972 and 1974[3] and the quadrupling of the crude oil price between 1973 and 1974 have led, at least within the more advanced countries, to a heightened sense of economic interdependence and to the view that inflation may be transmitted among nations more readily now than in the past when the world economy presumably was less fully integrated.

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[1]The views in this paper are not necessarily those of the Federal Reserve Bank of Boston. Cynthia Peters and Gary Tsuyuki were research assistants for this project. Parts of this paper draw upon Norman S. Fieleke, "The Worldwide Inflation," *New England Economic Review*, May/June 1976.

[2]For a brief discussion of some possible causes, see *ibid.*, pp. 3-9.

[3]In fact the declines in the production of grain amounted to only about 2 percent in 1972 and 3 percent in 1974, with an increase of 11 percent intervening in 1973; see Fieleke, "The Worldwide Inflation," p. 4.

Not only does it seem plausible that increased integration and increased transmission should go hand-in-hand, but — with fixed-exchange rates, presumably — an increase in integration is often *defined* essentially as an increase in transmission, or as an increase in the ease with which market forces establish uniformity of price movements in different countries for any particular good.[4] Accordingly, the degree of economic integration among countries is sometimes roughly measured by the degree of correspondence between their price movements for identical products; but it is also frequently measured by some ratio of trade between the countries to their total output.[5] While, as the saying goes, "Everyone is free to make his own definitions," it seems that a ratio of trade to output is a much better index of the extent to which two economies are integrated, in the sense of being interdependent or woven together,[6] than is the degree of correspondence between their price movements, and that correspondence between price movements is the better measure of the extent to which inflation can be transmitted, or of the "openness" of the two economies to each other's inflation.

To illustrate this point, imagine that there are virtually no transportation costs or governmental barriers to trade between two countries, which maintain a fixed-exchange rate between their currencies and are highly open to the transmission of economic disturbances from each other. In the absence of such disturbances, however, there might be very little commerce between the two because of close similarity in their underlying tastes, techniques, and resource bases; the "interdependence" of two such economies does not run very deep, even though their price movements correspond closely. On the other hand, imagine two other countries which also maintain a fixed-exchange rate but which erect numerous barriers to trade and payments that prevent a close correspondence between price movements for many commodities. In spite of the barriers, these countries might carry on a significant trade in relation to their total output because of substantial differences in tastes, techniques, or resource bases. These two countries are more interdependent than the first two; the interruption of commerce between them would be more disruptive.

If this distinction between interdependence and openness is accepted, the issue raised in the opening sentence of this section is not tautological but is an interesting question for research, because growing interdependence may or may not be accompanied by increasing openness and fuller transmission of inflation.[7] For example, two countries which had always been highly open to

[4]Cf. Fritz Machlup, *A History of Thought on Economic Integration* (New York: Columbia University Press, 1977), pp. 18-21.

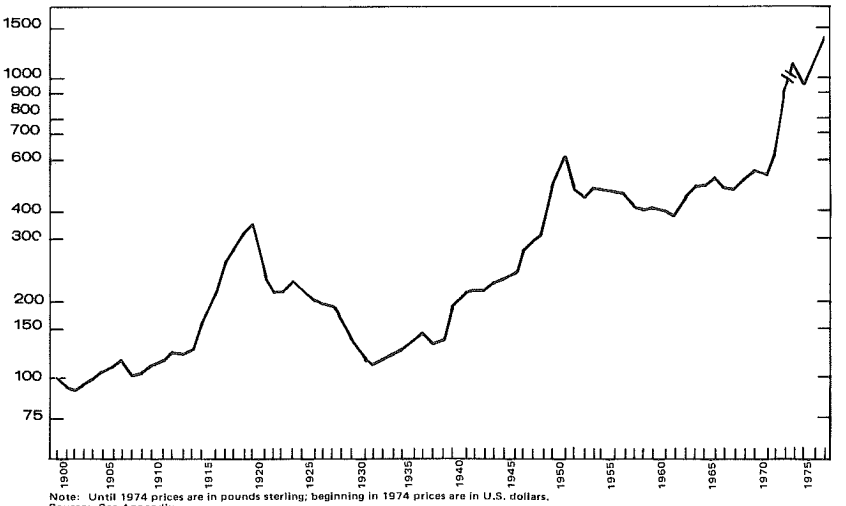
[5]For example, see Walter S. Salant, "International Transmission of Inflation," in *Worldwide Inflation: Theory and Recent Experience,* ed. by Lawrence B. Krause and Walter S. Salant (Washington, D.C.: The Brookings Institution, 1977), pp. 175-79.

[6]A geopolitical evaluation of interdependence would take into account not only trade in relation to output but strategic availability of substitutes for imported key raw materials, etc. Such matters are beyond the scope of this paper.

[7]As interdependence approached its limit, i.e., as a country's exports rose to absorb nearly all its output, the degree of openness would be approximately measured by the degree of interdependence. In my 1976 paper, "The Worldwide Inflation," "openness" and "interdependence" were used interchangeably.

Figure 1

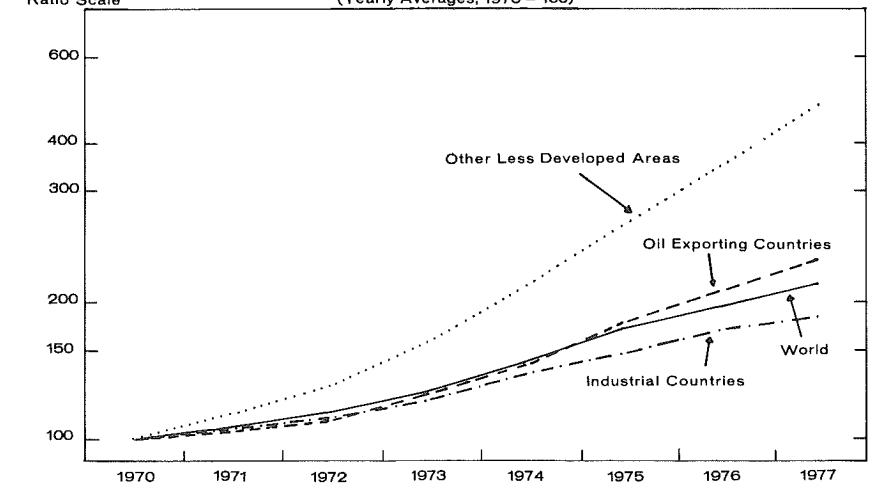
COMMODITY PRICES, 1900-77
(Yearly Averages; 1845-50 = 100)



Note: Until 1974 prices are in pounds sterling; beginning in 1974 prices are in U.S. dollars.
Source: See Appendix.

Figure 2

CONSUMER PRICES IN SELECTED WORLD AREAS, 1970-77
(Yearly Averages; 1970 = 100)

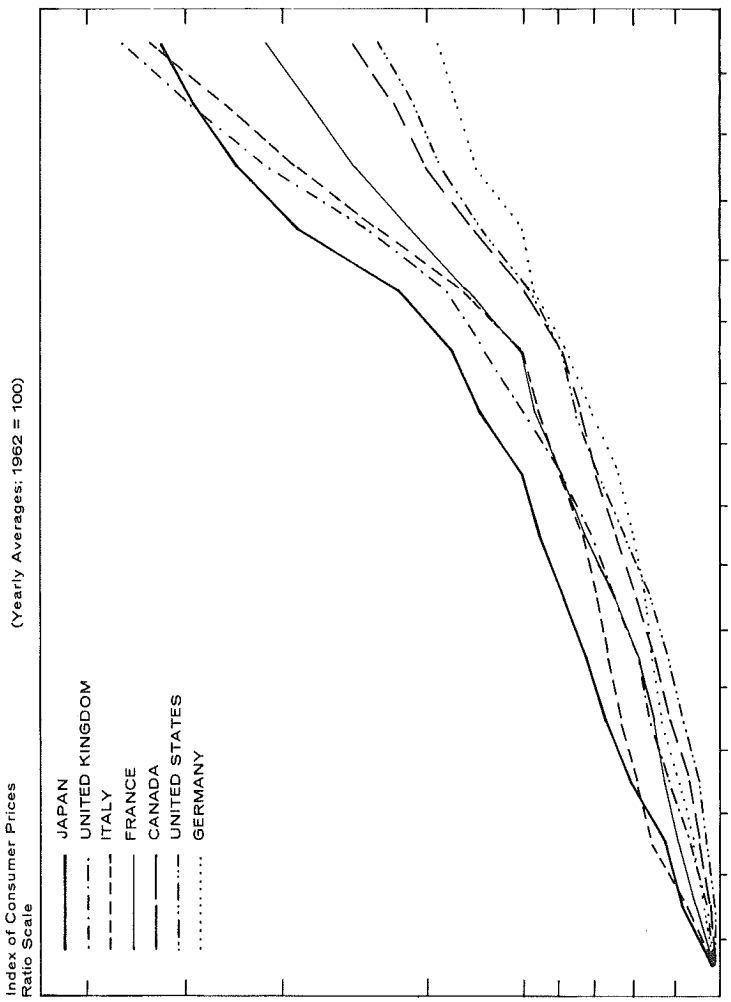


Source: See Appendix.

Figure 3

CONSUMER PRICES IN SEVEN INDUSTRIAL COUNTRIES, 1962-77

(Yearly Averages: 1962 = 100)



Source: See Appendix.

each other might start to trade more heavily with each other because of changes in tastes, techniques, or resource availabilities rather than because of reductions in trade barriers that would bring their prices closer together; on the other hand, an increase in trade relative to output, or in measured interdependence, might well reflect a reduction in trade barriers and be accompanied by greater correspondence of price movements.

The first column of Table 1 suggests that there has indeed been an increase in interdependence among industrial countries since 1960-61. However, the table also shows that the dispersion of consumer price inflation rates among these countries, whether measured by the standard deviation or the coefficient of variation, has risen rather than fallen between 1960-61 and 1976-77.

The relationship between interdependence and inflation can be tested empirically in another way. The argument that growing interdependence draws national inflation rates closer together seems to imply that inflation rates in various countries contribute to "explaining" the inflation of, say, Country A in the proportion that each of those countries trades with Country A, and that the higher the ratio of A's trade to its gross product, the more fully inflation in A can be explained by inflation in the countries with which A trades. More precisely,

$$(1)\quad \hat{\dot{P}}_a = \frac{X_{ab}+M_{ab}}{X_a+M_a}\dot{P}_b + \frac{X_{ac}+M_{ac}}{X_a+M_a}\dot{P}_c + \ldots + \frac{X_{an}+M_{an}}{X_a+M_a}\dot{P}_n,$$

where $\hat{\dot{P}} \equiv$ estimated rate of inflation,
$\dot{P} \equiv$ actual rate of inflation,
$X \equiv$ exports, $M \equiv$ imports,
and the subscripts refer to countries, with X_{ab} being exports of A to B, M_{ab} being imports of A from B, and X_a and M_a being total exports and imports of A.

The thesis that growing interdependence draws inflation rates closer together implies that this equation should be more accurate in predicting inflation in A, the greater is A's dependence, i.e., the greater is

$$\frac{X_a+M_a}{2GNP_a}$$

other things being equal. More generally, where the subscripts i and j refer to countries, one can compute

$$(2)\quad \hat{\dot{P}}_i = \frac{1}{\Sigma(X_{ij}+M_{ij})} \sum \dot{P}_j(X_{ij}+M_{ij}), \text{ for all j.}$$

Then the correlation for all i

between $\dfrac{|\hat{\dot{P}}_i - \dot{P}_i|}{\dot{P}_i}$ and $\dfrac{1}{2GNP_i}\sum_{\text{all j}}(X_{ij}+M_{ij})$ should be negative if

national inflation rates are influenced by dependence, other things equal. That is to say, the percentage error in estimating a country's inflation rate on the basis of foreign inflation rates should be lower, the greater is the country's measured dependence on foreign countries.

We have in fact computed $\hat{P}$ for each of the following ten countries: the United States, Japan, Canada, the United Kingdom, France, Germany, Italy, the Netherlands, Sweden, and Denmark. The computation was performed twice for each country, first using consumer price inflation rates for 1962-66 and trade and GNP (or GDP) data for 1964, and then using consumer price inflation rates for 1972-76 and trade and GNP (or GDP) data for 1974. In the computation of $\hat{P}$ for a country, all of the country's significant trade flows with other countries were included if the associated inflation rate data were available; the percentage of total trade included varied from 70 percent for Japan to 90 percent for the Netherlands.[8]

Completing the computations yielded a simple correlation coefficient of −0.55 for the 1962-66 period and a coefficient of −0.21 for the 1972-76 period. The latter coefficient is not significantly different from zero, while the former is (on a one-tail test at the 5 percent level). The coefficients are of the proper sign, and the decrease in the absolute value of the coefficient between 1962-66 and 1972-76 might be attributable to the greater degree of exchange-rate flexibility in the latter period, as exchange-rate flexibility may allow national inflation rates to diverge more widely.

In the foregoing analysis inflation was measured in terms of consumer price indexes. None of the available price indexes is ideal for international comparisons, if only because of the different weights employed from country to country, but indexes of consumer prices have the advantage of being both fairly comprehensive (including, in particular, many nontraded items) and genuine fixed-weight price indexes. Once trade has been opened, any subsequent reductions in transport costs and other commercial barriers (increases in openness) will shift goods from the nontradable into the tradable sector and thereby leave less room for national inflation rates to diverge, at least with fixed-exchange rates.[9] On the other hand, increases in *interdependence* need not bring national consumer price inflation rates closer together, even with fixed-exchange rates. After the advent of greater exchange-rate flexibility, national consumer price inflation rates in the industrial countries seem to have been uninfluenced by the degree of interdependence, according to the computations based on equation (2), and these inflation rates diverged more widely in spite of a marked prior increase in interdependence, according to the statistics in Table 1.

[8]This procedure is tantamount to assuming that the omitted trade flows and inflation rates are not much different from those included in their impact. Trade data were taken from IMF *Direction of Trade* computer tape, June 1978. All other data are from *International Financial Statistics, 1978 Supplement,* May 1978.

[9]For a somewhat different view, see Walter S. Salant, "International Transmission", p. 174-75. Also cf. R. J. Sweeney and T. D. Willett, "The International Transmission of Inflation: Mechanisms, Issues and Evidence," in *Bank Credit, Money and Inflation in Open Economies,* ed. by Michele Fratianni and Karel Tavernier (Berlin: Duncker & Humblot), p. 445.

Table 1

Interdependence and Dispersion of Consumer Price Change
for 12 Industrial Countries,[1] Selected Years

Period	Degree of intergroup dependence[2]	Dispersion of percent change in consumer price indexes[3]	
		Standard deviation	Coefficient of variation
	(1)	(2)	(3)
1960 - 1961	0.108	2.0	0.4
1965 - 1966	0.111	2.2	0.3
1970 - 1971	0.126	3.2	0.3
1976 - 1977	0.141	9.3	0.5

[1]The 12 countries are Austria, Canada, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the United States. *International Financial Statistics* lists 14 "industrial countries," of which Belgium and Denmark are omitted here for lack of data.

[2]Defined as the simple average of the ratios of trade to GNP (or GDP) for the 12 countries, where each country's trade is defined as half the sum of its exports to and imports from the other 11 countries.

[3]Percent change for 1960-61 is defined as the percent change in the level of the CPI between 1959 and 1961, etc.

Source: International Monetary Fund: *Direction of Trade Annuals,* 1960-64, 1961-65, 1964-68, 1966-70; *Direction of Trade,* May 1978; *International Financial Statistics,* May and August 1978.

Transmission of Inflation under Fixed- vs. Flexible-Exchange Rates: some general considerations

Before proceeding to some rather detailed analysis of inflation transmission under fixed- vs. flexible-exchange rates, it may be worthwhile to recall the key elements of the longstanding argument made on behalf of exchange-rate flexibility as a buffer against the international transmission of inflation. First consider the process by which inflation of demand is transmitted under fixed-exchange rates, a process whose essence can be summarized in a few words. If prices in one country (including prices of goods that have been imported) show a tendency to rise more rapidly than in the rest of the world, purchasers in that country will direct their spending toward cheaper goods obtainable abroad, while purchasers in the rest of the world will divert their spending away from the goods exported by the inflating country, so that there will be greater spending on the goods produced in the rest of the world and a rise in the prices of those goods. At the same time, the rest of the world will experience a balance-of-payments surplus, or a net influx of funds from the inflating country, and this influx of money will support (and perhaps magnify) the rise in prices that is taking place.

One argument on behalf of freely flexible-exchange rates is that they put an end to this transmission process. With freely flexible-exchange rates, governments do not buy or sell foreign currency in order to fix exchange rates; therefore, if the residents of a country were to receive more foreign currency (from foreign purchasers of their goods and securities) than they wanted to spend on foreign goods and securities, they would be unable, under flexible rates, to sell the excess to their government in exchange for domestic currency balances with which to bid up domestic prices. On the contrary, in such circumstances, with the supply of foreign exchange in excess of the demand, the price of foreign exchange would fall until market supply was reduced to the level of market demand. To make essentially the same point in a different way, if one country is experiencing inflation and another is not, the increasing demand by the inflating country for the goods of the stable country will operate to bid up the foreign-exchange price of the stable country's currency rather than the domestic prices of the stable country's goods. Therefore, it is asserted, a country with a freely flexible-exchange rate should be able to pick its own rate of inflation, while a country with a fixed-exchange rate cannot do so.[10]

There are counter-arguments, of course. Perhaps the most popular asserts that increased exchange-rate flexibility, rather than allowing countries to pick their own rates of inflation, has instead introduced an inflationary asymmetry into the movements of national prices. To illustrate, suppose that the development of popular new U.S. products results in a tendency toward

[10]See W. M. Corden, *Inflation, Exchange Rates and the World Economy* (Chicago: University of Chicago Press, 1974), p. 66; Gottfried Haberler, "The International Monetary System after Jamaica and Manila" in *Contemporary Economic Problems* 1977, ed. by William Fellner (Washington: American Enterprise Institute, 1977), pp. 251-52; and Harry G. Johnson, *Money, Balance-of-Payments Theory, and the International Monetary Problem,* Essays in International Finance, No. 124 (Princeton, N.J.: Princeton University, 1977), p. 23.

surplus in the U.S. balance of payments, including U.S. payments with the United Kingdom, so that the pound sterling depreciates substantially against the U.S. dollar in the foreign-exchange market. Because the dollar now costs more in terms of pounds sterling and British imports from the United States also cost more in pounds sterling, there is a tendency for prices to rise in the United Kingdom. If the cost of living goes up, British workers may well demand and obtain offsetting wage increases, giving further impetus to inflation. In the United States, on the other hand, wages and prices do not go down significantly — even if the cost of living initially declines as a result of the appreciation of the dollar and the accompanying reduction in the cost of imported goods — mainly because employees will strike rather than accept reductions in wage rates. Therefore, the change in the exchange rate between the dollar and the pound sterling is accompanied by a rise in prices in the United Kingdom, which is denied the option of picking a zero inflation rate, but not by a corresponding decline in prices in the United States, and the net result for the two countries combined is inflation.

While this argument may point out a genuine asymmetry in price behavior, it seems that any such asymmetry must exist under fixed- as well as under flexible-exchange rates.[11] A country whose currency would appreciate under a flexible-exchange-rate regime will instead experience a balance-of-payments surplus if exchange rates are fixed, and a country whose currency would depreciate will instead incur a balance-of-payments deficit. With fixed-exchange rates, then, a surplus country will tend to have inflationary pressure because of the net influx of foreign money, while a deficit country will fail to undergo a corresponding deflation, even though there is a net outflow of funds, because large firms and employee organizations refuse to accept reductions in prices and wages. Just as with flexible-exchange rates, the net result is inflation. In other words, the argument that flexible-exchange rates introduce an inflationary asymmetry into national price movements is itself asymmetrical, for it fails to acknowledge that if prices and wages resist reduction under flexible-exchange rates they will also resist reduction under fixed-exchange rates.

In addition, the claim made on behalf of freely flexible-exchange rates is that they *allow,* not that they *enable,* countries to opt for low rates of inflation. The fundamental point is that under fixed-exchange rates and an open trading system, a country with a low rate of inflation will begin to accrue surpluses if inflation surges in the rest of the world, while with flexible-exchange rates the country will not experience such inflationary surpluses. However, it is not maintained that exchange-rate flexibility makes a government stronger or a populace more willing to bear sacrifices; on the contrary, it may simply make it easier for a country to manufacture its own economic crisis — an exercise of independence not to be advocated, but such an exercise nonetheless.

[11]In a recent study, Morris Goldstein concluded that evidence for five large industrial countries generally failed to reveal such asymmetry. See his "Downward Price Inflexibility, Ratchet Effects, and the Inflationary Impact of Import Price Changes: Some Empirical Evidence," *International Monetary Fund Staff Papers,* XXIV (November, 1977), 569-612.

Inflation and Internationally Traded Goods

If it is true that countries can pick their own rates of inflation under flexible-exchange rates, it seems that national rates of inflation should have diverged after the abandonment of fixed-exchange rates, for it is unlikely that all countries would independently select the same rate of inflation. Inflation in *this* context should be measured by national changes in the (local currency) prices of internationally traded goods, because it is the national prices of these goods that presumably are linked together by fixed-exchange rates, while the prices of nontraded goods move differently in different countries under fixed-exchange rates if only because of national differences in productivity change.[12] Under flexible-exchange rates, it is asserted, even the link between national prices of traded goods is broken.

Because wholesale price indexes are relatively heavily weighted with internationally traded goods, an analysis of the dispersion in national rates of change in such indexes under fixed- vs. more flexible-exchange rates may offer some insight. Yearly percentage changes in the wholesale price indexes of seven major industrial countries are plotted in Figure 4, and for each year a vertical line represents the range between the highest and lowest percentage changes. Clearly, the range is much greater since 1973, when fixed-exchange rates were generally abandoned, than during the years when countries tried to maintain fixed-exchange rates. For those who prefer the standard deviation or the coefficient of variation rather than the range as a measure of dispersion, Table 2 shows that the standard deviation of changes in wholesale price indexes also has increased dramatically since the abandonment of fixed-exchange rates, although the same cannot be said of the coefficient of variation. Of course, the differences between national changes in wholesale prices might have become much greater after 1973 if governments had allowed exchange rates to float freely instead of intervening to influence the rates with very sizable foreign-exchange transactions.

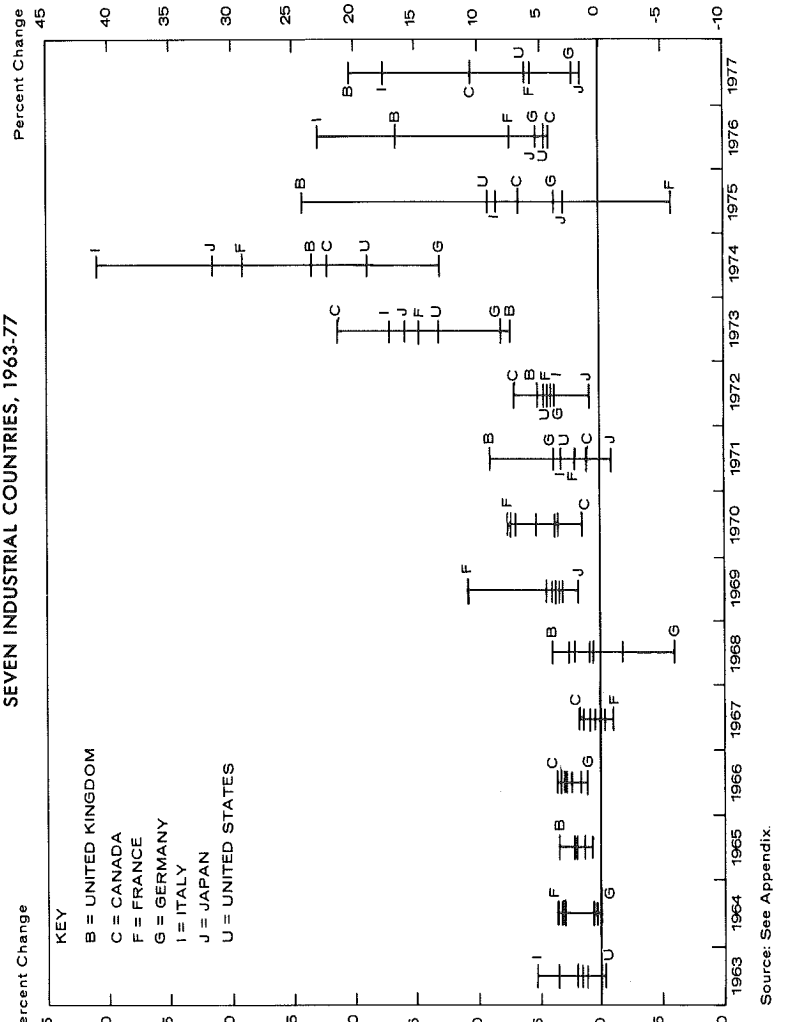
While such measures of dispersion in wholesale price indexes may suggest the right conclusion,[13] they are not very satisfying because the indexes include some nontraded items and because the weights employed in the

[12]For example, suppose that under fixed-exchange rates the prices of traded goods in Countries A and B are perfectly stable and that output per man hour is constant in the nontraded goods sectors in both countries and in A's traded sector but is growing by 10 percent per year in B's traded sector. Then wages and prices in the nontraded goods sector in A will be stable, other things being equal. In B, however, the stable price of traded goods coupled with the 10 percent rise in productivity implies that money wages are rising 10 percent per year in the traded sector, so that wages must also rise in the nontraded sector if that sector is to retain its labor force. Rising wages and constant productivity in B's nontraded sector imply rising prices in that sector. See Bela Balassa, "The Purchasing-Power Parity Doctrine: A Reappraisal," *The Journal of Political Economy,* LXXII (December 1964), 584-96, and Ronald I. McKinnon, *Monetary Theory and Controlled Flexibility in the Foreign Exchanges,* Essays in International Finance No. 84 (Princeton, N.J.: Princeton University, 1971), pp. 21-23.

[13]For a brief summary of recent studies on the dispersion of national rates of inflation, see Marina v. N. Whitman, "International Interdependence and the U.S. Economy," in *AEI Studies on Contemporary Economic Problems, 1976,* ed. by William Fellner (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1976), pp. 201-03.

Figure 4

YEARLY PERCENT CHANGE IN WHOLESALE PRICES FOR SEVEN INDUSTRIAL COUNTRIES, 1963-77



Source: See Appendix.

Table 2

Yearly Percent Change in Wholesale Prices for Seven Industrial Countries, 1963-1977: Standard Deviation and Coefficient of Variation

Year	Standard deviation	Coefficient of variation
1963	1.8	1.0
1964	1.5	1.0
1965	0.9	0.5
1966	0.9	0.3
1967	1.0	1.9
1968	3.1	10.2
1969	2.6	0.6
1970	2.2	0.4
1971	2.8	0.9
1972	1.7	0.4
1973	4.6	0.3
1974	8.5	0.3
1975	8.2	1.1
1976	6.8	0.7
1977	6.5	0.7

Note: The seven countries are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

Source: *International Financial Statistics,* May and August, 1978, except that for Germany the data are from OECD, *Main Economic Indicators,* February and January, 1978, and from OECD staff.

indexes differ radically from country to country.[14] Lacking uniformly weighted aggregative national price indexes for traded goods, we should nonetheless be able to shed some light on the issues at hand by comparing national price variations for individual traded commodities. With the resources available to us, such an examination must be very limited, but it seems worthwhile for two reasons. First, it offers greater precision than does the use of aggregative price indexes employing different or shifting weights. Second, its relevance extends beyond the issue of inflation transmission; if it turns out that national variations in the (national currency) prices of individual goods are poorly correlated under fixed-exchange rates, there will be doubt not only about whether inflation can be transmitted between countries but also about the performance of the goods markets, since efficient markets should equalize the prices of an individual commodity in different nations after allowing for

[14]Irving B. Kravis and Robert E. Lipsey, "Price Behavior in the Light of Balance of Payments Theories," *Journal of International Economics,* 8 (May 1978), 200; Ronald I. McKinnon, *Monetary Theory,* p. 21.

such things as tariffs, transportation and communications costs, and non-equivalence of currencies.[15] Precisely how much allowance should be made for transportation and communications would constitute a study in itself. In David Hume's time sizable differences in price for the same good between national markets may have been eliminated only slowly because of slow communications and transportation — so that the price-specie-flow sequence of balance-of-payments adjustment which he hypothesized may have been appropriate for the 18th century — but in modern times the existence of large price differences would be more surprising. On the other hand, communications and transportation costs do remain high enough that *perfect* price equalization is scarcely to be expected, even in the absence of governmental barriers to trade or various forms of nonprice competition that tend to offset differences in price; anyone who has shopped around within a large U.S. city for a particular car or camera knows that there are appreciable differences in the prices charged by different sellers even within the boundaries of a metropolitan area. The most that can reasonably be expected, then, is fairly close, but not perfect, parallelism between the movements of national prices for a particular traded commodity.

Using the U.S. and German detailed price statistics, we have identified six commodities which have highly similar, if not identical, definitions in both sets of statistics. German prices were chosen for comparison with U.S. prices because there has been substantial change in the mark-dollar exchange rate in recent years and because the German statistics are considered reliable. Figures 5-10 present the selected indexes, each covering a span of ten or more years; for each commodity, the first data plotted are from a period of relatively stable prices for that commodity, on the assumption that stable prices are more likely than rapidly changing prices to represent positions of equilibrium.

Prior to October 1969, there was very little variation in the mark-dollar exchange rate, and in accordance with theory there was fairly close correspondence between the movements of the mark and dollar prices for all six commodities except perhaps raw tobacco. Then the mark was revalued upward by 9.3 percent in October 1969, was allowed to appreciate by 13.6 per-

[15]Several empirical studies of the so-called "law of one price" have recently been completed, primarily for the purpose of partially testing the monetary approach to the balance of payments. These investigations have revealed substantial differences in both national price levels and national price variations for narrowly defined commodity *categories,* after expressing prices in a common currency; however, none of the investigations presents data on individual commodities, and it is not really clear whether the national price differences reported stem from market imperfections or from national differences in the commodity categories. See Peter Isard, "How Far Can We Push the 'Law of One Price'?," *The American Economic Review,* 67 (December 1977), 942-48; J. David Richardson, "Some Empirical Evidence on Commodity Arbitrage and the Law of One Price," *Journal of International Economics,* 8(May 1978), 341-51; and Irving B. Kravis and Robert E. Lipsey, "Price Behavior."

An earlier study by Robert M. Dunn of six individual commodities marketed in the United States and Canada by oligopolistic firms between 1950-62 also found that the law of one price failed to hold, although Dunn acknowledges that over extended periods the law may hold at least approximately. See his "Flexible Exchange Rates and Traded Goods Prices" in *The Economics of Common Currencies,* ed. by Harry G. Johnson and Alexander K. Swoboda (Cambridge, Mass.: Harvard University Press, 1973), pp. 259-80.

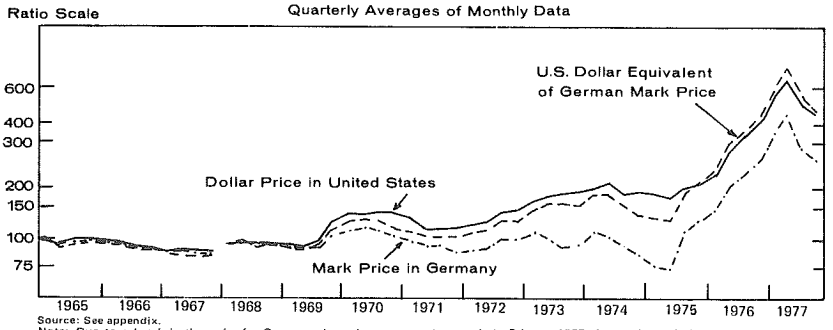
cent between May and December of 1971, was revalued upward by 11.1 percent in February 1973 (reflecting the devaluation of the dollar in that month), and has been allowed to vary widely against the dollar since March 1973, during which period it has risen well above its March 1973 level. As the charts show, during this period of substantial exchange-rate variation prices in Germany and in the United States, measured in the respective national currencies, have diverged widely, again in accordance with expectations, with much lower rates of price increase recorded in Germany. This observation holds for all six commodities, including those not produced within either country, such as cocoa, as well as those produced within both countries, such as pig iron. In other words, information presented in the charts is consistent with the view that countries which opt for exchange-rate flexibility can experience widely different rates of change in the prices of internationally traded goods, and that a country can achieve substantial insulation from outside inflationary (or deflationary) influences by allowing the foreign-exchange value of its currency to vary.[16]

For the purpose of bringing this same evidence to bear on the issue of market performance, the indexes of German mark prices in Figures 5-10 have been multiplied by an index of the dollar/mark exchange rate to yield the "U.S. Dollar-Equivalent of German Mark Price" shown in the figures. Significant inefficiencies might be present if there were wide divergences between this "U.S. Dollar Equivalent" and the "Dollar Price in United States." Such wide divergences do in fact appear for most of the commodities, but factors other than market inefficiency seem primarily responsible. First, note that in Figures 8-10, all of which pertain to industrial commodities, there is a common pattern, with divergences between the U.S. dollar equivalent and the dollar price in the United States developing in the early 1970s and disappearing by 1974 or 1975. For example, the U.S. dollar equivalent of the German mark price for magnesium had risen to nearly 50 percent above the dollar price in the United States in the last half of 1973 but had been overtaken by the dollar price in the United States by the middle of 1974. Even larger percentage divergences appeared and then disappeared for pig iron and steel wire rods. While market inefficiencies may have played a role, the chief explanation of this common pattern surely is the U.S. price control program, which suppressed the prices of many industrial commodities in the United States during the years 1971-73. After the controls were removed, the U.S. prices of magnesium, pig iron, and steel wire rods escalated to the levels previously attained by the U.S. dollar equivalents of German mark prices. This convergence suggests that the German and U.S. markets for each of these commodities is fairly efficiently linked in the absence of such interference as price controls. It also suggests, incidentally, that temporary price controls do not succeed in reducing the long-run rate of inflation.

[16]Simulation with the econometric model RDX2 suggests that Canada has attained such insulation by allowing the foreign-exchange value of its currency to vary. See Alan V. Deardorff and Robert M. Stern, "Modeling the Effects of Foreign Prices on Domestic Price Determination: Some Econometric Evidence and Implications for Theoretical Analysis" (University of Michigan, 1977; processed), 13-16.

FIGURE 5

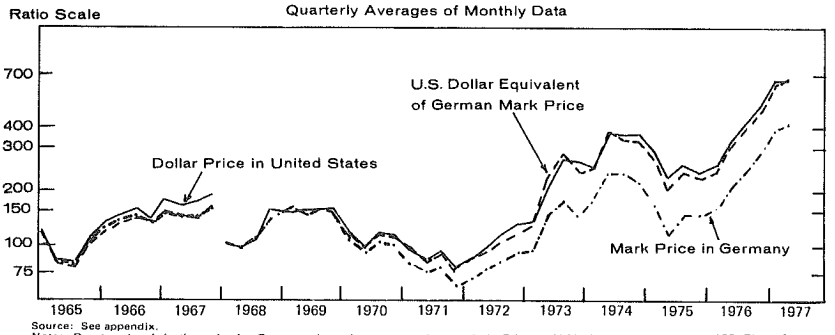
INDEXES OF PRICES FOR RAW COFFEE IN GERMANY AND THE UNITED STATES, 1965-77



Source: See appendix.
Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. – June, 1965 = 100. Thereafter, Jan. – June, 1968 = 100.
Data are plotted for every quarter for which observations are available for at least two months.

FIGURE 6

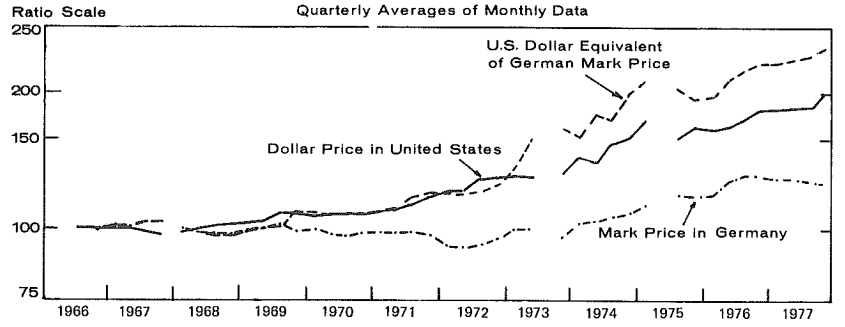
INDEXES OF PRICES FOR RAW COCOA IN GERMANY AND THE UNITED STATES, 1965-77



Source: See appendix.
Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. – June, 1965 = 100. Thereafter, Jan. – June, 1968 = 100.
Data are plotted for every quarter for which observations are available for at least two months.

FIGURE 7

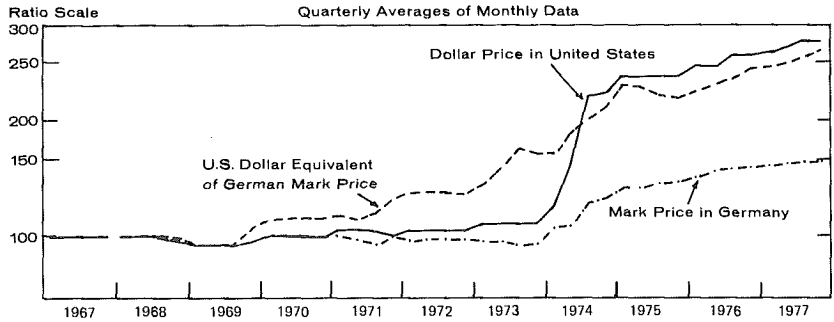
INDEXES OF PRICES FOR RAW TOBACCO IN GERMANY AND THE UNITED STATES, 1966-77



Source: See appendix.
Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. – June, 1966 = 100. Thereafter, Jan. – June, 1968 = 100.
Data are plotted for every quarter for which observations are available for at least two months.

FIGURE 8

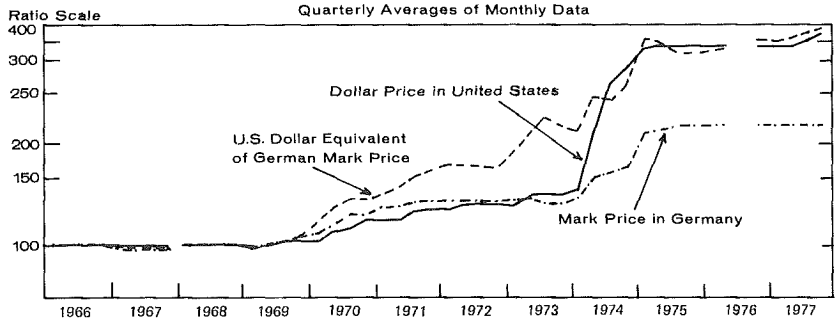
INDEXES OF PRICES FOR MAGNESIUM IN GERMANY AND THE UNITED STATES, 1967-77



Source: See appendix.
Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. – June, 1967 = 100. Thereafter, Jan. – June, 1968 = 100.
Data are plotted for every quarter for which observations are available for at least two months.

FIGURE 9

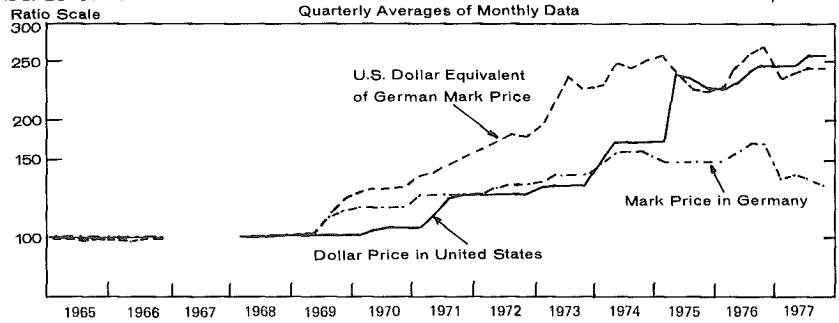
INDEXES OF PRICES FOR PIG IRON IN GERMANY AND THE UNITED STATES, 1966-77



Source: See appendix.
Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. – June, 1966 = 100. Thereafter, Jan. – June, 1968 = 100.
Data are plotted for every quarter for which observations are available for at least two months.

FIGURE 10

INDEXES OF PRICES FOR STEEL WIRE RODS IN GERMANY AND THE UNITED STATES, 1965-77



Source: See appendix.
Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. – June, 1965 = 100. Thereafter, Jan. – June, 1968 = 100.
Data are plotted for every quarter for which observations are available for at least two months.

At this writing we are not able to explain the divergence between the U.S. dollar equivalent of the German mark price and the dollar price in the United States that emerged for raw tobacco in 1973 and that has persisted for the four subsequent years shown in Figure 7. Even in this case, however, the two series have moved in more or less parallel fashion except during 1973.

On balance, although the evidence presented in Figures 5-10 is much too limited to be conclusive, it is consistent with the argument that countries can attain different rates of inflation for internationally traded goods under flexible, but not under fixed, exchange rates. Moreover, even our cursory investigation of market "inefficiencies" indicates the importance of taking into account factors other than market defects which can account for the seeming inefficiencies.[17]

Nontraded Goods: theory

A study of the international transmission of inflation may begin with goods that move in international trade, but it should not end there. Paradoxically, goods that do *not* cross national borders may also be of considerable importance in the analysis.

Perhaps it is not surprising that the theory of international trade should sometimes slight the goods that do not move in international trade. The classical theory of balance-of-payments adjustment is a case in point; Taussig was the first, in 1917, to argue that balance-of-payments adjustment could require a change in the price of traded goods relative to nontraded goods, a view which Viner also espoused in subsequent work.[18] Further emphasis of the role of nontraded goods appeared in Bertil Ohlin's renowned 1929 critique of Keynes's position on the problem of German war reparations.[19] As was true of Taussig and Viner before him, Ohlin's perceptions regarding nontraded goods arose out of concern with the "transfer problem," namely, the question of how a long-term financial transfer from one country to another becomes converted into an equivalent transfer of goods so that the transferor need not experience a substantial loss of international reserves over any extended period.[20] Unlike Taussig and Viner, however, Ohlin argued that change in the price of nontraded goods relative to traded goods was the primary price adjustment in the transfer process and that any change in the price of exports relative to imports,

[17]These factors include not only price controls but variations in tariffs and other indirect taxes.

[18]Jacob Viner, *Studies in the Theory of International Trade* (1937; reprinted: New York, Augustus M. Kelley, 1965), pp. 319-26. Also see Gottfried von Haberler, *The Theory of International Trade* (1936; New York, Augustus M. Kelley, 1968), pp. 36-37.

[19]Bertil Ohlin, "The Reparation Problem.: A Discussion," *Economic Journal,* 39 (June 1929), 172-78 and "A Rejoinder," *Economic Journal,* 39 (September 1929), 400-04.

[20]The fact that the insights of these writers were stimulated by the transfer problem does not at all impair the generality of their insights, for, as Harry Johnson has noted, the methodology applied to the transfer problem can readily be used to analyze any imbalance in international payments; see Harry G. Johnson, *International Trade and Economic Growth* (Cambridge, Mass.: Harvard University Press, 1958), p. 183.

which had preoccupied Taussig and Viner, would be only secondary.[21] Since World War II the role played by nontraded goods in the balance-of-payments adjustment process has been elaborated by a number of authors[22] and has become a crucial component of modern balance-of-payments theory.[23]

The essence of this theorizing, insofar as it relates to this paper, can be stated rather briefly. Posit a closed economy with full employment and without inflation. If the money supply were doubled overnight, one might expect all prices to rise in about the same proportion. Now suppose that the same economy is opened to trade with a second country, that the rate of exchange between the currencies of the two countries is fixed, that there is full equilibrium in all markets, and that the first country is so much smaller than the second that it cannot influence the price of anything it exchanges with the second. Then if the money supply in the small country were doubled, only the prices of its goods which did not enter into trade with the large country would be free to rise; the increase in money spending on importables and exportables would generate a greater quantity of imports and reduce the quantity of exports without affecting their prices and would produce a trade deficit. Thus, in the small country the rise in the relative price of nontraded goods, the rise in the overall price level due to the rise in the absolute price of nontraded goods, and the deterioration of the trade balance would jointly indicate an indigenous rather than imported inflation. Were the country large enough to exert some discernible influence on the prices of traded goods, those prices also

[21]P. M. Oppenheimer, "Non-traded Goods and the Balance of Payments: A Historical Note," *The Journal of Economic Literature,* XII (September 1974), 884. James Meade recently expressed regret that he did not make much greater use in his *Balance of Payments* of the distinction between tradable and nontradable goods emphasized by Ohlin. See James Meade, "The Meaning of 'Internal Balance,' " *The Economic Journal,* 88 (September 1978), 423.

[22]Many works could be cited. Most relevant to this paper are the following: J. E. Meade, *The Theory of International Economic Policy,* Vol. I: *The Balance of Payments* (London: Oxford University Press, 1951), chap. 18; Randall Hinshaw, "The Effect of Devaluation on the Price Level: Further Comment," *Quarterly Journal of Economics,* LXXII (November 1958), 616-25; W. E. G. Salter, "Internal and External Balance: The Role of Price and Expenditure Effects," *Economic Record,* 35 (August 1959), 226-38; Anne O. Krueger, "The Role of Home Goods and Money in Exchange Rate Adjustments" in *International Trade and Finance: Essays in Honor of Jan Tinberger,* ed. by Willy Sellekaerts (White Plains, N.Y.: International Arts and Sciences Press, 1974), pp. 141-61; Rudiger Dornbusch, "Real and Monetary Aspects of the Effects of Exchange Rate Changes," in *National Monetary Policies and the International Financial System,* ed. by Robert Z. Aliber (Chicago: University of Chicago Press, 1974), pp. 64-81; and W. M. Corden, *Inflation,* chap. 4.

[23]The role of nontraded goods was neglected not only by the classical theory but also by the so-called "elasticities" theory of the foreign exchanges which became popular in the middle of this century. Although the elasticities approach is sometimes equated with the "relative prices" approach, the latter (as developed by Ohlin and the authors cited in the preceding footnote) explicitly placed nontraded goods at the very heart of the analysis, while the former made little or no mention of nontraded goods. For classic expositions of the elasticities approach, see Joan Robinson, "The Foreign Exchanges," *Essays in the Theory of Employment* (2nd ed.; Basil Blackwell, Oxford, 1947), Part III, chap. 1, reprinted in *Readings in the Theory of International Trade,* ed. by Howard S. Ellis and Lloyd A. Metzler (Philadelphia: The Blakiston Co., 1949), pp. 83-103; and Gottfried Haberler, "The Market for Foreign Exchange and the Stability of the Balance of Payments: A Theoretical Analysis," *Kyklos,* vol. 3 (1949), 193-218, reprinted in *International Finance,* ed. by R. N. Cooper (Baltimore, Md.: Penguin Books Inc., 1969), pp. 107-34.

would rise, although not so much as the prices of the country's nontraded goods, and the country would thereby export inflation to its partner. Other things equal, the partner country would experience a rise in the price of traded goods, both absolutely and relative to the price of its nontraded goods, as well as an "improvement" in its trade balance.[24] For this partner country, the rise in the relative price of traded goods, the rise in the general price level due to the rise in the absolute price of traded goods, and the improvement in the trade balance would then jointly signify the importation of inflation from abroad.

This process of inflation transmission clearly constitutes a disequilibrium not only because of the inflation itself and the imbalance in international payments, but also because the price relationship between traded and nontraded goods is disturbed. If there are no further increases in the money supply, the inflation will come to a halt as real money balances in the inflation-exporting country are reduced by the rise in prices and by the outflow of international reserves. At the same time, the price of nontraded goods in this country must fall — not to the original level, but enough to restore the original relationship to the now higher price of traded goods — while in the other country the price of nontraded goods must rise; the underlying premise, of course, is that increases in the money supply, particularly one-time increases, do not bring about permanent and significant changes in relative prices.

If prices of nontraded goods display little downward flexibility in the country that had exported inflation, the country may experience unemployment in industries producing such goods. Devaluation of the country's currency would be an appropriate part of the proper policy response, because devaluation, as is well known, operates to raise the relative price of traded goods. Indeed, had the country allowed the foreign-exchange value of its currency to depreciate simultaneously with the increase in its money supply, no deficit could have arisen in its payments with its trading partner. One widely held theory asserts that under such circumstances there is no transmission of inflation, but that the full price impact is borne by the country in which the inflationary impulse originates.[25] As this country's currency depreciates, the price of traded goods rises along with the price of nontraded goods, so that disturbances to relative prices during the inflation are not so severe.

The case of downward price inflexibility is but one step removed from the case of "cost-push" inflation, and it is easy to extend the theory to cover the latter situation. Suppose that the inflation-exporting country suffers from severe cost-push inflation unaccompanied by increases in the money supply rather than from classic demand-pull inflation fueled by rapid expansion of the money stock. Again, the relative price of nontraded goods will rise in this country if the price of traded goods is constrained by foreign competition

[24]It is sometimes asserted or implied that such an improvement in the trade balance need not occur, on the grounds that the rise in traded goods prices is brought about by "arbitrage" rather than by an increase in foreign demand. But surely such "arbitrage" *entails* an increase in foreign demand for the country whose prices rise in response to foreign price increases. Cf. Harry G. Johnson, *Money, Balance-of-Payments Theory, and the International Monetary Problem*, p. 20.

[25]See W. M. Corden, *Inflation*, p. 66; Gottfried Haberler, "The International Monetary System after Jamaica and Manila," pp. 251-252, and Harry G. Johnson, *Money*, p. 23.

under a fixed-exchange rate, and the country's trade balance will deteriorate (since the price of traded goods in the country would not be constrained unless residents switched their purchases from traded goods produced domestically to those produced abroad). However, the country will also experience rising unemployment, which will mitigate the deterioration of the trade balance. In the partner country there will be a rise in the relative price of traded goods and an improvement in the trade balance. Devaluation would again be part of the appropriate medicine for the inflation-exporter.

This model of inflation transmission has definite limitations. In particular, the model does not explicitly consider capital flows or the formation of exchange-rate expectations,[26] elements which should be incorporated into a detailed general equilibrium approach. To illustrate the significance of these omissions, we may note that the importation of financial capital into a country might raise the relative price of nontraded items and engender a trade deficit in the country, leading the analyst to conclude (wrongly) that the country was experiencing internally generated inflation. Or, if the country had attracted foreign capital because it in fact was going through an inflationary boom that presented profit opportunities, the corresponding capital outflow from another country might prevent the capital-exporter's currency from appreciating enough to forestall an increase in traded goods prices and a trade surplus in the capital-exporting country; that is, exchange-rate flexibility might not provide full insulation from foreign inflation.[27] In spite of such limitations, the model of inflation transmission outlined in this section has gained much currency and provides at least a springboard for empirical inquiry.

Nontraded Goods: evidence

In spite of this attention to nontraded goods in the theoretical literature, the theorizing has seldom been tested or utilized in empirical work on the balance-of-payments adjustment process. Perhaps the earliest study of the behavior of nontraded goods prices during balance-of-payments adjustment is Frank Graham's 1922 article focusing on the impact of British loans to the United States and their repayment between 1862 and 1879.[28] In more recent empirical work emphasis has been placed on the consequences for balance-of-payments or exchange-rate adjustment of differences in productivity growth between nontraded and traded goods,[29] and very little is to be found that relates to the theoretical model outlined in the preceding section of this paper. This theoretical model may provide a useful framework for empirical anlaysis

[26]Rudiger Dornbusch has argued that if expectations are formed by an adaptive process rather than rationally, inflation can be transmitted temporarily even if exchange rates are flexible. See his "The Theory of Flexible Exchange Rates Regimes and Macroeconomic Policy," *The Scandinavian Journal of Economics,* 78 (June 1976), 255-75.

[27]See, for example, Marina v. N. Whitman "International Interdependence and the U.S. Economy," pp. 207-08.

[28]F. D. Graham, "International Trade under Depreciated Paper. The United States, 1862-79," *Quarterly Journal of Economics,* 36 (February 1922), 220-73.

[29]Bela Balassa, "The Purchasing-Power Parity Doctrine," 584-96; Ronald I. McKinnon, *Monetary Theory,* p. 21.

of the transmission of inflation; if not, current theory may be in need of revision.

To apply the theoretical model to actual experience, we must find a measure of the relative price of nontraded goods. This task is complicated by the fact that goods may shift from the nontraded into the traded category with changes in relative national inflationary pressures, in transportation costs, in tastes, and so forth. However, as a practical matter there is very little in the way of available data from which to choose, and for a measure of nontraded goods prices we will use the price index for consumer services, since it is relatively heavily weighted with items that seldom get traded internationally, such as medical care and automobile repair services. The price index for consumer goods (excluding services) is more heavily weighted with internationally traded items and can be directly compared with the price index for consumer services, and it will provide a proxy for the price of traded goods.

These data on consumer prices, along with data on the merchandise trade balance, have been plotted for seven major countries for the years 1961-77 in Figures 11-17. So as to facilitate comparisons between countries, trade balances are expressed as a percent of average annual GNP or GDP and all charts have about the same range in scales on the vertical axes. After some experimentation, it was discovered that two-year moving averages of the data seemed to reveal trends more clearly.

To begin with, suppose, as is generally believed, that productivity increases are consistently higher in traded goods industries than in the service industries. In that case inflation in the price of goods should proceed at a slower pace than inflation in the price of services, other things being equal, and the price lines on the charts should remain generally in the negative range, as they do. However, it is questionable whether sizable and extended *upswings or downswings* in the price lines are to be explained by *changes* in productivity growth in consumer goods relative to services. For example, the price line for the United States (Figure 11) declines steadily from roughly 1964 through 1970, but the rate of productivity growth (presumably largely in goods industries) declined significantly over this period, while a relative rise in productivity growth in the goods industries would be required to account for the decline in the price line. Nor can the decline in the price line in Canada (Figure 13) during the 1960s be explained by an acceleration of productivity growth, as productivity there grew at about the same rate during the second half of the 1960s as in the first half.[30]

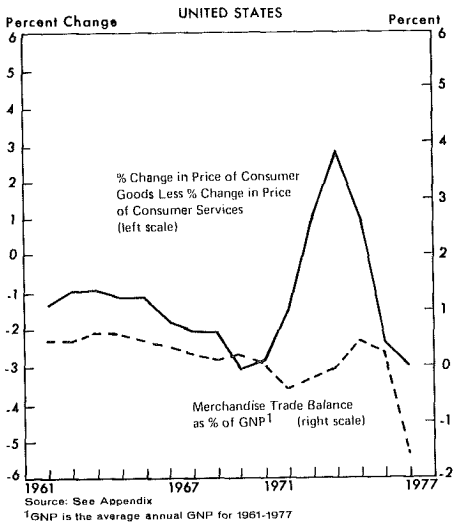
Another possible explanation of the declining price line in the United States from 1964-1970 is that demand was shifting away from traded goods toward nontraded items. However, such a shift in demand would tend to improve the U.S. trade balance, while in fact the balance deteriorated. A third explanation, which is consistent with both the declining price line and the wor-

[30]Patricia Capdevielle and Arthur Neef, "Productivity and Unit Labor Costs in 12 Industrial Countries," *Monthly Labor Review,* November 1974, p. 15. Our 1976 paper, "The Worldwide Inflation," presented a diagram for Canada in which the price line rose, rather than declined, during most of the 1960s. The consumer prices in that diagram were derived from quarterly data which we have found to be defective.

Merchandise Trade Balance and Percent Change in Selected Price Indexes for Various Countries, 1961-1977

(Two-year moving averages)

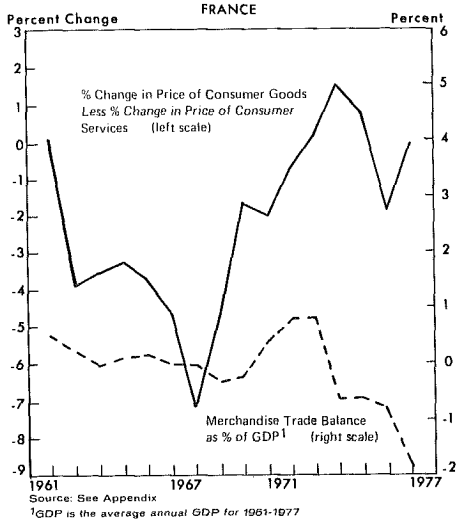
Figure 11



Source: See Appendix

[1]GNP is the average annual GNP for 1961-1977

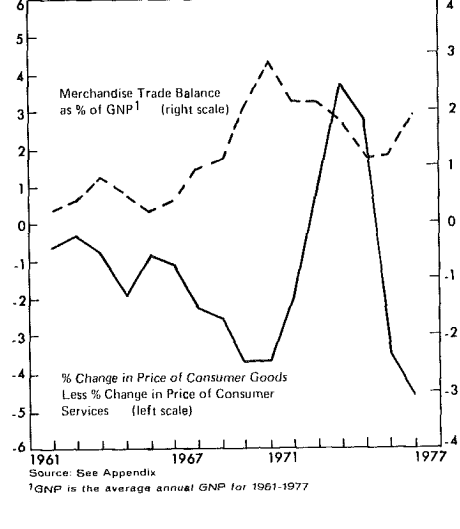
Figure 12



Source: See Appendix

[1]GDP is the average annual GDP for 1961-1977

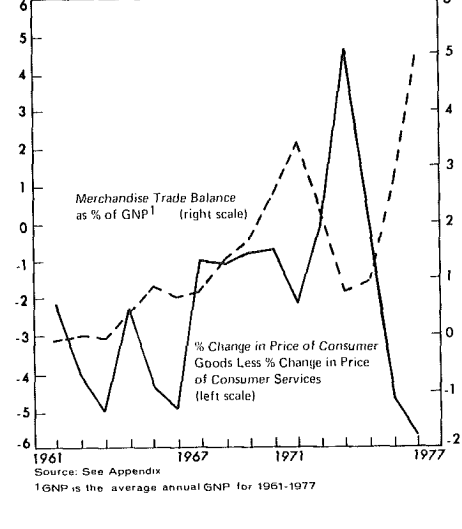
Figure 13



Source: See Appendix

[1]GNP is the average annual GNP for 1961-1977

Figure 14

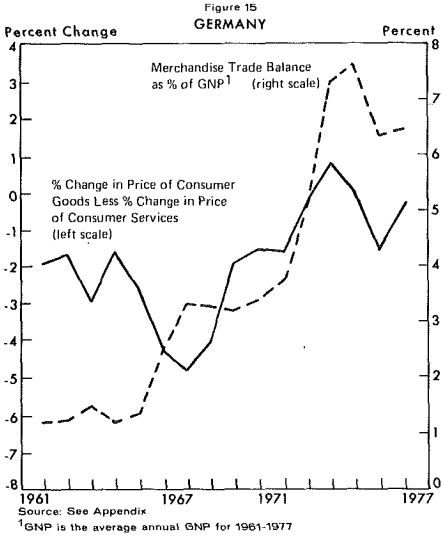


Source: See Appendix

[1]GNP is the average annual GNP for 1961-1977

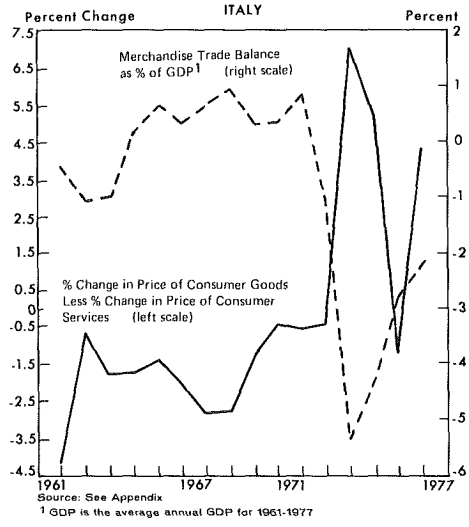
Merchandise Trade Balance and Percent Change
in Selected Price Indexes for Various Countries, 1961-1977
(Two-year moving averages)

Figure 15



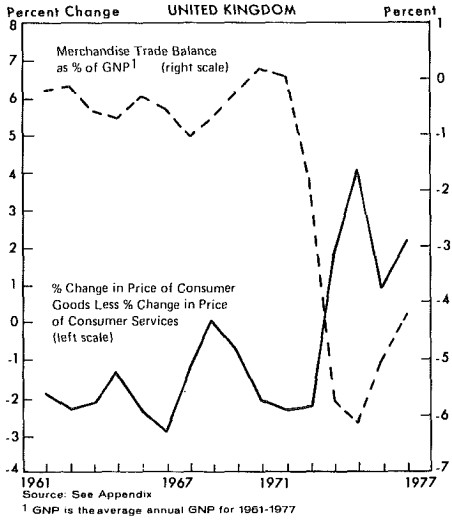
Source: See Appendix
[1]GNP is the average annual GNP for 1961-1977

Figure 16



Source: See Appendix
[1] GDP is the average annual GDP for 1961-1977

Figure 17



Source: See Appendix
[1] GNP is the average annual GNP for 1961-1977

sening of the trade balance, is that the United States was experiencing internally generated inflation, with higher and higher price increases for nontraded items relative to increases for the traded items whose prices were constrained by foreign influences. This explanation, of course, is suggested by the theory in the preceding section; that theory also suggests that the United States, because of its size, may have exported inflation to the rest of the world during this period. Again consistent with the theory, the interruption of this pattern approximately coincides with the advent of somewhat greater exchange-rate flexibility, as the German mark was revalued in 1969, the Canadian dollar was allowed to float fairly freely in the markets beginning in 1970, and a number of major currencies were set afloat briefly in 1971. Similar reasoning suggests that France (Figure 12) was also undergoing an internally generated surge of inflation, and perhaps exporting inflation as well, for several years prior to the devaluation of the franc in 1969.

On the other hand, on the basis of the charts it would be hard to make the case that any of the countries represented was importing inflation for any extended period, although Germany may have done so in the early 1970s and Japan in the late 1960s and first years of the 1970s, since the trade balance was improving and the inflation rate for traded goods was generally rising relative to the inflation rate for nontraded goods in those countries in those years. (In addition, the foreign-exchange reserves of each country surged upward during the years in question.[31]) To be sure, the charts for France and the United States both display the symptoms of imported inflation for short periods, from about 1970-73 in France and from roughly 1972-1974 in the United States. However, in both countries the rise in the relative inflation rate of traded goods and the improvement in the trade balance is to be explained at least partly, if not primarily, by prior devaluations of the home currency rather than by inflationary pressures imposed from abroad; such developments are consistent with the standard theoretical model, for this model implies that an improving trade balance and a rising relative inflation rate for traded items are necessary, but not that they are sufficient, conditions for the existence of imported inflation. In France and the United States the devaluation-induced increase in the relative inflation rate for traded goods operated to improve the balance of trade by shifting domestic consumption away from traded goods and by shifting domestic resources into the production of traded goods, both for export and to replace imports. By contrast, the 1971 upward revaluation of the yen probably contributed to a decline in the relative price of traded goods and a subsequent deterioration in the Japanese balance of trade (Figure 14).

[31]Herring and Marston have argued that Germany successfully sterilized nearly all of its overall payments imbalances, or changes in foreign-exchange reserves, during the 1960s. Our analysis also suggests that Germany did not import inflation in the 1960s, but that it did in the early 1970s. See Richard R. Herring and Richard C. Marston, *National Monetary Policies and International Financial Markets* (Amsterdam: North Holland, 1977), Pt. II. Also see Victor Argy and Pentti J. K. Kouri, "Sterilization Policies and the Volatility in International Reserves," in *National Monetary Policies and the International Financial System*, ed. by Robert Z. Aliber (Chicago: University of Chicago Press, 1974), pp. 209-30.

In sum, the United States and France may have exported inflation during the last half of the 1960s, but among the countries examined only Japan seems to have imported inflation during these years.[32] Of course, countries not scrutinized may also have imported inflation. In addition, there may be lags in transmission, as suggested by the fact that the signs of imported inflation were not manifest for Germany until the early 1970s. Finally, Canada may be so open to the United States that Canadian prices of services as well as goods may be strongly and quickly influenced by prices for corresponding items in the United States as long as the exchange rate is fixed,[33] so that the 1966-1969 decline of the price line in the chart for Canada, roughly contemporaneous with the decline for the United States, may have been caused by the transmission of inflation from the United States to Canada. This phenomenon would not contradict the standard theoretical model, which is relevant only to cases involving a substantial nontraded sector; for Canada, only a small part of the economy may be free from fairly direct influence by commerce with the United States, and that small sector may be quite different from the consumer services sector whose price movements are included in Figure 13. The sharp upward movement of the Canadian trade balance during this period supports the interpretation that Canada was importing inflation, especially since the trade balance improvement was primarily with the United States. In 1970, of course, the Canadian dollar was allowed to float, and the transmission seems to have been interrupted.[34]

For the years following the advent of greater exchange-rate flexibility, perhaps the most noteworthy feature of Figures 11-17 is that all countries represented recorded a sharp increase in the relative inflation rate for traded goods just prior to 1974-75, followed by a decrease in 1974-75. In all likeli-

[32]The fact that the total consumer price index rose as fast or even faster in most other industrial countries than in the United States during the last half of the 1960s (as shown by Figure 3) does not rule out the possibility that the United States was exporting inflation. A small increase for the traded goods component of the U.S. consumer price index might imply roughly the same small increase in traded goods prices in, say, Japan, but imply a much larger increase in the total consumer price index in Japan because of rapid productivity growth in Japan's traded goods industries. (See footnote 12.) This point has been made by a number of writers; see, for example, Marina v. N. Whitman, "International Interdependence and the U.S. Economy", pp. 195-96, and Michael Parkin, "World Inflation, International Relative Prices and Monetary Equilibrium under Fixed Exchange Rates," in *The Political Economy of Monetary Reform*, ed. by Robert Z. Aliber (Montclair, N.J.: Allanheld, Osmun & Co., 1977), pp. 220-42.

[33]Alan V. Deardorff and Robert M. Stern, "Modeling the Effects," pp. 12-15, report simulation results suggesting that the Canadian price of consumer services is much more strongly influenced by foreign prices (under a fixed-exchange rate) than is indicated by the directly estimated elasticity of the Canadian price with respect to foreign prices, and they infer that the Canadian price of consumer services is affected indirectly by the impact of changes in foreign prices on Canadian wages. Similarly, Bordo and Choudhri report difficulty in distinguishing a purely nontraded goods industry in Canada; see Michael David Bordo and Ehsan U. Choudhri, "Price Flexibility and the 'Law of One Price.' Some Evidence on the Relationship between Canadian and U.S. Industrial Prices, 1956-1975" (Carleton University, unpublished), 6-10, 23.

[34]The *degree* to which inflation may have been transmitted among the countries represented by Figures 11-17 is a question that is not addressed in this paper. There has been enough uncertainty about whether inflation was transmitted at all that an examination of this more basic issue seemed worthwhile.

hood, the grain and oil price increases were largely responsible for the sudden increase, and the subsequent decline probably represents primarily a restoration of more normal price relationships between traded and nontraded items. In this connection, it is well known that exchange-rate flexibility does not insulate countries from *relative* price changes, that is, from structural changes in the relationship between prices of different classes of goods, including changes effected by quasi-tariffs such as the administered oil price hikes. What has been claimed is that exchange-rate flexibility can insulate a country from *general* inflation across the whole spectrum of goods and services. This claim is not contradicted by the evidence on exchange-rate flexibility presented in this paper; however, that evidence is not conclusive, partly because the experience examined is limited to a few years during which there was a disruptive oil crisis and partly because exchange rates have not been allowed to float freely.

Conclusion

Although by one common measure there has been an increase in interdependence among industrial countries, the closer interdependence has been accompanied by more, rather than less, dispersion of national inflation rates; the growth of interdependence has not brought national rates of inflation closer together. One likely reason is the advent of greater exchange-rate flexibility. Evidence examined in this paper supports the view that exchange-rate flexibility allows divergence of national inflation rates for internationally traded goods. Moreover, empirical application of a well-known balance-of-payments adjustment model emphasizing nontraded goods suggests that the exportation or importation of inflation across national boundaries can be diminished, if not terminated, by the use of exchange-rate flexibility. Flexible-exchange rates have disadvantages, but transmission of inflation may not be one of them.

Appendix: Sources and Notes for Figures

Figure 1. Commodity Prices, 1900-77.
Source: *The Economist;* March 2, 1974, p. 86, September 6, 1975, p. 80, and all issues from July 1976 to the end of December 1977.

Figure 2. Consumer Prices in Selected World Areas, 1970-77.
Source: Staff, International Monetary Fund.

Figure 3. Consumer Prices in Seven Industrial Countries, 1962-77.
Source: *International Financial Statistics,* May and July 1978.

Figure 4. Yearly Percent Change in Wholesale Prices for Seven Industrial Countries, 1963-77.
Source: *International Financial Statistics,* May and July 1978, except for German data which are from OECD, *Main Economic Indicators,* February and June 1978, and from OECD staff.

Data for United Kingdom and for France are for industrial goods.

Figures 5-10: Indexes of Prices for Various Commodities in Germany and in the United States.
Source: U.S. prices: U.S. Bureau of Labor Statistics, unpublished machine run.

German prices for pig iron and steel rods: Statistiches Bundesamt, Preise, Löhne, Reihe 3 prior to 1976 and Reihe 2 for 1976 and later years, *Preise und Preisindices für industrielle Produkte,* various issues. Prices for these two commodities are producer's prices.

German prices for raw cocoa and magnesium: Statistiches Bundesamt, Preise, Löhne, Reihe 2 prior to 1976 and Reihe 3 for 1976 and later years, *Index der Grundstoffpreise.* For these two commodities, import prices were used.

German import prices for raw coffee and raw tobacco were obtained from the Statistiches Bundesamt by special request.

Exchange rates used to compute "U.S. Dollar Equivalent of German Mark Price" are from *Federal Reserve Bulletin,* various issues.

In the sources cited above, the German price series for raw cocoa, magnesium, pig iron and steel wire rods are accompanied by the following note: "Starting January 1968, without value added tax or without import sales tax. Until 1967 inclusive of accumulated sales tax or including equalization tax." German prices for raw coffee and raw tobacco are without tax and duty for all years. There was an additional break in the German price series for steel wire rods which necessitated omitting 1967 data from the chart.

Figures 11-17: Balance of Trade and Percent Change in Selected Price Indexes for Various Countries, 1961-77.

Source: Except for the United States, trade data are from *International Financial Statistics,* May 1978 and July 1978. Data are valued f.o.b. For France for 1961 only, f.o.b. import data were estimated by multiplying c.i.f. data by 1962 ratio of f.o.b. data to c.i.f. data. For the United States the data sources are *Survey of Current Business,* June 1977; *Business Statistics,* 1975, pp. 109 and 114; and U.S. Commerce Department News wire BEA, 78-30, May 1, 1978. For France and Italy GDP is used in place of GNP.

Consumer price data are from *Main Economic Indicators, Main Economic Indicators Historical Statistics 1955-71* and supplements, and OECD staff. Data for services component of CPI include rent.

Discussion

Robert M. Stern*

The subject of world inflation and its transmission among countries is obviously important and yet difficult to analyze. Fieleke is thus to be commended for undertaking this task. His effort is marred, however, because he does not develop a clear and consistent model from which particular hypotheses can be formulated and tested.

His beginning section on interdependence and inflation illustrates this point. There is first some confusion between the meanings attached to the concepts of openness and interdependence. Fieleke considers the ratio of trade to output as a measure of interdependence and the extent to which inflation is transmitted between countries as an indication of openness. I believe that it would be more useful to reverse the concepts. An economy's openness has typically been measured in terms of the ratio of trade to GNP, although the theoretically correct ratio is that of tradables to nontradables. Interdependence accordingly is to be interpreted as the extent to which international transmission of various kinds of economic changes occurs between countries.

This semantic confusion aside, I was not particularly surprised by Fieleke's conclusion, based upon Table 1 and the simple correlations based upon equation (2), that inflation rates in the major industrialized countries have shown more dispersion in recent years with exchange-rate flexibility than previously when exchange rates were pegged. Had Fieleke started with an explicit international macro model that allowed for alternative exchange-rate regimes, he could have hypothesized this result and then determined if the data confirmed his hypothesis. His calculations thus suggest that even though the degree of openness, as measured by the ratio of trade to GNP, has increased, national inflation rates have become more divergent because of the insulation effects of greater exchange-rate flexibility. This conclusion is confirmed also by the price comparisons that Fieleke makes later for particular goods between the United States and West Germany.

In his second section, Fieleke discusses some general considerations regarding the transmission of inflation under alternative exchange-rate regimes. He focuses here on ratchet effects in price behavior that may arise because of downward rigidities in wages and prices. He observes correctly that downward rigidities are not in themselves an attribute of the exchange-rate

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system and that problems may arise therefore whether exchange rates are fixed or flexible. What he fails to address, however, is the nature of the shocks that may occur and their aftermath. Thus, for example, if we assume an exogenous shock takes place and the exchange rate is fixed, any imbalance that occurs will be financed by changes in a country's international reserves. To the extent that reserve changes are sterilized, domestic adjustment will be delayed. If, however, the exchange rate is flexible, it will change instantly. If the rate depreciated and there were downward rigidities, the effects would be transmitted immediately in comparison to the delay that would be experienced with fixed rates and sterilization. Thus, with given downward rigidities, an exogenous shock that causes the exchange rate to change will be more inflationary than if the rate were to remain fixed.

Fieleke's theoretical analysis of nontraded goods raises a number of interesting issues with respect to the transmission of inflation. However, he is not clear on some important details. For example, he traces through the effects of an increase in a country's money supply on the prices of nontradables and tradables domestically and tradables abroad as if this were the only kind of exogenous change that could occur. It is easy to imagine other possible exogenous changes besides an expansion of the money supply, and it is by no means obvious that the domestic and foreign impacts will correspond to those of a monetary shock. This is all the more true if asset markets and expectational factors are taken explicitly into account from the start. Fieleke assumes for the most part that all the important effects will be experienced through the goods market in terms of the expenditure shifts that will occur in response to changes in relative prices. This is not necessarily incorrect, but it is incomplete and can be misleading with regard to the nature of the adjustments that may occur. To cite one particular example, he claims in footnote 24 that commodity arbitrage "*entails* an increase in foreign demand for the country whose prices rise in response to foreign price increases." Actually, within the tradable-nontradable goods model, the increase in foreign demand will be infinite if the domestic country's tradable goods prices do not rise fully. Another way of saying this is that arbitrage insures that domestic tradable goods prices *do* rise fully. Contrary to Fieleke's statement in the text to which the footnote is appended, an improvement in the trade balance is *not* a necessary condition for this arbitrage to take place. For example, if domestic expenditure rises at the same time, the trade balance could well deteriorate. Fieleke's error is repeated at the top of page 45. The important theoretical point is that arbitrage of prices of perfect substitutes does *not* require that actual flows take place.

The preceding discussion thus raises the question of what is the appropriate model for determining when a country is exporting or importing inflation. The model that Fieleke has chosen is one that assumes that a monetary disturbance will increase the price of nontradables relative to tradables, thus worsening the trade balance. The country will then be exporting inflation, and its trading partners will be importing inflation, which will be manifested in terms of an increase in the price of tradables relative to nontradables and an

improvement in the trade balance. This is not the end of the process, however, for there will be reserve changes if exchange rates are fixed and the rates themselves will change if they are flexible. Such changes in reserves or exchange rates will, of course, have still further effects in the countries involved.

The problem then is how to model a process of continuous change as compared to a single change such as monetary expansion. Because Fieleke has not been able to resolve this difficulty, his empirical analysis of consumer prices and trade balances in Figures 11-17 is inconclusive. To illustrate, using Fieleke's procedure, in a country experiencing excessive monetary expansion, the price of nontradables should rise relative to tradables, the trade balance should worsen, and it would therefore be concluded that the country is exporting inflation. At a subsequent stage when adjustment is taking place, the price of nontradables relative to tradables should return to its initial position and trade balance restored. Surely one could not label this as a case of a country importing inflation. Fieleke's procedure therefore cannot distinguish unambiguously cases of exporting inflation from cases of importing inflation.

In summary, Fieleke has called our attention to the insulating characteristics of flexible rates. This is by no means a new proposition, but it is nevertheless important to document it empirically. His paper is much less successful, however, in its treatment of the transmission process per se. It would be a useful next step if he and others could develop a more comprehensive model that encompassed the many channels by which international transmission can occur. Alan Deardorff and I have outlined such a model in our 1977 review of the evidence on international economic dependence contained in several large national and linked econometric models.[1] We hope that the work going on at the Federal Reserve Board and elsewhere on multicountry models with well-articulated financial sectors and endogenous exchange-rate determination will enhance our understanding of the international transmission of inflation. This type of model development is to be encouraged because simpler approaches such as Fieleke's cannot cope effectively with the complexities of international transmission effects.

[1]Alan V. Deardorff and Robert M. Stern, "International Economic Interdependence: Evidence from Econometric Models," Research Seminar in International Economics, University of Michigan, Seminar Discussion Paper No. 71 (January 28, 1977).

Response

Norman S. Fieleke

Robert Stern's comment gives me the opportunity to make several points related to my paper.

Perhaps it will be helpful to note that Stern's "theoretically correct" definition of openness as the ratio of tradables to nontradables is included in the concept of openness used in my paper, for the paper argues that openness to external inflation results from low commercial barriers (including transportation costs) — *i.e., from a high ratio of tradables to nontradables* — and from fixity of the exchange rate; low commercial barriers and fixed-exchange rates produce close correspondence between national movements in uniformly weighted general price indexes.[1] What should be emphasized is that the ratio of tradable to nontradable goods is not at all the same thing as the ratio of actually traded goods (exports and imports) to nontraded goods, or as the ratio of trade to GNP, which need not, in theory, rise with openness. Reasoning along these lines, I did not define interdependence as the transmission of economic changes, because there might be high transmission to one economy of disturbances in the other (due to absence of commercial barriers, etc.) even though the two economies might be so similar that, absent such disturbances, there would be so little trade between them that one would scarcely be affected by the obliteration of the other; it seems peculiar to speak of two such economies as highly dependent on each other.

With respect to rigidities, ratchet effects, and all that, it does seem that under a fixed-exchange rate sterilization may buy some time; but it should also be noted that a currency depreciation and any associated increase in tradables prices must persist for some time before becoming fully built-in in the form of higher wages (since wage contracts generally are fairly long term), so that a temporary shock may produce only a temporary depreciation which does not raise prices in the long run. Also, sterilization may not be a feasible option unless the reserve inflows are small in relation to the economy, in which case the equivalent exchange-rate change might also be relatively small. Finally, sterilization does not shield a country from increases in tradable goods prices determined in foreign markets.

It is true that my theoretical analysis traces through the effects of an increase in the money supply — but not as if this were the only kind of exogen-

[1]With low commercial barriers but without a fixed-exchange rate, a country's internal relative prices remain highly open to foreign influences, but, as is argued at length in the paper, its general price level is not so easily influenced; with insurmountable barriers to international transactions, both relative prices and the general price level would be insulated.

ous change that could occur. The analysis also deals with general cost-push inflation unaccompanied by increases in the money supply.

On the matter of "arbitrage," my paper merely posits that with fixed-exchange rates an inflation in a large country will not only raise prices in other countries but improve their trade balances with the inflating country. It is hard to accept as a working hypothesis some concept of "arbitrage" which asserts that a country's prices will rise in sympathy with generalized inflation abroad without any associated international flows.[2]

Certainly the model employed in Figures 11-17 has important limitations (as would be the case for any other abstract theoretical model), and some if not all of the limitations were pointed out in various places in my paper. Nothing more was claimed for the model than that it identifies necessary, but not sufficient, conditions (p. 49) for showing that generally rising *prices* are being transmitted between countries (provided the countries involved have significant nontradable sectors). If those necessary conditions could not be detected with the (imperfect) data available, there would be at least a presumption that inflation was not being transmitted, a finding which would be of some interest; if the necessary conditions were detected, then the proper approach — which I could pursue only a little way in the paper — would be to investigate whether those conditions were produced by factors other than the transmission of inflation. More elaborate models might be useful, but perhaps such models can occasionally be improved by ascertaining the reasons for any inconsistencies between their results and the results obtained from smaller models.

[2]Of course, a government might undertake inflationary measures designed to prevent a trade-balance improvement or balance-of-payments surplus with another inflating country, but in that case the government is generating its own inflation rather than waiting for it to be imported.

Further Results on the Efficiency of Markets for Foreign Exchange

Richard M. Levich*

I. Introduction

After more than five years of floating exchange rates, there remains serious and fundamental disagreement about how floating exchange rates have worked. It is convenient to consider this literature in two sections. First, there is the literature which considers the impact of floating rates on macroeconomic adjustment. Here, the concern is how well the floating rate system approximates an optimal system for linking the major industrial economies. A specific issue is whether the floating exchange rate system, per se, contributes as an exogenous variable to the level of inflation and degree of uncertainty in the system. A second body of research focuses on a more narrow aspect of positive economics. Given the market's knowledge of exogenous variables and economic structure, this research explores whether the foreign exchange market is efficient in the sense that prices fully reflect available information. This is a restatement of the efficient market hypothesis in the foreign exchange market.

In this paper, my emphasis will be on the second section of literature. The objective of this paper is to update both the theoretical and empirical arguments that pertain to efficiency in the foreign exchange market. Correspondingly, there are several general themes that will be developed in this paper. With respect to the theory of exchange rate determination, recent papers have examined the impact of (1) uncertainty concerning permanent shocks versus temporary shocks, (2) short-run changes in relative prices, (3) the time lag between contracting and delivery of internationally traded goods and (4) the positive costs associated with changing the fixed covenants of long-term contracts.

One interpretation of this literature is that exchange rates may fluctuate within a fairly broad range (say 5 percent) within a fairly short period (say, less than one week) without violating a rational pricing model and, therefore, without creating excess profit opportunities (inefficiencies) in the market. My first theme is that theoretical research is exploring fairly credible models of exchange rate behavior that are consistent with the recent exchange rate

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movements which the business and financial community would label as "erratic" — or perhaps "disorderly."

A second theoretical theme deals with the efficient market hypothesis. Early statements of this important hypothesis seemed to suggest that we could specify some criterion against which we could accept or reject the hypothesis. (In other words, market efficiency was considered an "either/or" concept.) Current research suggests that market efficiency is more aptly thought of as a process. Given that market participants have diverse opinions about future events, speculative markets will approach full efficiency in the long run but can never reflect all information in the short run.

My next theme examines empirical tests of foreign exchange market efficiency. Recent surveys of this literature by Kohlhagen (1978) and Levich (1979) have concluded that simple, risk-free profit opportunities are quickly arbitraged away. However, tests for risky profit opportunities through spot or forward exchange speculation have not been convincing (1) because the basic models of spot and forward exchange rate determination have not been satisfactory, (2) the techniques of analysis have borrowed too freely from the stock market literature and (3) the statistical power of the tests has been low and therefore unable to distinguish the market efficiency hypothesis from competing hypotheses.

Research reported within the last year has noted some evidence for market inefficiency, but these results are not totally convincing for the reasons cited above. Two other papers are especially interesting since they depart from the standard tests and obtain nonstandard results. Brillembourg (1978) reports evidence for a significant risk premium in forward exchange and Cornell (1978) suggests a new explanation for short-run exchange rate volatility that abstracts from price rigidity.

New empirical results for the floating rate period are also reported in this paper. These results show an increase in exchange-market volatility and the corresponding decrease in the forecasting accuracy of the forward rate. The data suggest three interpretations — (1) the foreign-exchange market has become less efficient, (2) the market is efficient but there are significant risk premiums for forward speculation, or (3) the market is generally efficient and the recent experience is a small sample result that was caused by unanticipated shocks. An implication of these results is that large profits were available for currency speculators. Data are reported which indicate the magnitude and other characteristics of these profits.

Each of these general themes is examined in more detail in the remainder of the paper. In section II we consider theoretical issues — first, those related to models of exchange rate determination and second, those related to tests and interpretations of the efficient market hypothesis. Empirical results on foreign exchange market behavior and efficiency are presented in section III. This section first surveys the previous literature and then reports new results on the current behavior of the foreign-exchange market. The final section presents a summary of the paper and conclusions.

II. Theoretical Issues in Exchange Rate Determination and Market Efficiency.

A. Exchange Rate Determination

The classic definition of an efficient market is a market where prices "fully reflect" available information. The operational significance of this definition is that all tests of market efficiency are testing a joint hypothesis — first, a hypothesis on the structure determining equilibrium prices or expected returns and second, a hypothesis about the available information set and the ability of agents to efficiently set actual prices or returns to conform to their expected values. Therefore, an empirical test based on an incorrect equilibrium model of the foreign exchange market or based on a model not generally available to agents might incorrectly reject market efficiency. The selection of the equilibrium process describing foreign exchange rates is obviously critical for a proper test of market efficiency.

Recent research on exchange rate determination has demonstrated the wide variety of exchange rate adjustments that may be consistent with rational behavior.[1] One popular approach (Dornbusch 1976, Calvo and Rodriguez 1977, Niehans 1977) examines an asset approach to the exchange rate with sticky prices in the short run but purchasing power parity (PPP) in the long run. One stylized result in this kind of model is the "overshooting" effect. For a simple numerical example which assumes the neutrality of money, if the domestic money supply increases by 1 percent, the foreign exchange value of domestic currency may immediately decline by say 2 percent; only in the long run does the exchange rate asymptotically approach its long-run equilibrium value.[2]

An alternate approach by Bilson (1978a) clearly illustrates that the current exchange rate depends on all the expected future values of the exogenous variables. As such, if information is received today that affects the expectation of future exogenous variables, the exchange rate will change immediately. When the percentage change in the exchange rate exceeds the observable percentage change in the contemporaneous exogenous variable, we can call this a magnification effect. An extreme case is when a government official announces that some policy (intervention or monetary) will be changed in the future; the exchange rate responds immediately while no change is currently observed and measured in any exogenous variable. In a less extreme case, the money supply growth rate may change from a historic level of 5 to 7 percent. If traders believe this change is permanent rather than temporary, the impact on the exchange rate will be larger than the observable change in the money supply — i.e., a magnification effect.

From these models it is clear that the nature of the disturbance, its expected duration and impact on future exogenous variables are critical deter-

[1] For a survey of popular models of exchange rate determination, see Isard (1978). An anthology of papers dealing with exchange rate determination and empirical tests is in Frenkel and Johnson (1978).

[2] An empirical study by Bilson (1978b) confirms that overshooting has occurred during the floating rate period although he rejects the model of long-run adjustment described by Dornbusch (1976).

minants of the current equilibrium exchange rate. An important new paper by Harris and Purvis (1978) attempts to incorporate many of these factors within a formal model. The Harris and Purvis model allows a very rich setting in which an n-sector economy experiences both monetary and real disturbances which can be either temporary or permanent. Each agent has complete knowledge of prices and real disturbances within his own sector, but incomplete knowledge of conditions in the other sectors. Therefore, there is diverse information across the n-sectors. Harris and Purvis demonstrate that when there is uncertainty whether disturbances are real or monetary and uncertainty whether the disturbance is permanent or temporary and, furthermore, this information is heterogeneous across investors, it follows that the realized time path of the spot exchange rate varies considerably from the "full information" time path.[3]

The Harris and Purvis paper is interesting for at least two reasons. First, it shows how the equilibrium exchange rate depends on the classification of the disturbance. In this regard, the authors argue that the distinction between permanent and transitory disturbances has been underemphasized. Second, the authors illustrate that in the context of their model, exchange rate changes may be positively or negatively autocorrelated without violating weak-form market efficiency. As the authors acknowledge, the demerits of using autocorrelation statistics to test for market efficiency have been noted previously. However, there appears no ready way to test the very general model which Harris and Purvis propose.

Using a very different approach with equally provocative results, Cornell (1978) argues against assuming rigid domestic prices in favor of maintaining the Law of One Price while allowing for changes in relative prices. Using this framework, if tradable goods constitute only a small part of the CPI, Cornell argues that the exchange rate will appear (highly) volatile vis-à-vis the CPI because of a diversification effect — very similar to the way an individual security can appear (highly) volatile vis-à-vis a large index such as the Standard and Poor's 500. In this framework the exchange rate may appear highly volatile, but the foreign exchange market is efficient, apparently by assumption.

A final theoretical consideration for exchange rate determination is suggested by the recent work of Magee (1978) on contracting. In Magee's model, all forward prices are set so that, ex ante, all profit opportunities from international arbitrage are eliminated. In other words, when agents make contracts in period t for delivery in period $t + k$, prices are set so that, ex ante, PPP holds. Magee then demonstrates that using realized exchange rates and contract pri-

[3]Models which allow for heterogeneous expectations may be especially helpful for the analysis of central bank intervention. As the problem is sometimes formulated, excessive central bank secrecy or open policy debates increase *uncertainty* as to the future value of international reserves, the money supply, and other policy variables (Meigs 1978, p. 63). However, most simple monetary models express the exchange rate as a function of the expected value of a few variables (Bilson, 1978a); changes in the variance or covariance of these variables should have no impact on the exchange rate. It seems that the impact of central bank intervention (both known and rumored) and central bank announcements (both clear and unclear) should be to increase the diversity of expectations across individuals rather than simply to widen the distribution of expectations in a similar manner for all individuals.

ces (the amounts actually received by exporters and the amounts actually paid by importers), substantial deviations from PPP can be measured. But these deviations cannot be exploited for profit because there is a lag in the delivery of and payment for goods. In fact, by assumption, contract prices continue to be set to remove expected profits in commodity arbitrage.

Spurious deviations from PPP can also be generated if there are fixed costs associated with changing the firm's price quotation. For example, suppose a company publishes a catalog of its merchandise. The catalog is published quarterly, requires a three-month lead time to produce, and contains price information on 1000 items. In response to an exchange rate change that affects, say, 200 items, the company may choose to forego the cost of republishing a new catalog and notifying customers and, instead, keep its prices unchanged.

The model becomes more rich and realistic if we allow for uncertainty in the time path of prices. Suppose we take a U.S. company which has been importing raw materials from a German company for 20 years. Implicitly we assume that this long-standing relationship has a value not reflected in the product price. If the DM appreciates sharply (say 5 percent in one week) against the U.S. dollar, the U.S. firm may not change its supply source if the exchange rate change is expected to be temporary and if there are costs associated with locating a new supplier. Only as the U.S. firm becomes convinced that the exchange rate disturbance is permanent will it be willing to incur the costs associated with recontracting with a new supplier.

In summary, we have argued (1) that exchange rate models incorporating rational expectations can easily generate large and variable exchange rate movements in response to small (if at all measurable) changes in exogenous variables, and (2) that new interpretations of PPP provide additional and rational arguments for sustained deviations from PPP. This argument does not necessarily lead us to the conclusion that the current floating exchange rate system, which has exhibited sharp price movements and (apparent) deviations from PPP, is efficient nevertheless.

It does suggest however that it may be difficult to reject the efficient market hypothesis in the foreign exchange market, precisely because there are so many credible models of exchange rate determination.[4] This suggests two

[4]A recent argument by Zellner (1978) may be relevant for this point. Addressing the issue of causality and econometric tests, Zellner argues that if we have a theory that X causes Y and that the two variables are related by the expression $Y = F(X)$, then demonstrating that the data are consistent with the expression $Y = F(X)$ is sufficient to demonstrate causality. We know that if our theory has omitted an exogenous variable (X') our conclusion on causality may be wrong. But Zellner's major point here is that the soundness of our conclusion concerning causality rests on the soundness of the original economic theory. Econometric technique cannot be substituted for economic theory in order to determine causality.

In our version of this argument, suppose we have a theory based on rational behavior which predicts that the spot rate is determined by $S = F(X)$. If the data are consistent with the expression $S = F(X)$, we conclude that the market is efficient. A problem arises if other models incorporating irrational behavior are also consistent with the data. Selecting the model which best describes the data may turn on the soundness of the economic theory and assumptions in each model, which departs from the traditional approach to positive economics.

conclusions: (1) It may be difficult or impossible to use a model of exchange rate determination to test for market efficiency, and (2) that it will be difficult for government policy which responds only to an inefficient (or disorderly) market to meet the burden of proof.

B. Market Efficiency

Early statements of the efficient market hypothesis tended to portray it in a manner similar to any statistical null hypothesis; the data may either reject or not reject market efficiency. A taxonomy was developed (weak-form, semi-strong-form and strong-form) to describe efficient market tests based on various information sets — historical prices, public information and all available information. So while the theory allowed for heterogeneous information and expectations, and some empirical tests supported weak-form efficiency but rejected strong-form, the theory was essentially static.

An important contribution was made by Grossman and Stiglitz (1976) who assume that information is costly to collect and analyze. Because of information costs, not all information will be collected, so markets will never be fully efficient (i.e., strong-form). Moreover, since the information industry will reach a competitive equilibrium, investments in information will earn only the normal competitive rate of return. As a consequence, marginal investors may choose to be informed (i.e., to buy information) or uninformed (i.e., not to buy information) with each state earning the normal rate of return. The market will have heterogeneous expectations and information.

A new and imaginative approach to market efficiency is developed in Figlewski (1978a, 1978b). Traders in Figlewski's model have heterogeneous information, but they also are allowed diverse price expectations, risk aversion, predictive ability and wealth. Based on these factors, traders make their investments in period 1. Traders with superior (inferior) ability generally incur an increase (decrease) in wealth in period 2. The transfer of wealth ("dollar votes") toward traders with superior track records gives the market its dynamic property and long-run tendency to full efficiency. Based on numerical simulation of his analytical model Figlewski concludes that

> The more risk averse the traders are, and the more homogeneous their information, the more efficient we expect the market to be. However, when there is a wide range of forecasting ability or a diversity of expectations among the participants, the market may deviate relatively far from (full or strong-form) efficiency.[5]

The recent theoretical literature on market efficiency supports several conclusions. First, it may be helpful to view market efficiency as a process rather than a hypothesis to accept or reject. Given that traders have diverse information, speculative markets will approach full efficiency in the long run but can never reflect all information in the short run. Since we live in a series of short runs, a related question is — what is the appropriate standard to use for a short-run analysis? We expect the short-run variation in prices to exceed the long-run, full information variation — but by what factor should they differ?

[5]Figlewski (1978a), p. 597.

A second question for policy concerns the optimal procedure for moving toward full-information efficiency in the short run. Should the government intervene directly in the market (presumably utilizing more complete information than is publicly available) or should the government simply release information to increase the homogeneity of expectations across traders?

III. Empirical Studies of Foreign Exchange Market Efficiency

A. Recent Literature-Results from an Earlier Survey

Recent surveys of the empirical literature have been reported by Kohlhagen (1978) and Levich (1979). Since one method of testing for market efficiency is to analyze the availability of unusual returns (where "unusual" is defined relative to some equilibrium risk-return model) Levich divides the literature into risk-free and risky investment opportunities. Both Kohlhagen and Levich agree that simple, risk-free profit opportunities (such as covered interest arbitrage in offshore markets) are quickly arbitraged away. However, research on the efficiency of arbitrage between onshore and offshore assets has not been conclusive. We are still unable to fully document whether it is risk factors (e.g., the possibility of capital controls which would reduce the realized return from covered arbitrage below the expected return) or cost factors (e.g., the known cost of existing taxes and capital controls) which determines the interest differential between onshore and offshore assets.

The research on risky profit opportunities has led to more ambiguous results. This is a direct result of the diversity in models of spot and forward exchange rate determination which we discussed in Section II. The essence of the problem can be put succinctly:

> . . . it is difficult to test if investors efficiently set the actual spot exchange rate equal to its equilibrium value unless there is some agreement on what the equilibrium value is. Similarly, it is difficult to test if risk bearing is efficiently compensated if there is no agreement on the fundamental nature of foreign exchange risk, an adequate measure of foreign exchange risk and a model which determines the equilibrium fair return for bearing foreign exchange risk.[6]

We proceed to discuss the research on risky profit opportunities by first briefly reviewing the survey by Levich (1979) and then updating this with more recent research. For convenience we first consider tests for spot market efficiency followed by tests for forward market efficiency. When the interest rate parity theorem holds, spot speculation and forward speculation are equivalent investments so our results should be consistent.

Spot Market Efficiency. Basically two techniques have been used to test spot market efficiency. The first considers the time series properties of the spot rate and very often tests the null hypothesis that changes in spot exchange rates are serially uncorrelated. As we discussed in Section II, the time series path of the spot rate depends on the time series path of the exogenous variables as well as the process which determines expectations. Any time series test which

[6]Levich (1979).

abstracts from these conditions cannot be the basis of a test of market efficiency, although it may be helpful for descriptive or forecasting purposes.

The second popular technique for testing spot market efficiency has relied on the profitability of simple filter rule trading strategies.[7] Some results indicate that small filters would have been profitable for some currencies during the floating rate period. However, there are many factors which cast doubt on the interpretation of these results. First, it is not clear, ex ante, that the size of the filter can be determined which assures or optimizes profits. Second, even a filter rule which earns a profit over a sustained period is likely to report losses during some interim periods. Thus there is an element of riskiness in these trading strategies which is difficult to measure and difficult to compare to some standard model.

Data considerations do not allow us to analyze another potential problem related to filter rule strategies. Market-maker quotations are typically valid only for a small and specified volume of contracts and for a limited time span. It is therefore possible that supply and demand elasticities are sufficiently large so that unusual profits would be eliminated quickly after a small volume of trading. This is important if we want to distinguish an inefficient market which permits $10 billion worth of profitable transactions in one hour, versus an inefficient market which eliminates a profit opportunity after $1 million of trade in one minute.

Forward-Market Efficiency. Empirical tests of forward market efficiency surveyed in Levich (1979) can be conveniently divided into four groups. First, there are regression tests which estimate models of the form

$$(1) \quad S_{t+n} = a + bF_{t,n} + u_t$$

or

$$(2) \quad \frac{S_{t+n}}{S_t} = a + \frac{bF_{t,n}}{S_t} + e_t$$

where S_{t+n} = Spot rate in period t + n.

$F_{t,n}$ = Forward rate in period t for delivery n periods in the future.

Generally these tests cannot reject the result that a = 0 and b = 1 so that the forward rate is an unbiased predictor of the future spot rate.

A second technique for analyzing forward bias has been to analyze the statistical properties of the forecast error

$$(3) \quad e_{t,n} = S_{t+n} - F_{t,n}$$

[7] An *x* percent filter rule leads to the following trading strategy: "Buy a currency, and then an interest-bearing asset denominated in that currency, whenever the currency rises *x* percent above its most recent trough; sell the currency, and the asset, and take a short position — in both the currency and the asset — whenever the currency falls *x* percent below its most recent peak." With profit-maximizing traders, and with currency expectations reflected in interest rates, the expected excess profit from this strategy is zero.

The important conclusion from this analysis is that first, over long periods and for most currencies, the mean errors are small — many times not significantly different from zero. When the mean is significantly nonzero, it is likely smaller than transaction costs. Second, forecast errors in independent time periods are serially uncorrelated. Therefore, watching linear patterns in past forecast errors will not improve future forecasting performance.

An important point to make regarding both the regression analysis and forecast error analysis approaches is that unbiasedness is very often taken as the null hypothesis and then often equated with market efficiency. Since several theories of forward market equilibrium are consistent with a forward rate bias (or forward risk premium) this approach is not correct.[8] And our conclusion about market efficiency must rest on which model of forward rate determination we assume to be correct.

A third approach for testing forward market efficiency is based on the returns from forward speculation

$$(4) \quad R_{t,n} = \frac{(S_{t+n} - F_{t,n})\ W_t}{M\ F_{t,n}}$$

where W_t is +1 or −1 to indicate long or short forward positions and M represents the initial margin. If the market is efficient there should be no method for selecting the W_t to earn unusual returns in excess of costs. Very few tests have used this approach. Even so, the test would not be conclusive since there is no adequate measure of risk to determine if speculative profits are unusually high.

A fourth, and final, approach is to test the forecasting accuracy of the forward rate against other models. In a world with free information and risk neutral traders (or fully diversifiable exchange risk) market efficiency requires that the forward rate should be the best available forecast of the future spot rate. Levich (1978a) reports that forecasts based on Euro-currency interest rates are often (marginally) superior to the forward rate. Other research (Bilson and Levich, 1977) concludes that both time series forecasts and composite forecasts constructed during a sample period do not outperform the forward rate in a post-sample period. Since these two popular alternative models could not improve on the forward rate forecast, the authors conclude that there is no firm evidence against the forecasting efficiency hypothesis.

B. Recent Literature — 1978 Papers

Several papers have been published within the past year which extend the testing described in the last section. The first set of papers (Cornell and Dietrich 1978 and Logue, Sweeney and Willett 1978) examines the time series properties of the spot exchange rate and the profits that result from using a filter rule trading strategy. The Cornell and Dietrich study examines daily data for six currencies over the period March 1973 - September 1975 while the

[8] For an analysis of the fundamental conditions which lead to a risk premium in the forward market, see Frankel (1978).

Logue, Sweeney and Willett research uses daily data on seven currencies for the period April 1, 1973 – January 7, 1976 (N = 692). Both studies find that the one-day rates of change in spot prices show little evidence of serial correlation. While this result says nothing about market efficiency, Logue, Sweeney and Willett (1978, p. 159) argue that it "contrasts sharply with the view that the markets 'overshoot,' or that there are 'bandwagon effects,' or that the amount of price stabilizing speculation is inadequate."

In their analyses of filter rule trading profits, Cornell and Dietrich calculate the percentage rate of return relative to a buy-and-hold (U.S. dollars) strategy while Logue, Sweeney and Willett report the dollar profits of a trader who begins with $100 and compare this to a buy-and-hold-the-foreign-currency rule.[9] Logue, Sweeney and Willett do not account for transaction costs "on the presumption that the direct cost . . . would be very low for any foreign exchange dealer." They also do not adjust for the interest earned or paid while maintaining a currency position. Cornell and Dietrich, however, adjust for transaction costs and note that "the existence of these costs substantially reduced profits when using the smaller filters"; they also adjust for interest earned in the Euromarket. Cornell and Dietrich calculate that filter rule profits in German marks, Dutch guilders and Swiss francs are significantly greater than the buy-and-hold alternative. However, the authors feel that given the unprecedented world economic events during this period and their other sample evidence, their evidence on market inefficiency "does not appear to constitute a strong case for official intervention in order to correct for under-or over-evaluation of currencies." (p. 120)

A second set of papers (Brillembourg 1978, Hakkio 1978 and Stockman 1978) examines the structure of forward rates and expectations of the future spot rate. Stockman decomposes the forward rate into three terms — the expected future spot rate, a risk premium, and a convexity term. The model is tested on weekly data for the period February 1973–May 1977. The data suggest that a risk premium exists for two currencies (the British pound and Swiss franc) but that it is significant only in smaller subperiods and may not be constant.

Brillembourg's analysis covers the period June 29, 1973–June 24, 1977 and examines the term structure of Canadian dollar and British pound forward rates at the 30–, 60–, 90–, 180–, 270– and 360–day maturities. Brillembourg utilizes this extensive term structure to test an error learning model for revisions in forward rates (e.g., the revision of the 360-day forward rate on January 1 to the 270-day forward rate on April 1). Brillembourg concludes that in his second sample period (10/24/75–6/24/77) the data do not reject the presence of a risk premium. Furthermore, the model allows Brillembourg to estimate a "risk premium curve" which has a humped shape, starting near zero for short maturities and rising to about 0.04 percent per week for the 30-40 week maturities before the risk premium curve declines.

As these authors note, the existence of a risk premium has important

[9]The authors explain that "the relevant alternative to the trading rule is not holding dollars; rather it is holding the foreign currency."

implications for both positive and normative issues in international finance. A major problem with this evidence is that it relies on relatively small sample periods. As we have noted earlier, "forward bias" tends toward zero as the sample size increases. Analyzing one-year sample periods between 1967 and 1975, Levich (1978a) reports many cases of bias, but the sign changes relatively often and in an (apparently) unpredictable way. Traders cannot benefit if bias exists but it cannot be predicted. All the authors agree that future research should be directed toward a theory of the fundamental determinants of spot and forward rates, and as a result, the determinants of the risk premium.

A third area of research in 1978 reports on the accuracy of foreign exchange forecasts prepared by foreign exchange advisory services.[10] Levich (1978b) analyzes the currency forecasts prepared by Predex Corporation in the 27-month period April 1975–October 1977. Predex publishes both judgmental and equation-based forecasts for the major industrial countries for horizons from one to six quarters ahead.

Overall, the data indicate that for two currencies (the DM and lira) the Predex forecasts appear significantly better than the forward rate. For two other currencies (the Canadian dollar and the yen) the Predex track record appears significantly worse than the forward rate. Forecasts of the final two currencies (the British pound and the French franc) showed mixed results not significantly different from the forward rate. However, for individual currencies the forecasts do exhibit some consistency over time. In other words, forecasts which led to a significant profit in a currency in the first nine months of the sample continued to be profitable (on average) in the remaining 18 months of the sample. Therefore, a user of the forecasts could have used this rule to make profits. A longer time series of observations would make these results more convincing.

A paper by King (1978) examines the combined accuracy of seven exchange rate forecasting firms versus the forward rate. The analysis is for the one-year-ahead forecasts of the quarterly average future spot rate. The forecasts were generated in the seven-quarter period 1975–1 to 1976–3 for six major currencies. The results suggest that the average professional forecast error is smaller than the average forward rate forecast error across all six currencies. However, only for the DM is this difference significant; here the average professional forecast error is roughly half as large as the forward rate forecast error. This is somewhat surprising since the DM is a key rate in the system and believed to be closely watched by a wide group of professionals.

Further analysis of advisory service forecasts will provide useful tests of semi-strong and strong-form market efficiency.

C. New Empirical Results

In this section we report new empirical results on the relationship

[10]A survey of the foreign currency advisory service industry is in *Euromoney* (August 1978). A somewhat related study by Giddy (1978) concludes that black-market exchange rates may have significant predictive power at the one-year horizon, but they are rather poor predictors in the short run.

between the forward rate and the future spot rate during the period January 1967–May 1978. The purpose of this section is to update the results in Levich (1978a) and to illustrate the time pattern of forecasting accuracy over the five-year floating rate period. The sample period includes 590 weekly observations for nine major currencies. The data are from the Harris Bank *Weekly Review* which reports end-of-week bid quotations from the interbank market.

The statistics which we calculate are standard and can be summarized as follows:

Table 1: Mean squared forecasting error
Table 2: Frequency distribution of forecasting errors
Table 3: Mean forecasting error
Table 4: Serial correlation of forecast errors
Table 5: χ^2 test for forecasting bias
Table 6: Mean absolute forecast error
Table 7: Regression analysis of forecasting

The main statistic we are analyzing is the percentage forecast error (e_t) of the three-month forward rate, which we calculate as[11]

$$e_t = (S_{t+n} - F_{t,n})/S_{t+n}$$

Therefore, positive (negative) forecast errors indicate underestimation (overestimation). Note also that the forecast errors are subscripted for time t:the time when the forecast was made. Therefore, when forecasts are aggregated over some time period, say 1974, the summary statistics describe errors of forecasts which were *formulated* in 1974.

Broadly speaking, the data suggest that after the initial shock of generalized floating, some calm returned to the market and the forecasting accuracy of the forward rate improved. In the last two years this "trend" has been reversed for many currencies. In what follows we will consider whether this implies market inefficiency.

Table 1 presents the mean squared forecasting error (MSE) classified by time period and currency. For most countries the MSE peaks in a year with a discrete change in the spot rate, however in several cases (Canada, the United Kingdom, Switzerland and Japan) the MSE appears on the rise in 1977-78 and headed toward its recent high. Overall however, the average MSE across all nine countries appears on the decline from the peak reached in 1973.

Part of the frequency distribution of forecast errors is presented in Table 2. Analysis of the frequency distribution is an alternative, and perhaps superior, technique for assessing forecast accuracy since we avoid the effect that extreme outliers can have the mean and MSE. Table 2 illustrates the large forecast errors associated with the devaluations in 1971 and 1973. Forecasting accuracy increased for most currencies in 1975-76, except for three countries — Canada, the United Kingdom, and Italy. A substantial decrease in forecast-

[11]Since the data are weekly, we compare today's three-month forward rate with the spot rate 13 weeks from today. Our statistics were also calculated for the one-month and six-month forward rates but the results, which are generally consistent, are not reported here.

Table 1
MSE by Year and Country for 3-Month Horizon

Period	Method	Canada	United Kingdom	Belgium	France	Germany	Italy	The Netherlands	Switzerland	Japan	Average (σ)
1967	Forward	0.281	68.853	0.085	0.255	0.297	0.060	0.098	0.272	0.0	8.78 (24)
1968	Forward	0.526	0.901	0.523	1.769	1.161	0.123	0.385	0.201	0.0	0.70 (0.6)
1969	Forward	0.104	1.642	2.359	27.140	9.799	0.324	0.800	0.283	0.0	5.31 (9.4)
1970	Forward	4.544	0.533	0.008	0.184	0.470	3.565	0.100	0.233	0.006	1.07 (1.7)
1971	Forward	0.813	5.362	12.272	9.768	10.605	4.228	9.406	6.714	11.710	7.88 (3.8)
1972	Forward	1.574	17.599	13.947	17.704	17.512	3.102	16.515	29.957	18.493	15.16 (8.5)
1973	Forward	1.501	22.456	70.124	80.194	100.691	36.533	60.940	67.586	37.497	53.06 (31)
1974	Forward	2.247	19.398	41.053	35.320	47.228	16.610	32.563	61.590	29.237	31.69 (17)
1975	Forward	4.669	21.856	25.706	26.199	27.445	58.819	27.898	16.639	3.482	23.63 (16)
1976	Forward	6.315	43.902	19.567	7.252	7.300	84.235	17.987	6.135	7.901	22.29 (26)
1977	Forward	3.980	17.634	20.230	6.760	15.249	13.877	15.501	52.142	25.051	18.94 (14)
1978	Forward	8.167	36.080	9.228	28.288	7.992	12.921	8.263	17.994	36.955	18.43 (12)
1967–1978	Forward	2.527	19.624	19.001	19.792	21.698	20.707	16.719	22.159	18.181	17.82 (6.0)

Table 2
Percentage of 3-Month Forward Rate Forecasts Within 0.5, 1.0, and 2.0 Percent of Future Spot Rate

Country	1967			1971			1972			1973			1974			1975			1976			1977			1978			1967–78		
	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0
Canada	57	83	100	45	61	100	31	43	92	33	60	87	16	36	92	13	25	44	13	23	40	23	37	63	38	38	50	37	56	79
United Kingdom	66	68	70	4	37	50	12	24	34	2	6	14	6	14	38	13	25	35	4	9	21	0	0	19	0	0	0	20	35	50
Belgium	91	100	100	34	38	42	47	68	86	6	14	20	4	8	16	23	40	56	15	26	47	8	15	35	0	12	50	38	50	62
France	57	100	100	53	61	71	22	47	75	4	10	16	2	4	26	8	17	35	15	59	80	2	6	37	0	0	0	23	40	56
Germany	54	98	100	8	12	24	29	56	72	6	8	12	4	10	16	8	27	52	11	25	53	4	19	46	0	12	50	22	39	58
Italy	98	100	100	36	42	74	59	69	85	10	20	34	8	18	40	10	21	35	6	6	15	0	0	2	25	38	38	36	47	58
The Netherlands	94	100	100	14	28	42	22	42	77	6	10	20	6	10	20	25	33	54	8	25	40	25	42	58	0	12	50	31	49	64
Switzerland	64	94	100	25	29	56	12	30	72	4	8	16	4	8	14	15	35	48	23	38	62	2	6	19	0	38	38	31	49	63
Japan	—	—	—	47	57	57	15	28	43	10	14	31	10	18	30	13	29	58	15	28	53	2	2	13	0	0	0	21	29	44
Average	73	93	96	30	41	57	28	45	71	9	17	28	7	14	32	9	26	46	12	27	46	7	14	32	7	17	31	29	44	59

Table 3

Mean Forecasting Error by Year and Country for 3-Month Horizon (T-Value in Lower Panel)

Period	Method	Canada	United Kingdom	Belgium	France	Germany	Italy	The Netherlands	Switzerland	Japan
1967	Forward	0.006	-4.459	0.135	0.098	-0.382	0.010	0.075	-0.264	0.0
1968	Forward	0.550	0.748	-0.567	0.488	-0.771	-0.192	-0.417	-0.313	0.0
1969	Forward	-0.094	1.054	0.731	-1.076	1.147	-0.079	-0.455	-0.383	0.0
1970	Forward	1.395	0.271	0.008	0.405	0.385	1.254	0.083	-0.273	-0.023
1971	Forward	0.034	1.992	2.653	1.489	2.976	1.490	2.525	1.904	2.057
1972	Forward	0.221	-1.465	1.087	1.579	0.910	0.818	0.630	1.968	0.542
1973	Forward	0.093	-0.620	-0.666	-1.103	1.126	-2.478	0.882	0.540	-1.834
1974	Forward	-0.562	2.319	4.708	4.933	3.030	2.889	3.645	5.691	1.326
1975	Forward	0.282	-3.336	-2.832	-0.849	-3.124	-3.384	-3.139	-1.614	-0.554
1976	Forward	0.035	-2.076	3.235	-0.938	1.375	0.622	2.003	-0.464	1.607
1977	Forward	-1.528	3.533	3.556	2.398	3.049	3.533	2.627	5.630	4.317
1978	Forward	-2.041	-5.819	0.852	5.110	0.030	2.687	0.935	-1.030	5.969
1967–1978	Forward	0.013	-0.210	1.118	0.744	0.890	0.455	0.785	1.114	1.065

Period	Method	Canada	United Kingdom	Belgium	France	Germany	Italy	The Netherlands	Switzerland	Japan
1967	Forward	0.072	-4.179	3.384	1.292	-6.585	0.275	1.657	-3.991	0.0
1968	Forward	8.297	9.042	-8.771	2.707	-7.177	-4.461	-6.290	-6.818	0.0
1969	Forward	-2.173	10.341	3.712	-1.493	2.757	-0.983	-4.178	-7.364	0.0
1970	Forward	6.243	2.881	0.640	20.711	4.893	6.410	1.971	-4.945	-1.679
1971	Forward	0.270	11.918	8.115	3.833	16.080	7.363	10.259	7.737	4.188
1972	Forward	1.266	-2.635	2.151	2.863	1.590	3.709	1.109	2.752	0.862
1973	Forward	0.544	-0.942	-0.564	-0.886	0.807	-3.179	0.812	0.470	-2.174
1974	Forward	-2.888	4.422	7.735	10.628	3.509	7.177	5.930	7.521	1.807
1975	Forward	0.939	-7.274	-4.809	-1.202	-5.306	-3.511	-5.277	-3.077	-2.219
1976	Forward	0.099	-2.379	7.735	-2.678	4.264	0.490	3.864	-1.376	5.024
1977	Forward	-8.505	11.117	9.222	17.050	8.928	21.336	6.398	8.890	12.176
1978	Forward	-2.700	-10.326	0.773	9.159	0.028	2.978	0.910	-0.662	13.723
1967–1978	Forward	0.190	-1.134	6.285	4.034	4.651	2.383	4.668	5.829	4.982

ing accuracy during 1977-78 is clear for five countries — the United Kingdom, France, Italy, Switzerland and Japan. These results are substantial evidence for the recent decline in forecasting accuracy of the forward rate. The contrast with 1967, a quiet year under pegged rates, is very sharp.

Table 3 presents mean forecast errors and their associated t-statistics. Mean forecast errors in 1977-78 are generally as large in absolute value as errors at any time in the last 12 years. Furthermore, all t-statistics for 1977 and many for 1978 are significant.[12] Throughout the floating period, the bias appears unstable. For many currencies the bias changes from being positive (and significant) to negative (and significant). All currencies go through periods of significant and insignificant bias. A formal runs analysis of the positive and negative bias in each series was not performed, however, since a dependent sample of weekly forecasts was aggregated to calculate yearly bias.

Instead, our approach calculates the serial correlation of forecast errors in an independent sample. For example, at the three-month horizon, the sample consists of every thirteenth forecast error.[13] These results are summarized in Table 4.

Table 4 reports statistics for the entire sample period in the upper panel and the floating rate period in the lower panel. For each currency we report the autocorrelation of forecast errors at lags one through ten and the Box-Pierce Q(k)-statistic, which is a general test for the presence of autocorrelation through k lags.[14] The asymptotic standard error of the autocorrelation is approximately $1/\sqrt{N}$ while the Q-statistic is distributed as χ^2 with (k–1) degrees of freedom.

Both panels of Table 4 present a total of 148 autocorrelation statistics. Eleven of these, or 7.4 percent, are significant at the 5 percent level. The autocorrelations are typically positive at the initial lag and turn negative at lags two through five or six. This pattern suggests that the forward rate is initially somewhat conservative in adjusting to expected exchange-rate changes. However, then there is a reversal (perhaps the spot rate hits a turning point) and the sign of the forecast error changes from its value several periods ago. While this

[12]It is important to note that the standard errors were calculated using a dependent sample of roughly 52 observations per year. The t-statistics were then calculated as $t = \bar{X}/(\sigma/\sqrt{52})$. If we assume there are only four independent observations in each year, we should compute

$$t' = \bar{X}/(\sigma/\sqrt{4}) = t/\sqrt{13} = .28(t).$$

So for the yearly periods, the reported t-values should be reduced by 72 percent. Also note that for a t-distribution with three degrees of freedom the 10 percent and 5 percent significance levels are 2.132 and 2.776, respectively. In this case, only t-values in Table 3 greater than 7.69 and 10.0 are significant at the 10 percent and 5 percent levels. Even with this adjustment, all t-values in 1977 are significant at least at the 10 percent level, except for the Netherlands.

[13]Such an independent sample could be formed by taking observations 1, 14, 27, . . . or observations 2, 15, 28, . . . etc. Our procedure was to select only *one* independent series for each currency. As a theoretical matter, there is likely to be some sampling error around our particular autocorrelation estimates. It might therefore be worth the additional effort to calculate the autocorrelation of errors for other independent samples.

[14]We draw an analogy with standard multiple regression tests where a t-test is used to test each separate coefficient and an F-test is used to test the significance of the entire regression.

Table 4

Tests for Serial Correlation of Forecast Errors

Country	N	1	2	3	4	5	6	7	8	9	10	Q(6)	Q(12)
Canada	42	0.217	−0.100	−0.011	−0.153	−0.104	−0.100	0.135	0.267	−0.027	−0.203	3.657	7.346
United Kingdom	42	0.226	−0.039	0.018	−0.342[a]	−0.326	−0.151	0.220	0.322	0.077	0.179	10.749[b]	17.546[b]
Belgium	42	−0.176	−0.117	0.210	−0.311	−0.002	−0.094	0.103	0.020	−0.248	0.275	6.994	11.190
France	42	0.154	−0.359[a]	−0.164	0.043	−0.139	0.104	0.435[a]	0.072	−0.360[a]	−0.175	7.611	17.024
Germany	42	0.424[a]	−0.215	−0.342[a]	−0.212	−0.162	0.002	0.262	0.195	−0.155	−0.257	14.900[a]	18.794[b]
Italy	42	0.109	−0.321	−0.152	0.195	−0.116	−0.174	0.053	0.188	−0.004	−0.130	7.686	8.625
The Netherlands	42	0.201	−0.307	−0.281	−0.055	−0.099	0.003	0.104	0.101	−0.108	−0.086	8.151	8.737
Switzerland	42	0.438[a]	−0.284	−0.389[a]	−0.225	−0.113	0.008	0.137	0.106	−0.057	−0.028	17.522[b]	16.366
Japan	25	−0.170	0.045	−0.008	−0.310	0.070	−0.117	0.154	0.208	−0.423	−0.121	2.767	6.421
Canada	31	0.283	−0.160	−0.070	−0.025	−0.138	−0.197	0.123	0.262	0.055	−0.022	4.232	6.332
United Kingdom	23	0.242	−0.068	−0.037	−0.338	−0.467	−0.302	—	—	—	—	8.297	—
Belgium	20	−0.125	−0.114	0.139	−0.375	0.140	−0.130	—	—	—	—	3.154	—
France	20	0.100	−0.246	0.006	−0.085	−0.374	−0.010	—	—	—	—	3.046	—
Germany	20	0.360	−0.114	−0.211	−0.365	−0.466	−0.116	—	—	—		7.710	—
Italy	20	0.071	−0.309	−0.252	−0.121	0.353	0.167	—	—	—	—	4.643	—
The Netherlands	20	0.320	0.246	−0.284	−0.082	−0.552	−0.501	—	—	—	—	11.286[a]	—
Switzerland	20	0.677[a]	0.182	−0.282	−0.522	−0.726[a]	−0.828[a]	—	—	—	—	28.793[a]	—
Japan	20	0.239	−0.041	−0.264	−0.096	−0.013	−0.380	—	—	—	—	3.955	—

NOTE: Top Panel is 1968-78 period except Japan.
Lower panel is floating rate period, March 20, 1973 — date, for all countries except Canada and the United Kingdom.
a) significant at 5 percent level
b) significant at 10 percent level

Table 5

Summary of χ^2 Tests for Forward Bias: Floating Rate Period

Country	1-Month		3-Month		6-Month	
	χ^2	N	χ^2	N	χ^2	N
Canada	69.4	102	14.9	31	11.4	15
United Kingdom	39.2	76	6.6	23	0.8	11
Belgium	42.6	66	20.0	20	10.0	10
France	46.3	66	12.4	20	6.4	10
Germany	45.6	67	15.9	20	10.0	10
Italy	40.7	66	7.6	20	6.7	10
The Netherlands	31.7	66	10.0	20	2.6	10
Switzerland	33.0	67	7.1	20	1.7	10
Japan	42.0	66	10.9	20	4.3	10

description may be a general pattern, it is significant in the floating rate period only for Switzerland. Tests to see if knowledge of this pattern could lead to an unusual profit, which would suggest a market inefficiency, have not been attempted.

In Levich (1977), a theory of the time pattern of forecast errors is developed. The theory predicts that positive forecast errors (underestimates) will be most common when the spot rate is rising and negative forecast errors (overestimates) will be most common when the spot rate is falling.

One way to test the theory statistically is to classify each time period along two dimensions: (1) the forecast error, positive or negative, and (2) the change in the spot rate, positive or negative. Accordingly, a 2 x 2 contingency table can be constructed for each country-horizon episode. The null hypothesis is that the sign of the forecast error is independent of the rate of change in the spot rate. The test statistic,

$$\sum_{I=1}^{2} \sum_{J=1}^{2} (A(I, J) - E(I, J))^2 / E(I, J)$$

where A (.) and E (.) are the actual and expected values in cell (I, J), is approximately chi-square with one degree of freedom. Table 5 summarizes these chi-square statistics for all nine countries. Independent samples were selected for each horizon so the observations are nonoverlapping.

The data confirm that the type of bias described in the theory is still present in the floating rate period.[15] The bias shows some tendency to decline in longer term forward contracts, but for the one-month maturity, the effect appears very strong.

We present calculations of the mean absolute forecast error in Table 6.

[15]The critical values of $\chi^2(1)$ are 3.84 and 6.63 at the 5 percent and 1 percent significance levels. All of the entries in Table 5 are significant except for the United Kingdom, the Netherlands, and Switzerland at the six-month maturity.

Table 6: Mean Absolute Forecast Error by Year and Country for 3-Month Horizon

Period	Method	Canada	United Kingdom	Belgium	France	Germany	Italy	The Netherlands	Switzerland	Japan
1967	Forward	0.428	4.677	0.229	0.406	0.445	0.200	0.272	0.420	0.0
1968	Forward	0.599	0.772	0.581	1.149	0.898	0.283	0.584	0.380	0.0
1969	Forward	0.283	1.054	0.892	3.695	2.093	0.477	0.757	0.429	0.0
1970	Forward	1.485	0.585	0.073	0.405	0.477	1.274	0.249	0.364	0.060
1971	Forward	0.724	1.992	2.728	1.909	2.976	1.539	2.549	2.047	2.352
1972	Forward	1.052	3.463	1.848	2.402	2.320	1.062	2.378	3.208	2.946
1973	Forward	0.927	4.249	6.614	7.379	8.603	4.572	6.208	7.096	4.944
1974	Forward	1.318	3.448	5.587	4.933	6.093	3.342	4.835	6.409	4.416
1975	Forward	1.886	3.733	3.321	4.068	3.552	5.219	3.452	2.943	1.637
1976	Forward	2.198	5.643	3.323	2.277	2.223	6.719	3.331	1.928	2.321
1977	Forward	1.628	3.652	3.577	2.400	3.128	3.533	2.803	6.060	4.369
1978	Forward	2.203	5.819	2.600	5.110	2.410	2.753	2.497	3.468	5.969
1967–1978	Forward	1.163	3.046	2.668	2.894	3.006	2.637	2.527	2.881	3.130

Table 7a

Regression Statistics for Equation (1), $S_{t+n} = a + b F_{t,n} + u_t$

Country	Constant (a)	Slope (b)	R^2	F	s.e.	D.W.	NOBS
Canada	-0.025	1.025	.93	402.0	.009	1.47*	31
	(.051)	(.051)					
United Kingdom	0.017	0.980	.81	87.6	.019	1.51	23
	(.103)	(.105)					
Belgium	0.001	0.993	.87	121.9	.001	2.40	20
	(.002)	(.090)					
France	0.004	0.864	.59	25.5	.002	1.79	20
	(.004)	(.171)					
Germany	0.001	0.997	.99	20,469	.002	1.40*	20
	(.001)	(.009)					
Italy	0.003	0.992	.92	213.9	.004	1.97	20
	(.014)	(.068)					
The Netherlands	0.051	0.771	.58	24.7	.008	1.33*	20
	(.033)	(.155)					
Switzerland	0.068	0.709	.66	35.4	.012	0.57**	20
	(.027)	(.119)					
Japan	-0.009	1.029	.99	2,568	.007	1.84	20
	(.007)	(.020)					

This statistic is useful as a standard of comparison because it represents the maximum average per period return if one had correctly made the decision to be long or short (W = +1 or W = -1).[16]

Table 6 suggests a similar story as Table 1. Potential profits in forward speculation are significantly higher under the floating rate system. Forecasting errors, and therefore potential profits, are near the historical high levels for several countries — the United Kingdom, France, Switzerland and Japan. The results for the entire 1967-78 period suggest that the potential rate of return from currency speculation is roughly the same across currencies, except for the Canadian dollar.

Finally, Table 7 presents ordinary least squares regression estimates of equations (1) and (2). As in our test of serial correlation of forecast errors, we estimate equations (1) and (2) on independent sample observations.[17] The results for equation (1) indicate that the constant (1) and slope coefficient (b) are generally close to 0 and 1 and the estimated equations have high R^2 values. In no case (even for Switzerland), can we reject the joint hypothesis that a = 0 and b = 1. The low Durbin-Watson statistic for Switzerland indicates positive first order correlation of residuals, consistent with what we showed earlier in

[16]One application is to test the speculative profits based on a currency advisory forecast relative to the profits by this standard. See Levich (1978b).

[17]We should note again, as in footnote 13, that the results in Table 7 are for one independent sample of observations. Using our weekly data base, we could have selected 12 other series of independent observations. Our results assume that our sample is representative.

Table 7b

Regression Statistics for Equation (2), $\frac{S_{t+n}}{S_t} = a + b\frac{F_{t,n}}{S_t} + e_t$

Country	Constant (a)	Slope (b)	R^2	F	s.e.	D.W.	NOBS
Canada	0.196	0.804	.02	0.6	.009	1.41*	31
	(0.992)	(0.992)					
United Kingdom	0.418	0.578	.02	0.4	.019	1.53	23
	(0.858)	(0.860)					
Belgium	1.906	−0.903	.02	0.5	.024	2.50	20
	(1.330)	(1.333)					
France	2.507	−1.507	.09	1.8	.051	2.15	20
	(1.110)	(1.116)					
Germany	1.795	−0.784	.03	0.5	.068	1.71	20
	(1.091)	(1.100)					
Italy	3.515	−2.522	.22	5.1	.014	1.39*	20
	(1.118)	(1.122)					
The Netherlands	2.047	−1.054	.06	1.2	.034	1.74	20
	(0.959)	(0.969)					
Switzerland	2.310	−1.325	.13	2.7	.052	0.68**	20
	(0.797)	(0.809)					
Japan	1.484	−0.477	.01	0.1	.018	1.74	20
	(2.148)	(2.144)					

Notes: Standard errors are in parentheses below each coefficient.
s.e. is the standard error of the equation.
*implies D.W. statistic is in uncertainty interval at 5% significance level
**implies D.W. statistic is significant at 5% level.
Sample is Floating Rate Period, March 20, 1973 — Date, for all countries except Canada and the United Kingdom.

Table 4. Equation (1) was reestimated for Canada, Germany, the Netherlands and Switzerland using the Cochrane-Orcutt procedure which corrects for serially correlated residuals. Using the Cochrane-Orcutt procedure did bring the Durbin-Watson statistic to within the acceptable range without significantly changing the parameter estimates or reducing the standard error of the equation.[18]

The results for equation (2) are reported in the second panel of Table 7. The results illustrate that the parameters a and b can take on a wide range of values. In several cases, individual parameters differ from their expected values under the null hypothesis. However, in no case does the constrained model (with a = 0 *and* b = 1) result in a significantly higher standard error (s.e.) than those reported in Table 7. In other words, we cannot reject the version of equation (2), with a = 0 and b = 1, which states that the forward premium is an

[18]In general, the significant D.W. statistic suggests that equation (1) is misspecified. The problem could result from omitting a variable (a risk premium term or government intervention term), selecting a nonstationary period for analysis or an errors-in-variables problem to name only a few.

unbiased forecast of the future exchange rate change. It is equally true, however, that the predictive power of this relationship, as measured by R^2, is very low and not significant.[19]

IV. Summary and Conclusions

We now approach the difficult job of finding some regularities in the many studies and statistics which we have reviewed. With respect to theories of exchange rate determination, we now have a range of models which can accommodate large and abrupt changes in the exchange rate. My personal bias favors a rational explanation of the exchange rate and my casual reflection suggests that there is a great diversity of opinion about future economic events, that public and private institutions often act so as to increase this diversity of opinion, and that realized economic events can be very far from their expected values. Given these reflections and the models in section II, the current behavior of floating rates becomes rather credible.

With respect to the empirical results, two preliminary remarks are important. First, the current experience with floating rates contains only 20 independent quarterly observations. While several authors (Bilson and Levich 1977, Brillembourg 1978, Stockman 1978) have developed methods that attempt to get around this constraint, the experience with floating may be too young for testing important hypotheses. Second, we have observed that exchange rates sometimes trade within a 1 or 2 percent daily range; recently for the Swiss franc and Japanese yen, the range has approached 4–5 percent.[20] This observation raises the question, what is a reasonable standard for forecasting accuracy? For example, on January 1 at 9:00 A.M., the three-month forward rate may be \$2.00. On April 1 at 9:00 A.M. the spot rate may be \$2.00 and then proceed to close at \$2.06. Is this a 3 percent forecast error even if the trader could have sold his position during the day at a favorable rate?

The empirical results surveyed in this paper and the new statistics which we present do provide evidence that the market is volatile and that large profit opportunities are possible. However, they do not provide convincing evidence that the market is inefficient. In part, this may reflect a problem in statistical methodology. The statistical tests may not be powerful enough to reject market efficiency, even if they should. This may be because it has been difficult to specify precisely the alternative hypothesis. Alternatively, it may be, as Figlewski (1978a) suggests, that we have been preoccupied with market efficiency as a hypothesis rather than a process. In the short run, we know that the

[19]The estimates of equation (2) with significant D.W. statistics were reestimated using the Cochrane-Orcutt procedure. In all cases this revised procedure eliminated the residual serial correlation. For Switzerland, the R^2 of the revised model ($S_{t+n} / S_t = 1.98 - 1.01 F_t/S_t + e_t - 0.64 e_{t-1}$) is 50 percent.

While this in-sample measure of R^2 is significant, we cannot conclude that this revised model will outperform the naive forward premium forecast in post-sample predictions. See Bilson and Levich (1977) for a further discussion of this issue.

[20]We could add to this that at any moment of time, foreign exchange rates vary across the world's many trading rooms.

foreign exchange market does not fully reflect *all* information. Traders invest in information, take positions, time passes, wealth shifts and the exchange market generally moves closer to a full reflection of all information. The test which checks to see if this process is evolving rationally has yet to be devised.

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Discussion

Rimmer de Vries*

Rather than attempting to comment in some detail about the findings reviewed in this research paper, I thought it useful to briefly discuss the foreign exchange-market performance in the period of managed float as seen from the commercial banking side. Specifically, I would like to touch on four sets of issues:

a) Have the foreign exchange markets displayed reasonably good judgment in setting exchange rates in recent months and years, or have exchange rates on balance been unrealistic?

b) How are judgments about foreign exchange-rate movements arrived at by market participants?

c) What factors have contributed to the seemingly large exchange-rate volatility in recent months and should we be overly concerned about it?

d) What is the best course of action to take to restore stability in the foreign exchange market?

As regards the first issue, I believe that, on the whole, the foreign exchange markets have exercised rather good judgments about exchange rates. Countries with very large current-account surpluses, low rates of inflation, and virtually no adjustment policies have seen their exchange rates appreciate substantially; countries with large deficits, relatively high rates of inflation and weak anti-inflationary policies have seen their currencies depreciate, and countries which have a middle position have experienced relative exchange rate stability. Reflecting these factors, the Swiss franc has moved up more than 50 percent against the dollar over the past year, the yen by more than 40 percent, and the mark by more than 20 percent, and most other European currencies by lesser amounts.

However, it is now well recognized that in a system of floating exchange rates whereby many important currencies undergo substantial changes it is far better to measure the changes on a trade-weighted or effective basis. On this basis the yen has appreciated about 35 percent over the past year, the Swiss franc about 30 percent, and the mark about 5 percent. Sterling, the French franc, and the Benelux currencies remained about unchanged on an effective basis over the past year. Even better than discussing exchange-rate changes in effective terms is to discuss them in *real* effective terms whereby the trade-weighted exchange-rate changes are adjusted for past inflation differentials. In real terms, the Swiss franc has moved up 26 percent and the yen 23 percent.

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On the same basis, the German mark has remained just about unchanged over the past year, and so have the Dutch guilder and the Belgian franc, while sterling and the French franc moved up about 2 percent.

I believe that these movements by and large reflect the reality of these countries' balance of payments and domestic economic situations. The major exception is probably that of the German mark, which has lagged behind despite Germany's continued strong current-account performance and very low rate of inflation. However, it looks as if the market is beginning to recognize the apparent undervaluation of the mark and is in the process of correcting it. A sizable appreciation of the mark would tend to reduce somewhat the real appreciation of the Swiss franc and also correct the small real upvaluations of such fragile currencies as sterling and the French franc.

I further believe the market judgment has at times been better than that of monetary authorities. As a result, a large part of past exchange-market intervention ostensibly undertaken to counter temporary disorderly markets in retrospect has proved to have suppressed inevitable exchange-rate changes. Outstanding examples are the extremely heavy intervention during 1976 by the Swiss authorities, which exceeded $10 billion and occurred in the face of the emergence of a very large current-account surplus. The policy of suppressing the appreciation of the Swiss franc during that year has obviously made the adjustment problems for the Swiss economy now much worse. Another example was the extremely heavy intervention by the British authorities in the summer of 1977 when they took in some $10 billion to prevent the rate from going above 174. Japanese officials engaged in heavy intervention in the summer of 1976 to hold the yen to the 290-300 rate range. They insisted at that time that the market was misreading the country's payments performance and argued that export growth would lose momentum and import growth would pick up later in the year, leading to a narrowing of Japan's then modest current-account surplus. In the fall of 1977 the Japanese authorities again intervened heavily in unsuccessful attempts to hold the yen at the 250-260 level. They were projecting a narrowing of the current account surplus and were fearful of the impact of yen appreciation on the viability of their industry. In March of this year they again engaged in heavy intervention which they now have acknowledged was counterproductive in that it induced more yen purchases by market participants. It should be stressed that all this intervention prior to March 1978 occurred when the real effective exchange rate of the yen was below the March 1973 level, entirely inconsistent with economic reality.

This is certainly not to say that the market has always had the correct view regarding exchange rates. An outstanding example of the market's misjudgment was its perception of the effect that the quadrupling of oil prices would have on the dollar. It will be recalled that several market participants incurred huge exchange losses during 1974 mainly as a result of bad judgment about the dollar. However, during the past few years the private sector has devoted sizable resources to improve its information and forecasting capabilities in order to get a better judgment about exchange rates.

Secondly, a few comments about the market's method of making

exchange-rate judgments. Most market participants use a judgmental approach rather than any specific theory of exchange-rate determination. Helpful has been the measurement of real effective exchange-rate changes which give a good perspective about exchange-rate movements over the past few weeks, months, a year, and longer periods, using several bases including a long-term base such as 1973-77. It should be stressed that they provide a broad *perspective* of relative movements of exchange rates but are not used in a *normative* sense. Thus, if the real effective exchange rate of the dollar stands at 94, using March 1973 as a base, there is no a priori reason to believe that it should move back to 100 over a particular period of time. Such a mistake was recently made by *Business Week* which indicated that with the real dollar rate at 94, a major upward surge was about due.

It is also useful to look at inflation differentials projected for the next year or so. In a world of widely varying rates of inflation, inflation differentials can be quite sizable. For example at the moment Japan, Germany, and Switzerland all will benefit from a favorable inflation differential of at least 5 percent over the next 12 months, while the United States will suffer an adverse inflation differential of 2 percent or more over the next year. In other words effective exchange rates should also be adjusted for the inflation differential projected for the next year or so.

Other important factors taken into consideration are actual and prospective current-account performance and the economic-policy framework in countries. Many factors influence current accounts but the market probably pays more attention to relative inflation rates and relative growth rates than to other factors. In all this, market psychology, confidence, and expectations are very important. Thus, when private and official sources are currently projecting a substantial narrowing of the U.S. current-account deficit for next year, the market has virtually ignored this information at the moment because the market still has little confidence that policies will bring about a better payment structure that will last. The unfavorable inflation gap will continue into 1979, how much and how soon the growth gap will narrow is still highly unclear, and sizable current-account imbalances will remain.

Thirdly, I have difficulty appreciating the common observation that exchange rates have been excessively volatile during the past year or so. As already indicated, when exchange rates are expressed in real terms, the changes become quite modest and probably still too small in some cases, such as the mark. Secondly, changes should be expected to be swift and sizable in a world where trade and current-account balances, inflation differentials and growth gaps change rapidly and substantially. In the past few years the United States has been affected adversely by one major structural factor after another. First, it was hit seriously by sharply rising oil imports. Then it was hurt by an unusually large adverse growth gap, which was succeeded by a sizable adverse inflation differential. On top of all this there has been the dramatic push of exports and rising market shares by the LDCs. When underlying fundamentals change so rapidly and trade and current-account imbalances move from a record deficit to a record surplus in a short time, we should not be surprised that exchange rates respond equally as fast.

comprehensive, they would completely disrupt the ability of merchants to hedge against exchange risk by forward covering. Indeed, the free and uncontrolled Eurocurrency market is, fortunately, now the principal vehicle or "loophole" by which commercial banks cover forward foreign-exchange obligations to their nonbank customers. More general exchange controls that curbed Eurocurrency transacting would greatly increase the riskiness of foreign trade as seen by merchants and manufacturers — and take away the weakly stabilizing impact of the forward market as it now exists.

More positively, governments should seek an explanation for the wild variations in the relative valuations of national monies at their source: differences in the goals and modes of implementation of national monetary policies. A central bank's basic mandate is to stabilize the purchasing power of the national currency through its unique ability to control the supply of money. Hence private speculators must continually gauge what the central bank is going to do, and much of the instability we observe reflects the difficulties of making this assessment subjectively.

How then can central banks improve the information flow "objectively" available to private traders? I see two principal avenues.

First, for the long run central banks should adhere better to their own announced rates of growth in monetary aggregates. This has the important effect of at least bounding exchange-rate expectations: fears of a really big price inflation in any one country would be allayed.

Secondly, in the short run direct official interventions in the foreign exchanges should be successful and unambiguous in intent. For example, if the Federal Reserve Bank of New York (or its agent the Bank of Japan) intervenes to defend the dollar by selling yen and buying dollars, both central banks should take great care to ensure that the intervention does not fail — that the decline of the dollar is actually halted within the relevant short-run time frame. And, of course, a "successful" intervention is virtually guaranteed as long as central banks adjust their domestic monetary bases to support it.

Since free floating began in 1973, central banks have been in the foreign-exchange market continually but with no clear signal to private traders that the official intervention would be successfully sustained: the supporting domestic monetary adjustments were uncertain. Nothing is more demoralizing for the private market than a failed official intervention that amounts to an unclear signal of official intentions. Far better for a government to intervene many fewer times, and only in those extreme cases where the real purchasing power of the national money is significantly disaligned from those of major trading partners. But then the monetary authorities should use their considerable powers to force the correct realignment. And keying on the currencies of stable trading partners — by putting a floor under — or ceiling over — the rate of exchange with the national currency — may well be a preferred technique of short-run monetary control. For example, there is great uncertainty about how to conduct a stable short-run monetary policy in the United States at the

present time. The use of the Federal funds rate of interest as an instrumental variable has fallen into disrepute.[3] Hence, a case can be made for the Federal Reserve to adjust the value of the dollar to the more stable yen or deutsche mark in ways that private traders could easily understand.

[3]In *ibid.*, I argue that the traditional technique of implementing short-run monetary policy — by using short-run money-market rates of interest as indicators of whether money is tight or easy — is no longer valid. Keying on short-term interest rates may lead to a serious loss of monetary control in an open economy where exchange-rage expectations are volatile. In particular, a case is made that the sharp fall in the international value of the dollar in the 1977-78 period was, in part, due to the Federal Reserve Bank keying on the Federal funds interest rate — instead of taking more direct exchange-market measures to prevent the dollar's decline against the yen and some European currencies.

Monetary Policy under Exchange-Rate Flexibility

Rudiger Dornbusch*

Introduction

The continuing depreciation of the dollar stands out as one of the big policy issues. It has started to impinge on U.S. monetary policy; it influences the chances for international commercial diplomacy, and it is enhancing the move toward European monetary integration. Above all it leaves most observers with a puzzle as to the causes of the ongoing depreciation.

This paper will, of course, not resolve the puzzle. It rather attempts to lay out the basic analytical framework that has been developed for the analysis of exchange-rate questions and to relate it to the question of monetary policy. Part I concentrates on the development of the relevant theoretical framework. The main points to be made here are: (i) exchange rates are primarily determined in asset markets with expectations playing a dominant role; (ii) the sharpest formulation of exchange-rate theory is the "monetary approach," Chicago's quantity theory of the open economy; (iii) purchasing power parity is a precarious reed on which to hang short-term exchange-rate theory; (iv) the current account has just made it back as a determinant of exchange rates.

In Part II we review the main strands of empirical research on exchange-rate determination. The review concentrates mainly on the monetary approach where work has been quite plentiful, but also looks at some alternative formulations.

Part III pulls together these elements to form some conjectures about the working of monetary policy under flexible rates and about the dollar depreciation. In particular we draw attention to the trade-off between increased net exports and the inflationary impact induced by a depreciation.

The topic covered in this paper has received an extraordinary amount of professional attention in the last few years and much fruitful research has been accomplished. The fine surveys by Isard (1978), Kohlhagen (1978) and Schadler (1977) will place our sketchy review in the perspective of the literature and the books by Black (1977) and Willett (1977) help relate our topic to the ongoing policy discussions.

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I. Theory

In this part we review the main strands of exchange-rate theory. We start off with two rock-bottom models that, in an oversimplified manner perhaps, represent exchange-rate theory as viewed by the person in "the Street." These models, purchasing-power parity and a balance-of-payments theory of the exchange rate, each contain, of course, more than a germ of truth and thus serve as a useful introduction to our review.

We proceed from there to more structured models that emphasize macroeconomic interaction or the details of asset markets. These theories can be described as asset-market theories of the exchange rate. Extensions of these models are then considered in an effort to add realism. These extensions deal with expectations, questions of dynamics and of indexing and policy reaction.

A. Purchasing-Power Parity and the Quantity Theory

The purchasing-power parity theory of the exchange rate is one of those empirical regularities that are sufficiently true over long periods of time to deserve our attention but deviations from which are pronounced enough to make all the difference in the short run. Clearly, purchasing-power parity (PPP for short) is much like the quantity theory of money and indeed can be viewed as the open economy extension of quantity theory thinking.[1]

1. PPP Theory: PPP theory argues that exchange rates move over time so as to offset divergent movements in national price levels. A country that experiences a hyperinflation, for example, will experience at the same time a corresponding external depreciation of its currency.

The theory leaves open two important operational questions. The first deals with the channels through which this relation between inflation differentials and depreciation will come about. The second question concerns the extent to which PPP is complete, — does it hold in the short run and is there no responsibility for trend deviations over time?

The extent to which PPP holds exactly, at every point in time, and without trend deviation has been an important issue in trade theory. There is no question that theory has shown the possibility of systematic deviation that arises from the existence of nontraded goods. Specifically, Balassa and Samuelson have argued that because services tend to be nontraded, labor-intensive and show low technical progress as opposed to traded manufactures, we would expect fast-growing and innovating countries to experience an increase in their real price level over time. With prices of tradables equalized, the productivity growth in the traded sector would raise wages and the relative price of nontraded goods and thus the real price level in the fast-growing countries.

A second source of systematic deviation has been pointed out by earlier literature, including Viner, that dealt with the effect of capital flows or current account imbalance. Here it was argued that a borrowing country has a relatively high (real) price level. The argument here relies on the fact that an

[1]For extensive reviews see Officer (1976), Frenkel and Johnson (1978) and the collection of essays in the May 1978 issue of the *Journal of International Economics*.

increase in aggregate demand, financed by borrowing and a current account deficit, would raise the relative price of nontraded goods and thus the real price level. There are thus two reasons for trend deviations or systematic deviations from PPP that serve as important reservations to the generality of the theory.

Setting these reservations aside we are still left with the issue of how rapidly and completely we expect PPP to hold and through what channels it comes about. Here the literature is considerably more diffuse. A hard-core theory, associated with what Marina Whitman (1975) has aptly called "global monetarism" asserts the "law of one price." Goods produced by us and by our competitors behave as if they were perfect substitutes. Simple arbitrage by market participants will establish uniformity of price in closely integrated markets.

This hard-core view is no longer very fashionable except, of course, for raw materials, commodities and food. A more differentiated view would argue that in the short run and perhaps even in the long run there is substantial scope for product differentiation. Under these conditions price adjustment is no longer a matter of arbitrage but rather becomes a question of substitution. When our prices get out of line with those of our competitors so that we become more competitive, then we would expect demand to shift toward our goods, and in a fully employed economy, start putting upward pressure on costs and ultimately prices. The price adjustment here is certainly time-consuming; it depends not only on substitutability between supply sources — Okun's distinction between customer and auction markets is important here — but also on the state of slack in the economy and on the expected persistence of real price changes. The description of this mechanism suggests that deviations from PPP are not only possible, but may persist for some time.

The empirical content of PPP theory can be summarized as in equation (1):

$$k = (1 - a_1)\bar{k} + a_1 k_{-1} + a_2 z \; ; \; 0 < a_1 < 1, a_2 > 0$$

where k and k_{-1} measure the current and lagged deviation from PPP, $\bar{k}$ is the equilibrium real price level that has perhaps a time trend and z measures the systematic effect of borrowing or current account imbalance on the deviation from PPP. We would expect a_1 to be positive thus showing some serial correlation or persistence in deviations from PPP.

2. Money, Prices and the Exchange Rate: We turn now to a development of the "monetary approach" of exchange-rate theory. This model or approach combines the quantity theory of money — fully flexible prices determined by real money demand and nominal money supply — with strict PPP to arrive at a theory of the exchange rate.

The approach can be simply formulated in terms of a combined theory of monetary equilibrium and exchange-rate determination. Let M, P, V and Y be nominal quantity of money, the price level, velocity and real income. Then the condition of monetary equilibrium can be written as:

$$\frac{M}{P} V(r,Y) = Y \qquad (2)$$

where our notation indicates that velocity may be a function of other variables, such as interest rates, r, or income.

We can rewrite equation (2), solving for the price level, as:

$$(2)' \qquad P = V\frac{M}{Y}$$

which states that for a given velocity an increase in money leads to an equiproportionate rise in the price level. A rise in velocity likewise raises the price level while an increase in real income, by raising real money demand, would lower the equilibrium level of prices.

To go from here to a theory of the exchange rate we draw on a strict version of PPP which states that our price level is equal to foreign prices, P*, converted at the exchange rate, E:

$$(3) \qquad P = P^*E$$

where E is the domestic currency price of foreign exchange. Substituting (3) in (2)′ yields an expression for the equilibrium exchange rate:

$$(4) \qquad E = (1/P^*)\, V\frac{M}{Y}$$

The equilibrium exchange rate depends on nominal money, real output and velocity. An increase in nominal money or in velocity will depreciate the exchange rate in the same proportion. A rise in real income will lead to appreciation. What is the mechanism?

The theory argues that domestic prices are fully flexible, but are linked to world prices by PPP. Given the nominal quantity of money any variations in the demand for money must be offset by compensating changes in the level of prices and thus in the exchange rate. An increase in real money demand, because say of an increase in real income, will be accommodated by a decline in the level of prices so as to raise the real value of the existing nominal money stock. With a decline in our prices, though, we are out of line with world prices and thus require appreciation of the exchange rate.

To complete the theory we note two extensions. First there is symmetry in that the foreign price level, P*, is determined by foreign money demand and supply so that we can write (3) as

$$(4)' \qquad E = \left(\frac{M}{M^*}\right)\left(\frac{V}{V^*}\right)\left(\frac{Y^*}{Y}\right)$$

Clearly then, what matters for exchange-rate determination in this view is *relative* money supplies, velocities and real incomes in the two countries. Our exchange rate will depreciate if, other things equal, our nominal money stock rises relative to that abroad.

The second extension is a specification of a velocity function. Here the tradition has been to assume that velocity depends on real income and the alternative cost of holding money:

$$(5) \qquad V = Y^{\lambda-1}\exp(\theta r)$$

where r is the nominal rate of interest. The functional form is a matter of expositional convenience and monetary tradition.

Substituting (5) in (4)′ and taking logs we obtain the standard equation of the "monetary approach":[2]

$$(6) \qquad e = m - m^* \lambda (y - y^*) + \theta (r - r^*)$$

where e, m, m*, y, y* are logarithms of the corresponding capital letter variables.

In the final form, equation (6) shows that an increase in our relative money stock or a decline in our relative income will lead to depreciation as would a rise in our relative interest rate. The last conclusion is particularly interesting since it certainly is the opposite of the conventional wisdom that a rise in interest rates will lead to appreciation. We return to the question below when we compare the relation between interest rates and the exchange rate in alternative theories. We note here the explanation: an increase in interest rates reduces the demand for real money balances. Given the nominal quantity of money the price level has to rise to reduce the real money stock to its lower equilibrium level. With our prices thus getting out of line internationally a depreciation is required to restore PPP.

B. Balance-of-Payments Theory of Exchange Rates

A textbook view of exchange rates will argue that the exchange rate adjusts to balance receipts and payments arising from international trade in goods, services and assets. The current account is affected by the exchange rate because it changes relative prices and thus competitiveness, the capital account is affected to the extent that expectational considerations are important. The theory can be formulated with the help of equation (7):

$$(7) \qquad BoP = 0 = C(EP^*/P, Y, Y^*) + K(r, r^*, s)$$

where BoP denotes the balance of payments, EP^*/P measures the relative price of foreign goods and thus serves as a measure of our competitiveness, C denotes the current account, K the rate of capital inflow and s is a speculative variable which we disregard for the present.

Figure 1 shows the schedule BB along which our balance of payments is in equilibrium, given prices, foreign income and interest rates. A rise in E or a depreciation of the exchange makes us more competitive and thus improves the current account. To restore overall balance-of-payments equilibrium, lower interest rates are required so as to generate an offsetting rate of capital outflow. We can readily show that in this framework the exchange rate depends on interest rates, activity levels, relative price levels and the exogenous determinants of the composition of world demand:

[2]The literature of the monetary approach has predominantly used the forward premium rather than the interest differential. See, for example, Frenkel and Clements (1978). The theoretical rationale is, I believe, the idea that the relevant substitution is between domestic and foreign monies rather than between money and bonds. For a further discussion see Abel et al. (1977).

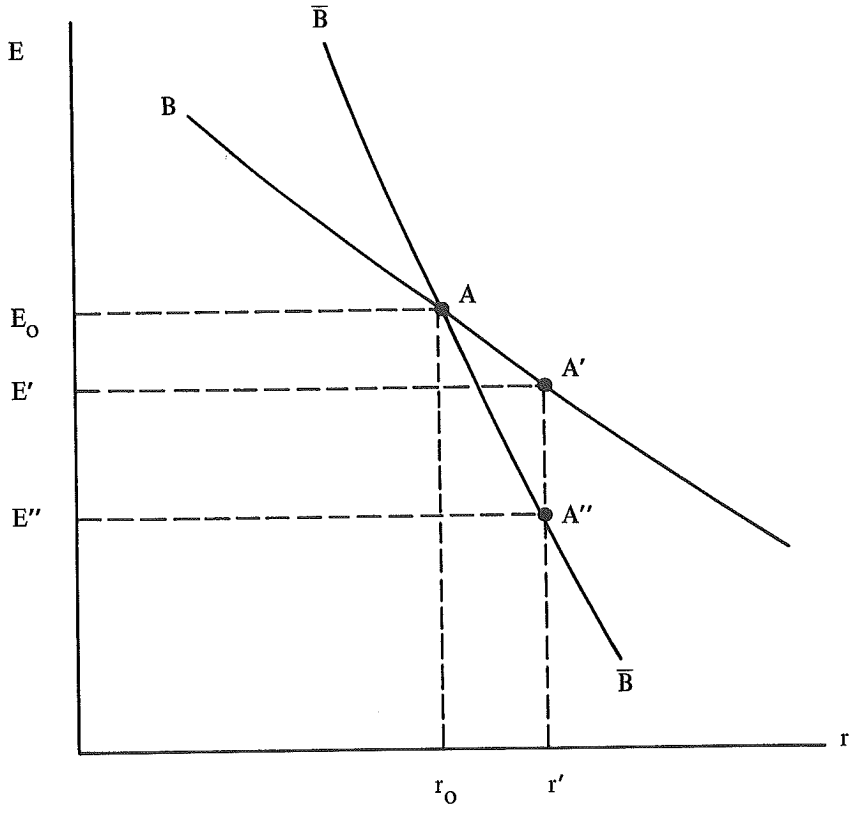


FIGURE 1

(8) $$E = E(Y, Y^*, r, r^*, P^*/P)$$

Specifically, an increase in our income, because of say an autonomous increase in spending, will worsen the current account and thus requires an offsetting depreciation. An increase in foreign prices leads to a precisely offsetting appreciation and an increase in our interest rate leads to an appreciation. The mechanism through which higher interest rates at home lead to an appreciation can be illustrated with the help of Figure 1. In the first place the increase in interest rates will lead to a net capital inflow or a reduced rate of outflow and thus causes the overall balance of payments to move into surplus. The exchange rate will accordingly appreciate — assuming the right elasticities — until we have an offsetting worsening of the current account. This is shown by the move from A to A′ on BB.

We may not want to stop at this point but rather recognize that the higher interest rates and the exchange appreciation will exert subsidiary domestic

effects. With higher interest rates aggregate demand declines and thus output will fall. The same effect arises from the appreciation and the resulting deterioration of the current account. Thus we have a second round of adjustments to the decline in income which shifts the BB schedule inward over time. The long-run balance-of-payments schedule that incorporates the equilibrium level of income implied by the real exchange rate and interest rate is the steeper schedule $\overline{BB}$. In the long run we have further appreciation until point A″ is reached.

Two points deserve emphasis here. First, the approach views changes in exchange rates as changing (almost one for one) relative prices and competitiveness. It in this respect represents a view opposite to that embodied in the monetary model. Second, it contradicts the monetary model in predicting that an increase in interest rates will lead to an appreciation. I will not pursue this model further, but rather take a specialized version and embody it in a macroeconomic setting.

C. The Mundell-Fleming Model

The balance-of-payments model has drawn attention to the role of capital flows in the determination of exchange rates. This is also the perspective adopted by the modern macroeconomic approach to exchange-rate determination that originated with the pathbreaking work of Mundell (1968) and Fleming (1962). Their theory argues that the exchange rate enters the macroeconomic framework of interest and output determination because changes in exchange rates affect competitiveness. Depreciation acts much in the same way as fiscal policy by affecting the level of demand for domestic goods associated with each level of output and interest rate. A depreciation shifts world demand toward our goods and thus acts in an expansionary manner.

The Mundell-Fleming model is illustrated in Figure 2 for the case of perfect capital mobility. Perfect capital mobility means that there is only one rate of interest at which the balance of payments can be in equilibrium. If the rate were lower, there would be outflows that would swamp any current account surplus and conversely if it was higher. This is illustrated by the horizontal BB schedule. The LM schedule is the conventional representation of monetary equilibrium. Higher income levels raise the demand for money. Given the money stock, interest rates will have to rise to contain money demand to the existing level of supply. Finally, the IS schedule resembles that of a closed economy except that it includes as a component of demand net exports as determined by income and competitiveness. That is why a depreciation will shift the IS schedule out and to the right.

Consider now a monetary expansion indicated by a rightward shift of the LM schedule. The impact effect is of course to lower interest rates and thus to exert an expansionary effect on demand. The decline in interest rates, however, leads to exchange depreciation because of incipient capital outflows. The depreciation in turn enhances our competitiveness raising demand and shifting the IS curve to the right until we reach point A′. Here output and income have risen sufficiently for the increased money stock to be held at the initial rate of interest.

The framework has an important lesson for exchange-rate theory and monetary policy. First, under conditions of perfect capital mobility and given

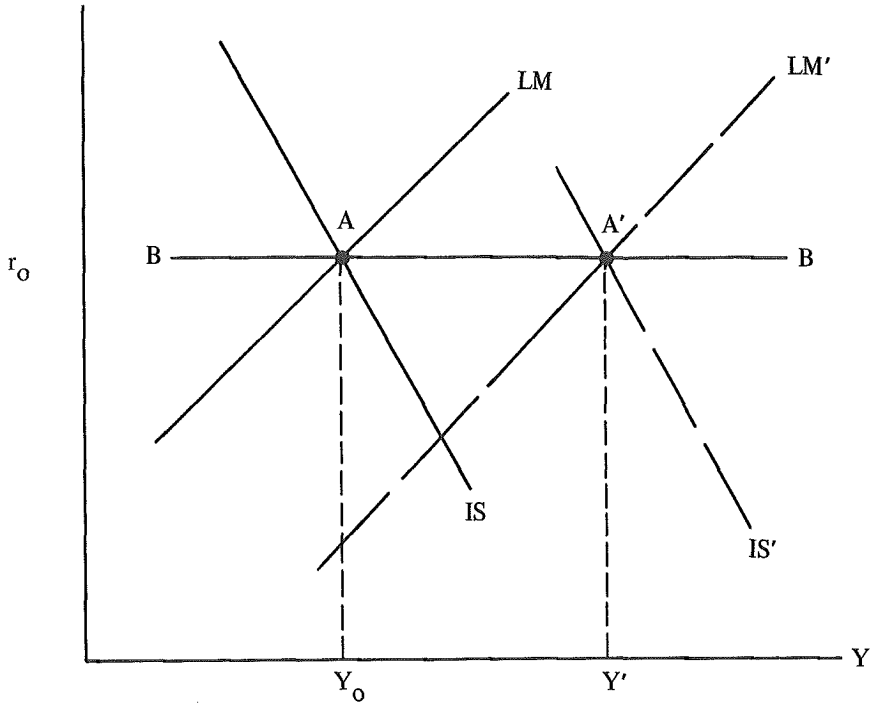


FIGURE 2

the world rate of interest, monetary policy works not by raising the interest-sensitive components of spending, but rather by generating a depreciation and thereby a current account surplus. Monetary policy works not through the construction sector but rather through the net export component of demand. This is of course a striking result, due in part to the small country assumption. It draws attention to the central role of net exports in aggregate demand and to the link between interest rates and exchange rates. It is the latter link that has become central to recent exchange-rate models.

The theory implies an equilibrium exchange rate which we can obtain either from the condition of goods market equilibrium:[3]

$$(9) \qquad E = E(r, Y, Y^*, P^*/P, \ldots)$$

or as a reduced-form equation of the full system:

$$(10) \qquad E = E(M, Y^*, \ldots)$$

where the dots denote fiscal policy variables and other exogenous determi-

[3]The condition of goods market equilibrium is: $Y = A(r,Y) + C(EP^*/P, Y, Y^*)$ where $A(\ )$ denotes aggregate spending by domestic residents and C is the trade balance. We solve the equation for the exchange rate to obtain (9).

nants of goods and money demand. It is interesting to note that in (9) an increase in the (world) interest rate, because it reduces aggregate demand and thus creates an excess supply of goods, requires an offsetting depreciation that increases competitiveness and gives rise to a trade surplus.

In its present form the model has three limitations: First, there is no role whatsoever for exchange-rate expectations. This point is important because it implies that strict interest equality must obtain internationally. Second, the model allows for no effect from the depreciation on domestic prices. The depreciation is not allowed to affect either the general price level, and therefore the real value of the money stock, or the price of our output and therefore our competitiveness. It is quite apparent that in fact we should expect at least some spillover into domestic prices and that this spillover will determine the extent to which the real effects of a monetary expansion are dampened. We return to this question in section 5 below and in part II where we look at the empirical evidence. The third limitation concerns the absence of any dynamics. This limitation is important not only in respect to the price adjustment that we just noted but also for the adjustment of trade flows. The existence of adjustment lags, reviewed below in part II, implies the possibility that monetary policy in the short run may fail to be expansionary.

D. The Portfolio-Balance Model

The Mundell-Fleming model emphasizes the high substitutability between domestic and foreign assets. Capital mobility is perfect so that the slightest deviation of interest rates from the world level unleashes unbounded incipient capital flows. An alternative formulation emphasizes a more limited substitutability between domestic and foreign assets and introduces the level of the exchange rate as a variable that along with asset yields helps achieve balance between asset demands and asset supplies.[4] The model concentrates on asset markets but can readily be extended to include the allocational effects of exchange rates in affecting the current account.

Consider now the basic model as shown in equations (11)-(13) and Figure 3. In equation (11) we show the condition of monetary equilibrium where W denotes nominal wealth and where $\phi(r,r^*)$ is the fraction of wealth people wish to hold in the form of domestic money:

$$(11) \qquad M = \phi(r,r^*)W \qquad \phi_r, \phi_{r^*} < 0$$

Equilibrium in the market for domestic assets requires that the existing supply, X, equal the demand:

$$(12) \qquad X = \psi(r, r^*)W \qquad \psi_r > 0; \psi_{r^*} < 0$$

where $\psi(r,r^*)$ is the desired ratio of domestic assets to wealth. The ratio is assumed to increase with the own rate of return and to decline with the return

[4]Portfolio balance models as discussed here have been developed among others by Boyer (1977), Dornbusch (1975), Dornbusch and Fischer (1978), Flood (1976) Henderson and Girton (1975), Kouri (1976, 1977), Branson (1976), and Porter (1977).

on foreign assets. Equations (11) and (12) together with the wealth constraint:

$$W = M + EF + X$$

imply an equilibrium condition in the market for net external assets:

$$(13) \quad EF = (1-\Psi - \phi)W = \rho\,(r, r^*)W \;\; ; \;\; \rho_{r^*} > 0, \rho_r < 0$$

where F denotes net holdings of foreign assets measured in terms of foreign exchange. Note that since net external assets can be negative, ρ can be negative. We assume that assets are substitutes so that asset demands respond positively to their own yield and negatively to yields on alternative assets.

In Figure 3 we show the money and domestic-asset market equilibrium schedules for given stocks of each of the assets. Along MM the domestic money market is in equilibrium. Higher interest rates reduce money demand so that equilibrium requires a depreciation and thus a rise in the domestic currency value of foreign assets and hence wealth. The exchange rate thus plays a balancing role by affecting the valuation of assets. Along XX the domestic asset market is in equilibrium. Higher interest rates raise the demand for domestic assets and thus require an appreciation to reduce wealth and asset demand thus restoring equilibrium.

We want to establish next the effect of changes in foreign interest rates, changes in domestic money or net external assets. In terms of Figure 3 an increase in the foreign interest rate creates an excess supply of domestic money and domestic securities thus shifting the MM schedule down and to the right and the XX schedule up and to the right. Without question the equilibrium exchange rate depreciates.

Consider next an increase in the domestic money stock. At the initial equilibrium there will be an excess supply of money and an excess demand for domestic (and foreign) securities. Accordingly the MM schedule will shift down and to the right while the XX schedule shifts down and to the left. It is readily established that the net effect is unambiguously a depreciation of the exchange rate.[5]

Finally we consider an increase in net external assets. Now both the money market and domestic security market schedules shift to the left. They will shift in the same proportion, as inspection of (11) and (12) together with the wealth constraint will reveal. Accordingly the equilibrium exchange rate appreciates in proportion to the increase in foreign assets.

The implications of the portfolio balance model are summarized in equation (14) which shows the reduced-form equation for the equilibrium exchange rate:[6]

[5]Using equations (11) and (12) along with the definition of wealth we have:

$$dE/dM = \left(\frac{1}{F}\right) \quad \frac{\Psi_r(1-\phi) + \Psi\phi_r}{\phi\Psi_r - \Psi\phi_r} \quad = \frac{1}{F} \quad \frac{\Psi_r\rho + \Psi(\Psi_r + \phi_r)}{\phi\Psi_r - \Psi\phi_r} \quad > 0$$

which is positive on our assumption of substitution.

[6]The effect of an increase in domestic securities on the equilibrium exchange rate is ambiguous.

$$(14) \qquad E = E(r^*, M, X, F); \quad E_{r^*} > 0; E_M > 0; E_X \lesseqgtr 0; E_F < 0$$

Furthermore since (14) is homogeneous in domestic nominal money and securities we can rewrite the equation as:[7]

$$(14)' \qquad E = \gamma(r^*, X/M)\frac{M}{F}$$

In this form we emphasize that the equilibrium exchange rate depends on relative asset supplies. In particular an increase in domestic nominal assets — money and securities — relative to external assets will lead to an equiproportionate depreciation. This homogeneity property is, of course, desirable since it corresponds to an ongoing, neutral inflation process.

The portfolio balance model draws attention to the substitution possibility between domestic and foreign assets. Domestic and foreign securities are no longer perfect substitutes and accordingly their relative supplies determine, along with the nominal money stock, equilibrium interest rates and the exchange rate. A link with the current account is established by virtue of the fact that external assets are acquired over time through the current account surplus. Accordingly, as Kouri (1976, 1977) and others have emphasized, the current account determines the evolution of the exchange rate over time. In particular a current-account surplus which implies accumulation of net external assets leads to an appreciating exchange rate.

The model remains a partial-equilibrium representation in two important respects. First, we do not consider the interaction between financial markets, the exchange rate, goods markets, and the current account. Second, we do not allow for any expectational effects.

What makes this model potentially attractive for the analysis of exchange-rate questions is the direct relation between asset-market disturbances and movement in exchange rates. It extends the monetary model because we do not have to rely on shifts in money demand or supply as sole determinants of exchange-rate movements but rather can consider shifts between domestic and foreign assets, for example, as motivated by, say, expectations.

E. Expectations and Exchange-Rate Dynamics

We have so far concentrated on models of the exchange rate that are largely static and that do not emphasize the role of expectations. We extend the analysis now to questions of dynamics and to the place of expectations. The role of expectations is central to exchange-rate determination, and therefore to policies under flexible exchange rates. The spot exchange rate is almost entirely dominated by the course the public expects it to take in the near future. These expectations, of course, are influenced by the structure of the

[7]To derive (14)′ we note that taking the ratio of (11) and (12) and solving for the equilibrium interest rate we have: $r = h(r^*, X/M)$. From (13) and the wealth definition we obtain:

$$E = \frac{\rho}{1-\rho}\,(M/F + X/F) = (M/F)\,\frac{\rho}{1-\rho}\,(1 + X/M)$$

Substituting the equilibrium interest rate $r = h(\quad)$ yields (14)′, where $\gamma(r^*x, X/M) \equiv \frac{\rho(r^*, h(r^*, X/M))}{1-\rho\,(r^*, h(r^*, X/M))}\,(1 + X/M)$.

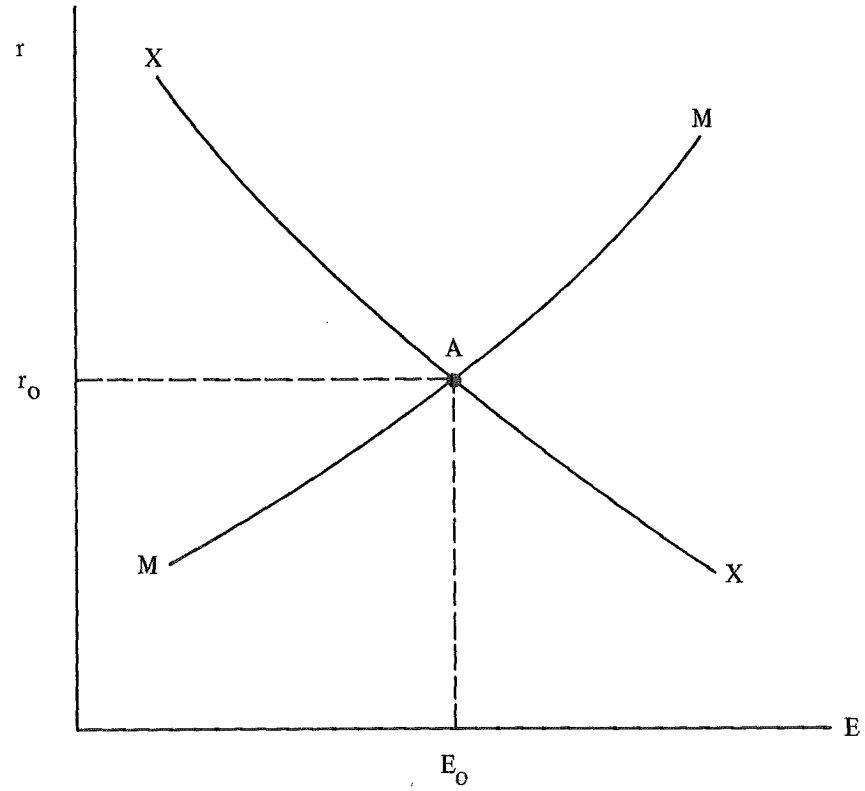


FIGURE 3

economy and institutional features such as indexing or systematic policy responses. We will in this section first review a fairly general model of exchange-rate expectations and dynamics and then extend the analysis to discuss the idea of a virtuous and vicious circle.[8]

1. Expectations: We return to the assumption of perfect capital mobility to establish a relationship between interest rates, current exchange rates and expected exchange rates. With perfect capital mobility asset holders would find themselves indifferent between holding domestic or foreign assets provided they carry the same yield, that is provided the interest differential matches the anticipated rate of depreciation:

$$(15) \qquad r\text{-}r^* \cong (\bar{E}/E - 1)$$

where $r\text{-}r^*$ is the interest differential, and where $(\bar{E}/E - 1)$ is the expected depreciation of the domestic currency which is defined as the percentage

[8]This section draws on Dornbusch (1976).

excess of the expected future spot rate, $\bar{E}$, over the current spot rate, E. We can rewrite (15) to yield an equation for the spot rate:

$$(15)' \qquad E = \frac{\bar{E}}{1 + r\text{-}r^*}$$

Equation (15)′ is central to a correct interpretation of exchange-rate movements. It argues that movements in the spot rate are due either to changes in interest differentials, given expectations, or to changes in expectations over the future course of exchange rates. Specifically, an increase in our interest rate will lead to an appreciation. The anticipation of depreciation, given interest rates, will lead to an immediate depreciation in the same proportion.

We close the model of exchange-rate determination with a theory of nominal interest rates and a theory of how exchange-rate expectations are formed. This is the point where our model ties in with the earlier theories. Thus we can appeal, for example, to the Keynesian model to argue that interest rates are determined by income, the terms of trade, and the real money stock. Suppose the foreign interest rate is given. The domestic interest rate, using the condition of money-market equilibrium as implicit in an LM schedule, will depend on income and real money:

$$(16) \qquad r = r(M/P, Y)$$

The expected future or long-run equilibrium exchange rate, $\bar{E}$ can be written as a function of the terms of trade, σ, and long-run price levels, $\bar{P}/\bar{P}^*$

$$(17) \qquad \bar{E} = \sigma(\quad)\frac{\bar{P}}{\bar{P}^*} = \sigma(\quad)\frac{\pi\bar{M}}{\pi^*\bar{M}^*}$$

which in turn are proportional to long-run money stocks, $\bar{M}$, $\bar{M}^*$ with the factors of proportionality, π and π^*, determined by exogenous real variables. Substituting (16) and (17) in (15)′ gives us a reduced-form equation for the equilibrium exchange rate:

$$(18) \qquad E = \frac{\sigma(\quad)(\pi\bar{M}/\pi^*\bar{M}^*)}{1 + r(M/P,Y)\text{-}r^*} = E(\sigma, M/P, Y; \pi, \pi^*, \bar{M}, \bar{M}^*)$$

What are the implications of our model for exchange-rate determination and monetary policy? The analysis is helped by Figure 4. The schedule QQ shows the equilibrium exchange rate of (18) for given long-run money, terms of trade and price levels and a given foreign interest rate.

The QQ schedule is downward sloping since, given money, a higher price level, say a move to point A‴ — raises the equilibrium interest rate at home and thus creates a differential in favor of the home country. To offset the differential the spot rate must appreciate — E must decline — to the point where the anticipated rate of depreciation matches the interest differential.

How will a permanent increase in the money stock work itself out in this framework? An increase in money in the long run, with all prices flexible will increase prices and exchange rates in the same proportion. This implies that

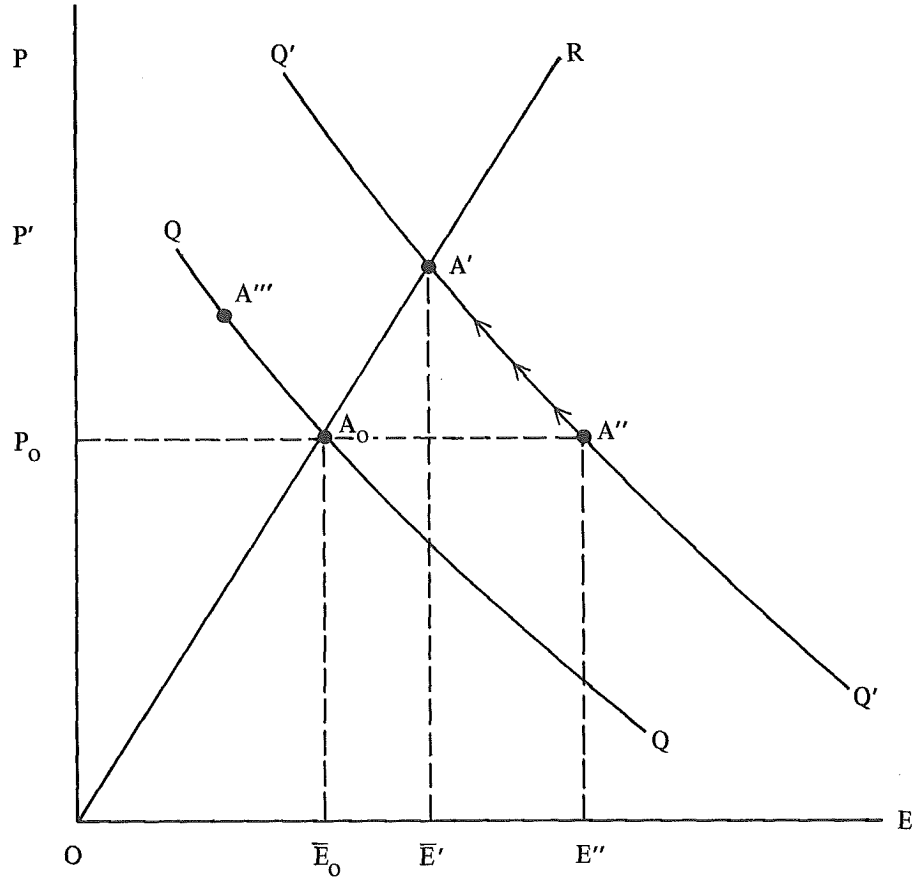


FIGURE 4

the QQ schedule shifts out to Q'Q' and that in the final long-run equilibrium we will be at point A' with all real variables unchanged. In the short run, though, an increase in nominal money is an increase in the real money stock. Prices are unlikely to jump and therefore a lower rate of interest is required for the public to hold the higher real money stock. With a decline in interest rates there will be an incipient capital outflow until the exchange rate has depreciated enough to create the anticipation of appreciation exactly at the rate of the interest differential. This is true at point A'' where the exchange rate has depreciated beyond its new long-run level. This *overshooting* of exchange rates is an essential counterpart of permanent monetary changes under conditions of short-run price stickiness and perfect capital mobility.

By how much will exchange rates overshoot? That depends on the nature of the price adjustment process. If prices rise very rapidly because interest response of money demand is low and that of goods demand is high or because

demand is highly responsive to relative prices — then the overshooting will tend to be small. Conversely, if the adjustment process of prices is slow, then the overshooting is large.

The adjustment, following the impact effect of an increase in money, is shown in Figure 4 by the movement along Q'Q'. The exchange rate has depreciated thus making domestic goods more competitive. Interest rates at home have declined thereby raising demand. Both factors work to put upward pressure on our price level. Prices will rise, real money declines and interest rates rise back up until the new long-run equilibrium at A' is reached.

2. Virtuous and Vicious Cycles[9] The framework we have laid out here helps understand a controversy that has developed about the working of a flexible-rate system. It has been argued that flexible rates make inflation stabilization more difficult in soft-currency countries and easier in hard-currency countries. The reason is that monetary policy, through the rapid reaction of exchange rates and through the overshooting, exerts rapid inflationary pressure in expanding countries and inflation-dampening in relatively tight countries. Monetary policy becomes quite possibly ineffective if one recognizes that the inflationary pressure of depreciation is quite soon translated into domestic price increases. These price increases limit the gain in competitiveness from a depreciation. In these circumstances monetary policy is primarily inflationary; it has very little, if any, effect on real aggregate demand. All that would happen is that renewed attempts at stimulating aggregate demand would translate into increasing inflation rather than more employment.

What institutional factors would check or enhance such an ostensibly unstable process? It has been argued with force that the virtuous and vicious cycle is entirely a matter of monetary determination. Unless monetary policy validates the depreciation it will ultimately undo itself. There can be little disagreement with this conclusion, except that it is fundamentally irrelevant as an observation about policy. The relevant policy setting is one where widespread indexation, for example, will immediately translate depreciation into wage and price inflation with the consequence of growing unemployment if the central bank fails to accommodate through further monetary expansion. The central bank may in practice have very little power to stop this inflationary process and the right starting point is incomes policy not monetary policy. At the same time it is, of course, true that the prospect of an effective stabilization program will immediately receive the side benefit of an appreciation and a consequent bonus in terms of inflation reduction.

F. Summary

We have now reviewed a wide spectrum of exchange-rate theories. There is little purpose in endorsing one particular formulation since each of these models seeks to capture a special effect and thus is more or less suitable for a particular instance of policy analysis. Some models view the place of the exchange rate mainly in its short-term effects on competitiveness and its long-

[9]The virtuous and vicious cycle has been discussed among others by Krugman (1977), Sachs (1978), Basevi and de Grauwe (1977) and Willett (1977).

term role in keeping prices in line internationally. Monetary and portfolio models assign importance to exchange-rate movements through valuation effects, exchange-rate movements change the real value of the money stock or the relative supplies of domestic and foreign assets.

If a choice has to be made between models, then I do see a difference between Quantity Theory-oriented models that leave for the exchange rate the purely passive role of keeping the current stock of real balances just right and expectations-oriented asset-market models in which the current level of the exchange rate is set primarily by references to its anticipated path. In this latter perspective changes in current rates bring about an adjustment dynamics the details of which depend on the differential speeds of adjustment in goods and money markets and where the adjustments that are taking place are quite possibly directed toward events that have not yet materialized but are already anticipated.

Monetarist models, of course, also recognize the importance of expectations. In those models, however, the spot rate is influenced by the effect of anticipated depreciation on real money demand. The anticipation of depreciation would reduce real money demand thus raising the price level and therefore, via PPP, lead to a depreciation of the exchange rate. The extent of the depreciation depends on the interest responsiveness of money demand. By contrast in the present model the anticipation of depreciation leads directly, as of given prices and interest rates, to an equiproportionate depreciation of the spot rate.

From the perspective of monetary policy these two strands of modeling differ of course quite radically. The Quantity Theory model assumes quite literally that prices are fully, instantaneously flexible. It thus cannot have any use for monetary policy, except perhaps to stabilize the price level in the face of money-demand fluctuations. All other models, of course, share a macroeconomic — as opposed to monetarist — persuasion where monetary policy works, more or less, because the central bank can move the real money stock. In this perspective exchange rates become a vehicle for monetary policy. One of the chief channels of monetary policy is the direct effect of money on interest rates and on the exchange rate and thereby on relative prices and aggregate demand. The empirical problem is of course whether this link makes price adjustment more rapid, or to put it differently, whether flexible rates make the Phillips curve steeper.

II. Some Empirical Evidence

In this part we will look at some of the empirical evidence that has a bearing on the exchange rate models discussed above. We will start with the evidence on PPP. From there we turn to the monetary model of exchange rates which is reviewed in section B. The asset market model is considered in section C. A discussion of the two key issues for monetary policy — the inflationary impact of import price changes and the response of trade flows to relative prices — is presented in section D.

Table 1

INFLATION AND DEPRECIATION: 1970-77
(Average Annual Rates)

	CPI	Deflator	Effective Nominal Rate	Effective Real Rate	$ Rate
Canada	7.5	8.4	–.3	.5	–.0
France	9.0	9.0	–.2	.8	–1.7
Germany	5.6	5.7	–5.3	–2.1	–6.3
Italy	12.9	n.a.	7.4	1.7	5.1
Japan	10.7	8.7	–3.6	–1.3	–4.1
United Kingdom	13.9	14.3	6.4	.9	4.7
United States	6.6	6.4	2.0	2.2	—

Note: In the last three columns a minus sign indicates an appreciation of the effective rate and an appreciation relative to the U.S. dollar respectively. The effective real rate is based on wholesale prices.

Source: *International Financial Statistics*

A. The Evidence on PPP

PPP has been studied in the literature for the last 50 years. We draw attention here to the recent review by Officer (1976) and careful study by Kravis and Lipsey (1978). Most students of PPP conclude that the theory does not hold up to the facts except in a very loose and approximate fashion. Thus Table 1 shows inflation and depreciation rates for some industrialized countries. It is true that the high inflation countries experienced on average a depreciation in their effective exchange rates. It is also true, however, that the matching between inflation differentials and depreciation is not very close.

To gain some measure of the performance of PPP we have looked at the real exchange rate for the United States and Germany. The real exchange rate here is defined as the ratio of the U.S. CPI multiplied by the exchange rate (DM/$) and divided by the German CPI, EP*/P. On strict PPP grounds that ratio should be independent of the exchange rate and should not show any persistence in deviations from its mean. Chart 1 shows the log of the real exchange rate as the solid line. Needless to say, the real exchange rate shows very substantial fluctuations that are systematically associated with movements in the exchange rate. Thus in mid 1975 for example the dollar appreciated relative to the DM by nearly 10 percent and we see in the chart associated increase in the real exchange rate. Conversely, the depreciation of the dollar in late 1977 and early 1978 is reflected in a declining real exchange rate.

Can these deviations from PPP be modeled in a simple fashion? In particular are these deviations from PPP short-lived and self-liquidating? A formulation that tests this hypothesis regresses the log of the real exchange rate, $k = e+p^*-p$, on its own lagged value and a constant. Using monthly data for the period March 1974-May 1978 we obtain:

$$(19) \qquad k = .33 + .69k_{-1} \qquad \text{Rho} = .65 \quad \text{SER} = .018 \quad \text{DW} = 1.91$$
$$(.11)\ (.10)$$

The model suggests that deviations from PPP do have persistence. To make that point we can rewrite (19) in terms of its long-run value $\bar{k}$:

$$(19)' \qquad k = .31\bar{k} + .69k_{-1}$$

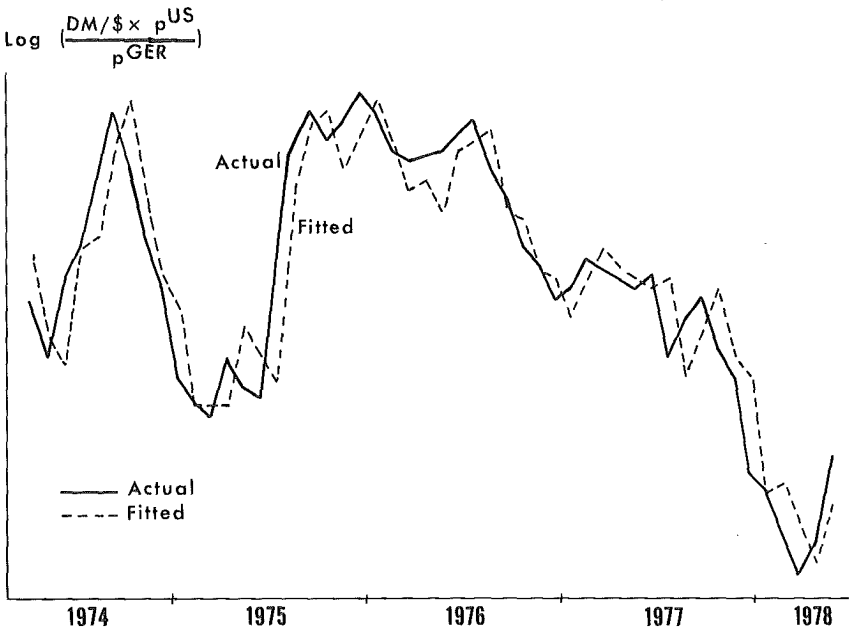
so that the real exchange rate depends to the extent of one-third on its long-run value and two-thirds on its recent history.[10]

One strand of literature, referred to earlier, sees deviations from PPP associated with current-account imbalance and capital flows. To the extent that an increase in interest rates will draw in capital flows we would expect the interest differential to help explain deviations from PPP. In (20) we report a PPP equation that includes the interest differential as an explanatory variable:

$$(20) \qquad k = .19 + .81k_{-1} - 2.61(r-r^*) \qquad \text{Rho} = .60 \quad \text{SER} = .018 \quad \text{DW} = 1.90$$
$$(.12)(.10)\quad (1.56)$$

Chart 1

The German - U.S. Real Exchange Rate



[10]From (19) we have $\bar{k} = \frac{.33}{1-.69} = \frac{.33}{.31}$. We can therefore rewrite (19) as $k = .31\left(\frac{.33}{.31}\right) + .69k_{-1}$ or $k = .31\bar{k} + .69k_{-1}$.

The equation shows that an increase in the interest differential in favor of Germany would cause the real exchange rate to decline. That would correspond to the case where the interest differential appreciates the mark at unchanged prices. While the interest differential thus has the expected sign, it is very imprecisely estimated and contributes little to explaining the behavior of the real exchange rate.

We have now seen the evidence on substantial and persistent deviations from PPP. I believe there is no surprise, if only because of the important role of nontraded goods. Consider for example the rates of inflation for different price indices reported in Table 2. We limit ourselves to Japan and Germany since these are the only countries that report export and import prices (as opposed to unit values). The table reveals persuasively the very substantial changes in relative prices. Export prices systematically rise at lower rates than the GNP deflator thus lending impressive support to the Balassa-Samuelson hypothesis. The terms of trade — the ratio of export to import prices — change by more than .5 percent per year.

Table 2

MEASURES OF PRICE CHANGE
(Average Annual Rates)

	GERMANY				JAPAN			
	CPI	DEF	EXP	IMP	CPI	DEF	EXP	IMP
1958-70	2.4	4.0	1.2	-0.3	5.2	4.9	0.8	0.2
1958-77	3.5	4.6	2.6	2.1	7.2	6.3	3.8	4.1

Source: Federal Reserve Bank of St. Louis and *International Financial Statistics*

In addition to sectoral changes in relative prices over time we have to recognize that pricing strategies differ across industries, across countries, and across the business cycle. In the United States pricing in manufacturing has been based on standard unit labor costs with little impact of aggregate demand or competitors' prices. Abroad there is evidence for substantially more flexible prices. The asymmetry reduces but does not eliminate the scope for exchange-rate changes to affect relative prices and thus bring about deviations from PPP.

B. The Monetary Approach

The sharpest formulation of exchange-rate determination is the "monetary approach" that is associated with the University of Chicago. It is represented in work such as Bilson (1978a, b, c)Dornbusch (1976b), Frenkel (1976), Frenkel and Clements (1978) and Hodrick (1978). The approach assumes, as we have seen, perfect price flexibility as well as PPP.[11] With these assumptions

[11]PPP is not always assumed to be instantaneous. Bilson (1978) allows for autoregressive adjustment such as in (19').

monetary equilibrium here and abroad implies an equilibrium exchange rate that can be written as in (6) and is repeated here for convenience:

$$(6) \qquad e = m - m^* - \lambda(y - y^*) + \theta(r - r^*)$$

The theory predicts that an increase in our income will appreciate the exchange rate and that monetary expansion or higher interest rates will depreciate the exchange rate. Equations such as (6) have been estimated for France in the 20s, Germany in the hyperinflation period, the United Kingdom and Germany, and the United States and Germany in the 70s. Table 3 reports in equations 1 and 4 estimates for such an equation. In each case the coefficient on relative money supplies was restricted to unity. The estimates for the period March 1974-May 1978 show that the coefficients have the expected sign, although the coefficient on interest rates is not statistically significant. We also note the very high estimate of serial correlation and the low level of the Durbin Watson even after correction for serial correlation. In sum, the equation is not very satisfactory.

There are several improvements on the basic formulation that deserve attention. A first one recognizes that the demand for money is poorly specified. There is no recognition of adjustment lags, although they have been found significant in domestic studies of money demand.[12] Nor does the equation include a long-term interest rate or deposit rate that measures the alternative cost of holding money rather than long-term assets.

Both equations 2 and 4 include a short-term and a long-term interest differential. The coefficient of the long-term rate is of the expected positive sign and is statistically significant.

Equations 3 and 6 complete the specification of money demand by allowing for partial adjustment so that our exchange rate equation becomes:

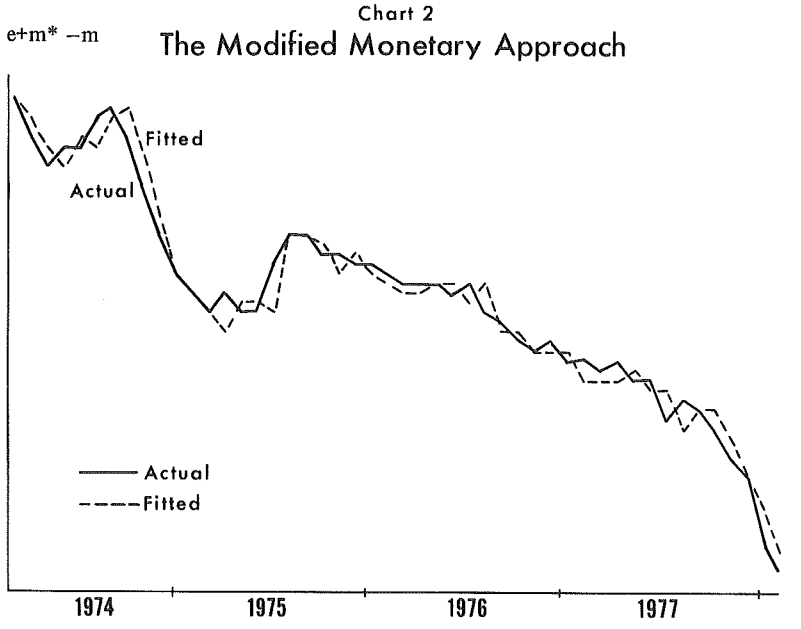
$$(6)' \qquad e = m - m^* + a_0 (e + m^* - m)_{-1} - a_1 (y - y^*) + a_2 (r - r^*) + a_3 (r_L - r_L^*)$$

This specification shown in Chart 2 substantially improves the equation by reducing the standard error and raising the Durbin Watson. The lagged coefficient is of the expected sign and magnitude and is statistically signficant. At the same time, however, the adjustment changes the sign of the short-term interest differential which now becomes negative, although it remains insignificant. This change of sign is maintained when instrumental variables estimation is used as in 6. In fact the stability of the coefficients across estimation techniques lends further support to our formulation.

One interpretation of this sign pattern has been offered by Jeffrey Frankel (1978). He argues that the exchange-rate equation of the form shown in 2 or 4 is a reduced-form equation from a system where we have both short-term real effects of monetary changes and longer term inflation differentials. In this perspective a rise in the short-term rate has to be matched by depreciation to

[12]In Bilson (1978b) the possibility of lagged adjustment of real money demand is explicitly recognized. In the empirical implementation, however, only a lagged exchange rate is used.

Chart 2



generate an offsetting expectation of appreciation. Changes in the long-term interest differential, by contrast, are a proxy for changes in the long-term inflation differential. Increased inflation thus raises long-term interest rates and leads to a depreciation of the spot rate.

C. A Criticism of the Monetary Model

A serious criticism of the monetary approach would start from the recognition that PPP does not hold as any direct test will show. Therefore an equation like (6), which explicitly relies on PPP, cannot be derived or expected to hold. This leaves expectations as the only direct link between exchange rates and the monetary sector. The argument returns us to equation (15)′ written for convenience in logs:[13]

$$(15)' \qquad e_t = {}_t\bar{e}_{t+1} - {}_td_{t+1}$$

where the prefix denotes the time at which expectations are formed and where ${}_td_{t+1}$ denotes the one-period interest differential starting at time t.

We now want to sketch what the implications for empirical testing of an

[13]Equalizing the expected return from an investment at home and abroad we have the following relation between the dollar returns:

$$(1 + r^*)\,\bar{E}/E = (1 + r)$$

where $\bar{E}$ is the exchange rate at which we anticipate to convert foreign exchange earnings. We can rewrite this equation as: $E = \bar{E}(1+r^*) / (1+r)$ or, taking logs, $e = \bar{e} - d$ where $d = \log(1+r) / (1+r^*) \propto r - r^*$.

Table 3

MONTHLY DM/$ EXCHANGE-RATE EQUATIONS: 1974/3 - 1978/5

#	$m-m^*$	$(e+m^*-m)_{-1}$	$(y-y^*)$	$(r_s-r_s^*)$	$(r_L-r_L^*)$	const.	Rho	SER	DW
1.	1		-.41	.87		1.13	.97	.021	1.28
			(.20)	(1.61)		(.10)			
2.	1		-.38	.14	9.12	1.24	.97	.021	1.41
			(.20)	(1.61)	(4.38)	(.09)			
3.	1	.67	-.23	-1.05	10.27	.46	.53	.018	1.94
		(.11)	(.17)	(1.49)	(3.18)	(.20)			
4.	1		-.45	3.23		1.13	.97	.022	1.36
			(.21)	(3.14)		(.12)			
5.	1		-.61	8.01	29.55	1.44	.65	.029	1.79
			(.33)	(6.65)	(3.52)	(.03)			
6.	1	.57	-.26	-1.51	13.37	.60	.58	.018	1.90
		(.21)	(.27)	(5.56)	(6.33)	(.31)			

Notes: The estimated equation is: $e+m^*-m = \text{const} + a_0 (e+m^*-m)_{-1} + a_1 (y-y^*) + a_2 (r_S-r_S^*) + a_3 (r_L - r_L^*)$ where all variables are defined in the text. Equations 1-3 were estimated using a correction for first order serial correlation. Equations 4-6 were estimated using Fair's method with production, the lagged right- and left-hand variables and time as instruments. Standard errors are in parentheses.

expectations based approach would be. For that purpose we subtract from (15)′ last period's exchange rate:[14]

$$(21) \qquad e_{t-1} = {}_{t-1}\bar{e}_{t+1} - {}_{t-1}d_{t+1}$$

where ${}_{t-1}d_{t+1}$ is the two-period interest differential:

$$(22) \qquad \begin{aligned} e_t &= e_{t-1} + ({}_t\bar{e}_{t+1} - {}_{t-1}\bar{e}_{t+1}) - {}_td_{t+1} + {}_{t-1}d_{t+1} \\ &= e_{t-1} + \epsilon_t + {}_{t-1}d_t - \eta_t \end{aligned}$$

The explanation for our equilibrium exchange rate as written here will rely on the rational use of information. Today's equilibrium exchange rate is equal to last period's adjusted for the one-period interest differential that prevailed between last period and this period. The remaining determinants of the exchange rate are white noise or fresh news or unanticipated events. They represent respectively the change in the expected future spot rate between last period and this period, ϵ_t and the reassessment of the one-period interest differential starting today, that is news about the term structure, η_t.[15]

The emphasis on exchange-rate movements as embodying new information is, of course, an essential aspect of assets-market theories of the exchange rate. This is particularly recognized in the work by Mussa (1976, 1977).

In this formulation the exchange rate will depreciate today relative to its previous level for one of three reasons:

(1.) the depreciation was anticipated and already reflected in the one-period interest differential ${}_{t-1}d_t$ which in this case would have been positive.

(2.) There is news about interest rates. The one-period differential, starting today, had been incorrectly predicted and the reassessment of the interest differential leads to a depreciation in the one-period rate. An unanticipated increase in interest rates with unchanged expectations about future exchange rates will lead to an appreciation of the spot rate.

(3.) The last piece that leads to a change in the exchange rate is news about next period's equilibrium exchange rate. Again here we look solely at a

[14]For subsequent reference we also define the log of the two-period interest rate starting last year: ${}_{t-1}d_{t+1} \equiv {}_{t-1}d_t + {}_{t-1}v_{t+1}$ where ${}_{t-1}v_{t+1}$ is the expected one-period rate differential between t and t+1, expectations being formed at t−1. With these definitions we can define the term $\eta \equiv {}_td_{t+1} - {}_{t-1}v_{t+1}$ as the unanticipated change in the one-period interest rate. The term $\epsilon_t \equiv {}_t\bar{e}_{t+1} - {}_{t-1}\bar{e}_{t+1}$ represents new information about the future exchange rate.

[15]A closely related question, the efficency of the forward market, has been extensively tested by running regressions of the form $e_t = a_o + a_1 f_{t-1} + u_t$ where f_{t-1} is the forward rate at t−1. The test involves the joint hypothesis of $a_o = 0$ and $a_1 = 1$. See Levich (1978). The focus of interest here, of course, is that the serially uncorrelated innovations should be explained in the terms of a structural model.

change in expectations due to new information. It is apparent that rationality requires that ϵ and η be serially uncorrelated.[16]

This model of the equilibrium exchange rate draws attention to the right variables in an exchange-rate equation. The right variables in addition to the lagged rate and the one-period differential and change of differential are the *unanticipated* components of the variables that systematically affect exchange rates. Thus an unanticipated, permanent increase in money will depreciate the exchange rate in the same proportion if interest rates remain unaffected and more than proportionately if interest rates transitorily decline. A change in the terms of trade with unchanged price trends and output will immediately depreciate the exchange rate in the same proportion.

From the perspective of the monetary approach this formulation suggests that we need both a structural model that will tell us about long-term determinants of exchange rates and the dynamics of the economy and we need a model of the unanticipated component of the exogenous variables. The model differs, of course, from the monetary approach since the latter could be written as:

$$(6)'' \qquad e_t = e_{t-1} + a_0 \Delta (m-m^*) - a_1 \Delta (y-y^*) + a_2 \Delta (r_S - r_S^*)$$

where the Δ denotes first differences. In contrast to (6)" we have in (22) the unanticipated components of these first differences but we have in addition other structural determinants of exchange rates as they arise in a world not bound by strict PPP. To implement an equation like (22) the procedure clearly parallels work on interest rates or output determination where the implications of rational expectations have started to be tested.

D. The Portfolio-Balance Model

The portfolio-balance model has received relatively less attention than the simple monetary model. This is due, in part, to the data requirements and in part to the fact that the theory is less structured in its predictions. Nevertheless, drawing on work by Branson, Halttunen and Masson (1977) and Porter (1977) we can report some results for the \$/DM exchange rate.

We recall from equation (14)' that the equilibrium exchange rate is determined by relative asset supplies. More particularly, an increase in the ratio of money to domestic assets will lead to a depreciation as will an increase in the ratio of domestic assets to foreign assets. The tests that have been performed have excluded domestic assets entirely and thus focus only on money and net foreign assets where the latter are obtained by cumulating current account surpluses.

In the Branson-Halttunen-Masson (BHM) model the \$/DM exchange rate is estimated for the period 1971:8-1976:12:

[16]Since η_t is observable there may be a temptation to run an equation

$$e_t = e_{t-1} + {}_{t-1}d_t + \eta_t + \epsilon_t$$

treating η_t as the error term. The procedure is not appropriate since the revision of interest rates is likely to be correlated with ϵ_t as the case of unanticipated money, for example, makes clear.

(23) $E = -4.85 - .0618M + .09M^* + .6758F - .3976F^*$
$\quad\quad (-.1) \quad (-1.7) \quad\quad (2.8) \quad\quad (1.7) \quad\quad (-1.9)$

$\text{Rho} = .87 \quad R^2 = .94 \quad DW = 1.35$

where t-statistics are given in parentheses, and where M, M*, F and F* denote German and U.S. nominal money stocks and net external assets. The equation supports the theory in that the coefficients of money and foreign assets have the correct signs. The corresponding elasticities are respectively: –.73, 1.85, .05 and –.22.

These elasticities with respect to money very broadly support a monetary view. The interesting novelty, however, is the inclusion of net foreign assets which here have an unambiguous effect. A current account surplus, by leading to accumulation of external assets, gives rise to an appreciation. This is an important link that had been neglected by earlier asset market views and for which support is therefore all the more important.

I see the chief interest of the portfolio model as a direction of research that moves exchange-rate theory away from money and PPP toward a perspective that emphasizes increasingly real variables: relative asset supplies, exchange-rate expectations, the terms of trade and the current account.

E. The Impact of Traded-Goods Price Movements

In this section we study briefly the impact that movements in traded-goods prices exert on the economy. Two questions concern us here. One is the extent to which an increase in import prices increases consumer prices and the GNP deflator. That question is important because it measures the inflationary impact of exchange depreciation as brought about, for example, by expansionary monetary policy. The second question concerns the responsiveness of trade flows to relative price changes. That question is of interest because it measures the extent to which depreciation induced movements in competitiveness create net exports and thus aggregate demand. Both questions are essential aspects of the dynamic extension of the Mundell-Fleming model in section I C above.

1. The Inflationary Impact of Import Prices: An exchange-rate depreciation will, for given world prices, raise the domestic price of imports. There is thus a direct impact on consumer prices to the extent that the CPI includes importables. There are additional effects, however, to the extent that prices of closely competing goods will tend to rise. Finally, there may be a more time-consuming adjustment as money wages rise in response to the induced CPI inflation. We have tried to capture all these effects in a rough way by a price equation that relates the rate of CPI and GNP deflator inflation to their own lagged levels, the prime male unemployment rate, u, and important price inflation, $\dot{P}$. Table 4 summarizes these results, using U.S. quarterly data for 1965/I-1977/IV.

The equations strongly support the idea that an increase in import prices spills over into increased domestic inflation. In the short run an increase in import price inflation of 2 percentage points will raise domestic inflation by about a third of 1 percent. The long-run effect is about double that figure. It is

Table 4

THE IMPACT OF IMPORT PRICE INFLATION IN THE UNITED STATES

Price Index	const	$\dot{P}_{-1}$	1/u	$\dot{P}_{m}$	R^2	DW
CPI	.002	.43	.007	.15	.64	1.92
	(.003)	(.14)	(.005)	(.03)		
GNP Deflator	.004	.40	.004	.15	.78	1.96
	(.002)	(.10)	(.003)	(.02)		

Note: The inflation rates on the right-hand side are one-year moving averages. Standard errors are in parentheses.

perhaps interesting to note that the magnitude of the short- and long-run effects of import prices substantially exceeds the share of imports in GNP or expenditures and thus demonstrates that there is substantial spillover.

The impact of import prices on domestic prices can thus be determined with considerable accuracy. The harder question is the impact of depreciation on import prices. Here we have substantial differences across commodities. A reasonable approximation would be to assume that an across-the-board 1 percent depreciation in the effective exchange rate would raise import prices by between a third and a half percentage point. The difference is made up in part by a decline in prices abroad and in part by a reduction in foreign profit margins.

If we combine these numbers with those in Table 1, we conclude that a 5 percentage point depreciation in the effective exchange rate would in the short run raise inflation by about .4 percent and in the long run by about double that amount. For the United States there is thus clearly an inflationary impact but it really is not very substantial in magnitude.

The experience of Germany, Switzerland, or Japan is of course quite different. With substantially more open economies import prices exert a more sizable effect on domestic prices. Accordingly, the large appreciations which these countries have experienced have made a large contribution toward stabilization of inflation. Table 5 shows inflation rates of consumer and import prices for these countries. Chart 3 looks at the case of Japan. With import prices actually declining there is a powerful check on domestic wage and price movements and thus a possibility of reducing inflation without a major recession.

2. The Responsiveness of Trade Flows: To complete our framework of reference we briefly look at the responsiveness of trade flows to changes in relative prices. We noted earlier that an expansionary monetary policy will depreciate the exchange rate and thus change relative prices. We now ask how much of a change in net exports can be expected. There is of course a wide body of empirical studies to draw on. We limit ourselves here to some recent estimates

by Deppler and Ripley (1978), Goldstein and Khan (1978) and Hooper (1978).

Table 6 summarizes the elasticities with respect to relative prices that emerge from these studies for the case of the United States.

The table reveals two by now well-established facts: First, that there is substantial long-run adjustment to relative price changes. The cumulative reponse of world demand to a reduction of 5 percent in the relative price of U.S. export goods is about 10 percent. Similarly on the import side we have evidence for substantial elasticities in the long-run response.

The second fact concerns adjustment lags. These lags are very pronounced as can be seen from the difference between short-run and long-run elasticities. The exact time shape of the response is very hard to determine with any precision but can readily be summarized by saying that full adjustment is a matter of years, not quarters.

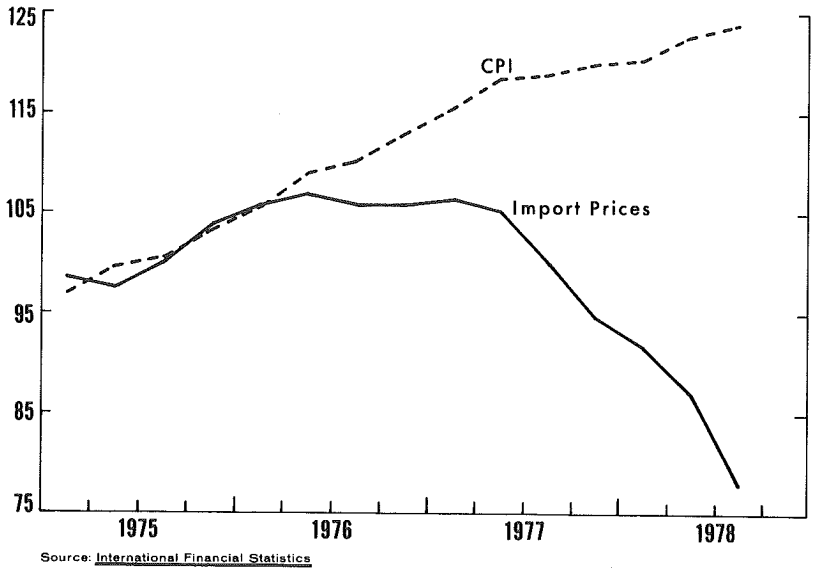
The evidence then suggests that a reduction in the relative price of U.S. goods will increase net exports and thus improve the current account and add to demand. In this direction there is some compensation for the inflationary effect of monetary policy through increased prices. It is important to recognize, though, that the trade adjustment is slow and that accordingly this channel of monetary policy may be a poor instrument of cyclical stabilization policy.

III. Concluding Observations

The theoretical framework and the empirical evidence allow us to form some tentative conclusions about the determination of exchange rates and the

Chart 3

Japanese Prices



Source: International Financial Statistics

Table 5

DOMESTIC AND IMPORT PRICE INFLATION

	GERMANY		SWITZERLAND		JAPAN	
	Domestic	Import	Domestic	Import	Domestic	Import
1975	5.9	-1.7	6.7	-9.8	11.9	7.6
1976	4.5	6.7	1.7	0.4	9.3	6.0
1977	3.9	1.5	1.3	1.2	8.1	-4.2
1977/78	2.7	-6.5	1.4	-10.0	3.6	-17.0

Note: Domestic inflation is measured by the CPI. The 1977/78 data correspond to the period 1977/II to 1978/II.

Source: *International Financial Statistics* and Federal Reserve Bank of St. Louis.

Table 6

TRADE ELASTICITIES

	Short Run	Cumulative
	EXPORT DEMAND	
Total: a.	—	-2.32
b.	-1.26	-2.12
Manufactures:	-0.29	-1.52
	IMPORT DEMAND	
Manufactures:	—	1.92
Total Nonoil:	—	.92-1.15

Note: On the export side estimates a. and b. are from Goldstein and Khan (1978). The estimates for manufactured goods are from Deppler and Ripley (1978). The short run for the former is a quarter, for the latter a year. The nonoil import elasticity estimates are from Hooper (1978) using equations without a time trend.

scope for monetary policy under flexible rates. The conclusions must remain tentative because the theory itself remains very much in flux — much as the domestic counterpart in macroeconomics, and because the empirical evidence is only starting to come in and to receive proper scrutiny. With these caveats in mind here are some conclusions:

A first conclusion must concern the "right" model of exchange-rate determination. I take the evidence, theoretical and empirical, to reject the monetary approach in the narrow way in which it has been empirically implemented. The portfolio approach is important because it draws attention to the current

account but the empirical work remains largely to be done. My own preference remains with an extended Mundell-Fleming model that recognizes the determination of exchange rates in assets markets, the differential speeds of adjustment of assets and goods markets and the central role of expectations of the future exchange rate in influencing the current rate. PPP in this model is a long-run tendency, although, of course, the terms of trade may have to change secularly to accommodate biased growth patterns. Given such a framework, what are our conclusions about monetary policy?

(A) Monetary policy under flexible rates and high capital mobility works not only by affecting the interest-sensitive components of aggregate demand but also by increasing net exports. Expansionary monetary policy will depreciate the exchange rate and thereby, at least temporarily, improve our competitiveness.

(B) Will expansionary monetary policy improve the current account? The gain in competitiveness that is at least transitorily achieved by an expansionary monetary policy will no doubt by itself improve net exports and thus add to aggregate demand. There is, however, a potentially offsetting increase in imports arising from the domestic expansion in demand due to lower interest rates and thus higher investment and consumption spending. The net effect on the current account remains uncertain since it depends on the relative magnitudes of the decline in interest rates and the response to relative prices. It is certainly not a foregone conclusion (except when interest rates cannot at all decline from the world level) that monetary expansion and depreciation *must* improve the current account. To the extent, though, that the interest rate effects in the first place affect construction, one would not expect the adverse absorption effects on the current account to arise early compared to the relative price effects.

(C) Monetary policy has an immediate effect on exchange rates. A change in the nominal quantity of money in the short run is a change in the real quantity of money which will bring about a change in interest rates. With changed interest rates and unchanged expectations spot rates have to move to maintain yields in line internationally. If monetary policy affects exchange-rate expectations, then the exchange-rate adjustments have to be even more pronounced.

(D) The instability or volatility of exchange rates arises from two sources. The first is the very low interest elasticity of money demand which implies that fluctuations in the demand or supply of money produce large fluctuations in interest rates and therefore require large movements in exchange rates to maintain yields internationally. The second source is instability in the exogenous variables — there is plenty of news.

(E) Movements in exchange rates affect the level of import prices directly and spill over into consumer, wholesale and producer prices. The extent and speed of this spillover is an essential question from the perspective of monetary policy. While the increase in import prices is helpful in establishing a gain in competitiveness, it, of course, hurts from a point of view of inflation. The more rapid and the more substantial the spillover of import prices into domestic prices, the more inflationary is monetary policy and the less effective it is with respect to aggregate demand.

Table 7

MONETARY GROWTH AND DEPRECIATION
(Annual Rates)

	MONETARY GROWTH				EFFECTIVE $ RATE
	Germany	Japan	United Kingdom	United States	
1976	10.3	14.2	11.4	5.1	-5.0
1977	8.3	7.0	21.5	7.1	1.1
1977 I	12.6	4.2	13.4	7.2	—
II	6.0	-3.0	15.9	8.6	2.7
III	12.7	16.9	29.5	8.3	2.7
IV	10.3	7.0	29.7	7.7	10.0
1978 I	25.3	9.7	17.3	6.3	13.2
II	6.5	13.2	n.a.	10.3	5.7

Note: The quarterly data show quarter-to-quarter changes at annual rates. The last column shows the annual rates of change of the effective dollar exchange rate. A minus sign indicates an appreciation of the dollar.

Source: Federal Reserve Bank of St. Louis, *International Financial Statistics* and *OECD Economic Outlook.*

(F) The empirical evidence indicates that the changes in real exchange rates and competitiveness induced by nominal exchange-rate movements persist for a considerable length of time. The reaction of trade flows and direct investment to these changes in relative prices are, however, slow to come about so that the net export channel cannot be counted upon as one of the more rapid responses to monetary policy.

Having reviewed in a broad manner the implications of theory and evidence for the role of monetary policy under flexible rates, we conclude with another aspect of the same question: to what extent do monetary factors account for the ongoing depreciation of the dollar? There is a worrying temptation, in this connection, to look to monetary factors as the dominant explanation. Thus the *Wall Street Journal* in a continuing public education effort has reminded us once more:

> . . . And surely the price of the dollar depends on supply and demand for the dollar. It declines because the Federal Reserve supplies more dollars than are demanded. For all the talk of swap networks, gold sales and so on, the *only* way the decline will be reversed is for the Fed to constrict the supply of dollars.[17]

Table 7 summarizes monetary growth rates for M_1 for some of the major industrialized countries and the United States. The table also shows the

[17]See *Wall Street Journal,* August 30, 1978 "The Counsel of Surrender".

behavior of the effective dollar exchange rate. Note that for the last five quarters the dollar has been depreciating, although U.S. monetary growth has been among the lowest. Note in particular German monetary growth which surely must be reckoned high. No doubt the lesson of the monetary approach — the exchange rate is the *relative* price of two moneys — must have been overlooked.

If monetary factors do not account for the full extent of the depreciation, what factors should we look to for an explanation? Of course, we should remember that real factors do have an impact on exchange rates. Suppose a given trend of monetary policies in the United States and abroad and therefore a given trend of prices. Suppose now that a current account deficit arises and that there is no expectation that it will close in the near future of itself. A change in the terms of trade will be required to restore competitiveness and thus help achieve full employment current-account balance. A deterioration of our terms of trade, of course, with a given path of prices will require a depreciation of the exchange rate.

Now let me argue why I believe this story to be a major explanation for the dollar depreciation. I see two main reasons for a "structural" U.S. current-account deficit. One is the medium-term reduced growth rates in other industrialized countries, in particular Japan and Germany. This implies that with unchanged U.S. growth (I take it a 3.5–4 percent growth path will be maintained) and given the evidence on U.S. and foreign income elasticities in trade, there will be continuing if not growing imbalance.

The second and possibly more important reason is the growing competitiveness of LDCs in manufacturing trade. These countries have achieved substantial industrialization in their domestic markets and have to look to the world market for continuing growth. They have already made an impressive performance in the U.S. market as shown by the fact that their share in our manufactured imports in the last five years has risen from 15 percent to more than 20 percent. I suspect that this trend will be substantially accelerated as the large European and Japanese direct investment in these countries starts to bear fruit. The U.S. market will increasingly prove to be the testing ground for newcomers' export drives. The resulting effect for our current account is unquestionably a deterioration unless we manage to outpace with new products and innovations the rate at which the rest of the world imitates U.S. techniques.

At present there is no evidence of a restructuring of the economy toward a dynamic, trade-oriented stance. Accordingly there is no surprise that the market should anticipate deteriorating terms of trade and ongoing depreciation. The anticipation of course translates into an immediate depreciation. The depreciation presents a conflict. It is directly and immediately inflationary and to that extent interferes seriously with an attempt to contain inflation. At the same time, though, it contributes to a restoration of U.S. competitiveness and thus helps maintain or increase aggregate demand. Since the medium-term deterioration in the terms of trade is largely inevitable, it is important not to interefere with the depreciation but rather to concentrate on

a more basic macroeconomic reorientation toward fiscal restraint for an improvement in the current account combined with monetary and fiscal policies conducive to investment and growth.

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Discussion

William H. Branson*

The conventional wisdom on exchange-rate determination and the role of monetary policy has changed dramatically in the past ten years, as can be seen by comparing the 1969 conference volume on the adjustment mechanism and this 1978 volume.

Rudiger Dornbusch's paper is a comprehensive and succinct survey of the new theoretical approaches and the evidence. I agree with the general conclusions stated at the end of the introduction and in the concluding observations. So my points here clarify or extend points on the paper, rather than raise serious objections. I will discuss these points on purchasing power parity, the monetary approach, the portfolio-balance approach, and capital mobility in the order that they appear in the paper.

1. Purchasing Power Parity (PPP)

At the beginning of his section I on theories, Dornbusch notes two reasons why the exchange rate might deviate from PPP in the long run — differential productivity growth between traded and nontraded goods, and a nonzero balance on capital account. There is another reason for long-run movement in the real exchange rate, k in section II of the paper. This is variation in the international distribution of ownership of assets, as shown in Branson (1978).

The long-run equilibrium condition to which the real exchange rate must adjust is that the current-account balance, plus any exchange-rate insensitive capital flows, be zero. For convenience, I will assume here that the latter are zero. Then we have the equilibrium condition that $X(k) - rF = 0$, where X is net exports of goods and noncapital services, and rF is net investment income on net foreign claims F. If the current-account balance is nonzero during disequilibrium periods, F accumulates or decumulates. This moves rF between long-run equilibria, requiring a change in k. This is essentially a restatement of the transfer problem; the real exchange rate must adjust to accommodate the annual "transfer" of capital income. If the adjustment mechanism also involves temporary migration, labor remittances may also require adjustment in k.

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2. The Monetary Approach

The monetary approach to the exchange rate is summarized in the "monetary approach" equation (6) (p. 94). Dornbusch emphasizes that the theory assumes both perfect price flexibility and instantaneous tracking of PPP. I would like to draw attention, in addition, to the assumption that the interest rates, r and r*, are assumed to be exogenously determined. If the broader asset-market model, or portfolio-balance model holds, then r is determined endogenously with the exchange rate, and the OLS estimate of θ in (6) will be biased upward. This can be seen easily by adding an error term u_t to (6), and considering a case where the random $u_t > 0$. This results in e_t rising above the predicted value from (6). This in turn increases wealth in the asset-market model, increasing the demand for money and the equilibrium interest rate. So if the interest rate is endogenously determined, r in (6) will be positively correlated with the error term, and the estimate of θ will be biased upward. This is a straightforward example of simultaneous-equations bias. The problem cannot be escaped by banishing wealth from the money-demand function, as in the MPS model. This is possible in a many-asset model with a short-term riskless asset that dominates money. But in the monetary approach, there is no such menu of assets. The r here must be the rate of return on the entire aggregate of nonmoney assets.

Now compare the estimates of θ, the coefficient of $(r_s - r_s^*)$ in equations 1 – 3 of Table 3 (p. 111) with those in equations 4–6. The first three equations are estimated by OLS, the second three by instrumental variables, eliminating the upward bias. In each case, the OLS estimates are higher, although in no case is the estimate significant. Getting the interest rate coefficient right in the exchange-rate equation evidently requires endogenizing the interest rate, which means moving from monetary approach to the broader portfolio-balance approach.

3. The Portfolio-Balance Approach

In section I D of the paper, Dornbusch lays out the portfolio-balance model [equations (11) – (14)'], and in section II D., he reports estimates for the dollar-deutsche mark rate from Branson-Halttunen-Masson, and the DM/SDR rate from Porter. In the form developed here, which exactly follows Branson (1977), the model is a pure revaluation model with static expectations, in the sense that the exchange rate tomorrow is expected to be what it is today. One of the purposes in developing and testing this model was to *test* the proposition that most people here take for granted: that expectations are especially important in the exchange market. The pure-revaluation version of the portfolio-balance model has the same qualitative implications for the path of the exchange rate following a monetary shock as an expectations-based model; compare Branson (1977) and Dornbusch (1976). And as Dornbusch notes, it provides a fair "fundamentals" equation for the \$/DM rate. So I would object to Dornbusch's attempt to define the asset market, or portfolio-balance, model as "expectations oriented" at the end of section I.

There is one peculiar feature of this model that Dornbusch (generously) ignores. In general, there is no requirement that F, net foreign assets, be positive. All the standard results of the model assume $F > 0$. But a country can be a net debtor in foreign assets. In that case, $\rho(\bullet)$ in equation (13) and $\lambda(\bullet)$ in (14)′ are negative, and an increase in F raises E. What is happening here? Consider the effect of excess demand for F in the pure revaluation model. In the "normal" case in which $F > 0$, the resulting increase in E raises EF, restoring equilibrium. All is well. But if $F < 0$, an increase in E reduces EF, increasing excess demand. So if $F < 0$ the model (and perhaps the foreign exchange market) is unstable and $\partial E / \partial F > 0$.

This all turns out to be relevant empirically. In reestimating the \$/DM equation (23) adding 1977:1 to 1978:6 to the data, BHM obtain quite similar estimates except that the coefficient of F (German private holdings of net foreign assets) is near zero and insignificant. In investigating the possible reasons for this, the fact that F was negative from 1973:1 to 1974:3 was noted. During that period the Bundesbank's interventions exceeded the current account surplus. The equation was then reestimated splitting the sample into periods with $F > 0$ and those with $F < 0$. In the $F > 0$ regime, the coefficient is significantly positive, and in the $F < 0$ regime it is significantly negative, as expected for German F in an equation for the \$/DM rate. So in the pure-revaluation model's view, the period 1973:1 – 1974:3 may have been unstable in the strict sense.

One additional point on the BHM equation (23) may be interesting. We have looked at the 1978 predictions from both equation (23) estimated through 1978:6, and the $F > 0$ version of the split-sample equation. Both say that the actual \$/DM rate was on target in the first two or three months of 1978. Then the actual fell increasingly below predicted to June 1978, where the gap was about 10 percent. Since June the gap has closed. So from the point of view of the portfolio-balance model, the surprise is not in the rapid fall of the dollar since summer, but the strength of the dollar (low \$/DM rate) in April – June. The recent movement has been a return (roughly) to equilibrium.

4. Capital Mobility and Free Capital Movements

The term "perfect capital mobility" is used at several points in the paper with meanings that are a little confusing. In the discussions of the Mundell-Fleming model and of expectations in section I, the term is assumed to imply interest equalization. I suggest that "perfect capital mobility" be broken into two components: (a) free capital markets, and (b) perfect substitutability of assets denominated in different currencies. Both (a) and (b) are needed for interest equalization, but only (a) is needed in conclusion (A) in Section III.

Direct evidence on assumption (b) is scarce, but it is used strongly in the Mundell models to pin down the interest rate and to give the result that an expansionary fiscal policy not accommodated by domestic monetary expansion will yield a capital account and balance-of-payments surplus. The upward pressure on the interest rate yields a potentially infinite inflow of capital. This assumption is contradicted by the RDX2 model for Canada, where

expansionary fiscal policy leaves the balance of payments roughly unchanged, and by my calculations using several models for the United States, where fiscal expansion worsens the balance of payments. So I would question the easy assumption of perfect substitutability, but it is not needed for Dornbusch's conclusions.

Monetary Policy under Alternative Exchange-Rate Regimes: Simulations with a Multi-Country Model

Ernesto Hernández-Catá, Howard Howe, Sung Y. Kwack, Guy Stevens, Richard Berner and Peter Clark*

Introduction

The purpose of this paper is to present some preliminary results on the impact of monetary policy in today's system of managed exchange-rate flexibility. Typical monetary policy actions in the United States, Japan, and West Germany will be investigated with an eye to both their effects at home and abroad, and the extent to which these effects depend on the degree of exchange-rate flexibility and exchange-market intervention.

The emphasis in this paper will be empirical. Although much theoretical work has been done contrasting the effects of policy actions under alternative exchange-market assumptions,[1] little has been done to quantify these effects. The Multi-Country Model which is under development at the Federal Reserve Board provides us with a tool to make such quantitative estimates — in fact, this was one of the primary purposes for its development. The results presented here are some of the first simulations of monetary and intervention policy run with that model.[2]

In the first part of this paper we describe the effects of a contractionary monetary policy in the United States implemented by an open-market operation. To highlight the differential impact obtained by linking the U.S. model with the rest of the Multi-Country Model, we present results both for the U.S. model alone and for the full Multi-Country Model. We then examine the effects of restrictive monetary policies abroad: 1) an increase in the Bank of Japan's discount rate, and 2) an increase in reserve requirements applicable to German banks. In the third part, we report on the results of experiments deal-

*At the time of the writing of this paper the authors were economists in the Quantitative Studies Section of the Division of International Finance at the Board of Governors of the Federal Reserve System. They wish to express their gratitude to a number of co-workers for their contributions to the completion of this paper. Joseph Formoso, Ann Mirabito, Sam Parrillo and Steven Schooler bore much of the responsibility and thus deserve much of the credit for the simulations of the Multi-Country Model. Helpful discussions with various members of the Board's Division of International Finance are gratefully acknowledged. The views expressed in this paper are those of the authors and do not necessarily represent the views of the Federal Reserve System.

[1]For example, Fleming (1962), Mundell (1968) and Girton and Henderson (1976).

[2]Needless to say, therefore, the estimates presented here are preliminary in nature and are in no way official estimates of the Board of Governors or the Division of International Finance.

ing with changes in exchange-market intervention behavior. We look at what would have happened if the monetary authorities had intervened to moderate exchange-rate changes with twice the intensity actually observed over the early floating-rate period between 1973 and 1975. Finally, we investigate how the effects of a contractionary monetary policy in the United States are altered when intervention behavior is modified in the manner just described.

The Multi-Country Model (MCM) is a system of linked national macroeconomic models, at the center of which is a medium-sized model of the U.S. economy. Linked to it, and to each other, are models for Canada, West Germany, Japan, the United Kingdom, and an abbreviated model representing the rest of the world.

These models explain the main domestic variables and international transactions of each country: real and nominal GNP and its components (consumption, investment, exports and imports of goods and services), deflators for domestic spending, exports and imports, as well as the wage rate, capacity utilization and unemployment.[3] Each country model has a monetary sector which determines short- and long-term interest rates together with monetary aggregates. The most important instruments of monetary and fiscal policy — reserve requirements, the discount rate, central bank holdings of domestic and foreign assets, and real government expenditures — are integrated into each country model.

The individual country models are linked through trade flows, prices, interest rates and capital flows. For example, the exports of each country are determined by other countries' imports from that country. In this way a change in one country's foreign trade has an immediate impact on the GNP of other countries. Similarly, the price of imported commodities depends on other countries' export prices and on the exchange rates that convert these prices into domestic currency. Movements in foreign price and cost conditions are transmitted to each country's import price, which in turn directly affects its domestic price level.

The monetary sectors of the various countries in the model are directly linked together through capital flows. A change in monetary conditions in one country will affect its short- and long-term interest rates and funds will move from one country to another insofar as portfolios are readjusted. These international capital movements will directly affect monetary conditions in the receiving countries to the extent that exchange-market intervention is allowed to impinge on the monetary base.[4] In addition, the interest rate changes in one country may affect exchange rates and therefore have an indirect impact on foreign monetary conditions through changes in foreign-trade balances and demand conditions.

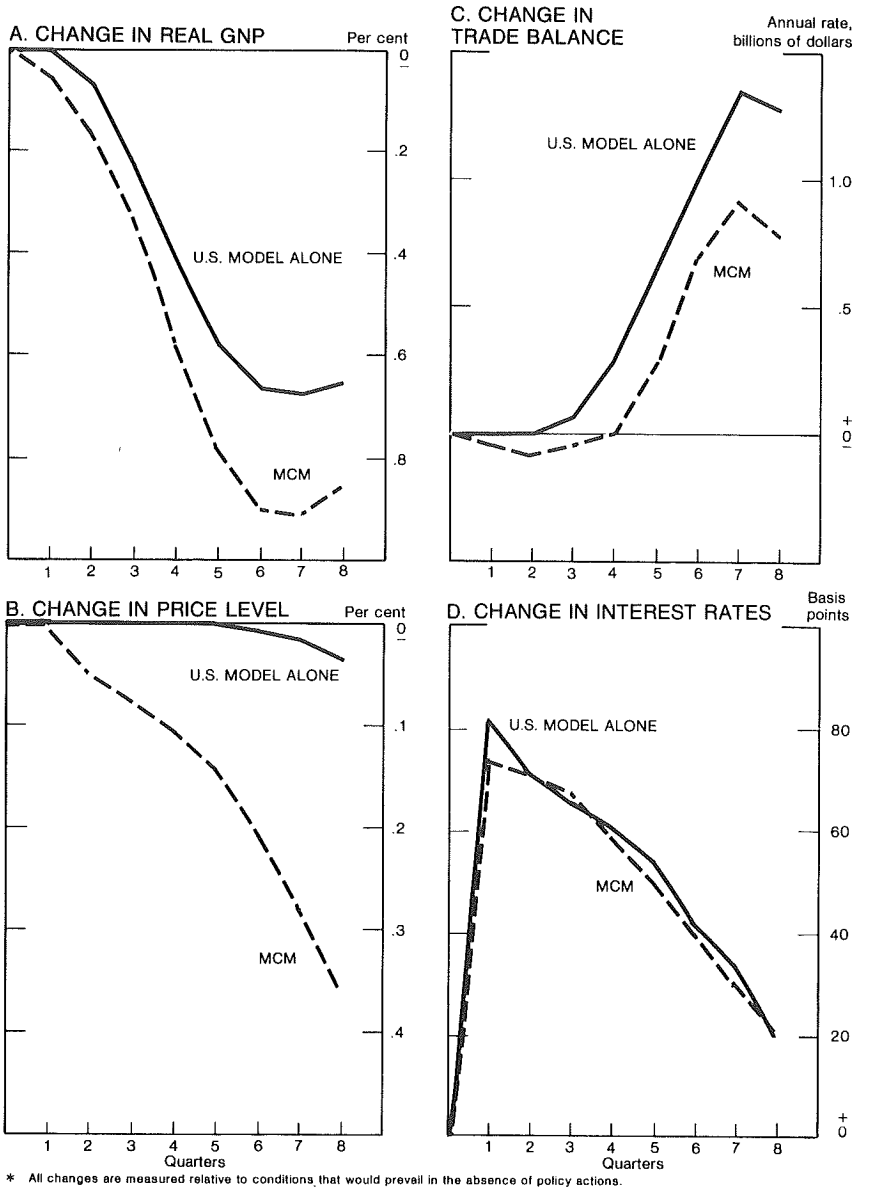
A special feature of the Multi-Country Model is that it can operate under a variety of exchange-rate regimes. When fixed-exchange rates are assumed,

[3]Trade flows of all countries other than the five mentioned above are explained in the abbreviated rest-of-the-world model.

[4]In the model describing the U.S. economy it is assumed that the monetary base is insulated from changes in international reserve assets by offsetting open market operations, whereas for other countries a change in international reserves will have some impact on the monetary base.

Chart 1

Effects of a Change in U.S. Monetary Policy*



* All changes are measured relative to conditions that would prevail in the absence of policy actions.

each country's overall balance of payments determines the change in its stock of international reserve assets. When the model operates under a managed floating system, the change in a country's international reserves is determined (for countries other than the United States) by the discretionary intervention behavior of the central bank; these official purchases and sales of foreign exchange, together with all the other items in the balance of payments, jointly determine the bilateral dollar exchange rates of these countries.

I. The Effects of U.S. Open Market Operations

The first set of simulations relates to a tightening of U.S. monetary policy: an open market sale of $1 billion in government securities carried out in a period of flexible-exchange rates.[5]

In order to illustrate the effects introduced by the MCM, among which are the endogenization of the exchange rate, the results will be presented in two stages. First, we will analyze the effect of the monetary tightening in the context of the model of the U.S. economy taken in isolation, i.e., when it is not linked with the other country models. In this case, the world outside the United States is assumed to be unaffected by the change in U.S. monetary policy, and all bilateral exchange rates are held exogenous. The results will then be discussed for the same policy change, but when the U.S. model is integrated into the multicountry system; in this case changes in U.S. variables are allowed to affect exchange rates and economic variables abroad, and these latter changes feed back onto the U.S. economy.

The heavy lines in Chart 1 show the changes in the key variables for the case where the U.S. model is not linked with the other country models. The results are generally consistent with those of most existing models of the U.S. economy, models that, by and large, do not allow foreign variables and exchange rates to vary. Panel A shows the expected negative impact on U.S. real GNP; the effect increases gradually, reaching a maximum after six quarters of some 7/10 of a percent below what it otherwise would have been.

This decline is caused in large part by the primary impact of the open-market operation, the rise in the interest rate (Panel D); the interest rate jumps by 80 basis points initially and, as aggregate demand falls off, declines slowly thereafter. In line with the weakening of aggregate demand, there is a small decline in the price level and an improvement in the trade balance.

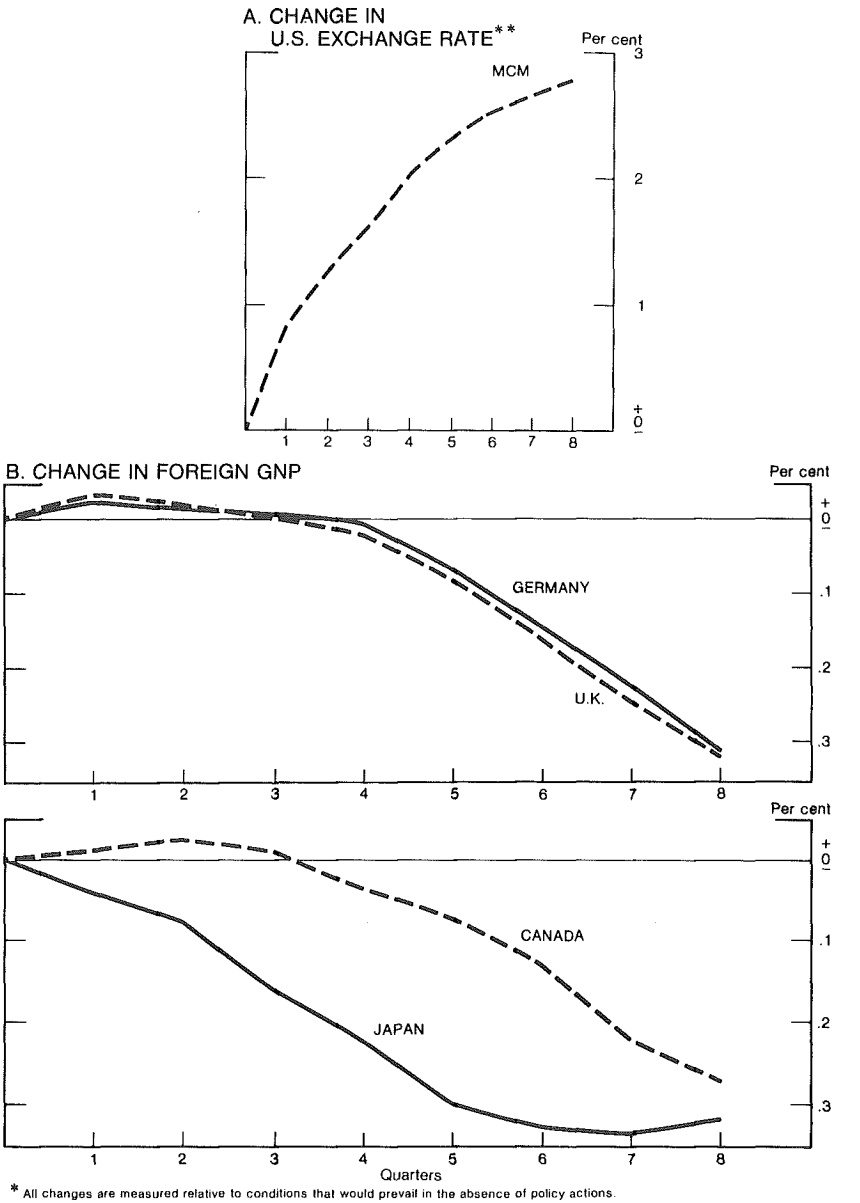
When the U.S. model is linked to the other five country models, the effects of the same change in U.S. monetary policy are modified significantly. As can be seen from the dashed line in the first panel of Chart 1, the negative impact on GNP is magnified: the maximum effect, seven quarters after the tightening of monetary policy, is some 2/10 of a percent more than when induced changes in external influences on the U.S. economy are ignored.

The most dramatic difference between the two sets of results is for the

[5]The simulations reported in this paper were for the period 1973:2 through 1975:1; in some cases the simulations have been repeated for other time periods and, to date, the conclusions have been largely unaltered by the period of simulation.

Chart 2

Effects of a Change in U.S. Monetary Policy*



* All changes are measured relative to conditions that would prevail in the absence of policy actions.

** Weighted-average of the bilateral exchange rates of the U.S. dollar vis-à-vis the German mark, the Japanese yen, the U.K. pound and the Canadian dollar, respectively.

price level; it falls by a full 1/3 of a percent after eight quarters. There is also a significant reduction in the trade-balance effect.

The large differences between the results are traceable both to exchange-rate changes, which become endogenous in the MCM, and to feedback effects from the foreign economies. The dollar appreciates with respect to every foreign currency and, consequently, as seen in Chart 2, the weighted-average exchange rate appreciates by almost 3 percent at the end of two years. Because of this appreciation of the dollar, the price of imports falls by 1½ percent over the period; this feeds directly and indirectly into the U.S. price level. Moreover, the appreciation reduces U.S. exports and increases imports; this relative reduction in the trade balance adds a second depressing effect on U.S. GNP, in addition to the direct effect of the monetary tightening.

A third negative influence on U.S. GNP is the reduction in foreign economic activity. As shown also in Chart 2, after an initial period,[6] GNP in each foreign country is affected adversely. This lower level of foreign demand feeds back to the United States, reducing U.S. exports and GNP and diminishing the improvement in the U.S. trade balance.

To summarize, this exercise shows that estimates of the effects of U.S. policy changes on important U.S. variables are altered significantly when international effects are taken into account. The general equilibrium framework of the MCM permits us to capture these international effects and their feedback on the U.S. economy.

Although these estimates do not amount to a conclusive test, their direction corresponds well to the theoretical results presented by Mundell (1963) and others on the comparison of the effects of monetary policy between exchange-rate regimes: in particular, a monetary tightening has a more powerful impact on GNP and prices under flexible-exchange rates.

II. The Effects of Restrictive Monetary Policies Abroad

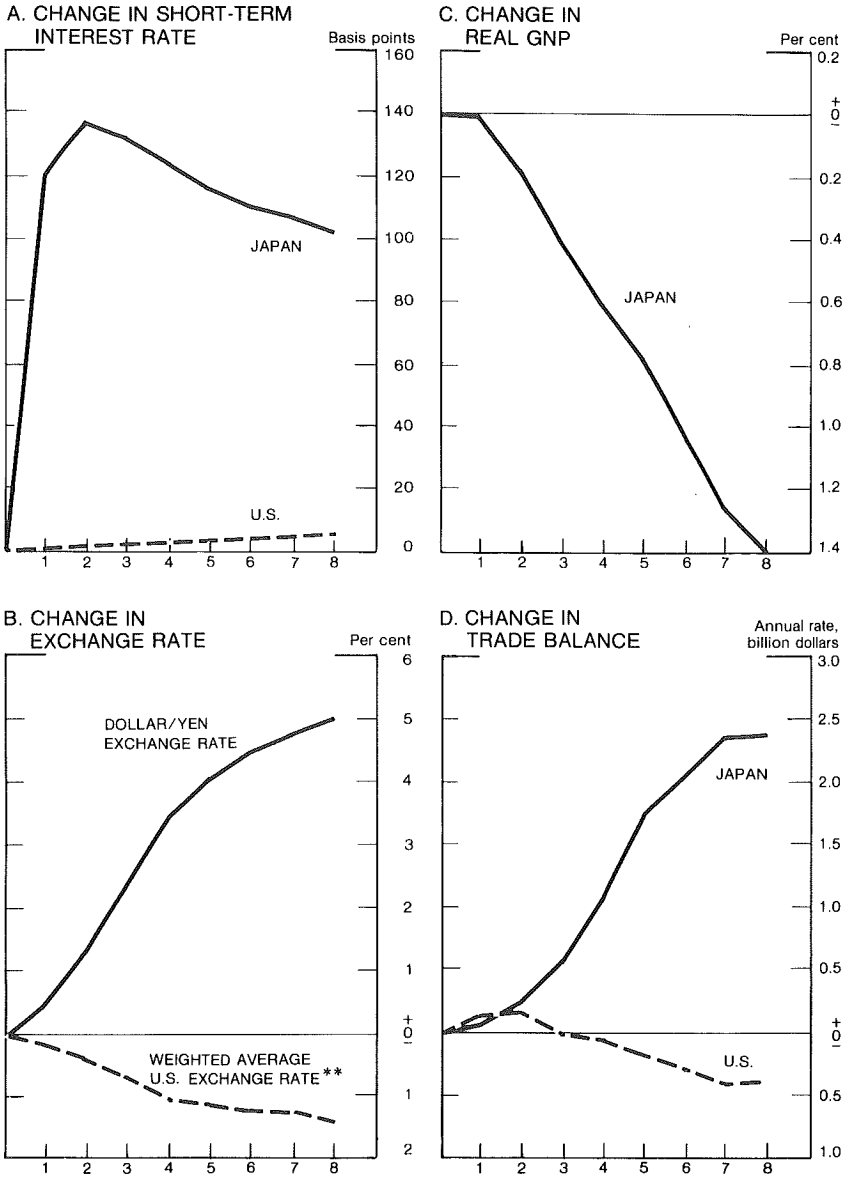
The following two simulations illustrate how the MCM can be used to trace the effects of monetary actions in foreign countries. This capability is illustrated with respect to (i) an increase in the Bank of Japan's official discount rate, and (ii) an increase in the reserve requirements applicable to German banks.

The effects of an increase in the Bank of Japan's discount rate by 1 percentage point are shown in Chart 3. In panel A, the Japanese short-term interest rate is seen to increase sharply in the first two quarters and to decline gradually thereafter. Although the U.S. short-term rate rises moderately, there is, initially, a substantial increase in the interest-rate differential in favor of Japan. This increase reduces the relative attractiveness of borrowing from the U.S. and Eurodollar markets, thus leading to an appreciation of the yen

[6]The GNPs of Germany, the United Kingdom, and Canada experience slight increases in the first three periods in response to the U.S. monetary contraction. The appreciation of the dollar vis-à-vis other currencies, by itself, would tend to improve foreign trade balances and stimulate foreign GNPs. Offsetting this exchange-rate effect, and dominating it in the later periods, is the reduction in U.S. imports due to the decline in U.S. GNP.

Chart 3

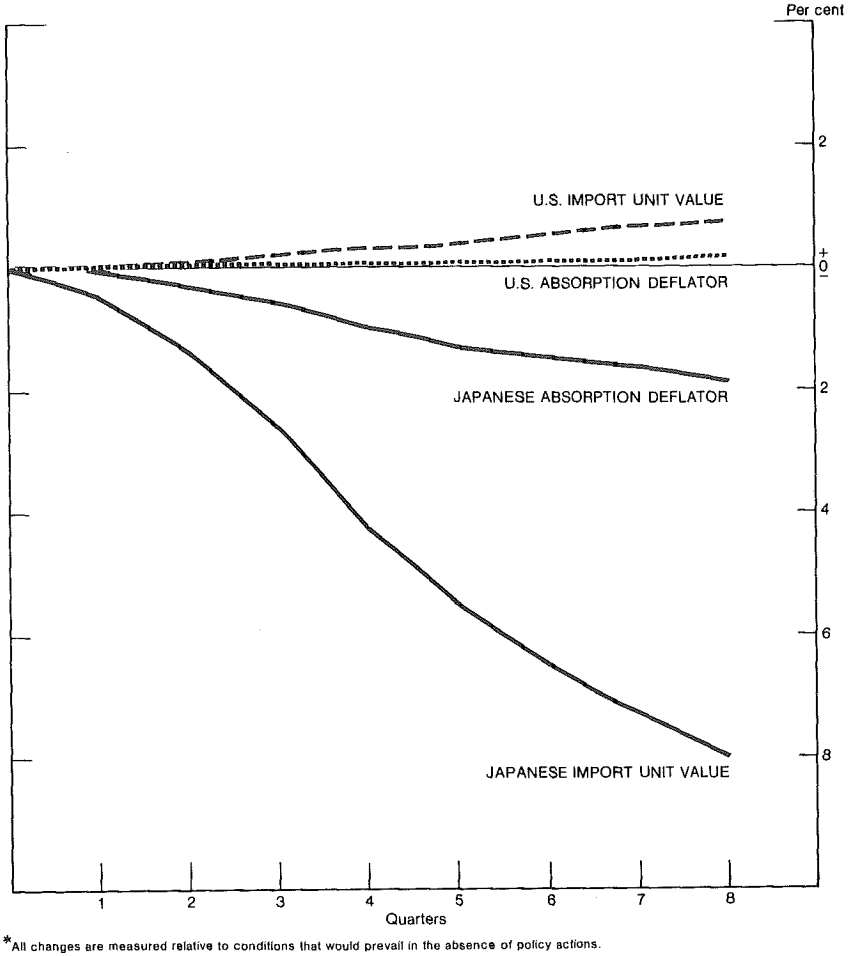
Effects of a One Percentage Point Increase in Japan's Discount Rate*



* All changes are measured relative to conditions that would prevail in the absence of policy actions.
** Units of foreign currency per dollar

Chart 4

Effects on Prices of a One Percentage Point Increase in Japan's Discount Rate*

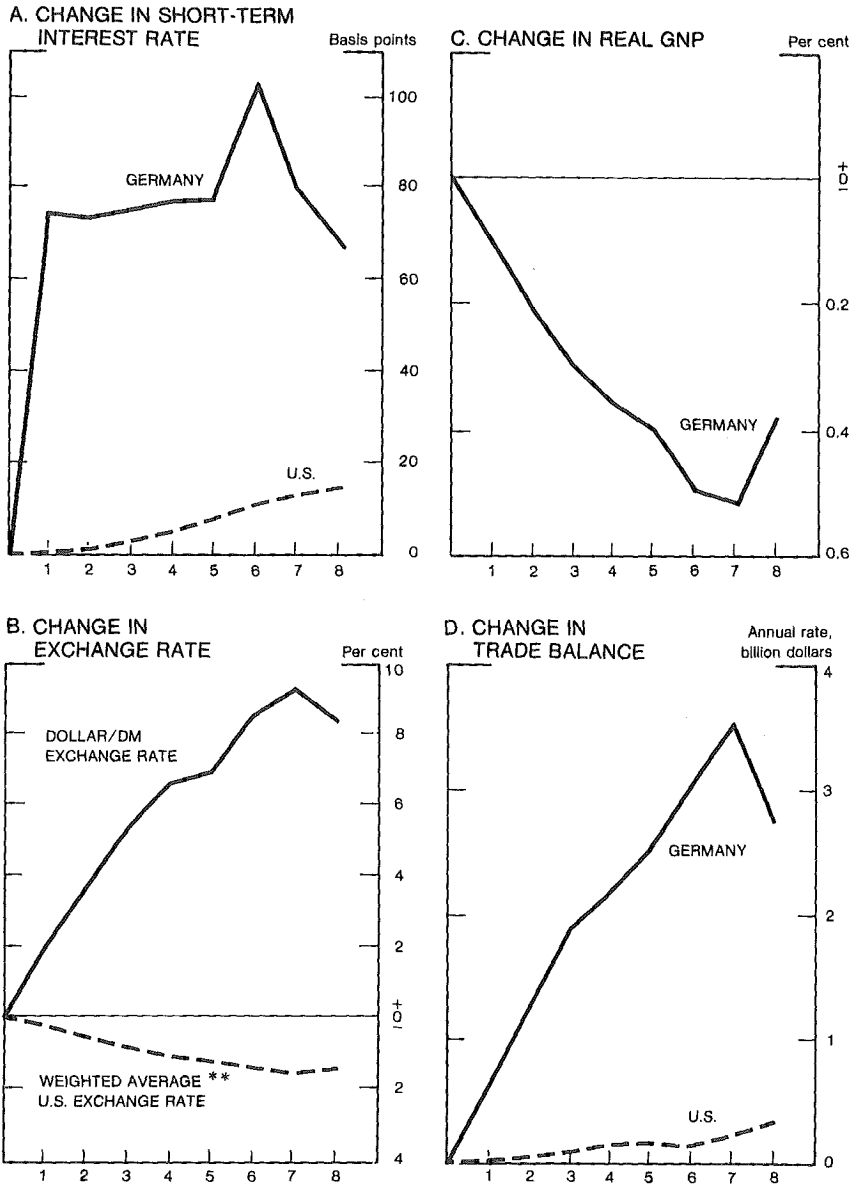


*All changes are measured relative to conditions that would prevail in the absence of policy actions.

against the dollar, as shown in panel B. The rise in domestic interest rates also has an adverse impact on fixed investment in Japan, resulting in a contraction of aggregate demand. This leads to an improvement in the Japanese trade balance (as seen in panel D) and to additional upward pressure on the yen. Finally, as indicated in Chart 4, Japanese prices decline under the combined effects of reduced capacity utilization, increased unemployment and exchange-rate revaluation; and there is also some upward pressure on U.S. prices stemming from the devaluation of the dollar.

Chart 5

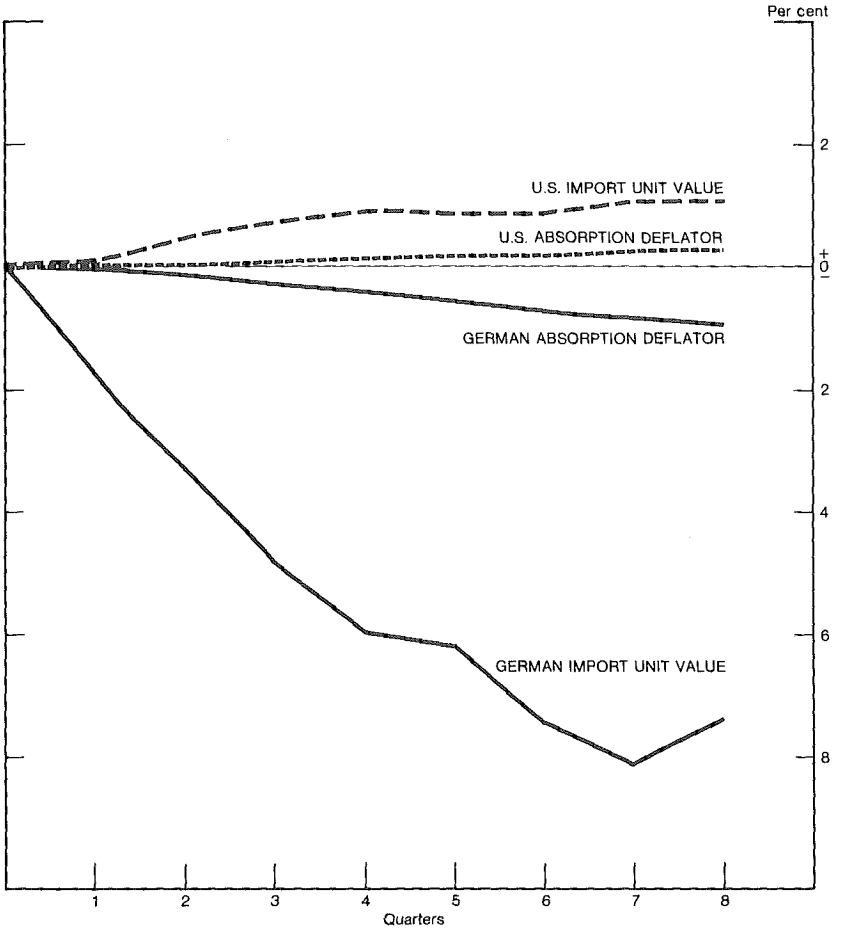
Effects of a One Percentage Point Increase in German Reserve Requirements*



* All changes are measured relative to conditions that would prevail in the absence of policy actions.
** Units of foreign currency per dollar.

Chart 6

Effects on Prices of a One Percentage Point Increase in German Reserve Requirements *



* All changes are measured relative to conditions that would prevail in the absence of policy actions.

Charts 5 and 6 show the effects of increasing by 1 percentage point the reserve requirements applicable to four types of deposit liabilities issued by German banks. The results are generally similar to those reported in the Japanese experiment. It may be noted, however, that the U.S. trade balance improves in response to the monetary contraction in Germany, because U.S. exports are stimulated by the sharp depreciation of the dollar. In the Japanese stimulation this exchange-rate effect is also present, but it is more than offset by the depressing impact on U.S. exports of a large reduction in Japanese GNP.

III. Changes in Central Bank Intervention and Monetary Policy

The structure of the Multi-Country Model makes it possible to analyze central bank intervention in foreign exchange markets and the effects of such intervention on exchange rates and other variables. The strategies of central banks in foreign exchange markets are too complex to be fully captured by any model and, in fact, have varied over recent years. Nevertheless, in estimating the equations of the MCM, it was found that the monetary authorities of Canada, Germany, and Japan have attempted, with some regularity, to moderate movements in exchange rates by exchange-market intervention. To investigate the sensitivity of the model to changes in intervention behavior, two simulations are analyzed in this section.

First, monetary authorities abroad were assumed to have intervened to resist exchange-rate changes with twice the intensity actually observed over the early floating-rate period. This increased exchange-market activity is found to reduce noticeably exchange-rate fluctuations.

The second simulation investigates how the effects of a monetary contraction in the United States are altered when the tendency of the central banks to resist exchange-rate changes is doubled. In other words, the assumptions concerning central bank intervention underlying the first simulation of this section are superimposed on the U.S. monetary contraction reported in Section II. The results of this experiment indicate that "leaning against the wind" with greater intensity does not necessarily reduce the impact of a monetary tightening on GNP and prices.

The first simulation investigates the extent to which the amplitude of exchange-rate movements during the early period of floating-exchange rates would have been reduced if the authorities of Canada, Germany, and Japan had all intervened with twice the resistance to exchange-rate changes as actually observed during that period. For example, it was estimated that from 1970:3 to 1975:4 the Bank of Canada sold, on average, about Can$110 million for each percentage point rise in the dollar value of the Canadian dollar and purchased the same amount for each percentage point fall in the Canadian dollar. For the purpose of this exercise, the amount was doubled to some Can$220 million per percentage point. Analogous changes were made for Germany and Japan.[7]

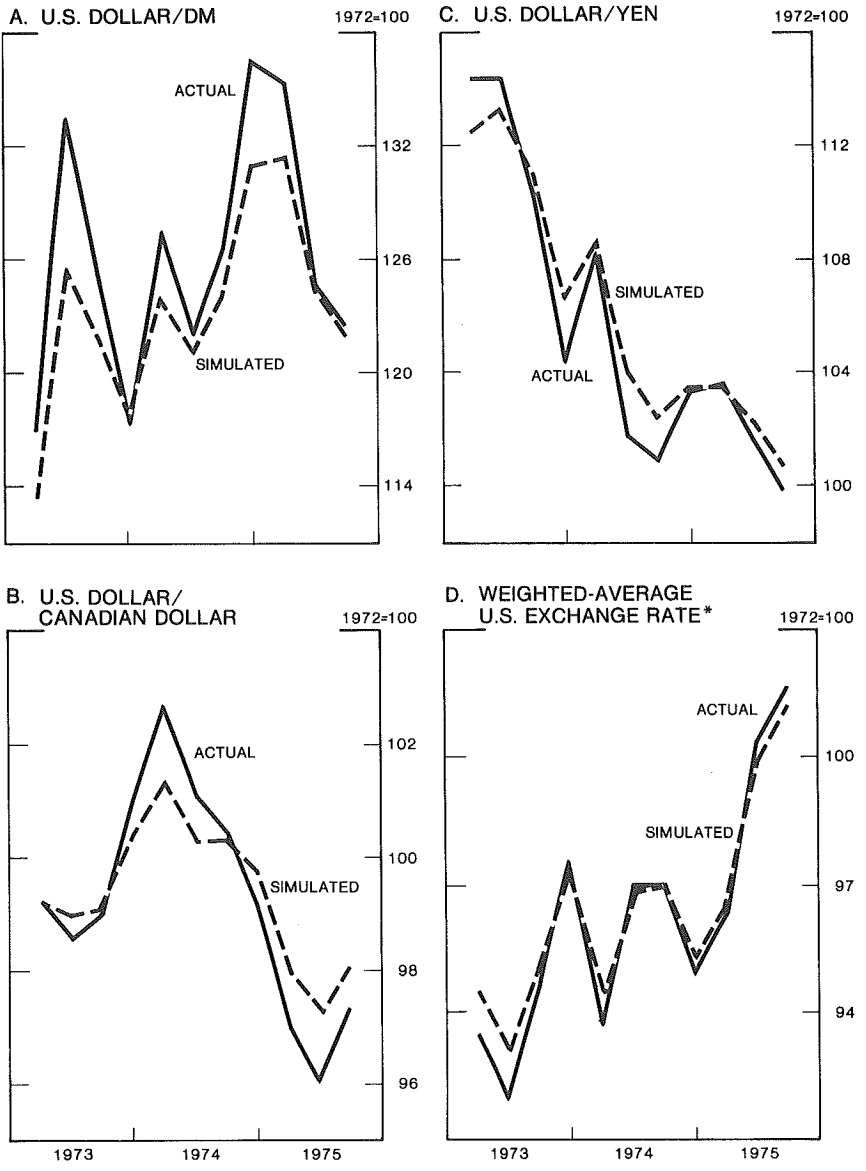
Chart 7 shows the actual and hypothetical paths of the dollar exchange rates for the deutsche mark, the yen and the Canadian dollar, as well as for the weighted average exchange rate of the U.S. dollar over this period. For each of the three currencies, the amplitude of exchange-rate movements would have been reduced if central banks had "leaned against the wind" with greater intensity, although large fluctuations would not have been eliminated. Reductions in the variability of the deutsche mark, the yen, and the average U.S. dollar exchange rate would have been on the order of about 20 percent; the reduction for the Canadian dollar would have been about 40 percent.[8]

[7]The intervention coefficients for Japan and Germany implied purchases of about $250 million and $140 million, respectively, per percentage point increase in the dollar value of the yen and the deutsche mark.

[8]These reductions were calculated as the percentage difference between the standard deviations of the historical and the simulated exchange-rate paths.

Chart 7

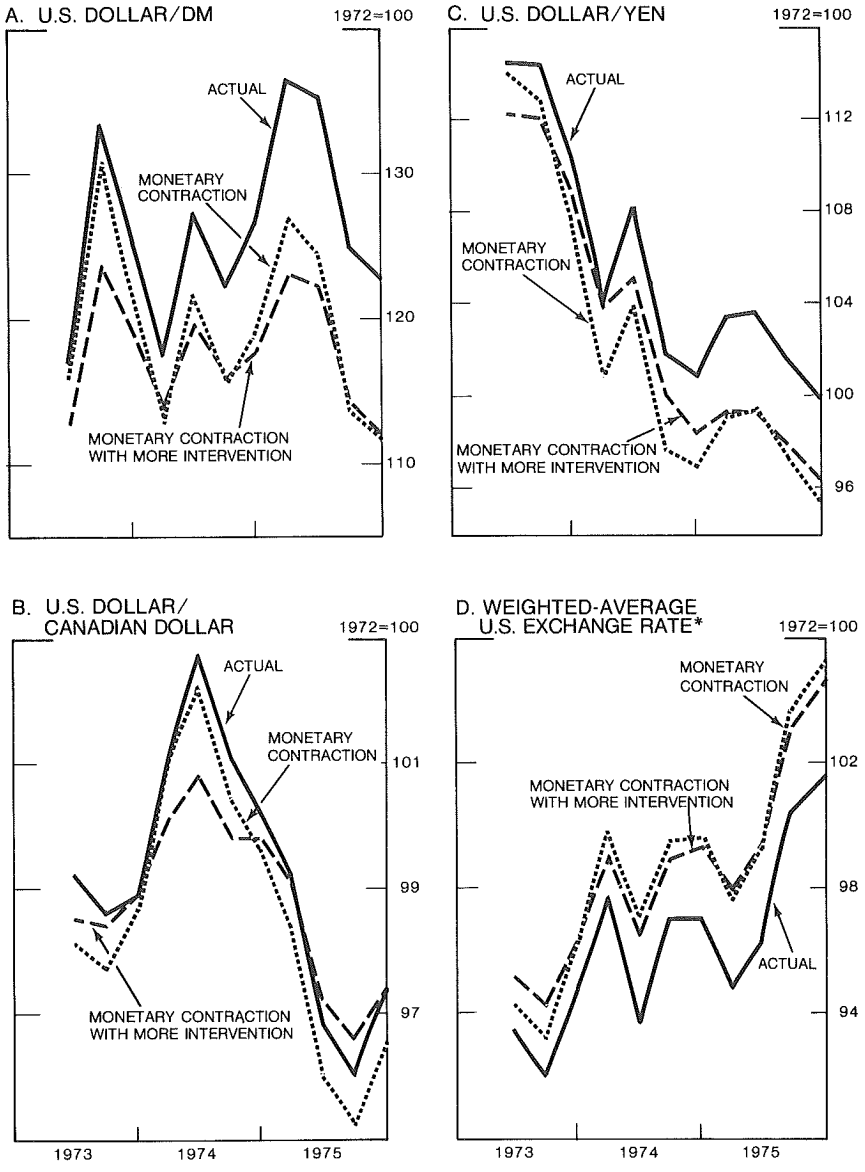
Effects of Increased Exchange Market Intervention on Exchange Rates



*Units of foreign currencies per dollar.

Chart 8

Effects of a Contraction in U.S. Monetary Policy Coupled With an Increase in Exchange Market Intervention



* Units of foreign currencies per dollar.

The effects of the increased exchange-rate smoothing on output would have been small — GNPs would have deviated by no more than 2/10 of 1 percent from their historical levels. Prices and trade flows would have differed more noticeably from their actual values although the changes would have been largely transitory. The increased exchange-market intervention would have led to substantial interest-rate variability in all countries, primarily because of the impact of the larger reserve changes on the monetary bases of these countries.

In the second simulation, the doubled intervention coefficients were combined with the $1 billion open market sale by the Federal Reserve. The joint effects of increased smoothing and the monetary contraction can be seen in Chart 8. Monetary restraint has led to an appreciation of the U.S. dollar and, in addition, the increased intervention has smoothed the paths of the three bilateral exchange rates. As compared to the case of the U.S. monetary contraction alone, the variabilities of the exchange-rate paths with the contraction and increased smoothing were lower by about 40 percent for the Canadian dollar, about 35 percent for the deutsche mark, about 10 percent for the yen, and approximately 15 percent for the U.S. weighted-average exchange rate.[9]

The effects of the increased intervention on the U.S. monetary policy multipliers are mixed. In Chart 9, the effects of the compound experiment on GNP, the trade balance, and the U.S. price level are compared with those of the simple monetary contraction. Panel A indicates that the GNP multiplier is slightly greater over the early part of the period for the simulation with more intervention. However, after the fifth quarter, the increased intervention reduces the GNP multiplier by about 1/10 of a percentage point. This seems to be a result of the reduced price level and consequent relative improvement in the real trade balance in the sixth quarter.

As shown in panel C, the initial effect of greater intervention is to increase the effect of the monetary contraction on the trade balance. The trade balance is the channel through which the effects of increased intervention are transmitted to GNP. The much larger initial appreciation of the U.S. weighted-average exchange rate (panel D) acts to enhance the reduction in the U.S. trade balance and thereby to reduce GNP further than in the case of the simple monetary contraction.

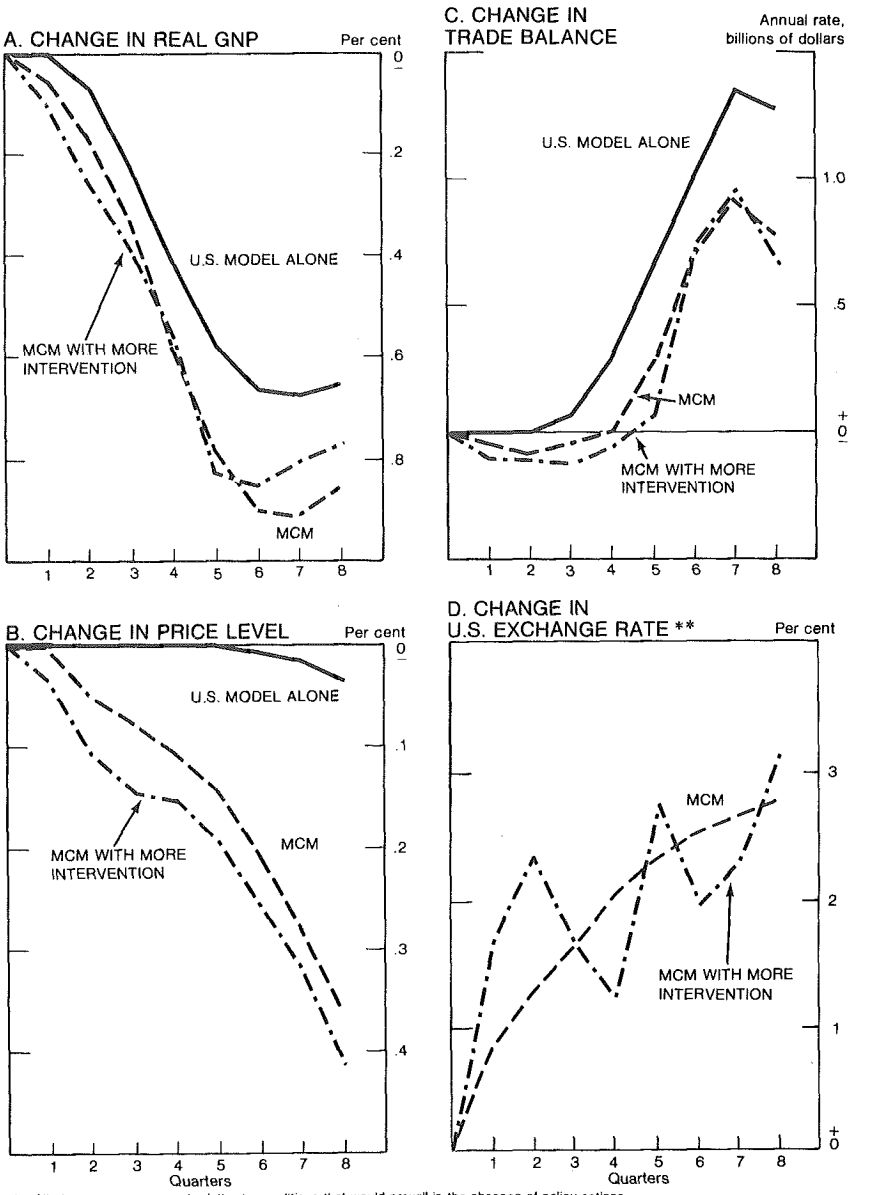
Panel B indicates the effect of increased intervention on the price level. Reflecting the greater impact on GNP in the earlier period, the price multiplier is greater under increased intervention than under "normal" intervention. In the early part of the period, this is a direct result of the greater contractionary effect on GNP. Later in the period, when increased intervention diminished the GNP effect, the price level remains below that for the normal intervention case. This is most likely a result of the dependency of price and wage changes in the model on past price changes.

Finally, as seen in panel D, the schedule showing the response of the aver-

[9]There was no change in the variability of the dollar/pound rate because no change in intervention was assumed in the case of the U.K. monetary authorities.

Chart 9

Effects of a Change in U.S. Monetary Policy*



* All changes are measured relative to conditions that would prevail in the absence of policy actions.

** Weighted-average of the bilateral exchange rates of the U.S. dollar vis-a-vis the German mark, the Japanese yen, the U.K. pound and the Canadian dollar, respectively.

age U.S. exchange rate exhibits greater variability in the case where the contraction is coupled with greater intervention than in the case of the simple monetary contraction. This is a result of the functioning of the intervention rules in the model which assumes that foreign monetary authorities intervene in such a way as to moderate exchange-rate changes. Given these rules, increasing the intensity of exchange-market intervention will result in smoothing the path of exchange rates and will therefore introduce deviations between the simulated and historical paths of these exchange rates.

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Discussion

Charles Freedman*

The Multi-Country Model (MCM) developed at the Federal Reserve Board is a welcome addition to the class of large macroeconometric models. These large models have the advantage of allowing for a variety of channels through which policy changes can influence the economic system. Furthermore, while most theoretical models of the international economy allow either prices or output to adjust but not both, the MCM has no difficulty in allowing for both kinds of effects and in tracing out the lagged responses of a variety of variables to policy changes. The disadvantage of large models is, of course, their complexity. Simulation results that are counter-intuitive can be telling us that we have ignored in our theoretical models a channel that is important empirically or that there is a weakness in the large model that is giving us a "wrong" answer. To distinguish between these two possibilities requires an in-depth understanding of the large model and a willingness to track down and evaluate the channels that are causing the surprising result.

A potentially important weakness of the MCM, which it shares with almost all empirical models, is that it does not deal with the incorporation of new information in its modeling of expectations formation. Unlike the efficient-markets literature, which emphasizes market responses to policy changes, most macroeconometric models tend to assume very simple expectational mechanisms, usually of an autoregressive form. In addition to leading to biased estimates, the lack of attention to expectations formation can at times lead to rather strange simulation results. Although it will be difficult to remedy this omission empirically, it is perhaps the most important order of business for the next generation of empirical international models.

There are two related aspects of this problem on which I would like to focus in discussing the MCM — (i) the response of the exchange rate to interest rate changes, and (ii) the specification of the equation for the expected exchange rate.

Empirical studies of exchange-rate determination often show results broadly similar to the MCM on the effect of an interest rate change on exchange rates. The two major results of these models are, first, that in the long run exchange rates move by a multiple of the change in interest rates, and, second, that the exchange rate adjusts with a lag.[1] Recent theoretical

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[1]See, for example, the results in Rudiger Dornbusch, "What Have We Learned from the Float?" (mimeo, February 24, 1977) or Richard D. Haas and William E. Alexander, "A Model of Exchange Rates and Capital Flows: The Canadian Floating Rate Experience," *Journal of Money, Credit and Banking* (forthcoming).

developments indicate that the effect of an interest rate change on exchange-rate movements depends on whether the interest rate change is a result of a temporary change in the level of the money supply, a permanent change in the level of the money supply[2], or a change in the rate of growth of the money supply. Figure 1 graphs the effects of the three types of money supply changes on short-term interest rates and on the exchange rate defined as the domestic-currency price of a unit of foreign currency. In Figure 1A a temporary change in the money supply leads to a temporary change in interest rates. The effect of this change on the exchange rate will depend on the length of time the temporary interest rate increase is expected to last. Thus, for example, a 1 percentage point increase in interest rates that is expected to last for three months will initially lead to a ¼ percent change in the exchange rate. If the same 1 percentage point increase in the interest rate is expected to last for a full year, it will lead initially to a full 1 percent change in the exchange rate.[3] Note that the domestic currency will gradually depreciate back to its initial equilibrium over the period during which the interest rate change is in effect.

Figure 1B depicts the effect of a permanent change in the level of the money supply. Here the expected long-run equilibrium exchange rate falls proportionately to the decline in the money supply. The impact effect on the exchange rate is even greater since the interest rates will remain high during the transition period to the new equilibrium. In this case an interest rate change of 1 percentage point will be associated with a substantially larger change in the exchange rate.

For completeness, Figure 1C presents the results of a decrease in the rate of growth of the money supply. In the standard macroeconomic model interest rates will rise for a period before falling to their new long-run lower level reflecting the lower rate of inflation. The domestic currency will appreciate continuously in the long run. In the short run, there is an overshoot since for a period interest rates remain temporarily higher in the domestic country and this requires a depreciating currency to equalize returns internationally.

Thus, theory tells us that the relationship between interest rate movements and exchange-rate movements depends crucially on the sort of shock that has brought about the interest rate movements. Nor will a comparison of actual movements of the money supply be sufficient to distinguish between the cases portrayed in Figures 1A and 1B since it is expected movements that lead to the difference and not these actual movements, which are the same in the short run. The empirical equations therefore must attempt to incorporate variables capturing the different cases or the results of both estimation and simulation will be questionable. As mentioned above, this is not done in the MCM.

Another aspect of the theoretical results is that one gets sharp overshoots in response to a change in money supply, not the gradual change portrayed in all of the shocks in the MCM paper. One way of reconciling the gradual

[2]This is the case discussed in Rudiger Dornbusch, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, Vol. 84, Number 6 (December 1976), 1161-76.

[3]In principle one could use the domestic term structure of interest rates to determine the length of time the market expects the interest rate change to last.

Figure 1

Effect on Interest Rate and Exchange Rate of Money Supply Change

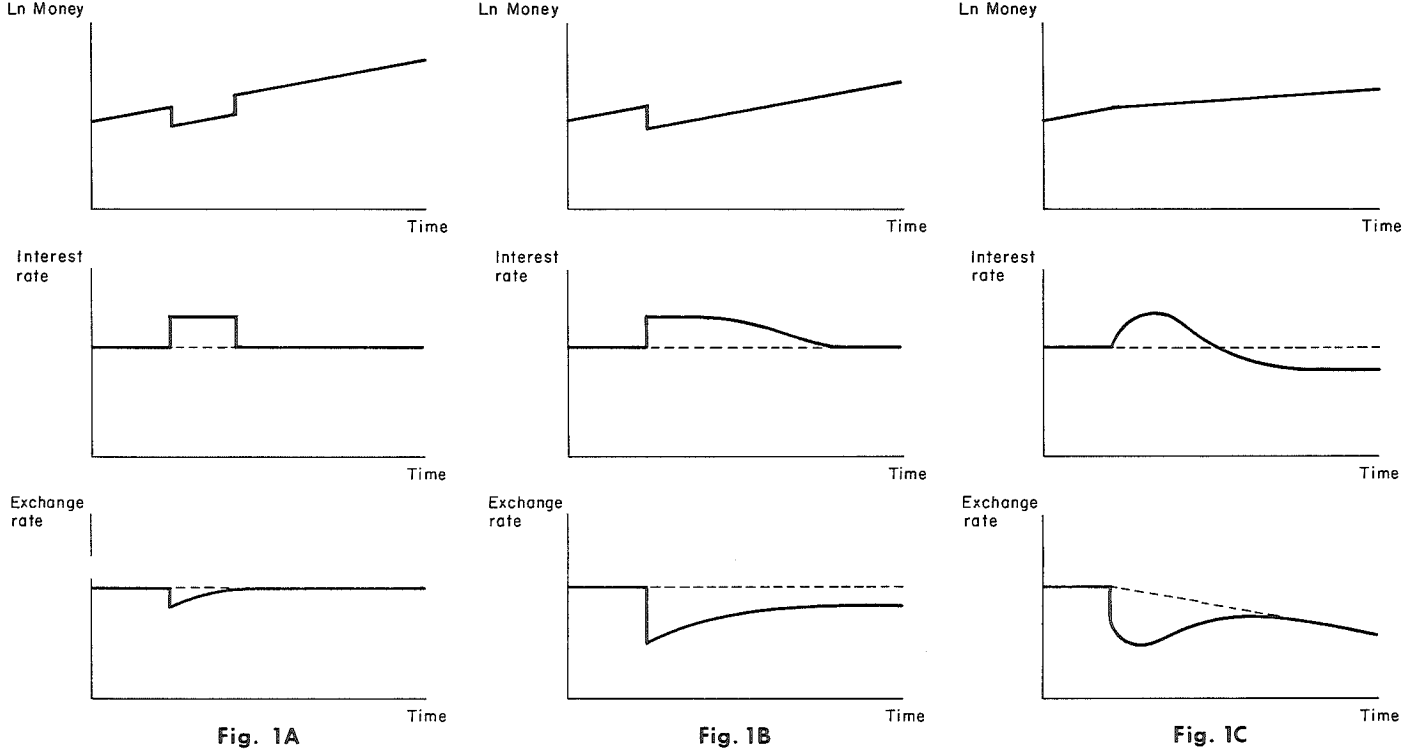

Fig. 1A
Temporary Change in Money Supply

Fig. 1B
Permanent Change in Money Supply

Fig. 1C
Change in Money Growth

response shown in many empirical studies (and quite often in the real world) with the sharp movements of the theoretical models is as follows. When interest rates change, it is not always clear which type of shock is occurring. As time passes, the market receives more information or is able to interpret the information received with a greater degree of assurance. Suppose, for example, the market is not certain when interest rates rise whether this signals a temporary or permanent change in the money supply. Suppose, further, that the longer interest rates remain high, the more likely the money supply change is permanent.[4] In such a model, whereas the initial change in the exchange rate would be only, say, ¼ percent in response to a 1 percentage point change in the interest rate, over time as interest rates remain high the currency would gradually appreciate in response to changed perceptions of the nature of the shock.

A second and related aspect of exchange-rate determination in the MCM that is problematical is the specification of the expected exchange-rate equation. In the MCM, for simulation purposes, the expected exchange rate is either a function of past exchange rates (Canada) or of the country's export price divided by other countries' export prices[5] (Germany, Japan, United Kingdom, United States). Since the latter moves more slowly than the exchange rate in response to a simulated shock, an appreciation of the currency gives rise to the expectation of a depreciation in the next period. At the risk of oversimplifying one might characterize as follows the short-run to intermediate-run behavior of short-term capital and the exchange rate in response to a shock that gives rise to a current-account surplus. Short-term capital outflows must be induced as an offset item to the current-account surplus.[6] Thus, the domestic currency must appreciate to yield the anticipated depreciation that results in the short-term capital outflow.[7] As indicated above, this anticipated depreciation apparently occurs because the expected exchange rate moves more slowly than the actual exchange rate in response to the shock. There are two major problems with this approach. First, if the shock that gives rise to the current-account surplus involves a change perceived to be permanent (e.g., a change in raw materials prices or a structural change), this information will likely be quickly incorporated into expected exchange rates by the market and, as a consequence, will lead to sharp changes in the latter. Second, no matter what the cause, current-account surpluses are highly autocorrelated, in part because of adjustment lags on the real side. Hence, there will be a long period in which a short-term capital outflow (induced by an expected depreciation in the domestic currency) is required to offset the current-account surplus. But the model results in a gradual appreciа-

[4]I am assuming that the lags are such that the price declines induced by the money supply decrease take a long time to be worked out.

[5]The ratio of imports to net foreign assets is also included as a variable in the expected exchange-rate equation; it is particularly useful in the fixed-rate period. See Richard Berner et al, "A Multi-Country Model of the International Influences on the U.S. Economy: Preliminary Results," Board of Governors of the Federal Reserve System, International Finance Discussion Paper, Number 115, December 1977.

[6]This assumes that reserve increases do not offset the entire current-account surplus.

[7]In the long run the appreciation causes the current-account surplus to disappear.

tion of the domestic currency such that the anticipation of a depreciation is continually falsified. In the particular shock shown in Chart 3 (5) for example, there is a short-term capital outflow at a time when interest rates are high in Japan (Germany) and the yen (mark) is continuously appreciating. Thus, speculators will be making losses over the short to intermediate run.[8]

Several other aspects of the results of the monetary shocks in the MCM require comment. The comparison of the closed economy with the open economy responses to a U.S. interest rate shock (Chart 1) illustrates well the point that exchange-rate changes have a relatively more important and faster impact on prices than on real output. What is surprising in these simulations is that the decline in U.S. GNP should have a somewhat smaller effect on Canada than on Japan, Germany, or the United Kingdom (Chart 2). Given the close trade relationships between the United States and Canada one would have expected the reverse result. Another interesting result is that the combination of a decline in the U.S. GNP and an appreciation of the U.S. dollar leads, after an initial increase, to declines in foreign GNP. In no case does the exchange-rate effect dominate the income effect and lead to expansion in foreign economies.

[8]This criticism applies also to other portfolio-balance models of exchange-rate determination.

Alternative Approaches to International Surveillance of Exchange-Rate Policies

Thomas D. Willett*

I. Introduction

How can we best attempt to ensure that national governments do not abuse the freedom generated by floating-exchange rates by engaging in beggar-thy-neighbor policies to overdepreciate their exchange rates or unduly retard the operation of the international adjustment process by maintaining an overvalued exchange rate? The major purpose of this paper is to develop a basis for choosing among the major alternative approaches which have been proposed for the international surveillance of national exchange-rate policies. The following section attempts to characterize the basic logic of the alternative approaches and isolate the major causes of differences of views among the advocates of alternative approaches. Emphasis is placed on political as well as technical economic considerations. In the third section, I briefly discuss my own views of the evidence on several economic issues which lead me to personally favor the judgmental case-history approach which has been adopted by the International Monetary Fund. The final section emphasizes the importance of strengthening the role of the I.M.F. in the international surveillance process if the judgmental approach is to be effective.

The major alternative approaches which have been suggested for the international surveillance of national exchange-rate practices under managed floating can be functionally classified under five categories:

1) reserve indicators
2) target zones
3) reference rates
4) leaning against the wind
5) judgmental assessment or the case-history approach

Proposals for allocating current-account positions will be discussed as a variant of the target-zone approach.

As a first approximation we can consider the major objective of all of these proposals to be to limit the emergence and persistence of disequilibrium or incorrect exchange rates. All of the proposals are concerned with the possibilities of government policies creating such disequilibrium. Some are also concerned with possible deficiencies in private market behavior, for example, due

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to poorly behaved private speculation or externalities, which would require government intervention to establish correct exchange rates. The supporters of the various proposals have different views about the relative seriousness of these two types of causes of incorrect exchange rates, about methods of attempting to detect or estimate disequilibrium and correct exchange rates, and about the political and management problems involved in attempting to implement the alternative proposals.

The *reserve-indicator* approach takes reserve movements as the best indicator of government-induced disequilibrium in the foreign-exchange market and seeks to set limits on the amount of such intervention. A reserve-indicator approach to international surveillance of the adjustment process was advocated by the United States in the early stages of the post-floating negotiations on international monetary reform. It has a history going back at least to Keynes and was recommended by Mikesell and Goldstein in their recent analysis of rules for a floating-rate regime.[1]

The *target-zone* and *reference-rate* approaches seek to establish internationally agreed levels or zones for appropriate exchange rates. The target-zone approach focuses on requiring intervention to keep market rates from moving outside of the zone and thus is closely akin to the old Bretton Woods adjustable peg system. A version of the target-zone approach was advocated in the 1974 I.M.F. Guidelines for Floating (which have been repealed by the 1977 set of Principles for Exchange Rate Policies) and enjoys a great deal of support in Europe.[2] The reference-rate approach turns the Bretton Woods procedures on their head and prescribes when intervention is prohibited rather than when it is required. Leading advocates of the reference-rate approach include Eithier and Bloomfield, Fred Hirsch, and John Williamson.[3]

The *leaning-against-the-wind* approach essentially prohibits aggressive official intervention, that is, selling domestic currency when its value is falling in the exchange markets or buying domestic currency when its value is rising. The proposition that official intervention only be allowed to lean against the wind can be included as an element of reserve indicator or judgmental

[1]Raymond F. Mikesell and Henry N. Goldstein, *Rules for a Floating Rate Regime,* (Princeton Essays in International Finance, No. 109, April 1975). For discussions and references to the literature on reserve indicator proposals, see Thomas D. Willett, *Floating Exchange-Rates and International Monetary Reform,* (Washington: American Enterprise Institute, 1977) ch. 4, and John Williamson, *The Failure of World Monetary Reform, 1971-1974* (New York: New York University Press, 1977) ch. 5.

[2]See, for example, Samuel I. Katz (ed.), *U.S.-European Monetary Relations* (Washington: American Enterprise Institute, forthcoming).

[3]See Wilfred Eithier and Arthur I. Bloomfield, *Managing the Managed Float* (Princeton Essays in International Finance, No. 112, Oct. 1975) and "The Reference Rate Proposal and Recent Experience," Banca Nazionale del Lavoro *Quarterly Review* (forthcoming); Fred Hirsch, "International Guidelines and Principles for National Financial and Exchange Rate Policies: Commentary," in Jacob S. Dryer, Gottfried Haberler and Thomas D. Willett (eds.), *Exchange-Rate Flexibility* (Washington: American Enterprise Institute, 1978); and "I.M.F. Surveillance Over Exchange Rates: Comment," in Robert A. Mundell and Jacques J. Polak (eds.), *The New International Monetary System* (New York: Columbia University Press, 1977); and John Williamson, "The Future Exchange Rate Regime," Banca Nazionale del Lavoro *Quarterly Review,* June 1975, and *The Failure of World Monetary Reform,* ch. 9.

approaches, and is a generally accepted common-law principle. Its major violations occur when countries have intervened in dollars to meet obligations under the European snake arrangements or to counter movements in trade-weighted exchange-rate indices. Thus there have been many instances in which other countries have sold dollars even though the dollar was falling against their currency or have bought dollars even though it was rising. While such practices are inconvenient from the standpoint of the United States and have probably contributed somewhat to the variability of the dollar, cases of more broadly based aggressive intervention have been quite rare.

Perhaps the most notable alleged case concerned the plunge of the pound below $2.00 in 1976, but it is somewhat unclear whether the beginning of this decline was deliberately engineered or was a mistake based on operating procedures which called for intervention in dollars based on movements in the Bank of England's trade-weighted index. In any event, such aggressive intervention lasted at most for one day. During most of the subsequent drop of the pound against the dollar, the Bank of England was buying pounds to slow the fall. For the purpose of this paper, I will assume that the principle that countries should not usually intervene aggressively is generally accepted.[4] The discussion of this category below will concentrate only on whether it is sufficient to obviate the need for other procedures. Recent discussion of the leaning against-the-wind approach has been presented by Cooper (who refers to it as the "smoothing and braking strategy" as contrasted with the "tracking strategy" of the target-zone and reference-rate proposals), Grubel, Tosini, and Wonnacott.[5]

The *judgmental* or *case-history* approach was strongly advocated by the United States in the later stages of the reform negotiations and was adopted in essence in the 1977 I.M.F. Principles for the Guidance of Members' Exchange Rate Policies. Advocates of various varieties of the judgmental approach have included Artus and Crockett, Cooper, Roosa, Whitman, and Willett.[6]

The first best argument for a judgmental approach is based on the view that desirable balance-of-payments and exchange-rate behavior is too complex to be adequately captured by a set of exchange-rate or reserve indicators

[4]"Aggressive" intervention might be desirable when a country needed to recoup severe losses. A more controversial rationale for desiring to intervene aggressively is the so-called "bear squeeze" in which a central bank attempts to punish speculators who have been "too pessimistic" about the outlook for the currency.

[5]See Richard N. Cooper, "I.M.F. Surveillance Over Exchange Rates," and Herbert G. Grubel, "How Important Is Control Over International Reserves," both in Mundell and Polak (eds.), *The New International Monetary System;* Paula A. Tosini, *Leaning Against the Wind: A Standard for Managed Floating* (Princeton Essays in International Finance, No. 126, December 1977) and Paul Wonnacott, *The Floating Canadian Dollar* (Washington: American Enterprise Institute, 1972).

[6]See Jacques R. Artus and Andrew D. Crockett, *Floating Exchange Rates and the Need for Surveillance* (Princeton Essays in International Finance, No. 127, May 1978); comments by Richard Cooper and Robert Roosa in E.M. Bernstein, *et. al., Reflections on Jamaica* (Princeton Essays in International Finance, No. 115, April 1976); and Sam Y. Cross, "The Role of the I.M.F. under the Amended Articles of Agreement," and commentaries by Marina Whitman and Thomas D. Willett in Dreyer, Haberler and Willett (eds.), *Exchange Rate Flexibility.*

and that acceptable norms must be built up over time based on the cumulative treatment of concrete situations. The second best argument for the judgmental approach is that it represents the best fallback available when sovereign national governments are not prepared to agree on a more highly structured approach to international surveillance.

There are, of course, many variants under each of these categories, and sometimes variants under different categories merge into one another. Thus, for example, efforts to ensure that leaning-against-the-wind intervention policies are applied symmetrically on the up and down sides are likely to merge into a reserve-indicator approach. Similarly, some of the European proposals for target zones represent something of a halfway house between the pure target-zone and reference-rate approaches. For example, C.J. Oort has proposed a system of consultation points.[7] If exchange rates move outside of these points, multilateral consultations to discuss intervention are called for, while intervention on the wrong side of the consultation points would be prohibited. Target-zone proposals with asymmetrical intervention requirements have also been put forward, reflecting a greater concern with "excessive" depreciation than with excessive appreciation.[8]

In the following section I shall attempt to lay out the rationales for the various approaches in more detail. As will be discussed, advocates of the various approaches tend to differ greatly in their judgments about such issues as the behavior of exchange markets, the ability of governments to determine "correct" or equilibrium exchange rates and secure international agreement on them, and the social costs of exchange-rate variability and government exchange-rate manipulation.

One important point which should be kept in mind is that the best guidelines for international surveillance may differ from the best strategies for national intervention policies. A good set of international procedures should not rule out desirable national intervention strategies, but the purpose of international procedures is to place limits on the ability of national governments or the private market to produce anti-social outcomes which harm the international community. Thus, for instance, while reserve changes are probably a better indicator for national exchange-rate policies than are reserve levels, it may be more appropriate to use reserve levels to set bounds on the range of permissible national behavior.[9] Likewise, as shall be argued in section III, I do not believe that the available evidence indicates that foreign-exchange

[7]See, for example, Oort's presentation in Katz (ed.), *U.S.-European Monetary Relations.*

[8]An example is the recent OPTICA Report, Commission of the European Communities, *Inflation and Exchange Rates: Evidence and Policy Guidelines for the European Community* (Brussels, 1977). For extensive discussion of the OPTICA proposal see Katz (ed.) *U.S.-European Monetary Relations,* and Giorgio Basevi and Paul De Grauve, "Vicious and Virtuous Circles," *European Economic Review,* 1977, pp. 277-301.

[9]Willett, *Floating Exchange Rates,* ch. 4. See also, Williamson's, *The Failure of World Monetary Reform,* ch. 5. This distinction is overlooked by Richard Cooper and Peter Kenen in their advocacy of flow over stock indicators. See Richard N. Cooper, "Comment on the Howle-Moore Analysis," *Journal of International Economics,* November 1971; Peter B. Kenen, "Floats, Guides and Indicators," *Journal of International Economics,* May 1975 and the papers by Cooper and Kenen in Mundell and Polak (eds), *The New International Monetary System.*

markets have operated in a manner that would make systematic leaning against the wind an optimal national intervention strategy, but I believe that barring exceptional circumstances, only intervention which leans against the wind should be internationally approved.

I should also note that this paper does not explicitly deal with issues of monetary and macroeconomic policy coordination. Where underlying conditions are highly variable, equilibrium exchange rates will display great variability and this can impose serious economic costs. Where private speculation is working reasonably well, attempts to substantially limit exchange-rate variations through exchange-market intervention are dealing with the symptoms rather than the basic cause of the problem. I believe that having a strong system of international surveillance of exchange-rate policies is important. But the creation and maintenance of relatively stable national macroeconomic policies and conditions are even more important for promoting international monetary stability. It is quite appropriate that a session at this conference be devoted to discussion of surveillance of exchange-rate policies, but we should be careful not to mislead ourselves into believing that effective surveillance of exchange-rate policies is a sufficient condition for the restoration of international monetary stability.

The officials of the International Monetary Fund have been well aware of this point, and perhaps the major focus of their attention recently has been on trying to induce more stable and better coordinated macroeconomic policies. Indeed a major aspect of the agreements among the major industrial countries at Rambouillet which cleared the way for international monetary reform was the emphasis on the need for more stable underlying economic policies if one hoped to obtain exchange-rate stability. However, there is still sufficient controversy about various aspects of proposals for narrowly defined exchange-rate policies to deter me from attempting in this paper to tackle the problems of international surveillance of macroeconomic policies as well.

I should also stress that although the International Monetary Fund has adopted one of the proposed alternatives for surveillance, I believe that it is quite appropriate that the alternative possibilities still be reviewed. It is certainly within the normal domain of policy research to focus on evaluating past decisions, as well as future possibilities. Adoption of the new I.M.F. guidelines has certainly not quelled advocacy of the alternative approaches. Obtaining a better understanding of the rationales for the alternative approaches is also quite important for understanding different points of view about national exchange-rate policies. Furthermore, as will be argued below, even when some of these proposals are rejected in their pure form, they still may have important, although less formal, potential roles to play in the implementation of the I.M.F.'s judgmental approach. And little appears to have been decided so far about how the new I.M.F. guidelines will be implemented.

II. The Logic of the Various Approaches

A. The Reference-Rate and Target-Zone Approaches

Advocates of the target-zone and reference-rate approaches tend to

assume that 1) "correct" or equilibrium exchange rates can be calculated relatively accurately, but that speculation in the foreign-exchange market is not sufficiently well behaved to keep market rates "close enough" to these "correct" rates, 2) that because correct rates can be calculated relatively accurately it will not be excessively difficult to achieve agreement among national governments as to what these rates or zones are and 3) that these figures can be renegotiated relatively promptly when changes in underlying conditions warrant.

In both of these approaches the idea is that officials can systematically do a better job of determining exchange rates than the market can, that official announcements of exchange-rate objectives will help to stabilize private speculative behavior. The advocates of the two approaches differ in their views of the costs of exchange-rate variability, however, as the reference rate supporters focus only on prohibiting beggar-thy-neighbor official intervention while the target-zone approach seeks to limit both national beggar-thy-neighbor policies and excessive exchange-rate fluctuations.[10]

On purely logical grounds the target-zone advocates appear to make a stronger case than do supporters of the reference-rate approach. If, indeed, officials can calculate and secure international agreement on correct exchange rates within relatively narrow bands, why should it not be as important to avoid incorrect exchange rates resulting from market forces as it is for those resulting from government manipulation?

It seems likely that reference-rate advocates may tend to be somewhat less confident than target-zone advocates of the ability to reach internationally negotiated agreements on exchange-rate norms that tend to be systematically better than market rates. Such a belief could justify a looser target-zone or consultation points approach which does not require mandatory intervention in opposition to strong market sentiments.[11] Reference-rate advocates could also believe that while the private market and government intervention may both lead to wrong exchange rates at times, there is a stronger tendency for incorrect rates to persist as a result of national policies than of market behavior. Such a tendency would be sufficient to establish a rationale for greater international concern with limiting national governmental behavior than with limiting market behavior.

In the first several years after the oil shock, a great deal of attention was focused on the allocation of the resulting oil deficits and a number of propos-

[10]Thus, as Eithier and Bloomfield stress ("The Reference Rate Proposal and Recent Experience,") it is not correct to group reference-rate proposals with target-zone proposals together as being on the pegged as opposed to flexible end of the spectrum of guidelines for floating. The pure reference-rate approach is much further toward the free-floating end of the spectrum than proposals that would impose a presumptive obligation for official intervention to lean against the wind.

[11]There is a considerable range of opinion among reference-rate advocates about whether fairly heavy official management is desirable because of deficiencies in the behavior of private speculation. Both Fred Hirsch and John Williamson have argued that a fair amount of official intervention is needed, while Eithier and Bloomfield appear to have been less concerned about the behavior of private speculation. Thus the characterization of the reference-rate advocates as believing that governments can determine correct exchange rates better than the market would apply more directly to Hirsch and Williamson than to Eithier and Bloomfield.

als were put forward to assign current-account targets to each country in order to avoid a beggar-thy-neighbor scramble for surplus positions which were not collectively feasible.[12] Functionally, comprehensive current-account allocation proposals may be considered a variant of the target-zone approach in which calculations of the exchange-rate norms are based on estimates of what is required to achieve the current-account norms. Proponents of the current-account allocations approach assume either that other policies can be adjusted to remove differences between the exchange rates which would yield overall payments balance and the current-account target or that, in the case of conflicts, achieving the current-account target is more important. Comprehensive versions of the current-account allocation entail the same types of problems of implementation as the more general target-zone approach (although most of the discussions have focused on the need to avoid a scramble for current-account surplus and how current-account targets should be allocated, with little explicit attention to the problem of achieving such targets once they had been accepted). Advocates of the judgmental approach would also argue that it will often be important to give considerable attention to current-account positions as well as overall payments but would tend to argue that this cannot usefully be done in a simple mechanical manner.

B. Leaning Against the Wind

Critics of the reference-rate and target-zone approaches tend to challenge the validity of all three of the propositions listed at the beginning of the previous subsection. Advocates of a leaning-against-the-wind approach are dubious of the ability to set internationally agreed accurate sets of exchange-rate norms, but usually assume that free markets will tend to display excessive volatility because of badly behaved private speculation and/or externalities resulting from exchange-rate fluctuations.[13] Since they tend to be skeptical of the desirability of freely floating rates, advocates of leaning against the wind tend to support this approach both as a norm for national behavior and of international surveillance and would tend to be tolerant of fairly large reserve changes in support of efforts to reduce the magnitude of exchange-rate fluctuations.[14]

The adoption of the proposal to allow only leaning-against-the-wind intervention as a complete solution to international surveillance implies a primary concern with avoiding aggressive beggar-thy-neighbor policies. However, while the avoidance of such aggressive actions is certainly to be

[12]See, for example, Andrew D. Crockett and Duncan Ripley, "Sharing the Oil Deficit," *I.M.F. Staff Papers,* July 1975; Robert Solomon, "The Allocation of 'Oil Deficits'," *Brookings Papers on Economic Activity,* No. 1 (1975); Thomas D. Willett, *The Oil Transfer Problem and International Economic Stability,* (Princeton Essays in International Finance, No. 113, December 1975); and John Williamson, "The International Financial System," in Edward R. Fried and Charles L. Schultze (eds.), *Higher Oil Prices and the World Economy* (Washington: Brookings Institution, 1975).

[13]See, for example, Cooper, "I.M.F. Surveillance over Exchange Rates," and Tosini, *Leaning Against the Wind.*

[14]Advocates of leaning against the wind have usually not made clear to what extent, if any, they believe it should be a positive international obligation.

desired, this has not really been a major problem since the 1930s. It is quite understandable that with the 1930s fresh in their memory, the architects of the Bretton Woods monetary system considered the avoidance of such aggressive beggar-thy-neighbor policies as a major rationale for adopting the adjustable-peg exchange-rate system. However, in my view, the much more serious problem of national government policies creating disequilibrium under both the adjustable-peg and managed floating has been not by overt exchange-rate changes, but rather through government policies which maintained exchange rates or allowed them to adjust only slowly in circumstances in which equilibrium exchange rates were changing by substantial amounts, in other words, through excessive leaning against the wind rather than aggressive policies.[15]

C. Reserve Indicators

To attempt to limit this problem, some type of provisions for symmetry between the extent of leaning in an upward and downward direction would need to be introduced into leaning-against-the-wind proposals for international surveillance. The most obvious method is to adopt bounds on the amount of net cumulative intervention in either direction. In her recent analysis of leaning against the wind, Paula Tosini accepts the proposition that intervention should be symmetrical over the long run but argues against quantitative limitation on cumulative reserve changes. She argues that such limitations would encourage the use of alternative methods of influencing the exchange rate and would increase exchange-rate volatility.

The existence of substitutes for intervention such as official borrowing from private markets, monetary policy, capital controls, and official guidance of private-capital flows clearly indicates that quantitative limits on reserve changes are not sufficient to eliminate the possibility of beggar-thy-neighbor policies, but it does not establish a case against the use of quantitative limits on cumulative reserve movements in conjunction with supplementary guidelines concerning the use of intervention substitutes. To argue against quantitative indicators on this score would require additional arguments such as that intervention substitute policies are so easy to adopt and would be so quantitatively important that it wouldn't be worth the trouble to attempt to negotiate reserve indicators or that agreement on quantitative reserve indicators would inappropriately deflect international attention away from the use of intervention-substitute policies.

The second type of argument cuts more directly against the basic case for

[15]Some advocates of leaning against the wind argue that an essential part of this approach is that exchange rates must be allowed to move in the face of strong market pressures (although not by a market clearing amount). Such a provision would reduce the problem of cumulatively mounting disequilibrium which resulted from the excessive rigidity of the adjustable peg system.

I should also note that following the tradition of most discussions of the leaning-against-the-wind approach, I have assumed that monetary policy is set independently of exchange-market intervention, i.e., that reserve flows under managed floating are fully sterilized. As Richard Sweeney has pointed out to me, an alternative type of defense of leaning-against-the-wind policies would be as a guide to monetary policy. This would, of course, imply that reserve flows should not be sterilized, at least not fully. This is an intriguing idea which deserves more consideration. Along somewhat similar lines, see Ronald I. McKinnon, *A New Tripartite Monetary Agreement* (Princeton Essays in International Finance, No. 106, Oct. 1974).

reserve indicators. Tosini's assumption is that private speculation does not work well so that limitations on official intervention will reduce the ability of governments to counteract the excessive volatility of the private market. As I have argued elsewhere, the basic logic of the reserve-indicator approach rests on the opposite assumption that private speculation usually works fairly well.[16]

In the case of well-behaved private speculation and no intervention substitute policies, reserve changes or cumulative intervention would measure the extent to which national governments have caused exchange rates to diverge from their equilibrium levels.[17] Quantitative limitations would then be set on the basis of how much discretion would be given to national authorities to use exchange-market policies to achieve domestic objectives such as reducing inflation, stimulating employment, or correcting for externalities caused by exchange-rate movements.

Presumably these limitations would be set more stringently, the less important externalities from equilibrium exchange-rate movements were judged to be, and the more willing countries were to accept limitations on their own scope for discretionary action in return for similar limitations on the actions of others. Similar considerations would influence the width of exchange-rate bands under the target-zone and reference-rate approaches. In such a world, the width of reserve bands or permissible cumulative reserve changes would be determined purely by the trade-offs involved between the costs and benefits of international policy coordination in the exchange-rate area.

When the possibility of clearly recognizable poorly behaved private speculation is introduced, this would suggest a widening of the limitations on reserve changes in order for governments to combat disequilibrium movements in exchange rates, or the establishment of an international intervention authority with a mandate to intervene only to offset destabilizing speculation or make up for an insufficiency of stabilizing speculation. As the latter alternative seems unlikely to be a serious candidate for adoption over the foreseeable future, let us concentrate on the case in which the limitations on the extent of possible cumulative net national interventions are widened as views about the magnitude of private speculative deficiencies increase. As a set of statistical rules cannot distinguish between intervention in response to imperfections in private market behavior and interventions to achieve national objectives, countries can be given greater scope to reduce excessive market volatility only at the risk of giving them more potential scope to engage in exchange-rate manipulation as well.

[16]Willett, *Floating Exchange Rates,* ch. 4, and "The Emerging Exchange Rate System," in Katz (ed.), *U.S.-European Monetary Relations.*

[17]Because of nonmarket transactions such as interest earnings on official foreign currency holdings and some types of military payments, figures for reserve changes and net official intervention over the same period will not necessarily coincide. The appropriate standard would be to have such nonmarket transactions put into the market. For example, the interest earnings on foreign official dollar holdings should be sold in the foreign-exchange market to acquire the foreign countries' currency. Otherwise foreign official dollar holdings would grow even in the absence of any exchange-market intervention.

Thus the adoption of a reserve-indicator approach may make a lot of sense if private exchange markets work fairly well. If they work very poorly, reserve limitations sufficiently tight to set strong constraints on exchange-rate manipulations also would be likely to result in excessive exchange-rate volatility, while limitations broad enough to allow the elimination of excess volatility caused by poorly behaved private speculation might provide little effective check on the scope of exchange-rate manipulation by national governments. It is thus not surprising that Mikesell and Goldstein, who believe that the exchange markets work fairly well, recommend a relatively tight reserve indicator system, while Tosini, who assumes that the exchange markets work poorly, is highly critical of Mikesell and Goldstein's recommendation.

Two other types of economic objections to reserve indicators should also be briefly discussed. One is the argument that a reserve-indicator system might encourage disruptive private speculation. When reserves were close to their permissible limit, the market would know that future exchange-rate changes would be much more likely to be in one direction than the other and this tendency would be exaggerated in the face of rules that required some proportion of interventions to be reversed within a given time period. In reply it can be argued, however, that the prospect of such developments would place a healthy discipline on national governments to refrain from intervening so much that they get themselves out on such a limb. Obviously such an argument is much more persuasive to those who believe private markets work fairly well and are concerned primarily about excessive government intervention, than to those who believe that the private market works poorly and a considerable amount of official intervention is desirable. It should also be noted that the perverse speculative incentives which might be generated by a poorly working reserve-indicator system are unlikely to be as bad as the one-way speculative option which developed under the adjustable-peg system and which critics believe would be likely to reemerge if a target-zone approach were adopted.

The second additional objection concerns the feasibility of determining reasonable mechanics and quantitative values for the reserve-indicator approach. How should stock and flow considerations be combined? How tight should the quantitative limitations be and how should this vary for stock and flow indicators? How should base levels and rates of growth of reserve norms be selected? Such questions are the analogs for the reserve-indicator approach to the problem of deciding upon exchange-rate norms under the target-zone and reference-rate approaches.

While at first glance, it would seem that the technical difficulties involved in implementing the exchange-rate norm approaches are a good deal less than for the reserve indicator approach, it is not clear that this is really so. For example, would norms be set for each set of bilateral exchange rates or would it be sufficient to use some type of composite exchange-rate index for each country? And if it is granted that it may be appropriate at times for reserve deficient countries to recoup reserves (for example, the United Kingdom during 1976 and 1977) or for some reserve countries, such as Germany and Japan, to reduce their reserve holding (for example, the sales of some of their recently

accumulated dollar holding at the beginning of the floating-rate period in 1973), then reserve considerations must be taken into account in the calculation of equilibrium exchange rates. This implies that, in fact, the determination of correct exchange rates may not be less difficult conceptually than the determination of optimal reserve levels and flows.

Furthermore, optimal reserve positions may not tend to change as rapidly as equilibrium exchange rates. Thus once adopted, the need for frequent revisions might well be less of a problem with the reserve-indicator approach than with the exchange-rate norm approaches. It also seems likely that where mistakes are made in calculating norms or norms are not adjusted promptly in the face of changing circumstances, incorrect reserve norms will cause less severe problems than incorrect exchange-rate norms, especially where the norms are used to require as well as prohibit intervention.

While the above considerations make me skeptical of arguments that problems of implementation are substantially less for the exchange-rate norm than for the reserve indicator approach, I find the technical difficulties involved in implementing either approach to be quite impressive. Recognition that such norms do not necessarily have to be optimal to be helpful reduces these difficulties, but not in my view to a manageable level.

D. The Judgmental Approach

This belief that the issues surrounding appropriate norms for exchange-rate behavior are too complex to be adequately captured in calculations of the exchange rate or reserve norms is the major basis for first best arguments for the judgmental or case-history approach. Advocates of this approach tend to be doubtful that government experts can forecast correct exchange rates sufficiently accurately to make such estimates a sound basis for internationally agreed intervention guidelines. As noted above, the accuracy requirements necessary to make a target-zone approach of mandatory intervention work well are greater than for the reference-rate approach. Conceptually, as the magnitude of expected official forecast errors increased, the appropriate response would be to widen the target zone or consultation points, just as one would increase the width of reserve indicators in response to increases in the magnitude of poorly behaved speculation. In both cases, however, one reaches a point in which the reserve or exchange-rate bands are so wide that at best they become almost meaningless and at worst they may become counterproductive by diverting attention from more important aspects of surveillance.

Advocates of the judgmental approach do not necessarily believe that it is inappropriate for national governments or international organizations to attempt to estimate appropriate exchange-rate zones and perhaps even to make these estimates public. They tend to be doubtful, however, that the market frequently behaves so obviously poorly that one could reach international agreement in advance on meaningful limits to possibly appropriate exchange rates.

Apart from the technical difficulties in estimating correct exchange rates, proponents of the judgmental approach also tend to emphasize the difficulties

in reaching international agreement among governments on such estimates, and once having reached agreement, being able to revise such norms sufficiently quickly when unanticipated developments lead to changes in estimates in equilibrium levels or rates of change of exchange rates. The greater the variability in the underlying economic and financial environment, the greater this problem becomes.

If there were some simple set of calculations which gave good estimates of equilibrium exchange rates, these problems of political implementation might not be very serious. For example, if some standardized set of Purchasing Power Parity (PPP) indices gave good approximations of medium-term equilibrium exchange rates, then political negotiations would need only to focus on choosing the formula to be used. Calculations of exchange-rate norms could be automatically updated as new price data became available. Indeed, it is probably not coincidental that many of the advocates of the target-zone approach appear to believe that various types of PPP calculations can provide a reasonable normative guide to appropriate exchange rates.[18]

In such circumstances, there would probably be some initial hard political bargaining over just what formula to use, as many countries attempted to secure an agreement which they believed was more likely to see their currency a little undervalued than a little overvalued. As will be discussed in section III various PPP calculations can give an extremely wide range of values. Still there is a fairly high probability that such political negotiations could be reasonably successfully concluded. Unfortunately, however, as will also be discussed in section III, there are serious questions whether PPP calculations can give a good guide to appropriate exchange rates. Even holding the degree of accuracy of forecasting constant, the more complicated are the procedures for forecasting, the greater is the extent to which the outcome of international negotiations over exchange-rate norms would be likely to reflect political bargaining strength rather than economic analysis. And as the ability to forecast accurately declines, the political component in negotiations would rise still further.

Perhaps even more significant, the less simple and accurate is the technical economic analysis, the more difficult it would be to renegotiate a new set of norms when underlying fundamentals change. In such circumstances a target-zone approach could easily take on the type of status quo bias which led to the breakdown of the Bretton Woods adjustable peg exchange-rate procedures. Critics argue that it is difficult enough to determine what equilibrium exchange rates are at any one point in time, much less to estimate the equilibrium pattern of exchange rates which will hold over a substantial period into the future. But if the latter cannot be done or some automatic formula for updating norms cannot be adopted, then the international community might well be in almost continuous negotiation over exchange-rate norms.

E. Negotiating Costs and Problems of Implementation

Advocates of the judgmental approach would argue that international cooperation and the time of top-level policy makers are very scarce and valua-

[18]See, for example, the OPTICA Report.

ble resources. Where the technical issues are complicated, the use of a less formal judgmental approach allows a much more economical use of these scarce resources, concentrating them on the international economic issues which seem of greatest overall importance. It is a frequent, but unfortunate, characteristic of many proposals for international monetary reform to treat the supply of high-level attention and international cooperative behavior as if it were a free good.[19]

In general, advocates of the judgmental approach tend to give greater weight to questions of the allocation of policy-making resources and the willingness of countries to compromise than do advocates of the exchange-rate or reserve norm approaches. Under the ideal circumstances for the application of these objective norm approaches, these questions largely disappear. But as conditions begin to deviate from these ideals, then questions of international decision-making costs become increasingly important. This in turn increases the difficulties with the objective norm approaches more rapidly than on the basis of technical economic considerations alone.

It is also important to recognize that concerns with the maintenance of traditional areas of national sovereignty and appearances to their electorates (who are not international economic experts) will often keep national governments from engaging in as much international cooperative behavior as many international economic experts would judge to be desirable. While continuing to press the case for greater degrees of cooperative behavior over the long run, this leaves technical experts with the short-run problem of seeking second or n-th best solutions which utilize the currently available supply of cooperative behavior as effectively as possible.

An ideal system of surveillance would have a clear-cut set of rules and a well-specified schedule of penalties for violations of these rules. This explains much of the attractiveness of the exchange-rate and reserve norm approaches. They contain objective rules and lend themselves easily to graduated sets of penalties for violations of these rules. But even apart from the difficulties of finding objective rules which would be describable in practice, it may not be possible to get national governments to agree to give up traditional sovereignty in the interests of similarly constraining the range of behavior of other countries. In my judgment this had at least as much to do with the failure to agree on a set of reserve indicators during the earlier phase of the monetary reforms negotiations as did technical economic problems with the indicator proposals.

F. Precision and Sovereignty

As I argued in my earlier analysis of international surveillance issues,[20] it appears that at present many countries are willing to behave more cooperatively in actual practice than they are willing to accept explicit formal constraints on their behavior. It seems quite likely that adoption of an informal judgmental approach to international surveillance would make it more difficult to secure agreement to grant substantial explicit sanctioning authority to

[19]The importance of international decision-making costs is one of the major points of emphasis in a study being prepared by Robert Tollison and myself on *The Challenge of Economic Interdependence: A Public Choice Perspective.*

[20]Willett, *Floating Exchange Rates,* ch. 4.

a surveillance body. On such issues, countries often tend to engage in worst-case analysis, making them very hesitant to give great power to international authorities. And the incentives against granting such power are greater, the more scope there is for discretion in the application of such power.

Thus I believe it should be granted by advocates of the judgmental approach that under such procedures the International Monetary Fund is unlikely to be given many additional powers to sanction explicitly the behavior of countries deemed to be engaging in beggar-thy-neighbor policies. (At Bretton Woods, the Fund was given the power to expel a country from membership and to authorize discriminatory trade measures against any country whose currency has been judged to be scarce, but these sanctions proved to be much too blunt to be useful in practice as methods of penalizing moderate beggar-thy-neighbor behavior.)

If my previous assessment of the willingness of countries to behave cooperatively is correct, however, then it seems likely that even without formal sanction, the informal judgmental approach may be the way to achieve the greatest amount of cooperative behavior under present circumstances. In practice, the moral suasion generated by international surveillance under the judgmental approach may be a much more potent method of inducing countries to refrain from or modify beggar-thy-neighbor policies than the more legalistically appealing blueprints for explicit rules and sanctions.

Again, political and economic considerations interact. The case for the judgmental approach becomes stronger, the less well simple explicit rules would conform to ideal surveillance norms and the stronger are political biases against the acceptance of formal contraints and penalties.

Even if it were believed that the greatest amount of effective cooperative behavior in the short run would be induced by the judgmental approach without formal sanctions, there are possible grounds for opposing this approach, however. The hope of the advocates of the informal judgmental approach is that this will not only maximize the effectiveness of surveillance in the short run, but also will be an effective forum for continuing to strengthen cooperative tendencies over time. It is also possible, however, that the judgmental approach could serve as a cover to hide fundamental disagreements and weaknesses in the surveillance process. This could breed a false sense of complacency and achieve the appearance of greater international harmony in the short run at the expense of the development of more serious difficulties over the longer term. While I am personally somewhat more on the optimistic side on this question, the history of international surveillance efforts over the postwar period contains enough examples of national and international officials giving primary concern to the public appearances rather than the substance of surveillance policies that the more pessimistic possibilities cannot be prudently overlooked.[21]

[21]See, for example, the excellent chapter on multilateral surveillance in Susan Strange, *International Monetary Relations* (London: Oxford University Press, 1976). Strange concludes with respect to I.M.F. surveillance over the United Kingdom that "... the weight to be attached to particular instruments of Fund surveillance, and even the effectiveness of the surveillance itself, must remain to some extent a matter for subjective judgment ... All that may be said with some confidence is that both parties were a great deal more concerned with appearances than with realities." (p. 146)

In this section, I have attempted to sketch out what I see as the basic logic of the major alternative approaches to surveillance and the major economic and political factors on which their relative desirability depends. In the following section I shall briefly comment on two of the major technical economic issues relevant to the choice among the alternative approaches, the alleged excessive volatility of free market exchange rates and the ability to calculate reasonably accurate exchange-rate norms.

III. Some Technical Economic Considerations

A. Badly Behaved Speculation

Excessively volatility of exchange rates may result from two different sources. The most frequently discussed source is poorly behaved private speculation. Actively destabilizing private speculation would, of course, generate socially undesirable fluctuation in exchange rates. Recently a good deal of attention has also been focused on the possibility that while private speculators may generally behave in a stabilizing manner, such factors as excessive risk aversion, barriers to entry, and government regulation may cause the supply of stabilizing speculative funds to be insufficient to smooth out temporary fluctuations in nonspeculative demand and supply in the foreign-exchange market or to avoid unnecessary short-run exchange rates resulting from J-curve effects in the trade accounts. There are still some technical ambiguities to be resolved concerning the conditions under which the absence of a perfectly elastic supply of speculative funds is not a sign of market inefficiency because of rational risk aversion. Thus, for example, a finding that the forward rate is a biased predictor of future spot rates is evidence that the supply of speculative funds is less than perfectly elastic, but not necessarily that there are imperfections in the foreign-exchange market.[22] Likewise, equilibrium is not an entirely unambiguous concept. Still, I think we may usefully think of destabilizing or insufficiently stabilizing speculation as examples of inefficiencies in the foreign-exchange market which cause free-market exchange rates to deviate from equilibrium rates.[23]

It is fairly generally agreed that where exchange-rate fluctuations result from such private speculative inefficiencies that can be clearly identified, they should be offset by official intervention to maintain or establish equilibrium rates. The particular difficulties in implementing such a strategy, of course, are to what extent public authorities can correctly identify such speculative

[22]See, for example, Richard James Sweeney and Thomas D. Willett, "Concepts of Speculation and Efficiency in the Foreign Exchange Market," OASIA Research Discussion Paper, U.S. Treasury, 1976. A later version will appear in Richard James Sweeney and Thomas D. Willett (eds.), *Studies in Exchange-Rate Flexibility* (Washington: American Enterprise Institute, in preparation), and Steven W. Kohlhagen and Thomas D. Willett, "Risk Premium and Biases in Forward Rates," in *ibid.*

[23]One of the major ambiguities in defining equilibrium is the time dimension involved. Real world speculation, whether by the public or private sectors, will never be as farsighted as ideals which can be imagined. For the purposes of this paper, we might think of equilibrium as a medium-term concept based on the assumption of speculation which is not "excessively" short sighted. This is obviously a topic which could use a great deal of refinement.

inefficiences, and whether in practice imperfect government intervention will reduce or add to the deviation between market and equilibrium rates caused by imperfect private speculation.

I have reviewed the empirical studies on the behavior of speculation under the current float recently, and this is the topic of another paper at this conference as well, so I shall just briefly record my own conclusions based on the evidence available so far.[24] I should begin by noting that it has been common to draw strong conclusions about the behavior of speculation from the presentation of one or more hypotheses about speculative behavior combined with a few facts that are consistent with the hypothesis in question. The difficulty is that often the facts presented will also be consistent with other major hypotheses as well. Thus, for example, the fact that we have great variability of exchange is certainly consistent with hypotheses such as bandwagon effects or insufficient stabilizing speculation. However, at this level of specificity, it is also quite consistent with alternative major explanations such as the Dornbusch hypothesis of efficient exchange-market speculation leading to exchange-rate overshooting in the face of monetary shocks and sluggish adjustments in the domestic economy, or with models of rational expectations and efficient adjustment in all markets under conditions of great variability in past and expected future underlying conditions.

At this level it is easy to put forward a limited set of facts consistent with any of these hypotheses. What is needed is less grand generalization about speculation and more careful empirical work which considers more systematically the behavior of exchange rates and their relation to an alternative hypothesis about the behavior of speculation. I have in mind here the type of empirical work being done by economists such as Artus, Arndt and Pigott, Bilson, Cornell and Deitrich, Dooley and Shaffer, Fieleke, Frankel, Giddy and Dufey, Kolhagen, Levich, and Logue, Sweeney, and myself.[25] Such studies employ a wide variety of approaches including direct attempts to model the foreign-exchange market, investigations of the predictive behavior of forward exchange rates, patterns in exchange rates which would be consistent with various hypotheses about badly behaved speculation, the behavior of bid-ask spreads, the relationships between sets of variables such as exchange rates and monetary aggregates and price-level movements and the search for episodes in which there is presumptive evidence that market rates differed from the expectations of a substantial majority of exchange-market dealers and experts.

[24] Willett, *Floating Exchange Rates,* ch. 2.

[25] For extensive references to the empirical studies on the behavior of flexible exchange rates see, Steven W. Kohlhagen, *The Behavior of Foreign Exchange Markets: A Critical Survey of the Empirical Literature* (New York University Monograph Series in Finance and Economics, 1978); Richard M. Levich, "On the Efficiency of Markets for Foreign Exchange" in Rudiger Dornbusch and Jacob A. Frenkel (eds.) *International Economic Policy* (Baltimore: John Hopkins University Press, 1978) and "Further Results on the Efficiency of Markets for Foreign Exchange" (this volume). Dennis E. Logue, Richard James Sweeney, and Thomas D. Willett, "Speculative Behavior of Foreign Exchange Rates during the Current Float," *Journal of Business Research,* No. 2, 1978; Susan Schadler, "Sources of Exchange-Rate Variability: Theory and Empirical Evidence," *I.M.F. Staff Papers,* July 1977; and Willett, *Floating Exchange Rates,* ch. 2.

No one of these studies could hope to be definitive, but as part of a cumulative process they offer the prospect of substantially improving our empirical knowledge of the behavior of speculation and the foreign-exchange markets. As is not surprising, the evidence so far is somewhat mixed. I believe that the studies to date have been sufficient to disconfirm some of the more extreme hypotheses about badly behaved speculation. The available evidence does not generally support the views that there are large systematic tendencies for speculation to behave inefficiently. The possibility of smaller systematic inefficiencies or occasional large sporadic inefficiencies in some exchange markets cannot be ruled out, but neither has really strong presumptive evidence for their existence been presented either, especially if one exempts the early days of generalized floating as a transition period.

In my own judgment based both on the results of the empirical studies available so far and direct observation of the behavior of participants in the foreign-exchange market, private speculation has been reasonably well behaved under the current float. The market is certainly not always right, but it is not so easy to tell when it is wrong. Most of the charges of significant episodes of badly behaved speculation, I believe, have been based on oversimplified views of what should determine equilibrium exchange rates.

B. Forecasting Equilibrium Rates

Frequently such judgments are made on the basis of comparison with various types of Purchasing Power Parity calculations. There is little evidence to support the view that such calculations can present reasonable normative criteria for determining equilibrium exchange rates. At the simplest level, different price indices can yield widely different parity calculations. For example, calculations presented in Morgan Guaranty *World Financial Markets* showed a range of over 20 percent for the United States, 14 percent for the United Kingdom, 25 percent for Italy and over 40 percent for Japan.[26] And there is no one single theoretically correct price index to use for these purposes. More seriously from an analytical viewpoint proponents of PPP calculations as normative criteria must assume that short-run exchange-rate deviations from PPP will tend to be self-reversing.[27] Even apart from the problems of calculating trade competitiveness, we would expect PPP relationships to hold only if equilibrium trade or current accounts did not change over time and nonprice factors (such as income effects) did not have significant long-run influences on trade balances. Such factors are likely to have substantial quantitative importance at times, however. For example, one cannot explain the magnitude of the fall of the dollar that began toward the end of 1977 in terms of either past or reasonable expectations of future inflation differentials. (The direction, but not the magnitude, of the decline can be

[26]Morgan Guaranty Trust Company of New York, *World Financial Markets,* May 1978.

[27]Recent empirical work by Charles Pigott and Richard Sweeney suggests that there has not been a strong tendency for deviations from PPP to be self-revising during the current float. See Pigott and Sweeney, "Purchasing Power Parity and Exchange Rate Dynamics," Claremont Economic Discussion Papers, 1978. For recent discussions of PPP see the symposium in the *Journal of International Economics,* May 1978 and Lawrence H. Officer, "The Purchasing Power Parity Theory of Exchange Rates: A Review Article," I.M.F. *Staff Papers,* March 1976.

explained in terms of such expectations.) However, when one takes into account the effects of a lowering of expected growth rates abroad and increased pessimism about the outlook for reducing oil imports, and perceptions of increased riskiness of investing in the United States, then it becomes easy to explain a quite sizable drop in the dollar in terms of the change in the real exchange rate necessary to restore a current-account position which would be sustainable over the medium term, especially if one is not an elasticity optimist.[28]

Such shifts in expectations cannot be easily modeled, but I believe that they are often important in determining equilibrium exchange rates. The past history of balance-of-payments forecasting does not offer strong support for the view that official estimates of equilibrium exchange rates can be calculated with the degree of accuracy necessary to make either reference rates or target zones desirable as a general system at present. My beliefs in the importance of nonprice determinants of the balance of payments and of shifts in expectations which cannot be adequately proxied by mechanical methods make me doubtful that our forecasting technology can be improved sufficiently in the near future to make these approaches attractive.[29] I also believe, however, that it is important to push on as rapidly as possible with efforts to improve our technical capacity for balance-of-payments and exchange-rate analyses and forecasting and that such efforts should play an important, though informal, role in international surveillance discussions.

Returning to the issue of the behavior of speculation, the available evidence convinces me that beliefs that the market always tends to exaggerate movements in equilibrium exchange rates are themselves greatly exaggerated. Thus I am dubious that it would be a wise policy for national authorities to systematically follow leaning-against-the-wind intervention policies in hopes of keeping market-exchange rates more in line with equilibrium ones. On the other hand, I do not believe that the available evidence in support of beliefs that speculation is almost always well behaved is sufficiently strong that arguments against a relatively tight reserve-indicator system can be confidently rejected.

C. Externality Arguments for Intervention

The arguments against adopting a tight reserve-indicator system are reinforced when the second possible source of excessive exchange-rate variability

[28]See Thomas D. Willett, "Economic Fundamentals, Purchasing Power Parity, and the Decline of the Dollar," Claremont Economic Discussion Papers, 1978. For an interesting treatment of the effects of increased riskiness resulting from monetary expansion see Richard J. Sweeney "Risk, Inflation and Exchange Rates" presented at the Fall Academic Conference, Federal Reserve Bank of San Francisco, November, 1978.

[29]For examples of the huge errors which have been made in recent years in forecasts of trade and current-account balances, see Willett, *Floating Exchange Rates,* pp. 121-122 and 139-142. On the current state of the art in balance-of-payments and exchange-rate modeling and forecasting, see Jacques R. Artus, "Methods of Assessing the Long-Run Equilibrium Value of an Exchange Rate," *Journal of International Economics,* May 1978, pp. 277-299; Peter Isard, *Exchange-Rate Determination: A Survey of Popular Views and Recent Models,* (Princeton Studies in International Finance, no. 42, May 1978); Steven W. Kohlhagen, *The Behavior of Foreign Exchange Markets,* and Susan Schadler, "Sources of Exchange-Rate Variation."

is considered. This second possible source of excessive variability has only begun to be discussed explicitly in the last few years. It is the argument that even when speculation in the foreign-exchange market is itself fully efficient, exchange-rate variations may cause important domestic externalities which make the market equilibrium rate differ from the welfare maximizing rate. Often discussions of the costs of exchange-rate variability have not adequately recognized that these costs will vary depending upon the cause of the exchange-rate variations. Indeed, in many common circumstances exchange-rate variations are required in order to reduce both the uncertainty and resource distortion costs of disturbances.[30] Thus despite the frequency with which it is done, it is quite erroneous to treat the costs of floating exchange rates as a simple function of the amount of exchange-rate variability.

Such a treatment is usually the closest to being accurate, however, when the cause of the exchange-rate variability is badly behaved speculation. As Richard Sweeney and I have argued, most of the discussions of the various costs of exchange-rate variability assume (often implicitly) that the variability was "unnecessary," resulting from speculative inefficiencies which create disequilibrium exchange rates.[31] When exchange-rate variations are the result of efficient speculative responses to underlying economic conditions, most of the costs traditionally assumed to accompany exchange-rate variation disappear. In these conditions, what are commonly called the costs of the variability of equilibrium exchange rates are usually really the costs of the underlying conditions which cause exchange-rate variations. To suppress the symptoms by intervening to limit such exchange-rate variations would decrease rather than increase economic welfare unless externalities were present.

The explicit discussion of such possible externalities in the face of an efficiently functioning foreign-exchange market is still very much in its infancy, and treatments to date have been quite cryptic. So far discussions of such possible externalities have focused primarily on the effects of exchange-rate variations on domestic inflationary pressures and on the frictional cost of resource reallocation. Richard Cooper has argued that the welfare-maximizing exchange rate will generally show less variability than the monetary equilibrium rate because of the effects of such variations on unemployment. This would hold, he argues, "to the extent that labor can be dismissed and will remain unemployed because of downward stickiness in wages or because rational individual search behavior in a world of imperfect information leads to a period of frictional unemployment."[32] In other words, exchange-rate variations are likely to cause some at least temporary unemployment as resources are reallocated. As exchange-rate variations often will be reversed even in an efficient foreign-exchange market, there may be a case for systematically

[30]See, for example, Charles Pigott, Richard Sweeney, and Thomas D. Willett, "The Uncertainty Effects of Exchange Rate Variations," OASIA Research Discussion Paper, U.S. Treasury, 1976. A revision which treats the effects of exchange-rate variability on both uncertainty and distortions in price and exchange-rate signals will appear in Sweeney and Willett (eds.), *Studies in Exchange-Rate Flexibility*.

[31]See Sweeney and Willett, "Concepts of Speculation and Efficiency."

[32]Cooper, "I.M.F. Surveillance Over Exchange Rates," p. 72.

intervening to slow down exchange-rate variations, i.e., lean against the wind, to reduce reallocation costs even when private speculation in the foreign-exchange market is efficient.

The conditions when this will be so have not been well worked out, however. The problem is one of specific applications of the theory of the second best. When some markets do not behave fully efficiently, and this condition cannot be corrected directly, then there may be a second-best case for government intervention in other markets.[33]

At this level, the possibility that intervention may be desirable is not a useful guide to desirable government policy. This requires rigorous analysis of just what types of intervention policies would be called for in the face of various types of Pareto relevant externalities. In this regard, Cooper's analysis is quite helpful in terms of emphasizing the importance of such questions, but it falls far short of conclusively establishing the premise that leaning-against-the-wind intervention would usually be desirable.[34] For example, even if additional unemployment is generated by a free exchange rate, this cost would have to be balanced against the efficiency cost of distorting price signals which would arise from government intervention in an efficient exchange market.

While the price distortion costs of moderate leaning-against-the-wind intervention might not be great, the avoidable unemployment costs of exchange-rate variations may not be as large as many have argued either. Often scenarios are presented in which it is envisioned that large amounts of resources are wrenched back in the face of rapidly fluctuating exchange rates. But unless businessmen are extremely inept, they will recognize that where rates are highly variable, there is a great deal of uncertainty about what future rates will be, and will in consequence slow down the speed with which they reallocate resources. Even though the current rate reflects the best guess of future developments, this may be the mean of a very wide distribution of possible future outcomes. Where there are substantial reallocation costs, there will be incentives to private enterprise to slow down their adjustments to changes in prices or exchange rates in order to lower costs and increase profits.

The case for government intervention to slow the adjustment process must assume either that the private market systematically underestimates the likelihood that exchange-rate changes will be reversed, or that economic

[33] I am indebted to my colleague, Richard Sweeney, for suggesting that this question be analyzed as an example of the theory of the second best.

[34] I would also conclude that Grubel's attempt to justify systematically leaning against the wind in an efficient foreign-exchange market was not successful ("How Important is Control Over International Reserves"). Grubel bases his argument on the proposition that systematically leaning against the wind would reduce exchange-rate variance. He fails to consider, however, that whether economic welfare would be increased by reducing exchange-rate variability would depend on the causes of the variations. In his model, exchange-market inefficiencies have been ruled out and he does not consider externality arguments explicitly. Grubel also fails to consider the possible need of intervention to rebalance cumulative reserve changes resulting from leaning-against-the-wind intervention. If the need for such rebalancing is taken into account, then it is possible that attempts to lean against the wind could end it, increasing the range of exchange-rate variation because aggressive intervention may be required when one is at the end of the feasible range of reserve variations.

decision-makers are not faced with all of the relevant marginal costs of adjustment. On the first question, I don't think there is a strong a priori reason to suspect that economic decision-makers will on average tend to systematically over or underestimate the probability of exchange-rate reversals. On the second question, there is a presumption that businesses would not fully take into account the cost of resource reallocations on labor and the taxpayer who provides unemployment insurance payments. It is not clear to me how strong a case for systematic intervention such externalities present, however. This is a question which deserves a great deal more attention.[35]

The same holds for the conditions under which exchange-rate variations increase domestic inflationary pressures. Again, discussions frequently have not sufficiently recognized the extent to which the domestic inflationary effects of exchange-rate changes vary depending upon the cause of the exchange-rate change.[36] This has been particularly true of many of the popular discussions of the hypothesized vicious circle of exchange-rate depreciations and inflation.

An exchange-rate depreciation may generate negative externalities by putting additional pressures on monetary authorities through causing a worsening of the short-run inflation unemployment trade-off. As with the case of effects on resource allocation and unemployment, this is most likely to be true where the decline is caused by destabilizing speculation. On the other hand, in a neoclassical economy, with rational expectations, an exchange-rate depreciation resulting from expansionary macroeconomic policies will not be a source of additional inflationary pressures at all (at least in comparison with a closed economy benchmark).[37] Measured inflation can, of course, always be held down in the short run by, in effect, subsidizing imports through running down reserves. But if these reserve losses must eventually be recouped, then the major effect would be to transfer inflation to later periods.

In between the extremes of destabilizing speculation and depreciations in a completely rational expectations world, there are many complicated cases resulting from disturbances such as shifts in asset preferences and from the dynamics of price and exchange-rate markets in which all markets are not efficient. In particular circumstances, some episodes could justify official intervention even when speculation in the foreign-exchange market is efficient. Indeed, even in a world of rational expectations and complete *ex ante* efficiency in all markets, there may be cases in which official intervention would be justified. Suppose that a government is determined to launch a strong anti-inflation program after a history of past unsuccessful attempts. The market will quite rationally discount the probability that such policies will really be

[35]I am now working on the development of a more rigorous analysis of these questions in collaboration with Richard Sweeney and Edward Tower.

[36]See Willett, *Floating Exchange Rates,* pp. 57-68 and Charles Pigott, John Rutledge, and Thomas D. Willett, "Some Difficulties in Estimating the Inflationary Impact of Exchange-Rate Changes," Claremont Economic Discussion Papers, 1978 (presented at the June 1978 meetings of the Western Economic Association in Hawaii. A revision of this paper will appear in Sweeney and Willett (eds.), *Studies in Exchange-Rate Flexibility.*

[37]See Pigott, Rutledge, and Willett, "Some Difficulties."

carried through and this in turn will make it more difficult for the anti-inflationary policies to take effect. If the government is really determined to carry through, however, such "insider" information can make it a reasonable strategy for the government to bet on itself through exchange-market information as a way of slowing down inflation more quickly.[38]

While such considerations present a legitimate argument for official intervention, these arguments should be applied with caution. In practice, there is probably at least as great a danger of governments being overly optimistic, as of markets being overly pessimistic. And where expectations aren't formed rationally, the use of such intervention could increase the incentives to generate domestic business cycles for political advantage, the so-called political business cycle.[39]

Thus one should be cautious about assuming that government actions always have benign intentions, or that the government has superior foresight. For example, in a recent paper, Pentti Kouri and Jorge Braga de Macedo conclude that where long-term expectations do not have a stable anchor, "there is a presumption that 'efficient' speculation has macroeconomic costs."[40] The example on which they base their presumption, however, is one in which an anticipated monetary disturbance does not occur. They argue, "This mistake in speculation is compatible with 'efficiency' in the foreign exchange market but it imposes macroeconomic costs by forcing unnecessary adjustments in output and labor markets. Offsetting action by the central bank may thus be necessary."[41]

Whether offsetting actions should be attempted or not would have to depend on whether the government could reasonably be expected to have better expectations than the market. Kouri and de Macedo have assumed implicitly that the government can know ahead of time that the disturbance will not occur while an efficient market does not. As discussed above, there are circumstances in which government expectations may diverge from the market's and this may at times present a case for the desirability of official intervention. But the causes of divergent expectations need to be explained in more depth than in the Kouri-de Macedo analysis.

Furthermore, Kouri and de Macedo did not draw the correct logical conclusion from their example. They did show that there are cases in which the

[38]See, for example, Willett, *Floating Exchange Rates*, pp. 57-68.

[39]The incentives for the political business cycle result from the difference between the long-run and short-run inflationary effects of expansionary policies coupled with a high time rate of discount for governments concerned primarily with winning the next election. By reducing the initial inflationary effects of expansionary policies, official intervention to prop up exchange rates may thus increase the incentives for politically motivated manipulation of the economy. The basic article on this subject is William Nordhaus, "The Political Business Cycle," *Review of Economic Studies*, 1975.

For references to the growing literature on this subject, see Leroy Laney and Thomas D. Willett, "The Political Business Cycle and U.S. Monetary Expansion," Claremont Economic Discussion Papers (in preparation).

[40]Pentti J. K. Kouri and Jorge Braga de Macedo, "Exchange Rates and the International Adjustment Process," *Brookings Papers on Economic Activity*, no. 1, 1978, p. 149.

[41]*Ibid.*, p. 142.

free market can create additional macroeconomic costs ex post even when speculation is efficient ex ante. They did not establish that there is a general presumption that efficient private speculation creates additional macro costs in an unstable inflationary environment, however. To establish such a presumption, the whole range of significant types of possible disturbances would have to be considered. This is an important area for further research.

I hope that this brief discussion has been sufficient to illustrate the complexities involved in analyzing such questions. I do not believe that we have a good idea yet of how much intervention might be desirable in the face of efficient foreign-exchange markets. Recent work has established that there may be such cases, but the practical advisability of intervention strategies based on externality arguments needs much more consideration. A considerable amount of technical economic analysis remains to be done and the danger of abuse of such rationales by national governments must be recognized.

We can hardly expect national governments to stop taking policy actions until more economic research can be completed, but it would seem reasonable to attempt to make such rationales for intervention the subject of especially close attention in the international surveillance process. This is, in fact, already done to some degree because the funds for the official intervention accompanying domestic stabilization efforts are frequently made available through international stabilization loans in which the borrower often must convince the lender of the credibility of his intentions.

I would conclude that the complexities involved in the externality arguments for official intervention policies even when exchange-market speculation is efficient, further increase the case for a judgmental case-by-case approach to international surveillance as opposed to more formal exchange-rate or reserve norm approaches. We just do not have sufficient understanding yet of these issues to allow them to be incorporated adequately in the determination of formal exchange-rate or reserve indicators.

IV. Concluding Comments: Strengthening I.M.F. Surveillance

In this paper I have attempted to lay out a framework for evaluating the major alternative approaches to the international surveillance of exchange-rate policies and indicate briefly why I believe that the judgmental approach adopted in the new I.M.F. principles for surveillance represents the best strategy given our current knowledge about the major economic and political factors involved.[42] It is important to stress, however, that merely adopting the judgmental approach does not resolve the various technical complexities discussed above, nor does it ensure informal political cooperation.

If there is to be effective international surveillance of exchange-rate policies, the I.M.F. must play an important role in attempting to analyze the many

[42]These principles were adopted by a decision of the Executive Board of the I.M.F. on April 29, 1977. They appear in *Annual Report of the Executive Directors for the Fiscal Year Ended April 30, 1977* (Washington: International Monetary Fund), appendix II and are reprinted in Artus and Crockett, *Floating Exchange Rates and the Need for Surveillance,* and Willett, *Floating Exchange Rates.*

complexities of distinguishing between appropriate and inappropriate exchange-rate policies on a case-by-case basis. It must become a forum for international discussions of complaints about national exchange-rate policies and a leader in the exertion of moral suasion to secure the abandonment of policies which are judged to be seriously antisocial.

So far there is discouragingly little public evidence that the I.M.F. is beginning to play a substantially expanded role in the international surveillance process. It is hard for an outsider to judge accurately whether much progress is being made, for sometimes the most effective exertion of moral suasion is that which is kept the quietest. (Publicity may at times stiffen the backs of offenders and make it more difficult on domestic political grounds to appear to give in to foreign pressures.) I wish that there were more substantial external signs of progress, however. There are many unsettled issues concerning both economic analysis and political and administrative feasiblity which assure that we shall not quickly solve all of the questions concerning optimum surveillance, and it could discredit the whole process if the I.M.F. tried to push too quickly to enforce standards for which there is not reasonably widespread international acceptance, but if the I.M.F. does not move relatively swiftly to establish itself as a major forum for the discussion of the economic and political issues involved, it may miss an important opportunity for strengthening the international surveillance of exchange-rate policies and the adjustment process.

An important early step in this process should be the establishment of an extensive monitoring system which contains the latest available information on exchange-rate movements, official intervention, and reserve changes, and the many other types of policies which may influence exchange rates such as official borrowing from the international financial markets, controls and other measures which may influence private capital flows, etc.[43]

One of the most important issues in the implementation of surveillance will be the respective roles of the Managing Director and senior staff, the Executive Directors, and the successor to the Interim Committee within the I.M.F. framework and the interrelationships between these and the surveillance activities which take place through other organizations such as the OECD and the BIS and bilateral and the less structured multilateral forums such as the recent series of Economic Summits. Again this is an area where an initial detailed blueprint would not be sensible. These relationships will have to evolve gradually over time. But it is important that the progress be begun with all deliberate speed. In this regard, I would favor that the management of

[43]Obtaining needed data is not a trivial problem. Most countries have been much more reluctant than the United States to make public data on their intervention activities even with a considerable lag and even on the strictest confidential basis and most major central banks have been hesitant to make available to the Fund the kind of information on exchange-market developments and official intervention which they exchange among themselves on a daily basis. Since the major function of the Fund would be surveillance over the broad course of policies, access to such information on a current daily basis would not be necessary, but it is important that the Fund be given access to more intervention information on a regular basis than it currently receives (or at least than it received when I left the U.S. Government in August 1977).

the Fund be allowed substantial independence in exerting moral suasion concerning countries' exchange-rate policies.

It is clear that any formal reports or sanctions concerning the surveillance process should be the result of collective decisions of the representatives of national governments, but I believe that it would be useful to treat the Fund (i.e., its senior management) as an independent actor to a large extent in the early stages of surveillance investigations. Thus, for example, I think it might be well worthwhile for the Fund staff to begin to more formally estimate and update on a timely basis sets of reference rates or zones for a number of countries. To economize on scarce negotiating resources and to allow prompt adjustments, no attempt should be made to secure formal political agreement on the set of rates or their revisions. When any sizable amount of intervention contrary to the reference rate estimates takes place, however, discussions including both political and technical level representatives should be initiated on the reasonableness of the Fund staff's rate calculations and analysis of the national authorities in question. This will allow higher level attention to focus on the issues which appear to be most important.

Likewise, I believe it would be useful to begin to develop a presumption that national authorities should be called upon to justify cumulative net exchange market intervention which exceeds some order of magnitude and that the intensity of such discussions should increase as the size of the cumulative net intervention increases. Over time such discussions may lead to the development of widely accepted rules of thumb. In such ways I believe that elements of the reference rate and reserve indicator approaches could play an important role in the implementation of the judgmental approach.

There are a thousand and one more important questions concerning the implementation of I.M.F. surveillance. For example, should estimates of reference rates be made public and should this vary with the stage of surveillance? And should I.M.F. surveillance focus only on discouraging government actions which are impeding the efficient operation of the adjustment process or should it also to some extent attempt to encourage official intervention to offset the effects of poorly behaved private speculation? But this paper is already overly long. Adoption of the judgmental approach is just the beginning, not the end, of the search for the most effective operational principles and mechanisms for the international surveillance of exchange-rate policies.

Discussion

Jacob A. Frenkel*

In late April 1977 the Executive Board of the International Monetary Fund (IMF) approved the details of the second amendment to Article IV of the amended Articles of Agreement dealing with the principles and procedures for surveillance of exchange-rate policies. Willett's paper "Alternative Approaches to International Surveillance of Exchange Rate Policies" provides a comprehensive review and analysis of the various approaches that were suggested for the implementation of surveillance. Willett classifies the various approaches into five categories: (i) reserve indicators, (ii) target zones, (iii) reference rates, (iv) leaning against the wind and, (v) judgmental assessment or the case-history approach. After analyzing the principal arguments for and against each of the approaches, Willett concludes that he favors the Fund's decision to adopt the fifth approach according to which surveillance should be a judgmental matter based on a case-by-case study. My remarks deal with the general topic of surveillance and they are divided into four parts. The first contains comments on some of the approaches for surveillance; the second deals with some procedural and conceptual aspects of the principles which were adopted; the third discusses issues of implementation; and the fourth contains concluding remarks.

I. Comments on Approaches for Surveillance

I.1. International Reserves

One of the most popular approaches for surveillance views movement in international reserves as the indicator of the nature of national exchange-rate intervention policies. According to this indicator a decumulation of international reserves indicates that the country in question is intervening in the foreign exchange market in support of its currency. This approach, however, can be criticized on several grounds. In addition to the weaknesses pointed out by Willett, three are noteworthy. First, not all movements in international reserves reflect countries' attempts to manipulate exchange rates. Empirical studies on the demand for international reserves suggest that, even in the recent period of managed float, there is a relatively stable demand for international reserves. This would suggest that changes in the stock of reserves might

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just reflect the process by which individual countries attempt to attain their desired stock of reserves. It follows, therefore, that identifying changes in reserve holdings as the indicator for foreign-exchange intervention can be misleading if not coupled with an analysis of the patterns of countries' demand for international reserves. Therefore, implementing the reserve indicator approach requires a decomposition of reserve changes into those that are associated with attaining the equilibrium level of reserves and those which are not. This issue is similar to the one raised in the discussion concerning monetary indicators in the context of macroeconomic policies and the discussion concerning "free reserves" and "excess reserves" of the banking system.

A second difficulty concerns the formal definition of international reserves. The present definition does not include borrowing from the IMF, nor does it include agreements concerning various swap arrangements among central banks. In practice, countries may use these instruments to finance intervention in the market for foreign exchange that will not be reflected in changes in the official holdings of international reserves. The third difficulty involves the practice of foreign-exchange intervention. Central banks do not need to intervene directly since intervention can be carried out through intermediaries and through various agencies that operate on behalf of the central bank. Under these circumstances the extent of the intervention (including the indirect one) will not be reflected in changes of the official holdings of international reserves.

I.2. Target Zones, Reference Rates and Leaning Against the Wind

The common characteristic to the three approaches — target zones, reference rates and leaning against the wind — is a degree of skepticism with regard to the efficiency of the free market for foreign exchange. This skepticism may arise from doubts concerning the ability of the market to find the "equilibrium" exchange rate, or doubts concerning the ability of the market to move in the "correct" direction or at the "correct" speed without going through "unnecessary" and costly overshooting. I will return to these issues in Section II.

How much foreign-exchange intervention could be expected under the target zones or the reference rates approaches? The answer to this question depends on the efficiency of the market for foreign exchange. When the reference rates or the target zones are known in advance, it is very likely that private speculators would take positions whenever exchange rates move towards the region which would otherwise call for government intervention. These transactions would be undertaken by private speculators in anticipation of official intervention and, thereby, could render the intervention itself unnecessary. The degree to which private transactions reduce the need for government intervention to secure the target zone or the reference rate depends on the efficiency of the market in eliminating unexploited profit opportunities. The evidence concerning the efficiency of the foreign-exchange market suggests that a credible commitment to secure the target zone or the reference rate might yield the circumstances that require a relatively low degree of intervention.

II. The Principles of Surveillance

II.1. The Document

In evaluating the content of the document concerning the principles and procedures for the guidance of member countries with respect to exchange-rate policies and for the exercise of the IMF surveillance over those policies, it is important to recognize that the final text is the result of many iterations and of numerous earlier drafts. It replaces an earlier document on Guidelines for Management of Floating Exchange Rates (1974) which was modified through negotiations in various forums including the meetings of the Deputies of the Group of Ten, the Ministers of the Group of Ten, the Rambouillet summit and the Interim Committee in Jamaica. The final text represents therefore the ultimate political and legal compromises mainly between the interests and views of France and the United States. As a result, the language is occasionally vague and the precise operational meaning of some of the guidelines is left unclear.

The document starts with the general principle that "The Fund shall exercise firm surveillance over the exchange rate policies of members." A principal objective is "to assure orderly exchange arrangements and to promote a stable system of exchange rates." Along with the global international interest, the document recognizes that, to a large extent, economic policies are guided by national interests and thus

> These principles shall respect the domestic social and political policies of members, and in applying these principles the Fund shall pay due regard to the circumstances of members.

The Principles for the Guidance of Members' Exchange Rate Policies are also broad and somewhat vague.

> A member shall avoid manipulating exchange rates or the international monetary system in order to prevent effective balance of payments adjustment or to gain an unfair competitive advantage over other members.
> A member should intervene in the exchange market if necessary to counter disorderly conditions . . .
> Members should take into account in their intervention policies the interests of other members, including those of the countries in whose currencies they intervene.

These Principles attempt to express the notion that the Fund recognizes the potential conflict between national domestic interests and global international interests, but the resolution of this conflict is left unclear. For example, what is the definition of "an unfair competitive advantage"? What are "disorderly conditions"? How can a country determine that intervention is "necessary"? What is the operational meaning of "taking into acount" the "interests of other members"?

According to the Principles, the Fund determines that a country pursues policies that might be in violation of the Principles if there is

> (i) Protracted large-scale intervention in one direction in the exchange market; (ii) an unsustainable level of official or quasi-official borrowing, or excessive and prolonged short-term official or quasi-official lending, for balance of payments purposes; (iii) (a) the introduction, substantial intensification, or prolonged maintenance, for balance of payments purposes, of restrictions on, or incentives for, current transactions or payments, or (b) the introduction or substantial modification for balance of payments purposes of restrictions on, or incentives for, the inflow or outflow of capital; (iv) the pursuit, for balance of payments purposes, of monetary and other domestic financial policies that provide abnormal encouragement or discouragement to capital flows; and (v) behavior of the exchange rate that appears to be unrelated to underlying economic and financial conditions including factors affecting competitiveness and long-term capital movements.

In these Principles of Fund Surveillance some key concepts like large-scale, unsustainable, excessive, substantial intensification and the like remain undefined. Furthermore, by emphasizing countries' intentions, the Principles assign to the Fund the impossible task of identifying the motives which underlie the various policy choices and thus, the same set of policies may or may not be regarded as being in violation of the Principles depending on whether or not they are carried out "for balance of payments purposes." I turn now to a discussion of some conceptual issues related to surveillance.

II.2. Conceptual Aspects of Surveillance

The central conceptual issue can be phrased in the question "how can the Fund recognize a violation when one occurs?" Since countries are permitted to intervene to counter "disorderly conditions," one should specify in greater detail what these conditions are and what is meant by the concept of "intervention."

It is clear that "disorderly conditions" or "excessive fluctuations" or "overshooting" are all concepts which compare the actual path of exchange rates with the equilibrium path (or with the socially optimal path). Therefore, prior to implementing the surveillance principles there should be an agreement on the equilibrium path of the exchange rate or, equivalently, on the most appropriate model for the analysis of exchange-rate determination. At the present such a consensus (at least among academic economists) is clearly lacking. A related question is whether, in evaluating the path, one should look at the nominal exchange rate, the effective (trade-weighted) exchange rate, or the effective real exchange rate (effective exchange rate adjusted for inflation). As a matter of fact, the extent of fluctuations, and probably the implied inference concerning overshooting, may depend heavily on the definition of exchange rate. For example, at the present (October 4, 1978) the German mark/U.S. dollar exchange rate shows an appreciation of 47.9 percent since March 1973 while, during the same period, the effective German mark exchange rate rose by 32.3 percent and the effective real exchange rate appre-

ciated by only 2.2 percent (the above is based on inflation in wholesale prices of manufactured goods, excluding food; the Morgan Guaranty Trust Company of New York did the computation). This example illustrates the difficulties involved in justifying intervention on the basis of (poorly defined) characteristics of the path of exchange rates. It may also be noted in passing that the choice of the relevant definition of exchange rates is not trivial. Among the relevant questions would be the choice of weights in the construction of effective exchange rates. For example, in computing the effective exchange rate for the U.S. dollar, should the Canadian dollar receive the high weight that is implied by the large share of Canadian-U.S. trade? A second and somewhat deeper question involves the comparison of effective and bilateral exchange rates. Would those who emphasize the need for stability of the weighted exchange rate rather than the stability of bilateral rates also place less emphasis on the cost of fluctuations of individual relative prices as compared with fluctuations of the aggregate price level? These and other questions suggest that some further reflection might have been warranted.

Even if there could be an agreement concerning the choice of the model and the definition of the exchange rate, there still remains the question of whether large fluctuations justify government intervention in the foreign-exchange market. As an analytical matter, the mere fact that exchange rates have fluctuated can clearly not be used as the rationale for intervention. If the only problem was that of fluctuations, the optimal system would have been that of fixed exchange rates. To make the case for intervention one has to demonstrate that the market is either inefficient or that social and private costs differ. As an empirical matter there is overwhelming evidence that the foreign-exchange market is efficient in the sense that it does not seem to entail (ex ante) sure unexploited profit opportunities. Therefore, the case for intervention must rest on the supposition that social and private costs differ and thus that the free market yields sub-optimal outcomes from the social viewpoint. While such a possibility may not be ruled out on a priori grounds, the optimal policy should be directed at eliminating the source of the difference between social and private cost rather than taking the form of intervention in the market for foreign exchange.

The previous discussion concerning the necessity of evaluating the path of exchange rates relative to the prediction of the model, suggests that it would be useful to distinguish between anticipated and unanticipated fluctuations since the case for intervention may arise from the latter and not from the former. It also seems that if the source of the cost is lack of information that can be provided at a relatively low social cost, then the optimal policy should provide that information rather than intervene directly in the market. As a practical matter it would be very difficult to evaluate the benefits from intervention yielding increased stability of exchange rates without knowledge of the resulting increased fluctuations elsewhere in the economy. Putting the argument differently, there are two ways of dealing with socially costly fluctuations; the first involves interventions which reduce the extent of fluctuations and the second involves the provision of information which reduces the cost of given fluctuations by turning unanticipated changes in exchange rates

into anticipated ones. The design of optimal policies should consider the costs and benefits associated with alternative degrees of fluctuations rather than concentrating only on the extent to which exchange rates fluctuate without regard to alternative cost.

Whether or not intervention is warranted, the question that remains is how can the Fund determine if a country is "manipulating" its exchange rate? Put more generally, what is the definition of "exchange rate policies" and of "foreign exchange intervention"? These questions are of prime importance since they determine the scope of the Fund's surveillance. If exchange-rate policies are defined as all policies through which the authorities can affect exchange rates, then the domain of policies over which the Fund should exercise its surveillance consists of the entire range of macroeconomic policies including all fiscal and monetary policies which affect interest rates, the supply of money, credit, and the like. It is clear that no sovereign government would delegate such an authority of a meaningful surveillance to an external body. If, on the other hand, intervention is defined more narrowly, then the restrictions on policies that are imposed by the Principles for the Guidance of Members' Exchange Rate Policies and by the Principles of Fund Surveillance over Exchange Rate Policies could be easily evaded through the use of other indirect policies which are not covered by the Surveillance. I conclude that a successful surveillance seems doubtful. These issues are similar to those raised in connection with the principles of GATT concerning commercial protectionist policies. Since tariffs can be replicated by a combination of domestic excise taxes on and subsidies to production and consumption, it became clear that the principles of GATT could not be implemented unless they covered such aspects of excise taxes and subsidies.

In a sense the emphasis on surveillance over exchange-rate policies (in the narrower sense) might be somewhat counterproductive since it might convey the impression that exchange-rate policies can be discussed independent of the entire range of macroeconomic policies. One of the major advances of the theory of exchange rates in recent years has been the recognition that exchange rates and the balance of payments can not be viewed as an appendix to the entire system but rather that they are an integral part of it. Therefore, it is important that policy discussions incorporate this notion and recognize that an effective surveillance over exchange-rate policies must mean surveillance over the entire spectrum of macroeconomic policies.

III. The Implementation of Surveillance

The text of the statement on Surveillance over Exchange Rate Policies states that if the Managing Director considers a country to be in a possible violation of the Principles,

> he shall raise the matter informally and confidentially with the member, and shall conclude promptly whether there is a question of the observance of the principles. If he concludes that there is such a question, he shall initiate and conduct on a confidential basis a discussion with the

> member under Article IV, Section 3(b). As soon as possible after the completion of such a discussion, and in any event not later than four months after its initiation, the Managing Director shall report to the Executive Board on the results of the discussion.

The question that is not discussed in great detail concerns the means by which the Fund can deal effectively with violations. It seems that the Fund might be able to deal effectively with deficit countries who need to rely on it for borrowing. Among the deficit countries the Fund might have even greater power in dealing with less-developed countries than with developed countries since the latter group has some access to alternative world commercial capital markets. It is less likely that the Fund will have great enforcement powers in dealing with lenders and with surplus countries. Experience suggests that the instrument of "moral persuasion" cannot be relied upon and that international cooperation can be productive only in the absence of conflicts of interest. It is noteworthy that a similar asymmetry between deficit and surplus countries was also a characteristic of the Bretton Woods system in which the burden of adjustment fell mainly on the deficit countries. A question, however, is whether this allocation of the burden of adjustment is optimal from the global viewpoint.

The distinction between deficit and surplus countries and between developed and less-developed countries is not reflected in the principles of surveillance "which apply to all members whatever their exchange arrangements and whatever their balance of payments position." Since the needs for, and the optimal degree of intervention may differ from country to country, it would have been useful to recognize that there is an intimate connection between each country's optimal degree of managed floating and the principles of surveillance that are most appropriate for that country. Among the considerations relevant for the determination of the specific set of surveillance principles would be the degree of capital mobility, the extent of diversification of production, the degree of trade dependence, the degree of policy harmonization, the degree of similarities of preferences concerning the "desired" or the "tolerable" rate of inflation, the dependence of domestic shocks, and other arguments that are relevant for the determination of each country's optimal degree of exchange-rate flexibility. The fundamental lack of symmetry in the world economy suggests that a homogeneous set of surveillance principles may not be the most appropriate one. This could have provided the ultimate justification for the decision that surveillance is being viewed as a judgmental matter which is implemented by adopting a case-by-case approach.

In specifying the policies that member countries are required to undertake, the principles determine that countries should intervene to counter disorderly conditions. As a practical matter the question is whether the authorities of each member country can be relied upon to recognize the occasions which call for intervention and to implement the intervention policies in a way which increases stability rather than contributes to instability. The track records of central banks' intervention policies have not been too promising. It seems that for most of the major central banks interventions in the foreign-

exchange markets entailed losses which indicate that in many cases the policies of intervention did not contribute to increased stability.

IV. Concluding Remarks

In analyzing the issues concerning surveillance over exchange-rate policies it is important to note that the final draft of the amendments is the outcome of a compromise among diverse views. In particular it represents a compromise between the French who desired to return to a system with greater fixity of exchange rates and the Americans who wished to maintain flexibility. As a result important issues have been left somewhat vague and only time will show what the practical content and interpretation of the various principles are. In this context it is interesting to quote from Mr. de Larosiere's speech at the IMF-World Bank meeting (September 1978). In his first speech as managing director, Mr. de Larosiere said that there is a pressing need to eliminate the differences in the rate of economic growth and inflation among industrial countries. He argued that only if divergent growth and inflation rates are brought into line, can greater stability be achieved in foreign-exchange markets. It is noteworthy that the elimination of divergent growth and inflation rates creates precisely the circumstances which are essential for the smooth operation of a system of fixed-exchange rates.

The analysis of surveillance in the above pages did not deal with a potentially important development which might make the whole surveillance issue obsolete. Current discussion among the European leaders might lead to the formation of a new European Monetary System, the creation of which would probably change the entire set of rules of the game. It might lead to a creation of a European Monetary Fund (EMF) which might also wish to have some power of surveillance. Under those circumstances many new questions would have to be answered; for example, should Germany accept the authority and follow the advice of the IMF surveillance or of the EMF surveillance? Since such developments are not entirely unlikely, it would have been useful for the IMF to consider them prior to the development of the detailed bureaucratic machinery needed for the implementation of the principles of surveillance.

In the last several years, the issue of IMF surveillance has been subjected to many critiques and praise. To gain perspective it is noteworthy that similar discussion took place during the shaping of the final drafts of the documents which laid the foundations for the Bretton Woods system. In conclusion, it is instructive to recall John Maynard Keynes' remarks in his closing speech to the Bretton Woods Conference:

> I am greatly encouraged, I confess, by the critical, skeptical and even carping spirit in which our proceedings have been watched and welcomed in the outside world. How much better that our projects should *begin* in disillusion than that they should *end* in it.

Discussion

Jacques R. Artus*

The paper by Thomas Willett provides us with a fairly extensive review of the possible approaches to exchange-rate surveillance and a conclusion that the judgmental case-by-case approach is the one most suited to present circumstances. I broadly agree with this conclusion, and, rather than discussing minor aspects of his argumentation, I would like to use the few minutes allocated to me to consider some of the problems that will have to be faced in implementing such an approach. After all the judgmental case-by-case approach has now been officially chosen by the international community. So where do we go from there?

Two main problems arise in the implementation of surveillance. The first problem results from the fact that there is no broad consensus concerning the appropriate role of the exchange rate. There are basically two views. The first view — the free market view — is that the exchange rate is an endogenous variable that is not, cannot be, and should not be under the control of the authorities, and whose main role is to keep external transactions in balance. The second view — the interventionist view — is that the exchange rate is the proximate determinant of the domestic price level, and, therefore, that, one way or another, the authorities must keep the exchange rate under control. Advocates of the free-market view do not argue that the exchange rate has no effect on the domestic price level; they only point out that normally both the exchange rate and the domestic price level are jointly determined by the monetary and fiscal policies of the authorities — policies that should not be influenced by exchange-rate developments per se. Advocates of the interventionist view do not deny that the exchange rate influences external transactions; they are only less hesitant to advocate the use of official compensatory borrowings, capital controls, liquidity squeezes, and other such means to relax the external constraints in the short run while relying on "structural adjustments" to take care of them in the longer run.

The April 1977 decision that specifies how surveillance is to be implemented does not take the side of either of the two views; it only outlaws the most radical versions of these views. Countries cannot follow a benign neglect policy; they must intervene to counter disorderly market conditions. They cannot either control the exchange rate to the extent of preventing effective

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The views expressed here are the author's; they are not to be interpreted as indicating the position of the Executive Board or of the officials of the Fund.

balance-of-payments adjustment. In practice, it may, however, be difficult to decide when intervention is warranted. Of course, some cases are cut and dried. A deliberate attempt by a country to depreciate its exchange rate to increase an already large trade-balance surplus so as to export unemployment, for example, would not raise any issue. Those cases, however, do not seem prevalent at present. In most of the cases that do occur, it is difficult to decide where the freedom of a country to follow either view stops, and where the violation of the obligations not to hinder the working of the external adjustment process and to avoid disorderly market conditions begins. Take a prevalent case — the one of a country that resists a depreciation of its exchange rate because it considers that this would be inflationary. It is understood that such a policy would be appropriate only if the domestic policies of the country were such that the prevailing exchange rate is not inconsistent with the maintenance of external balance in the longer run. The problem is that as long as the external position of a country is not absolutely untenable, it may well find supporters among countries that tend to follow the interventionist view by pleading the need to fight inflation; and once it has become absolutely untenable, who needs surveillance?

The second problem is that, while surveillance takes into account the overall policy stand of the country, the focus is mainly on its exchange-rate policies. In the case of most countries, this makes sense because a wrong exchange-rate policy — for example, too much or too little intervention in the foreign-exchange market, or too much or too little use of official compensatory borrowings — can cause a great deal of harm to the country in question or to its trading partners. In the case of the largest industrial countries, the United States, the Federal Republic of Germany, and Japan, in particular, one may doubt, however, that the authorities can significantly influence their exchange rate other than in the short term by having recourse to intervention in the foreign-exchange market or to other similar measures. The reason is simply that private capital transactions are potentially so large that they can always swamp official transactions. If the authorities cannot affect their exchange rates by using such measures, they can hardly be blamed for using them or not using them. This, of course, does not mean that the authorities cannot be held responsible for what is happening to their exchange rates, it only means that they are responsible only because their exchange rates reflect their domestic policies. If the international community is unhappy about what happens to the U.S. dollar, the deutsche mark, or the yen, then it should logically be unhappy about the domestic policies of the United States, of the Federal Republic of Germany, or of Japan. Surveillance over domestic policies is what is involved, rather than surveillance over exchange-rate policies. It is obvious, however, that countries are not all enthusiastic about seeing their domestic policies subjected to surveillance by the international community. So that here again it will not be easy to implement firm surveillance so as to bring about more orderly exchange-market developments.

The problems involved in implementing exchange-rate surveillance are considerable, but there is also little doubt that the need for it is great. The

breakdown of the Bretton Woods system has given much influence to market forces and much freedom to national authorities as far as exchange-rate policies are concerned. The risks of destabilizing speculation and of exchange-rate manipulations by national authorities have led the international community to agree on a surveillance mechanism. It is to be hoped that the pressure of the events will now give to national authorities the will to give substance to that agreement. Progress in that direction will require that some form of consensus be reached on the issue of the proper role of the exchange rate. It will also require that dominant countries be willing, if only to a limited extent, to see their domestic policies examined by the international community.

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