OCCASIONAL PAPER
28

Exchange Rate Volatility and World Trade

A Study by the Research Department of the International Monetary Fund

Prepared in Response to a Request from the Director-General of the General Agreement on Tariffs and Trade

International Monetary Fund
Washington, D.C.
July 1984

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CHARTS

The following symbols have been used throughout this paper:

... to indicate that data are not available;

— to indicate that the figure is zero or less than half the final digit shown, or that the item does not exist;

– between years or months (e.g., 1979–81 or January–June) to indicate the years or months covered, including the beginning and ending years or months;

/ between years (e.g., 1980/81) to indicate a crop or fiscal (financial) year.

"Billion" means a thousand million.

Minor discrepancies between constituent figures and totals are due to rounding.

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Prefatory Note

This study was prepared in the Research Department of the International Monetary Fund, in consultation with the Exchange and Trade Relations Department. The study was prepared in response to a request from the Director-General of the General Agreement on Tariffs and Trade, and in its preparation the Fund staff benefited from consultations with the staff of that organization.

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I Introduction

In view of the continuation of substantial movements in exchange rate relationships among major currencies, the recent increase in protectionist pressures, and the disappointing performance of world trade, renewed concern has been expressed about the possible adverse effects of exchange rate variability on trade. Against the background of this concern, the following decision was reached at the ministerial meeting of the General Agreement on Tariffs and Trade (GATT) in November 1982.

> THE CONTRACTING PARTIES DECIDE:
>
> To request the Director-General to consult the Managing Director of the International Monetary Fund on the possibility of a study of the effects of erratic fluctuations in exchange rates on international trade, to report to the Council on the results of these consultations and to forward any such study to the Council so that it may consider any implications for the General Agreement.

This paper has been prepared in response to the above decision, and in consultation with the Director-General and officials of the GATT. It is worth noting that concern over the recent functioning of the exchange rate regime goes beyond those officials concerned primarily with trade issues. Early in 1983, U.S. Secretary of State George Shultz (1983, p. 379), noting that the Japanese yen/U.S. dollar rate had moved down by 20 percent and then back up again by the same amount over a seven-month period in 1982, stated that "the problem [of excessive exchange rate volatility] warrants close study by the major currency countries." Alexandre Lamfalussy (1983, p. 2), Economic Adviser to the Bank for International Settlements, says: "It is hard to imagine that the volatility of such a key price as the exchange rate could have anything other than an adverse influence on economic decision-making . . . . [It] creates a climate of uncertainty which is bound to have an adverse impact on decisions concerning investment, production and trade." Akio Morita (1983, p. 3), Chairman of Sony Corporation of Japan, expresses the view: "If the value of currency fluctuates widely for various reasons entirely unrelated to the business involved, then it would not be difficult to understand that normal economic activity suffers as a result." And the former Governor of the Bank of England, Lord Richardson (1983, p. 198), says that "one must suspect that [exchange] markets have displayed a persistent tendency to overshoot, and have produced greater volatility than justified by underlying conditions."

These concerns have been heightened by the recent weakness of world trade. The volume of world trade, which had grown at an annual average rate of 8½ percent during the period 1963–72, increased by only 6 percent per annum during the remainder of the 1970s, and was stagnant, on balance, during 1980–82. While a number of factors have contributed to this development, as discussed in more detail below, the coexistence of trade weakness and exchange rate instability has naturally prompted questions about the possibility of a causal link.

The objective of this paper is to review, analyze, and, where possible, present evidence concerning the implications of exchange rate variability for international trade. It adopts a deliberately broad definition of "erratic exchange rate fluctuations," and of the consequences that are relevant for trade flows. The aim is to deal with as many as possible of the potential costs and uncertainties for producers and traders that arise from reversible movements in exchange rates. All reversible movements will be considered, whether or not the reversal takes place within a short time span, and whether or not the movement can be "explained" with reference to financial market factors such as shifts in interest rate differentials. Indirect as well as direct consequences of exchange rate variability will be discussed. The paper will, therefore, consider not only direct effects of exchange rate fluctuations on the level and pattern of international trade but also their effects on domestic production and investment decisions, their implications for inflation, and the constraints they place on governments' ability to pursue domestic economic objectives.

Given the breadth of the subject, it is necessary to place certain limitations on the scope of the paper. First, it will be concerned with the implications of fluctuations in exchange rates rather than with levels. The judgment of what constitutes an appropriate exchange rate level, and what are the trade implications of indefinite maintenance of an inappropriate level, lies beyond the purview of this paper. Of course, some of the adverse effects of exchange rate volatility arise from a sequence of inappropriate levels—as when resources have to be shifted in and out of the foreign trade sector in response to shifting incentives. Thus a hard-and-fast distinction between the

consequences of fluctuations in exchange rates and inappropriate levels is not really sustainable. When an exchange rate movement is reversed only after a considerable period (something that is considered here as a long-term fluctuation and thus within the scope of the paper), any perceived misalignment during the intervening period may well appear to observers as a problem of the exchange rate level (Williamson, 1983).

Second, the paper does not venture into an accounting of the welfare costs and benefits of international trade. It is generally assumed that a reduction in the level of trade tends to reduce welfare. While this is true, broadly speaking, the welfare implications are hard to measure and not always clear cut (Lanyi, 1969). In some circumstances, an increase in trade can imply substantial welfare benefits, whereas in others, the benefits may be offset by distortions in the pattern of trade. The paper will attempt to point out some of the considerations that need to be taken into account in judging the gains and losses from changing levels and patterns of trade but does not go into formal measurement.

Third, the paper does not attempt to compare one exchange rate system with another (e.g., fixed vs. floating rates). The objective is rather to assess the implications of exchange rate variability for trade whatever the formal system that is in existence for establishing nominal exchange rates. Exchange rate variability is only one dimension of instability or uncertainty, and changes in it may be associated with offsetting (or compounding) changes in other factors.

Fourth, the paper deals largely with exchange rate variability among the major industrial countries. While it is true that the exchange rates of other countries, particularly developing countries, exhibit considerable movement over time, it is the degree of movement among the major currencies that constitutes the exchange rate "environment" within which other countries have to plan their policies. The implications of this "environment" for developing countries are discussed and analyzed in the sections that follow; but the additional variability resulting from the actions of countries outside the major seven is not explicitly considered.

Last, the paper does not discuss whether policies are needed to achieve greater exchange rate stability and if so what those policies should be. The considerations to be taken into account in managing the evolution of the international monetary system go beyond its implications for trade flows, although this is important.

Section II of the paper provides a comprehensive summary of the mechanisms by which exchange rate variability could be expected to influence trade flows. It attempts to cover the main concerns that have been raised about the possible adverse consequences of exchange rate variability, and to identify the kinds of evidence that might be relevant in assessing them. Section III is concerned with the quantitative measurement of exchange rate variability. Measurement involves a number of quite difficult conceptual issues, on which no final agreement is possible, since economic agents are in different situations, and the kinds of instability that matter to them vary. After a discussion of the conceptual issues, this section turns to an analysis of the evidence on variability over the past two decades, using a variety of definitions.

Section IV discusses evidence on the direct effects of exchange rate variability on trade flows. Existing theoretical and empirical work is reviewed, and in some cases updated. In addition, the results of survey work are reported. Section V deals with the indirect impact of exchange rate variability on trade, through its effect on the pattern of output and investment. Among the subjects included in this section are differential impacts on traded versus nontraded goods industries; consequences for small versus large firms; and impacts on competition and industrial concentration. Section VI assesses the effects of exchange rate fluctuations on the economic environment in which firms operate. The issue here is whether exchange rate fluctuations worsen the trade-off between unemployment and inflation, or otherwise complicate the process of formulating macroeconomic policy and controlling inflation. Another important issue that is dealt with in this section is whether exchange rate volatility leads to greater pressures for protection.

Section VII attempts to put the preceding discussion in perspective by analyzing the significance of the findings that have been reached. It discusses some of the reasons why exchange rates might have been so variable over the past ten years, and the economic functions that exchange rates perform, over and beyond their task of providing appropriate signals for international trade flows. Section VIII of the paper is intended to be a self-contained synopsis of the analysis and conclusions of the main text.

A number of appendices present statistical series on exchange rate variability and describe the empirical tests that are reported more briefly in the main text.

II Overview of the Issues

Fluctuations in exchange rates can affect international trade in a number of ways. They may increase the costs and uncertainties of trade, inducing economic agents to directly reduce their international transactions. More indirectly, they may induce producers and traders to alter the structure of their output and investment, in order to reduce their exposure to risk. This, in turn, can have implications over the long run for trade flows. Going beyond the impact of exchange rate fluctuations on the behavior of economic agents, they can also affect governments' policy formation by changing the policy trade-offs faced by governments or by increasing pressure on the government to counteract their perceived ill effects.

Uncertainty Costs

It is an accepted proposition in economics that economic agents are, in general, risk averse, so that greater risks either get built into prices or reduce quantities supplied and demanded at a given price. If the only source of uncertainty in international trade related to the exchange rate, it would probably be undeniable that greater variability in exchange rates inhibited trade (Clark, 1973; Hooper and Kohlhagen, 1978). There are, however, many forms of uncertainty to which economic agents are exposed, and it is not necessarily the case that exchange rate variability is independent of the others (Friedman, 1953). To take only the most obvious example, if exchange rates move to offset divergences in underlying inflation rates, the uncertainties facing traders might be less than in a situation where inflation rates continued to diverge but exchange rates remained constant (Pigott, Sweeney, and Willett, 1975). Similarly, where balance of payments pressures have previously been dealt with by changes in trade restrictions, acceptance of greater rate movements may simply substitute price uncertainty for the previous equally important uncertainties about administrative restraints on trade (Johnson, 1969).

Empirical testing of the effect of exchange rate variability would ideally seek a measure of the net additional uncertainty introduced by exchange rate variability in any period. In the absence of such a measure, the only available approach, and the one adopted by virtually all researchers in the field, is to use observed exchange rate variability as a measure of uncertainty. If no adverse consequences for trade are detected, the conclusion is either that the uncertainty costs are small or that they have been systematically offset by countervailing changes in other elements of uncertainty. It cannot be stressed too strongly, however, that the difficulty of separating out the effects of exchange rate uncertainty from those of other and related features of the economic environment implies that considerable caution should be employed in interpreting empirical results, whether the results are positive or negative.

There remains the question of what measure of variability best approximates the uncertainty faced by participants in international trade. As discussed in more detail in Section III below, there is no clear-cut answer to this. Some trade has a very short-term time horizon, and is conducted on an essentially fixed price basis. In such cases, traders are concerned with the short-term variability of a bilateral nominal rate. Other forms of trade involve producing for worldwide markets that are expected to absorb sales over an extended period. In these cases, the producer is concerned with stability in the relationship between his production costs and sales proceeds in the average of all his foreign markets; the most relevant variability measure would be long-term fluctuations in the real effective exchange rate.

Adjustment Costs

In addition to increasing costs through uncertainty, exchange rate fluctuations may require costly shifts of resources between economic activities in response to changing price incentives (Kreinin and Heller, 1974). As the exchange rate for a given currency moves down, a wider range of products becomes profitable to produce and export. For currencies that are strengthening, the size of the foreign trade sector tends to shrink correspondingly. Thus traders may be induced in favorable times to develop foreign markets, and even to install production capacity that turns out to be unprofitable when exchange rates move in the opposite direction.

This effect was reviewed in the Fund's Annual Report for 1982 (p. 45):

> Although little direct evidence is currently available on the costs of such swings in resource allocation, it seems likely that they have contributed to uncertainty about the profitability of various industries and may thereby have inhibited fixed capital formation, particularly in countries with a large foreign trade sector. In addition, because goods and labor markets are far from being perfectly efficient, such swings can contribute to wasteful investment and to unemployment.

The kinds of exchange rate fluctuations that give rise to adjustment costs are likely to be those that persist for a protracted period. Investment and production decisions are rarely changed in response to short-term fluctuations in profitability, nor will such short-term fluctuations affect the viability of firms or industries (Williamson, 1983). Indeed, as McKinnon (1978) points out, the fact that exchange rates have become more variable may well reduce the responsiveness of resource allocation decisions to relative price changes, at least in the short term. Economic agents may be reluctant to change existing patterns of resource use and trade flows until they are persuaded that a given exchange rate change will not soon be reversed. It is more likely to be relatively long-lasting departures from exchange rate trends that cause decisions to be taken which, in a more stable environment, would not have been made.

Quantitative assessment of adjustment costs is particularly difficult. They may not show up in a reduction in the volume of trade relative to output since the ebb and flow of trade shares among countries may be offsetting in an aggregate sense. To the extent that adjustment costs do have an adverse effect on trade flows, this may work through reducing levels of output and investment and creating higher levels of frictional unemployment. Since such an effect would not alter the relationship between trade and its other determinants, there would not necessarily be any residual effect to be explained by exchange rate factors.

Some broad indication of the degree of adjustment that is taking place in the external sector is provided by developments in current account positions. Section V, below, therefore presents some evidence on the extent to which greater fluctuations in exchange rates have been associated with greater shifts of real resources into and out of the foreign trade sector.

International Investment

As well as influencing patterns of trade, exchange rate variability can have an impact on the pattern of international investment. A multinational firm, in deciding where to locate new investment, has to take into account not only technical factors affecting cost but also the uncertainties of currency relationships. This may lead to a diversification of investment, even at some cost in terms of efficiency, in order to minimize risks stemming from currency instability. As a result, instead of production facilities being concentrated in the lowest-cost location, they may be located in a number of different currency areas.

While this kind of diversification may appear to be in response to exchange rate uncertainty, in the majority of cases it is more likely to be the prospective level of the rate, rather than its variability, that causes the uncertainty. When a company decides to invest abroad to diversify its exchange rate risk, the risk it is likely to be most concerned about is the level around which the exchange rate is likely to fluctuate rather than the size of month-to-month or quarter-to-quarter fluctuations that cancel out over time. Such a company will also be more concerned with exchange rate movements that affect the relationship between its cost of production and its sales return rather than just the nominal value of one currency in terms of another. For example, a company could prefer to invest in a country that had a well-established mechanism for adjusting its exchange rate, to ensure that domestic costs and prices did not get too far out of line with those abroad,rather than in a country where nominal exchange rate variability was less but exchange rate "stickiness" resulted in more uncertainty about real rates and hence profitability.

Structure of Output

While the potential adverse effects of exchange rate variability are most apparent for producers and traders directly involved in international transactions, they can be important also for suppliers in their domestic markets. If foreign producers have a significant share of a given market, an improvement in their competitiveness may require domestic producers to cut their profit margins or face an erosion of their market share. Hieronymi (1983) suggests that a more erratic behavior of relative prices, engendered or reinforced by exchange rate movements, has shortened the time horizon of decision makers, made long-term commitments less attractive, and had a dampening or delaying effect on investment decisions.

To the extent that relative price uncertainty is a major factor in decisions on resource allocation, it would be expected to also result in a gradual switch in investment and output away from traded goods industries (which are more exposed to such uncertainty stemming from exchange rate variability) and toward nontraded goods in the service and other sectors. If, as seems plausible, the capital/labor ratio is generally higher in manufacturing and traded goods industries than in the nontraded goods sector, such a shift in industrial structure could also result in lowering the total level of investment. If, as is also sometimes alleged, technological advances tend to

be more rapid in manufacturing than in services, this factor would compound the influence of lower investment in reducing potential growth rates. These and other issues are investigated further in Section V, below.

Large vs. Small Firms

It is sometimes argued that excessive exchange rate variability tends to have a more serious effect on small firms than on large firms, and thus tends, over time, to promote an undesirable degree of industrial concentration. There are several channels by which this effect could come about. Since foreign exchange risk management involves fixed costs, in terms of management time, these weigh more heavily on smaller enterprises. It is also likely that larger enterprises have a more diversified product and market structure than smaller ones, and have more "natural" protection against swings in exchange rates. This is particularly true for multinational enterprises (Aliber, 1983), whose production sources, as well as markets, are in several countries whose currencies move independently. Last, it is argued that larger firms have greater financial resources, and are thus better able to withstand a period of weak profitability due to an adverse movement in exchange rates.

If, for these reasons, larger firms tend to acquire a competitive advantage vis-à-vis smaller firms during periods of exchange rate volatility, this could affect trade in several ways. A reduced role for smaller firms could inhibit innovation, which is sometimes considered to be stronger in smaller enterprises, while more concentration would tend to reduce competition.

It is perhaps unlikely that these effects could be detected among all the other influences on trade and productivity. Whether there is a measurable effect at all depends on the initial premise that rate variability works against the interests of smaller enterprises. Very short-term movements in rates need not impose uncertainty costs, since hedging through the forward market is an option that is available to all. Considering longer periods, for which effective hedging in the forward market is not an option, the issue is whether small firms are less able to survive periods in which exchange rates have an adverse effect on profitability. The kind of evidence that would be relevant, although not conclusive, in this connection is whether the survival rate of small firms, relative to large firms, has changed significantly during the period of exchange rate volatility.

Competition and Concentration of Output

For similar reasons that exchange rate variability could favor large firms over small ones, it could also favor relatively efficient producers over less efficient ones. In broad terms, of course, this is desirable, and indeed is the mechanism by which economic resources are redirected over time to their most appropriate uses. But if it leads to an undue concentration of production, in particular firms or countries, it could, over the longer term, have adverse effects on the level of competition and on the stimulus to innovation and productivity.

It may be, for example, that when a particular country's exchange rate is low relative to trend it makes such inroads into export markets that local producers in these markets lose economies of scale and are forced to cease, or severely curtail, production. (It is sometimes alleged that this has tended to happen to European producers of consumer electronic goods in the face of Japanese competition.) Then, when the exchange rate moves back again, the exporter may have a sufficiently strong market position to maintain his export share, despite a loss of competitiveness. Over time, this could lead to a pattern of international trade in which countries become increasingly specialized in particular products and industries. This would actually lead to more trade (relative to production), but the advantages of such added specialization could be outweighed by a reduction in effective competition, and also by the fact that adjustments to changes in trade flows resulting from exogenous developments would become more difficult.

Such a tendency could be examined by reviewing data on the commodity composition of trade to ascertain whether there had been an observable increase in concentration. Among all the other factors that affect the commodity composition of countries' foreign trade, however, it seems unlikely that exchange rate variability could easily be distinguished as a separate causal element.

Inflation

It has been argued that greater variability of exchange rates may itself be an independent cause of inflationary pressures (Wanniski, 1975). The basic mechanism at work depends on price increases resulting from exchange rate depreciation having a larger or more lasting impact than reductions that occur when the exchange rate appreciates (Mundell, 1976). This can occur for a variety of reasons: because price setters respond more rapidly to developments that tend to erode their incomes than to those that increase them; because there is downward rigidity in prices, so that a ratchet effect operates on the price level; and because it is easier for price setters to put through an increase in real prices when there is an external circumstance (e.g., a declining exchange rate) on which to place the blame. It could also be the case that monetary authorities are more willing or able to resist exchange rate appreciation through exchange market in-

tervention than to undertake the corresponding action to resist depreciation. If this were so, intervention, to the extent that it was not sterilized, would tend to increase the global stock of money. Countries with appreciating rates would tend to acquire foreign exchange and thus to provide in return domestic currency which would form part of the money supply. Countries whose exchange rates are depreciating, on the other hand, might be less willing to squeeze domestic liquidity through unsterilized intervention.

Such a relationship between exchange rate variability and inflation would influence trade both because a higher average rate of inflation would increase uncertainty, and thus tend to lower output, and because the policies adopted by the authorities to counteract inflation would themselves be likely to curtail demand. The kind of empirical evidence that would be relevant to this question would involve a comparison of countries' inflationary experiences with the degree of variability in their exchange rates. More indirectly, the speed with which the domestic price level responds to increases/decreases in import prices would provide evidence regarding the existence of a ratchet effect.

Macroeconomic Policy

Beyond their impact on inflation, exchange rate movements can have implications for other objectives of macroeconomic policy, and for the effectiveness of the various policy instruments used to achieve them. To the extent that exchange rate variability interferes with or complicates the authorities' task in stabilizing the domestic economy, it would tend to worsen the conditions for optimal trade growth. Of course, the opposite also applies: if the freedom of exchange rates to move frees other policy instruments for the pursuit of stabilization goals, it can promote trade growth. This, indeed, was one of the principal arguments advanced for flexible exchange rates during the fixed rate period (Friedman, 1953; Johnson, 1969).

A distinction should be drawn between exchange rate flexibility and exchange rate variability. The fact that exchange rates are free to move may provide a shock-absorbing capacity to the system that helps permit national authorities to focus on domestic economic priorities, despite external disturbances. However, if exchange rates actually do vary substantially and unpredictably, this may be a source of uncertainty that the authorities need to counteract through diverting other policy instruments to the task of exchange rate stabilization.

Perhaps the most serious difficulty that exchange rate variability presents for macroeconomic policy is its potential to generate a "vicious circle" of exchange rate depreciation (Bilson, 1979). The "vicious circle" hypothesis holds that an exogenous exchange rate depreciation will cause the country that suffers it to experience an increase in domestic inflation and a deterioration in its balance of payments (since terms of trade effects will dominate volume of trade effects in the short run). These two factors have adverse effects on exchange rate expectations, bringing about a further depreciation of the exchange rate and a renewed twist to the vicious circle. For countries undergoing an initial exchange rate appreciation, a "virtuous circle" of price stability, balance of payments strength, and exchange rate appreciation sets in. These divergent trends, it is sometimes alleged, are encouraged by, and in turn help to perpetuate, exchange rate variability. They complicate the task of restoring and maintaining stability in individual national economies, and can create strains in the operation of the international adjustment process.

Protectionism

One of the most serious potential consequences of exchange rate instability is its impact on the international trading climate (Bergsten and Williamson, 1983). Swings in exchange rates involve movements in competitiveness, which can create hardship for industries that find their foreign (and, indeed, their domestic) markets shrinking in consequence. If transitory or "unjustified" movements in exchange rates are perceived as being the cause of such hardships, there will inevitably be pressure for protection against them. If this protection cannot be provided by action to prevent or reverse the original exchange rate movement, then it may be sought in the form of direct restrictions on trade, temporary tariff protection, domestic and/or export subsidies, or a slowing down of the pace of liberalization.

Against the costs which an exchange rate movement provides to countries whose competitiveness suffers, there are benefits for countries whose competitiveness is improved. It could be that the margin for a reduction in protection in countries where the exchange rate moves down counterbalances the increase in protectionist pressures in countries where demand is adversely affected by exchange rate factors. Nevertheless, it is often observed that a ratchet effect is likely to operate: protectionist measures are quicker to be imposed than removed, and once imposed tend to acquire a constituency of interest that makes their removal difficult. It has also been suggested (Bergsten and Cline, 1983) that a "bicycle" effect operates: forward momentum toward liberalization is more sustainable than a stationary situation. When this momentum is arrested, protectionist pressures begin to feed on themselves. Thus, if exchange rate variability results in substantial swings in competitiveness, the cumulative effect may be to generate a net increase in protectionist pressures, and, by blunting the case for an open trading system, may halt the progress toward liberalization.

To the extent that such effects show up in reduced levels of international trade, their impact will be captured in the quantitative relationships discussed in Section IV, below. It would not be possible, however, to distinguish from such relationships between the effects of protectionism and those of uncertainty and other factors in inhibiting trade flows. In Section VI, therefore, a more qualitative assessment is made of the relationship between exchange rates and the stance of trade policies.

Developing Countries

For the most part, developing countries have maintained some form of pegging arrangement for their currencies (International Monetary Fund, Annual Report, 1983). This means that the uncertainty in their nominal exchange rate relationship has two components: variability in the rate at which they peg to the numeraire currency or composite, and variability in the relationship between the numeraire and the other major currencies in world trade. In terms of competitiveness, a further element of variability is added by fluctuations in relative price levels, though it is perhaps to be expected that over time this would be offset by changes in the peg.

Helleiner (1981) argues that exchange rate turbulence has relatively greater adverse consequences for developing countries than for developed countries. Since trade is less frequently denominated in domestic currencies, traders face a greater measure of uncertainty, especially because forward facilities are less readily available or more expensive. Furthermore, when a developing country pegs its currency to that of a major trading partner, and therefore floats against the currencies of other industrial countries, this creates a preference for bilateral trade with the country to which it is pegged. Such a tendency forgoes the benefits of multilateral trading relationships and causes a less than full exploitation of comparative advantage. Another potential disadvantage arises from the premium which variable exchange rates place on responsiveness and flexibility in production and trade. Helleiner considers that this is likely to leave poor countries (and small firms) at a relative disadvantage. Last, if debt is largely denominated in a single currency, as indeed is the case for most developing countries, its value relative to exports is likely to vary in response to exchange rate swings among industrial country currencies. These exchange rate fluctuations could, therefore, result in random changes in perceived creditworthiness of developing countries, with potential adverse consequences for a stable level of capital inflows.

III Measuring Exchange Rate Variability

The fundamental uncertainty in business is that unforeseen fluctuations in revenues relative to costs will make a particular transaction or activity uneconomic. When revenues and costs are in different currencies, possible exchange rate movements are clearly an important dimension of this uncertainty. They are not, however, necessarily an independent source of uncertainty, nor do they affect different enterprises in the same way.

The simplest kind of international transaction is the basic trading transaction of nineteenth century textbooks, whereby a trader makes a contract to buy a fixed quantity of goods at a given price in one country, and to sell them after, say, 90 days, at a fixed price in another country. His profit is the difference between the purchase price and the selling price (less freight, insurance, and interest costs), and the only source of uncertainty is the exchange rate at which he can translate his sales revenue in foreign currency into local currency to repay his borrowing. It is the possibility that the nominal exchange rate will move by an unknown amount during the life of his contract that is the proper measure of the uncertainty he faces.

Where forward markets exist, of course, the nature of the uncertainty faced by traders is transformed. A forward market represents, in effect, a "guaranteed" forecast of the exchange rate that will prevail at the end of the contract period, which a trader can take advantage of by payment of a small margin around the forward rate. Since currency uncertainty can be removed from the short-term trading transaction by payment of this margin, the "cost" of such uncertainty cannot be higher than the cost of purchasing insurance against it.[1]

Since spreads between bid and offer rates in the 3-month forward market have rarely exceeded 0.2 of 1 percent for major currencies (see Chart 1), the implicit cost of short-term exchange rate uncertainty would appear to be too small to have a significant effect on aggregate trade flows. Spreads for forward contracts of 12 months' maturity have generally been larger, reflecting the relative "thinness" of this market. Nevertheless, spreads for the major currencies are generally well under 1 percent (so that the cost for a one-way transaction is under 1/2 of 1 percent of the central rate).

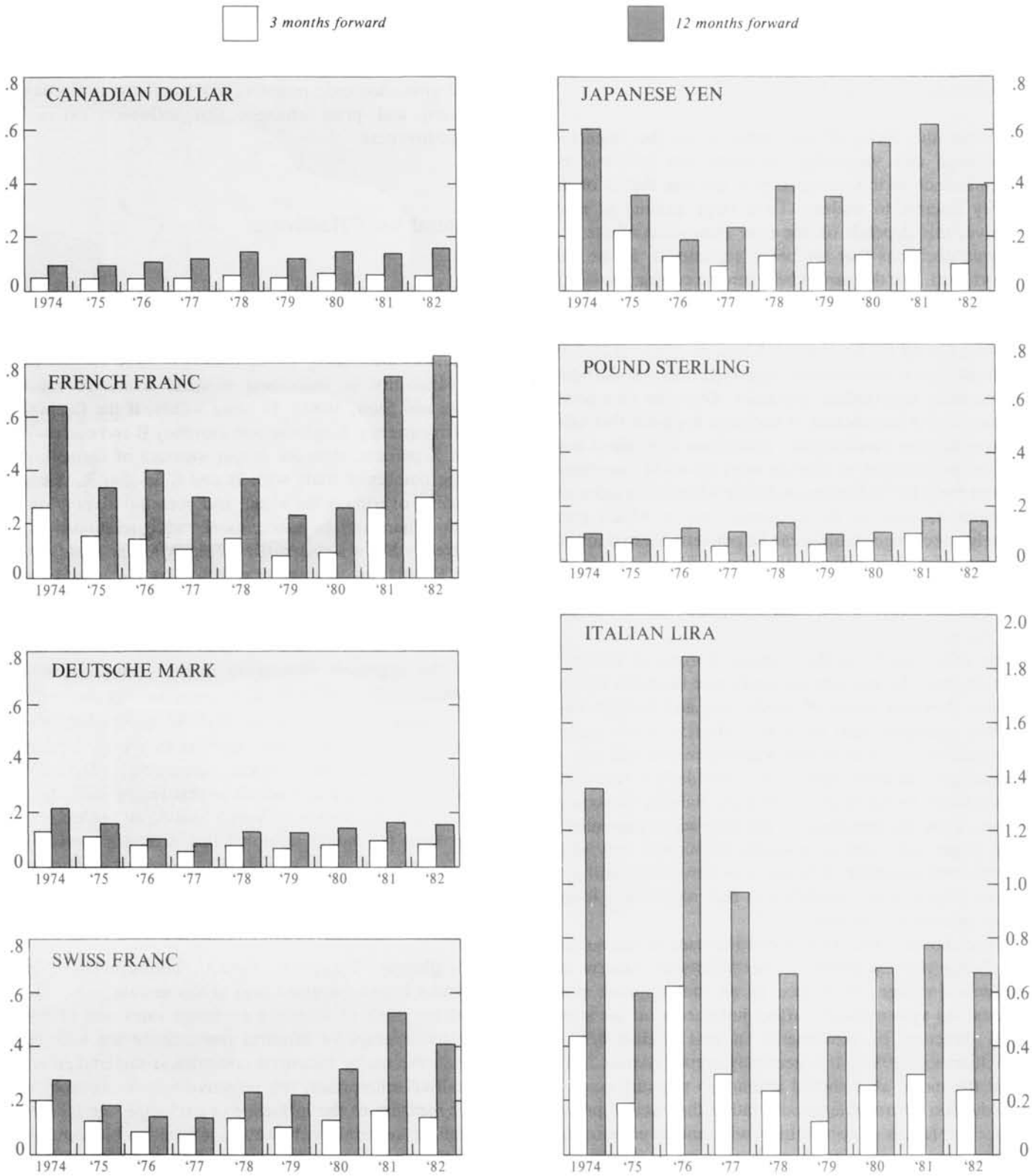
Most international trading activity, however, has a longer time horizon than that corresponding to the shipment of goods. It generally involves the commitment of resources, and the development of markets, for an extended period of time. During this time, domestic production costs and foreign selling prices will both change in local currency terms. The key question, therefore, is whether, and by how much, fluctuations in exchange rates offset or accentuate these uncertainty-producing movements in production costs and sales receipts. The answer to these questions requires the adjustment of nominal exchange rate relationships to take account of changes in prices and costs. This in turn presents the problem of choosing suitable indices to capture the particular costs and prices that are most relevant from the point of view of traders.

It is also relevant that the "commitment period" for resources varies widely among activities. The decision to market excess production of a homogeneous commodity with a well-developed international market (e.g., a primary commodity or raw material) can be effected at short notice, and then not repeated if market conditions change. The decision to take advantage of market conditions to sell a manufactured product for which domestic demand falls short of established production capacity requires an investment in developing market outlets that is not worthwhile unless sales are expected to continue for some time. Finally, the decision to create new production capacity to meet foreign demand may entail a commitment to investment in plant and equipment, as well as labor force training, that will continue for a period of many years.

Enough has been said so far to indicate that different kinds of uncertainty are important for different kinds of international enterprise. There is no unique measure of "exchange rate variability" that can be used as a proxy for the uncertainty and adjustment costs that traders face as a result of exchange rate movements (Lanyi and Suss, 1982). In what follows, four dimensions of variability are presented and discussed. They are then combined in various ways to produce proxies for exchange rate uncertainty. The behavior of these proxies—over time and

[1]While for an individual transactor the cost of forward cover may appear to be the discount from the spot rate, it should be remembered that this discount is matched by a premium facing those wishing to make transactions in the other direction. The net cost facing traders in the aggregate is the difference between the discount in one direction and the premium in the other (i.e., the spread).

Chart 1. Selected Industrial Countries: Spreads Between Buying and Selling Rates in Forward Exchange Markets, 1974–82[1]



[1]Averages of daily rates; exchange rates are U.S. dollars per unit of local currency in the New York foreign exchange market.

among countries, as well as relative to the other proxies—is discussed later in the section (and in more detail in Appendix I). These measures are used in the empirical analysis presented later in the paper.

Dimensions of Exchange Rate Variability

Nominal vs. Real Exchange Rates

Since the focus of this paper is on the impact of exchange rate variability on trade, the rate that has significance in this connection is the one that is of primary interest to traders. To a large extent, as noted above, this depends on the time dimension of the economic decisions that are being considered. In the very short term, say the period between the contract to supply goods that have already been produced and their actual delivery to a foreign purchaser, all costs and prices are known except the nominal exchange rate. It is, therefore, fluctuations in the nominal exchange rate that introduce uncertainty into traders' decisions. Once the time period concerned is lengthened, it becomes apparent that other prices become variable also. A decision to produce more in the expectation of foreign sales involves uncertainty about the price in foreign exchange which such sales will realize, as well as the exchange rate at which given foreign exchange receipts can be converted into domestic currency. And a decision to increase domestic production capacity involves uncertainties about the future cost of factors of production (labor and other inputs) as well as the price to be received for final sales.

In other words, as the planning horizon of traders is lengthened, the relevant exchange rate becomes that between domestic costs of production and foreign sales prices converted into domestic currency. From such a perspective, it is clear that stability in the real rate of exchange (somehow defined) is more likely to reduce the uncertainty facing traders than mere stability of nominal rates. Thus, the comparisons and time series presented in this paper will focus on nominal magnitudes only when short-term variability is being considered, and will give more emphasis to variability in real rates when longer time periods are involved.

The choice of the price index to be used in making real exchange rate calculations is not simply an esoteric and technical matter. Reference to an inappropriate price index can systematically affect judgments on the scope and direction of movements in real exchange rates (Williamson, 1983). It is generally argued (Artus, 1978) that the index used should attempt to measure costs of production of tradable goods, rather than actual prices, since the forces of competition will tend to equalize the latter among countries through changes in profit margins. This consideration has led to the adoption of indices of unit labor costs in manufacturing industry (normalized for cyclical changes in productivity) as a proxy for the competitiveness measure that is most relevant for exchange rates. Such indices, however, have problems of their own, notably the difficulty of incorporating secular shifts in productivity and the incomplete coverage of the traded goods sector (which also includes important parts of agriculture, mining, and services). For the latter reason, it can also be useful to refer to the more broadly based gross domestic product (GDP) deflator as a proxy for cost and price changes that influence external competitiveness.

Bilateral vs. Effective Exchange Rates

Each individual trade transaction takes place between two countries, and therefore involves only one bilateral exchange rate. Thus, it might seem that the appropriate measure of uncertainty facing traders is some average of the variability in individual bilateral exchange rates (Lanyi and Suss, 1982). In other words, if the fluctuations in currency A against both currency B and currency C are X percent, then the proper measure of variability for the combined trade with B and C is also X. Such reasoning overlooks the actual and potential diversification that characterizes international trading relationships. If currency B has a systematic tendency to rise against A when C falls, the average or effective exchange rate for A may be much more stable than either of the two bilateral rates. For traders dealing with both foreign countries, it is the effective exchange rate that best reflects the aggregate uncertainty in their future income stream.

It becomes clear, therefore, that the choice between bilateral and effective rates depends to a considerable extent on whether one wishes to measure the uncertainty facing the economy as a whole or that facing individual traders, and the degree to which individual traders are diversified. (It should be noted that diversification applies to import sources as well as to export destinations. Bilateral exchange rates would be the appropriate focus of concern when imports are dominated by a single major supplier.)

For illustrative purposes, the calculations presented in Appendix I, and discussed later in this section, cover the variability both of effective exchange rates and of the weighted average of bilateral rates. Since the bulk of trade in the major industrial countries is undertaken by diversified enterprises, the effective rate is probably a better measure of the influence of exchange rate factors on trading uncertainty; however, it needs to be borne in mind that a significant proportion of producers (probably including a relatively greater number of small enterprises) will have a high degree of export concentration.

Time Period of Variability

One of the most difficult issues in choosing a measure of exchange rate variability is the time period over which such variability is to be measured. The average period-to-period movement in an exchange rate is likely to be quite different depending on whether day-to-day, quarter-to-quarter, or year-to-year swings are considered. Actually, two issues are involved. Since exchange rates display serial correlation (i.e., the level of the rate in any period is strongly correlated with its level in the previous period), it is important to assess both how much the exchange rate has shifted since the previous period and how far it has moved relative to some average or trend.

Since exchange rates vary continuously, it might seem appropriate to measure variability over very short periods (i.e., for practical purposes, day to day). Transactions take place at individual moments in time, and the possibility of exchange rate movements from day to day imposes uncertainties on traders, even if these very short-term fluctuations are quickly reversed.

While this is true, and such short-term uncertainties undoubtedly impose costs, it can be doubted whether these are the most significant adverse aspect of exchange rate variability. Trade transactions are usually not entered into for settlement within one or two business days. A much more normal practice would be a contract covering a period of, say, three months. In this case, a more important uncertainty for the trader would be the degree to which an exchange rate was likely to change between the date at which a contract was entered into and the date at which it matured.

While three months may be a typical contract/settlement lag for individual transactions, it is much less than the normal planning horizon for strategic decisions to participate (or refrain from participating) in international trade. A manufacturer who contemplates developing a foreign market or markets will have a stream of receipts in foreign currency, and a stream of payments in local currency, extending over a number of years. Day-to-day variability in exchange rates will be of little concern to such an enterprise, since the law of large numbers will ensure that random daily fluctuations in the rate tend to be self-canceling. Even quarterly fluctuations that reverse themselves from period to period may not be regarded as of great significance.

This consideration leads on to the importance of sustained deviations from trend, as well as period-to-period movements, in introducing uncertainty into trade. If exchange rates move by an average of, say, 2 percent a month, but in a random manner, this may well be an easier type of uncertainty for businesses to absorb than where monthly movements are held to, say, 1 percent, but tend to cumulate through a succession of such movements in the same direction before undergoing a reversal.

Since manufacturers and traders face different planning horizons, depending on the nature of the activity in which they are engaged, there can be no single "correct" measure of the most appropriate time period for gauging exchange rate variability. In the statistical analysis presented here, evidence is provided of monthly and quarterly period-to-period movements in exchange rates. Deviations of monthly and quarterly exchange rates from their average, or trend, levels are also considered.

Actual vs. Predicted Movements

The fact that exchange rates move does not, of course, mean that such movements involve uncertainty. To the extent that exchange rate developments are foreseen and reflected in forward market quotations, they are perfectly consistent with a well-functioning mechanism for allocating resources. This consideration suggests use of deviations between actual and predicted (on the basis of earlier forward quotations) exchange rates as the relevant measure of exchange rate uncertainty.

Once forward exchange rates are brought into the analysis, it can be argued that a better measure of the uncertainty cost of exchange rate variability is the cost of insuring against it. This cost is reflected by the spread between bid and offer quotations for forward exchange contracts (not the forward premium or discount, since the cost of a forward premium to one party is the benefit of a forward discount to the other, if the bid/offer spread is ignored).

Before proceeding to a discussion of some of the evidence on variability, it is worth noting one other difficulty in the way of generating statistical estimates of variability. Traditional measures of variance, such as the standard deviation, have well-defined properties that make them particularly useful for analysis. However, as Westerfield (1977) points out, these properties depend on assumptions about the underlying statistical series that are not borne out in the case of exchange rates. The "skewness" of the distribution, particularly in the fixed rate period when the bulk of the observed variance is accounted for by individual discrete exchange rate changes, means that observed standard deviations do not necessarily have the normal properties. For this reason, most of the tables in Appendix I present data in the form of average changes rather than in standard deviations.

Exchange Rate Variability, 1960–83

The foregoing discussion implies that there are a large number of potential measures of variability. Several of these are presented, using data for the major industrial

countries, in Appendix I. (For another presentation and discussion of exchange rate variability, see Kenen, 1979.) The footnotes to the tables indicate the definitions that have been used in their construction. Interpretation of these results, however, requires some simplifying organizational structure. The following discussion is grouped around a series of frequently asked questions concerning exchange rate variability:

–Has exchange rate variability (however defined) increased in the floating rate period compared with what it was before?

–Has there been a "learning" process during the floating rate period, such that volatility has tended to diminish as experience with floating rates accumulates?

–Are some currencies more prone to fluctuations than others? Specifically, are countries that participate in cooperative exchange rate arrangements shielded from volatility?

–Have exchange rate movements tended to offset price movements, so that real exchange rate fluctuations are systematically smaller than fluctuations in nominal rates?

–Are deviations of exchange rates from medium-term trends greater or less than would be expected on the basis of their short-term volatility?

Volatility in Floating vs. Fixed Rate Period

There is no doubt that, on almost any definition of exchange rate variability, fluctuations in exchange rates have been greater in the decade since floating was adopted than they were in the period of the 1960s. The weighted average of monthly changes in nominal effective exchange rates (see Appendix I, Table 4) among the major industrial countries was 0.2 percent during the period 1961–70, and averaged almost 1.2 percent over the period 1974–83, a sixfold increase. Quarterly movements in nominal exchange rates, which are somewhat larger than average monthly movements, have also increased about sixfold. The variability of real exchange rates was somewhat greater than that of nominal exchange rates during the late 1960s, and the increase between then and the more recent period has been proportionately smaller. Nevertheless, the weighted average of changes in real rates has still been 2½–3 times greater in the period 1974–83 than in the decade of the 1960s. Indeed, for no year after 1974 is the average variability of the seven major currencies less than for the year of greatest variability in the period to 1970.

Is There a "Learning" Process?

For most measures of monthly or quarter-to-quarter variations in exchange rates, 1973 is the year of greatest variability. However, although there was an apparently systematic trend toward greater stability over the four or five years following the adoption of floating exchange rates, this trend was interrupted at the end of the 1970s. Since 1978, Japan and the United States have experienced notably greater fluctuations in their effective exchange rates (in both nominal and real terms) than prior to that date. Italy and the United Kingdom, by contrast, had greater fluctuations in the external value of their currencies in the middle of the floating period than at the beginning or more recently. There is, therefore, no convincing evidence of any trend toward greater or lesser variability over time.

Intercountry Variations

It has already been noted that different currencies have experienced increases in variability at different times. This suggests that there have been country-specific influences on exchange rate variability as well as common external causes. In addition, some currencies have tended to be relatively more stable than others over time. It is noteworthy that the real effective exchange rates of France, the Federal Republic of Germany, Canada, and Italy have shown considerably smaller quarter-to-quarter variations over the period 1974–83, taken as a whole, than have those of the United States, the United Kingdom, and Japan. This could reflect, in the case of the European currencies, the influence of cooperative monetary arrangements, and, in the case of Canada, the close ties between the Canadian economic and financial system and that of its principal trading partner, the United States.

Exchange Rates and Price Movements

It is generally accepted that prolonged inflation differentials among countries will eventually lead to broadly offsetting movements in the exchange rate between their currencies. The reasons for this relationship are well known (Officer, 1976), and experience during the floating exchange rate period generally bears it out. Among the major currencies, those with the most rapid rates of inflation during the past decade have been Italy, the United Kingdom, and France, and the currencies of these three countries have depreciated most. Japan has been the most successful of the major industrial countries in containing inflation, and the exchange rate for the yen has risen over the floating period.

But while such a relationship can be detected over long periods, when relative prices move by significant amounts, it is much less certain whether the connection is so close in the short or medium term. A comparison of Table 4 and Table 5 in Appendix I suggests that month-to-month changes in real effective exchange rates are

broadly similar in size to those in nominal exchange rates. For several countries and in a number of years, the relationship is perverse. A similar result was obtained by Kenen (1979). From this it can perhaps be concluded that movements of nominal exchange rates do not appear to be primarily due to contemporaneous shifts in national price levels. This does not, of course, mean that expectations concerning inflationary developments, and the policies that may be adopted to deal with them, might not themselves have a significant impact on interest differentials and hence on exchange rates.

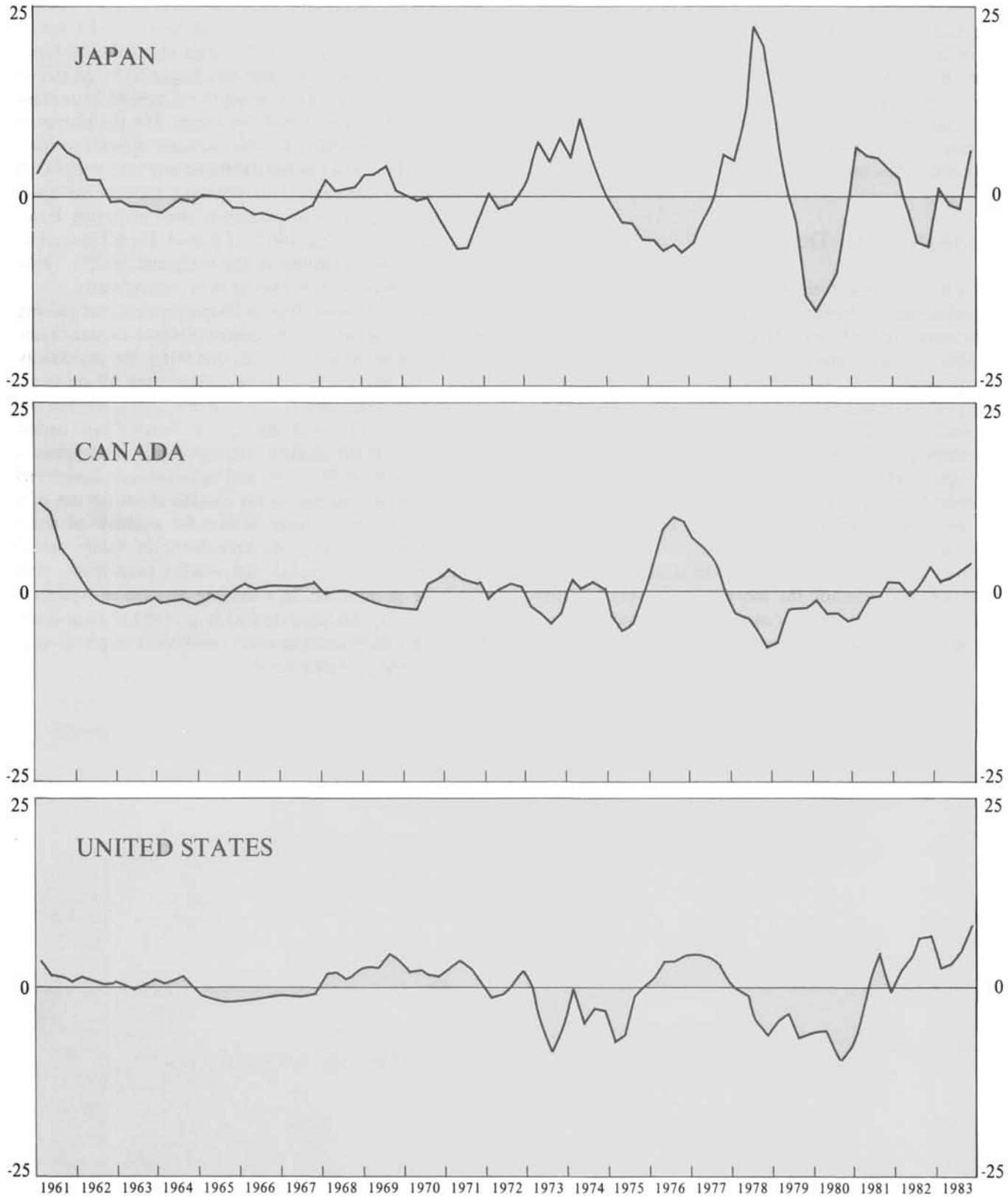
Deviations from Trends

As may be seen from Tables 4 and 5 in Appendix I, period-to-period movements in exchange rates, though substantially greater in the floating than in the prefloating period, are still relatively small in absolute terms. If the quarterly variability faced by traders was in the range of 2–3 percent suggested by these tables, it could perhaps be assumed that the adverse impact of the resultant uncertainty on trade was relatively limited. What is perhaps more significant is to know the extent to which short-term movements are quickly and systematically reversed, or rather tend to cumulate before ultimately changing direction.

Chart 2 offers a perspective on the issue of deviations from trend by plotting the movements in real effective exchange rates around their medium-term trend, which is defined as a 19-quarter centered moving average. It may be seen that these have become quite large during the floating period. The series have been brought up to the end of 1983 by assuming that the exchange rate for the future period needed to calculate the moving average is the same as the average for the quarters available for the calculation. For Japan, the United States, and Canada, there is clear evidence that swings about the medium-term real effective exchange rate began to be greater in the early 1970s and have, if anything, tended to increase in amplitude in the period since then. For the European economies, variability by this measure appears to have begun earlier, and has not exhibited any very significant tendency to increase. This probably reflects the quite sizable realignment of exchange rates involving European currencies in the 1967–71 period. For all countries, however, the variability in the early and middle 1960s was considerably less than it was subsequently.

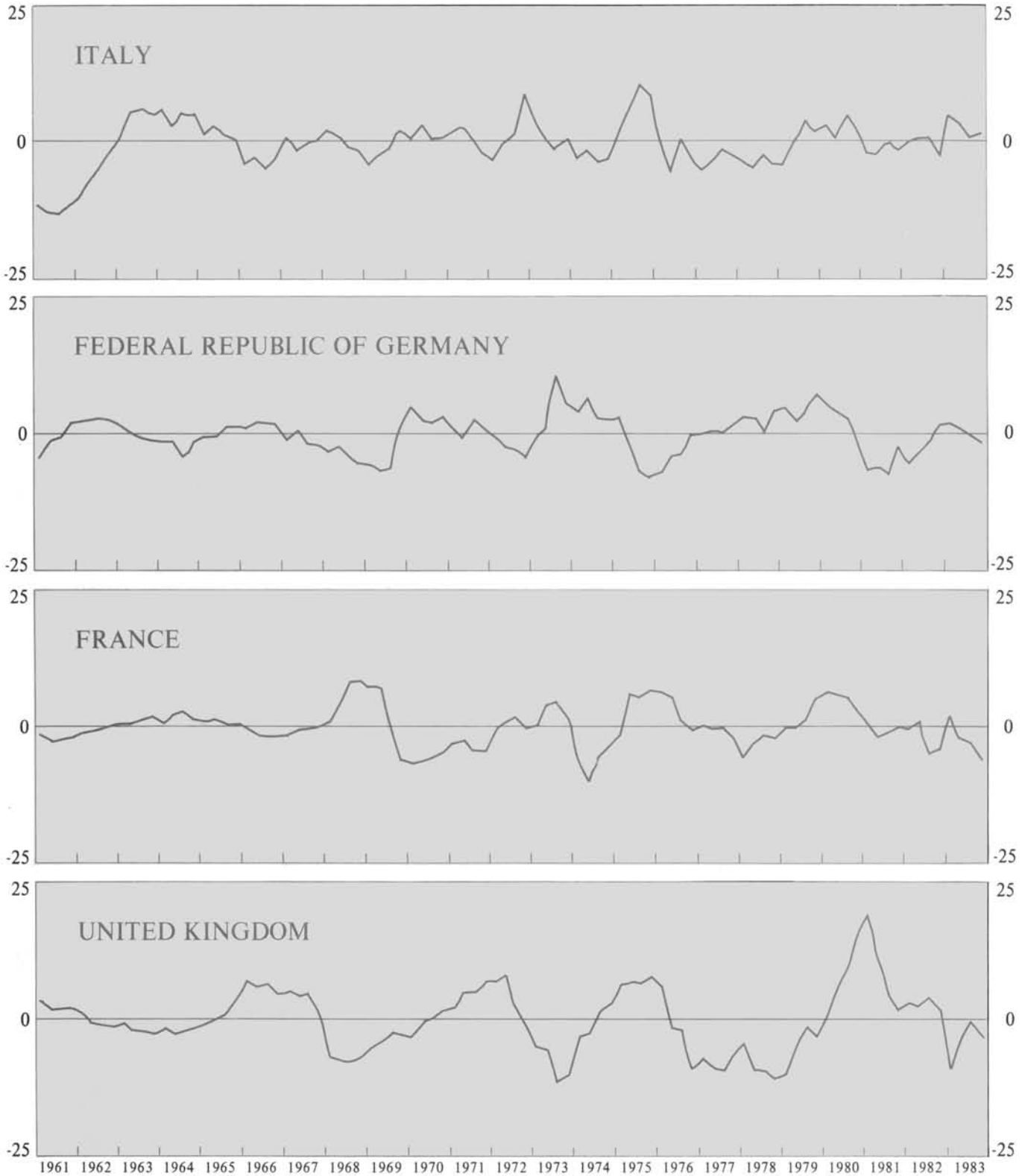
Even the deviation from a 19-quarter centered moving average can understate the degree to which exchange rate swings cause uncertainty. For one thing, the periodicity of a complete cycle may be longer than 19 quarters. Chart 7 in Appendix I, for example, suggests that the behavior of the dollar during the floating rate period includes a trend decline (though with interruptions) throughout the 1970s, followed by an increase from 1980 onward. A second reason for caution about the use of a centered moving average is that the estimate of trend used in Chart 2 requires knowledge of future actual observations, knowledge that market participants will not have at the time. If a moving average of historical observations were used instead (e.g., for the 19 quarters up to the observation quarter), somewhat larger divergences would probably result.

Chart 2. Major Industrial Countries: Deviations from Trend in Real Effective Exchange Rates, 1961–83[1]
(In percent)



[1]Quarterly data, with the trend exchange rate defined as a 19-quarter centered moving average.

Chart 2 (*concluded*). Major Industrial Countries: Deviations from Trend in Real Effective Exchange Rates, 1961–83[1]
(In percent)



IV Volume and Pattern of World Trade

Empirical work relating exchange rate variability to trade flows has taken place on several different levels. At the most aggregated level, attempts have been made to relate the growth of total world trade to the growth of world income, to see whether this relationship changes in periods of exchange rate variability. A more disaggregated approach has involved the specification of models explaining changes in bilateral trade flows over time, including exchange rate variability as an argument in the equations. A variant of this approach has been to explain differences in the level of trade, during a single time period, with reference to various characteristics of the partner countries (including variability in bilateral exchange rates). In what follows, we deal first with aggregated models of world trade, then with bilateral models based on time-series analysis, and last with bilateral models based on cross-section analysis.

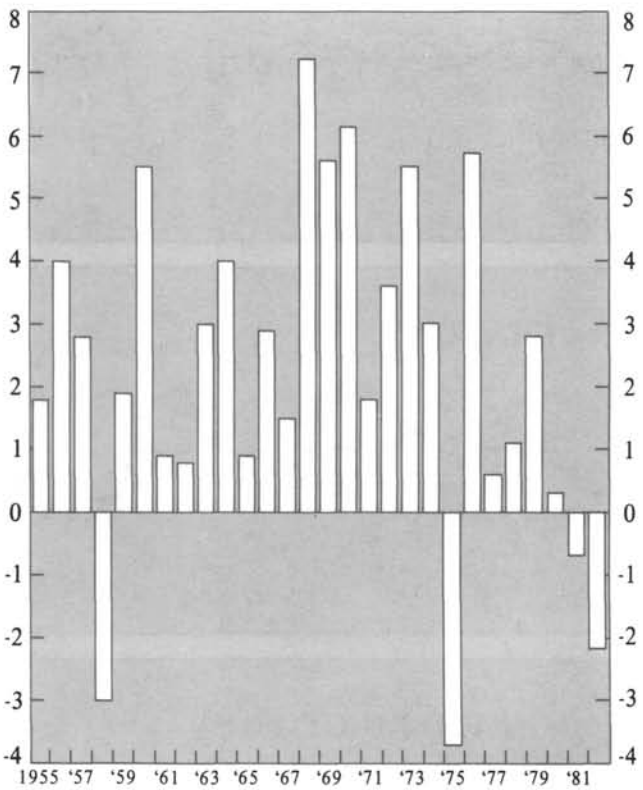
Aggregate Relationships Between Exchange Rate Variability and Trade

Perhaps the simplest test of the proposition that erratic exchange rate fluctuations have had an adverse effect on world trade is to examine what has in fact happened to the rate of growth of world trade in recent years. In undertaking this kind of exercise, it has to be recognized that other factors affect the volume of trade flows, most notably, of course, the level and rate of growth of world output.

Blackhurst and Tumlir (1980) make a rough correction for this factor by presenting a chart showing the extent to which the increase in world trade has exceeded the increase in world output over the period 1955–78. These data are reproduced and updated in Chart 3. For the period which Blackhurst and Tumlir observed, which ended in 1978, there did not appear to be any very sustained and systematic impact of the more variable exchange rates that were presumed to characterize the floating rate period. However, as may be seen quite clearly from Chart 3, the addition of four years shows quite a significant change in the relationship between the two variables.

This evidence, however, would be consistent with a change in the structure of the relationship between world output and trade only if there were some reason to expect that trade would always grow more rapidly than output by a fixed percentage. In fact, as Bergsten and Cline (1983) show, international trade flows tend to be particularly responsive to cyclical factors, so that trade grows considerably more rapidly than output during cyclical

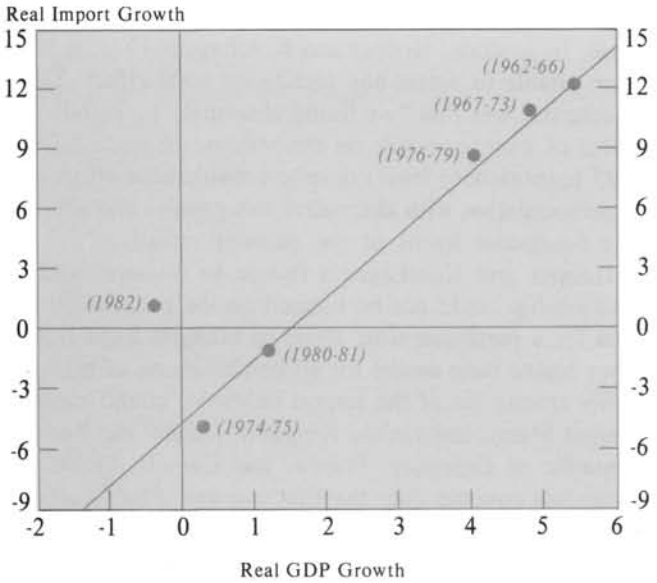
Chart 3. Number of Percentage Points by which World Export Growth Exceeded World Output Growth, 1955–82



Source: Reproduced from Blackhurst and Tumlir (1980, p. 15) and updated by Fund staff.

upswings and less rapidly when output is stagnant or contracting. Bergsten and Cline's chart describing this relationship is reproduced as Chart 4 (with an observation added for 1982).

Chart 4. OECD Member Countries: Relationship Between Real Import Growth and Real Gross Domestic Product Growth, 1961–82
(In percent)



Source: Bergsten and Cline (1982, p. 78), with an observation for 1982 added by Fund staff.

The conclusion that would be drawn from this chart, if taken at face value, is that the poor performance of world trade in the past three to four years (the most prominent feature of Chart 3, above) can in fact be fully explained by using a different functional form to relate trade flows to GDP. There is thus no evidence that any special feature of the recent past (e.g., exchange rate variability) has had an independent negative effect on the level of trade.

However, as Bergsten and Cline would themselves undoubtedly admit, the fact that a highly simplified model provides a serviceable explanation of broad trends in world trade does not mean that other factors are not important, or could not be detected through more detailed work. In the first place, their model explains only about three fourths of the observed variance in the growth of trade flows (see Appendix II), leaving an important element still to be explained. Second, as can be seen from the chart, its good fit is strongly influenced by the observations during the 1974–75 and 1980–81 recessions. If these observations were themselves influenced by exchange rate uncertainty, the latter phenomenon could be helping to determine the slope of the curve. Thus the absence of a residual in the estimated relationship cannot be taken to imply that exchange rate variability is unimportant. Third, there is no strong theoretical reason to expect the relationship to be linear as in their chart. Indeed, it seems more likely that the strong relationship between trade growth and output growth (whereby a 1 percent more rapid growth in output leads to a 3 percent increase in trade growth) is a short-run phenomenon that may not persist to the same degree when longer-run adaptations are considered.

Appendix II provides some further evidence on the link between world output and world trade. It appears that this relationship has changed over the floating rate period, compared with the 1960s. As may be seen from Chart 10 (Appendix II), which plots actual world trade growth against the growth that would be "predicted" on the basis of the relationship between output and trade that obtained during the 1960s, trade has fallen short of what might have been expected. However, the equations reported in the appendix do not reveal any systematic relationship between the size of this shortfall and the level of exchange rate variability.

Trade Flows of Individual Countries: Time-Series Analysis

A shortcoming of the studies noted above is that they may be too aggregated to detect the presence of exchange rate uncertainty in discouraging particular trade flows. This could come about for several reasons. First, since one effect of uncertainty is to induce transactors to try to avoid risk, it may be reflected in shifts in trade patterns to avoid transactions using an exchange rate that is particularly susceptible to volatility. For example, if the exchange rates between North American currencies, on the one hand, and European currencies, on the other, become more variable, but exchange rates within North America and within Europe remain reasonably stable, it may be that trade is diverted from the less stable to the more stable currency relationship. Second, it is difficult to construct a satisfactory proxy for exchange rate uncertainty for the world as a whole. Trade takes place between pairs of countries, and the aggregation of a large number of individual currency risk situations is inevitably somewhat arbitrary. Last, the number of factors that go to determine the volume of world trade cast doubt on the reliability of equations that use only a small number of explanatory variables.

For these reasons a number of investigators have focused on the determinants of bilateral trade flows. The basic approach has been to specify an equation that

explains the level and rate of growth of bilateral trade flows over time, including some measure of exchange rate variability as one of the determinants. The other factors that are included generally cover demand conditions in the importing country and relative prices.

A number of early studies focused on experience in the nineteenth century and in the interwar period. These are summarized in Yeager (1976), who found little evidence of an adverse impact of exchange rate variability on trade. Of more direct relevance to current circumstances, which are, of course, quite different from those of fifty or a hundred years ago, is the evidence presented in more recent studies. These studies have also had the added advantage of being able to use more advanced statistical techniques.

One of the first such papers is that by Clark and Haulk (1972), which antedates the move to generalized floating in 1973. They investigate the experience of Canada during the period 1952–70, during the earlier part of which the Canadian dollar floated, before being pegged again in 1962. The indicator of variability which they use is the standard deviation of daily rates about the average for each quarter, applied to both the spot and the 90-day forward quotation, though they recognize that variability over longer periods would be required to correspond better to the planning horizon used by firms.

Clark and Haulk did find that exchange rate variability was significantly greater in the flexible than in the fixed rate period, and that the determinants of Canadian exports and imports seemed to shift somewhat between the two periods. However, inclusion of exchange rate variability in the trade equations did not add to their explanatory power. They concluded that nominal exchange rate variability did not adversely affect Canadian trade during this period, though they conceded that a different formulation of their model could perhaps lead to a different result.

A test in the same vein is presented by Makin (1976), who attempted a preliminary assessment of the effects of floating on trade, using data up to the end of 1973. Makin fitted import equations for the Federal Republic of Germany, Japan, the United Kingdom, and Canada, using as his variability measure a moving standard deviation calculated from six-month blocks of data. Like Clark and Haulk, he is unable to detect any systematic relationship between exchange rate variability and trade volume.

These early studies suffered from a number of shortcomings, most of which were recognized by the authors themselves. First, the exchange rate variability they measured was either limited in extent, as in the case of Canada, or in time, as in the case of studies that included only two or three quarterly observations from the flexible rate period. Second, they did not take explicit account of the possibility of exchange rate movements and relative prices offsetting one another. Third, they used the variability in the exchange rate against one currency (the U.S. dollar) as a proxy for exchange rate uncertainty effects on all trade flows.

A paper by Hooper and Kohlhagen (1978) addresses some (though not all) of these difficulties by covering an additional two years and disaggregating the trade of individual countries into its constituent bilateral flows. In their theoretical analysis, Hooper and Kohlhagen show that the effect of exchange rate uncertainty on price depends on the currency in which international contracts are denominated. As far as volumes are concerned, theoretical considerations are unambiguous in suggesting that increased uncertainty should reduce the level of trade. In practice, Hooper and Kohlhagen (1978, p.505) were unable to detect any significant such effect. Their conclusion was that "we found absolutely no significant effect of exchange risk on the volume of trade (at the 0.95 [confidence] level) despite considerable effort and experimentation with alternative risk proxies and alternative functional forms of the quantity equation."

Hooper and Kohlhagen's failure to discover such a relationship could not be blamed on the peculiarities of data for a particular time series of bilateral trade flows. They tested their model for all combinations of bilateral flows among six of the largest industrial countries—the United States, the United Kingdom, Japan, the Federal Republic of Germany, France, and Canada. However, their data covered only the first two and a half years of the floating rate period, and it could be argued that their tests were unable to capture possible lagged adverse effects of the greater volatility that has characterized exchange rate behavior since 1973. Although Hooper and Kohlhagen used numerous alternative proxies for exchange rate variability, they were all of a relatively short-term character, covering periods of not more than three months. Partly because of the short-term orientation of their variability measure, they used only nominal exchange rate variability, and did not attempt to estimate "real" exchange rate movements through the use of deflating techniques.

A paper by Coes (1981) investigated the impact of exchange rate uncertainty on trade flows in Brazil using real exchange rates, and covering quite long periods of relatively more stable and relatively more variable exchange rates. Brazil adopted a crawling peg system in August 1968, and, as can be seen from Chart 5, which is taken from Coes' paper, that date separates a period of extreme volatility in the real dollar/cruzeiro rate from a period of relative stability. Coes proposes a measure of monthly variability in exchange rates as a proxy for real exchange rate uncertainty, and includes this (along with price and income variables) in an equation explaining exports by sector.

Coes' equations are based on annual data, and cover exports of 22 sectors, both manufacturing and primary products. The great majority of his equations show that

Chart 5. Brazil: The Real Brazilian Cruzeiro/U.S. Dollar Rate, 1957–74

Source: Coes (1981, p. 115).

uncertainty has a highly significant impact on export volumes. While this evidence is suggestive, it should be interpreted with caution, as Coes himself acknowledges. In the first place, other changes in the Brazilian economic environment occurred at the same time as the adoption of the crawling peg. The restoration of domestic economic and financial stability, and the resumption of sustained economic growth, may have been more important factors than the reduction of exchange rate instability—although the latter factor cannot really be separated from the measures that were undertaken to restore domestic economic stability.

It should also be noted that the degree of real exchange rate instability in Brazil prior to 1968 was unusually large, and in part reflected an economic and political environment of considerable uncertainty. It would not necessarily be appropriate to assume that proportional effects on trade would flow from reductions in exchange rate variability when the initial degree of variability was smaller and resulted from different causes. Nevertheless, Coes' analysis suggests that, when uncertainty reaches substantial proportions, it can have a marked adverse effect on trade flows.

Cushman (1983) uses real exchange rate variability in his investigation of uncertainty effects on trade flows among industrial countries. Basically, his model resembles that of Hooper and Kohlhagen (1978), with the advantages of (i) more recent data and (ii) the use of real as opposed to nominal exchange rates. The uncertainty measure used in each bilateral trade flow equation is quarterly variability in the bilateral exchange rates, in real terms. The price index used to deflate nominal exchange rates is relative movements in wholesale prices. For reasons given above, this may not be the best available deflator, but its use is unlikely to bias the results substantially. Cushman's results can be interpreted as providing some, though not overwhelming, support to the proposition that exchange rate variability adversely affects trade flows. Of the fourteen sets of bilateral trade flows, real exchange rate variability is significantly and negatively associated with trade flows in six cases, against only two where the association is statistically significant and positive. However, among the six cases where the relationship is not significant at the 95 percent confidence level, only two have negative signs while four have positive signs.

The studies reviewed here have for the most part been based on data for the early part of the floating exchange rate period. With the exception of the papers by Coes (1981) and Cushman (1983), the evidence they evaluate refers to the variability of nominal exchange rates. Since it has been argued earlier that real exchange rates may be of more relevance for international trade flows, and since the two studies using real exchange rates have shown more impact on trade, Appendix IV presents an updating of Cushman's work, though on a somewhat cruder basis,

using data through 1981. No significant impact of exchange rate variability on trade was found through the updating.

Bilateral Trade Flows: Cross-Section Studies

An alternative to tests that attempt to explain changes in trade volumes over time are those that compare the level or rate of growth of trade across countries at a given point in time. The hypothesis to be tested is that the level or rate of growth of trade flows will be greater when the relevant exchange rate is more stable. Kenen (1979) takes a group of 16 industrial countries and tests whether the rate of growth of their exports between 1973–74 and 1976 was systematically related to the variability in their exchange rate. Four definitions of variability are used (two real and two nominal), but none is statistically significant. In a more disaggregated vein, Abrams (1980a) specifies a model in which the level of trade between countries is explained by factors such as income levels, geographic proximity, and membership in trade associations. He also includes a measure of exchange rate variability, which is defined as the variability, in nominal terms, of monthly exchange rate observations over the previous year. He finds that his exchange rate variability measure is significantly related to the volume of bilateral trade flows. In a simulation exercise, he finds that the volume of trade in 1976 could have been expected to be almost 20 percent larger had exchange rate variability been the same as in 1970.

This is in many respects a surprising result, given the rather mixed conclusions that emerged from other studies, and the question naturally arises how robust it is with respect to changes in the specification of Abrams' model. In a subsequent paper, Abrams (1980b) presented results based on quarterly exchange rate variability, using real rates. This latter study, which used the same data base, found a much weaker association between exchange rate variability and trade flows. Not only was the statistical significance of the relationship much less, but the size of the coefficient was also considerably smaller. A similar simulation to the previous one suggested that the extent of trade loss in 1976 was only of the order of 1 percent. Given the revealed sensitivity of his results, Abrams cautions against drawing strong conclusions.

Another paper using cross-section analysis is that of Thursby and Thursby (1981), who attempted to see whether the change in the export/gross national product ratio over the period 1973–77 varied between countries depending on the variability in their exchange rates. They employed both nominal and real exchange rates, and used both wholesale and consumer prices as deflators. In none of the tests was exchange rate variability found to be significant.

A somewhat more sensitive test performed by Thursby and Thursby involves disaggregating trade flows by export destination, and pooling data for five years. This gives them 95 observations for each country (exports to 19 trading partners in each of five years). Bilateral exports (in value terms) are made to depend on bilateral exchange rate variability, relative income levels, and the change in the exchange rate. Three statistical measures of variability and three different exchange rate series (one nominal and two price adjusted) are used. There are thus nine separate variability series for each of the 20 countries—180 equations in all. Exchange rate variability is found to be negatively correlated with trade volumes in almost 90 percent of the cases reviewed. Approximately half of these cases are significant at the 95 percent confidence interval, lending some support to the hypothesis that exchange rate uncertainty inhibits trade.

An interesting feature of the Thursbys' results is that no significant impact from exchange rate variability is detected from aggregated data, yet a pattern of significant effects tends to show up when bilateral flows are identified separately. The Thursbys suggest that this is consistent with exchange rate variability affecting the pattern, but not the overall volume, of trade for each country. This does not seem entirely plausible: if a higher degree of exchange rate variability systematically caused a reduction in bilateral trade flows, then one would expect the country whose average variability had increased most would tend to have a lower export/gross national product ratio. On the whole, it seems more likely that if the phenomenon suggested by the disaggregated equations actually exists, and variability does affect trade flows, it is not strong enough to emerge in a significant manner in more aggregated equations, where its influence is likely to be overwhelmed by other factors.

The Evidence from Surveys

An alternative method for obtaining some impression of the effect of exchange rate variability on trade flows is simply to poll participants in international trade. This method has a number of obvious drawbacks: the responses depend to some extent on the nature of the question, and being an expensive technique the samples may be small and/or the responses insufficiently considered for great confidence to be placed in them. Nevertheless, sample surveys provide the only opportunity to assess directly what participants in international markets believe to be the effect on their behavior of exchange rate variability. Furthermore, they are clearly superior to anecdotal evidence by which the perceived experience of individual traders is extrapolated to derive general conclusions.

An early such survey was conducted by the Federal Reserve Bank of Boston (Fieleke, 1971) following the

floating of the Canadian dollar. The questions revolved around whether the greater variability of the Canadian dollar in the year and a half following its floating on June 1, 1970 had led to greater costs in transactions with Canadian residents, or had otherwise inhibited trade. One hundred and fifty-six U.S. companies trading with Canada responded to the questionnaire, and none of them reported having decided against entering into a transaction with a Canadian resident on the grounds that forward cover would be too difficult or expensive to obtain. On the basis of this and other questions, Fieleke (p. 187) concluded that "the evidence presented in this study does not support the claim that international trade is impaired by flexibility in the exchange rate." It should be noted, however, that the period of flexibility covered by the survey was short, the degree of actual variability in the U.S./Canadian rate limited, and the questionnaire rather specifically directed to the adequacy of forward market facilities. Thus, while it is true that the survey did not reveal evidence of adverse effects from exchange rate variability, neither should it be taken as strong confirmation that such effects do not exist.

A later study sponsored by the Conference Board (Duerr, 1977) did not attempt to measure costs but focused more on the various alternative hedging mechanisms. A panel of 75 representatives of major U.S. manufacturing firms participated in the survey, which did not, however, pose specific questions allowing an easy classification of responses. In summarizing the views of panelists, Duerr notes (p. 2) that "the great majority of panelists cooperating in this survey agree that the system of floating exchange rates . . . has made the practice of international business much more difficult." As evidence of this, he quotes three statements of panelists, each of whom seems to be more concerned about substantial swings in exchange rates than about short-term variability.

Although the results of the Conference Board study reveal a much less sanguine assessment of exchange rate flexibility than the Federal Reserve Bank of Boston survey, the two are not necessarily inconsistent. By the time of the Conference Board study, floating exchange rates had become generalized, and the amplitude of fluctuations was much greater than the earlier movements of the Canadian dollar against the U.S. dollar. Nevertheless, apart from revealing that exchange rate matters had become a more widespread source of concern to corporate managers, the Conference Board study does not provide much indication of how this might have affected decisions to engage in international transactions.

A more comprehensive study of corporate risk management practices emerged from a survey undertaken by the British North America Committee in 1981 (Blin, Greenbaum, and Jacobs, 1981). Twenty-seven companies domiciled in Canada, the United Kingdom, and the United States responded to the survey, which revealed a wide and growing use of systematic hedging procedures to protect against foreign exchange risk. While recourse to such hedging mechanisms clearly involves costs (in terms of management time as well as direct payments to financial intermediaries), the authors of the study (p. 4) concluded that "the firms interviewed and surveyed for this report . . . have indeed adapted to the reality of unpredictable exchange rates. They do not appear to have refrained from increasing their direct foreign investment in the face of rate uncertainties." The authors did not attempt to reach a similar conclusion on trade, but if they had done so, it would presumably have been similar. Most responding firms reported that they had increased the frequency of price adjustments in response to foreign exchange rate volatility, but only two of twenty-seven felt this imposed any significant costs. Similarly, most respondents did not experience problems in practice with fixed price contracts, and those that did mostly employed hedging mechanisms.

The survey that bears most directly on the issue of whether exchange rate volatility has affected trade is that undertaken by the Group of Thirty (1980). Separate questionnaires were sent to banks (from whom 35 replies were received) and to major international corporations (an unspecified number) in five countries. The paper did not attempt to classify the replies received but rather to provide an analytical interpretation in verbal form. The question most relevant to the subject of this section was as follows: "3. Have floating rates rendered international trade more or less attractive? Have they, in fact influenced the level of your international trade?" (p. 40). All respondents replied that floating exchange rates had had a negligible impact on the level of their foreign trade. Similarly negative replies were given to questions on whether floating rates and the need to manage foreign exchange exposure had led to increases in costs or price, and whether floating had led to a cutback in foreign investment.

Banks were also asked about the effect of exchange rate floating on the costs of international trade and investment in real terms. Most replied that there had been some increase, but that it was minimal, and marginal compared with other sources of instability in the system.

Overall, the evidence from surveys provides little support for the proposition that exchange rate variability has had a major adverse effect on the volume of international trade. For a variety of reasons, however, some of which have already been mentioned, this kind of evidence has to be interpreted with special care. First, the samples are generally small. Second, for the most part they cover large and diversified companies, which are perhaps better able to cope with the uncertainties of exchange rate variability than smaller firms. Third, they are not always addressed to the same question as that discussed here. For example, the Group of Thirty's questionnaire asked all of its questions in terms of "floating" exchange rates

rather than exchange rate variability. One respondent pointed out that floating itself had little effect because if rates had been pegged, they might have been just as unstable. In other words, respondents may have been thinking more of the mechanism by which exchange rates moved rather than the extent to which they moved.

For all these reasons, no strong conclusions should be drawn from the results reported here. Nevertheless, it is of interest that, even in studies undertaken as late as 1980 and 1981, businessmen in general were not reporting significant adverse effects on trade and investment from the system as it was operating then.

V Structure of Output and Investment

In addition to the effects of exchange rate variability on the aggregate volume and pattern of international trade, which have been reviewed in the preceding section, fluctuations in exchange rates can have a potential effect on the structure of output and investment in the domestic economy.

Adjustment

Exchange rate variations may lead to shifts in the allocation of resources as producers gain and lose international competitiveness. To the extent that such variations are temporary and reversible, there may be adjustment costs, since resource shifts often involve temporary periods of unemployment, retraining of manpower, adaptation of plant and equipment, etc. (see Kreinin and Heller, 1974). It may be, however, that producers do not react to exchange rate shifts until they are viewed as being "permanent," so that the resource reallocation that takes place as a result of short-run exchange rate variability is actually quite limited (McKinnon, 1978). The long and distributed lags found in most studies of the effect of relative prices on trade flows suggest that sudden and substantial resource shifts are unlikely in the face of exchange rate movements that are reversed within a short time. The consequence of such short-run movements is more likely to be apparent in the time path of company profits (which may, of course, be regarded as undesirable).

For exchange rate movements of longer duration, it is plausible that trade flows will be affected. The questions we therefore wish to ask are:

(i) Is the volume of resource shifts related to the amplitude of exchange rate movements?

(ii) Has the volume of these shifts been excessive in terms of the operation of the international adjustment process?

The addition of the second question is important, since resource shifts into and out of the foreign sector should be viewed differently when they are responding to an adjustment need (say, a permanent shift in the price of oil) than when they result from temporary and reversible factors that bring about a short-term exchange rate movement.

There appears to be relatively little empirical evidence on this question. Thursby (1981) found no evidence that the adjustment costs faced by Canada were greater under flexible rates than under fixed rates. Adjustment costs in her model were proxied by the volume of resources shifted into and out of the export sector as a result of exchange rate changes. In a later extension of the same model to 19 other industrial countries (Thursby and Thursby, 1981), a generally similar result was found, though in the case of 2 countries in the group, there did appear to be significant costs. However, this test is not quite the same as asking whether exchange rate variability per se (i.e., whatever the exchange rate regime) has had undesirably large adjustment effects.

It does appear that exchange rate variability has been accompanied by greater shifts of resources into and out of the foreign sector. Table 1 presents two alternative measures of the extent of these shifts for the seven major industrial countries during the periods 1960–70 and 1974–82. The first two columns of the table show the variance of the real net foreign balance as a percentage of GDP, while in the last two columns average year-to-year changes in the net foreign balance as a percentage of GDP are set out. Because they comprise variations in both export and import shares, movements in the net

Table 1. Major Industrial Countries: Fluctuations in the Real Net Foreign Balance as a Proportion of Gross Domestic Product[1]

(In percent)

	Annual Variance		Average Annual Change[2]	
	1960–70	1974–82	1961–70	1974–82
Canada	1.06*	3.89*	0.8	1.3
United States	0.43	0.47	0.3*	0.8*
Japan	0.39*	7.05*	0.8*	1.5*
France	0.77	0.93	0.6*	1.1*
Germany, Fed. Rep. of	0.90	1.78	0.9	1.2
Italy	1.90	2.85	0.9	1.2
United Kingdom	0.48*	1.80*	0.7*	1.3*

[1]Data marked by asterisks are significantly different at the 95 percent confidence level.

[2]Absolute change from preceding year.

foreign balance (in real terms) are a comprehensive indicator of foreign sector resource shifts.

For each of the seven countries, and according to both of the measures, variations in the net foreign balance were greater during the floating exchange rate period than during the 1960s. This, of course, is not the same as saying that the greater fluctuations were caused by increased exchange rate variability. Other economic developments of recent years, such as the sharp rise in energy prices and higher inflation, also undoubtedly played a role. While it may be impossible to sort out the differential effects with any degree of certainty, it is probably not unreasonable to suggest that exchange rate shifts were a contributing factor, at least to some extent.

Certainly the increase in the variance of the net foreign balance from the earlier to the later period has been quite pronounced. The average year-to-year change during 1974–82 was over 1 percent of GDP in every country except the United States, and in Japan it was 1.5 percent. In contrast, during the earlier period these changes averaged only 0.7 percent of GDP for all the countries of the group. Taking the square root of the variance to find the standard deviation of the net foreign balance, the increase in the average for the group was from 0.89 percent of GDP during 1960–70 to 1.52 percent during 1974–82.

Company Structure

It is sometimes argued that exchange rate variability bears most harshly on smaller companies, since the kind of uncertainty that it generates imposes proportionately greater costs on small units than on large units (Helleiner, 1981). There are two main reasons for this. First, exchange rate variability imposes certain costs that are essentially fixed in nature—for example, the need to assign management time to the appraisal of foreign exchange trends and the making of foreign exchange decisions. Since these costs do not necessarily rise with the volume of international transactions a company undertakes, they represent a smaller share of costs for companies with a large volume of international transactions. Second, larger companies find it easier and more practicable to hedge against the risks of currency fluctuations. Being large, they are likely to have more diversified production sources and markets in the first place; and if they do not, it is perhaps easier for them to plan the growth of their operations in such a way as to minimize their exposure to currency fluctuations. The existence of production and/or marketing subsidiaries in a number of different currency areas also enables large companies to allocate their financial assets and liabilities more easily toward currencies that offer security against loss or the possibility of profit.

McCulloch (1983) notes that input price uncertainty is a recognized motive for vertical integration. To the extent that exchange rate variability adds to this uncertainty, it would constitute an added motive for foreign direct investment, and a stimulus to the growth of vertically integrated and geographically diversified multinational enterprises. McCulloch considers that the expansion of U.S. direct investment in Canada during the period in which the Canadian dollar was floating, as well as more recent Japanese investments in the United States, fits this explanation. However, it is not difficult to think of alternative plausible explanations for such an investment pattern, such as the growing size, on technological grounds, of optimum production units, the desire to build security against protectionist measures, and simply changes in comparative advantage.

It is also sometimes argued that the sheer size of large companies gives them greater strength to withstand the losses that are brought about by temporary adverse movements in exchange rates. However, since the losses of large firms are themselves likely to be larger, this argument depends on large firms systematically holding (or having access to) financial reserves that are larger, as a proportion of sales, than smaller companies. Even if such a tendency existed, it should be noted that smaller firms typically have more flexibility to cut back costs (by releasing labor or reducing their unit cost) during a downturn in demand than do larger firms.

Evidence on these various subjects is scanty. In two surveys (Duerr, 1977; Blin, Greenbaum, and Jacobs, 1981) respondents were specifically asked how they had reacted to the risks created by greater currency volatility. The great majority of nonfinancial trading companies had undertaken administrative reorganizations that involved either the creation of new departments to monitor foreign exchange exposure or the allocation of greater amounts of senior management time to analysis and decisions involving foreign exchange exposure. They also noted that a variety of hedging mechanisms had been employed to protect their firms against the risk of loss or to enhance the chance of profit. These mechanisms included greater use of forward cover, more systematic distribution of liquid assets among different currencies, diversification of production sources, and others.

Respondents to surveys generally discounted the impact that uncertainty, and the need to hedge against it, had on their external operations. They were, of course, for the most part large corporations, so that it is difficult to tell whether effects that seemed small to them would loom larger for smaller units. At an anecdotal level, it is possible to identify small producers that have traced their difficulties to currency fluctuations. De Lorean Motor Company and Laker Airways, for example, both saw themselves in part as victims of the strong (and subsequently partially reversed) rise of sterling. Their competitors were mostly larger companies with more diversi-

fied costs and revenue sources, as well as more substantial financial resources.

Individual examples, while suggestive, do not in themselves make the case for the adverse effects of currency fluctuations, since it is impossible to know the extent to which a particular company's difficulties stem from other factors.

International Specialization

A mechanism similar to the one that generates a concentration of output in large firms could also work to encourage a greater degree of international specialization. Where producers of a particular commodity in a given country are only marginally competitive (whether because of the factor endowment of the country or because of efficiency considerations in the industry concerned), the additional loss of competitiveness stemming from an adverse shift in the exchange rate could cause them to drop out of international competition. Given the large start-up costs in many modern industries, exchange rate swings may accentuate the tendency toward international concentration in production.

This factor would, of course, tend to increase trade levels over time, as countries specialized more in the production of commodities in which they received increasing economies of concentration and scale. However, the diminution of competition, and its incentive to increasing productivity and technological innovation, could eventually be detrimental to output and welfare. Such considerations can give rise to protectionist pressures, such as those coming from certain sectors of the automobile and electronics industries in Europe and North America, which feel that the market shares recently lost to Japanese producers will be hard to recoup, even if the Japanese exchange rate were to move up again.

Evidence on the effect of exchange rate variability on international specialization is not easy to collect. Table 2 provides information on the concentration of exports within a group of 14 industrial countries. Taking 19 separate commodity categories at the two-digit Standard International Trade Classification (SITC) level, there is little evidence that country concentration (defined as the share of exports accounted for by the three largest exporters) has increased for the majority of commodities over the period of floating exchange rates. In only 4 out of the 19 cases did this measure of concentration rise. During the prefloating period, by contrast (i.e., from 1961–63 to 1968–70), export concentration increased in half the country categories.

Sectoral Allocation of Resources

As well as influencing specialization within the industrial sector, the uncertainty costs associated with exchange rate variability could influence the allocation of resources between traded goods and nontraded goods production within the economy. It is, after all, not simply the production of goods for export that is vulnerable to the uncertainties of exchange rate movements, but of any goods that enter into competition with foreign sources of supply, whether in domestic or export markets. Indeed, in many cases, it is production for the domestic market (e.g., automobiles, electronic equipment) where the problems of loss of international competitiveness have given rise to the most difficult adjustment requirements.

If the price at which traded goods can be marketed becomes more uncertain, this uncertainty will be reflected either in a higher average price or a reduced level of supply. In either case, it could be expected that there would be a transfer of resources toward the less volatile sector of nontraded goods production. Such a tendency would show up, statistically, in a reduction in the size of the traded goods sector, and also in an increase in its average profitability (to compensate for the greater variance in profits). Another consequence could be a reduction in the level of investment. If manufacturing industries have higher capital/labor ratios than the service sectors, then a shift in the pattern of output away from the capital-intensive industries would result in a declining rate of capital formation associated with a given level of output. It might also be expected that, even within industries, there would be a tendency for investment to decline, as businessmen hesitated to put in place long-lived capital equipment that might be rendered uneconomic (temporarily or permanently) by unexpected movements in exchange rates.

Testing these hypotheses presents a number of difficulties. In the first place, there is no clear distinction between industries producing traded goods and those producing nontraded goods. Rather, a country's output can be thought of as lying along a spectrum of greater or lesser exposure to foreign competition. In Chart 6, two alternative approximations of the traded goods sector of the economy are presented—the manufacturing sector alone and manufacturing plus agriculture and mining—and the output of these sectors as a proportion of GDP in the seven major industrial countries is plotted for the period 1960–81. A second problem in interpreting the data in Chart 6 is that, other things being equal, the shares of these sectors would probably not be expected to remain constant over time. Just as Engel's Law predicts a declining share of expenditure on food as income rises, the income elasticity of demand for services is believed to exceed that for goods, which would cause a secular fall in the proportion of total output emanating from the

Table 2. Industrial Countries: Changes in Export Concentration, 1961–81[1]
(In percent)

	Proportion of Total Exports Accounted for by Three Largest Exporters in 1968–70				
SITC Code[2]	1961–63	1968–70	Change	1979–81	Change
61	53.0	50.0	−3.0	44.7	−5.3
62	50.0	46.8	−3.2	45.4	−1.4
63	49.0	46.3	−2.7	32.6	−13.7
64	66.2	58.0	−8.2	47.2	−10.8
65	38.9	45.2	6.3	44.7	−0.5
66	48.6	54.4	5.8	53.8	−0.6
67	48.1	54.2	6.1	56.7	2.5
68	54.9	49.7	−5.2	35.2	−14.5
69	49.6	49.5	−0.1	45.6	−3.9
71	69.5	61.5	−8.0	55.6	−5.9
72	53.9	55.1	1.2	59.0	3.9
73	51.3	55.7	4.4	45.2	−10.5
81	49.2	50.8	1.6	49.8	−1.0
82	34.6	53.9	19.3	56.7	2.8
83	57.9	65.4	7.5	65.1	−0.3
84	48.2	49.5	1.3	47.3	−2.2
85	69.4	72.9	3.5	73.1	0.2
86	64.3	58.7	−5.6	43.0	−15.7
89	57.7	52.0	−5.7	49.8	−2.2

[1]Countries are Austria, Belgium, Canada, Denmark, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the United States.

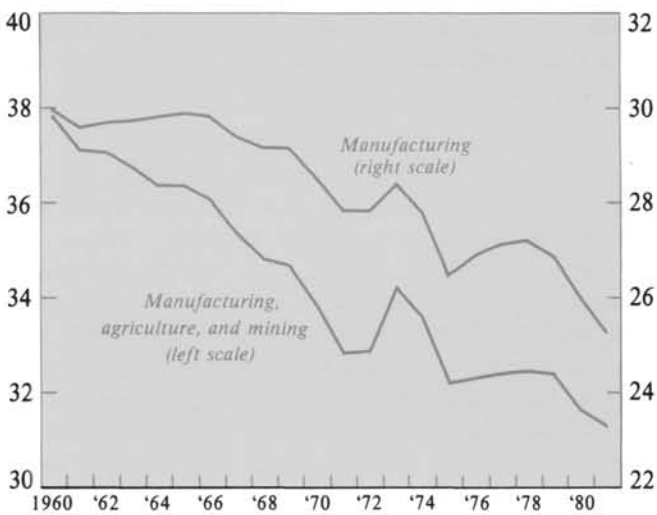
[2]Standard International Trade Classification (SITC) codes are 61 leather and leather manufactures; 62 rubber manufactures; 63 wood manufactures (excluding furniture); 64 paper and paper manufactures; 65 textile yarn and fabrics; 66 nonmetallic mineral manufactures; 67 iron and steel; 68 nonferrous metals; 69 metal manufactures; 71 nonelectrical machinery; 72 electrical machinery and appliances; 73 transport equipment; 81 plumbing, heating, and lighting fixtures and fittings; 82 furniture; 83 travel goods and handbags; 84 clothing; 85 footwear; 86 professional and scientific instruments, photographic and optical goods, and watches and clocks; and 89 miscellaneous manufactured articles.

goods sector. A third complication is that manufacturing and mining production is more strongly affected by the business cycle than is the output of the economy as a whole. These cyclical effects are particularly apparent in Chart 6 in the periods 1973–75 and 1980–81.

Looking at manufacturing production only, it does appear that its share of aggregate output in the major industrial country group dropped more rapidly during the 1974–81 period of floating exchange rates than during the 1960s. If one looks at the broader measure of the traded goods sector, the situation seems to be the reverse, with the relative decline of traded goods output slowing during the floating exchange rate period. To abstract from cyclical influences by examining only periods of more or less steady growth, 1960–69 (average growth of 5.0 percent) can be compared with 1977–79 (4.1 percent average growth). Manufacturing production declined relative to GDP at about the same pace in both periods, whereas the GDP share of manufacturing, agriculture, and mining stabilized during 1977–79, in contrast with its rather steady fall during the earlier period.

While the evidence in Chart 6 is by no means conclusive, it does not provide any strong support for the proposition that the uncertainty associated with exchange rate variability has accelerated the shift of resources out of the traded goods sector. Such an effect might, however, be revealed if it were possible to construct a more reliable measure of traded goods output.

Chart 6. Major Industrial Countries: Traded Goods Output as a Proportion of Gross Domestic Product, 1960–81[1]
(In percent)



[1]Weighted average for the seven major countries based on the U.S. dollar value of gross domestic product.

Investment

Empirical evidence on whether exchange rate variability has had a deleterious effect on investment is difficult to come by. The level of investment in an economy is determined by many factors, both social and economic, and the effect of any individual factor is not easy to isolate. Moreover, investment decisions also seem to be heavily influenced by such intangibles as "business confidence."

The alleged negative impact of exchange rate fluctuations on investment (Hieronymi, 1983) could occur through several channels. By increasing business uncertainty, exchange rate variability could directly dampen producers' willingness to undertake longer-term commitments to expand productive capacity. And if, as a consequence of greater risk in traded goods production, businessmen become more inward-looking, the resultant focus of output in the nontraded goods sector could depress profit margins and the incentive to invest there also. Moreover, nontraded goods output is concentrated in services, which generally have lower capital/labor ratios than traded goods production. Thus, investment requirements may be less in the nontraded goods sector, and the scope for productivity-increasing technological innovation may also be less.

Kenen (1979) investigated the effect of exchange rate variability on investment by testing whether the rate of growth of investment in 16 industrial countries between 1973–74 and 1976 was systematically associated with the month-to-month volatility in exchange rates. Each of the four equations he estimated had the right (negative) sign, and one achieved significance at the 95 percent confidence level. (Similar results are obtained when the investment growth considered is that between 1975 and 1976). More puzzling is the fact that the significant association is found with nominal but not with real exchange rate variability.

To further investigate the relationship between exchange rate volatility and investment, Table 3 compares nonresidential fixed capital formation in the seven major industrial countries in the periods before and after the move to more flexible rates. While the data in Table 3 do not shed light on the extent to which the focus of investment might have shifted to the nontraded goods sector during the floating exchange rate period, they do cast doubt on the often-stated contention that exchange rate turbulence in recent years has led to a sharp reduction in the rate of business investment. This table shows gross fixed capital formation (excluding residential construction) as a proportion of GDP for the periods 1960–70 and 1974–82. While investment rates were down significantly in the latter (floating rate) period in the Federal Republic of Germany and Italy, and somewhat in the United States, they were up sharply in Japan and slightly in Canada, France, and the United Kingdom; for the group as a whole the rate of investment was little changed.

These data are, of course, subject to differing interpretation. The substantial increase in investment in Japan may have reflected the country's attempt to adjust to higher energy prices, and, if those prices rendered a large portion of the existing capital stock uneconomic, net investment may have risen considerably less than gross investment (or even have declined). Unfortunately, capital consumption allowances do not provide a reliable measure of the actual retirement of plant and equipment, and therefore accurate information on net additions to the capital stock cannot be derived from the national ac-

Table 3. Major Industrial Countries: Real Nonresidential Gross Fixed Capital Formation as a Proportion of Gross Domestic Product, 1960–82
(In percent)

	Average 1960–70	Average 1974–82	Change
Canada	17.3	17.6	0.3
United States	14.7	14.2	−0.5
Japan	22.0	25.4	3.4
France	15.7	15.9	0.2
Germany, Fed. Rep. of	16.2	14.9	−1.3
Italy	15.3	13.1	−2.2
United Kingdom	14.9	15.2	0.3
Weighted average[1]	16.3	16.5	0.2

[1]Weighted according to the U.S. dollar value of gross domestic product in 1982.

counts data. On the other hand, very sharp increases in real wages in several European countries during the early 1970s are believed to have seriously undermined investment incentives in those countries, and the weakness of German and Italian investment rates during 1974–82 may have reflected this factor more than the impact of fluctuating exchange rates. Moreover, other things being equal, one might have expected the recessions of 1974–75 and 1980–82 to have led to lower investment ratios during the post-1974 period. In view of these opposing factors, about all that can be said with certainty is that there is no real evidence that the rate of investment in the industrial world as a whole has been weaker during the period of floating exchange rates than it was earlier.

VI Macroeconomic Policy

Besides the effect which exchange rate volatility can have on the decisions of individual economic agents in a given macroeconomic environment, exchange rate factors can themselves influence the environment in which the international economy functions. They can influence the transmission of price and income effects across national economic boundaries; they can change the constraints on domestic macroeconomic policy formulation; and they can give rise to changes in the climate of protectionist pressures.

Inflation

It is well known that changes in exchange rates have implications for the price level. A depreciation, by increasing import prices and exerting upward pressure on the price of domestically produced traded goods, tends to bring about an increase in the overall domestic price level; conversely, an appreciation in the exchange rate exerts downward pressure. This in itself is not sufficient to conclude that fluctuations about a given trend in the exchange rate will cause the rate of inflation to be different than if no such fluctuations took place. In order to reach such a conclusion, it is necessary that exchange rate appreciations and depreciations have asymmetrical effects on prices. This could cause the price level to ratchet upward, if increases in prices that resulted from depreciation were less than fully reversed during subsequent appreciations.

This proposition has been attributed to Laffer and Mundell (see Wanniski, 1975), who apparently see it as a likely consequence of the "law of one price." The argument goes as follows: the increasing integration of world markets tends to produce a similar price level for traded goods in all markets; this means that relative price levels in local currencies must adjust to offset movements in nominal exchange rates; and because of an institutionally induced downward inflexibility of prices, this adjustment takes place mainly through an upward movement of local prices in countries whose currency is depreciating.

Others (e.g., Shields, Tower, and Willett, 1975; Kenen, 1979) have noted another mechanism by which exchange rate volatility might produce a systematic tendency toward inflation. If countries with depreciating exchange rates accept the stimulus to domestic demand caused by improved competitiveness while countries with appreciating currencies try to offset demand effects through stimulating domestic demand, the net result could be an increase in global demand relative to global supply. Nowadays, however, it seems less likely that governments would use demand management policies in such an overt way to maintain nominal aggregate demand at the expense of price stability objectives.

Goldstein (1977) provides tests of these possible asymmetrical effects using data for the period 1958–73 for five major industrial countries, both separately and on a pooled basis. His conclusion is that " . . . the empirical tests . . . are *not* supportive of the hypothesis that negative changes in import prices have a significantly different proportionate effect on domestic prices than do positive changes." Of course, it should be noted that Goldstein's analysis is based on data for a period before floating exchange rates, and when variability of real and nominal exchange rates was considerably less than in the more recent period. It could be the case that the large changes in foreign trade prices that have characterized the past ten years or so have had more than proportionate effects on domestic price levels. There does not appear to be any direct evidence bearing on this proposition, but indirect evidence does not suggest that the elasticity of response to exchange rate changes is systematically different when the change is large than when it is small. Goldstein and Khan (forthcoming) found no evidence that demand elasticities or response lags for imports were affected by the absolute size of price changes for imports; and in an earlier study of price behavior in the United Kingdom, Goldstein (1974) found that large changes in import prices did not have a greater proportionate effect on retail prices than did small changes.

It is also possible that, by generating shifts in the structure of demand, exchange rate movements result in more inflation for a given level of aggregate demand, since prices will tend to rise by more in sectors where demand increases than they will fall in sectors where

demand declines. The argument has been advanced by Witteveen (1974, pp. 113–14) as follows:

> Exchange rates influence the distribution of demand between domestic and foreign products, and rate fluctuations will involve demand shifts which will later in some measure be reversed. These demand shifts may well exert a ratchet effect on inflation. . . .[S]hifts in purchase patterns brought about by the exchange rate changes, or even the expectation of such shifts, may tend to raise prices in the countries of depreciating currency without effecting a corresponding price reduction in the countries of appreciating currency.

It is also possible that institutional arrangements for administered prices (e.g., under the European Economic Community's Common Agricultural Policy) may impart an upward bias to particular prices as a result of exchange rate changes (Marsh and Swanney, 1980).

Empirical testing of the influence of exchange rate variability on inflation has usually proceeded by indirect means. Direct tests of such a relationship require one to "control" for other factors affecting the inflation rate. This is particularly difficult to do, not least because of difficulties in identifying the channels by which inflation is generated and sustained in an economy. For example, if an external disturbance, say an unforeseen decline in the exchange rate, causes an increase in the domestic price level, this may cause workers to seek wage increases to protect real incomes. The authorities may allow this kind of inflationary pressure to be accommodated (at least to some extent) by an increase in the money supply. This in turn will tend to perpetuate the inflationary process set in motion by the initial disturbance. It is not clear how much the continuance of inflation should be blamed on the initial disturbance, or on the reaction to it of the monetary authorities. While in principle it can be said that over the long run the price level in domestic currency is under the control of domestic monetary authorities, disturbances in the economic environment can worsen the short-term trade-off between price stability and other economic objectives, thus causing the authorities to acquiesce in a higher rate of price increase than they would have accepted in the absence of such disturbances (Bond, 1980).

Bearing these caveats in mind, it is of interest to consider whether in practice there appears to be any broad association between exchange rate instability and the level of inflation. This is done in Appendix III, by specifying equations that attempt to measure the effect on inflation of domestic and external policy developments (specifically monetary growth and the level of the exchange rate) and adding a variable designed to capture exchange rate variability. Of the seven countries for which results are presented in Appendix III, six exhibit a positive association between exchange rate variability (defined as the standard deviation of the exchange rate during the previous five quarters) and inflation. In no case, however, is this association statistically significant at the 95 percent confidence level.

Policy Constraints

From the discussion in the previous section, it is clear that, if exchange rate variability has systematic effects on inflation, it is through its adverse implications for the constraints facing economic policymakers. That is, a worsening in the trade-offs among economic objectives could cause national authorities to opt for policies that could lead to higher rates of price increase. By the same logic, it follows that such a deteriorating trade-off could lead to a retreat from other objectives also, for example, in the field of the level and rate of growth of economic activity.

One of the initial arguments in favor of a system of flexible, rather than fixed, exchange rates was that economic policy would be freed from the requirement of stabilizing the exchange rate and authorities would be able to concentrate on objectives more directly related to economic welfare (Johnson, 1969). Of course, this argument depended on exchange rates being free to move, not on their actually moving by significant amounts. The relevant question for the subject of this paper is whether actual fluctuations in exchange rates have had adverse implications for macroeconomic policy formation.

One such effect has already been discussed: that on inflation. Another concerns the related possibility that exchange rate movements can become self-perpetuating, and give rise to vicious or virtuous circles. The "vicious circle" hypothesis, as set out in Section II above, argues that in the short run an exchange rate depreciation will both push up the domestic price level and worsen the balance of payments (the latter because initially the price effects on the trade balance will more than offset volume effects, which are subject to lags). Higher prices will push up wage costs (especially when wage contracts have cost of living provisions or indexation clauses), while balance of payments weakness will exert further downward pressure on the exchange rate. Thus a vicious circle is set in motion from which, it is argued, it is very hard to escape. For countries with strong currencies, a "virtuous circle" of low inflation and balance of payments strength results.

If countries do not fix their exchange rates, it is maintained, the only way the adverse consequences of a vicious circle can be avoided is through strong action affecting domestic demand. Since J-curve effects cause an exchange rate depreciation to have an initial adverse effect on the trade balance, countries will have to have relatively greater resort to demand deflation to improve their payments balance, and arrest the vicious circle.

While there is little reason to doubt that economic disturbances generate a momentum that carries their effects beyond the initial direct consequences, it is harder to maintain that exchange rate variability alone can start, and then maintain, a vicious circle of substantial proportions. In the 1977 Annual Report of the Bank for International Settlements, it was observed that

> The. . .striking fact. . .is that both the United Kingdom and Italy got *into* the vicious circle because of domestic developments. . . .one need not be an orthodox monetarist to regard the 30 per cent rise in the money supply (M3) in 1973 as the main factor behind the sharp decline in the value of sterling during the same year.

Regarding the perpetuation of vicious circles, most studies suggest that a depreciation of the exchange rate, even in countries with substantial indexation in wage contracts, does not cause a fully offsetting increase in domestic costs in the short term (Bond, 1980). Thus, the competitive advantage provided by exchange rate depreciation tends to endure long enough for volume effects on trade flows to exceed price effects, and thus to bring about an improvement in the balance of payments.

Protectionism

One of the most disturbing trends in recent years has been the increase in protectionist pressures and actions, particularly in a number of the major industrial countries that had previously been in the vanguard of the movement toward more liberal trade.

During the fixed exchange rate period, it was often contended (e.g., Friedman, 1953; Bergsten, 1972) that greater flexibility of exchange rates would work to reduce protectionist tendencies by weakening the balance of payments justification for import restrictions. Nowadays, however, it is recognized that the actual behavior of exchange rates has had domestic consequences that may have substantially increased pressure for protection on the part of domestic industries. Bergsten and Williamson (1983), for example, note that when a currency is overvalued employment in traded goods industries is threatened, and political realities make governments receptive to requests for protection. When the exchange rate shifts toward undervaluation, there is no comparable focus of disadvantaged interest groups to press for the removal of trade barriers. Not only is there relatively weak pressure for easing restrictions, there may also be a shift of resources into temporarily competitive industries. These activities may cease to be competitive as the exchange rate moves back once again, creating pressure for further measures of protection. Thus, prolonged deviation of exchange rates from fundamental equilibrium generates protectionist pressures, and asymmetrical responses compound the problem by failing to produce countervailing pressures. From this, Bergsten and Williamson conclude that the prevalence of equilibrium exchange rate levels is an essential ingredient in trade liberalization. While the interrelationship between an open and stable exchange and trade system is well recognized, some other observers take the argument further, and view the introduction of restrictive trade measures as an inevitable consequence of inappropriate exchange rate levels.

Most observers would agree that exchange rates have implications for the strength of protectionist pressures, though the argument is usually couched in terms of the exchange rate level rather than its variability. An overvalued exchange rate can adversely affect the balance of payments, or domestic employment opportunities, or both, and trigger demands for protection from sectors adversely affected by these developments. An appreciating exchange rate will hurt, ceteris paribus, export and import competing industries in relation to foreign competitors. While a given exchange rate, or change in the exchange rate, is the same for all sectors and firms in the economy, its impact on the individual firm/sector's competitive position will differ according to the initial profitability position, supply elasticity, etc. Sectors suffering from the severest protectionist pressures may be those with long-standing problems of structural adjustment, which recession and/or exchange rate changes tend to aggravate.

There are, however, difficulties in establishing an unequivocal relationship between exchange rates and the stance of trade policy. Apart from the problem of determining the exchange rate that would correspond to "fundamental" equilibrium, it is generally difficult to separate the effects on trade policy of swings in exchange rates from other factors affecting competitiveness, such as demand shifts, technological changes, and sensitivity to the business cycle. Many of the current protectionist measures have been sector or country specific, rather than across the board, and influenced by more fundamental and long-lasting shifts in competitiveness arising from factors other than exchange rate shifts. In the textiles and clothing sector, for example, restrictions have been directed specifically against developing countries with a comparative cost advantage in this sector, and have persisted for a quarter of a century during which they have become progressively more severe, irrespective of the abandonment of the par value system and the swings in exchange rates among major currencies that have taken place during this period.

Restrictions may be introduced to protect domestic industries suffering from overcapacity or depressed demand; an additional motivation may have been the perceived "unfairness" of subsidization practices or import restrictions maintained by exporting countries. The steel sector is a case in point; the restrictiveness of trade policy in this sector has been increasing in both the United States and the European Community since the mid-

1970s, notwithstanding the exchange rate fluctuations experienced by their currencies over this period. Protection of the agricultural sector is fairly well entrenched in most industrial countries and is to a significant extent motivated by sociopolitical reasons. The exchange rate relationships observed in the past two decades among the U.S. dollar, the Japanese yen, and the key European currencies do not appear to explain the relatively high and, some observers would argue, increasing agricultural protection in many of these countries. In the automobile sector, a shift in U.S. demand to smaller, fuel-efficient cars following the energy crisis was an important factor in the loss of market shares of U.S. automakers, which culminated in the introduction of the export restraints by Japan on shipments to the United States; the widening of the restraints to the Canadian market was prompted importantly by Canadian concerns about trade diversion in this sector.

Strategic considerations appear to be the main factors in determining the stance of trade policies in the field of high technology. Examples of protectionist actions can be cited for periods of exchange rate shifts as well as for other periods; during the former, the exchange rate argument (which often emphasizes bilateral exchange rates) is, understandably, played up by the industry seeking relief from foreign competition, particularly because the industry itself cannot be "faulted" for loss of competitiveness owing to exchange rate factors.

There are counterexamples where moves toward liberalization were introduced despite exchange rate variability and associated trade uncertainties. Measures to improve market access have been negotiated or implemented during periods when exchange rate developments would appear to militate against a more liberal trade policy. For example, the Multilateral Trade Negotiations took place during a period (1973–79) of major swings in exchange rate relationships. The Generalized System of Preference was phased in by the industrial countries over a ten-year period beginning in 1966 which, at least in its latter stages, was similarly characterized by major exchange rate fluctuations.

A further point is that not only economic considerations but also institutional and political factors play an important role in determining the extent to which protectionist pressures translate themselves into restrictive trade policies. For example, industries can use the existing legislative provisions for protection from foreign competition more or less intensively, depending in part upon their perception of the government's attitude in accommodating or rejecting requests for protection. Accommodation of the political pressure for protection in one sector can trigger heightened demand for protection in other sectors, and prompt criticism of "unfairness" in trade policy if the other sectors are denied protection. To the extent that an exchange rate is above its trend or equilibrium value, the coalition of interests supporting protectionist actions will tend to broaden.

On the other hand, restrictive trade measures can be delayed or avoided if governments can argue convincingly that such measures would be detrimental to national welfare and international economic cooperation. For example, the U.S. Trade Act of 1974 authorized a four-year suspension of countervailing duties on subsidized imports where this was needed in order to promote the ongoing trade negotiations on a GATT subsidies code. Thus, it would be a fallacy to assume that governments inevitably succumb to protectionist pressures. In the final analysis, the openness of markets depends critically on the strength of a government's adherence to free trade principles. Although exchange rate factors can provide industries seeking protection an additional argument for countering deteriorating market shares of the domestic industry, a government's trade policy is likely to be influenced by its assessment of the political risk of not accommodating the demand for restrictions, against the likelihood of retaliatory restrictions by other countries and greater demands for protection from other domestic industries.

Another point to be borne in mind is the capacity of inappropriate exchange rate movements and protectionist tendencies to be mutually reinforcing. An exchange rate shift that leads to deteriorating competitiveness inevitably leads to protectionist pressures from the industries most seriously affected. Government acquiescence in such pressures tends to validate the exchange rate movement that has occurred, since restrictions take the place of market forces in ensuring payments equilibrium at the new exchange rate. The process can be carried further if those industries that have not gained protection, and have thus experienced an erosion in competitiveness, press for equal treatment. Additional import restrictions will then make for an even higher exchange rate level.

VII Further Observations

The foregoing analysis has revealed relatively little in the way of directly measureable adverse effects of exchange rate variability on trade. This might seem surprising in view of the widely accepted proposition that uncertainty is bad for economic activity, and the obvious fact that, for businessmen, exchange rate variability is a source of uncertainty for which they must allow in their business decisions.

Part of the explanation for the lack of positive findings may lie in the inadequacy of the statistical techniques employed. There is always room to refine the empirical measures of exchange rate variability, and the lags with which changes in the economic environment affect behavioral relationships may be too long and variable to be easily captured by standard analytical techniques. Nevertheless, given the wide variety of empirical testing that has been performed, it seems unlikely that, as far as data up until the early 1980s are concerned, more intensive or sophisticated tests would show a greatly different result.

The reason for this probably lies in the difficulty of trying to separate the independent effect of exchange rate variability from the impact of other changes in the economic environment (Williamson, 1983). Moreover, as McCulloch (1983) points out, of the large number of risks involved in commercial activity, exchange rate variability may be a relatively minor one. These other risks arise not only from the microeconomic uncertainties of business activity but also from uncertainties concerning the level and variability of inflation, the amplitude of the trade cycle, the need for balance of payments adjustment, and so on. These factors can have direct and substantial effects on the growth of world trade, and also affect exchange rate relationships. This impact on exchange rate relationships may magnify or offset the direct impact on trade flows, but in any event it will not be related in a simple manner to any straightforward measure of exchange rate variability. In principle, it would be desirable to measure that part of exchange rate variability that was independent of, and in addition to, the uncertainty already present as a result of the volatility of other variables. No satisfactory way of making such a measure has yet been proposed.

In this connection, it is worth recalling that the exchange rate is a price, and like any other price it appears as exogenous to any individual market participant but endogenous to the aggregated system of market demands and supplies. A stable price reflects stability in the underlying system, and an unstable price reflects instability in supply and demand. It should be recognized that, although varying, the price is nevertheless fulfilling a stabilizing function, equalizing supply and demand. If the price were somehow prevented from moving, it would be unable to fulfill the function of calling forth additional supply and restraining demand (or vice versa), and there would be a disequilibrium between supply and demand and an inappropriate level of transactions. Translated to the exchange market, the implications of this are that exchange rate variability is a symptom of unexpected shifts in demand relative to supply, and an absorber of part of the impact of such shifts (Mussa, 1982). It is not in itself independent of the transactions that are influenced by it.

The foregoing argument suggests the response that if the exchange rate system is supposed to promote trade between countries but actually discourages useful exchange because of uncertainty, should there not be an alternative way of ensuring continuous equilibrium between supply and demand? Furthermore, when exchange rate movements are reversible, and when they are clearly inconsistent with current account equilibrium, would it not be better to smooth such movement rather than permit temporary false price signals to distort the allocation of resources?

These questions approach, and in some respects step outside, the limitations that have been placed on the scope of this paper. Nevertheless, it is worth noting that, while the case for smoothing exchange rate fluctuations is strong in principle, there are considerable complications in practice. These complications are numerous, but can be grouped under two main headings:

(1) The difficulty of determining whether a given exchange rate movement represents a shortly to be reversed shift or is part of a movement to a new equilibrium.

(2) The fact that exchange rates determine, and respond to, capital account developments as well as to factors that influence the current account.

In practical terms, it is not possible to identify within narrow bounds what exchange rate would secure a current account position of a given size. This reflects in part weakness of data and estimating procedures but more

important the dynamic evolution of economic structures in different countries, unexpected exogenous disturbances, and more or less foreseen economic policy reactions. When exchange rates move in response to market forces, it is even more difficult to say that they are "wrong" in a longer-term sense.

Sometimes, of course, it may be possible to say with greater confidence that an exchange rate has proceeded beyond the point that would produce a given balance on current account. In this connection, it should be remembered that the function of international exchange is not just to exploit comparative advantage under the constraint of a given current account position but at the same time to permit shifts of real resources among countries in response to changing savings and investment preferences. As savings and investment flows change, reflecting shifting opportunities and preferences, a movement in the exchange rate is needed to call forth a counterbalancing shift in the current account. Savings and investment flows can change for a wide variety of reasons, some of a fundamental character and others of shorter-term significance.

One of the most important insights of recent theoretical developments in international economics is the recognition that the exchange rate is a price that balances the willingness to hold claims (or maintain liabilities) in different currencies, as well as the desire to exchange one currency for another in order to effect trade in goods. Since the stock of assets denominated in different currencies is large relative to the flow of transactions over exchange markets, a change in the attractiveness of assets denominated in one currency relative to another can have significant short-term effects on the desire to acquire or dispose of foreign exchange.

In a world of integrated capital markets, interest rate differentials could give rise to sizable flows of funds across the exchanges, unless there were some mechanism to dampen this effect. One such mechanism is the freedom of exchange rates to vary in response to autonomous shifts in supply and demand. An increase in the desire to hold, say, U.S. dollars, results in the foreign exchange price of the dollar being bid up to a point where asset holders are just willing to hold the available stock of assets at the new price. If the price of the dollar were somehow prevented from moving, there would be a large excess demand for dollars which, if the authorities accommodated it, would generate a big increase in the money supply.

The upshot of this discussion is that it is not really meaningful to pose the question what would be the effect on trade if exchange rates were stable and all other conditions remained the same. The determination of exchange rates is part of a complex policy nexus and cannot be separated from the effect of other influences that interact with exchange rates. They have as well a separate and independent effect on economic activity and on trade flows.

VIII Summary and Conclusions

The objective of this paper has been to consider the various ways in which exchange rate variability might have an impact on international trade flows; to present various measures of exchange rate variability, both across countries and over time; to discuss tests of the link between trade and exchange rate variability, where appropriate extending the results of published studies into a more recent period; and finally to interpret the implications of the results. The consideration of what constitutes an "appropriate" exchange rate and what are the consequences of a rate that remains at a "wrong" level have been deliberately left outside the ambit of the study. The paper also has not attempted to make policy recommendations concerning measures to reduce exchange rate variability or offset its consequences.

In principle, exchange rate variability can affect trade directly, through the willingness of economic agents to enter into particular transactions, and indirectly, through the effect of exchange rate movements on the pattern of domestic output and investment and the induced policy reactions of the authorities. Direct effects can work through (i) the cost imposed by greater uncertainty in the relationship between production costs and sales returns, when both are expressed in a common unit, and (ii) the adjustment costs of shifting resources between different occupations in response to transitory shifts in comparative advantage. The consequences of these costs can be to reduce the volume and distort the pattern of international trade.

Indirect effects on trade can occur if exchange rate variability results in a shift in the pattern of domestic output and investment that in turn influences the international pattern of comparative advantage and the willingness to engage in international trade. Such effects might include a tendency to favor the production of nontraded goods over traded goods, a tendency for undue concentration of output in particular enterprises or geographical locations, and a reduced level of investment, particularly in traded goods industries.

Exchange rate variability can potentially affect trade through the induced policy reactions of the authorities. If it adds to inflationary pressures at a given level of output and employment, it may induce the authorities to adopt more accommodative policies, and the resultant inflation may worsen the climate for sustainable expansion in trade and output. A similar effect could work if countries had a systematic tendency to intervene on the foreign exchange markets more forcefully when their currencies were appreciating than when they were depreciating. This would tend over time to lead to increased reserves and, if not offset by sterilizing monetary policy, to upward pressure on the growth of the money supply.

The paper discussed a variety of possible measures of exchange rate variability in the light of the possible transmission mechanisms linking exchange rate movements and trade. It was pointed out that trade transactions are financed in a variety of different ways and are therefore subject to different types of uncertainty. Short-term instability in the nominal exchange rate is relevant for traders undertaking individual transactions in which the purchase price in the exporting currency and the selling price in the importing currency are known in advance. Such individual transactions are perhaps the exception rather than the rule in international trade, and in any event evidence suggests that the uncertainty involved can be hedged against (in forward markets) at relatively small cost. It is more common for an importer's or exporter's involvement in foreign trade to extend over a longer period and to involve a sequence of transactions rather than a single purchase or sale. In such a case, the law of large numbers will make short-term fluctuations in exchange rates self-canceling, and exchange rate instability is more likely to affect transactions when it involves exchange rate movements that are only reversed over a somewhat longer period. Uncertainty is also more likely to arise from movements in the "real" exchange rate, that is, divergences between nominal exchange rate movements and movements in relative costs and prices in the countries concerned. More generally, it may be noted that, for transactors engaging in a longer-term commitment to international trading relationships, it may be the divergence of the exchange rate from its underlying trend, rather than its movement from one period to the next, that is the most significant source of uncertainty.

The evidence presented in this study suggests that both short-term and long-term exchange rate variability have increased sharply following the move to more flexible exchange rates at the beginning of the 1970s. This increase is significantly more noticeable in nominal ex-

change rates than in real exchange rates. During the 1960s, as might be expected, nominal rates tended to be much more stable than real rates. Since the move to generalized floating, both measures reveal a similar degree of variability. The fact that variability in real rates is not less than that in nominal rates suggests that inflation differentials explain only a relatively small part of exchange rate shifts, at least over the short to medium term. There also appears to be no clear tendency for variability in exchange rates to decline as experience with floating exchange rate arrangements accumulates. All the major currencies have diverged from the medium-term trend in their real effective exchange rate by at least 10 percent during the past decade, and for some (including the U.S. dollar) the divergence has reached 20 percent.

The large majority of empirical studies on the impact of exchange rate variability on the volume of international trade are unable to establish a systematically significant link between measured exchange rate variability and the volume of international trade, whether on an aggregated or on a bilateral basis. The three studies that do appear to establish an empirical link do so subject to particular conditions. One study is concerned with Brazil, where the restoration of real exchange rate stability following the establishment of the "crawling peg" in 1968 can be regarded as only one among a number of factors contributing to a revival of Brazilian trade. Another study appears to have obtained positive results only after extensive experimentation with lag structures (including some rather implausible ones). In the third, positive findings must be regarded as doubtful in the light of results reported in a subsequent (unpublished) paper that produced contradictory results. Replication of some of these tests was undertaken expressly for the purposes of the present study, and had similarly inconclusive results.

The failure to establish a statistically significant link between exchange rate variability and trade does not, of course, prove that a causal link does not exist. It may well be that the measures of variability used are inadequate measures of uncertainty; that other factors overwhelm the impact of variability in the estimating equations; or that the presence of statistical problems (e.g., serial correlation, dependence among explanatory variables) interferes with the effectiveness of statistical tests. It may also be that the lags with which greater variability in the exchange rate regime affect trade flows are longer and more variable than imagined by previous investigators.

The indirect effects of exchange rate variability on the structure of domestic output, and thereby on the level and pattern of international trade, are extremely difficult to trace. Exchange rate uncertainty is only one relatively minor consideration among many others in each individual decision to invest at home or abroad, expand output, merge with another enterprise, and so on. It is, therefore, not to be expected that empirical work would reveal powerful statistical relationships between such phenomena and the level of exchange rate variability. In recent years there has been a tendency toward larger enterprises and increased international investment. This is consistent with what might be expected as a rational reaction to increased uncertainty about relative factor and product prices in different markets. However, it is a phenomenon that stretches back beyond the period of greater exchange rate variability, and can just as easily be attributed to the effects of greater international integration of markets and the impact of technological progress on the nature of production processes.

The volume of business fixed investment (in relation to GDP) does not appear to have declined in recent years, as might have been expected on the basis of theoretical considerations concerning the effect of uncertainty. It is possible, however, that the adverse effects of uncertainty were outweighed by the need to invest in energy conservation and exploration following the large rise in the relative price of energy.

As far as the relationship between exchange rate instability and government macroeconomic policy is concerned, most attention has focused on the possible adverse effects on inflationary pressures. The most comprehensive survey of the literature on this subject, that of Goldstein (1980), reached the view that neither theoretical reasoning nor empirical evidence was conclusive in establishing a link between exchange rate variability and inflation. While depreciation certainly adds to price inflation, the corresponding appreciation in other countries should retard price increases commensurately, unless some asymmetrical or "ratchet" effect is at work. The literature surveyed by Goldstein did not produce strong evidence of such an effect, and the additional results presented in Appendix IV of this paper are not conclusive either.

Another aspect of macroeconomic policy that could be influenced by exchange rate variability is the nature of the foreign trade regime. During the period when exchange rates were fixed, and foreign exchange crises were more frequent for the major countries, it was frequently suggested that exchange rate flexibility would reduce the balance of payments need for restrictions on foreign trade and payments. It has since been argued that an excessive degree of exchange rate variability has generated pressure for protectionism on the part of those industries most vulnerable to sudden shifts in external competitiveness. This is sometimes said to lead to a global increase in protectionist pressure because of asymmetrical effects between occasions when competitiveness declines as a result of an exchange rate change and occasions when it increases.

Evidence on this matter is sometimes anecdotal, since it is difficult to know what lies behind pressure by a particular industry for protection. In any case, it is not the pressure that produces protection but the response of

policy authorities to it; the sum of these responses determines the stance of trade policy. What can perhaps be said is that the recent period of more turbulent exchange rates has seen a reversal of the generally liberal trend of trade policy that prevailed for much of the postwar period. Many factors probably contributed to such a change in trend, but the existence of volatile exchange rates has given one additional reason for interest groups to offer when they seek protection, and a further factor for authorities to cite when granting it.

Overall, the arguments and the evidence presented in this paper point to rather indefinite conclusions. Uncertainty inhibits economic activity: that much is clear. But that does not necessarily mean that exchange rate volatility of a relatively short-term character has a serious adverse effect on international trade. In the first place, economic agents react to the presence of uncertainty by seeking hedging mechanisms that allow such risks to be reduced. Second, exchange rate variability is only one dimension of the uncertainty associated with international transactions.

More fundamentally, exchange rates, though an uncontrollable "given" to an individual transaction, are themselves determined by interacting supplies and demands for foreign exchange. It is shifts in these supply and demand schedules that give rise to price (i.e., exchange rate) changes. Thus, it is the factors that give rise to such shifts, rather than the exchange rate changes that are their consequence, that should be regarded as the basic cause of uncertainty. Whether or not prolonged shifts in underlying conditions that cause sustained departures from some medium-term trend in exchange rate relationships are harmful for trade is a question that falls outside the scope of the present paper, and cannot be satisfactorily answered by the kinds of empirical test surveyed here.

Appendix I

Measurement of Exchange Rate Variability

The tables and charts in this Appendix provide the means to assess exchange rate variability over the period 1962–83, using a number of different measures of variability. Tables 4–7 provide information on month-to-month and quarter-to-quarter changes in nominal and real exchange rates, respectively. The figures cited are annual averages of absolute percentage changes in period average (i.e., monthly or quarterly) indices of effective exchange rates (Line am.x in the Fund's *International Financial Statistics*) deflated where appropriate by indices of relative prices. For monthly series, the consumer price index was used as the deflator, while for the quarterly series, relative normalized unit labor costs were used. Tests were also run using other price indices to adjust for inflation; none of the results were sufficiently different from those reported here to warrant separate presentation. Table 8 presents information on the effective variation in exchange rates, defined as the weighted average of variability in bilateral (nominal) rates. It will be seen that trends in effective variation are similar to those in the variability of the effective exchange rate, but, as expected, the level of variability under this measure is somewhat greater.

Table 4. Major Industrial Countries: Month-to-Month Changes in Nominal Effective Exchange Rates, 1961–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1961	0.20	0.26	0.23	0.48	0.20	0.66	0.19	0.27
1962	0.10	0.07	0.04	0.12	0.13	0.45	0.04	0.13
1963	0.04	0.05	0.02	0.12	0.15	0.12	0.06	0.08
1964	0.04	0.08	0.02	0.05	0.11	0.09	0.06	0.06
1965	0.06	0.09	0.04	0.11	0.17	0.18	0.06	0.10
1966	0.06	0.10	0.13	0.15	0.07	0.11	0.08	0.10
1967	0.17	1.24	0.25	0.29	0.16	0.14	0.17	0.35
1968	0.08	0.21	0.17	0.30	0.13	0.18	0.15	0.17
1969	0.26	0.27	1.21	1.01	0.27	0.15	0.36	0.53
1970	0.13	0.17	0.10	0.18	0.11	0.56	0.16	0.20
1971	0.56	0.25	0.51	0.58	0.80	0.36	0.39	0.50
1972	0.47	1.03	0.61	0.34	0.54	0.58	0.27	0.53
1973	2.09	1.53	1.07	2.03	1.64	0.63	2.10	1.67
1974	1.66	0.56	1.82	1.54	1.50	0.55	1.50	1.37
1975	1.22	0.97	1.20	0.83	0.98	0.74	0.33	0.94
1976	0.40	2.18	1.05	1.39	0.99	1.05	3.07	1.28
1977	0.72	0.75	0.37	0.75	1.66	1.09	0.91	0.83
1978	1.40	1.22	1.11	1.07	2.66	1.53	0.80	1.34
1979	0.93	1.68	0.50	0.64	2.06	0.86	0.40	0.94
1980	1.78	1.18	0.73	0.86	2.50	0.55	0.83	1.20
1981	2.14	1.81	1.26	1.37	1.83	0.55	1.30	1.55
1982	2.03	1.11	1.16	0.65	2.03	1.06	0.64	1.28
1983	1.25	1.73	0.95	0.79	1.22	0.34	0.80	1.04
Averages								
1961–70	0.11	0.26	0.22	0.27	0.15	0.26	0.13	0.20
1974–83	1.35	1.32	1.01	1.00	1.74	0.82	1.06	1.18
1961–83	0.78	0.81	0.64	0.67	0.95	0.61	0.64	0.71

[1]The average percentage change, ignoring sign, in the monthly average nominal effective exchange rate index (weights derived from the Fund's multilateral exchange rate model).

[2]Weighted according to current trade shares (exports plus imports).

Charts 7 and 8 show deviations of effective exchange rates from their medium-term trend, with the medium-term trend defined as a 19-quarter (or 57-month) moving average of the effective exchange rate (real or nominal). For periods for which calculation of the moving average requires exchange rate data extending beyond the end of 1983, the missing data are assumed to be equal to the average of the data available for the calculation. In Tables 9 and 10, changes in nominal and real effective exchange rates relative to their medium-term trend are set out. These figures are also annual averages of absolute percentage changes in period average indices.

Table 5. Major Industrial Countries: Month-to-Month Changes in Real Effective Exchange Rates, 1961–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1961	0.38	0.46	0.52	0.70	0.94	0.73	0.28	0.50
1962	0.35	0.31	0.28	0.35	0.53	0.63	0.32	0.38
1963	0.31	0.20	0.27	0.27	0.72	0.17	0.30	0.29
1964	0.23	0.32	0.19	0.29	0.70	0.15	0.31	0.28
1965	0.23	0.27	0.33	0.25	0.89	0.19	0.25	0.29
1966	0.21	0.35	0.21	0.22	0.55	0.15	0.28	0.25
1967	0.31	1.43	0.32	0.45	0.75	0.34	0.27	0.52
1968	0.20	0.45	0.26	0.33	0.52	0.23	0.25	0.30
1969	0.38	0.36	1.21	1.04	0.61	0.27	0.43	0.63
1970	0.18	0.31	0.22	0.27	0.67	0.67	0.31	0.34
1971	0.78	0.47	0.53	0.61	1.21	0.55	0.44	0.66
1972	0.48	1.02	0.63	0.43	0.59	0.60	0.38	0.56
1973	2.18	1.75	1.19	2.12	2.35	0.50	1.90	1.79
1974	1.76	0.98	1.82	1.54	1.66	0.57	1.79	1.50
1975	1.30	0.82	1.09	1.03	1.16	0.89	0.42	1.02
1976	0.49	2.07	0.96	1.08	1.31	1.06	2.37	1.16
1977	0.78	1.09	0.42	0.70	1.57	1.01	0.84	0.87
1978	1.33	1.23	1.19	1.05	2.68	1.67	0.75	1.35
1979	1.07	2.13	0.55	0.58	2.43	0.96	0.84	1.10
1980	1.91	1.53	0.67	1.25	2.45	0.60	0.69	1.37
1981	2.26	1.99	1.16	1.47	1.67	0.69	0.83	1.57
1982	1.85	0.93	1.19	0.56	2.15	1.13	0.79	1.23
1983	1.24	1.84	0.73	0.77	1.36	0.52	0.64	1.04
Averages								
1961–70	0.28	0.45	0.38	0.42	0.68	0.35	0.30	0.38
1974–83	1.41	1.46	0.98	1.00	1.85	0.91	1.00	1.22
1961–83	0.87	0.97	0.69	0.76	1.27	0.63	0.68	0.83

[1]The average percentage change, ignoring sign, in the monthly average real effective exchange rate index (based on weights derived from the Fund's multilateral exchange rate model and consumer price indices).
[2]Weighted according to current trade shares (exports plus imports).

Table 6. Major Industrial Countries: Quarter-to-Quarter Changes in Nominal Effective Exchange Rates, 1962–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1962	0.19	0.11	0.05	0.09	0.29	1.01	0.03	0.23
1963	0.07	0.05	0.02	0.23	0.32	0.16	0.07	0.13
1964	0.05	0.12	0.04	0.41	0.15	0.21	0.14	0.09
1965	0.13	0.20	0.13	0.23	0.27	0.25	0.16	0.19
1966	0.11	0.16	0.33	0.34	0.13	0.19	0.13	0.20
1967	0.21	1.69	0.48	0.51	0.20	0.25	0.30	0.52
1968	0.35	2.10	0.46	0.58	0.53	0.43	0.43	0.66
1969	0.48	0.44	3.58	2.86	0.30	0.11	0.65	1.28
1970	0.38	0.35	0.14	0.49	0.22	1.33	0.48	0.48
1971	1.33	0.53	1.32	1.47	1.72	0.71	0.90	1.19
1972	1.44	2.48	1.58	0.25	1.55	0.80	0.38	1.16
1973	4.15	2.48	1.47	5.37	2.70	1.78	4.23	3.49
1974	3.28	1.22	4.31	2.93	2.09	1.40	3.03	2.74
1975	2.87	3.07	2.44	1.70	1.37	1.87	0.61	2.14
1976	0.71	3.09	2.44	3.44	2.28	1.63	6.91	2.85
1977	1.00	1.65	0.63	1.01	3.76	2.98	2.03	1.60
1978	2.83	2.46	2.01	2.53	5.42	2.56	2.03	2.75
1979	1.44	3.96	1.14	1.67	6.13	1.36	7.24	2.11
1980	1.56	3.30	1.16	1.64	5.08	0.77	2.04	2.05
1981	5.75	3.57	2.38	2.42	2.27	0.93	3.34	3.26
1982	3.43	1.66	2.59	1.32	1.88	1.39	1.50	2.10
1983	2.44	4.30	2.57	1.08	4.18	0.41	1.91	2.33
Averages								
1962–70	0.22	0.58	0.58	0.64	0.27	0.44	0.28	0.42
1974–83	2.53	2.81	2.13	1.97	3.44	1.53	3.06	2.39
1962–83	1.55	1.77	1.41	1.48	1.95	1.02	1.76	1.53

[1]The average percentage change, ignoring sign, in the quarterly average nominal effective exchange rate index (weights derived from the Fund's multilateral exchange rate model).

[2]Weighted according to current trade shares (exports plus imports).

Table 7. Major Industrial Countries: Quarter-to-Quarter Changes in Real Effective Exchange Rates, 1962–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1962	0.41	0.91	0.45	0.33	1.51	1.57	2.40	0.84
1963	0.40	0.67	0.42	0.93	0.64	0.31	2.03	0.69
1964	0.71	1.08	0.90	1.35	0.58	0.54	2.04	1.00
1965	0.53	1.13	0.29	0.60	0.65	0.62	1.82	0.73
1966	0.16	1.59	0.51	0.42	0.29	0.39	2.26	0.66
1967	0.19	1.48	0.22	1.53	0.91	0.19	2.35	0.87
1968	0.97	2.60	1.63	0.99	1.68	0.56	1.19	1.27
1969	0.92	1.05	4.34	2.56	1.77	0.29	2.22	1.77
1970	1.52	1.46	0.56	2.26	0.89	1.78	1.61	1.54
1971	1.84	1.15	1.31	1.60	2.04	0.78	1.65	1.51
1972	1.56	2.45	1.78	0.57	2.55	1.34	3.19	1.68
1973	4.56	3.08	2.20	5.18	3.29	1.84	2.85	3.65
1974	3.03	2.77	4.69	1.70	4.15	2.08	2.09	2.85
1975	2.74	1.18	2.87	2.65	2.06	2.49	3.18	2.50
1976	0.97	3.71	1.97	2.19	0.86	2.43	6.07	2.29
1977	0.87	2.02	0.77	0.81	2.79	3.05	1.90	1.49
1978	2.25	2.81	2.19	2.09	4.91	3.16	2.02	2.59
1979	2.00	4.76	1.55	1.95	7.79	1.61	2.51	2.80
1980	2.25	6.42	0.97	2.69	3.03	1.10	2.48	2.74
1981	5.87	4.08	1.38	3.30	3.48	1.68	1.98	3.50
1982	3.33	1.82	1.82	1.87	2.27	1.50	1.30	2.16
1983	1.73	4.95	2.42	0.94	3.34	0.85	1.97	2.12
Averages								
1962–70	0.65	1.33	1.04	1.22	0.99	0.69	1.99	1.04
1974–83	2.50	3.46	2.06	2.02	3.47	1.99	2.75	2.51
1962–83	1.77	2.42	1.60	1.75	2.34	1.38	2.41	1.87

[1]The average percentage change, ignoring sign, in the quarterly average real effective exchange rate index (based on weights derived from the Fund's multilateral exchange rate model and relative normalized unit labor costs).

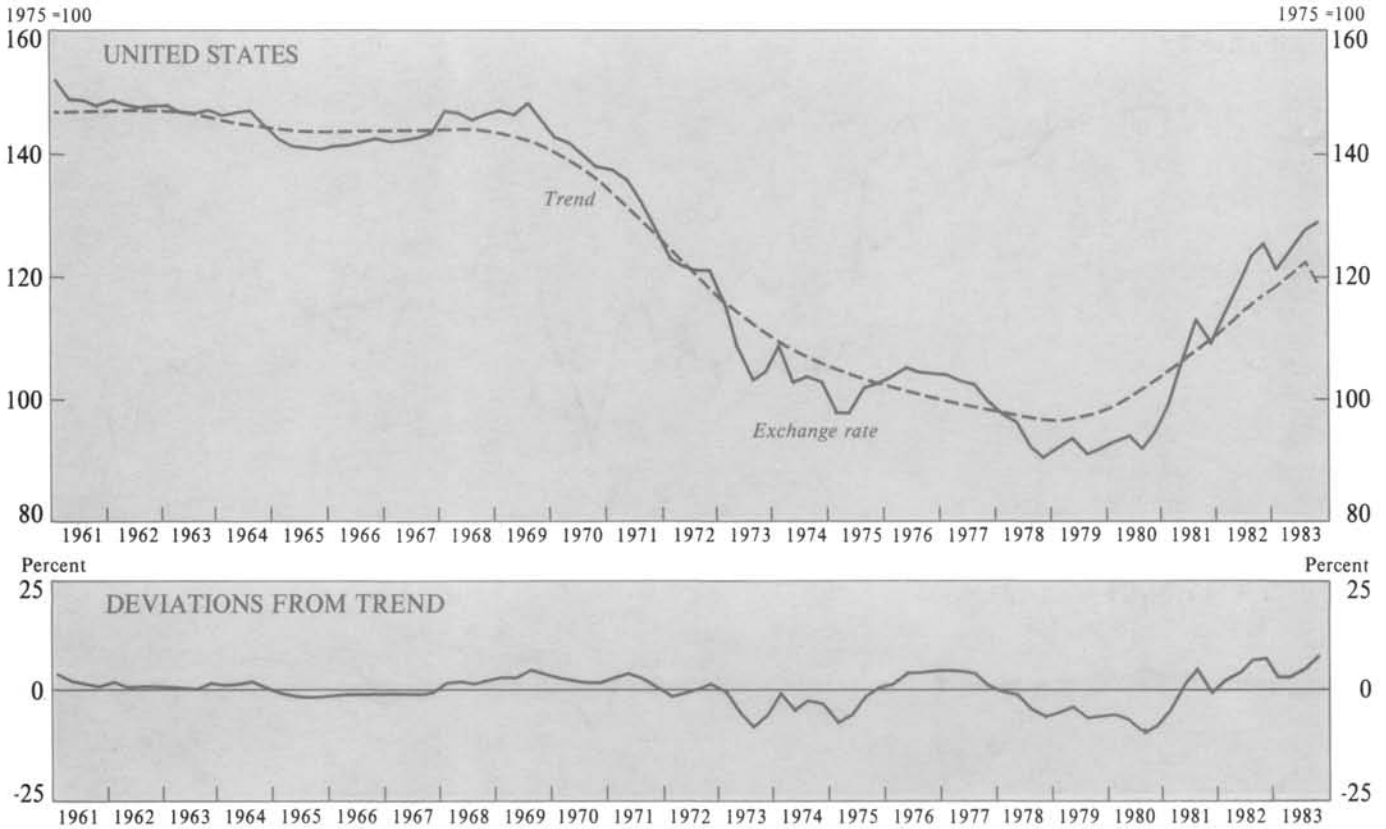
[2]Weighted according to current trade shares (exports plus imports).

Table 8. Major Industrial Countries: Effective Variation[1] of Nominal Exchange Rates, 1961–83

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy
1961	0.63	0.55	0.60	1.11	0.35	0.99	0.51
1962	0.42	0.24	0.11	0.19	0.30	0.95	0.11
1963	0.13	0.10	0.08	0.13	0.24	0.16	0.10
1964	0.11	0.14	0.07	0.10	0.18	0.13	0.10
1965	0.17	0.14	0.10	0.17	0.23	0.25	0.10
1966	0.15	0.19	0.28	0.25	0.10	0.15	0.17
1967	0.46	2.99	0.43	0.44	0.26	0.46	0.40
1968	0.22	0.31	0.34	0.45	0.17	0.25	0.29
1969	0.42	0.54	2.59	1.85	0.31	0.23	1.10
1970	0.48	0.32	0.23	0.34	0.24	0.96	0.31
1971	0.86	0.69	0.85	0.87	1.53	0.64	0.70
1972	0.89	1.84	1.09	0.66	0.98	0.91	0.68
1973	2.33	2.87	2.07	2.65	3.02	0.94	3.40
1974	1.95	1.67	2.38	1.69	2.48	1.09	1.90
1975	1.47	1.57	1.36	1.04	1.41	1.03	1.22
1976	1.35	2.88	1.89	1.38	1.21	1.51	3.98
1977	1.32	1.46	1.04	1.09	1.75	1.27	1.16
1978	2.26	2.29	2.23	1.56	3.55	1.57	1.71
1979	1.64	2.24	0.82	0.85	2.26	1.37	1.03
1980	2.34	1.45	0.87	0.84	3.27	1.28	0.93
1981	2.31	2.95	1.77	1.71	2.55	1.16	1.76
1982	2.58	2.34	1.94	1.41	3.50	1.68	1.34
1983	1.40	2.45	1.30	1.42	1.83	0.65	1.08
Averages							
1961–70	0.32	0.55	0.48	0.50	0.24	0.45	0.32
1974–83	1.86	2.13	1.56	1.27	2.38	1.26	1.61
1961–83	1.12	1.40	1.06	0.95	1.38	0.85	1.05

[1]Weighted average of monthly variability of bilateral nominal exchange rates.

Chart 7. Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83



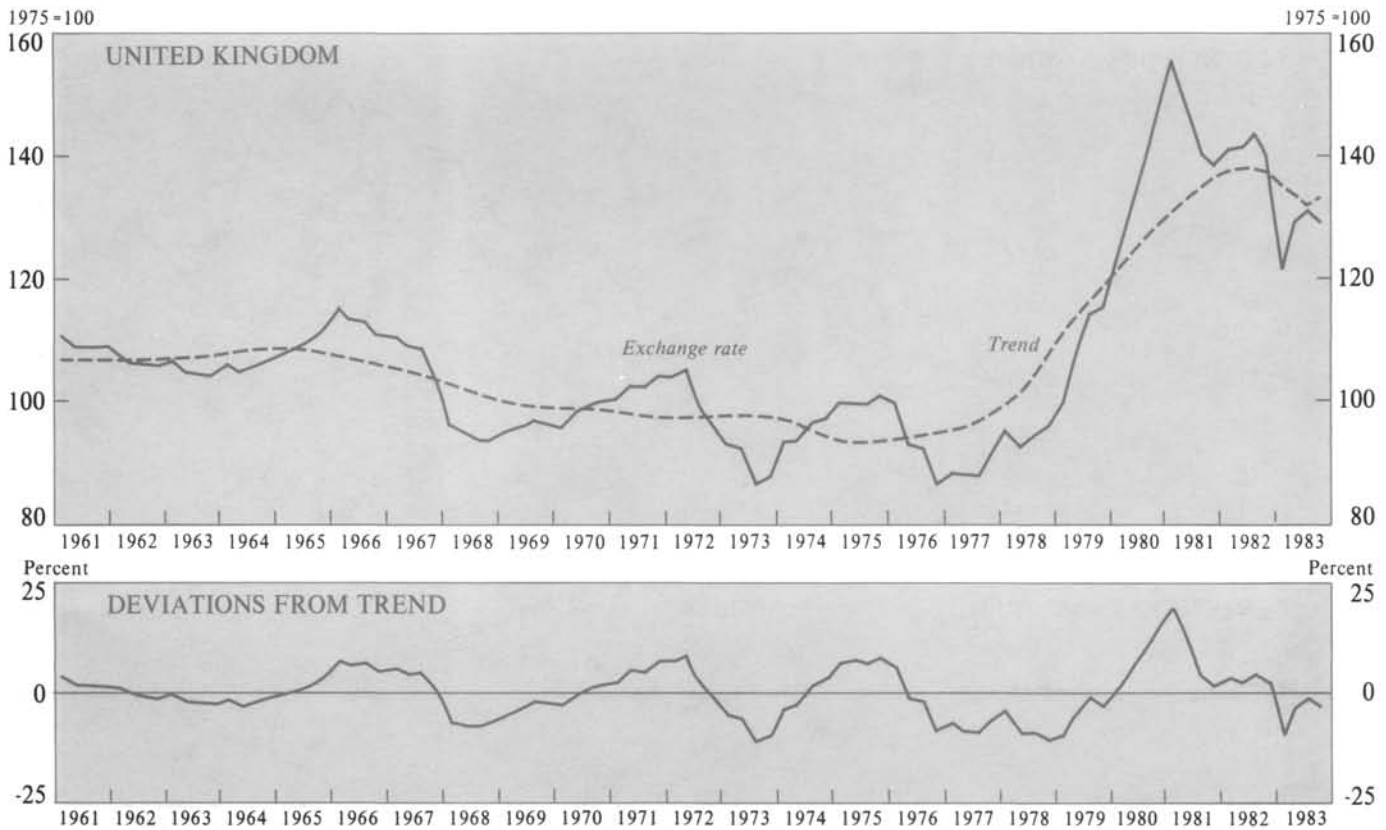
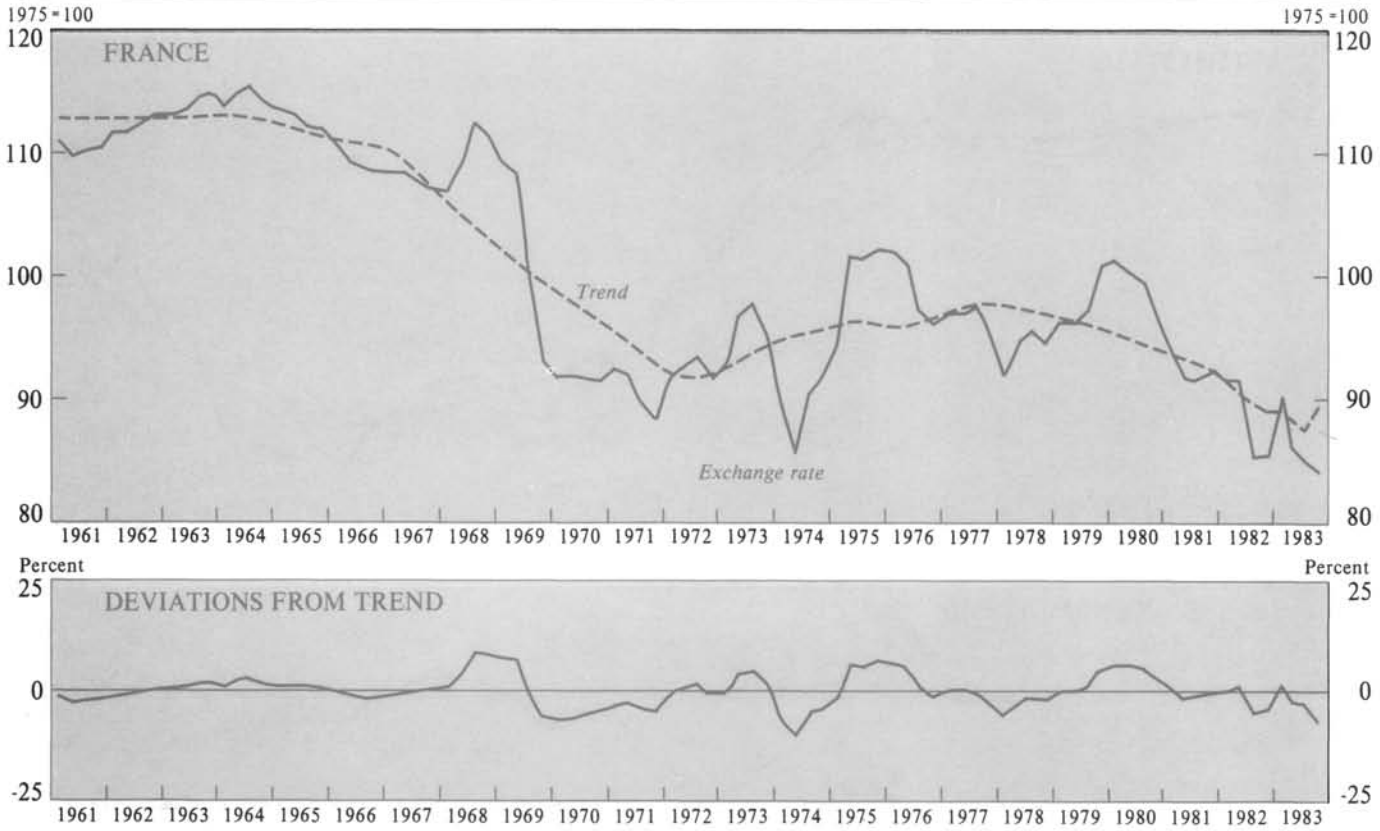


Chart 7 (*continued*). Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83



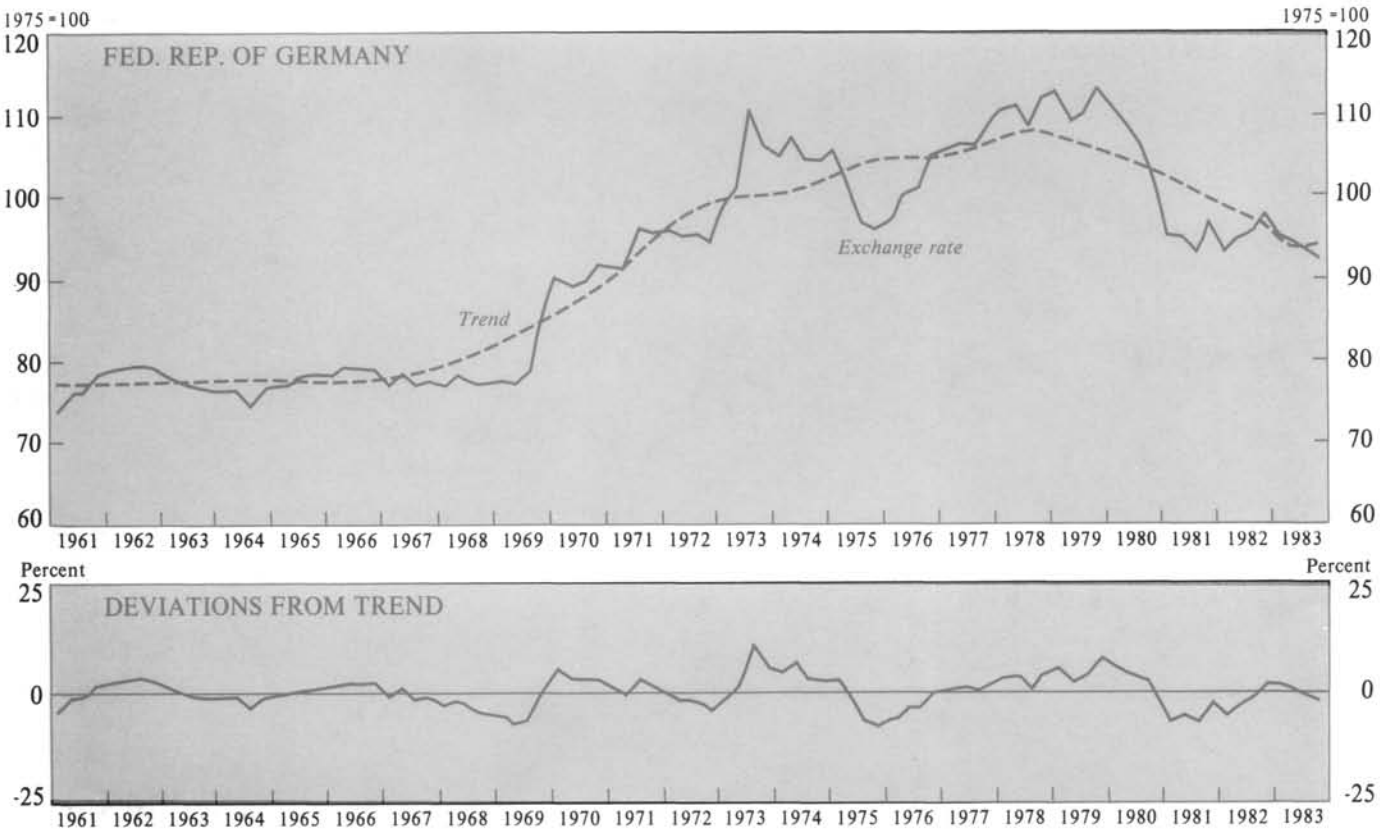


Chart 7 (*continued*). Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83

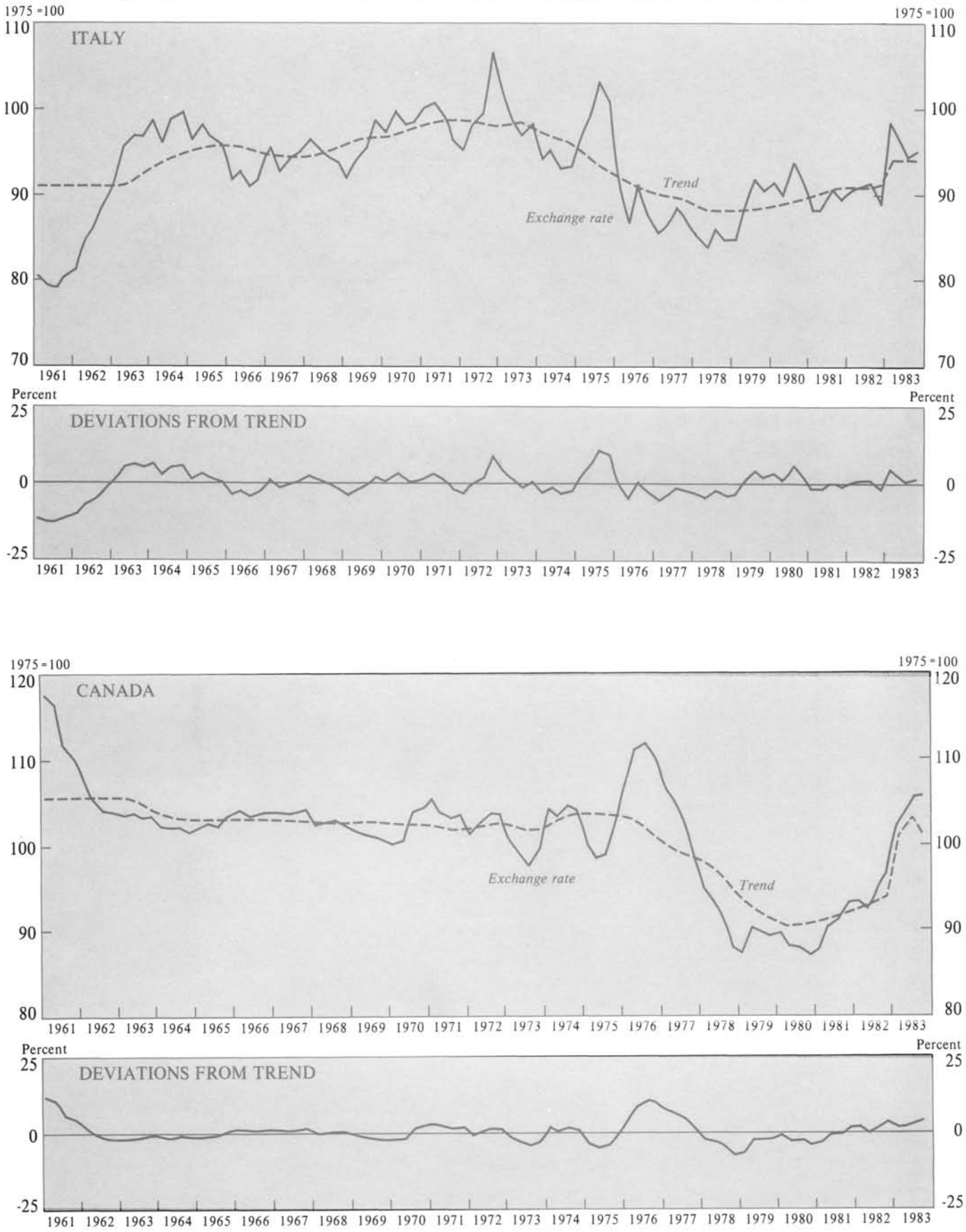


Chart 7 (*concluded*). Major Industrial Countries: Quarterly Real Effective Exchange Rates, 1961–83

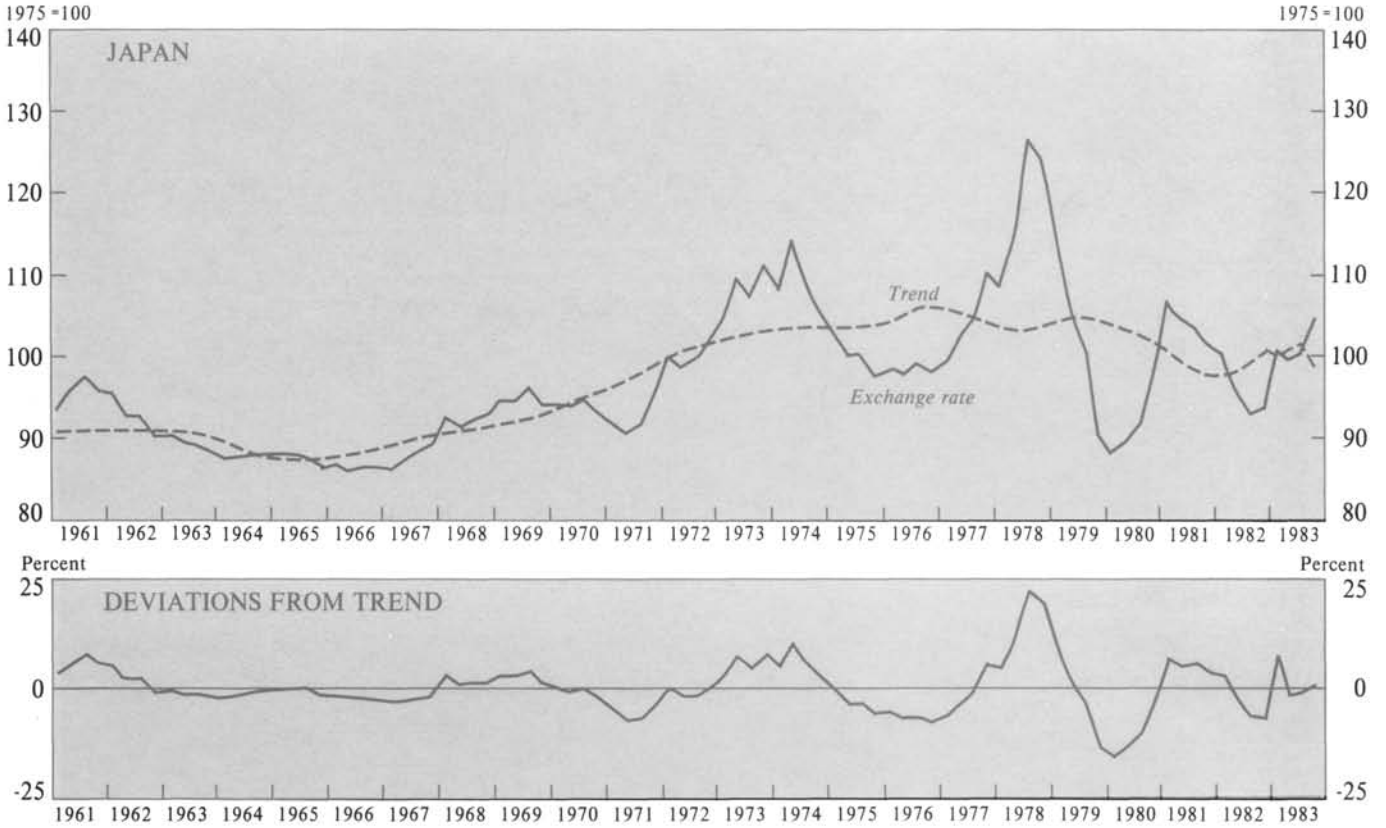
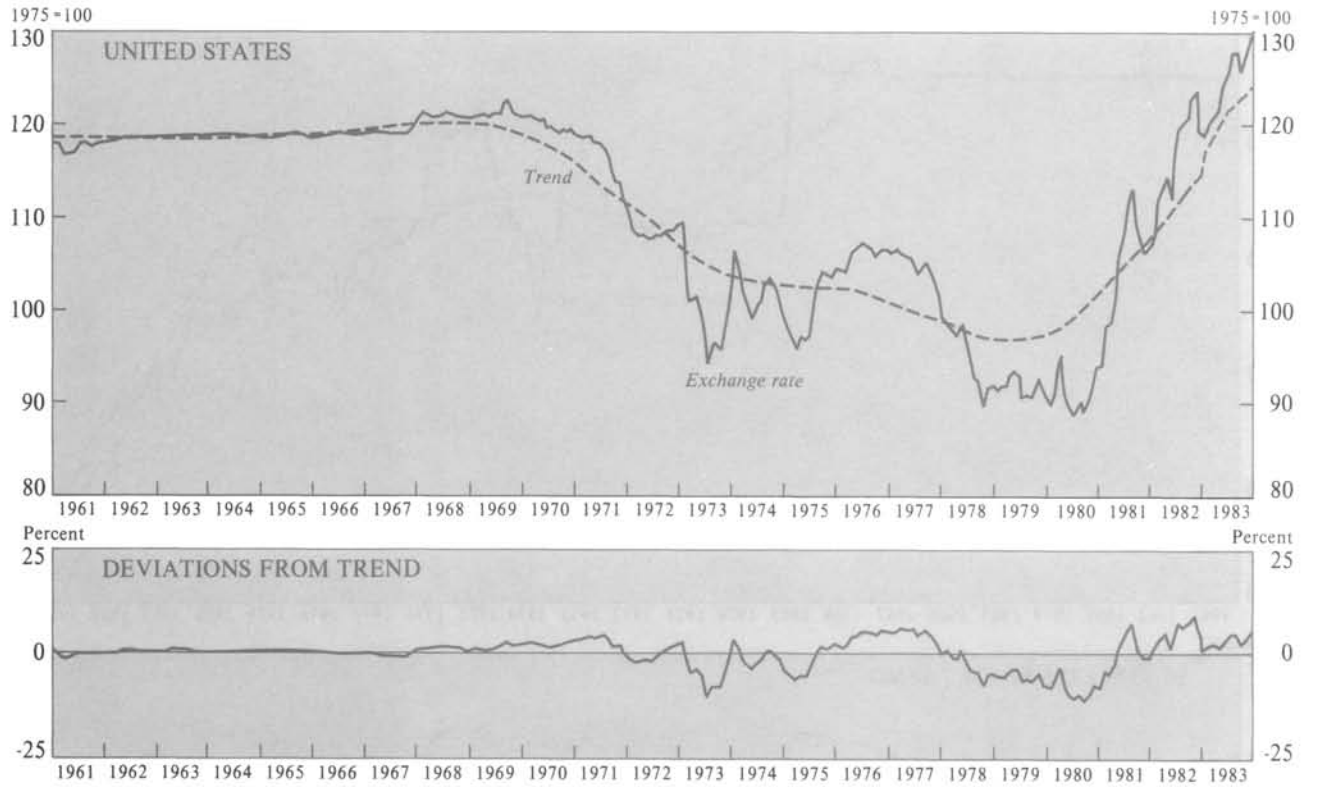


Chart 8. Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83



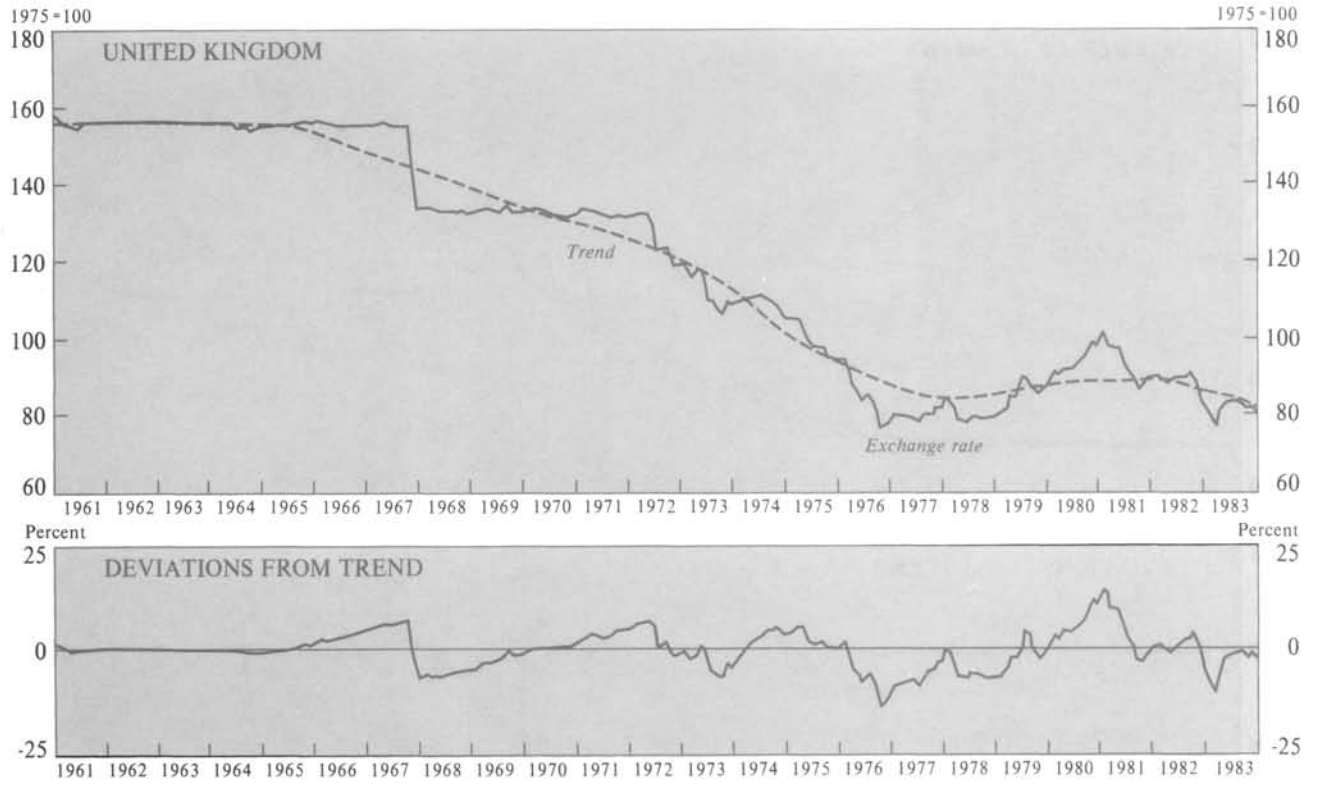
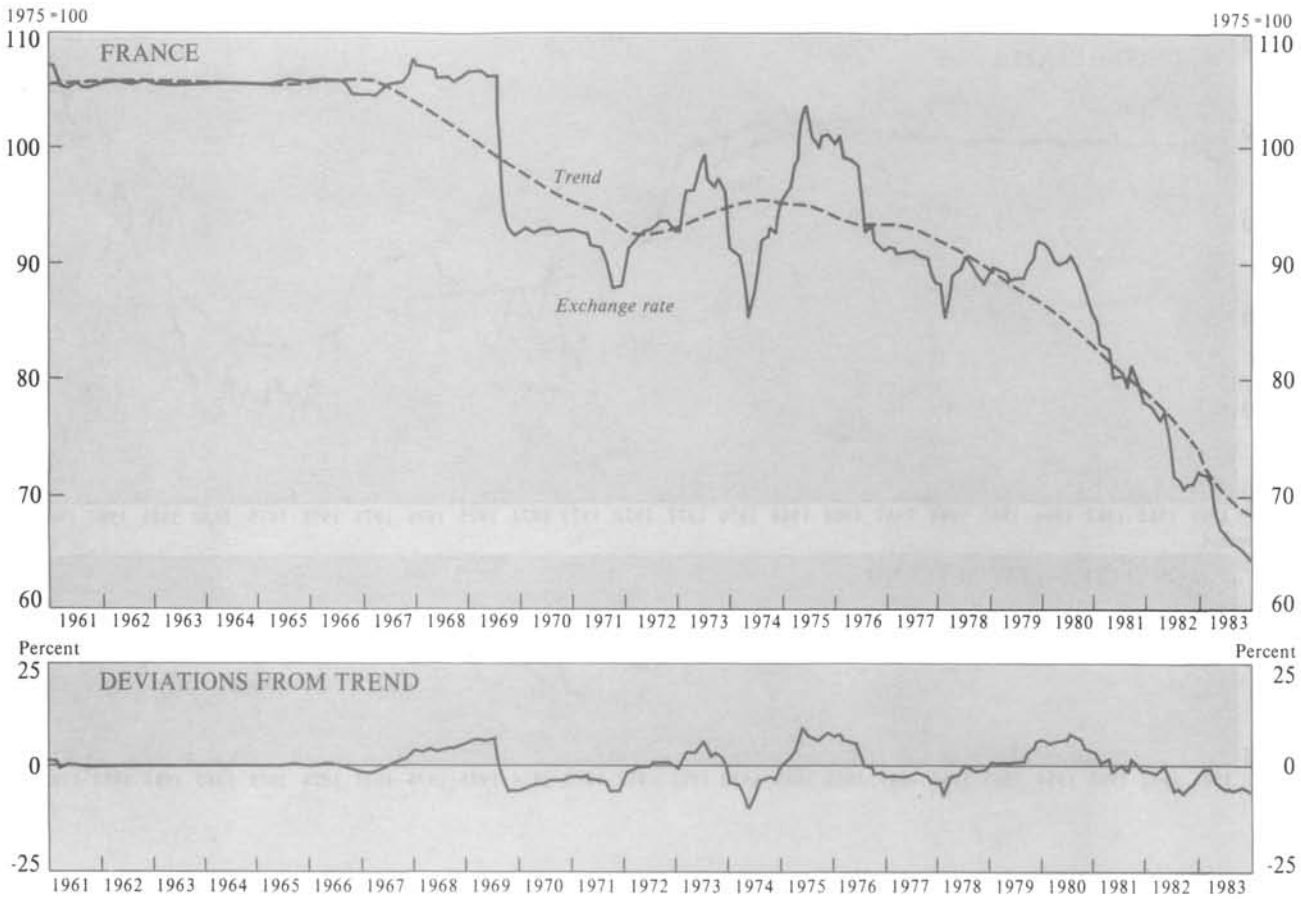


Chart 8 (*continued*). Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83



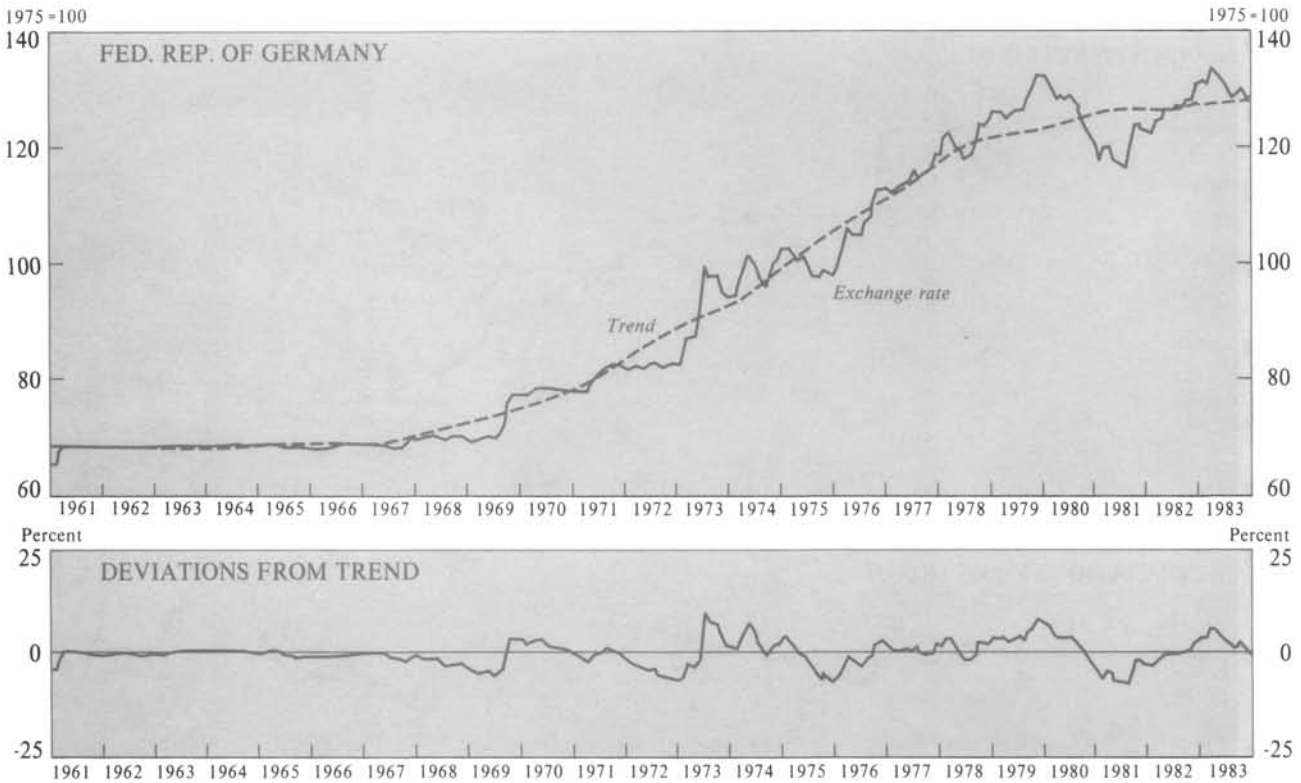
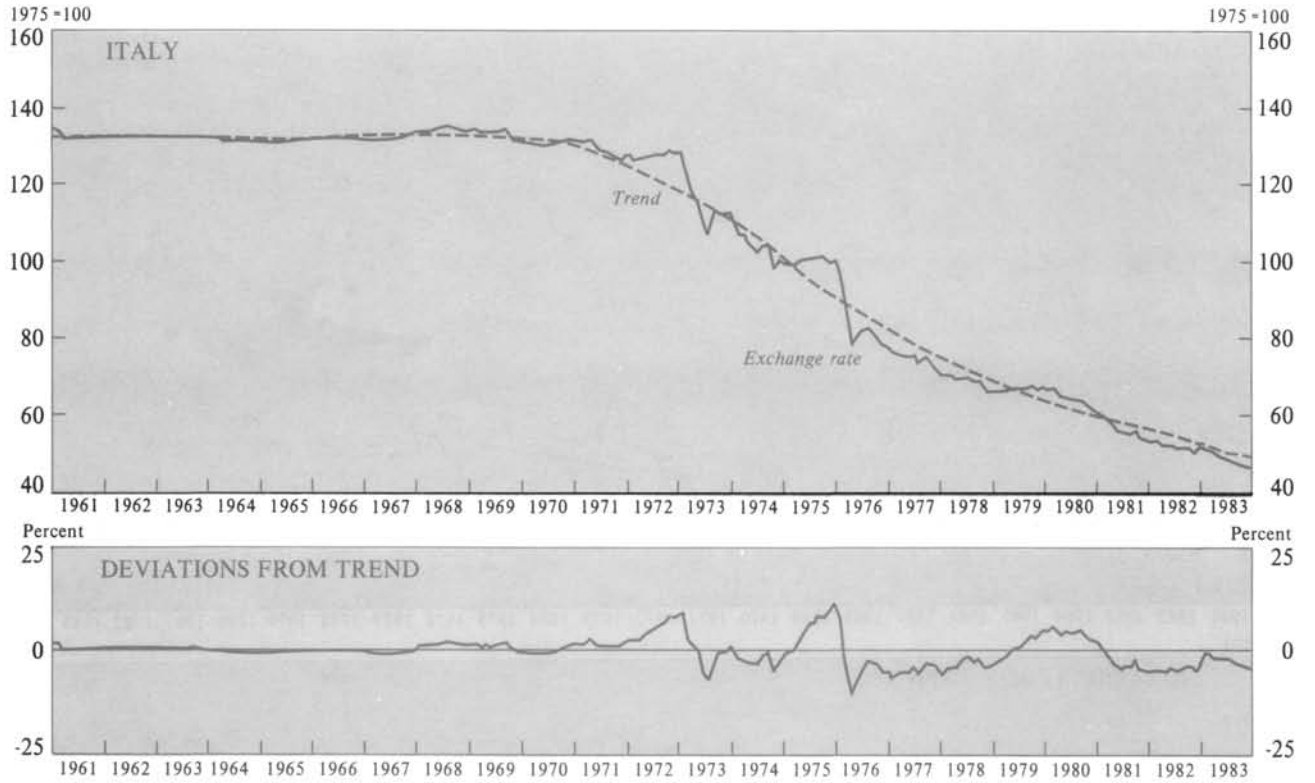


Chart 8 (*continued*). Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83



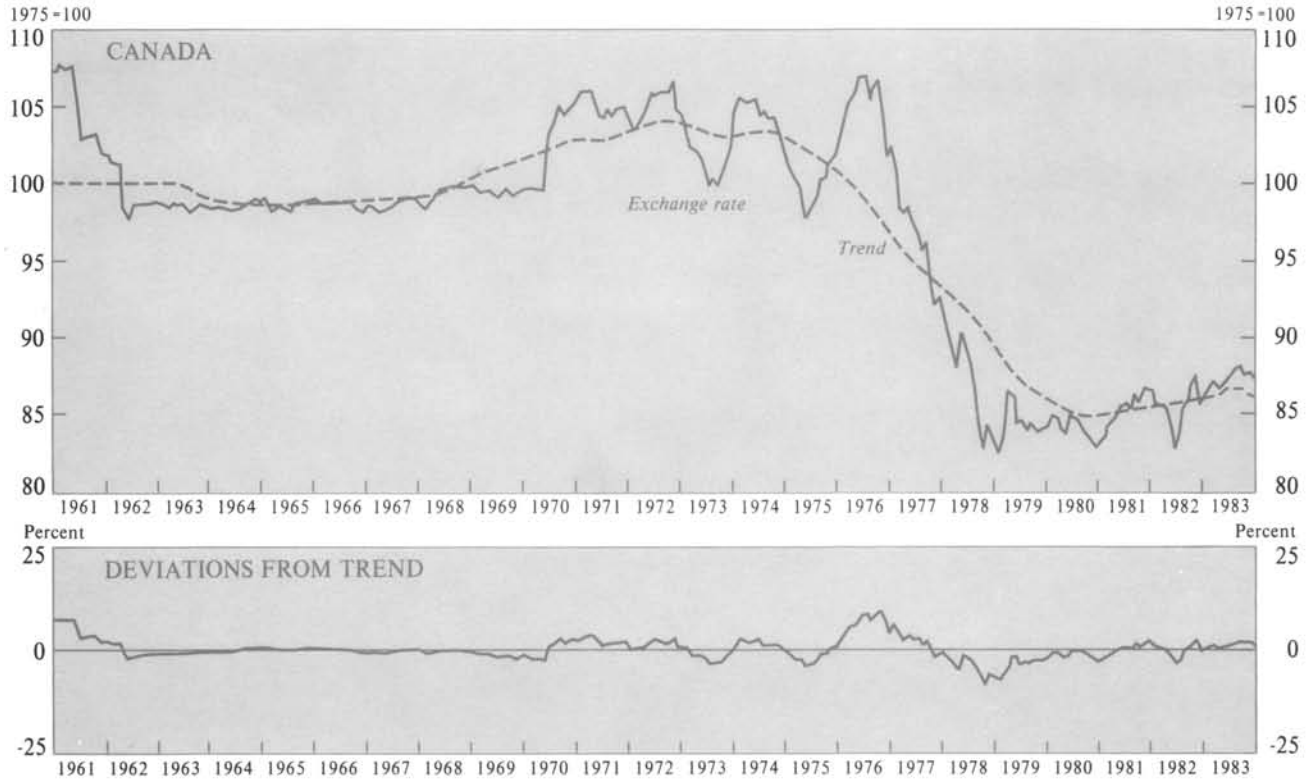


Chart 8 (*concluded*). Major Industrial Countries: Monthly Nominal Effective Exchange Rates, 1961–83

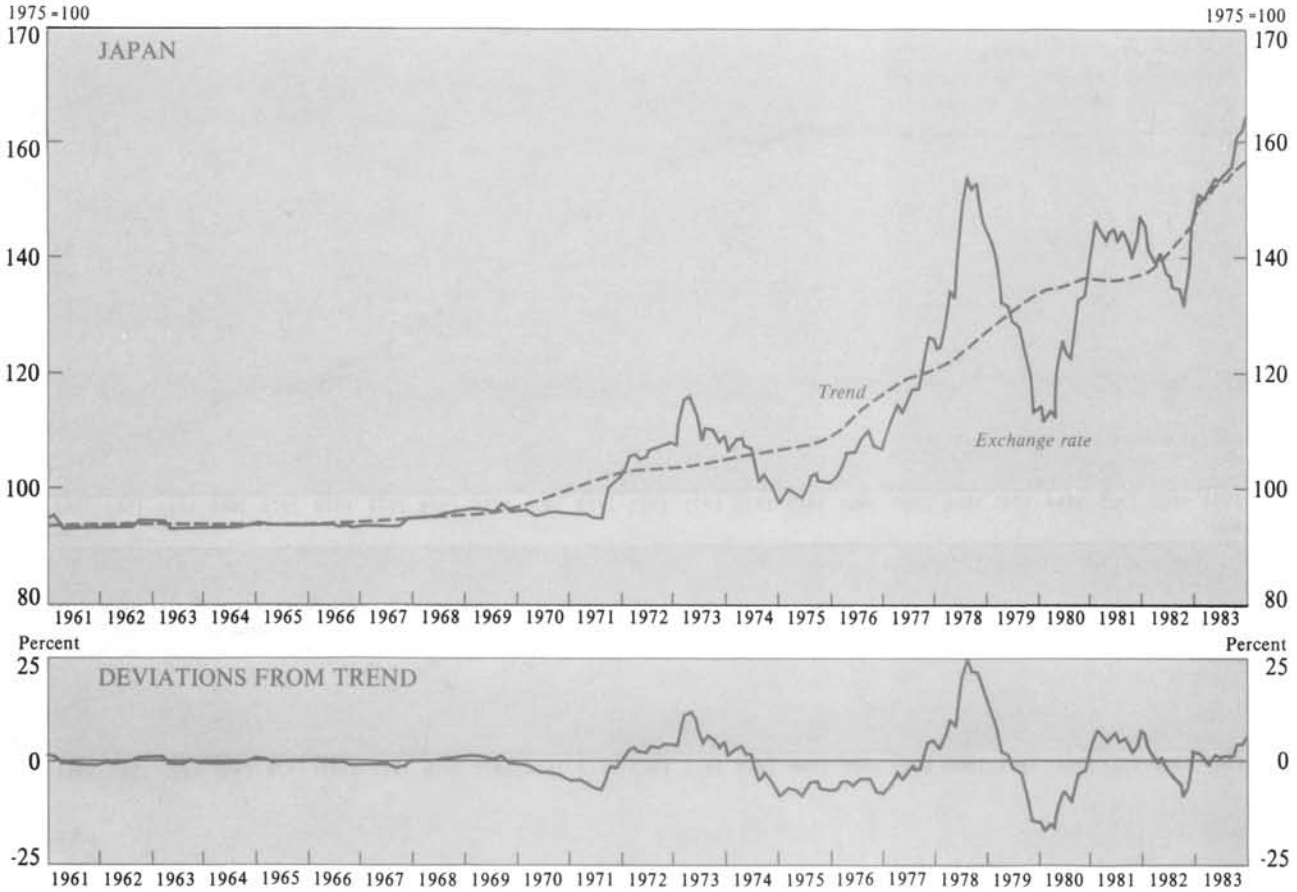


Table 9. Major Industrial Countries: Month-to-Month Changes in Nominal Effective Exchange Rates Relative to Trend, 1964–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1964	0.04	0.08	0.03	0.06	0.11	0.10	0.06	0.06
1965	0.07	0.19	0.05	0.12	0.16	0.18	0.07	0.12
1966	0.05	0.24	0.13	0.14	0.09	0.11	0.08	0.12
1967	0.19	1.37	0.40	0.35	0.16	0.13	0.18	0.40
1968	0.08	0.29	0.24	0.38	0.11	0.18	0.15	0.20
1969	0.28	0.45	1.27	0.95	0.33	0.18	0.34	0.55
1970	0.17	0.23	0.25	0.36	0.29	0.54	0.20	0.29
1971	0.51	0.35	0.47	0.56	0.84	0.38	0.37	0.50
1972	0.57	1.06	0.63	0.49	0.49	0.58	0.61	0.62
1973	1.99	1.40	1.09	2.05	1.76	0.57	1.94	1.63
1974	1.62	0.94	1.79	1.52	1.52	0.54	1.37	1.39
1975	1.17	0.71	1.26	1.05	0.97	0.77	1.02	1.02
1976	0.45	1.94	1.06	1.15	0.75	1.26	2.68	1.18
1977	0.75	0.84	0.30	0.66	1.44	1.06	0.69	0.77
1978	1.26	1.13	1.10	1.11	3.00	1.23	0.69	1.30
1979	0.87	1.61	0.63	0.59	2.47	0.79	0.76	0.99
1980	1.59	1.19	0.60	1.00	2.19	0.53	0.62	1.12
1981	2.03	1.99	1.11	1.32	1.90	0.51	0.94	1.50
1982	1.76	1.18	1.05	0.64	2.16	1.06	0.49	1.22
1983	1.10	1.65	0.67	0.87	1.03	0.31	0.47	0.93
Averages								
1964–70	0.13	0.41	0.34	0.34	0.18	0.20	0.15	0.25
1974–83	1.26	1.32	0.96	1.00	1.75	1.03	0.97	1.15
1964–83	0.75	0.95	0.71	0.77	0.98	0.55	0.69	0.80

[1]The trend exchange rate is defined as a 57-month moving average.
[2]Weighted according to current trade shares (exports plus imports).

Table 10. Major Industrial Countries: Quarter-to-Quarter Changes in Real Effective Exchange Rates Relative to Trend, 1964–83[1]

	United States	United Kingdom	France	Federal Republic of Germany	Japan	Canada	Italy	Weighted Average[2]
1964	0.72	0.99	0.93	1.34	0.58	0.39	1.74	0.95
1965	0.48	1.31	0.24	0.70	0.69	0.69	1.99	0.78
1966	0.24	1.62	0.57	0.42	0.36	0.36	2.22	0.69
1967	0.25	1.37	0.47	1.62	0.64	0.18	2.32	0.89
1968	1.21	2.24	2.09	1.30	1.45	0.74	1.32	1.42
1969	0.78	1.20	3.60	2.27	1.54	0.46	2.23	1.61
1970	0.68	1.28	0.67	1.95	1.05	1.11	1.56	1.18
1971	1.24	1.30	1.07	2.39	1.93	0.79	1.73	1.53
1972	1.36	2.73	2.09	1.36	2.08	1.26	3.41	1.84
1973	3.57	2.92	1.99	5.02	3.29	1.67	3.06	3.33
1974	3.08	3.20	4.59	1.94	4.37	1.91	2.08	2.95
1975	3.01	1.36	2.73	2.88	1.87	2.43	3.77	2.64
1976	0.98	4.22	1.75	1.97	0.75	2.84	5.93	2.30
1977	0.85	1.74	0.84	0.59	3.25	2.26	1.79	1.36
1978	1.90	2.24	2.09	2.02	5.54	1.88	1.65	2.31
1979	1.61	2.70	1.85	2.17	8.15	1.27	2.45	2.53
1980	1.62	4.58	1.15	2.13	3.61	0.90	2.57	2.28
1981	4.54	5.40	1.54	3.05	3.07	1.32	2.01	3.25
1982	2.08	1.00	2.03	1.62	2.53	1.30	1.05	1.71
1983	2.12	5.51	2.84	1.13	4.05	1.02	2.16	2.53
Averages								
1964–70	0.62	1.43	1.22	1.37	0.90	0.56	1.91	1.07
1974–83	2.17	3.20	2.14	1.95	3.72	1.71	2.55	2.39
1964–83	1.62	2.45	1.76	1.89	2.54	1.75	2.35	1.91

[1]The trend exchange rate is defined as a 19-quarter moving average.
[2]Weighted according to current trade shares (exports plus imports).

Appendix II

Determination of Aggregate Trade Levels

In a recent paper, Bergsten and Cline (1983) investigate the aggregate relationship between the growth of trade and output over the period 1961–81. Their basic purpose is to ascertain whether there are any residuals from this observed relationship in recent years that could be explained as a consequence of increasing protectionism. However, the results they obtain could equally be used to assess whether there was any observable adverse impact from growing exchange rate uncertainty. The estimated relationship is as follows:

$$\dot{M} = \underset{(2.6)}{-4.6} + \underset{(7.9)}{3.14}\,\dot{Y} \qquad \bar{R}^2 = 0.77$$

where

$\dot{M}$ = Annual rate of growth of OECD real non-oil imports

$\dot{Y}$ = Annual rate of growth of real GDP in OECD countries

Several points about this equation are noteworthy. First, it explains more than three fourths of the year-to-year variations in the rate of growth of imports in member countries of the Organization for Economic Cooperation and Development (OECD), indicating that real income levels are by far the major determinant of overall trade levels. Second, the elasticity of trade growth with respect to real income growth is very high, above 3 in fact. This implies that an additional 1 percent of output growth in any year has typically been associated with an additional 3 percent of import growth. Third, the weak performance of trade in recent years is fully explained by the decline in the rate of growth of output. Chart 9 plots actual and predicted non-oil imports in OECD countries during the period 1962–81 on the basis of the relationship calculated by Bergsten and Cline (1983). As may be seen, there is no tendency for actual trade to fall below predicted levels in recent years. Output growth in OECD countries was about 1 percent in 1981 and was actually negative in 1982. From the relationships of the estimated equation, this would lead one to expect a cumulative decline of non-oil imports of some 6 percent over the two years 1981–82. The decline that actually occurred was some 2 percent. There is no negative "residual" in this period to be attributed to the impact of other factors, such as protectionism or exchange rate uncertainties.

The purpose of this Appendix is to replicate Bergsten and Cline's test, with certain modifications that are of interest for the subject of the present study.

(i) Overall world trade is considered, rather than just OECD non-oil imports. This is partly to test the robustness of Bergsten and Cline's results and partly because exchange rate uncertainty can (at least potentially) affect a broader cross-section of trade than is captured in the variable used by Bergsten and Cline.

(ii) The time period covered by the data is extended backward by two years (to include 1959 and 1960) and forward by one year (to include 1982).

(iii) A variable intended to capture exchange rate uncertainty is introduced. This is defined as the weighted average quarterly variation in the real effective exchange rate of the major industrial countries, and is explained in footnote 2 to Table 11. It is introduced both in unlagged and lagged form.

Table 11 presents the results of a selection of equations from a larger number that were in fact estimated. (The other equations mostly involved different specification of the exchange rate uncertainty variable, and produced broadly similar results.)

It may be seen from equations 1–3, covering the longer time period, that the results are similar to those obtained by Bergsten and Cline, and that the inclusion of exchange rate variability, whether in lagged or unlagged form, does not help the explanatory power of the equation. The coefficient on exchange rate variability is not significant, and it has a perverse sign. The only noteworthy difference from Bergsten and Cline's results is that the elasticity of trade growth with respect to income growth is somewhat lower (about 2 instead of 3).

Equations 1–3 do not provide support for the proposition that exchange rate variability has had a significant adverse effect on trade growth. However, firm conclusions cannot be reached on the basis of such relatively simple tests. One possibility that is not tested in equations 1–3 is that the impact of exchange rate uncertainty on trade accumulates gradually over time, and cannot easily be related to measured variability in a given time period, such as a year. To investigate this, equations 4 and 5 estimate the relationship between growth of world

output and trade over two subperiods, one of which (1959–71) was characterized by relative stability in exchange rates and the other (1974–83) by relative instability. It will be seen that there is a striking difference between the equations for the two subperiods. Moreover, Chart 10, which shows predicted and actual rates of growth of world trade over the past 20 years on the basis of the equation estimated for 1959–71, reveals a tendency toward negative residuals. This chart suggests that some unincluded factor has in the late 1970s and early 1980s reduced the growth of world trade relative to that of world output below what would have been expected on the basis of experience in the 1960s.

This having been said, it must be recognized that a number of fundamental changes have occurred in the world economy in the past ten years, and it is not possible on the basis of the evidence presented here to conclude that exchange rate variability is the one that has been responsible for the negative residuals shown in the chart. Also, it should be noted that the explanatory power of the equation used to extrapolate the "expected" values in the chart is very low.

Chart 9. OECD Member Countries: Growth Rate of Non-Oil Imports, 1962–81

(In percent)

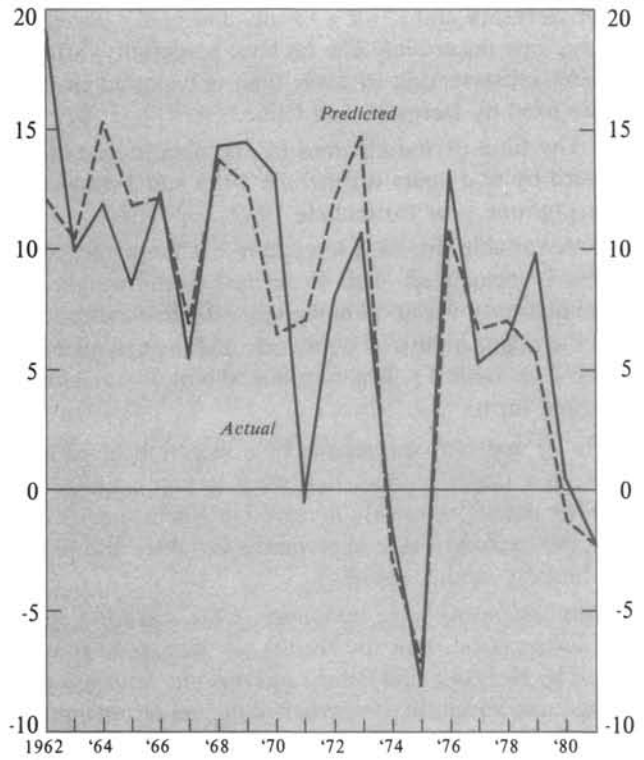
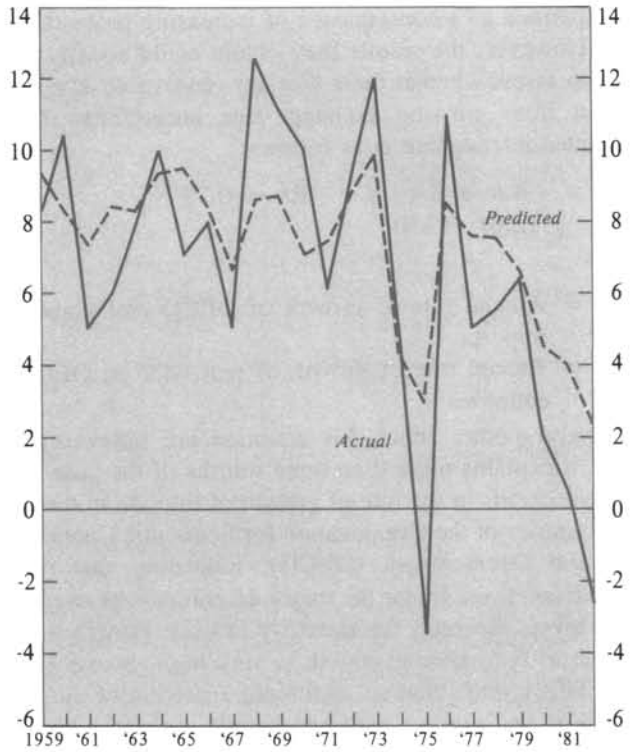


Chart 10. Rate of Growth of World Trade, 1959–82

(In percent)



Source: Based on equation 4 in Table 11.

Table 11. Equations Relating Growth of World Output and World Trade[1]

Time Period	Constant	Growth of World Output	Real Exchange Rate Variability[2]	Real Exchange Rate Variability (Lagged)[2]	$\overline{R}^2$	D-W	SEE
1959–82	−1.83	2.02			0.77	2.00	2.06
	(1.02)	(0.23)					
1962–82	−2.72	2.13	0.32		0.80	1.88	2.08
	(1.52)	(0.26)	(0.45)				
1963–83	−3.57	2.32		0.51	0.80	1.84	2.03
	(2.06)	(0.34)		(0.58)			
1959–71	2.63	1.12			0.08	1.82	2.31
	(3.99)	(0.79)					
1974–83	−2.31	2.18			0.82	2.36	1.96
	(1.09)	(0.36)					

[1]Coefficients of determination ($\overline{R}^2$); Durbin-Watson statistics (D-W); standard estimated errors (SEE); standard errors in parentheses.
[2]Seven-country trade-weighted average of quarterly variability in real effective exchange rates (based on the gross domestic product deflator).

Appendix III

Inflation and Exchange Rate Variability

A possible mechanism by which exchange rate variability could affect inflation is through a "ratchet" effect on the domestic price level. If increases in traded goods prices from exchange rate depreciations are passed on into consumer prices more rapidly or completely than are any reductions attributable to exchange rate appreciations, this could lead to a faster rate of price increase when exchange rates are volatile than when they are stable.

One way of testing the presence of such an effect is to estimate an equation explaining variations in the rate of inflation, including among the explanatory variables a measure of exchange rate variability. Table 12 presents the results of such a test for seven major industrial countries. The equation employed is based on that used by Spitäller (1978) with the only substantive difference being the extension of the estimation period by five years (to 1981) and the addition of a variable to capture exchange rate movements. Specifically, the estimating equation is as follows:

$$\dot{CP} = a_o + a_1\dot{M} + a_2\frac{\dot{Y}}{\overline{Y}} + a_3\dot{MP} + a_4\dot{CP}_{-1} + a_5XV$$

where

CP = consumer price index
M = money stock
Y = output
$\overline{Y}$ = an exponential growth trend of output
MP = import prices
XV = standard deviation of the effective exchange rate over the previous five quarters

A dot above a variable indicates a rate of change.

The results are broadly consistent with those obtained by Spitäller in his equations. The lagged dependent variable is highly significant in all cases except that of Japan, and has a value in the range 0.75–0.95. Both in the results reported here and those of Spitäller, import prices seem to have a dominant effect in Japan, with a given change in the import price index having an impact roughly one fourth the size on the consumer price index.

Changes in the pressure of demand (as measured by output growth relative to trend) are generally positively associated with inflation, though the results do not appear to be highly significant, or robust across countries. The rate of growth of the money supply is only significant (with the correct sign) in one country, as against three in Spitäller's results.

For present purposes, the greatest interest attaches to the estimates for the coefficient on exchange rate variability. Six out of the seven countries exhibit a positive relationship between inflation and exchange rate variability, but in no case is the coefficient significantly different from zero at the 95 percent confidence level. While these results do not, therefore, preclude the possibility of a systematic inflationary effect coming from exchange rate instability, they do not provide any strong support for it.

Table 12. Major Industrial Countries: Determinants of Inflation[1]

Country	Constant	$\dot{M}$	$\dot{Y}/\overline{Y}$	$\dot{MP}$	$\dot{CP}_{-1}$	XV	$\overline{R}^2$	D-W
Canada	1.67	0.01	−1.07	0.08	0.83	0.04	0.94	2.11
	(0.69)	(1.10)	(0.47)	(3.79)	(15.08)	(0.35)		
France	1.74	0.05	−1.47	0.05	0.86	0.02	0.95	2.19
	(0.84)	(2.80)	(0.72)	(6.09)	(26.59)	(0.29)		
Germany, Fed. Rep. of	−2.59	−0.01	3.09	0.02	0.84	0.04	0.90	1.91
	(2.12)	(0.19)	(2.46)	(1.55)	(14.97)	(0.79)		
Italy	1.62	0.04	−1.63	0.08	0.83	0.05	0.95	2.02
	(0.37)	(1.17)	(0.38)	(5.68)	(21.15)	(0.41)		
United Kingdom	−3.18	0.08	3.79	0.08	0.77	0.03	0.77	1.87
	(0.38)	(1.51)	(0.18)	(2.36)	(10.87)	(0.25)		
United States	−5.29	0.05	5.29	0.03	0.92	−0.09	0.96	2.02
	(2.14)	(1.27)	(2.29)	(3.12)	(24.67)	(1.89)		
Japan	−25.63	−0.01	25.37	0.21	0.23	0.27	0.80	1.19
	(2.94)	(0.09)	(3.12)	(10.07)	(3.33)	(1.75)		

[1]Coefficients of determination ($\overline{R}^2$); Durbin-Watson statistics (D-W); *t*-ratios in parentheses.

Appendix IV

Determination of Bilateral Trade Flows

Several recent papers have undertaken an empirical investigation of the relationship between exchange rate variability and bilateral trade flows using time-series data (Clark, 1973; Hooper and Kohlhagen, 1978; Cushman, 1983). Of these, only Cushman has claimed any success in relating the volume of trade to exchange rate variability. In a study of 14 sets of bilateral trade flows (all involving the United States or the Federal Republic of Germany as a partner country), he finds six cases in which his measure of exchange rate variability enters with a negative (i.e., expected) sign, and is significantly different from zero at the 95 percent confidence level. Cushman's study differed from the earlier ones cited above in covering a greater portion of the floating rate period (though still only until 1977), and in employing a measure of real rather than nominal exchange rate variability.

While Cushman's results are suggestive, closer examination reveals that they are by no means conclusive. Even in the six equations where the coefficient on exchange rate variablility was negative and significant, the level of significance was not high (the highest *t*-ratio being 3.45); the equations concerned employed five different lag structures (including two where trade levels were made to depend on future exchange rate variability); and there were two equations where the coefficient on exchange rate variability was positive (i.e., perverse) and significant. Moreover, in four of the six equations where the coefficient was not significant at the 95 percent level, it also had a perverse sign.

One purpose of this appendix is to present results of estimating a model similar to Cushman's (though somewhat simplified in structure) and applied uniformly across countries. This model is as follows:

$$X_{ij} = a_o + a_1 GNP_j + a_2 RCU_{ij} + a_3 RXR_{ij} + a_4 RXV_{ij}$$

where

X_{ij} = volume of exports from country i to country j
GNP_j = real GNP in country j
RCU_{ij} = relative capacity utilization
RXR_{ij} = real bilateral exchange rate
RXV_{ij} = variability in the real bilateral exchange rate

The equation is estimated in logarithmic form

As in Cushman's model, all independent variables were lagged by one quarter, and 42 equations were estimated, covering exports from seven industrial countries (the United States, the United Kingdom, Japan, the Federal Republic of Germany, France, Canada, and Italy) to each of the other six (Table 13). All the equations were estimated for first quarter 1965 to fourth quarter 1982. In the absence of specific information about bilateral trade flows in volume terms, the bilateral flows in value terms (derived from the Fund's *Direction of Trade Statistics*) were deflated by the export price index for all trade. The real bilateral exchange rate is the nominal bilateral rate (quarterly average obtained from the Fund's *International Financial Statistics*), adjusted for changes in relative normalized unit labor costs. Variability in this rate is the standard deviation of percentage changes during the five quarters ending with the observation period.

The variable measuring exchange rate variability has the correct (negative) sign in 16 out of 42 equations and the incorrect sign in the remaining 26. In only two cases where the coefficient is negative is it statistically significant, while positive coefficients are significant in several more cases.

The results reported in Table 13 have a number of similarities to, as well as differences from, those of Cushman. In nearly every equation, gross national product in the importing country is strongly and positively related to bilateral imports, as would be expected. The influence of relative capacity utilization (a measure of relative cyclical position) shows the expected negative sign in a majority of cases, although the tendency is not particularly striking. The real exchange rate variable is specified as the real price of the importer's currency in terms of the exporter's currency; since an increase in this variable increases the exporter's competitiveness, it is expected to exhibit a positive association with trade flows. (It should be noted that insofar as rising exports tend to pull up the exchange rate, the opposite association could also be justified.) In fact, there does appear to be a general positive association between exports and competitiveness that is statistically significant in more than half the cases considered.

Table 13. Major Industrial Countries: Determinants of Bilateral Trade Flows[1]

Trade Flow Exporter–Importer	Constant	Gross Domestic Product	Relative Capacity Utilization	Real Exchange Rate	Exchange Rate Variability	$\overline{R}^2$	D-W
United States–United Kingdom	−23.78 (7.96)	2.00 (8.13)	1.48 (3.36)	0.54 (3.72)	−0.01 (0.81)	0.80	0.99
United States–France	−6.19 (5.19)	0.43 (5.33)	−0.14 (0.38)	0.89 (5.34)	0.03 (3.01)	0.71	0.99
United States–Germany	−15.97 (8.36)	1.19 (8.74)	−0.49 (2.11)	0.24 (2.24)	−0.004 (0.67)	0.83	1.74
United States–Italy	−17.55 (9.28)	0.91 (9.27)	−0.16 (0.51)	0.76 (4.00)	0.002 (0.22)	0.75	1.91
United States–Canada	−11.73 (14.75)	1.11 (16.94)	0.15 (0.40)	0.89 (3.61)	−0.01 (0.58)	0.86	2.20
United States–Japan	−14.28 (8.33)	0.81 (9.03)	−0.36 (2.87)	0.23 (1.99)	0.03 (3.56)	0.93	0.81
United Kingdom–United States	−22.47 (8.23)	1.54 (8.16)	−0.60 (1.35)	0.40 (2.49)	0.001 (0.11)	0.69	0.88
United Kingdom–France	−14.39 (7.14)	0.92 (6.54)	−1.38 (1.65)	−0.33 (0.92)	0.81 (3.69)	0.64	0.60
United Kingdom–Germany	−42.45 (30.97)	2.99 (30.43)	1.58 (4.95)	−0.53 (5.42)	0.01 (1.88)	0.95	1.33
United Kingdom–Italy	−31.17 (17.89)	1.54 (16.93)	0.23 (0.90)	−0.39 (3.15)	0.02 (2.27)	0.93	1.67
United Kingdom–Canada	−1.19 (0.86)	−0.13 (0.11)	−0.94 (2.36)	0.73 (7.47)	−0.01 (0.86)	0.61	1.44
United Kingdom–Japan	−11.32 (9.85)	0.50 (8.21)	−1.16 (9.64)	0.61 (5.67)	−0.01 (1.01)	0.88	1.32
France–United States	−38.83 (22.78)	2.75 (23.59)	0.59 (0.29)	0.68 (5.88)	−0.01 (1.21)	0.93	2.07
France–United Kingdom	−64.42 (27.30)	5.39 (27.65)	0.28 (0.77)	0.42 (2.85)	0.01 (1.31)	0.96	1.39
France–Germany	−22.07 (15.59)	1.76 (17.48)	−0.87 (2.63)	0.88 (4.10)	0.003 (0.48)	0.93	1.29
France–Italy	−54.24 (26.43)	2.90 (27.44)	0.72 (2.59)	0.73 (3.37)	0.02 (2.32)	0.96	1.68
France–Canada	−23.77 (12.70)	1.88 (12.43)	−0.96 (1.96)	0.82 (5.09)	−0.00004 (0.01)	0.86	1.73
France–Japan	−34.47 (13.91)	1.79 (13.60)	−0.84 (4.34)	0.64 (0.26)	0.01 (1.26)	0.94	1.44
Germany–United States	−26.57 (8.85)	1.92 (9.37)	0.60 (1.79)	0.63 (3.94)	−0.003 (0.32)	0.64	0.78
Germany–United Kingdom	−64.55 (33.81)	5.36 (34.18)	−0.28 (0.92)	0.86 (8.68)	0.03 (3.33)	0.96	1.48
Germany–France	−10.13 (6.43)	0.84 (7.77)	0.99 (1.28)	1.41 (3.30)	−0.01 (0.75)	0.68	0.80
Germany–Italy	−45.76 (21.86)	2.43 (22.67)	0.09 (0.48)	0.88 (5.76)	0.02 (3.10)	0.94	0.92
Germany–Canada	−15.39 (7.12)	1.19 (6.82)	−0.18 (0.45)	0.47 (2.78)	−0.003 (0.33)	0.58	1.60
Germany–Japan	−17.55 (14.64)	0.91 (14.17)	−1.37 (9.32)	0.51 (2.99)	0.01 (2.27)	0.92	0.89
Italy–United States	−20.07 (9.14)	1.84 (12.19)	0.76 (1.94)	1.30 (5.18)	−0.05 (3.71)	0.71	1.14
Italy–United Kingdom	−39.87 (15.85)	3.77 (18.13)	−0.65 (1.94)	1.07 (6.89)	0.02 (1.99)	0.94	1.66
Italy–France	−4.95 (3.08)	0.85 (7.72)	−0.92 (1.58)	2.12 (5.63)	0.01 (0.68)	0.77	0.97
Italy–Germany	−15.68 (6.56)	1.67 (9.87)	−0.70 (2.77)	0.36 (1.74)	0.001 (0.13)	0.90	0.78

Table 13. (*concluded*). Major Industrial Countries: Determinants of Bilateral Trade Flows[1]

Trade Flow Exporter–Importer	Constant	Gross Domestic Product	Relative Capacity Utilization	Real Exchange Rate	Exchange Rate Variability	$\overline{R}^2$	D-W
Italy–Canada	−13.13 (10.26)	1.44 (13.74)	−0.59 (1.52)	1.07 (5.91)	−0.01 (1.46)	0.81	1.47
Italy–Japan	−21.81 (7.35)	1.39 (8.86)	−1.09 (4.29)	0.55 (2.38)	0.016 (1.42)	0.92	1.61
Canada–United States	−29.15 (18.42)	2.15 (19.58)	−0.24 (0.53)	−1.03 (3.50)	0.01 (0.42)	0.90	1.08
Canada–United Kingdom	6.30 (2.07)	−0.53 (2.09)	0.86 (1.89)	−0.14 (1.34)	−0.18 (1.57)	0.38	1.41
Canada–France	−8.23 (5.74)	0.43 (4.33)	−2.76 (4.54)	1.29 (7.57)	0.03 (2.92)	0.78	1.28
Canada–Germany	−19.21 (4.66)	1.27 (4.34)	−1.20 (2.15)	0.29 (1.33)	0.00003 (0.03)	0.70	1.52
Canada–Italy	−28.27 (7.64)	1.36 (7.07)	0.34 (0.52)	0.30 (1.04)	0.03 (2.02)	0.69	1.38
Canada–Japan	−18.42 (5.95)	0.95 (5.86)	0.62 (2.11)	0.40 (1.79)	0.02 (1.52)	0.89	0.94
Japan–United States	−56.32 (15.25)	4.34 (17.18)	0.55 (4.33)	0.59 (1.15)	−0.29 (2.96)	0.94	0.95
Japan–United Kingdom	−82.50 (14.85)	7.13 (15.70)	0.49 (1.94)	0.86 (3.57)	0.001 (0.08)	0.89	1.25
Japan–France	−8.40 (3.00)	0.81 (4.19)	−0.79 (1.85)	−2.72 (7.53)	0.07 (3.25)	0.85	0.68
Japan–Germany	−59.03 (31.76)	4.56 (34.10)	−0.23 (1.60)	−0.05 (0.31)	−0.01 (1.98)	0.98	1.53
Japan–Italy	−63.06 (10.57)	3.42 (11.11)	0.84 (3.09)	0.51 (2.10)	0.003 (0.27)	0.88	0.91
Japan–Canada	−28.48 (6.06)	2.68 (7.07)	0.64 (1.84)	0.68 (2.13)	−0.018 (0.95)	0.75	0.47

[1]Coefficients of determination ($\overline{R}^2$); Durbin-Watson statistics (D-W).

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International Monetary Fund, Washington, D.C. 20431, U.S.A.
Telephone number 202 473 7430
Cable address: Interfund