AN EMPIRICAL INVESTIGATION INTO THE ROLE OF THE FUNDAMENTAL ECONOMIC VARIABLES IN THE DETERMINATION OF THE FOREIGN EXCHANGE RATES OF NINE COUNTRIES, 1973-1978

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This dissertation examines the role of the fundamental economic variables (price levels, interest rates, and income levels) in the determination of foreign exchange rates during the period 1973-1978. Purchasing power parity, the International Fisher Effect, and the relationship of exchange rates with income levels through the marginal propensity to import were integrated, as suggested by the literature, and a fairly reasonable specification of a model for exchange rate determination was measured.

In principle, the purchasing power parity theory would operate as follows: currencies of nations with smaller degrees of inflation would rise in relative value against currencies of nations with higher inflation rates. This would occur, first, because people generally value monies for what they will buy, and, second, because international currency markets in the current system give relatively free interplay to forces of

supply and demand. Also, the International Fisher Effect maintains that the current spot exchange rate should change in an equal but opposite direction to the difference in national interest rates for securities of similar risk and maturity should result in an appreciation of the domestic currency in the foreign exchange market (ceteris paribus) if the interest rate differential is in favor of the domestic economy and vice versa. Finally, an increase in the income level might result in an increase in consumption through the effect of the marginal propensity to consume. However, imports and, indirectly, exchange rates are linked to income level movements via the marginal propensity to import, which is a part of the marginal propensity to consume. Therefore, a growth in national income may result in an increase in the imports and, consequently, an increase in the supply of domestic currency in the foreign exchange markets. This would probably cause the domestic currency to depreciate (ceteris paribus).

Determination of the extent to which variations in the level of exchange rates are explained by the fundamental economic variables is the issue of this dissertation, coupled with a test of the nature of the speculation in the foreign exchange markets. Multiple regression analysis methodology is used to assess the role of the

fundamental economic variables in explaining the variations in the level of exchange rates for nine countries (Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Switzerland, and the United Kingdom), with the United States as the base for comparison. The empirical results show that over the period of the study, 1973 to 1978, the fundamental economic variables played either a weak or a minor role in explaining the fluctuations in the exchange rates. In other words, movements in the exchange rates of the countries under study during the period 1973 to 1978 were apparently not related to changes in relative price levels, interest rates, and relative income levels.

The results of speculation tests indicate destabilizing results for some currencies and stabilizing results for the others; the coefficient of expectation tests, however, lend support to the destabilizing hypothesis. The conclusion of the research, therefore, is that the exchange rates of the major industrial countries which are of prime importance to the international financier and investor, and to the student of international finance and trade, are primarily determined, not by the fundamental economic variables, but by speculative forces which are believed to be of a destabilizing nature.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I

THE RESEARCH OBJECTIVE

Introduction

In the sphere of international finance, the classical gold standard operated from about 1870 to 1914 and was characterized by relatively free trade and unrestricted international capital movements. World War I, however, brought the classical gold standard to an end. The interwar period was characterized by generally chaotic conditions in international trade and finance; exchange rates fluctuated from the end of the war to 1925, except in the United States, which returned to gold in 1919. Beginning in 1925, attempts were made to reestablish the gold standard, but they collapsed by 1931 at the time of the Great Depression. There followed a period of competitive devaluations, as nations tried to export their unemployment (beggar-thy-neighbor policies). Tariffs, quotas, and exchange controls also became widespread, with the result that the volume of world trade was cut almost in half (20, pp. 129, 168).

The basis for the post-World War II international monetary system was laid at Bretton Woods, New Hampshire, in 1944. It can best be understood as an attempt to prevent a recurrence of the chaotic conditions in international

trade and finance that prevailed after World War I. The new system called for the establishment of an International Monetary Fund (IMF) to see that nations followed an agreed-upon code of rules in their conduct of international trade. In addition, this system set up borrowing facilities for nations facing temporary balance of payment difficulties. The one overriding characteristic of the international monetary system, at least as it operated until February of 1973, was its adherence to fixed exchange rates. In setting up the International Monetary Fund, the Bretton Woods Agreement did foresee the need for occasional adjustments in exchange rates, but this was expected to be a seldom-used and highly exceptional emergency operation to which most nations, and certainly the industrialized nations, would not have to resort.

The Bretton Woods system of fixed, but in principle adjustable, parities came to an end on August 15, 1971, when the United States government terminated the sale of gold to foreign monetary authorities and allowed the dollar to depreciate de facto in the exchange market. The necessity for a general realignment of exchange rates was generally recognized. While nations were awaiting an agreement on the size and application of this realignment, fixed parities between the main currencies were abandoned. The tensions caused by the huge payment deficits of the

United States had led in May of 1970 to the floating of the Canadian dollar, and in May of 1971 to the floating of the West German Deutschemark (4, p. 129). The British pound was floated in June, 1972; the Swiss franc in January, 1973; and the Japanese yen and the Italian lira in February, 1973 (27, p. 329).

Floating rates as an accepted general adjustment mechanism in the international monetary system had come of age. The remaining months of 1973 and 1974 witnessed wide fluctuations in the exchange markets. Forces that had been supressed in previous periods were now free to operate. The emerging floating system is called managed float, in which the monetary authorities will act to counter what are termed "disorderly market conditions," or erratic fluctuations, in exchange rates. By contrast, in a perfectly flexible exchange-rate system, the lack of balance between the demand and supply of two currencies would lead to an alteration of exchange rates without any government intervention until it reached some level at which demand and supply were once again in balance.

Academicians have been attracted by the notion of flexible exchange rates because of the apparent conflict among macro-policy goals inherent in a system of fixed exchanges. The potential resolution of the conflicts among the simultaneous achievement of free multilateral

trade, balance of payments equilibrium, and high levels of domestic aggregate demand constitutes the basic intuitive appeal of flexible exchange rates. Advocates of this system claim that by providing an automatic balance of payments adjustment mechanism, flexible exchange rates would enhance the feasibility of achieving policy-engineered high levels of employment and growth and contribute to a general relaxation of trade restrictions (23, p. 167).

Although flexible exchange rates have become accepted as the basis for the new international monetary system, some critics have argued that the exchange rates themselves have behaved poorly in terms of the frequency of instances of destabilizing or insufficiently stabilizing speculation. These writers believe that, in a freely fluctuating exchange system, speculators would cause wide swings in exchange rates, thereby increasing the element of risk in international trade (or increasing the cost of covering forward).

The experience since March, 1973, is that a major currency such as the German mark has risen 25 per cent in three or four months, then fallen 20 per cent, then risen again by 15 to 20 per cent. It seems unlikely that the basic economic position has moved back and forth to that extent. The foreign-exchange market appears to be sending exaggerated price signals. Numerically, the swings from high to low (and back again) are summarized in Table I

for the dollar-mark and dollar-franc rates from 1973 to 1978. Other floating currencies have displayed similar wide swings, although some have shown more of a trend in one direction or another.

TABLE I

CHANGES IN DOLLAR-MARK AND DOLLAR-FRANC RATES, 1973-1978

Changes in the Value of the German Mark in U.S. Cents		Changes in the Value of the French Franc in U.S. Cents	
Period	Percentage of Change	Period	Percentage of Change
3/73-7/73	+ 25	3/73-7/73	+ 17
7/73-1/74	- 22	7/73-1/74	- 26
1/74-5/74	+ 19	1/74-5/75	+ 32
5/74-8/74	- 9	5/75-9/75*	- 15
8/74-2/75	+ 20	9/75-9/76**	- 10
2/75-10/75*	- 15	9/76-9/78	+ 15
9/75-9/78**	+ 37		

Source: Wall Street Journal, various issues, 1973-1978.
* 1973-1975 based on daily highs and lows.
**1976-1978 based on monthly averages.

Psychological influences, as opposed to fundamental economic factors, are said to be the predominant factors determining exchange rates. Charles Kindleberger (10) and Ronald McKinnon (13) are two prominent critics of the current system of floating exchange rates. Both argue that the behavior of floating exchange rates has

been unsatisfactory and that the variability of exchange rates has been too great. Kindleberger attributes this variability to destabilizing speculation and McKinnon to an insufficiency of stabilizing speculation.

It clearly behooves management, when committing funds abroad, receiving income from abroad, importing goods and services, and managing international capital transactions generally, to know the role of the fundamental economic factors in the determination of foreign exchange rates and also to assess the role and the nature of speculation in foreign exchange variations. This knowledge is also essential to governments and international monetary institutions in managing exchange rates of the international monetary system. It is the basic objective of this dissertation to assess the impact of fundamental economic factors and speculation on exchange rate determinants over the period 1973 to 1978.

Review of the Literature

A survey of recent studies in the field of international finance reveals three major criticisms which have been made against the system of flexible exchange rates: First, flexible exchange rates hamper international transactions; second, flexible exchange rates may have inflationary effects; and, third, flexible exchange rates may be of a destabilizing nature in the foreign exchange

markets. In the following section, the arguments on both sides of these issues will be presented.

Flexible Exchange Rates and International Trade and Resource Allocation

Traditionally it was widely believed that flexible exchange rates would seriously harm international trade. One aspect of the argument is that exchange rate variations under a system of flexible rates will greatly curtail long-term foreign investment because either borrowers or lenders will refuse to conclude long-term contracts. The lender might protect himself by insisting upon repayment and servicing in his own currency, but this would merely shift to the borrower the risk of unanticipated gains or losses entailed by exchange rate changes.

Furthermore, if elasticities of demand and supply of foreign exchange are very small, shifts in demand or supply will cause relatively large changes in exchange rates. Also, with given prices in each country, the exchange rate determines which commodities will be imported and exported. Large changes in the exchange rate will alter comparative advantage positions and call for resource movements. Such changes in exchange rates, if frequent, could cause much wasteful movement of resources into and out of industries on the borderline of comparative advantage (9, pp. 91-92).

In a similar vein, critics of the flexible exchange system argue that flexible rates restrict commodity trade because buyers and sellers are reluctant to make commitments when the rates fluctuate. The possibility of rate changes creates a risk of lower profits because of a change in the price traders pay or receive for foreign currency. Although they could theoretically hedge such risks in the forward exchange market, this action involves costs and may not be possible if forward markets are thin. The cost of hedging, assuming it is possible, or the added uncertainty concerning the profitability of foreign transactions will discourage foreign trade and investment and thus keep them below optimum levels (2, p. 265). R. S. Masera (5, p. 58) in assessing the impact of 1973 floating on that year's world trade found that the values of the parameters and those of exchange rate variables in his regression equation indicate that the beneficial effect of exchange rate variability in the course of 1973 was more than offset by the negative impact of gyrations, thus suggesting that the overall impact of exchange rate movements was detrimental to the growth in the volume of world trade.

Proponents of flexible rates have several counterarguments. First, pegged rates assure borrowers and lenders only of temporary rigidity, not of long-run stability of exchange rates. With the possibility of periodic

adjustments of rates under the pegged system, conversion risks continue to exist in the long run. Second, the risk of exchange controls is greater under a system of pegged rates, a threat which could be as great a deterrent to long-term investment as variations or potential variations of flexible rates (14, p. 17). Third, the advocates of flexible exchange rates object strongly to the assumption that such rates will be unstable. They argue that, if flexible rates are unstable, it is because of major disturbances in domestic economies that require large adjustments in the exchange rate system. If the exchange rates do not change, countries will have to induce substantial price and income changes or resort to trade and exchange controls to cope with payment disequilibria. The existence of unstable economies in some countries will discourage foreign trade and investment under either pegged or flexible rate systems. If the disturbances are such as to cause only moderate changes in flexible rates, the disturbance to foreign trade and investment might be smaller than that under a fixed rate system in which the deficit country is inclined to impose controls rather than to devalue. Haberler, for instance, argues that minor fluctuations in exchange rates are less disturbing to international trade than the imposition of controls that may wholly or partially close certain markets (6, p. 26).

Furthermore, Willett argues that businessmen have found that the difficulties of operating under a flexible rates system are not as great as many of them had anticipated (26, pp. 42-43). He states that this favorable view stems from a growing realization that the difficulties of operating under flexible-rate systems must be compared not with some ideal system but with realistic alternatives such as the adjustable peg and associated uncertainties of occasional large changes in par values and tendencies towards greater use of controls. Earlier in his book Willett argues that whatever harmful effects floating may have on international trade have clearly been quite limited. Trade flows during the period 1973 to 1975 have not shown a significant deline from the levels that would normally be expected on the basis of changes in domestic economic activity. If a basic change should occur in competitive positions among countries, flexible rates will speed the adjustment to a new equilibrium, and this adjustment would be accomplished without the financial crises that mark the fixed system.

Flexible Exchange Rates and Possible Inflationary Effects

Another argument against the flexible exchange rates system concerns the possibility of a feedback of depreciation upon the domestic price level of a country, producing

inflation and, therefore, the need for further depreciation (21, pp. 97-98). It is argued that, if governments are relieved of balance-of-payments discipline, more inflationary policies are the likely result. Central banks would lose their leverage on governments concerning fiscal matters that are provided by reserve losses, and this leverage is of great importance in some countries. Also fluctuations in exchange rates themselves may give an upward lift to prices. When a currency depreciates, prices of imports rise in terms of domestic currency, and these are usually quickly passed on to consumers both directly and indirectly as imported raw materials and other imports create cost pressures for domestic production. These price increases in turn add to pressures for larger wage settlements and still higher costs and prices. When a currency appreciates, however, not all cost reductions are translated into price reductions. Wage rates are notoriously sticky downward, and thus part of the appreciation gain will be absorbed in higher real wages. The asymmetric adjustment to exchange rate changes--depreciation leading to higher prices and appreciation to higher real factor returns--will on the balance leave the price level higher than it would be in the absence of exchange rate fluctuations (11, p. 332).

It is important to recognize that a change in relative inflation rates will tend to depreciate the equilibrium

exchange rate even in a system of pegged exchange rates, because it will generate strictly analogous demand shifts and price pressures. If, by running down its foreign exchange reserves or by running up its international indebtedness, the country prevents the actual exchange from depreciating, it will succeed for a time in exporting its inflation to its trading partners and thus in holding down the extent of price increases. With finite reserves and borrowing power, however, the exchange rate adjustment required by the differential inflation rates cannot be postponed indefinitely. When actual and equilibrium exchange rates are finally aligned, imports prices will rise, and these increases must properly be attributed not to devaluation but to the country's relatively higher inflation (26, p. 59). It is ironic that in such instances countries frequently complain about importing back the inflation they had previously exported. There is, of course, an element of truth in the argument that flexible exchange rates complicate the financial transactions of inflation-prone countries; their ability to export inflationary pressures and thereby to extract subsidies from their neighbors is sharply circumscribed. But from the standpoint of the international system as a whole, this may be viewed as a virtue rather than a vice.

Willett (26) argues that, given the degree of underlying inflationary pressures, exchange rate adjustments

would have been much prompter and smoother under relatively freely flexible rates than they have been under adjustably pegged and heavily managed rates. Recognition of this fact is rapidly spreading, but it will still take some time to work off the legacy of past heavy management of exchange rates. By making it more difficult to disguise the initial effects of inflationary pressures, Willett continues, relatively flexible exchange rates will not only reduce instabilities in the foreign exchange market, but will also provide greater discipline for governments to resist yielding to the pressures to adopt inflationary policies.

Therefore, it is believed that flexible rates minimize the harm done to international trade and international economic cooperation by the inflation differentials that do exist. Given the various propensities to inflate exhibited by different countries over the past few years, it seems likely that these countries would have resorted to substantial use of trade controls and other protectionist measures if the old regime of adjustably pegged exchange rates had remained in force. Flexible rates do not eliminate the importance of securing greater underlying economic and financial stability in all countries, but they do minimize adverse consequences for the international economy when countries do not succeed in this endeavor (26, p. 67).

Speculation and Exchange Rate Volatility

One of the most frequent criticisms of the performance of flexible exchange rates is the charge that they have been excessively volatile because of destabilizing or insufficient stabilizing speculation. The terminology in the early part of this debate was, at best, poorly defined. "Speculation" was usually used synonymously with "private short-term capital flows"; more formally, it can be assumed that speculation is the deliberate assumption of a net open position in a foreign currency, reflecting a judgment on the part of the transactor as to future exchange rate movements (22, p. 257).

The term "destabilizing speculation" has several connotations. In Ragnar Nurkse's context (16), it appears to apply to those speculative capital movements that tend to prevent the exchange rate from stabilizing at equilibrium level. In Milton Friedman's context (5), destabilizing speculation refers to speculative capital movements that are not based on judgments about the long-run equilibrium level of the exchange rate as determined by the relative stance of economic policy in the countries concerned. In theoretical models destabilizing or stabilizing speculation is concerned with whether speculators forming expectations about future exchange rates merely extrapolate from a trend and move funds so as to reinforce that trend,

or whether, on the basis of a consistent appraisal of the forces at work in the foreign exchange markets, speculators form some idea of an equilibrium rate and transact in a way that moves the actual rate toward that value. If the former were the case, speculators could be accused of destabilizing the market, and large exchange rate gyrations could result from almost any small disturbance that initiated a trend.

In his frequently-quoted attack on the free exchange market, Nurkse claims, "Experience has shown that, apart from exchange control, the only effective means to prevent the disturbing exchange movements . . . is a direct stabilization of the exchange market . . . " (16, p. 121). Free exchange markets, in his opinion, are inherently unstable.

> Anticipatory purchases of foreign exchange tend to produce or at any rate to hasten the anticipated fall in the exchange value of national currency, and the actual fall may set up or strengthen expectations of a further fall. Exchange rates in such circumstances are bound to be highly unstable, and the influence of psychological factors may at times be overwhelming (16, p. 118).

Friedman, however, seriously challenges the destabilizing speculation theory with the assertion that destabilizing capital flows could not be profitable for the market as a whole. He postulates that the market transactors have linear supply and demand functions for foreign exchange and that profitable speculation should

always drive exchange rates toward their equilibrium values. Friedman states,

> Despite the prevailing opinion to the contrary, I am very dubious that in fact speculation in foreign exchange would be destabilizing. . . . The widespread belief that speculation is likely to be destabilizing is doubtless a major factor accounting for the rejection of a system of flexible exchange rates in the immediate postwar period. Yet this belief does not seem to be founded on any systematic analysis of the available empirical evidence (5, p. 175).

He also claims that

> People who argue that speculation is generally destabilizing seldom realize that this is largely equivalent to saying that speculators lose money, since speculation can be destabilizing in general only if speculators on the average sell when the currency is low in price and buy when it is high (5, p. 175).

Thus, according to Friedman, speculators will continue in business only so long as it is profitable. This will be the case if they buy cheap and sell dear. But to buy cheap and sell dear is to stabilize.

Based on the arguments cited above, when speculators tend to move an exchange rate close to the equilibrium rate, their activity is stabilizing; only when they move the rate away from the equilibrium level is their influence destabilizing. Proponents of flexible rates argue that speculation is more apt to be stabilizing under flexible rates than under fixed rates. They argue that, when a pegged rate is clearly wrong, everyone will expect it to change in one direction only. Under flexible rates, by

contrast, speculators will not be unanimous in their expectations concerning the future equilibrium exchange rates. At any given time, some will think that a particular currency will appreciate in the future while others will think that it will depreciate. Whenever uncertainty exists concerning the future rate, there will be some risk in shifting funds, for example from a depreciating currency to an appreciating one. The risk is that the appreciating currency may fall in price because it has over-appreciated. Speculators who believe that the strong currency has over-appreciated will move funds back to the weak currency. As long as there is some doubt about the future equilibrium exchange rate, speculation will not be a one-way street as it is under pegged rates (3, p. 267).

However, certain conditions are necessary for speculation to be stabilizing under flexible rates, and these conditions will not exist in all circumstances. Speculators must be well-informed; if they are uninformed or misinformed about market conditions and act at the wrong time, they will accentuate fluctuations in rates and may even cause a breakdown of the payment system. Furthermore, financial authorities in the deficit country must demonstrate their willingness to adopt appropriate policies to help restore equilibrium. If depreciation results from more rapid inflation in one country than in others and if

financial policies of that country are such as to suggest a continuation of this condition, speculators and others will naturally move funds out of that country's currency.

Empirical studies have provided conflicting results on the nature of speculation for previous cases when the exchange rates were allowed to fluctuate relatively freely. Tsiang (25) analyzed the 1919-1926 data for three countries and concluded that speculation was not generally destabilizing; indeed, he thought it was stabilizing more often than not. He also examined Peru's experience with flexible rates from 1950 to 1954 and concluded that speculation in that country did not contribute to instability of the rate (24). Similarly, Rhomberg found that, on the whole, speculation tended to stabilize the Canadian exchange rate during the period from 1952 to 1960 (19).

On the other hand, Aliber (1) has supported the view that speculation in the French franc was destabilizing during much of the period after World War I in which exchange rates were allowed to float freely. Aliber's conclusions are based largely upon the behavior of an indicator of speculative anticipations. The indicator, a crude proxy for speculation, was constructed from data on the spot rate of exchange, the forward rate, and the yield-differential on short-term debt-instruments. If the net forward premium significantly differs from that

justified by the yield-differential, it is assumed that speculators (who prefer to deal in forward markets) are responsible. By examining the behavior of the indicator in conjunction with the spot exchange rate, Aliber concludes that speculators became bearish on the French franc the further it depreciated.

Myhrman (15), concentrating on previous experiences of flexible exchange rates, found that in the long run the exchange rate was basically determined by changes in relative money supply, relative productivity, and some relationship such as the saving function. He concluded that there was very little evidence of inherent instability and destabilizing speculation, except for Germany under hyperinflation and possibly Russia in the nineteenth century and France in the 1920s. Hodgson (7), analyzing the dollar-sterling 1919-1925 floating exchange rates, found that the actual rate, even in this period of highly volatile fluctuations, does not appear to have been given to erratic gyrations unconnected with movements in the fundamental economic forces. In general, he concludes that the high degree of variability in the dollar price of sterling during the early 1920s appears to have reflected rather faithfully a high degree of variability in the fundamental economic factors.

Thomas (23) analyzed the behavior of the flexible exchange rates for the 1920s, when most of the major currencies of the world floated without significant governmental intervention in the exchange markets. He used two sets of tests; the first examined the role of the fundamental economic variables in explaining the variations of those currencies at that time, and the second assessed the nature of speculation in the foreign exchange market for those currencies. Thomas concluded that the predominant portion of the variation in the level of exchange rate could be explained on the basis of fundamental economic factors potentially capable of being influenced by aggregate economic policy.

Ingram (8), investigating the Canadian exchange rate between 1950 and 1957, found the Canadian dollar to be remarkably stable. Ingram computed a series of quarterly changes in some economic variables and then measured the relationship between one variable and another, or between one variable and two or more others, by means of correlation and regression analysis. Various combinations of leads, lags, and simultaneous changes were used to ascertain the closest relationship. Ingram concluded that modest movements in the Canadian dollar seemed related to changes in relative prices, the volume of trade, and capital movements. Lawrence Officer (17)

developed two autoregressive equations of first and second order for the Canadian dollar. He tested two periods; the first period--1955-1961--served as the record of experience under flexible rates, and the second period--1962-1967--served as the record of experience under fixed exchange rates. Officer found high explanatory power for both equations. However, quite surprisingly to those who associate exchange-rate uncertainty and unpredictability with a freely-fluctuating rate, the equation with the better fit was the one for the floating-rate period. Officer argued that the high predictability and stability of the flexible exchange rate must have been associated with stabilizing speculation, a conclusion he has confirmed in his econometric model of Canada under the fluctuating exchange rate (18).

The current system of floating exchange rates has been characterized by a number of informed observers as economically unsatisfactory. Kindleberger (10) and McKinnon (13) are two of the more serious critics of the current system of floating exchange rates. Both argue that the behavior of floating exchange rates has been unsatisfactory and that the variability of exchange rates has been too great, Kindleberger attributing this to destabilizing speculation and McKinnon to an insufficiency of stabilizing speculation.

Kindleberger argues that the criterion "to judge whether speculation is stabilizing or destabilizing is whether it narrows or widens the variance in the amount of price (in this instance, the exchange rate) over time" (10, p. 62). Logue, Sweeney, and Willett in their research (12), however, argue that criticisms of the alleged poor speculative performance of the foreign exchange markets under the current float have weak empirical foundations. They believe that the evidence concerning cycles or bandwagon effects is not strong, even for the initial period of floating exchange rates. Furthermore, these writers claim that their tests lend support to the view that foreign exchange rates have tended to become more stable as experience with floating has progressed. But Logue, Sweeney, and Willett are not able to suggest to what extent this may be due to an increase in expertise on the part of foreign exchange dealers; an expanded supply of speculative funds, et cetera; or a reduction in instability and uncertainty about underlying economic and financial developments. They conclude that, in either case, their empirical results are difficult to explain in terms of views that hold that substantial continuing speculative inefficiencies exist in the operation of the major foreign exchange markets.

The survey of the literature presented above indicates that there is no agreement on the nature of speculation in a freely-fluctuating exchange system. Some writers argue that the speculation was stabilizing in previous cases when the exchange rates were allowed to fluctuate relatively freely; others disagree and claim that the speculation was destabilizing. Also, some writers have found that the role of the fundamental economic variables in explaining the variations in exchange rates in the previous fluctuating rate periods was statistically significant. However, there is no additional empirical evidence for the role of the fundamental variables in the current floating exchange rates period. As mentioned earlier, the literature indicates a conflicting view regarding the nature of speculation. Some researchers contend that the speculation is indeed destabilizing in the current float, while others argue that there is no empirical evidence for the alleged instability.

The Research Objective

The objective of this dissertation should now be clear. How does speculation actually behave under the current exchange rates? This is an extremely important question. If speculation is actually stabilizing (depressing exchange-rate fluctuations through time), the case for flexible exchange rates is strengthened. If

speculation is destabilizing, however (amplifying exchange-rate fluctuations through time), the case for flexible exchange rates is weakened. It is hoped that this investigation will provide additional empirical evidence concerning the behavior of exchange rates in the current flexible exchange rate system, 1973-1978. The impact of the variations in the fundamental economic factors on the level of exchange rates will be studied by means of multiple regression analysis. A framework similar to that utilized by Ingram (8), Thomas (23), and Hodgson (7) will be employed to test for the role of the fundamental economic variables in the exchange rate determination. The purchasing power parity and the coefficient of expectation tests will be employed to analyze the nature of the speculation.

The goals of this study are, specifically, to assess the role of the fundamental variables in explaining the variations in the level of foreign exchange rates from 1973 to 1978 and to test the hypothesis of destabilizing speculation.

These objectives are believed to be significant, since stabilizing speculation performs a socially useful function, ironing out temporary fluctuations in the exchange rates and thereby achieving a better allocation of resources over time; but destabilizing speculation

aggravates fluctuations in the exchange rate and interferes with optimum allocation of resources over time. Previous experience with the flexible exchange rate systems lent support to the role of fundamental economic factors in some studies but confirmed the role of destabilizing speculation in other studies. There are conflicting view in the current float, and here additional evidence will be presented.

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CHAPTER II

THE THEORETICAL AND CONCEPTUAL RELATIONSHIPS BETWEEN EXCHANGE RATES AND FUNDAMENTAL ECONOMIC VARIABLES

Introduction

The purpose of this chapter is to present the conceptual and theoretical relationships between exchange rates and the fundamental economic variables. The relationship between the exchange rates and each individual fundamental economic variable will be explained, and an integrated relationship for all variables and the exchange rates will then be developed. The chapter will conclude with a discussion on the nature of speculation, both stabilizing and destabilizing, and the theoretical basis of the tests which will be conducted to draw inferences on the nature of speculation.

For the empirical tests of this study six fundamental economic variables will be utilized: foreign and domestic consumer price levels, foreign and domestic short-term interest rates, and foreign and domestic income levels. Each domestic variable and its foreign counterpart will be converted into a ratio to alleviate the problem of

correlation among the independent variables themselves. Thus, three ratio variables will be presented.

Other important variables also exist, of course, such as money stocks, both domestic and foreign, and short-term and long-term capital accounts in the balance of payments. However, several reasons support the choice of the three variables employed in this study. First, all these variables are the most important ones in the determination and the adjustment process of the balance of payments. Relative price level differences make one country's goods and services more competitive and consequently increase the demand for them from its trading partners. This demand shift for that country's goods and services will be translated into an increase in the demand for its currency, an eventual appreciation in its foreign exchange rates, and a concurrent depreciation in the foreign exchange rates of the trading partners. Interest rates differentials encourage the flow of liquid funds from the low interest rate country to the high interest rate country, resulting in an increase in the demand for that currency and an appreciation in the foreign exchange of that country. The opposite phenomena will take place for the trading partners with lower interest rates. Finally, imports and exports are sensitive to domestic and foreign income levels. Higher domestic income level encourages imports through

the marginal propensity to import. As a result, higher incomes increase imports, thus increasing the supply of the national currency in the foreign exchange markets and resulting in a depreciation of the foreign exchange rate of a relatively higher income country.

Second, the three variables employed here have been selected to avoid severe multicollinearity in the multiple regression equations because of the high degree of correlation between these three fundamental economic variables and those which are not included.

Third, these variables are common denominators for similar studies used as the basis for this study's empirical analysis. Thomas (20), for example, presents econometric models analyzing the behavior of the flexible rates experience after World War I. Thomas uses income levels, price levels, and interest rates for Canada, the United Kingdom, the Netherlands, Spain, and Sweden, arguing that these variables are the most important ones in the determination and the adjustment process of the balance of payments. Ingram (7), concentrating on the Canadian exchange rates of 1950-1957, examines empirically the relationships between foreign exchange rates and relative price level, export-import ratio, relative income levels, and short-term and long-term capital movements. Ingram states that the reason for the choice of these

variables was that they were usually associated with exchange rates in theoretical discussion. On the other hand, Hodgson (6) analyzes the floating exchange rates of the dollar-sterling for the period March, 1919, to April, 1925. He employs price levels, real income levels, interest rate differentials, money-stock magnitudes, and seasonal effects in his analysis, stating that these variables were the fundamental determinants of foreign exchange rates.

The Fundamental Economic Variables

Price Levels

The relationship between foreign exchange rates and price levels is explained by the theory of purchasing power parity, which holds that if the spot exchange rate between two countries starts at equilibrium, any change in the differential rate of inflation between them tends to be offset over the long run by an equal but opposite change in the spot exchange rate. A justification for this relationship is that if a country experiences higher inflation rates than its main trading partners, its exports of goods and services will become less competitive with comparable products produced elsewhere. Imports from abroad will also become more price competitive with higher-priced domestic products. Therefore, the demand for foreign currencies will increase, accompanied by a

concurrent decrease in the demand for the domestic currency (or an increase in the supply of the domestic currency). Thus the country with relatively high inflation rates will develop a deficit in its balance of payments in goods and services. If not offset in the capital account, this deficit will lead to downward pressure on the country's spot exchange rate because demand for foreign currency to settle imports of goods and services will be greater than other countries' demand for the currency of the country in question for the same purpose.

This relationship between prices and exchange rates has long been recognized, and for Gustav Cassel it became the basis of the doctrine of purchasing power (3).

The traditional monetarist approach, which views exchange rates as the price of one money in terms of another, suggests that not only randomly distributed real shocks but also the commonly observed divergences between countries' monetary policies would largely explain the variations in bilateral exchange rates (18, p. 254). In terms of the familiar Mundellian analysis (12), when capital mobility is infinite, output is at full-employment level, and the expected future spot rate is identical to the current spot rate; and, assuming the adjustment in the price level rather than in the income level (18), a monetary expansion in one country is illustrated in Figure 1.

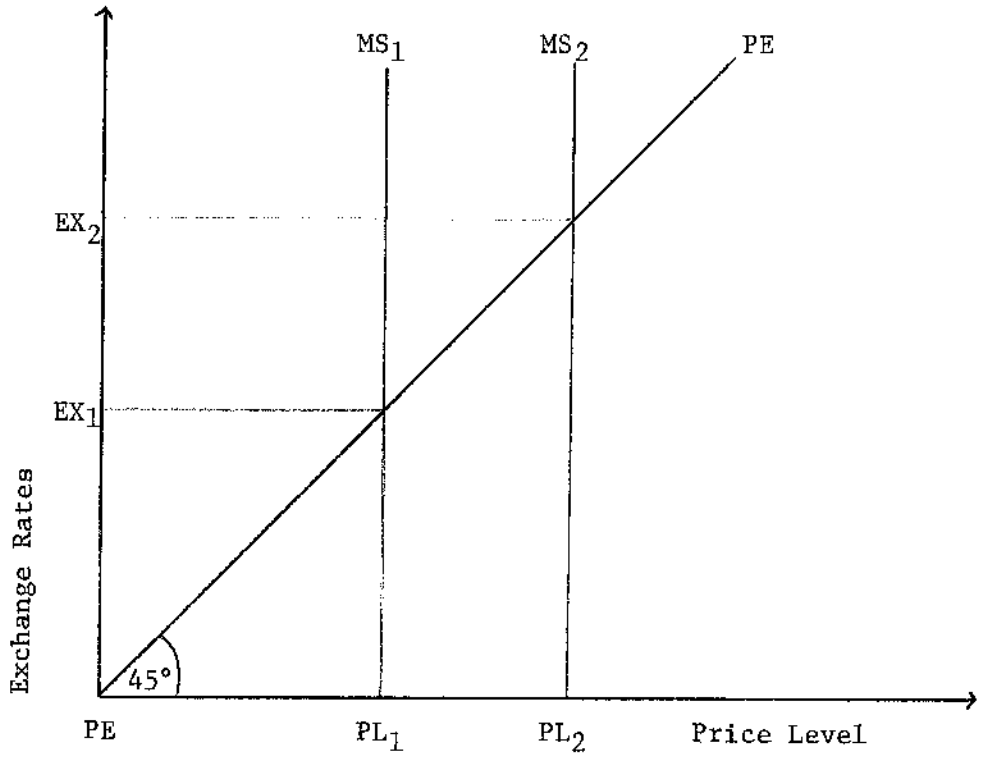

Fig. 1--Money stocks-price level-exchange rates relationships.

PE is the locus of combinations of the price level and exchange rate consistent with the domestic goods market equilibrium. MS_1 is the equivalent locus of points consistent with money market equilibrium. PE must be a 45-degree upward-sloping line, since an increase in prices reduces demand for domestic goods and must therefore be offset by a diversion of foreign demand to domestic goods via an exchange rate depreciation. MS_1 is vertical because the equality of forward and spot rates implies that the domestic interest rate must always equal the foreign rates.

Prices must, therefore, change in proportion to changes in the money supply to preserve money market equilibrium. The analysis shows that an increase in the domestic money supply from the MS_1 to the MS_2 level produces an increase in prices and a depreciation in the exchange rate, as seen in the movement from PL_1 to PL_2, and from EX_1 to EX_2 (18, p. 255).

Therefore, the rise in the domestic price level of goods, commodities, and services would lead in the long run to the depreciation of that country's currency in the foreign exchange markets, while a rise in the price level of the rest of the world would lead to the appreciation of that country's currency. More generally, the absolute version of the purchasing parity doctrine is postulated thus:

$$\frac{P_A^t}{P_B^t} = EXR^t \qquad [1],$$

where P_A^t is the price level in country A, P_B^t is the price level in country B, and EXR^t is the A/B exchange rate, all at period t. When this absolute version of the doctrine proved inconsistent with the facts, it was replaced by a relative version (17, p. 341), which postulated that the change in the exchange rate between two countries over a period of time should equal the relative change in the price levels of those countries over the same period of time:

$$\frac{P_A^t / P_B^t}{P_A^o / P_B^o} = \frac{EXR^t}{EXR^o} \qquad [2],$$

where o refers to the base period preceding t. Subtracting 1 from each side of equation [2], the following equation results:

$$\frac{P_A^t/P_B^t - P_A^o/P_B^o}{P_A^t/P_B^o} = \frac{EXR^t - EXR^o}{EXR^o} \qquad [3].$$

Maintenance of the purchasing-power parity between the currency of country A and the currency of country B over time requires, therefore, that the proportional (percentage) change in the exchange rate equal the proportional (percentage) change in the price levels (16, p. 341). Solving equation [2] for EXR^t brings the following result:

$$EXR^t = EXR^o \left(\frac{P_A^t/P_B^t}{P_A^o/P_B^o}\right) \qquad [4].$$

Figure 2 shows a more general case of purchasing-power parity. The vertical axis shows the per cent appreciation of the foreign currency relative to the home currency, and the horizontal axis shows the per cent higher or lower rate of inflation in the foreign country relative to the home country. The diagonal parity line shows the equilibrium position between a change in the exchange rate and relative inflation rates. For instance, point K represents the equilibrium position where inflation in

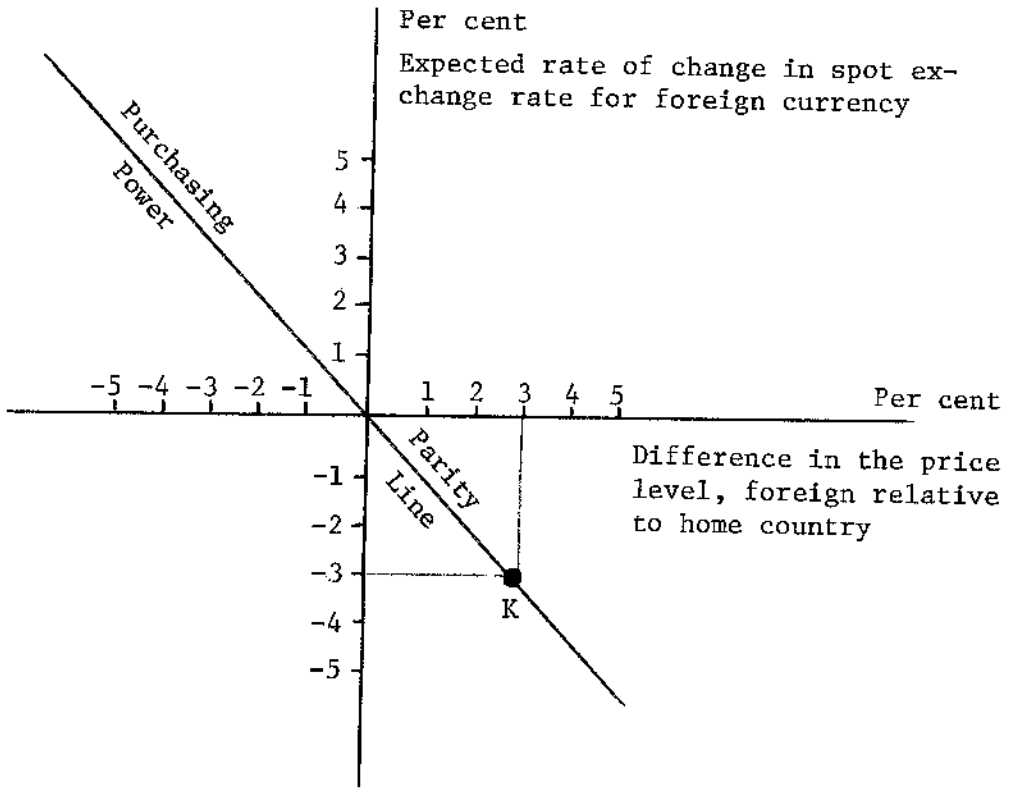

Fig. 2--General case of purchasing-power parity doctrine.

country B is three per cent higher than in country A; therefore, country B's currency is expected to depreciate by the same three per cent.[1] Therefore, it is expected that $\frac{\delta EXR}{\delta P_D} < 0$, where EXR is the current spot exchange rate and P_D is the domestic price level. Also, it is expected that $\frac{\delta EXR}{\delta P_F} > 0$, where P_F is the foreign price level.

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[1]For a detailed analysis of the meaning of the purchasing-power parity doctrine, see Leland Yeager's "A Rehabilitation of Purchasing-Power Parity" (24).

Consequently, it is hypothesized that $\frac{\delta EXR}{\delta P_r} < 0$, where P_r represents the ratio of P_D to P_F.

Economists have raised several objections to the purchasing-power parity theory on both theoretical and empirical grounds. The principal theoretical objection to the doctrine lies in its inadequate coverage of the transactions that determine the rate of exchange. Only the price levels of goods are used to determine purchasing-power parities, whereas exchange rates are determined by capital transactions as well as goods transactions (17, p. 341). On empirical grounds, the most serious objection is the question of the appropriate price indices to be used as measures of price levels. The ideal index would be one based on the same assortment of goods in both countries, but governments do not compile such indices. Root (17) considers the cost-of-living index as the most appropriate one to use in applying the purchasing-power parity doctrine. Other objections point to conditions that would create disparities between the purchasing-power parity exchange rate and the actual exchange rate over the short run, such as various government restrictions, the lagged response of officials in adjusting to payments disequilibria, the influence of exchange rate variations on the price level, and speculation. Most critics of the purchasing-power parity doctrine do not reject it outright, and it is

widely accepted that in periods of rapid inflation the single most important determinant of change in exchange rates is the relative shift in the purchasing power of national currencies (17, p. 342).

Interest Rates

In order to explain the relationship between exchange rates and interest rates a discussion of the term interest arbitrage is helpful. Interest arbitrage refers to the transfer of liquid funds from one monetary center and currency to another to take advantage of higher rates of returns (interest). If the return on three-month treasury bills is 12 per cent (on a yearly basis) in Paris and 8 per cent in New York, a U.S. resident can exchange his dollars for French francs at the current spot rate and invest them in Paris where he earns 4 per cent more per year or 1 per cent more per quarter. This interest rate differential, as described above, will strengthen the demand for the French franc, resulting in an appreciation in the value of the franc and a corresponding depreciation in that of the dollar. However, in three months, since these are short-term investments, the U.S. resident will convert his francs into dollars and collect the extra interest earned. Since in three months the spot rate of the dollar with respect to the franc may be lower, the resulting loss may cancel or even surpass his gain in interest. To protect himself

against this exchange risk, at the same time that the U.S. investor exchanges dollars for French francs to invest in Paris for three months, he will also engage in a forward sale of an equal amount of francs for dollars for delivery in three months. If the forward discount on the franc is 1 per cent on a yearly basis, he will lose .25 per cent for the quarter on the foreign exchange transaction, but will gain an extra 1 per cent interest for the quarter, for a net riskless return of .75 per cent on his foreign investment (3 per cent on a yearly basis). Therefore, the interest rate differential in favor of the Franch franc will enhance the demand for the franc, eventually creating an upward pressure on the spot rate of the franc. Concurrently, an outflow of liquid funds will take place from New York toward Paris seeking higher interest rates and, consequently, a downward pressure on the dollar's spot rate.

However, as covered interest arbitrage proceeds, the positive interest rate differential in favor of Paris tends to decline while the forward discount on the franc tends to increase, until they are equal. At interest parity, there is no further possibility of gain, and covered interest arbitrage comes to an end.

The International Fisher Effect. The International Fisher Effect maintains that the current spot exchange rate should change in an equal but opposite direction to

the difference in interest rates between two countries. Figure 3 shows a more general case of the International Fisher Effect. The vertical axis represents the forecast

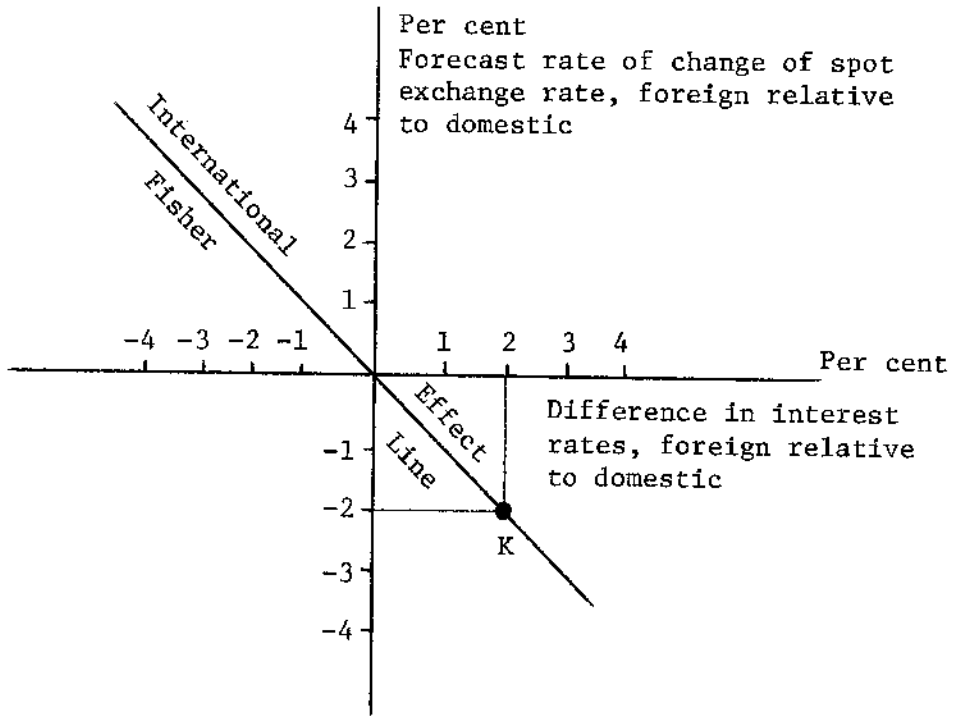

Fig. 3--Graph of the International Fisher Effect.

rate of change in the spot exchange rate, and the horizontal axis represents the difference in the interest rates. The parity lines show the International Fisher Effect. For instance, point K shows the position where the two per cent forecast depreciation in the exchange rate of a foreign country relative to the U.S. dollar is equal to the two per cent higher rate of interest in the foreign country.

Interest parity theory. The theory of interest-rate parity states that, except for transaction cost, a difference in national interest rates for securities of similar risk and maturity should be equal but opposite in sign to the forward exchange rate discount or premium for the foreign currency.

The interest parity theory is easily explained algebraically. It may be assumed that a U.S. investor has X dollars to invest in ninety-day treasury bills, either in New York or in Paris. If X dollars are invested in the New York money market, the return, R (principal plus interest), at the end of ninety days will be

$$R = X(1 + \frac{I_{US}}{4}) \qquad [5],$$

where I_{US} is the annual interest rate on treasury bills in New York. Therefore, $\frac{I_{US}}{4}$ is the quarterly interest rate.

On the other hand, if the investor buys X dollars worth of bills in Paris and covers against the exchange risk, the return at maturity will be

$$(R) = \frac{X}{S_{EXR}}(1 + \frac{I_F}{4})F_{EXR} \qquad [6],$$

where S_{EXR} is the spot dollar/franc rate of exchange (the dollar price of one French franc); I_F, the interest rate in France; and F_{EXR}, the dollar/franc forward rate of exchange (the dollar price of one franc for delivery ninety days

hence). The expression $\frac{X}{S_{EXR}}$ is the amount of the spot francs that can be purchased with X dollars; the expression $\frac{X}{S_{EXR}}(1 + \frac{I_F}{4})$, the amount of francs the investor will receive at the end of ninety days; and the entire expression is the amount of dollars the investor will receive when the franc amount is converted into dollars at the ninety-day forward rate of exchange. This is the practice known as interest arbitrage. Therefore, if $X(1 + \frac{I_{US}}{4}) > \frac{X}{S_{EXR}}(1 + \frac{I_F}{4})$ F_{EXR}, then the investor will invest his funds in New York, as will short-term investors in Paris. Hence, funds (hot money) will move from Paris to New York. Conversely, if $X(1 + \frac{I_{US}}{4}) < \frac{X}{S_{EXR}}(1 + \frac{I_F}{4})F$, funds will move from New York to Paris.

The interest parity theory asserts that interest arbitrage will cause the forward rate to adjust to the interest rate differential until it reaches an equilibrium value at which it is no longer profitable to shift funds between the two money markets (17, p. 280). In equilibrium, therefore,

$$X(1 + \frac{I_{US}}{4}) = \frac{X}{S_{EXR}}(1 + \frac{I_F}{4})F^E_{EXR} \quad \text{[7]},$$

where F^E_{EXR} is the equilibrium forward exchange rate. Solving equation [7] for F^E_{EXR}, the result is

$$F^E_{EXR} = \frac{S_{EXR}(1 + \frac{I_{US}}{4})}{(1 + \frac{I_F}{4})} \quad \text{[8]}.$$

Adjusting the interest rates of both centers for the length of the forward exchange contract, equation [8] becomes

$$F^{E}_{EXR} = \frac{S(1 + I_{US})}{(1 + I_{F})} \qquad [9].$$

Transposing and subtracting 1 from both sides of equation [9], the following equation results (17, p. 280):

$$\frac{(I_{US} - I_{F})}{(1 + I_{F})} = \frac{F^{E}_{EXR} - S_{EXR}}{S_{EXR}} \qquad [10].$$

If I_F is a small fraction, as is assumed, equation [10] can be approximated as

$$I_{US} - I_{F} = \frac{F^{E}_{EXR} - S_{EXR}}{S_{EXR}} \qquad [11].$$

Therefore, at interest parity, the interest rate differential between New York and Paris is equal to the forward-spot differential as a percentage of the spot rate.

Graphic demonstration of interest parity theory. The interest rate parity theory is demonstrated graphically in Figure 4. The vertical axis measures the difference in interest rates, foreign relative to home country. Above the origin the interest rate is higher in the foreign country than in the home country; below the origin the interest rate is higher domestically than it is abroad. The horizontal axis measures the forward premium or discount on foreign currency. To the right of the origin

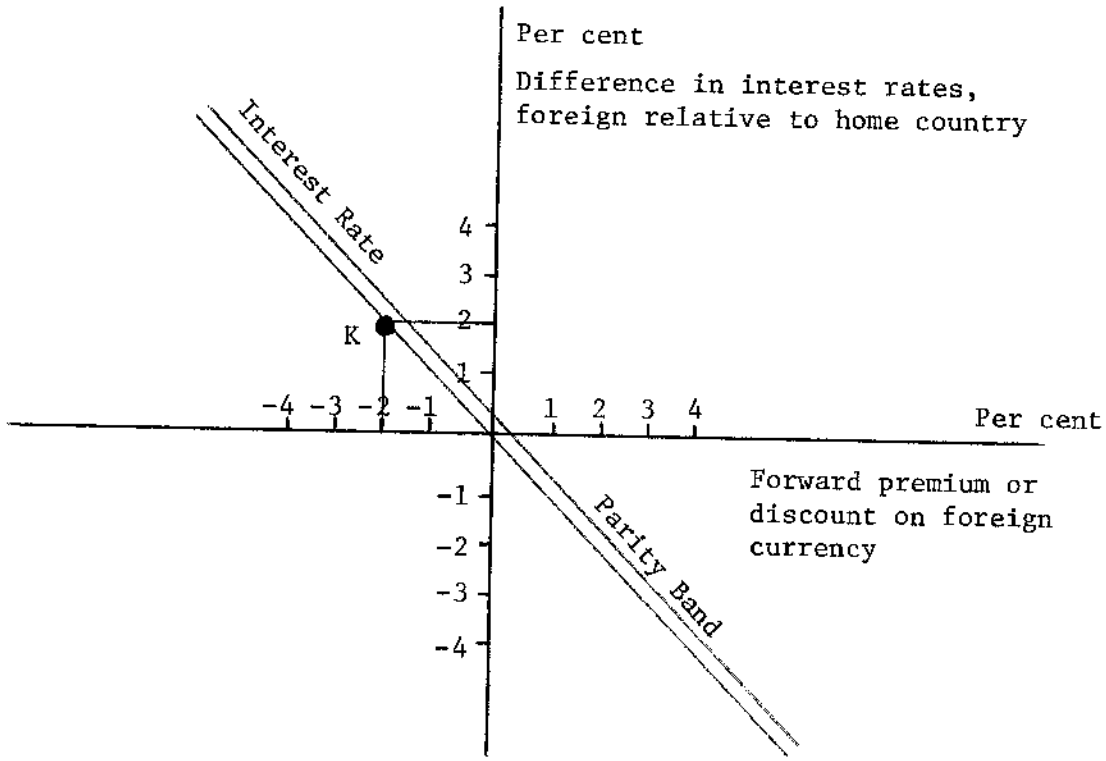

Fig. 4--Graph of interest parity theory.

the foreign currency sells at premium over spot; to the left of the origin it sells at a discount under spot rate.

According to the interest parity theory, the domestic-foreign forward rate will move to a point on the interest parity line at which the forward rate differential (the implicit interest rate) equals the interest rate differential. In Figure 4, the interest rate parity line shows the equilibrium rate, but transaction costs cause the line to be a band rather than a thin line. Transaction costs arise from the foreign exchange brokerage costs on spot and forward contracts as well as from the investment

brokerage cost on buying and selling securities (4, p. 56). Point K shows the approximate position where the two per cent higher foreign interest is accompanied by a two per cent discount in the forward exchange rate of that country.

Based on the previous discussions and on the basis of balance of payments mechanics one would hypothesize that $\frac{\delta EXR}{\delta I_D} > 0$, where EXR is the current spot exchange rate and I_D is the domestic interest rate. Also, it is expected that $\frac{\delta EXR}{\delta I_F} < 0$, where I_F is the foreign interest rate. Consequently, it is hypothesized that $\frac{\delta EXR}{\delta I_r} > 0$, where I_r represents the ratio of I_D to I_F.

Interest parity may be violated in the real world because, as Tsiang (22) points out, the use of liquid funds for arbitrage purposes involves increasing opportunity costs in terms of inconvenience and loss of liquidity. Second, in times of political upheaval or financial distress arbitragers avoid the transfer of funds either because governments officially prohibit such movements or because of the possibility that such measures may be adopted before they have the chance to repatriate their funds (11, p. 25).

Income Levels

The impact of national income on trade and, consequently, on foreign exchange rates derives from the relationship between this variable and national consumption.

When national income rises, consumption increases. Some of this consumption is channeled to foreign markets via imports. It is also reasonable to assume that growth in national income may have an impact on foreign investment by the citizens of the country in question. This factor constitutes another avenue for an increase in the supply of domestic foreign exchange and an increase in the demand for the foreign exchange of trading partners. The increase in both imports and foreign investment will exert downward pressure on the national currency and upward pressure on foreign currencies.

In an open economy economists assume that GNP (gross national product) takes the following form:

$$GNP = C + I_d + G + (X - M) \quad \text{[12]},$$

where C represents expenditures by individuals for consumption; I_d, domestic gross investment; G, expenditures by government for both consumption and investment; X, expenditures on exports; and M, expenditures on imports.

Equation [12] may be rewritten as follows:

$$X - M = GNP - (C + I_d + G) \quad \text{[13]}.$$

This equation demonstrates that when exports are greater than imports, GNP will be greater than domestic expenditure on goods and services ($C + I_d + G$) by the same amount. Conversely, when imports are greater than exports, GNP will be less than domestic expenditure by the same amount.

Rewriting equation [13],

$$B = Q - E \qquad [14],$$

where B is the current account balance (X - M; assuming the absence of unilateral transfers and thus considering the balance on current account as synonymous with the balance on goods and services), Q is the gross national product, and E is the domestic absorption of goods and services ($C + I_d + G$). If $X < M$, then $B < 0$ and $Q < E$. Hence, to correct a current account deficit, a country must either 1) increase its physical output of goods and services (Q) or 2) decrease its absorption of goods and services (E) (17, p. 311). Since output cannot be expanded in the short run with full employment, adjustment to a deficit in such a situation requires a reduction in the real absorption of goods and services to allow for higher exports and lower imports.

As a result of marginal propensity to import (MPM), an increase in the level of income may stimulate imports, inducing an increased supply of domestic currency in the foreign exchange markets. Therefore, it is hypothesized that $\frac{\delta EXR}{\delta Y_D} < 0$, where Y_D is the domestic income level. Alternatively, it is hypothesized that $\frac{\delta EXR}{\delta Y_F} > 0$, where Y_F is the foreign income level. And finally $\frac{\delta EXR}{\delta Y_r} < 0$, where Y_r represents the ratio of Y_D to Y_F.

External Equilibrium Curve

The purpose of this section is to present an integrated relationship among foreign exchange, income level, domestic and foreign interest rates, money inflows and outflows, and exports and imports. Figure 5 links net exports (X - M), domestic interest rate (I_D), foreign interest rate (I_F), domestic income level (Y), money inflows (+MF), and money outflows (-MF) in a pattern in which these factors are directly proportional to each other. It is also believed that all these variables are mutually determined in a freely-floating exchange system.

Generally, in the short run there are two important components in the balance of payments that presumably have significant impact on the fluctuations of the country's exchange rate in a floating rate system:

1. Short-term capital flow (hot money): This is the volume of funds that moves from one country to another motivated by short-term interest rates differentials. Thus, this money is sensitive to interest rates.

2. Net exports (X - M): As stated above, these are sensitive to income level through the marginal propensity to import (MPM). In Figure 5 I_D is the domestic interest rate; I_F is the foreign interest rate; +MF is the money inflow and -MF is the money outflow; (X - M) is net exports; and Y is the income level.

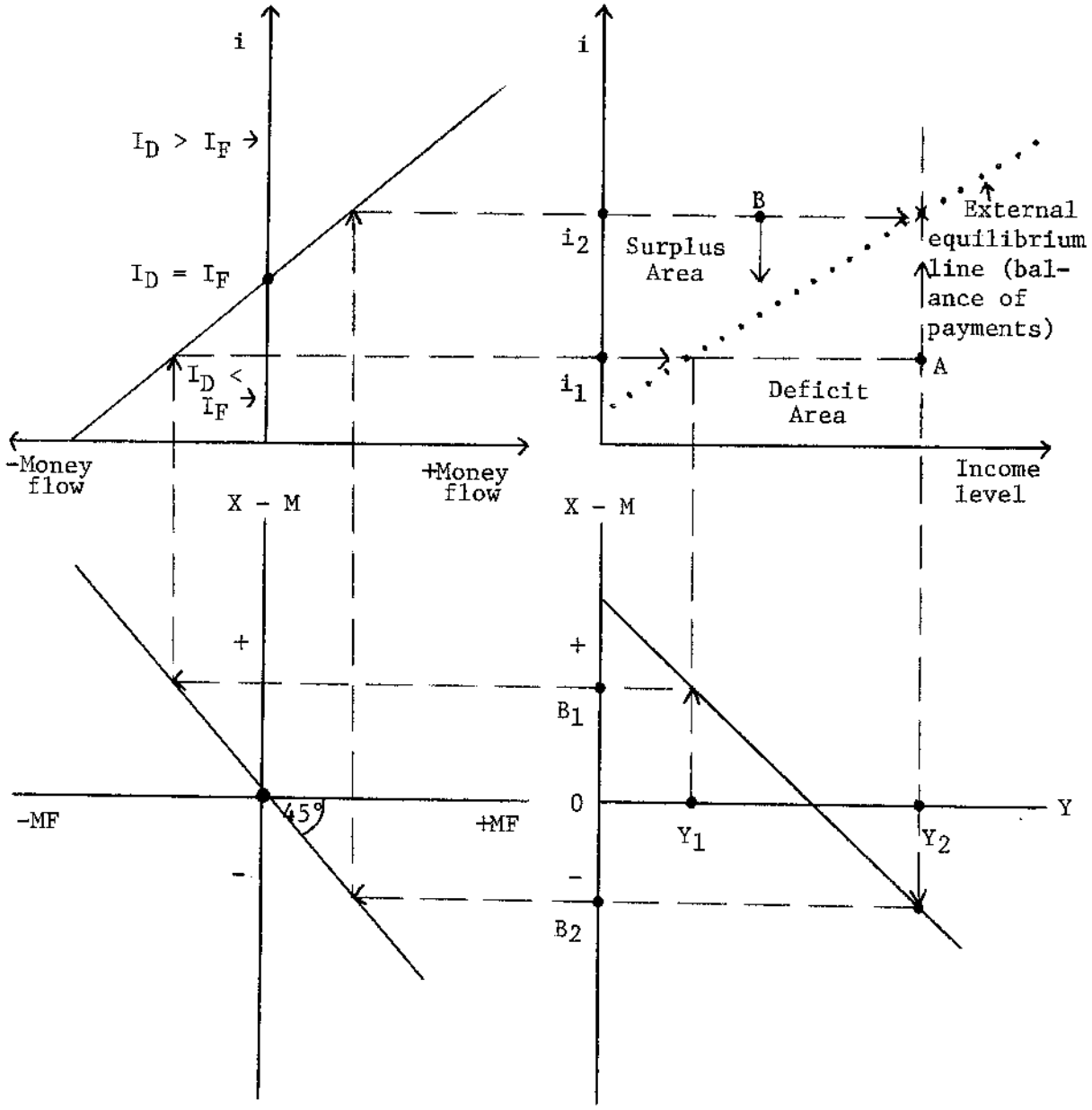

Fig. 5--Graph of external equilibrium curve.

When income rises imports tend to rise also, for, if domestic income expands, it is easier to sell in the domestic economy. On the other hand, when income level declines the domestic economy becomes thinner and the

domestic producers may find it easier to export. At a very low income level (Y_1), imports may be very low and exports may be stimulated; therefore, a positive net export may result, indicating a surplus in the current account of the balance of payments. At that low level of income if the domestic interest rate is lower than the foreign interest rate there will be a large outflow of "hot money" seeking higher interest rates abroad. Therefore, at income level Y_1 the net exports are equivalent and offset by an outflow of capital. Hence, the external equilibrium is maintained.

Point A is the case of a country experiencing an external disequilibrium (a deficit in the balance of payments). This point could represent the situation of the United States in November of 1978. Here, the U.S. government moved upward from point A to the EE line and to the left. Such movements were translated in a simultaneous interest and income decision. If the interest rate was increased domestically, foreign investment in the United States would be stimulated; and at the same time the U.S. economy's growth rate would be cooled down by discouraging aggregate demand, ultimately reducing the income level. If the movements in both directions were strong enough, the external equilibrium at least theoretically could be achieved.

Point B also represents a country experiencing an external disequilibrium, in this case a surplus in the balance of payments. West Germany and Japan are good examples of this situation. For both countries an expansion in the domestic economy with a reduction in their interest rate (moving to the right or downward from B or a combination of both) could help in maintaining an external equilibrium. The United States has been continuously urging both West Germany and Japan to adopt expansionary policies in order to solve their external disequilibria and help the U.S. by doing so.

The Nature of Speculation

In the previous sections of this chapter the theoretical and conceptual relationships among the fundamental economic variables have been developed; in the following paragraphs a discussion of stabilizing and destabilizing speculation and the theoretical basis for speculation will be presented.

It seems beneficial to note at this point that speculation is quite different from the arbitrage discussed earlier in this chapter. Arbitrage is a riskless operation of buying and selling the same thing when its price is not the same within a single market (19, p. 199). The existence of arbitrage operations means that price discrepancies will not arise frequently and will be

quickly eliminated when they do. Arbitrage operations can involve currencies, commodities, interest rates, and any other assets.

Speculation, on the other hand, is an inherently risky purchase or sale with the expectation that the future price will go up or down, respectively. The speculator can make money if his expectation is correct, but he will lose money if he is wrong.

Stabilizing and Destabilizing Speculation: Definitions and Illustrations

Speculation is called stabilizing when it depresses exchange-rate variations and destabilizing when it amplifies them (11, p. 146).

As depicted in Figure 6, the curve AB describes a sinewave pattern which the exchange rate follows in the absence of speculation. Presumably this cyclical behavior of the exchange rate reflects the influence of cyclical factors on the foreign-trade sectors. The curves AD and AC show the manner in which the exchange rate would fluctuate in the presence of stabilizing and destabilizing speculation, respectively (11, p. 146).

If speculators had perfect foresight and their transaction costs were zero, speculation would stabilize the exchange rate perfectly, as shown by the horizontal line AE (Fig. 6). Speculators would stand ready to sell foreign

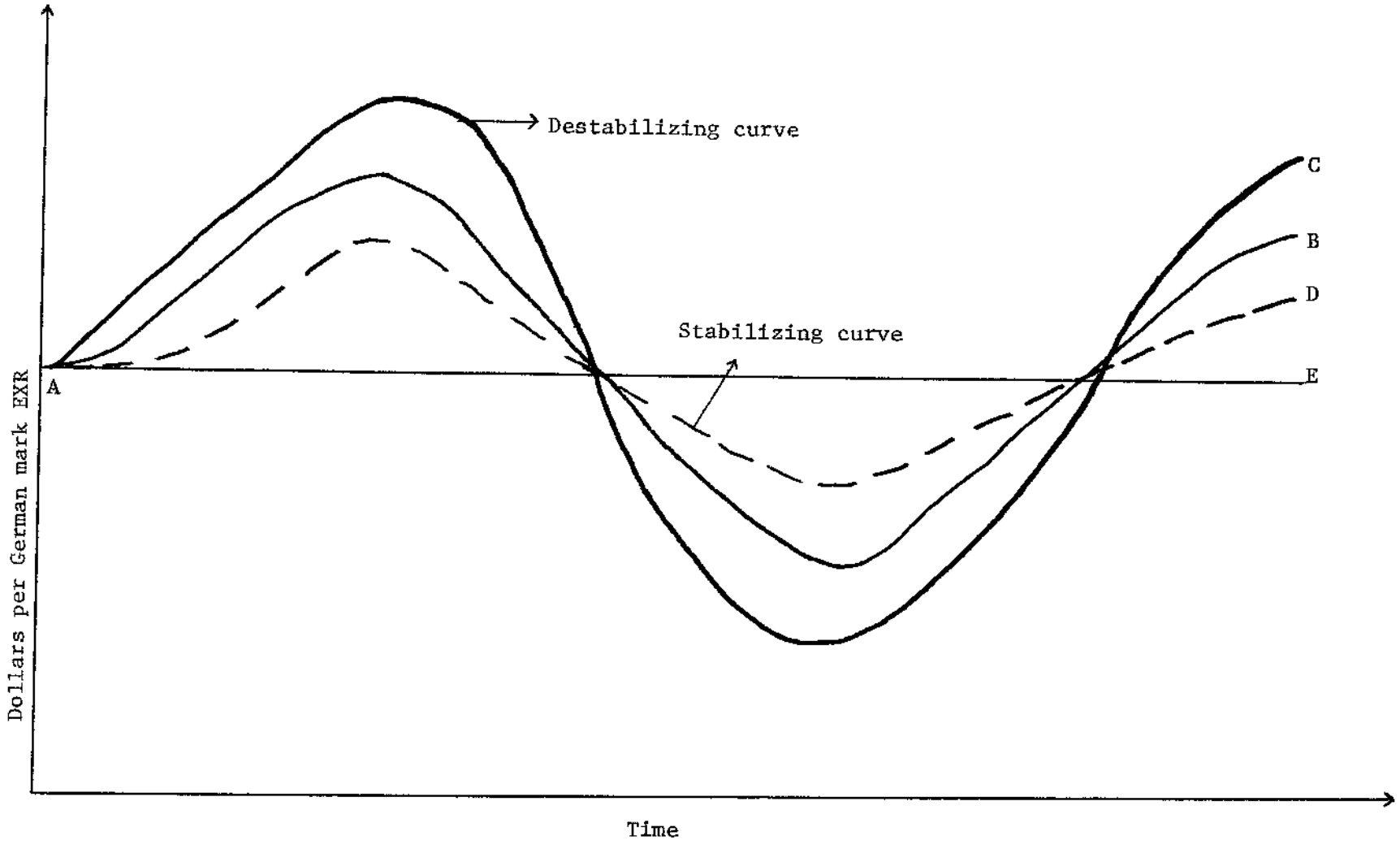

Fig. 6--Stabilizing and destabilizing speculation distorting the behavior of the exchange rate from AB to AD and AC, respectively.

exchange whenever the rate rose above AE, and they would stand ready to buy foreign exchange whenever the rate fell below AE. Their purchases and sales of foreign exchange would cancel over a whole cycle, and their profits would be zero. These results are guaranteed by perfect competition (11, p. 146).

Unfortunately, however, perfect foresight never exists. Speculators form expectations regarding the future course of the rate of exchange, and on the basis of these expectations and the current rate they decide whether to buy or sell and how much. Thus, speculative expectations lie at the heart of speculative activity. When expectations are formed correctly, speculation is stabilizing; otherwise speculation is destabilizing.

Another illustration may be used to explain a case in which expectations are not formed correctly. If the exchange rate begins to rise from its long-run equilibrium value AE and speculators interpret the rise in the current rate as a signal that the rate will go higher, they now purchase foreign exchange in the hope of selling it in the future at a higher rate. These speculative purchases intensify the rise in the current rate (curve AC). The foreign country's balance of trade now shows a surplus which makes possible a short-term capital flow to the home country. Accordingly, in the

present case, the speculative activity is destabilizing, amplifying the initial increase in the current rate and inducing a short-term capital flow in the wrong direction.

By contrast, if expectations are formed correctly and speculators expect the rate to return to AE in the near future, speculation will be stabilizing. Thus, speculators will sell foreign exchange, thereby preventing the rate from rising too much (curve AB). By their activity, the speculators induce a short-term capital inflow which fills the gap (deficit) in the foreign country's balance of trade caused by the fact that the rate of exchange was not allowed to rise sufficiently. "This short-term capital movement prompted by stabilizing speculation is very desirable, because it minimizes the need for switching resources back and forth. Such switching of resources is obviously wasteful and undesirable" (11, p. 147).

Stabilizing and Destabilizing Speculation: Scholarly Viewpoints

In the past three decades varying opinions on the subject of speculation have been presented by experts in the field of international economics. Nurkse (13) was one of the first scholars to introduce the notion of destabilizing speculation with his analysis of exchange rate behavior in the interwar floating European markets. He

examined evidence of volatility of exchange rate changes and deviations from equilibrium rates. His primary concern was that exchange rates would be determined by psychological rather than fundamental factors in the market, causing large fluctuations that would lead to declining international trade and investment and frictional unemployment as a result of continuous resource shifts between home- and export-oriented industries.

Friedman (5) has claimed that Nurkse's evidence is hardly compelling and that, in fact, only in the case of the French franc in the period 1922 to 1926 did he actually present enough evidence to make a defensible case for the existence of destabilizing speculation. Friedman notes that if speculation is profitable, it is likely to be stabilizing. The literature on this subject demonstrates what can happen to the study of an economic issue for which there is no generally accepted testable hypothesis and in which authors have not agreed on basic definitions. Recently, however, Kohlhagen (8) identified some seven different testable views of what constitutes significant evidence of destabilizing speculation.

One concept of destabilizing speculation that has been employed by scholars is any movement of the exchange rate away from equilibrium that is induced by the effects of exchange rate expectations. Aliber (1) uses both the

size of forward premium during spot rate peaks and troughs and short-run deviations from purchasing power parity as evidence of this sort.

A more popular approach has been to represent exchange rate changes that "overreact" to price changes and interest rate changes as evidence of destabilizing speculation. Williamson (23) and Price and Wood (15) have suggested this as one possible indication of speculative activity. Thomas (20, 21) shows that exchange rates in the interwar period were in general determined by fundamental variables, but that in the French case the exchange rates did "over-track" price changes. Artus (2) and Kohlhagen (9, 10) both find significant evidence for such behavior (as a function of both interest rates and relative prices) for the Canadian dollar and the Deutschemark during recent short-term periods.

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CHAPTER III

RESEARCH METHODOLOGY

Introduction

The purpose of this chapter is to outline the statistical techniques to be utilized in this research. A brief presentation of multiple regression as a general data analytical system will be made, followed by a brief introduction of the deviations from the basic regression model caused by multicollinearity, autocorrelation, and heteroscedasticity. The basic model will then be developed and specific hypotheses regarding the parameters and other statistics will be made. Finally, the description of data for each variable and country with the sources will be presented.

Regression as a General Data Analytical System

Regression analysis is a method of estimating the parameters of an equation with simple data in order to show the separate effects of the independent variables on the dependent variable. Simple regression analysis is applied to an equation with one dependent and one independent variable. Multiple regression analysis is applied

to an equation with one dependent and two or more independent variables (5, p. 33).

Simple Regression Analysis

The simple linear equation [15] may be used as a basis for explaining simple regression analysis.

$$Y_t = \alpha + \beta X_t + U_t \qquad [15].$$

It states that in period t the value of Y, the dependent variable, is determined by four factors: the constant α; the regression coefficient β; the level of X, the independent variable; and the level of U_t, the disturbance term (U is the sum of all the other factors that influence Y, but which are each assumed to be of minor importance). The equation is simple because only one important independent variable is specified; it is linear because the effect on Y of a one-unit change in the variable X is in the same amount regardless of the value of X from which the change takes place (the size of the effect is shown by the slope β).

Simple least-squares regression analysis is a technique for estimating α and β from a set of sample values of X and Y. The task of least squares is to compute the typical change in the dependent variable which accompanies a given change in the independent variable. In the regression model $\hat{Y} = \alpha + \beta X$, α and β are the unknown population coefficients. The object of the regression analysis is to

compute the coefficients α and β which maximize the explanatory or predictive power of the model. The maximization of the regression model's explanatory power is the same as the minimization of the sum of the squared residuals (ΣU^2). In other words, the line of best fit is a line put through the data which minimizes the sum of the squared deviations of each individual variate from the regression line.

The least-squares criterion (using vertical measurement) may be restated formally as follows:

$$\text{Minimize } \sum_{i=1}^{N}(Y_i - \hat{Y}_i)^2 \qquad [16],$$

where $\hat{Y}_i = \alpha + \beta X_i$ is the fitted value of Y corresponding to a particular observation X_i, and N is the number of observations as illustrated in Figure 7.

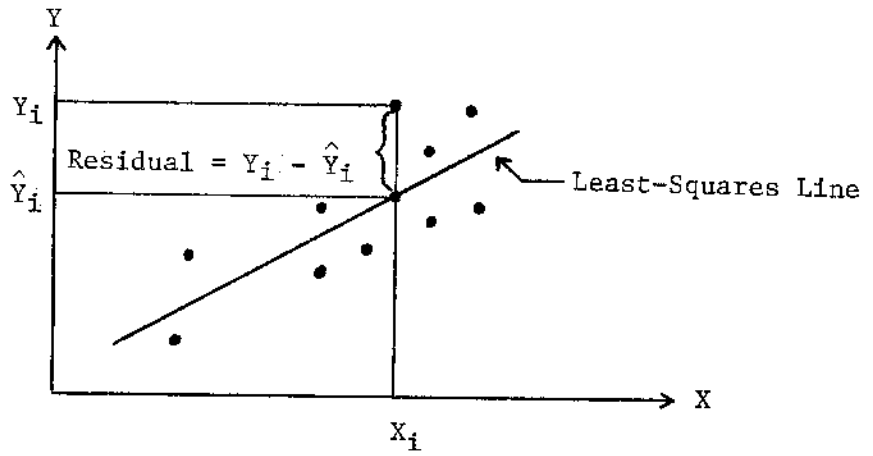

Fig. 7--Scatter diagram for two variables.

The problem is to choose, simultaneously, values for α and β which minimize the expression in equation [16]. This can be done using elementary calculus (7, p. 7). α and β can be calculated by using the following equations:

$$\alpha = \frac{\Sigma Y_i}{N} - \beta\frac{\Sigma X_i}{N} \qquad [17]$$

$$\beta = \frac{N\Sigma X_i Y_i - \Sigma X_i \Sigma Y_i}{N\Sigma X_i^2 - (\Sigma X_i)^2} \qquad [18]$$

Multiple Regression Analysis

With the inclusion of more than one independent variable, an equation with several variables is needed. The general form is shown in equation [19]:

$$Y = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + \ldots + \beta_K X_{Kt} + U_t \qquad [19]$$

Here α is the constant, and X_1 through X_K are the independent variables. The meaning of equation [19] is that in period t, the value of Y is equal to the constant α plus the sum of the values X_1 through X_K, each multiplied by its respective regression coefficient (β_1 through β_K), plus the value of the disturbance term U. Each of the regression coefficients shows the average change in the dependent variable resulting from a one-unit change in the respective independent variable, when the effects of the other independent variables are held constant.

In economic terminology, a regression coefficient approximates the relation between the associated independent variable and the dependent variable, ceteris paribus. In mathematical terminology, a regression coefficient is an approximation of the partial derivative of the dependent variable with respect to the associated independent variable (5, p. 16).

Some Statistical Assumptions of Regression Analysis

Before turning to the discussion of the use of multiple regression as a general data analytical tool, it will be useful to review some of the assumptions underlying this technique.

1. For the i_{th} observation, $E(U_i) = 0$ and $V(U_i) = \sigma^2$. The expression U_i is often referred to as a residual, because it represents the residual deviation after the regression line has been fitted $U_i = (Y_i - \hat{Y}_i)$. That is, the many influences that are combined in U are assumed to be unrelated to one another and to offset each other so as to sum zero in each time period (6, p. 413).

2. The error components in any pair of trials are not correlated. For example, it is assumed that U_t is not correlated with U_{t-1}. A departure from this assumption gives rise to the problem of autocorrelation, a systematic time pattern in the residuals. When

autocorrelation is present, the usual tests of significance are not valid.

3. The variability (strictly, the variance) of the error term U is the same for all observations. A departure from this assumption might occur if the disturbance term were usually greater in absolute size (further from zero) when the dependent variable Y is larger than when it is small. Conversely, larger variance with small values of Y would also be a departure. When this assumption does not hold, the result is called heteroscedasticity, or variation in dispersion of the disturbance term. Agreement with the assumption is called homoscedasticity. Heteroscedasticity results in less precise estimates of the regression coefficients; that is, the estimates are subject to greater variability and are thus less certain.

4. An assumption that causes much confusion is that no two independent variables, or no two groups (strictly, linear combinations) of independent variables should be identical. A departure from this assumption causes the phenomenon called multicollinearity. "Multicollinearity is common and even inevitable in much of the data in fields like sociology, economics, business and geography" (10, p. 49).

Multicollinearity is a condition that usually, but not necessarily, manifests itself in correlations among

the independent variables in the data. A high degree of multicollinearity may lead to imprecision (large standard errors) in the estimation of regression parameters. The estimators, however, are still unbiased. In general, there is little that can be done about multicollinearity except to take a larger sample, preferably in a way that decreases the tendency. When an independent variable that is correlated with others in the regression is not included and the regression parameter of this variable is not zero, the remaining coefficients will be biased estimators (10, p. 55).

5. Also, it is usually assumed that the disturbance term is normally distributed; that is, the frequency distribution of U is described by the normal curve of error.

The Use of Multiple Regression as a Statistical Tool

The system of multiple regression as a general data analytical tool has many uses. These may be broadly summarized as follows:

1. A regression equation may be used to describe a given process or as a model for a complex interacting system (1, p. 196) and to test the structural hypothesis as a prerequisite to experimentation. In this case, the effect of the individual independent variables is paramount

as their size and statistical significance test the validity of the postulational model (theory).

2. Regression analysis is a useful tool in forecasting. Here the major concern is to obtain estimates or guesses as to the movement of certain variables, given additional information about the movement of other variables. It is useful to distinguish between two types of forecasting, ex post and ex ante. In terms of time-series models, both types of forecast predict values of a dependent variable beyond the time period in which the model is estimated. However, in an ex post forecast the forecast period is such that observations on both the endogenous variables and the exogenous explanatory variables are known with certainty. An ex ante forecast predicts values of the dependent variable beyond the estimation period, using explanatory variables which may or may not be known with certainty, depending on the nature of the data and the length of the lags associated with the explanatory variables (7, p. 157). Here the major concern is reducing the error term and maximizing R square.

3. A regression model may be used to test causal hypotheses. In such tests the independent variables are experimental or quasi-experimental covariates. In this case the value and significance of the regression coefficent or experimental variable are paramount as the bases

for testing the causal hypothesis and estimating the basis for ameliorative intervention.

The Rationale for the Use of Multiple Regression in This Study

The objective of this study, as stated in Chapter I, is primarily to assess empirically the role of the fundamental economic variables (price levels, interest rates, and income levels) in the determination of foreign exchange rates and to draw inferences regarding the nature of speculation in the foreign exchange markets. Therefore, in the case of the fundamental factors the impact of each individual variable as well as the type of the relationship with the dependent variable is significant. Furthermore, the collective impact of all variables on the exchange rates is paramount.

Thus, it is believed that multiple regression is an appropriate statistical tool to be employed to achieve the objective stated above; multiple regression is being used here to test specific hypotheses regarding some theoretical and conceptual relationships. Multiple regression as a general data analytical tool is capable of measuring the individual effect of each independent variable as well as the direction of effect and the statistical significance; it also permits the the measurement of the explanatory power of all independent variables. In addition, regression

analysis is appropriate in conducting the purchasing power parity and coefficient of expectation tests. In both cases the exchange rates are expressed in a functional relationship with specific independent variables. Therefore, given appropriate data for the dependent variable and each of the independent variables, the measurement of the parameters for the functional relationship is quite simple.

To ascertain the relative importance of the fundamental economic forces in exchange rate determination, the following basic model will be utilized:

$$EX_t = f(P_D, P_F, I_D, I_F, Y_D, Y_F) \quad \text{[20]}$$

EX_t is the foreign exchange market value of one unit of the currency of a foreign country expressed in units of United States currency. P_D and P_F represent domestic and foreign price levels, respectively. Domestic and foreign interest rates are represented by I_D and I_F, respectively; finally, Y_D and Y_F represent the level of domestic and foreign income, respectively. Based on the theoretical and conceptual relationships developed in Chapter II, one would hypothesize that

1. Domestic inflation would make the export of goods and services less competitive; and, accordingly, the demand for the domestic currency in the foreign exchange market would decrease, resulting in an eventual depreciation of

the currency. Therefore, the expected result would be $\frac{\delta EX}{\delta P_D} < 0$. On the other hand, higher inflation in a trading partner country would make the export of goods and services more competitive while depressing imports. These conditions would be translated into an increase in the demand for the domestic currency in the foreign exchange markets and, in all probability, into an appreciation of the currency. The expected result would be $\frac{\delta EX_t}{\delta P_F} > 0$.

2. The International Fisher Effect maintains that the current spot exchange rate should change in an equal but opposite direction to the difference in interest rates between two countries. Thus, a higher interest rate in a trading partner relative to the domestic rate would encourage the flow of "hot money" from the domestic economy into the higher interest rates countries seeking a more attractive return. This would result in an increase in the demand for foreign currencies and a concurrent decline in the demand for the domestic currency in the foreign exchange markets. Higher domestic interest rates relative to the foreign rates would result in an opposite outcome. Therefore, it is expected that $\frac{\delta EX_t}{\delta I_F} < 0$ and $\frac{\delta EX_t}{\delta I_D} > 0$.

3. As discussed in Chapter II, the impact of national income on trade and, consequently, on foreign exchange rates derives from the relationship between this variable and national consumption. When national income rises,

consumption increases. Some of this consumption is channeled into the foreign market via imports. Therefore, the growth of the national income will probably result in more imports and, consequently, a larger supply of the domestic currency in the foreign exchange markets than demanded, leading to the depreciation of the domestic currency. However, higher growth rates in national incomes abroad will result in more imports on their parts and an increase in the demand of the domestic currency to accommodate the surge in the domestic exports. Therefore, the result will be $\frac{\delta EX_t}{\delta Y_D} < 0$ and $\frac{\delta EX_t}{\delta Y_F} > 0$.

When the price level, interest rate, and income level variables of equation [20] were expressed in ratio form, the six-variable equation was converted into a three composite variable equation:

$$EX_t = \alpha + \beta_1 P_r + \beta_2 I_r + \beta_3 Y_r \quad \text{[21]},$$

where EX_t is the spot exchange rate of one unit of foreign currency in U.S. dollars, P_r is the ratio of P_D to P_F, I_r is the ratio of I_D to I_F, and Y_r represents the ratio of Y_D to Y_F. Based on equation [20], one would intuitively hypothesize that $\frac{\delta EX_t}{\delta P_r} < 0$, $\frac{\delta EX_t}{\delta I_r} > 0$, and $\frac{\delta EX_t}{\delta Y_r} < 0$.

Conceptually, one may regard the hypothesis that exchange rates are primarily a function of speculative or psychological forces as equivalent to the hypothesis that either the estimated coefficients of the fundamental

economic variables do not consistently exhibit the correct sign or these parameter estimates have the correct sign but their degree of statistical significance is low or the collective explanatory power of the fundamental factors is weak.

Statistics Used in the Evaluation of the Fundamental Economic Variables Equations

1. Coefficient of multiple determination R-squared: R-squared shows the degree of association between the dependent variable and the set of independent variables in a regression equation. R-squared shows the proportion of the variation in the dependent variable that is accounted for or explained by the set of independent variables.

2. F-test: The F-test is an analysis of variance test. In regression analysis, F-tests are conducted to test the entire regression. R-squared provides a summary measure of the goodness of fit, but a significance test of the explanatory power of the set of independent variables is also valuable, particularly in borderline cases where R-squared is low (5, p. 24). The hypothesis to be tested is that there is no relation between the dependent variable and the set of independent variables, or that the population regression coefficients are equal to zero ($\beta_1 = \beta_2 = \ldots \beta_N = 0$).

3. Standard error of the estimate: The standard error of the estimate gives a measure of how close the estimated values have been to the actual values in the past. The R-squared, the standard error of the estimate, and the error term are related in such a way that when R-squared is one, the standard error of the estimate is zero and there is no error term.

4. T-statistic: The T-statistic shows the significance of each explanatory variable in predicting the dependent variable. It is desirable to have as large a T-statistic (either positive or negative) as possible for each explanatory variable. Generally, any T-statistic greater than +2.0 or less than -2.0 is acceptable. If the T-statistic is between -2.0 and +2.0 for any independent variable, that variable is not contributing significantly to explaining the dependent variable.

5. Beta coefficients: Beta coefficients are occassionally used to make statements about the relative importance of the independent variables in a multiple regression model. The beta coefficient adjusts the estimated slope parameter by the ratio of the standard deviation of the independent variable to the standard deviation of the dependent variable (7, p. 71).

6. The Durbin-Watson statistic: This is a measure of autocorrelation of the residuals. The Durbin-Watson

statistic (D-W) can assume values from zero to four. If no autocorrelation is present in the residuals, the average value in repeated sampling (the expected value) of D-W is two. Small values of D-W result when successive values of the residual term are positively correlated.

Statistics Used in the Assessment of the Nature of Speculation Tests

Purchasing Power Doctrine Tests

1. One-variable equation purchasing power tests: The first technique for attempting to draw inferences about the behavior of speculators utilizes the purchasing power parity doctrine of foreign exchange. One version of this doctrine asserts that if the (flexible) exchange rate begins at equilibrium and then experiences a monetary disruption, the percentage of change in the exchange rate under free conditions should approximate the percentage of change in the relative price ratio between the countries involved. Referring to equation [22], EX_t (the rate of exchange) is the exchange value of the currency of the foreign country in terms of the U.S. dollar, and P_r is the ratio of the price index of the foreign country to the price index of the U.S., both indices being based on 1970 = 100.

$$\text{Log}EX_t = \alpha_1 + \beta_1 \text{Log}P_r \qquad [22]$$

The parity doctrine would hypothesize that under free conditions, the coefficient of regression (β_1) would tend toward minus one, since a 10 per cent relative increase in the domestic price level must be accompanied by a 10 per cent depreciation of the domestic currency in the foreign exchange markets in order to maintain purchasing power parity. Now, if speculation is basically of a destabilizing nature, one would expect speculators to seize upon weak currencies and cause them to depreciate by an amount greater than is justified on the basis of the current price ratio. That is, one would expect generally to find β_1 in equation [22] to be greater than unity in absolute value. If speculation is basically stabilizing, price level inflation and exchange depreciation would be regarded as temporary departures from normal and would result in speculators taking positions in fundamentally weak currencies. Thus, the currency would be prevented from depreciating by an amount justified by the current P_r. One would thus expect empirically to find β_1 less than unity, if speculation is stabilizing (9, p. 144).

2. Three-variable equation purchasing power tests: In order to avoid an important criticism concerning the specification of equation [22] another model is developed here. In fact, proponents of the purchasing power parity doctrine recognize that the exchange rate is

influenced by other fundamental forces in addition to price levels. A plausible specification of the parity doctrine would assert that the partial elasticity of the exchange rate with respect to P_r should approximate (minus) one. The price coefficient of equation [22] (β_1) does not represent a partial elasticity. The absence of other important independent variables from equation [22] may result in biased elasticity estimates. Other factors which one would expect to influence the trade balance or capital flows and, consequently, the exchange rates would include, as discussed in Chapter II, the interest rates and income levels in the countries involved. Therefore, equation [23] will meet the above criticism by the inclusion of the other fundamental economic variables:

$$\text{Log}EX_t = \alpha_2 + \beta_2\text{Log}P_r + \beta_3\text{Log}I_r + \beta_4\text{Log}Y_r \quad [23]$$

EX_t and P_r represent the quantities defined above; I_r represents the ratio of domestic to foreign interest rates, and Y_r that of domestic to foreign income levels. As demonstrated earlier in this chapter, one expects $\beta_2 < 0$, $\beta_3 > 0$, and $\beta_4 < 0$. Here, as in the case in equation [22], speculation will be considered destabilizing when the coefficient of regression for the price level β_2 exceeds unity in absolute value, and stabilizing when it falls short of unity.

Coefficient of Expectation Tests

The second technique for dealing with speculation involves an attempt to draw inferences concerning the elasticity of speculators' expectations. Equation [24] presents one method of estimating the elasticity of expectation in the foreign exchange market.[1]

$$EX_t = (1 - \beta_1)EX_{t-1} + \lambda P_t - \alpha P_{t-1} \quad [24],$$

where EX_t is the current spot exchange rate, β is the coefficient of expectation, EX_{t-1} is the spot exchange rate lagged one month, P_t is the current relative price ratio, and P_{t-1} is the relative price ratio lagged one month. In this case the major concern is the magnitude of β. β can be estimated by subtracting the regression coefficient of EX_{t-1} in equation [24] from unity. If β is zero, discrepancies between what has been expected and what is currently observed result in no revision of expectations. Thus, it is believed that the learning process regarding exchange rate adjustment is very insensitive to recent events. However, in equation [24] a beta greater than zero and statistically significant can be interpreted to imply that the expectations are elastic and consequently destabilizing. An insignificant beta, on the other hand,

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[1]This model has been thoroughly developed by Lloyd Thomas (8, 9). This section of the discussion draws heavily upon these sources.

may imply that the expectations are inelastic and consequently stabilizing. Statistical estimation of the parameters of equation [24] is plagued by multicollinearity. Since the current exchange rate is highly correlated with the current price ratio, it follows that the lagged exchange rate is also highly correlated with the lagged price ratio. To avoid this collinearity problem an alternate estimating equation is also utilized:

$$EX_t = (1 - \beta_1)EX_{t-1} + \delta(P_t - P_{t-1}) \quad \text{[25]}$$

Equation [25] is the same as equation [24] except that the difference between the current relative price ratio and one period lagged relative price ratio is considered as an independent variable. Therefore, the estimation and interpretation of β are virtually the same as in the case of equation [24].

Correction for Autocorrelation

It is assumed that each of the error terms in a linear regression model is drawn from a normal population with zero expected value and constant variance and that the disturbance term is not correlated over time. Autocorrelation, as mentioned earlier in this chapter, is interdependence among the disturbance terms of different observations; the value of the error term in one time period is correlated with the value in another time period. The tables in Appendices B and C indicate that

the original equations are suffering from severe autocorrelation. Examination of the residuals of the equations generally suggests the presence of both a time trend and seasonal patterns. The seasonal element in the residuals probably reflects seasonal patterns in international demand for (or availability of) particular products (and thus exchange rates) that are independent of price level and income level phenomena. Regression variables called dummy, or binary, variables provide a flexible tool for handling categories in data and are utilized in this study to capture the seasonal and time trend in the data.

Table II represents a dummy variable coding scheme. It involves successive dichotomizing so that no more than n - 1 independent variables represent n groups of a nominal scale. The following interpretation may be placed

TABLE II

CONSTRUCTION OF QUARTERLY DUMMY VARIABLES

Quarter	DQ_1	DQ_2	DQ_3
1. Jan.-March	1	0	0
2. Apr.-June	0	1	0
3. July-Sept.	0	0	1
4. Oct.-Dec.	0	0	0

on the dummy variables constructed in Table II. DQ_1 represents the magnitude of the differential shift between the first and second quarters of the year, DQ_2 represents the magnitude of differential shift between the second and third quarters, and DQ_3 represents the magnitude of the differential shift between the third and fourth quarters. However, the dummy variable system did not improve the autocorrelation problem; and, furthermore, the time trend variable happened to be correlated with some independent variables, resulting in multicollinearity. Therefore, a more sophisticated technique has been employed to correct the problem of autocorrelation.

One method for adjusting the model is the use of a transformation that involves the unknown autocorrelation parameter, ρ. The introduction of ρ causes the model to be nonlinear. The direct application of least squares is not possible; however, there are a number of procedures that may be used to circumvent the nonlinearity (4, 7). The method developed by Cochrane and Orcutt (2) in 1949 will be utilized in this research.

When the errors have an autoregressive structure, as given in equation [19], it is seen that by transforming to $(Y_t - \rho Y_{t-1})$ and $(X_t - \rho X_{t-1})$ the errors in the model are uncorrelated (1, p. 128).

$$U_t = \rho U_{t-1} + \varepsilon_t, \qquad |\rho| < 1 \quad \text{[26]}$$

$$Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \ldots + \beta_K X_{Kt} + \varepsilon_t \quad \text{[27]}$$

Lagging equation [27] by one period, multiplying both of its sides by ρ, and subtracting the resulting form from equation [27], the desired transformation is obtained:

$$Y_t^* = \beta_1(1 - \rho) + \beta_2 X_{2t}^* + \ldots + \beta_K X_{Kt}^* + v_t \quad \text{[28]},$$

where $Y_t^* = T_t - \rho Y_{t-1}$,

$X_t^* = X_{2t} - \rho X_{2t-1}$,

$X_{Kt}^* = X_{KT} - \rho X_{Kt-1}$, and

$v_t = \varepsilon_t - \rho \varepsilon_{t-1}$

are generalized differences of Y_t, X_{2t}, . . . X_{Kt}, and U_t. By construction the transformed equation has an error process which is independently distributed with zero mean and constant variance (7, p. 110).

The Cochrane-Orcutt procedure involves a series of iterations, each of which produces a better estimate of ρ (coefficient of autocorrelation) than the previous one. In the first step, ordinary least squares is used to estimate the original model, equation [27]. The residuals from this equation are then used to estimate an equation in the form of equation [28].

The estimated value of ρ is used to perform the generalized differencing transformation process, and a new regression is run. Fortunately, Interactive Data Analysis (IDA), an interactive statistical and data

management package developed by computers of the HP2000 series by Roberling and Harry Roberts of the Graduate School of Business, University of Chicago, calculates the coefficient of autocorrelation in its multiple regression section and has the transformation capacity to perform the correction of autocorrelation quite easily.

The Problem of Multicollinearity

Multicollinearity is the case of a high degree of intercorrelation among independent variables. When two independent variables are highly correlated in a set of sample observations, the data do not permit precise estimates of the separate effects of the independent variables on the dependent variable; that is, the estimates of the regression coefficients are imprecise.

When the six fundamental economic variables were utilized in the regression estimate, there was a high degree of correlation between the domestic and foreign price level and the domestic and foreign interest rates and income levels. Therefore, the ratio of each domestic variable to its foreign counterpart was calculated and used to estimate the regression equations. This procedure avoided the simultaneous existence of highly correlated pairs of independent variables in the same equation.

On the other hand, for the estimation of the coefficient of expectation in the speculation tests both the current and one period lagged price level ratio variables appear in the same equation. Since these two variables are highly correlated, causing multicollinearity, the difference between the current and one period lagged price level ratios is employed as an independent variable, thus avoiding the existence of both variables in the same equation at the same time.

Countries Included in the Study

It should be emphasized that the floating exchange rate system is by no means a universal practice. According to the IMF Survey of August 25, 1975, only a small minority of currencies are actually floating; however, this minority includes the most important national currencies. The practices of IMF members in 1975 are summarized in Table III. Of 122 member nations, only 18 nations were allowing their currencies to float, seven of them linked in a joint float (3, p. 246). The other 104 were pegging to the dollar, British pound, mark, special drawing rights, or some other currency. However, it should be noted that the 18 nations with floating exchange rates accounted for nearly 70 per cent of world trade.

TABLE III

EXCHANGE-RATE PRACTICES OF IMF MEMBERS
(JUNE, 1975)

Exchange-Rate Regime	Number of Countries	% of World Trade
Floating	18*	69.6
Pegged	104	30.4
TOTAL	122	100.0

Source: International Monetary Fund, IMF Survey, Aug. 25, 1978.
*Includes seven European nations participating in a joint float (3, p. 246).

For the purpose of this study, nine countries, plus the United States as a base for comparison, are used. These countries have the most active trading currencies and collectively constitute the most important segment among the 18 floating countries mentioned above. The countries analyzed in this dissertation are listed alphabetically below:

1. Belgium
2. Canada
3. France
4. Germany
5. Italy
6. Japan
7. Netherlands
8. Switzerland
9. United Kingdom
10. United States

Time Span of the Study

This study covers the period from February, 1973, to October, 1978. Sixty-nine monthly observations were used to measure the equations in the study. Data availability was the only reason for this frequency choice; no data were available for shorter time periods.

Data Used in the Estimation of the Regression Equations

In order to measure the regression equations, data on price levels, interest rates, and income levels are needed. Before detailing the data and sources, three important observations should be made:

1. The consumer price index is used for all countries under study to represent the price level.

2. Short-term interest rates and specifically three-month treasury bills are used to represent the interest rate. However, because of the discontinuation or lack of data the official discount rates are used for France and Switzerland and the yields of long-term government bonds are used for Italy.

3. The industrial production index is used as a proxy for the income level, since income data are not available for many countries on a monthly basis.

The Data and Sources

Belgium:

CP--consumer price index (monthly). Source: Organization for Economic Cooperation and Development (OEDC); main economic indicators, various issues, February, 1973-November, 1978.

IR--interest rates (three-month treasury bills), last Tuesday of month. Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Y^2--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Canada:

CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

IR--interest rates (60-day treasury bills). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

France:

CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

IR--interest rates (official discount rates). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Germany:

CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

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[2]All the inflation indicators (CP indices) and income levels (Y indices) are reported in monthly series rebased to 100 at periodic intervals. To establish the sequence supporting the model used in this study, it was essential that the year 1970 remain equal to 100 and that subsequent indices running through 1978 be adjusted to eliminate any change of base year occurring in the intervening period.

IR--interest rates (two- to three-month treasury bills). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Italy:
CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
IR--interest rates (yields of long-term government bonds). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Japan:
CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
IR--interest rates (sixty-day treasury bills). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Netherlands:
CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
IR--interest rates (three-month treasury bonds). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Swizterland:
CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
IR--interest rates (official discount rates). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.
Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

United Kingdom:

CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

IR--interest rates (ninety-one-day treasury bills). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978.

United States:

CP--consumer price index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978. Federal Reserve Bulletin, various issues, 1973-1978.

IR--interest rates (three-month treasury bills; sixty-day treasury bills; official discount rates; yields of long-term government bonds). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978. Federal Reserve Bulletin, various issues, 1973-1978.

Y--total industrial production index (monthly). Source: OECD; main economic indicators, various issues, February, 1973-November, 1978. Federal Reserve Bulletin, various issues, 1973-1978.

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CHAPTER IV

PRESENTATION AND ANALYSIS OF EMPIRICAL RESULTS

Introduction

This chapter addresses itself to a case-by-case presentation of the empirical results derived from this study. The first section of the chapter will include descriptive statistics for the variables employed in the analysis. In the second section the regression results of the fundamental economic variables will be presented for each country, and in the third section the results of the tests of speculation will be evaluated. The fourth section will include a general conclusion and summary of the empirical results.

Presentation of Exchange Rate, Price Level, Interest Rate, and Income Level Statistics for Ten Countries

Descriptive Statistics for Variables Employed in the Empirical Study

The purpose of this section is to present some descriptive statistics regarding the variables which are employed in this study. The arithmetic mean, standard deviation, and coefficient of variations are included in Table IV; percentage of change in the level of exchange rates and

in the price level, together with the high and low values of exchange rates, are reported in Table V.

The tabular summary in Tables IV and V is believed to demonstrate a crude and rudimentary description of the variables involved. Although the statistics presented here possess the attribute of simplicity, they may serve as a general basis for subsequent analysis.

Two observations may be made about the figures given in Table IV. First, the United Kingdom has the highest average for price level, 193.6, while Germany has the lowest, 135.7, the base being 1970 = 100 for all countries. Italy experienced the highest average interest rate, 10.99 per cent, while Switzerland registered the lowest level, 3.3 per cent. The average income level was highest in Canada at 128.19 and lowest in Switzerland at 103.54. Second, the coefficient of variation, which divides the standard deviation by the arithmetic mean and measures the dispersion measured in a relative value, is highest for Switzerland at .1878 and lowest for Canada at .0499. This indicates that there is more dispersion in the movements of Switzerland's currency than in those of the Canadian dollar.

TABLE IV

DESCRIPTIVE STATISTICS FOR THE VARIABLES EMPLOYED IN THE EMPIRICAL STUDY, 1973-1978*

Country	Mean	Standard Deviation	Coefficient of Variation	Sample Size
Belgium				
EX	U$ .271104	.0220022	.0812	69
CP	152.02	22.826	.1502	
IR	.07856	.02137	.2720	
YL	117.12	12.302	.1050	
Canada				
EX	U$ .9772	.04876	.0499	69
CP	145.99	21.08	.1444	
IR	.0751	.0129	.1718	
YL	128.19	9.896	.0772	
France				
EX	U$ .2168	.01346	.0621	69
CP	157.53	26.27	.1668	
IR	.1031	.0113	.1096	
YL	121.81	15.76	.1294	
Germany				
EX	U$ .4129	.0399	.0966	69
CP	135.74	10.76	.0793	
IR	.0415	.0153	.0686	
YL	112.37	8.67	.0772	
Italy				
EX	U$ .13902	.02289	.1650	69
CP	187.15	49.08	.2622	
IR	.1099	.0285	.2593	
YL	116.30	16.72	.1438	
Japan				
EX	U$ .00368	.000478	.1299	69
CP	173.35	29.96	.1728	
IR	.0549	.011	.2004	
YL	125.49	9.83	.0783	

TABLE IV--Continued

Country	Mean	Standard Deviation	Coefficient of Variation	Sample Size
Netherlands				
EX	U$ .3932	.03309	.0842	69
CP	154.83	20.30	.1311	
IR	.04918	.01852	.3766	
YL	123.01	11.02	.0896	
Switzerland				
EX	U$ .39713	.07458	.1878	69
CP	141.48	9.83	.0695	
IR	.03304	.0165	.4993	
YL	103.54	6.978	.0674	
United Kingdom				
EX	U$ 2.0845	.2943	.1412	69
CP	193.57	49.08	.2536	
IR	.0966	.0217	.2246	
YL	106.75	7.24	.0678	
United States				
EX	. . . .	. . . .	. . .	69
CP	140.4	17.27	.1230	
IR	.06348	.01266	.1994	
YL	119.75	8.91	.0744	

EX--exchange rate; CP--consumer price index; IR--interest rate; YL--income level.
* Source: Tables IX, X, XI, and XII, Appendix A, pp. 133 - 148.

Percentage of Change in Exchange Rates and Price Levels in the Period 1973-1978

Table V indicates that for Belgium the franc appreciated about 44 per cent over the period under study.

TABLE V

PERCENTAGE OF CHANGE IN EXCHANGE RATES AND PRICE LEVELS IN THE PERIOD 1973 TO 1978*

Country	EX (%)	CP (%)	High (U$)	Low (U$)
Belgium	43.47	61.40	.3273	.2282
Canada	(15.42)	60.97	1.0412	.8452
France	16.04	48.23	.2475	.19608
Germany	62.83	29.84	.5157	.3167
Italy	(29.37)	95.67	.1773	.1115
Japan	59.21	87.61	.005287	.00332
Netherlands	50.9	40.71	.4746	.3145
Switzerland	134.8	26.74	.6481	.2760
United Kingdom	(17.22)	122.6	2.582	1.606
United States	. . .	55.91	. . . .	. . . .

EX--exchange rate; CP--consumer price index.
*Source: Tables IX, X, XI, and XII, Appendix A, pp. 133 - 148.

Since the price level increased 61.4 per cent over the same period, compared to a 56 per cent increase for the United States, it is apparent that the Belgian franc's appreciation was not justified on the basis of purchasing power parity. In fact, the inflation differential remained generally in favor of the United States throughout the

six-year period. The Canadian dollar, the Italian lira, and the British pound depreciated over the same period by 15.42 per cent, 29.41 per cent, and 17.22 per cent, respectively. The depreciation was justified on the basis of price level differentials, because these differentials were in favor of the United States for all three cases.

The French franc, the German mark, the Japanese yen, the Dutch guilder, and the Swiss franc appreciated over the period 1973 to 1978, the amount of appreciation ranging from 16 per cent for the French franc to 135 per cent for the Swiss franc. However, all of these appreciations could be justified on the basis of the purchasing power doctrine except that of the Japanese yen which, like the Belgian franc, appreciated, while the price level differentials for the Japanese case were strongly in favor of the United States currency. These currency movements and the sheer magnitude of changes in the exchange value of these currencies may indicate that, during the period under study, the foreign exchange market did not smoothly and efficiently correct the differences in rates of inflation among various countries by appropriately adjusting currency values.

Regression Results of the Fundamental Economic Variables

The purpose of this section is to present and evaluate the final regression equation for each of the countries

included in this study. The corrected equations for all countries are reported in Table VI. The Cochrane-Orcutt procedure (1) described in Chapter III was utilized to correct for serial correlation. Appendix B, and specifically Tables XIII, XIV, XV, and XVI (pp.150 - 153), contain the original equations and the subsequent recommended steps prescribed in Chapter III to deal with multicollinearity and autocorrelation.

Before presenting the regression results, it is appropriate to define the abbreviations that will accompany each equation. EX_t is the foreign exchange value of the currency of the foreign country in terms of the U.S. dollar. P_r is the ratio of the domestic consumer price index to the U.S. consumer price level, I_r is the ratio of the domestic short-term interest rate to the U.S. short-term interest rate, and Y_r is the ratio of the domestic income level to the U.S. income level. The numbers appearing in parentheses below the equation parameters are the t-statistics. R-squared is the coefficient of multiple determination, which shows the degree of association of the dependent variable with the entire set of independent variables. F-ratio is an analysis of variance test used to test the statistical significance of R-squared. D-W is the Durbin Watson statistic, a measure of the autocorrelation in the residuals. For equations in

TABLE VI

FUNDAMENTAL ECONOMIC VARIABLES IN RATIO FORM, CORRECTED FOR AUTOCORRELATION
(MONTHLY DATA, FEBRUARY 1973-OCTOBER 1978)

Country	Constant	CP_r	I_r	Y_r	SEE	F	R^2	D-W	Coeff. of Autocorr.
Belgium	43.17 (1.46)	115.06 (1.096)	.325 (.05)	-15.44 (1.107)	10.91	.87	.0393	1.80	.74
Canada	97.12 (12.3)*	-184.4 (-8.29)*	3.7 (2.96)*	-1.37 (-.524)	1.457	23.13	.524	1.63	.50 .32
France	56.93 (3.62)*	-71.14 (-.907)	-13.28 (-1.58)	3.78 (.65)	6.32	1.49	.065	1.632	.82
Germany	14.22 (4.65)*	-44.42 (-2.31)*	-.875 (-.477)	2.4 (.909)	1.31	2.29	.097	1.411	.83
Italy	3.92 (12.50)*	-7.42 (-4.11)*	-1.51 (-2.13)*	-.143 (-.541)	.371	14.8	.409	1.702	.85
Japan	63.4 (2.75)*	28.18 (.27)	-42.0 (-2.67)*	15.17 (.709)	12.95	2.82	.118	1.20	.68 .45
Nether-lands	5.07 (1.99)	1.45 (.081)	.263 (.303)	.196 (.099)	1.19	.04	.002	1.482	.87
Switzer-land	35.82 (8.21)*	-104.1 (-5.38)*	-4.13 (-.771)	5.53 (1.038)	1.676	29.98	.584	1.058	.75
United Kingdom	158.5 (18.35)*	-128.8 (-13.53)*	-15.62 (-5.94)*	31.95 (2.27)*	5.72	88.76	.806	1.73	.583

t-statistics in parentheses.
* statistically significant at the .05 level.

which there are 3 and 64 degrees of freedom the F-ratio will be statistically significant if it has values of at least 2.75 and 4.10 at the .05 and .01 levels of significance, respectively (6, pp. 282-283).

Furthermore, it is important to note that in the presentation of the regression results two basic statistical concepts will be employed. First, the collective explanatory power of the equation may be statistically significant measured by F-ratio. This means that the relationship did not happen by mere chance, or that the probability of such a chance relationship is remote (probably only 5 per cent or 1 per cent, depending on the level of statistical significance). Second, this relationship which is considered to be statistically significant might be weak depending on how much the independent variables contribute in explaining the variations in the level of exchange rates (dependent variable). Hence, cases may be found in which the relationship is statistically significant and strong in terms of explanatory power, or in which the relationship is statistically significant but weak judged on the basis of its explanatory importance. Of course, when the relationship is not significant statistically it ought also to be extremely weak.

For the Durbin-Watson statistic to be acceptable for 70 observations at the .05 and .01 levels of significance with four variables, the statistic should be higher than 1.74 and 1.34, respectively (6, pp. 286-287). The countries are presented in alphabetical order.

1. Belgium: The final corrected equation for Belgium which contains the three fundamental economic variables is as follows:

$$EX_t = \underset{}{43.17} + \underset{(1.46)}{115.06P_r} + \underset{(1.096)}{.325I_r} - \underset{(.05)}{15.44Y_r} \quad \underset{(-1.097)}{\qquad} \quad [29]$$

$R^2 = .04$ F-ratio = .87 D-W = 1.80

From equation [29] and the accompanying statistics, it is clear that the explanatory power of the equation represented by R-squared is extremely low. More specifically, the independent variables collectively explain only 4 per cent of the variations in the spot exchange rate of the Belgian franc in the period 1973 to 1978. None of the parameters is statistically significant at the .05 level. The t-statistics (the numbers in parentheses) are less than 2 in absolute value. Also, the consumer price level (P_r) coefficient carries the wrong expected sign. The F-ratio is statistically insignificant since the statistics for 3 degrees of freedom for numerator and 65 degrees of freedom for denominator are 2.75 and 4.10 for the .05 and .01 levels of significance, respectively. The Durbin-Watson statistic falls in the acceptance

area since the critical value bounds for three variables and seventy observations are 1.67 and 1.52 at the .05 level of significance. The results in the case of Belgium support the hypothesis that the fundamental economic variables did not determine the level of exchange rates for the Belgian franc in the period 1973 to 1978.

2. Canada: The Canadian corrected equation, as shown in Table VI, is given below:

$$EX_t = \underset{(12.3)}{97.14} - \underset{(-8.29)}{184.4P_r} + \underset{(2.96)}{3.71I_r} - \underset{(-.524)}{1.37Y_r} \qquad [30]$$

$R^2 = .524$ F-ratio = 23.13 D-W = 1.63

The regression equation for the Canadian dollar indicates that the explanatory power of the equation is relatively weak. The fundamental economic variables explain only 52.4 per cent of the total variations in the level of Canadian exchange rates. The F-ratio indicates that the relationship is statistically significant at both the .05 and .01 levels. On the other hand, all the parameters are statistically significant at the .05 level except income level, which is not significant. In addition, all the regression coefficients carry the expected sign. The Durbin-Watson statistic indicates the disappearance of autocorrelation since it falls in the acceptance area. The results for the Canadian dollar indicate that the fundamental economic variables did not

play a significant role in the determination of the foreign value of the Canadian dollar between 1973 and 1978.

3. France: The corrected equation for the French franc is as follows:

$$EX_t = \underset{(3.62)}{56.93} - \underset{(-.907)}{71.14P_r} - \underset{(-1.58)}{13.28I_r} + \underset{(.65)}{3.78Y_r} \qquad [31]$$

$R^2 = .065$ F-ratio = 1.49 D-W = 1.632

From Table XIV in Appendix B and equation [31] it is clear that the explanatory power of the equation was reduced from 32.2 per cent to 6.5 per cent as a result of correction of autocorrelation. Thus, the fundamental economic variables explain only 6.5 per cent of the total variations in the French franc in the period 1973 to 1978. This percentage is extremely low and is, of course, statistically insignificant since the F-ratio is below 2.75 and 4.10 for the .05 and .01 levels of significance, respectively. The regression coefficients for all independent variables are statistically insignificant at the .05 level. Furthermore, only the relative price level coefficient carries the expected sign. The Durbin-Watson statistic indicates the disappearance of serial autocorrelation, which was a problem before correction. The results for France also indicate that the fundamental economic variables were not by any means the dominant factors in the determination of the French exchange rates between 1973 and 1978, since the

unexplained variations constituted more than 93 per cent of the total variations.

4. Germany: Equation [32] is the estimated multiple regression for the German mark:

$$EX_t = \underset{(4.65)}{14.22} - \underset{(-2.31)}{44.42P_r} - \underset{(-.477)}{.875I_r} + \underset{(.909)}{2.4Y_r} \qquad [32]$$

$R^2 = .097$ F-ratio = 2.29 D-W = 1.411

The fundamental economic variables explained collectively 9.7 per cent of the total variations in the Deutschemark during the period under study; about 90 per cent of the total variations remained unexplained. The price level regression coefficient carries the expected sign and is statistically significant at the .05 level. However, the interest rates and relative income levels regression coefficients are not only statistically insignificant but also carry the wrong sign. The F-ratio is below the acceptance level for both the .05 and .01 levels of significance, indicating that the R-squared is not significant. The Durbin-Watson statistic, though improved from .295 before correction to a high of 1.411, is still in the inconclusive area for the .01 level of significance. Therefore, the independent variables in the case of the German mark did not determine its foreign exchange rates in the period 1973 to 1978.

5. Italy: The equation for the Italian lira is presented below:

$$EX_t = \underset{(12.3)}{3.92} - \underset{(-4.11)}{7.24P_r} - \underset{(-2.13)}{1.51I_r} - \underset{(-.541)}{.143Y_r} \quad [33]$$

$R^2 = .409$ F-ratio = 14.8 D-W = 1.702

From equation [31] it is evident that the three fundamental economic variables contributed about 41 per cent in explaining the variations of the Italian lira from 1973 to 1978. The R-squared for Italy is not only statistically significant but also higher than those in the previous cases, except Canada. The F-ratio, which exceeds the .05 and .01 levels of significance, indicates the statistical significance of the explanatory power of the independent variables. However, this explanatory power is still relatively low and leaves more than 59 per cent of the variations in the Italian lira unexplained. The Durbin-Watson statistic indicates the disappearance of serial autocorrelation, which plagued the previous uncorrected equations.

6. Japan: Equation [34] represents the estimated multiple regression equation for the Japanese yen:

$$EX_t = \underset{(2.75)}{63.4} + \underset{(.27)}{28.18P_r} - \underset{(-2.67)}{42.0I_r} + \underset{(.709)}{15.71Y_r} \quad [34]$$

$R^2 = .118$ F-ratio = 2.82 D-W = 1.20

As Tables XII and XIV (Appendix B) indicate, the price level differentials and interest rates differentials remained in favor of the United States dollar over the period 1973 to 1978, but the Japanese yen appreciated about 60 per cent during that period. This observation

is reflected in the regression coefficients of equation [34]. In fact, even the income differential was in favor of the United States dollar. The explanatory power of the three independent variables is extremely low. The independent variables explain only 11.8 per cent of the total variations in the level of the Japanese foreign exchange value. Although low, this relationship is statistically significant at the .05 level, as the F-ratio indicates. All the regression coefficients carry the wrong sign and only the coefficient of the interest rate is statistically significant. Furthermore, the autocorrelation correction method failed to improve the Durbin-Watson statistic, although a considerable degree of autocorrelation was eliminated from the original equation. Based on the results, it is evident that the fundamental factors did not determine the foreign exchange value of the Japanese yen during the period under investigation.

7. Netherlands: The estimated equation for the Dutch guilder is as follows:

$$EX_t = \underset{(1.99)}{5.07} + \underset{(.081)}{1.45P_r} + \underset{(.303)}{.263I_r} + \underset{(.099)}{.196Y_r} \qquad [35]$$

$R^2 = .002$ F-ratio = .04 D-W = 1.482

It is quite clear from equation [35] that the fundamental economic variables played virtually no role in the determination of the foreign value of the Dutch guilder.

In fact, the price level, interest rate, and income level differentials remained generally and on the average in favor of the United States dollar; nevertheless, the Dutch guilder appreciated during the period under study by more than 50 per cent. Equation [35] indicates that the Dutch guilder performed counter to all the fundamental variables. The independent variables failed to explain even one per cent in the total variations of the level of the guilder. In addition, all the regression coefficients are statistically insignificant, and the price level and income level coefficients carry the wrong sign. The Durbin-Watson statistic indicates the virtual disappearance of serial autocorrelation.

8. Switzerland: The multiple regression equation for the Swiss franc is given below:

$$EX_t = \underset{(8.21)}{35.82} - \underset{(-5.38)}{1.04.1P_r} - \underset{(-.771)}{4.13I_r} + \underset{(1.038)}{5.53Y_r} \qquad [36]$$

$R^2 = .584$ F-ratio = 29.98 D-W = 1.058

The R-squared for the Swiss franc equation is .584, indicating that the fundamental economic variables explained only 58.4 per cent of the total variations in the level of the Swiss franc's spot foreign value. This is relatively low explanatory power, even though it is higher than that displayed in the previous cases. Only the price level regression coefficient is statistically significant and carries the expected sign; the interest rate

and income level coefficients are not significant. As in the case of the Japanese yen, the autocorrelation correction method explained in Chapter III failed to improve the Durbin-Watson statistic for the Swiss franc.

9. United Kingdom: The estimated regression equation for the British pound is presented below:

$$EX_t = \underset{(18.35)}{158.5} - \underset{(-13.53)}{128.8P_r} - \underset{(-5.94)}{15.621I_r} + \underset{(2.27)}{31.95Y_r} \quad [37]$$

$R^2 = .806$ F-ratio = 88.76 D-W = 1.73

The results of the British pound equation [37] indicate that the fundamental economic variables collectively explained more than 80 per cent of the variations in the level of the British foreign currency value between 1973 and 1978. This result is significantly better than those obtained in other cases. Only the price level coefficient of regression carries the expected sign, but all the estimated parameters including the constant are statistically significant. Moreover, the Durbin-Watson statistic indicates the disappearance of the serial autocorrelation which was a serious problem for the original equation in Table XIV (Appendix B). As a result of equation [37], it may be stated that the fundamental economic variables played a rather important role in the determination of the British pound's foreign value during the period 1973 to 1978.

Summary

From the presentation of the regression results of the three fundamental economic variables, this section is concluded with a summary of the main results of the regression analysis:

1. The explanatory power and the existence of relationships of five countries (Canada, Italy, Japan, Switzerland, and the United Kingdom) are statistically significant, measured by R-squared and F-ratio. Only in the case of the British pound sterling is the relationship moderately strong.

2. The price level coefficients are statistically significant at the .05 level and carry the expected negative for Canada, Germany, Italy, Switzerland, and the United Kingdom. The regression coefficients carry the wrong sign and are statistically insignificant for Belgium, Japan, and the Netherlands. For France the coefficient carries the expected sign, but the parameter is statistically insignificant.

3. Only the interest rate coefficient for Canada carries the expected positive sign and is statistically significant. The coefficients for Belgium and the Netherlands also have the expected sign, but they are insignificant. The same regression coefficient is statistically significant with the wrong sign for Italy, Japan, and

the United Kingdom. However, the parameters for France, Germany, and Switzerland neither carry the expected sign nor are statistically significant.

4. The income level coefficients regressions for Belgium, Canada, and Italy carry the expected sign but are all insignificant. The parameters for income level for other countries carry the wrong sign and are all statistically insignificant, except for the United Kingdom.

5. The Durbin-Watson statistics for all countries are improved significantly, and all are in the acceptance area except for Japan and Switzerland. The removal technique outlined in Chapter III succeeded in correcting autocorrelation almost entirely, with the exception of these two cases.

6. Overall, the majority of cases indicate that the foreign exchange rates for the countries under study did not follow the movement in the fundamental economic variables. In fact, in some cases the exchange rates moved counter to the movements in the fundamental economic variables. Only in the case of the British pound did the fundamental variables play a relatively significant role in the determination of a currency's value during the 1973-1978 period's floating exchange system.

Regression Results of the Nature of Speculation Tests

In this section the nature of speculation will be evaluated for each country. The results of purchasing power tests will be presented first, followed by the coefficient of expectation tests and a conclusion.

The Purchasing Power Doctrine Test

As discussed in Chapter III, one version of the purchasing power doctrine asserts that if the flexible exchange rate begins at equilibrium and then experiences a monetary disruption, the percentage of change in the exchange rate under a freely fluctuating exchange-rates system approximates the percentage of change in the relative price ratio between the countries involved. In equation [38], EX is the exchange rate of the foreign country in U.S. dollars and P_r is the ratio of the consumer price index of the foreign country to the price index of the U.S., both indices based on 1970 - 100.

$$\text{Log}EX_t = \alpha_1 + \beta_1 \text{Log}P \qquad [38]$$

As stated earlier, the purchasing power parity doctrine would hypothesize that, under free conditions, β_1 would tend toward minus one since a 10 per cent relative increase in the price level of the foreign country should be accompanied by a 10 per cent depreciation of the currency of that country. If speculation is basically of

a destabilizing nature, one would expect speculators to seize upon weak currencies and cause them to depreciate by an amount greater than is justified on the basis of the current price ratio. Therefore, it is expected generally that β_1 will be greater than one in absolute value. If speculation is basically stabilizing, on the other hand, price level inflation and exchange depreciation would be regarded as temporary departures from normal by speculators, and would result in their taking positions in fundamentally weak currencies. Thus, the currency would be prevented from depreciating by an amount justified by the current P_r. One would thus expect empirically to find β_1 less than one, if speculation is stabilizing.

Table VII contains the multiple regression results for both the estimate of total elasticity (β_1) of the exchange rate with respect to P_r (the price level ratio) and the partial elasticity (β_2) of the exchange rate with respect to relative price ratio. The reason for the estimation of β_2 is, as stated in Chapter III, to avoid a systematic downward bias to the estimates of β caused by a single independent variable. The estimates of β_1 in Table VII indicate that

1. In seven out of nine cases the coefficient regression of the price level ratio was short of unity,

TABLE VII

SUMMARY OF EQUATIONS OF THE FORM

1. $LogEX = \alpha_1 + \beta_1 LogP_r$
2. $LogEX = \alpha_2 + \beta_2 LogP_r + \beta_3 LogI_r + \beta_4 LogY_r$**

Exchange Rate	Equation [1]				Equation [2]			
	β_1	F-Ratio	R^2	D-W	β_2	F-Ratio	R^2	D-W
U.S.-Belgium	.43 (.966)	.93	.014	2.13	.519 (1.25)	1.12	.05	1.82
U.S.-Canada	-1.49 (4.334)*	18.78	.224	1.443	-2.07 (-8.6)*	24.83*	.54	1.45
U.S.-France	-.468 (-.971)	.94	.014	1.59	-.394 (-.99)	1.68	.073	1.66
U.S.-Germany	-.914 (-2.14)*	4.58	.065	1.40	-.943 (-2.1)*	2.25	.095	1.42
U.S.-Italy	-.914 (-5.38)*	27.86	.297	1.73	-.728 (-4.01)*	14.65*	.407	1.73
U.S.-Japan	.173 (.812)	22.84	.52	1.35	.239 (.903)	10.75*	.338	1.47
U.S.-Netherlands	.0943 (.185)	.03	.005	1.57	.072 (.135)	.24	.011	1.49
U.S.-Switzerland	-2.31 (-6.52)*	42.44	.39	1.51	-1.64 (-3.37)*	20.17*	.486	1.36
U.S.-United Kingdom	-.382* (-2.58)*	6.65	.0916	1.38	-.84 (-12.1)*	63.27*	.75	1.66

t-statistics in parentheses.
* statistically significant at the .05 level.
** Source: Tables XVIII and XX, Appendix C, pp. 155 - 158.

indicating stabilizing speculation. These cases are Belgium, France, Germany, Italy, Japan, the Netherlands, and the United Kingdom. However, in only three of these seven cases are the betas statistically significant, namely, Germany, Italy, and the United Kingdom.

2. In two cases, the Canadian dollar and the Swiss franc, speculation was destabilizing. For both cases the parameters are statistically significant.

The estimates of β_1 in Table VII did not change the results obtained from β_2 calculations; however, it did change the magnitude of some parameters. It increased the betas in absolute value for Belgium, Canada, Germany, Japan, and the United Kingdom and reduced the magnitude for France, Italy, the Netherlands, and Switzerland.

In closing this section, it may be appropriate to consider why the data did not exactly fit the model of the purchasing power doctrine. First, the model assumes that exchange rates are permitted to float freely while in fact governments still intervene in foreign exchange markets from time to time in order to achieve a managed float. In brief, the model may not be a completely accurate description of existing exchange rate regimes.

Second, monthly data may not be suitable for testing what is essentially a model of long-run equilibrium. As such they may be dominated by transitory dynamic adjustment

phenomena that are absent in long-run static equilibrium. In fact, Moon Lee (2) tested the purchasing power parity for eight of the countries examined in this study for the period 1900 to 1972 and found a strong empirical relationship between changes in exchange rates and the difference in the changes in price levels in the United States and major non-U.S. countries. Furthermore, his conclusions are the same whether general wholesale or the consumer price index is used in the tests.

Unfortunately, the post-Bretton Woods era of floating rates is only six years old and the number of annual observations is insufficient to test the purchasing-power doctrine. Even the number of quarterly observations is distressingly low.

The Coefficient of Expectation Test

Before any evaluation is made regarding the coefficient of expectation test, it should be made clear that this framework has been thoroughly developed by Thomas (4, 5). In this test an attempt is made to draw inferences concerning the elasticity of speculators' expectations. Thomas, depending on Nurkse's (3) analysis of the exchange markets of the early 1920s, argues that when expectations become highly elastic they also become destabilizing. A brief discussion of the coefficient of expectation model was given in Chapter III, and a detailed

development of the model is presented in Appendix D. Referring to equation [39], EX_t is the current exchange rate, EX_{t-1} is the exchange rate in the previous period, P_t is the current relative prices, and P_{t-1} is the relative prices in the previous period. β is the coefficient of expectation.

$$EX_t = \alpha + (1 - \beta_1)EX_{t-1} + \sigma P_t - \delta P_{t-1} \qquad [39]$$

Estimation of equation [39] provides a method of empirically estimating the magnitude of beta, the coefficient of expectation. One need merely subtract the estimated coefficient of the EX_{t-1} term from unity to obtain the estimate of beta. If the betas are significantly greater than zero, expectations are considered highly elastic and it is argued that speculation is destabilizing.

Table VIII and Tables XXI and XXII in Appendix D contain the regression results and the beta estimates for both the original equation and the reduced form which was developed to avoid the probable multicollinearity in equation [39]. It is quite clear from Table VIII that all the betas (β_1 and β_2) are greater than zero and all are statistically significant. Therefore, all cases indicate an elastic expectation and thus support the hypothesis of destabilizing speculation. All the betas are statistically significant at both the .05 and .01 levels.

TABLE VIII

RESULTS OF EQUATIONS OF THE FORM

1. $EX_t = (1 - \beta_1)EX_{t-1} + \alpha P_{r_t} - YP_{r_{t-1}}$
2. $EX_t = (1 - \beta_2)EX_{t-1} + \delta(P_{r_t} - P_{r_{t-1}})$*

Country	β_1	β_2
Belgium	.138 (12.375)**	.1039 (14.22)**
Canada	.0465 (17.54)**	-.0256 (31.67)**
France	.143 (13.52)**	.125 (14.91)**
Germany	.148 (10.85)**	.03 (18.2)**
Italy	.068 (14.06)**	.034 (46.8)**
Japan	-.055 (35.85)**	-.055 (36.1)**
Netherlands	.064 (20.59)**	.0667 (20.76)**
Switzerland	.0302 (15.877)**	-.0515 (38.42)**
United Kingdom	.052 (18.447)**	.0212 (47.84)**

t-statistics in parentheses.
* Source: Tables XXI and XXII, Appendix D, pp.160 - 161.
** statistically significant at the .05 level.

The results of the purchasing power parity tests, both for the one-variable and three-variable equations, indicate that in seven cases out of nine the absolute value of the coefficient regression of the relative prices fell short of unity; this was interpreted as stabilizing speculation. Only three of these cases, however, were statistically significant. The cases for the Canadian dollar and the Swiss franc indicated destabilizing speculation and were statistically significant.

The coefficient of expectation tests indicate that both sets of betas are statistically greater than zero. The implication of those estimates is that the expectations were generally elastic and thus very sensitive in the adjustment process. Simply, this elasticity is an indication of the existence of destabilizing speculation.

A General Conclusion and Summary

The purpose of this chapter has been to assess empirically the role of three fundamental economic variables (relative price levels, relative interest rates, and relative income levels) in the determination of the foreign exchange rates of the most important international floating currencies. Another purpose has been to draw some inferences regarding the nature of speculation in the foreign exchange market.

From the conceptual and the theoretical framework presented in Chapter II, the hypothesis that exchange rates are primarily a function of speculative or psychological forces was regarded as equivalent to the hypothesis that either the estimated coefficients of the fundamental economic variables in the multiple regression equations do not consistently exhibit the correct sign, that these parameter estimates have the correct sign but their degree of statistical significance is low, or that the collective explanatory power of the fundamental factors is weak.

Taking these criteria as a basis for evaluation, the majority of cases lent support to the hypothesis that psychological and speculative forces did dominate the behavior of the foreign exchange market for the currencies under investigation during the period 1973 to 1978.

On the other hand, the purchasing power doctrine test employed in this analysis gave mixed and in some cases inconclusive results. Some currencies were interpreted to have experienced destabilizing speculation; some, stabilizing speculation with statistical significance; and the rest, stabilizing speculation without statistical significance. Two preliminary reasons were given for the inconclusive results of the purchasing power tests, namely, governmental intervention in the foreign exchange market

to alleviate erratic and disorderly fluctuations and the use of short-term data to test a long-run phenomenon.

The second test of the nature of speculation gave a consistent result, indicating that destabilizing speculation dominated the foreign exchange market for the currencies under investigation between 1973 and 1978.

Therefore, it is concluded here that the movements in the values of the foreign currencies studied in this research did not follow the movements in the fundamental economic variables; rather, it is concluded that the gyrations in these currencies over the period under investigation were influenced by destabilizing speculative forces. This result implies that some currencies depreciated in spite of their relative fundamental strength while other currencies appreciated regardless of their relative fundamental weakness. In other words, the speculative forces in the foreign exchange markets acted counter to the underlying economic forces and, as a result, the demand for some currencies was intensified, leading to a disequilibrium price which was not justifiable on the basis of pure fundamental forces. On the other hand, the same speculative forces abandoned some currencies by converting their holdings of such currencies into the other group mentioned above, resulting in depreciation which could not be related to the fundamental economic variables. Therefore,

in the current floating system the fundamental economic variables are not by any means the sole determinant of foreign exchange rates. The results of this study indicate that psychological and speculative forces influenced the exchange rate movements to a large extent in the period studied.

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CHAPTER V

FINDINGS AND IMPLICATIONS OF RESULTS

In Chapter I the arguments for and against the flexible and fixed exchange rate systems were presented. Among the arguments in favor of the flexible rates system was one that maintained that if authorities stayed out of the market, exchange rates would behave in response to the demand and supply forces and would consequently adhere to the movements of the fundamental economic variables. This dissertation has concentrated mainly on this proposition. The role of the fundamental economic variables, specifically relative price levels, relative interest rates, and relative income levels, in the determination of foreign exchange rates was investigated. The empirical results presented in Chapter IV indicated that in eight out of nine cases studied the fundamental economic variables either played a relatively weak role or had a very minor one in explaining the variations in the level of the foreign currency values during the period of the current float, 1973 to 1978.

Therefore, the reasonable explanation was that there should be other influences that move the "hot money" and eventually drive the foreign prices of national

currencies counter to the expected direction suggested on purely economic grounds. Among these influences were rumors, funds seeking political safety, and psychological and speculative forces. Here it was argued that, if the fundamental economic variables did not explain the movements of the currency rates, speculative activity in the foreign exchange market might be responsible.

In an attempt to draw inferences on the nature of speculation, specifically, whether it was stabilizing or destabilizing, two tests were conducted, the purchasing power doctrine test and the coefficient of expectation test. The first test divided the currencies into two groups, stabilizing and destabilizing, whereas the latter test lent support to the destabilizing nature of speculation. Two likely reasons were mentioned for the lack of adherence to the purchasing power doctrine demonstrated by the currencies under investigation. The first was the frequent governmental interference in the foreign exchange market; the second was the utilization of short-run data to investigate the long-run equilibrium. Some explanation of the second reason may be useful at this point. There is considerable empirical evidence that relative price changes have a strong influence on volume of imports and exports and, consequently, on demand and supply of the foreign value of the national currency.

Time is needed, however, for the requisite changes in demand and production to take place, so that only some fraction--say one-fourth to one-half--of the ultimate volume effects will be observed over a period as short as a year (1, p. 8). It is argued that it is likely to take time for some consumers to switch from traditional suppliers with whom they may have long-term contracts to producers located in a country whose currency has depreciated. In addition, it may be necessary for producers to set up new marketing networks in countries to which they have not previously exported. Therefore, the inconsistency in the purchasing power doctrine tests may be related to the arguments that the doctrine is a long-run equilibrium case.

Interpretations and Policy Implications Suggested by the Results

1. The analysis of the flexible exchange rates in the period 1973 to 1978 did not produce the same empirical results as those yielded by the flexible system of the 1920s when studied by some scholars. In fact, Thomas (6) hinted at that contrast in his analysis of the post-World War I episode by saying, "Since a cross section of the countries studied in the 1920's suggests that the viability of the system is a function of the extent of price level inflation, one cannot be assured that a system of freely

fluctuating exchanges would be tenable in the 1970's, when world-wide secular inflation appears to be an increasingly likely prospect" (6, p. 182). Using an econometric model similar to the one utilized in this study, in his analysis of the flexible exchange rates of the 1920s Thomas found that the exchange rates were not determined primarily by speculative or psychological influences; rather, the fundamental economic variables played a dominant role in explaining the variations in the level of the exchange rates for the years he studied. However, the basic environment in which the exchange rate is determined has changed drastically in recent years. The reduction in downward wage and price flexibility, the evolution of OPEC as an economic and financial element in the world economy, and the rise of some developing countries as competitive factors in world trade have important implications. Furthermore, the influence of exchange rate expectations is believed to be strong. The changes in exchange rate expectations are perhaps worthy of special note because many factors influence these expectations and because the factors themselves are subject to frequent change, especially in an environment of high inflation and irregular economic growth. Although the factors affecting exchange expectations are not directly observable, it is known that they include monetary and fiscal policies, inflation

differential, current and trade accounts imbalances and relative competitive positions, political uncertainties, official intervention in exchange markets, and the change in the exchange rate itself.

Furthermore, the flexible system of the 1920s was probably viewed as a temporary practice which would be abandoned very soon, whereas in the current float there is no reason for the participants in the market to believe that a return to a fixed system is imminent.

2. The data presented in Chapters I and IV indicate large month-to-month and year-to-year movements in the exchange rates. It is believed that there are two likely reasons for these movements. First, as indicated by McKinnon (4) and Mussa (5), the period of the current float has been one of turmoil in economic affairs: the increase in oil and food prices, the pursuit of stop-go policies by many governments, and the acceleration of world inflation followed by the onset of world recession. All this turmoil has clearly generated uncertainty which has been reflected in the markets for all types of assets, including foreign exchange markets. Almost all of these variables have an impact upon expectations, as mentioned earlier. Second, for a number of major currencies there was no well-established bench-mark for the appropriate value of the exchange rate at the start of the flexible

exchange rate period. Perhaps, as the market gains greater experience, bench-marks will be established for the rates between major currencies and there will be some moderation in month-to-month and quarter-to-quarter movements of exchange rates.

3. Since most currencies' movements could not be explained by the movements in the fundamental economic variables and, in some cases, the movements in the exchange rates were counter to the fundamental variables' shifts, it seemed quite clear that some currencies stayed overvalued despite their fundamental weaknesses while others remained undervalued even though that could not be justified on the basis of economic considerations. Advocates of flexible rates argue that government interventions are the reason for the foreign exchange market's imperfections, especially the short-run instability of rates. They argue that if authorities would stay out the market, speculators would no longer have to anticipate the central banks' behavior; they could concentrate on underlying economic trends and act to stabilize exchange rates. Kennen (3) argues that there have been large movements of reserves, testifying to official intervention in the foreign exchange markets, and that there has been an unprecedented volume of official and quasi-official borrowing that has served the same purpose as outright

intervention. Furthermore, the Wall Street Journal and financial press carry items about governmental intervention by many countries either to prevent their currencies from appreciating or from depreciating.

4. The level of exchange rates can be expected to change when economic conditions, such as real incomes, price levels, interest rates, and the supply of money, change in different proportions in the countries involved. From time to time, however, as noted earlier in Chapter IV, exchange rate changes have been erratic, reversible, and on occasion difficult to relate to underlying economic conditions. The influences operating on exchange markets are too numerous and diverse to permit a single explanation for recent exchange rate variability. However, it is believed that, for countries with well-developed money and capital markets, conditions in the financial markets are probably more important than those in the goods markets for determining short-run exchange rate movements (2, p. 37). Changes in exchange rate expectations and official intervention and short-term capital movements also influence the size of short-term fluctuations.

An important policy implication of this study is that measures are needed to reduce the frequency and duration of disorderly market conditions. To the extent that unexpected changes in monetary and fiscal policies

lead to short-term exchange rate changes, there is a potential contribution to be made by greater stability in the conduct of these policies. Greater official intervention in the exchange markets is another option, but the effects of past intervention are not well established (2, p. 37). The principal difficulty faced by the authorities in intervening in the market is, of course, that of distinguishing reversible short-term influences from those changes reflecting changes in the underlying fundamental economic variables. Therefore, restoration of greater exchange rate stability probably requires the restoration of economic stability at the national level and a coordinated effort to bring compatability in policies regarding rate of inflation, output growth, monetary expansion, and, consequently, intercountry differentials in these variables, with a significant reduction of the existing large account imbalances among industrial nations.

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APPENDIX A

EXCHANGE RATES, CONSUMER PRICE INDICES, INTEREST RATES, AND INDUSTRIAL PRODUCTION INDICES FOR TEN NATIONS, 1973-1978

TABLE IX

EXCHANGE RATES (MONTHLY AVERAGES): U.S. DOLLARS PER UNIT OF NATIONAL CURRENCY

Year	Belgium	Canada	France	Italy
1973				
Jan	.22815	.9994	.19897	.001719
Feb	.25329	1.0059	.22080	.001751
Mar	.24950	1.0010	.22022	.001717
Apr	.24802	.9968	.21882	.001692
May	.25934	1.0050	.22676	.001708
Jun	.22739	1.0016	.24361	.001712
Jul	.27886	.9988	.24225	.001710
Aug	.26560	.9946	.23121	.001765
Sep	.27100	.9942	.23529	.001773
Oct	.27115	1.0010	.23518	.001752
Nov	.25291	1.0000	.22262	.001656
Dec	.24201	1.0042	.21224	.001645
1974				
Jan	.23557	1.0119	.19608	.001514
Feb	.24777	1.0322	.20764	.001547
Mar	.25674	1.0284	.20991	.001607
Apr	.26638	1.0412	.20513	.001582
May	.26226	1.0395	.20362	.001552
Jun	.26309	1.0286	.20734	.001544
Jul	.26144	1.0212	.21304	.001549
Aug	.25413	1.0126	.20730	.001513
Sep	.25491	1.0144	.21093	.001514
Oct	.26212	1.0156	.21299	.001498
Nov	.26874	1.0128	.21584	.001505
Dec	.27685	1.0089	.22497	.001540
1975				
Jan	.28555	1.0006	.23127	.001563
Feb	.29330	1.0020	.23992	.001592
Mar	.28849	.9968	.23719	.001582
Apr	.28425	.9812	.24172	.001579
May	.28523	.9777	.24710	.001599
Jun	.28369	.9703	.24752	.001586
Jul	.26015	.9692	.22857	.001503
Aug	.25996	.9688	.22727	.001495
Sep	.25003	.9754	.22046	.001455
Oct	.25955	.9831	.22973	.001486
Nov	.25278	.9895	.22416	.001461
Dec	.25299	.9839	.22292	.001463

TABLE IX--Continued

Year	Belgium	Canada	France	Italy
1976				
Jan	.25484	.9990	.22336	.001331
Feb	.25549	1.0156	.22277	.001304
Mar	.25608	1.0161	.21418	.001190
Apr	.25760	1.0219	.21455	.001115
May	.25095	1.0217	.21137	.001185
Jun	.25191	1.0324	.21097	.001190
Jul	.25445	1.0254	.20329	.001197
Aug	.25723	1.0190	.20325	.001189
Sep	.26589	1.0275	.20296	.001163
Oct	.27071	1.0286	.20008	.001157
Nov	.27124	.9662	.20028	.001157
Dec	.27791	.9909	.20121	.001143
1977				
Jan	.26896	.9795	.20096	.001143
Feb	.27235	.9556	.20052	.001131
Mar	.27319	.9463	.20125	.001127
Apr	.27733	.9547	.20165	.001128
May	.27728	.9515	.20214	.001129
Jun	.27751	.9435	.20329	.001130
Jul	.28273	.9357	.20488	.001134
Aug	.27999	.9305	.20383	.001134
Sep	.27978	.9316	.20396	.001133
Oct	.28391	.9024	.20623	.001137
Nov	.28486	.9030	.20580	.001139
Dec	.30358	.9137	.21254	.001147
1978				
Jan	.30574	.9028	.21128	.001153
Feb	.31598	.8971	.20982	.001172
Mar	.31766	.8832	.21829	.001173
Apr	.30981	.8842	.21683	.001153
May	.30415	.8905	.21706	.001154
Jun	.30572	.8893	.22217	.001170
Jul	.31075	.8841	.22868	.001188
Aug	.31946	.8687	.22973	.001197
Sep	.32733	.8452	.23089	.001214

TABLE IX--Continued

Year	Germany	Japan	Nether-lands	Switzer-land	United Kingdom
1973					
Jan	.3167	.00332	.3145	.2760	2.3822
Feb	.3517	.00370	.3503	.3197	2.4900
Mar	.3524	.00376	.3397	.3089	2.4775
Apr	.3525	.00377	.3372	.3086	2.4888
May	.3663	.00377	.3531	.3230	2.5665
Jun	.4124	.00377	.3817	.3378	2.5820
Jul	.4252	.00380	.3848	.3489	2.5130
Aug	.4052	.00377	.3726	.3301	2.4585
Sep	.4132	.00376	.3945	.3309	2.4135
Oct	.4090	.00375	.3934	.3229	2.4390
Nov	.3820	.00357	.3622	.3123	2.3430
Dec	.3700	.00357	.3541	.3083	2.3232
1974					
Jan	.3595	.00333	.3438	.3040	2.2770
Feb	.3750	.00347	.3579	.3203	2.3055
Mar	.3964	.00362	.3724	.3333	2.3940
Apr	.4087	.00357	.3852	.3431	2.3428
May	.3954	.00355	.3765	.3360	2.3930
Jun	.3914	.00352	.3771	.3336	2.3905
Jul	.3865	.00336	.2791	.3361	2.3761
Aug	.3754	.00330	.3685	.3324	2.3178
Sep	.3769	.00335	.3698	.3394	2.3323
Oct	.3876	.00334	.3789	.3484	2.3338
Nov	.4037	.00333	.3902	.3682	2.3237
Dec	.4149	.00332	.3989	.3937	2.3485
1975					
Jan	.4272	.00336	.4107	.4000	2.3778
Feb	.4376	.00349	.4261	.4167	2.4268
Mar	.4264	.00340	.4175	.3956	2.4090
Apr	.4205	.00341	.4114	.3911	2.3531
May	.4261	.00343	.4156	.3997	2.3114
Jun	.4246	.00337	.4098	.3995	2.1980
Jul	.3880	.00336	.3766	.3685	2.1472
Aug	.3868	.00336	.3779	.3729	2.1110
Sep	.3757	.00330	.3655	.3639	2.0409
Oct	.3914	.00331	.3812	.3811	2.0757
Nov	.3805	.00330	.3712	.3733	2.0168
Dec	.3814	.00328	.3719	.3817	2.0235

TABLE IX--Continued

Year	Germany	Japan	Nether-lands	Switzer-land	United Kingdom
1976					
Jan	.3855	.00329	.3751	.3846	2.0291
Feb	.3899	.00331	.3736	.3903	2.0201
Mar	.3940	.00334	.3722	.3946	1.9157
Apr	.3943	.00334	.3723	.3979	1.8440
May	.3855	.00333	.3630	.4097	1.7640
Jun	.3885	.00336	.3655	.4044	1.7813
Jul	.3932	.00341	.3694	.4032	1.7843
Aug	.3957	.00346	.3771	.4037	1.7746
Sep	.4103	.00348	.3893	.4075	1.6775
Oct	.4158	.00341	.3968	.4105	1.6060
Nov	.4158	.00338	.3986	.4093	1.6484
Dec	.4232	.00341	.4070	.4080	1.7024
1977					
Jan	.4131	.00346	.3946	.3973	1.7142
Feb	.4175	.00354	.4000	.3917	1.7092
Mar	.4186	.00360	.4013	.3932	1.7201
Apr	.4215	.00360	.4078	.3962	1.7184
May	.4243	.00361	.4055	.3994	1.7176
Jun	.4277	.00374	.4044	.4063	1.7202
Jul	.4371	.00376	.4097	.4156	1.7374
Aug	.4307	.00374	.4078	.4174	1.7429
Sep	.4335	.00377	.4070	.4275	1.7465
Oct	.4439	.00399	.4125	.4482	1.8320
Nov	.4488	.00407	.4155	.4619	1.8150
Dec	.4751	.00417	.4386	.5000	1.9060
1978					
Jan	.4735	.00414	.4423	.5048	1.9504
Feb	.4812	.00419	.4556	.5339	1.9343
Mar	.4943	.00450	.4621	.5350	1.8563
Apr	.4836	.00448	.4525	.5173	1.8313
May	.4760	.00448	.4442	.5244	1.8222
Jun	.4819	.00489	.4478	.5182	1.8602
Jul	.4900	.00524	.4533	.5741	1.9317
Aug	.5033	.00526	.4640	.6075	1.9425
Sep	.5157	.00529	.4746	.6481	1.9721

TABLE X

CONSUMER PRICE INDICES
(BASE 1970 = 100)

Year	Belgium	Canada	France	Germany	Italy
1973					
Jan	114.0	111.4	115.5	115.6	116.2
Feb	115.3	112.0	115.8	116.4	117.5
Mar	115.5	112.3	116.4	117.1	118.8
Apr	116.2	113.6	117.2	118.0	120.0
May	116.6	114.4	118.3	118.7	121.8
Jun	117.2	115.4	119.2	119.5	122.9
Jul	117.7	116.4	120.2	119.5	123.6
Aug	118.3	118.0	121.0	119.4	124.4
Sep	118.8	118.7	122.1	119.8	125.1
Oct	119.6	119.0	123.4	120.7	126.1
Nov	120.4	119.9	124.5	121.8	127.5
Dec	121.9	120.6	125.3	122.9	129.1
1974					
Jan	123.3	121.5	12.74	123.7	130.8
Feb	124.9	122.7	129.1	124.8	133.0
Mar	126.4	124.0	130.6	125.2	136.9
Apr	128.2	124.8	132.7	125.9	138.7
May	130.1	126.9	134.3	126.7	140.6
Jun	132.0	128.5	135.8	127.2	143.3
Jul	133.0	129.5	137.5	127.5	146.8
Aug	135.6	130.8	138.6	127.7	149.8
Sep	137.4	131.5	140.1	128.1	154.7
Oct	138.6	132.8	141.8	128.8	157.9
Nov	140.0	134.2	143.1	129.7	160.3
Dec	141.0	135.5	144.3	130.1	161.7
1975					
Jan	142.5	136.2	145.9	131.3	163.6
Feb	144.1	137.2	147.0	132.0	165.5
Mar	145.1	137.9	148.2	132.6	165.7
Apr	146.7	138.6	149.5	133.6	168.0
May	147.9	139.8	150.6	134.4	169.2
Jun	148.5	141.9	151.7	135.4	170.8
Jul	149.9	143.8	152.8	135.4	171.8
Aug	151.0	145.3	153.8	135.2	172.7
Sep	152.3	145.6	155.1	135.9	174.2
Oct	154.1	146.9	156.3	136.3	176.5
Nov	153.7	148.3	157.3	136.7	178.0
Dec	156.5	148.5	158.2	137.1	179.7

TABLE X--Continued

Year	Belgium	Canada	France	Germany	Italy
1976					
Jan	158.0	149.3	159.9	138.2	181.5
Feb	158.5	149.8	161.0	139.2	184.5
Mar	159.5	150.4	162.4	139.7	188.4
Apr	161.0	151.0	163.8	140.6	194.0
May	162.2	152.3	164.9	141.1	197.3
Jun	162.4	153.0	165.6	141.5	198.2
Jul	163.7	153.6	167.2	140.9	199.4
Aug	164.4	154.3	168.4	141.4	201.1
Sep	166.5	155.0	170.2	141.4	204.7
Oct	166.9	156.1	171.8	141.5	211.6
Nov	167.5	156.6	173.2	141.8	216.1
Dec	168.4	157.1	173.8	147.5	218.8
1977					
Jan	170.1	158.4	174.3	143.8	221.8
Feb	171.4	159.9	175.5	144.7	226.3
Mar	171.3	161.5	177.1	145.2	230.3
Apr	172.2	162.4	179.4	145.9	232.7
May	173.9	163.8	181.1	146.5	235.7
Jun	175.0	164.9	182.5	147.2	238.0
Jul	175.5	165.5	184.1	147.0	239.8
Aug	176.1	167.2	185.1	146.9	241.4
Sep	177.3	168.1	186.7	146.7	244.0
Oct	177.7	169.8	188.2	146.9	246.6
Nov	178.3	170.9	188.9	147.1	250.3
Dec	178.9	172.0	189.4	147.5	251.5
1978					
Jan	180.0	172.6	190.3	148.4	253.9
Feb	180.6	173.8	191.7	149.2	256.5
Mar	181.0	175.7	193.4	149.7	259.1
Apr	181.2	176.1	195.5	150.1	262.0
May	181.5	178.6	197.4	150.5	264.8
Jun	181.5	180.1	198.9	150.9	267.0
Jul	182.5	182.8	201.4	150.9	269.0
Aug	183.3	183.0	202.4	150.5	270.0
Sep	184.0	182.7	203.8	150.1	274.0

TABLE X--Continued

Year	Japan	Nether-lands	Switzer-land	United Kingdom	United States
1973					
Jan	114.5	120.6	118.9	122.2	109.8
Feb	115.4	121.1	119.7	123.0	110.6
Mar	118.4	122.3	120.7	123.7	111.6
Apr	120.7	124.4	120.9	126.0	112.4
May	122.8	125.0	121.8	127.0	113.1
Jun	123.0	125.3	122.7	127.6	113.8
Jul	123.9	125.0	122.9	128.2	114.1
Aug	125.0	125.7	123.3	128.5	116.2
Sep	128.6	127.0	124.4	129.7	116.5
Oct	129.1	128.2	127.0	132.2	117.5
Nov	130.4	128.8	129.6	133.2	118.3
Dec	135.2	129.4	131.6	134.2	119.1
1974					
Jan	140.7	130.4	132.7	136.8	120.1
Feb	145.3	131.7	131.7	139.2	121.7
Mar	146.2	133.6	132.3	140.4	123.0
Apr	150.0	135.3	131.5	145.1	123.7
May	150.4	135.9	133.8	145.5	125.1
Jun	151.2	136.4	134.5	146.7	126.3
Jul	154.8	136.9	135.0	148.6	127.3
Aug	155.8	137.9	136.3	149.0	128.9
Sep	158.2	140.1	138.5	150.6	130.4
Oct	161.7	141.9	139.4	153.6	131.6
Nov	162.9	143.0	141.3	156.1	132.7
Dec	163.6	143.5	141.5	158.6	133.6
1975					
Jan	164.4	144.9	142.3	162.8	134.2
Feb	165.0	145.3	142.8	165.5	135.2
Mar	166.5	147.4	143.3	168.6	135.7
Apr	170.1	149.2	143.7	174.8	136.4
May	171.4	150.1	144.7	182.1	137.0
Jun	171.4	150.4	145.3	185.2	138.1
Jul	171.9	151.3	145.0	187.1	139.6
Aug	171.7	152.7	145.4	188.7	140.0
Sep	174.6	154.6	146.0	190.3	140.7
Oct	177.4	156.0	146.1	192.9	141.5
Nov	176.4	156.4	146.6	195.2	142.4
Dec	176.3	156.7	146.4	197.4	143.0

TABLE X--Continued

Year	Japan	Nether-lands	Switzer-land	United Kingdom	United States
1976					
Jan	179.4	157.5	147.2	199.4	143.3
Feb	180.6	159.0	147.1	201.3	143.7
Mar	181.3	160.5	146.9	202.0	144.0
Apr	186.0	163.9	146.9	205.6	144.6
May	186.6	164.5	146.6	208.3	145.5
Jun	187.3	164.5	146.9	209.9	146.3
Jul	188.3	163.7	147.1	211.8	147.1
Aug	187.0	165.4	147.6	214.1	147.8
Sep	191.6	167.2	147.3	216.1	148.4
Oct	192.8	169.5	147.6	219.9	149.0
Nov	192.8	169.7	147.9	222.6	149.4
Dec	195.1	169.7	148.3	225.3	149.9
1977					
Jan	196.8	169.5	148.5	230.9	150.7
Feb	197.8	170.8	148.6	233.0	152.3
Mar	199.0	177.2	148.4	235.5	153.2
Apr	202.3	175.1	148.5	241.4	154.4
May	204.1	176.0	148.4	243.8	155.3
Jun	203.3	176.4	149.4	246.4	156.3
Jul	202.8	176.1	149.5	247.9	157.0
Aug	203.1	176.7	149.5	249.8	157.6
Sep	206.4	177.8	149.6	251.5	158.2
Oct	207.6	187.6	150.0	253.0	158.6
Nov	205.3	179.0	149.8	254.2	159.4
Dec	204.8	178.4	149.7	255.3	160.0
1978					
Jan	205.7	177.8	150.0	256.9	160.9
Feb	206.7	178.5	150.2	258.6	162.0
Mar	208.6	180.0	150.3	259.9	163.1
Apr	210.6	181.3	150.6	263.4	164.0
May	212.2	181.6	150.7	264.9	166.2
Jun	211.2	181.4	151.0	266.5	168.0
Jul	212.0	182.8	151.0	268.5	169.1
Aug	212.4	183.7	151.2	270.7	169.9
Sep	214.8	185.0	150.7	272.1	171.2

TABLE XI

INTEREST RATES

Year	Belgium	Canada	France	Germany	Italy
1973					
Jan	.0510	.0390	.075	.0475	.0672
Feb	.0520	.0399	.075	.0475	.0666
Mar	.0520	.0446	.075	.0475	.0670
Apr	.0520	.0490	.075	.0475	.0668
May	.0525	.0518	.075	.0575	.0676
Jun	.0570	.0548	.075	.0675	.0692
Jul	.0655	.0774	.085	.0700	.0687
Aug	.0685	.0618	.095	.0700	.0688
Sep	.0735	.0650	.110	.0700	.0688
Oct	.0765	.0651	.110	.0700	.0697
Nov	.0765	.0643	.110	.0700	.0704
Dec	.0765	.0635	.110	.0700	.0706
1974					
Jan	.0765	.0622	.110	.0700	.0698
Feb	.0850	.0607	.110	.0700	.0705
Mar	.0900	.0651	.110	.0700	.0757
Apr	.0940	.0764	.110	.0563	.0783
May	.1000	.0863	.110	.0563	.0861
Jun	.1125	.0875	.130	.0563	.0933
Jul	.1175	.0910	.130	.0563	.0985
Aug	.1175	.0911	.130	.0563	.0994
Sep	.1175	.0894	.130	.0563	.1026
Oct	.1125	.0831	.130	.0563	.1083
Nov	.1075	.0749	.130	.0563	.1073
Dec	.1050	.0712	.130	.0563	.1078
1975					
Jan	.0950	.0640	.120	.0513	.1057
Feb	.0850	.0626	.110	.0463	.1024
Mar	.0730	.0633	.110	.0338	.1016
Apr	.0715	.0685	.100	.0338	.1035
May	.0660	.0687	.100	.0338	.1022
Jun	.0600	.0699	.095	.0338	.0998
Jul	.0625	.0744	.095	.0338	.0985
Aug	.0605	.0787	.095	.0338	.1040
Sep	.0605	.0841	.080	.0313	.1021
Oct	.0605	.0816	.080	.0313	.0986
Nov	.0605	.0852	.080	.0313	.0962
Dec	.0605	.0864	.080	.0313	.0965

TABLE XI--Continued

Year	Belgium	Canada	France	Germany	Italy
1976					
Jan	.0605	.0860	.080	.0313	.0966
Feb	.0640	.0875	.080	.0313	.1012
Mar	.0900	.0905	.080	.0313	.1098
Apr	.0925	.0899	.080	.0313	.1166
May	.0950	.0890	.080	.0313	.1238
Jun	.0900	.0898	.080	.0313	.1334
Jul	.1000	.0907	.095	.0315	.1292
Aug	.1150	.0913	.095	.0315	.1290
Sep	.1300	.0911	.105	.0315	.1316
Oct	.1350	.0901	.105	.0315	.1405
Nov	.1150	.0859	.105	.0315	.1423
Dec	.1000	.0814	.105	.0315	.1439
1977					
Jan	.0825	.0804	.105	.0315	.1467
Feb	.0750	.0765	.105	.0315	.1498
Mar	.0725	.0754	.105	.0315	.1511
Apr	.0725	.0758	.105	.0315	.1537
May	.0700	.0705	.105	.0315	.1518
Jun	.0675	.0707	.105	.0315	.1516
Jul	.0665	.0714	.105	.0315	.1505
Aug	.0625	.0714	.105	.0315	.1499
Sep	.0625	.0710	.095	.0315	.1444
Oct	.0625	.0724	.095	.0315	.1421
Nov	.0625	.0726	.095	.0315	.1386
Dec	.0925	.0717	.095	.0265	.1354
1978					
Jan	.0775	.0713	.095	.0265	.1353
Feb	.0675	.0730	.095	.0265	.1338
Mar	.0575	.0775	.095	.0265	.1337
Apr	.0560	.0819	.095	.0265	.1325
May	.0560	.0820	.095	.0265	.1316
Jun	.0575	.0826	.095	.0265	.1304
Jul	.0635	.0866	.095	.0265	.1316
Aug	.0700	.0880	.095	.0265	.1319
Sep	.0750	.0917	.095	.0265	.1291

TABLE XI--Continued

Year	Japan	Nether-lands	Switzer-land	United Kingdom	United States
1973					
Jan	.0415	.0316	.045	.0813	.0569
Feb	.0415	.0233	.045	.0806	.0581
Mar	.0415	.0153	.045	.0794	.0553
Apr	.0491	.0122	.045	.0767	.0628
May	.0555	.0290	.045	.0720	.0669
Jun	.0555	.0359	.045	.0696	.0799
Jul	.0555	.0558	.045	.1089	.0832
Aug	.0555	.0593	.045	.1097	.0878
Sep	.0580	.0564	.045	.1094	.0715
Oct	.0580	.0525	.045	.1067	.0810
Nov	.0580	.0529	.045	.1245	.0736
Dec	.0683	.0641	.045	.1242	.0741
1974					
Jan	.0683	.0650	.055	.1203	.0695
Feb	.0683	.0650	.055	.1182	.0768
Mar	.0683	.0600	.055	.1198	.0836
Apr	.0683	.0664	.055	.1148	.0891
May	.0683	.0704	.055	.1121	.0830
Jun	.0683	.0700	.055	.1124	.0781
Jul	.0683	.0746	.055	.1119	.0851
Aug	.0683	.0750	.055	.1125	.0917
Sep	.0683	.0739	.055	.1098	.0639
Oct	.0683	.0730	.055	.1089	.0788
Nov	.0683	.0672	.055	.1098	.0752
Dec	.0683	.0669	.055	.1099	.0711
1975					
Jan	.0683	.0661	.055	.1026	.0567
Feb	.0683	.0656	.055	.0977	.0564
Mar	.0683	.0595	.050	.0937	.0556
Apr	.0683	.0516	.050	.0924	.0536
May	.0683	.0364	.045	.0945	.0526
Jun	.0631	.0276	.045	.0948	.0601
Jul	.0631	.0298	.045	.1044	.0646
Aug	.0606	.0289	.040	.1038	.0636
Sep	.0606	.0268	.035	.1048	.0655
Oct	.0568	.0428	.030	.1141	.0560
Nov	.0568	.0466	.030	.1099	.0552
Dec	.0568	.0488	.030	.1064	.0523

TABLE XI--Continued

Year	Japan	Nether-lands	Switzer-land	United Kingdom	United States
1976					
Jan	.0568	.0454	.025	.0930	.0481
Feb	.0568	.0286	.025	.0862	.0526
Mar	.0568	.0255	.025	.0842	.0496
Apr	.0568	.0297	.025	.0994	.0492
May	.0568	.0362	.025	.1100	.0558
Jun	.0568	.0568	.020	.1099	.0537
Jul	.0568	.0694	.020	.1087	.0519
Aug	.0568	.0927	.020	.1094	.0509
Sep	.0568	.0943	.020	.1235	.0493
Oct	.0568	.0856	.020	.1443	.0447
Nov	.0568	.0731	.020	.1403	.0441
Dec	.0568	.0561	.020	.1351	.0472
1977					
Jan	.0568	.0534	.020	.1174	.0471
Feb	.0568	.0540	.020	.1078	.0459
Mar	.0555	.0520	.020	.0935	.0481
Apr	.0491	.0446	.020	.0750	.0499
May	.0491	.0239	.020	.0743	.0496
Jun	.0491	.0218	.020	.0746	.0516
Jul	.0491	.0245	.015	.0730	.0557
Aug	.0491	.0266	.015	.0642	.0598
Sep	.0415	.0349	.015	.0530	.0628
Oct	.0415	.0391	.015	.0448	.0606
Nov	.0415	.0441	.015	.0643	.0614
Dec	.0415	.0450	.015	.0629	.0644
1978					
Jan	.0415	.0419	.015	.0577	.0643
Feb	.0415	.0448	.010	.0598	.0631
Mar	.0339	.0457	.010	.0599	.0629
Apr	.0339	.0406	.010	.0699	.0666
May	.0339	.0382	.010	.0848	.0697
Jun	.0339	.0376	.010	.0927	.0689
Jul	.0339	.0396	.010	.0911	.0732
Aug	.0339	.0507	.010	.0883	.0811
Sep	.0339	.0568	.010	.0917	.0845

TABLE XII

INDUSTRIAL PRODUCTION INDICES
(BASE 1970 = 100)

Year	Belgium	Canada	France	Germany	Italy
1973					
Jan	111	114.8	126	104	98
Feb	117	121.6	128	114	102
Mar	118	123.1	130	113	107
Apr	120	123.0	125	120	115
May	118	122.0	129	116	119
Jun	119	126.1	128	119	123
Jul	85	112.5	110	101	118
Aug	111	112.1	80	100	76
Sep	121	123.1	123	118	123
Oct	120	125.9	132	117	126
Nov	126	124.2	132	125	125
Dec	119	119.9	127	119	119
1974					
Jan	124	115.3	130	107	121
Feb	129	119.6	132	115	121
Mar	128	120.7	130	116	124
Apr	130	124.2	130	120	129
May	129	126.6	130	118	127
Jun	136	125.7	130	124	130
Jul	90	118.5	81	102	122
Aug	111	118.6	127	98	74
Sep	128	145.8	125	112	129
Oct	124	124.4	125	113	122
Nov	130	124.4	121	120	115
Dec	114	120.3	122	108	106
1975					
Jan	113	113.5	119	98	108
Feb	116	118.1	122	105	115
Mar	118	117.5	119	110	111
Apr	118	123.0	118	105	113
May	112	123.6	112	110	108
Jun	114	122.7	117	107	114
Jul	77	116.8	99	90	109
Aug	96	117.5	68	91	114
Sep	110	148.7	112	104	115
Oct	113	122.8	117	108	114
Nov	120	124.6	120	120	118
Dec	105	123.6	124	111	107

TABLE XII--Continued

Year	Belgium	Canada	France	Germany	Italy
1976					
Jan	112	119.2	125	104	110
Feb	120	123.6	128	113	121
Mar	119	125.5	129	111	122
Apr	127	132.7	128	118	124
May	123	133.7	126	117	130
Jun	127	132.1	129	119	129
Jul	85	126.1	111	99	123
Aug	108	127.4	77	98	70
Sep	127	154.7	130	114	134
Oct	130	131.6	129	120	128
Nov	130	133.1	135	124	135
Dec	125	131.6	133	114	128
1977					
Jan	119	126.2	135	112	130
Feb	123	129.7	136	117	133
Mar	124	130.7	137	115	130
Apr	127	136.1	131	117	129
May	126	137.3	127	119	130
Jun	124	136.9	134	121	124
Jul	83	130.8	109	101	118
Aug	109	132.7	79	99	118
Sep	120	157.1	126	117	129
Oct	121	137.4	129	122	125
Nov	126	138.8	135	127	124
Dec	125	135.1	130	120	112
1978					
Jan	114	127.3	132	113	119
Feb	121	133.3	134	118	125
Mar	123	133.2	126	119	125
Apr	125	141.4	137	123	125
May	124	140.4	131	121	128
Jun	118	142.7	131	120	130
Jul	90	133.6	113	105	123
Aug	109	135.4	81	101	71
Sep	127	153.4	131	123	115

TABLE XII--Continued

Year	Japan	Nether-lands	Switzer-land	United Kingdom	United States
1973					
Jan	114	125	106	109	110
Feb	120	129	106	115	114
Mar	134	126	106	119	117
Apr	126	128	108	108	117
May	125	123	108	112	118
Jun	132	117	109	112	121
Jul	132	101	108	100	115
Aug	126	112	108	98	119
Sep	135	121	107	114	123
Oct	136	133	112	116	123
Nov	137	138	112	119	120
Dec	138	137	116	106	115
1974					
Jan	124	134	113	98	115
Feb	131	126	113	104	117
Mar	139	126	110	112	117
Apr	129	124	113	107	117
May	128	123	113	111	119
Jun	129	121	115	111	122
Jul	130	101	112	101	115
Aug	119	113	112	97	118
Sep	126	121	108	112	122
Oct	124	129	110	115	120
Nov	120	131	110	117	114
Dec	118	122	111	104	107
1975					
Jan	98	116	101	105	104
Feb	102	120	101	112	105
Mar	111	122	90	111	104
Apr	108	117	93	105	103
May	107	114	93	102	104
Jun	113	112	96	101	107
Jul	115	88	95	92	103
Aug	107	101	95	86	108
Sep	117	113	94	103	113
Oct	116	120	102	107	112
Nov	114	133	102	110	110
Dec	118	131	110	99	108

TABLE XII--Continued

Year	Japan	Nether-lands	Switzer-land	United Kingdom	United States
1976					
Jan	106	123	100	100	113
Feb	115	128	100	108	119
Mar	128	128	90	111	119
Apr	125	127	94	102	119
May	122	123	94	107	120
Jun	128	122	98	102	124
Jul	132	98	96	95	117
Aug	122	111	96	89	122
Sep	131	126	94	107	125
Oct	130	134	95	112	124
Nov	131	138	95	115	123
Dec	133	140	95	105	119
1977					
Jan	118	130	96	106	119
Feb	124	131	96	112	124
Mar	137	126	96	116	126
Apr	132	132	100	110	126
May	127	135	100	109	127
Jun	134	126	104	100	131
Jul	134	123	103	96	124
Aug	125	101	102	91	128
Sep	135	112	101	108	132
Oct	133	124	107	110	132
Nov	130	133	107	113	129
Dec	133	136	113	104	125
1978					
Jan	118	141	107	106	125
Feb	125	128	106	114	130
Mar	140	133	100	111	131
Apr	134	132	105	110	133
May	131	133	105	112	134
Jun	136	124	110	114	138
Jul	138	127	106	105	132
Aug	131	102	106	100	136
Sep	142	133	109	116	141

APPENDIX B

FUNDAMENTAL ECONOMIC VARIABLES FOR NINE NATIONS, FEBRUARY 1973-OCTOBER 1978

TABLE XIII

FUNDAMENTAL ECONOMIC VARIABLES (MONTHLY DATA, (FEBRUARY 1973-OCTOBER 1978)

Country	Constant	CP_D	CP_F	IR_D	IR_F	Y_D	Y_F	SEE	F	R^2	D-W
Belgium	62.137 (1.86)	-1.554 (-1.6)	3.118 (2.55)	-1.126 (-1.32)	3.86 (1.57)	.0093 (.579)	-.157 (-.517)	13.86	18.24	.638	.884
Canada	112.89	-.88 (-3.97)*	.737 (2.75)*	179.16 (8.1)*	-141.9 (-6.86)*	-.042 (-1.14)	.0897 (1.76)	1.73	79	.88	1.04
France	238.4	-.683 (-.61)	1.22 (.77)	-559 (-5.25)*	928.6 (4.26)*	-.076 (-.91)	-.67 (2.35)*	10.25	9.22	.471	.62
Germany	24.24	-.58 (-2.32)*	.63 (3.94)	79.34 (1.82)	63.52 (1.76)	.0503 (1.45)	-.043 (.926)	2.03	33.53	.764	.51
Italy	33.37	.0309 (2.67)*	-.138 (-4.70)	-27.93 (-8.61)*	53.43 (6.766)*	-.0018 (-.44)	-.539 (4.05)*	.52	212	.953	.81
Japan	-349	-5.53 (-6.29)*	10.76 (6.85)	-456.4 (-.99)	903.03 (3.84)*	.517 (1.65)	.501 (.93)	15.54	96.67	.90	.83
Nether-lands	7.78 (1.99)	-.245 (-1.93)	.450 (3.32)	.002 (.016)	.589 (1.74)	.0284 (1.27)	-.008 (-.182)	1.81	27.48	.727	.553
Switzer-land	91.8 (5.83)*	-1.021 (-7.8)*	.9601 (9.6)	-1.151 (-1.72)	3.481 (5.61)*	-.2031 (-2.96)*	-.333 (-4.703)*	2.21	119.3	.9203	.957
United Kingdom	241.3	-.815 (-4.3)*	1.173 (2.53)	-415.7 (-8.32)*	807.98 (7.29)*	.535 (3.79)*	-.902 (4.42)*	7.06	186.6	.947	1.003

t-statistics in parentheses.
* statistically significant at the .05 level.

TABLE XIV

FUNDAMENTAL ECONOMIC VARIABLES IN RATIO FORM
(MONTHLY DATA, FEBRUARY 1973-OCTOBER 1978)

Country	Constant	CP_r	I_r	Y_r	SEE	F	R^2	D-W
Belgium	-35.6 (-.4)	318.8 (4.3)*	-16.61 (-2.85)*	-15.98 (-.684)	18.47	9	.297	.41
Canada	327.99 (25.36)*	-221.4 (-19.498)*	7.71 (9.58)*	-9.53 (-2.39)*	1.89	128.8	.858	.873
France	317.86 (8.76)*	-50.22 (-1.612)	-26.99 (-4.111)*	-2.16 (-.21)	11.28	10.15	.322	.336
Germany	104.55 (10.86)*	-62.36 (-5.37)*	-.929 (-.319)	-2.097 (-.445)	2.48	31.44	.596	.295
Italy	27.81 (25.65)*	-7.33 (-8.1)*	-2.37 (-5.29)*	-.585 (-.873)	.74	188.8	.899	.284
Japan	447.8 (3.95)*	152.35 (2.83)*	-170.2 (-12.0)*	-108.2 (-1.68)	26.37	52.33	.7104	.549
Nether-lands	45.8 (2.122)*	2.47 (.128)	.28 (.251)	-9.04 (-2.422)*	3.12	1.98	.085	.19
Switzer-land	171.93 (11.33)*	-150.1 (-8.64)*	6.97 (1.425)	19.14 (2.57)*	3.01	112.5	.841	.344
United Kingdom	347.3 (18.56)*	-124.4 (-20.34)*	-20.28 (-11.01)*	69.7 (4.78)*	7.47	326.8	.938	.835

t-statistics in parentheses.
* statistically significant at the .05 level.

TABLE XV

FUNDAMENTAL ECONOMIC VARIABLES IN RATIO FORM WITH DUMMY VARIABLES FOR SEASONAL EFFECTS AND TIME TREND (MONTHLY DATA, FEBRUARY 1973-OCTOBER 1978)

Country	Constant	CP_r	I_r	Y_r	Q_1	Q_2	Q_3	T	SEE	F	R^2	D-W
Belgium	685.4 (5.88)*	-448 (-4.02)*	-2.66 (-.55)	17.65 (.704)	5.087 (1.067)	6.84 (.144)	2.78 (.464)	1.53 (8.04)*	13.22	16.8	.662	.91
Canada	229.32	8.47 (10.62)*	-7.01 (-1.71)	-125.7 (-3.59)*	-.0099 (.000)	.513 (.82)	.247 (.39)	-.124 (-2.94)*	1.79	63.16	.879	.92
France	1018	-20.35 (-3.08)*	9.51 (.62)	-756.6 (-3.67)*	.07 (.000)	4.15 (1.08)	4.11 (.82)	1.80 (3.53)*	10.74	6.54	.428	.54
Germany	108.62	-67.79 (-1.85)	1.035 (.29)	-3.09 (.38)	.53 (.54)	1.20 (1.19)	.087 (.06)	.0095 (.11)	2.58	14.54	.625	.33
Italy	14.82	-1.60 (-10.1)*	.293 (.50)	3.57 (1.55)	-.11 (-.57)	-.0152 (-.07)	.0015 (.00)	-.097 (4.77)*	.54	165.2	.949	.60
Japan	887.13	-75.0 (-4.94)*	67.23 (1.40)	-516.5 (-5.75)*	10.27 (1.53)	16.4 (2.5)*	8.02 (1.24)	2.92 (8.66)*	18.04	59.33	.87	.54
Nether-lands	48.5 (2.31)*	2.40 (.40)	.22 (.22)	-6.3 (-2.31)*	4.01 (.99)	3.61 (.16)	1.77 (.32)	1.41 (2.01)*	3.4	7.02	.12	.32
Switzer-land	159.3 (4.83)*	-140.0 (-4.7)*	6.67 (1.19)	20.37 (2.43)*	.925 (.769)	-.04 (-.035)	.363 (.297)	.033 (.433)	3.07	46.35	.844	.329
United Kingdom	375.33	-172.5 (-7.04)*	-18.83 (-10.45)*	85.66 (4.70)*	2.41 (.97)	3.85 (1.48)	5.56 (1.85)	.49 (2.23)*	6.97	164.5	.949	1.03

t-statistics in parentheses.
* statistically significant at the .05 level.

TABLE XVI

FUNDAMENTAL ECONOMIC VARIABLES IN RATIO FORM, CORRECTED FOR AUTOCORRELATION
(MONTHLY DATA, FEBRUARY 1973-OCTOBER 1978)

Country	Constant	CP_r	I_r	Y_r	SEE	F	R^2	D-W	Coeff. of Autocorr.
Belgium	43.17 (1.46)	115.06 (1.096)	.325 (.05)	-15.44 (1.107)	10.91	.87	.0393	1.80	.74
Canada	97.14 (12.3)*	-184.4 (-8.29)*	3.7 (2.96)*	-1.37 (-.524)	1.457	23.13	.524	1.63	.50 .32
France	56.93 (3.62)*	-71.14 (-.907)	-13.28 (-1.58)	3.78 (.65)	6.32	1.49	.065	1.632	.82
Germany	14.22 (4.65)*	-44.42 (-2.31)*	-.875 (-.477)	2.4 (.909)	1.31	2.29	.097	1.411	.83
Italy	3.92 (12.50)*	-7.42 (-4.11)*	-1.51 (-2.13)*	-.143 (-.541)	.371	14.8	.409	1.702	.85
Japan	63.4 (2.75)*	28.18 (.27)	-42.0 (-2.67)*	15.17 (.709)	12.95	2.82	.118	1.20	.68 .45
Nether-lands	5.07 (1.99)	1.45 (.081)	.263 (.303)	.196 (.099)	1.19	.04	.002	1.482	.87
Switzer-land	35.82 (8.21)*	-104.1 (-5.38)*	-4.13 (-.771)	5.53 (1.038)	1.676	29.98	.584	1.058	.75
United Kingdom	158.5 (18.35)*	-128.8 (-13.53)*	-15.62 (-5.94)*	31.95 (2.27)*	5.72	88.76	.806	1.73	.583

t-statistics in parentheses.
* statistically significant at the .05 level.

APPENDIX C

PURCHASING POWER DOCTRINE TESTS FOR NINE NATIONS

TABLE XVII

ONE-VARIABLE PURCHASING POWER DOCTRINE TEST (MONTHLY DATA, FEBRUARY 1973-NOVEMBER 1978)

Country	Constant	$LogCP_r$	SEE	F	R^2	D-W
Belgium	2.40 (259.04)*	.94 (3.704)*	.031	13.72	.172	.323
Canada	2.019 (633)*	-1.85 (-10.87)*	.0135	118.16	.645	.191
France	2.359 (297.9)*	-.505 (-3.28)*	.0247	10.76	.14	.234
Germany	1.59 (442.37)*	-1.54 (-10.11)*	.024	102.11	.607	.321
Italy	1.26 (189.09)*	-1.075 (-20.95)*	.259	438.83	.869	.196
Japan	2.56 (108.2)*	.0077 (.305)	.0517	.09	.0014	.046
Nether-lands	1.59 (69.5)*	.162 (.303)	.035	.09	.0014	.128
Switzer-land	1.607 (439.4)*	-2.56 (-18.87)*	.0296	355.87	.84	.250
United Kingdom	2.44 (306.64)*	-.93 (-16.77)*	.0027	281.14	.81	.223

t-statistics in parentheses
* statistically significant at the .05 level.

TABLE XVIII

ONE-VARIABLE PURCHASING POWER DOCTRINE TEST, CORRECTED FOR AUTOCORRELATION
(MONTHLY DATA, FEBRUARY 1973-NOVEMBER 1978)

Country	Constant	$LogCP_r$	SEE	F	R^2	D-W	Coeff of. Autocorr.
Belgium	.534 (135.3)*	.43 (.966)	.0176	.93	.014	2.13	.78
Canada	.3417 (267.5)*	-1.49 (-4.334)*	.006	18.78	.224	1.443	.83
France	.331 (86.04)*	-.468 (-.971)	.0125	.94	.014	1.59	.86
Germany	.274 (126.5)*	-.914 (-2.14)*	.0138	4.58	.065	1.401	.83
Italy	1.49 (48.05)*	-.914 (-5.28)*	.0113	27.86	.297	1.73	.88
Japan	.937 (121.05)*	.173 (.812)	.016	22.84	.5170	1.35	.63
Nether-lands	.193 (64.7)*	.0943 (1.85)	.0132	.03	.0005	1.57	.88
Switzer-land	.259 (135.34)*	-2.31 (-6.52)*	.0157	42.44	.39	1.51	.84
United Kingdom	.262 (93.2)*	-.382 (-2.58)*	.0115	6.65	.0916	1.375	.889

t-statistics in parentheses.
* statistically significant at the .05 level.

TABLE XIX

THREE-VARIABLE PURCHASING POWER DOCTRINE TEST (MONTHLY DATA, FEBRUARY 1973-NOVEMBER 1978)

Country	Constant	$LogCP_r$	$LogI_r$	$LogY_r$	SEE	F	R^2	D-W
Belgium	2.397 (276.65)*	1.289 (4.44)*	-.0902 (-2.89)*	.040 (-.52)	.0287	9.33	.304	.47
Canada	2.02 (738)*	-2.50 (-18.3)*	.1064 (8.89)*	-.132 (-2.63)*	.00904	114.74	.845	.83
France	2.38 (251.6)*	-.249 (-1.59)	-.204 (-4.26)*	-.0094 (-.23)	.022	10.68	.33	.339
Germany	1.58 (224.45)*	-1.33 (-4.87)*	-.0415 (-.919)	-.103 (-.134)	.0248	33.77	.613	.334
Italy	1.26 (212.6)*	-.726 (-7.82)*	-.24 (-4.43)*	-.0275 (-.74)	.0227	196.45	.902	.266
Japan	2.51 (173.47)*	.337 (2.82)*	-.364 (-15.96)*	-.173 (-1.26)	.027	91.47	.81	.54
Nether-lands	1.596 (70.37)*	.1057 (.205)	.0257 (1.148)	-.239 (-2.63)*	.0334	2.49	.105	.213
Switzer-land	1.62 (69.8)*	-2.706 (-5.58)*	-.022 (-.44)	.314 (2.3)*	.0288	126.5	.856	.286
United Kingdom	2.466 (397.14)*	-.836 (-18.79)*	-.155 (-9.2)*	.311 (4.39)*	.0178	245.34	.92	.775

t-statistics in parentheses.
* statistically significant at the .05 level.

TABLE XX

THREE-VARIABLE PURCHASING POWER DOCTRINE TEST, CORRECTED FOR AUTOCORRELATION
(MONTHLY DATA, FEBRUARY 1973-NOVEMBER 1978)

Country	Constant	$LogCP_r$	$LogI_r$	$LogY_r$	SEE	F	R^2	D-W	Coeff. of Autocorr.
Belgium	.702 (155.3)*	.519 (1.25)	.00175 (.048)	-.057 (-1.22)	.01807	1.12	.049	1.82	.71
Canada	.726 (443)*	-2.07 (-8.6)*	.047 (3.00)*	-.019 (-.603)	.0067	24.83	.542	1.45	.52 .25
France	.428 (102.38)*	-.394 (-.992)	-.101 (-1.7)	.0128 (.604)	.0124	1.68	.073	1.66	.82
Germany	.289 (124.6)*	-.943 (-2.1)*	-.0183 (-.544)	.06 (.993)	.0139	2.25	.095	1.42	.82
Italy	.175 (56.73)*	-.728 (-4.01)*	-.171 (-2.08)*	-.007 (-.52)	.0111	14.65	.407	1.73	.86
Japan	.665 (97.5)*	.239 (.903)	-.19 (-5.64)*	.0052 (.077)	.0147	10.75	.338	1.47	.63 .29
Nether-lands	.225 (65.59)*	.0702 (.135)	.0137 (.825)	-.00447 (-.09)	.01339	.24	.011	1.49	.86
Switzer-land	.284 (67.56)*	-1.64 (-3.37)	-.111 (-2.178)*	.103 (1.045)	.0153	20.17	.486	1.36	.82
United Kingdom	.949 (226.4)*	-.84 (-12.1)*	-.106 (-4.7)*	.105 (1.67)	.0128	63.27	.75	1.662	.61

t-statistics in parentheses.
* statistically significant at the .05 level.

APPENDIX D

COEFFICIENT OF EXPECTATION EQUATIONS FOR NINE NATIONS

TABLE XXI

COEFFICIENT OF EXPECTATION EQUATION: THREE VARIABLES
(MONTHLY DATA, 1973-1978)

Country	Constant	EX_{t-1}	CP_t	CP_{t-1}	SEE	F	R^2	D-W
Belgium	-9.119 (-.239)	.86209 (12.375)*	38.63 (.318)	5.678 (.046)	10.55	70.92	.769	2.319
Canada	22.738 (1.436)	.953 (17.547)*	-20.56 (-.496)	2.1815 (.066)	1.2127	344.05	.9416	2.114
France	45.719 (1.681)	.857 (13.5)*	-43.54 (-.228)	30.76 (.161)	6.46	74.52	.777	1.568
Germany	12.60 (1.645)	.8902 (13.617)*	39.67 (1.041)	-47.57 (-1.266)	1.259	183.05	.8960	1.356
Italy	1.505 (.772)	.9319 (14.06)*	-10.60 (-1.65)	10.18 (1.69)	.373	804.91	.9742	1.854
Japan	-20.82 (-.849)	1.055 (35.85)*	-211.3 (-1.93)	214.7 (2.055)*	10.40	452.2	.955	1.711
Nether-lands	.979 (.12)	.935 (20.59)*	3.65 (.205)	-2.047 (-.114)	1.180	144.14	.8711	1.603
Switzer-land	12.26 (1.32)	.969 (15.87)*	-10.86 (-.348)	.463 (.015)	1.46	543.99	.962	1.53
United Kingdom	17.83 (.831)	.948 (18.45)*	-74.6 (-1.35)	6.93 (1.272)	4.98	757.6	.973	1.44

t-statistics in parentheses
* statistically significant at the .05 level.

TABLE XXII

COEFFICIENT OF EXPECTATION EQUATION: TWO VARIABLES
(MONTHLY DATA, 1973-1978)

Country	Constant	EX_{t-1}	$CP_t - CP_{t-1}$	SEE	F	R^2	D-W
Belgium	29.55 (1.728)	.89606 (14.216)*	25.727 (.212)	10.58	105.28	.7641	2.358
Canada	-2.717 (-.858)	1.0256 (31.67)*	-18.5 (-.441)	1.228	501.71	.9392	2.177
France	27.63 (2.163)*	.875 (14.91)*	-40.35 (-.212)	6.44	112.24	.7755	1.585
Germany	1.207 (.733)	.970 (18.21)*	63.56 (1.722)	1.188	167.57	.839	.1880
Italy	.472 (1.546)	.965 (46.8)*	-8.68 (-1.64)	.371	1220.6	.974	1.887
Japan	-16.57 (-1.53)	1.055 (36.13)*	-218.5 (-2.144)*	10.32	688.44	.955	1.713
Nether-lands	2.745 (1.547)	.936 (20.75)*	2.94 (.169)	1.1716	174.5	.8710	1.603
Switzer-land	-1.51 (-1.411)	1.055 (38.42)*	-10.12 (-.322)	1.477	799.76	.9609	1.616
United Kingdom	4.29 (.99)	.978 (47.84)*	-68.85 (-1.27)	4.95	1146.5	.972	1.48

t-statistics in parentheses
* statistically significant at the .05 level.

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