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THE COVERED INTEREST ARBITRAGE MARGIN: AN INVESTIGATION INTO THE RELEVANCE OF THE MODERN THEORY OF THE FORWARD FOREIGN EXCHANGE RATE

by

Philippe Callier
M.A., Facultés Universitaires de Namur, 1969

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
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The Covered Interest Arbitrage Margin: An Investigation Into the Relevance of the Modern Theory of the Forward Exchange Rate

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ABSTRACT

This thesis assesses the theoretical and empirical relevance of the "Modern Theory of the Forward Foreign Exchange Rate" which is the standard explanation of the covered interest arbitrage margin found in the textbooks of International Finance.

The theoretical part of the thesis consists of an exposition of the "Modern Theory" and of a discussion of its underlying assumptions. From a theoretical point of view, the relevance of the "Modern Theory" rests critically on the assumption that the difference between comparable interest rates in various countries do not equal the difference between the rates of appreciation or depreciation of the currencies of those countries on the foreign exchange markets. As such an inequality is contrary to the implications of the standard models depicting the relationships between those variables, we present an alternative model sketching the markets' interactions and the price adjustment mechanisms likely to yield a divergence between interest rate differentials and relative rates of appreciation or depreciation of currencies. Analyzing the experience of 12 industrialized countries during the period

1959-1977, we find several instances where the empirical evidence is consistent with the implications of our alternative model.

Having thus shown that the "Modern Theory" is not theoretically inconsistent with a more general economic model, we inquire whether it can account for the covered arbitrage margins on Treasury Bills between Canada and the U.S.A. and between the United Kingdom and the U.S.A. during the period 1959-1977. According to the "Modern Theory", the nonzero covered arbitrage margins are the result of speculation or of transactions costs. Using the technique of regression analysis, we find a significant effect of speculation on the forward exchange rate of the pound sterling under the parity regime, but no evidence of a significant effect of speculation is found in the case of the Canadian dollar nor in the case of the floating pound, despite the existence of large covered arbitrage margins. Transactions costs are found to have a significant effect on the covered arbitrage margins, but are of too small an order of magnitude to fully account for those margins. The empirical relevance of the Modern Theory thus appears limited to special cases, such as the case of the pound sterling under the parity regime.

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CHAPTER I: INTRODUCTION

Section 1: Topic and choice of the theoretical approach.

The topic of this dissertation is the covered arbitrage margin: Our project is to inquire why the yield of comparable assets denominated in different curriencies are sometimes still significantly unequal after the exchange risk has been covered on the foreign exchange market. This puzzling fact, apparent for example from a comparison of the interest differential between U.K. and U.S. 90-days Treasury Bills with the forward premium or discount on the Pound against the Dollar, is responsible of my undertaking this work(1).

Two theoretical approaches are presently available to provide in principle an explanation of the covered arbitrage margin. The first theoretical approach is the assets pricing model, which constitutes today's orthodoxy in the field of the pure theory of finance(2). The second approach is the so-called "Modern Theory of the Forward Exchange Rate", which has been devised specifically to explain the covered arbitrage margin but whose relevance is still questioned by some authors(3).

The model of the "Modern Theory" of the Forward Rate explains the forward exchange rate as the result of the interaction between covered interest arbitrage and speculation on the forward foreign exchange market in a partial equilibrium framework suitable to empirical investigation. The formal framework it provides can also be easily adapted to test the covered interest parity theorem, interpreted as a special case of the model, or to analyze the effects of transaction costs on the equilibrium forward foreign exchange rate.

The assets pricing model suggests that assets have different yields to the extent that the risk attached to their future price or to their return is not diversifiable, i.e. that their future price or their return are corrolated with the value or with the return of the so-called "market portfolio" composed of all existing assets. As a matter of pure logic, it is possible to extend this explanation to assets denominated in different currencies but covered on the forward foreign exchange market or to any other assets. Nevertheless, risk is not the dominant feature of the short-term assets usually involved in interest arbitrage transactions and, for that reason, the assets pricing model is inappropriate for our purpose.

We will thus organize our investigation within the framework of The "Modern Theory". This thesis is, in summary, a test of the empirical relevance of the Modern Theory of the Forward Exchange Rate.

Section 2: Survey of the thesis

Except for this introductory chapter and for the conclusions, the dissertation consists of 4 substantive chapters. Although those 4 chapters are arranged in a logical sequence, they are fairly self-contained and may be read separately, depending on the particular theme of interest of the reader. The necessary references to the literature are made in each chapter but I want to mention here that I have drawn heavily on the works by Dornbush(1976), McCallum(1977) and Frenkel and Levich(1975).

We have limited ourselves to arguments relevant to our subject, the explanation of non-zero covered arbitrage margins. This does not imply, however, that the relevance of the developments we present is limited to this narrow topic: They also deal with such themes as the relative role of changes in price levels and exchange rates in the adjustment process, the

measurement of expectations regarding future exchange rates or the nature and the order of magnitude of transaction costs on the foreign exchange markets. Our presentation of rather self-contained chapters makes those developments more accessible to readers who may be more interested in one or another of those themes than in the context in which the argument is presented, i.e. the explanation of the covered arbitrage margin by the "Modern Theory" of the Forward Foreign Exchange Rate.

The Modern Theory of the Forward Foreign Exchange Rate is not yet received as a component of the orthodoxy in the field of international finance. The two fundamental reasons which explain the controversial status of this theory are:

1. The lack of some broader macroeconomic model embodying the mechanisms and markets interactions likely to yield the discrepancies between the interest rate differential and the expected rate of appreciation or depreciation of a country's currency, discrepancies which are at the core of the "Modern Theory".
2. The lack of unanimity of the findings of the few empirical tests performed so far in the framework of that theory.

The content of this thesis, it is hoped, represents a contribution to the removal of these 2 obstacles.

The substantive part of the thesis begins with Chapter II, which presents in some details the model of the Modern Theory of the Forward Foreign Exchange Rate. We proceed then, in Chapter III, to remove the first obstacle to a wider acceptance of this theory: Taking as a reference Dornbusch's(1976) model of exchange rate dynamics, we show in the first section of that chapter that the discrepancy between the interest rate differential and the expected rate of appreciation of a currency may arise in the short run, even though long run interest rate differentials and relative rates of appreciation or depreciation of 2 currencies both equal the difference between expected rates of inflation in the relevant countries. This is in conformity with the traditional doctrine. The occurence of such discrepancies critically rests on the assumption that arbitrage between domestic real and financial assets takes place more quickly than arbitrage between domestic and foreign financial assets.

After having thus established the relevance of the Modern Theory as a logical possibility, we proceed, in the second section, to examine whether the empirical evidence is consistent with Dornbusch's original model or with the modified model we have introduced. We find several instances where the evidence is consistent with the pedictions of our model, suggesting that the Modern Theory approach is potentially appropriate to analyze the

short run equilibrium on the forward foreign exchange market. Simultaneously, several other instances are consistent with the adjustment process implicit in Dornbush's model, even during the era of parity rates.

After having thus shown that the convenient partial equilibrium framework of the Modern Theory is not inconsistent with a broader macroeconomic general equilibrium, we then proceed, in Chapter IV, to estimate the reduced form of the model on the basis of weekly data on the U.K. - U.S. and the Canada - U.S. pairs of 90-days Treasury Bills for the years 1960-1977, using the method applied by McCallum(1977) to Canada for the years 1953-1960. Given our very large number of observations, the conclusions based on the asymptotic properties of the estimating technique are especially reliable. In this test, we find that speculation played a significant role in the determination of the 90-day forward rate of the Pound Sterling during the parity exchange rate regime -- but we were unable to find any significant effect of speculation on the forward rate of the Canadian Dollar, or on the forward rate of the Pound during the recent period of floating exchange rate.

For the period of the floating Pound, we do observe, however, several instances when the covered arbitrage margin on the U.K. - U.S. Treasury Bills was as high as 4% per annum. We

inquire, in Chapter V, whether the introduction of transaction costs provides an explanation for those large deviations from interest parity. Following a method inspired by Frenkel and Levich's(1975) idea to use deviations from the triangular or geographic parity of the exchange rates, we estimate the transaction costs prevailing on the foreign exchange market at the relevant dates. Our findings show simultaneously that the order of magnitude of the transaction costs is too small to fully account for the observed extreme values of the covered arbitrage margin, but that the transaction costs did nevertheless play a statistically significant role in the determination of the covered arbitrage margin. The empirical evidence thus supports the idea that transaction costs cause deviations from covered interest parity, but also clearly indicates that they are an insufficient explanation of the large covered arbitrage margins we actually observe.

The last chapter highlights the conclusions.

Section 3: List of the original contributions to the literature

It is not uncommon for some readers of Ph.D. dissertations to be more interested in the novel contributions they contain than in the chain of arguments as a whole. To help those readers to focus on those aspects of my thesis, I list here the points which, to the best of my knowlege, present some originality.

Chapter II:

- This chapter is mainly an exposition of the Modern Theory as it is found in the literature, as for example in Grubel (1966). More original are the discussion of speculation on the future forward exchange rate (as opposed to the future spot rate) and the discussion of the assumption underlying the interpretation of the intercept of the speculative schedule as the "expected future spot (or forward) rate" in a multi-currency world providing opportunities for a diversified portfolio of speculative positions.

Chapter III:

1- We generalize Dornbusch's (1976) model by dropping the assumption of a zero long-run rate of growth of the money supply and a zero long-run rate of inflation. The model thus extended suggests an important distinction between expected and unexpected changes in the money supply.

2- We present, within the framework of this model, an alternative dynamic assumption concerning the asset markets: For Dornbusch's assumption of perfect arbitrage between domestic and foreign bonds, we substitute the assumption of perfect arbitrage between domestic real assets and bonds.

3- We devise an empirical test, based on the deviations from purchasing power parity predicted by Dornbusch's model and by our alternative model, to discriminate between them. We report results concerning 12 countries for the last years of the parity exchange rate regime and for the recent years of floating exchange rates.

Chapter IV:

1- We estimate the reduced form of the Modern Theory, using McCallum's (1977) procedure, for a very large sample of new data (Canada - U.S.A., 1960-1977), contrasting the periods of fixed and of floating exchange rates. We find that speculation played a significant role to determine the equilibrium forward rate of the Pound Sterling during the period of the parity regime.

2- We introduce speculation on the expected future 30-days forward rate as well as speculation on the spot exchange rate in the specification of the equations to be estimated.

3- We construct, from the information provided by our estimates, a series of weekly data of expected future spot and 30-day forward rates for the Pound Sterling for the period April 22, 1960 - June 23, 1972.

Chapter V:

1- We point out the possibility of applying Frenkel and Levich's (1975) procedure of estimating transaction costs to generate a time series of estimates of the transaction costs on the foreign exchange markets.

2- We argue that the transaction costs relevant to explain deviations from covered interest parity should exclude the component of the cost corresponding to the remuneration paid to the dealer as compensation for his bearing a foreign exchange risk, and we provide some empirical evidence supporting this argument.

FOOTNOTES OF CHAPTER I

(1) See Annex I.

(2) For an exposition of this model, see Mossin (1973).

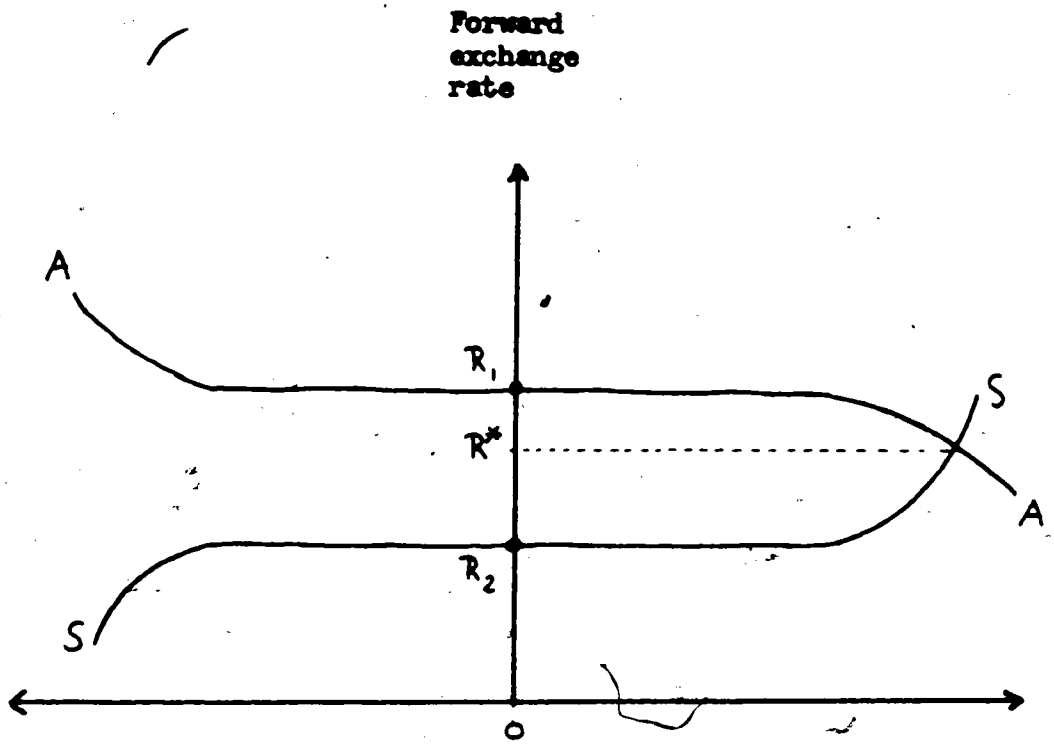
(3) For an exposition of this model and some empirical evidence supporting its relevance see Grubel (1966). For a criticism of this model, on theoretical grounds, see Prissert and Coulbois (1976). The empirical relevance of the model is also questioned by the papers of Aliber (1973) and Frenkel and Levich (1975 and 1977) and by the results obtained by McCallum (1977).

CHAPTER II: THE MODERN THEORY OF THE FORWARD EXCHANGE

The model we are testing in this thesis is the model of the "Modern Theory" of the Forward Exchange Rate. It is a partial equilibrium model of the forward exchange market according to which the equilibrium forward exchange rate obtains when the net demand of forward exchange for covered interest arbitrage purpose is exactly matched by the net supply of forward exchange for another purposes, mainly "speculation" (1). Figure 2-1 illustrates this equilibrium: The vertical axis measures the forward exchange rate, where the exchange rate is expressed as the price of one unit of foreign currency in terms the domestic currency, and the horizontal axis measures the net demand of foreign exchange for covered interest arbitrage purpose and the net supply for other purposes.

Section 1: Arbitrage - Discussion of the AA schecule.

The AA schedule represents the net stock demand of forward foreign exchange by the arbitragers: For the different levels of the forward rate, it indicates the amount of foreign



-Net demand of forward foreign exchange for covered arbitrage purposes : The AA schedule.

-Net supply of forward foreign exchange for other purposes (including speculation) : The SS schedule.

Figure 2-1

exchange the interest arbitragers commit themselves to purchase at the specified date to cover the exchange risk of holding assets denominated in domestic currency. For any given spot exchange rate and interest differential, the covered arbitrage margin in favour of assets denominated in the domestic currency increases when the price of the foreign exchange decreases on the forward market, inducing the interest arbitragers to increase their holdings of those assets and to increase their demand of foreign exchange on the forward market. The forward exchange rate R1 at which the net demand of forward contract by interest arbitragers is nil is usually interpreted in the literature as the rate corresponding to the interest parity. The extremities of the schedule are described as inelastic since (2):

1. The funds available for arbitrage purposes are limited, and the use of these funds meets rising opportunity costs.

2. Liquid funds denominated in various currencies and held in various financial centers yield non-pecuniary returns such as convenience and goodwill of various business partners. Those non-pecuniary services exhibit decreasing marginal returns.

3. As concentration of holdings of a given asset increases the risk attached to that portfolio by reducing portfolio diversification, a higher return is necessary to induce the economic actors to increase further their holdings of a given asset.

The risks involved in covered arbitrage belong to one of the following three categories:

1. Specific risk of holding a given asset; i.e., default risk. As interest arbitrage transactions typically involve either claims on governments denominated in their own currency or deposits in first ranking banks, this risk is usually negligible.

2. Specific risk of the forward exchange contract. This risk may actualize itself either as a result of the incapacity of the counterpart in the contract to meet his obligations or as a result of a government introducing regulations limiting or prohibiting foreign exchange transactions. The risk resulting from the incapacity of the counterpart to meet his obligations is reduced in the case of members of the public by the practice of banks to ask for a deposit covering the possible difference between the forward exchange rate and the future spot exchange rate before accepting an order from their customers. However,

this practice is not followed on the interbank foreign exchange market. Furthermore, in a regime of flexible exchange rates, exchange rate fluctuations may be wider than the deposit requirement covering a transaction on the forward market. Thus, this risk cannot be overlooked, in particular in a regime of flexible exchange rates. The risk arising from a possible introduction of exchange controls by the authorities is also serious, either in a regime of fixed exchange rates in which the authorities may prefer controls of short-term capital movements over alternative methods to maintain the stability of the exchange rate, or in a regime of flexible exchange rates in which the authorities may find it convenient to use controls to influence the evolution of the exchange rate and, for example, the domestic price level (3).

3. Risk related to the evolution of the interest rates and the price of the assets in the two countries. This risk is different from the two previous categories of risks: It consists of the impossibility to take advantage of a profitable opportunity, not in an actual loss. Its nature is thus similar to an opportunity cost rather than to a direct cost. Suppose an economic actor decides to hold assets in sterling and to sell forward the proceeds for dollars rather than to hold a comparable dollar denominated asset. Suppose further that, before maturity, the interest rate in London rises in such a

way that the price of sterling-denominated assets decreases. Since the actor under consideration is holding sterling assets, he is not able to take advantage of this reduced price. Had he held dollar assets, he would have been able to sell them before maturity, convert the proceeds to sterling and buy sterling-denominated assets at the reduced price. The expected return on such transactions may be high enough to induce economic actors to hold funds even in the financial center for which the covered arbitrage margin is negative and to diversify their holdings of covered short-term assets.

Of these three justifications of the inelasticity of some portions of the arbitrage schedule -- limitation to the availability of funds, non-pecuniary returns and risk -- the last two may provide a priori grounds for criticizing the traditional way of drawing the AA schedule so that it intersects the vertical axis at the forward rate corresponding to the interest parity. At the forward rate corresponding to interest parity, differences in non-pecuniary yields or in risk may still induce the arbitragers to express a net demand for covered assets denominated in various currencies. The traditional framework of the "Modern Theory" thus rests implicitly on the assumption that the positions arising from consideration of risk diversification or of differences in non-pecuniary yields by each individual actor offset each other

in the aggregate at the arbitragers' portfolio equilibrium corresponding to interest parity forward exchange. Once non-pecuniary yields and risk are introduced, the justification of this implicit assumption is ultimately the empirical judgement of the proponents of the Modern Theory rather than a theoretical argument. This assumption, which is usually not discussed explicitly, is essential to the interpretation of the tests of the theory which have been done so far.

Section 2: Speculation and Trade - Discussion of the SS Schedule

The SS schedule depicts the net stock supply of forward foreign exchange arising from transactions other than interest arbitrage. The shape of the schedule is best explained by first considering that those "other transactions" consist only of speculation on the future spot exchange rate (4). This simplifying assumption will be relaxed later.

A. Speculation on the Future Spot Rate

For a given level of the expected future spot rate, the higher the present forward exchange rate, the higher the

expected profit from a speculative position resulting from a sale of forward exchange combined with a future purchase of foreign exchange on the spot market and, consequently, the larger the speculative supply of forward foreign exchange. The SS schedule is thus upwards sloping. When the forward rate is equal to the corresponding spot rate expected to prevail in the future, no profit is expected from speculation in either direction and the net supply of speculative forward commitments is nil. The SS schedule intersects the vertical axis at a value of the forward exchange rate equal to the expected spot rate of the corresponding futher date.

As the AA schedule, the SS schedule is typically drawn with relatively inelastic extremities. The reasons for this inelasticity are different. To start with, the limited availability of funds argument does not apply to speculation. A forward sale or purchase of foreign exchange is a commitment to sell or buy foreign exchange at an agreed upon date in the future. As such, no payment is required at the time of the contract and, as far as the date of delivery is concerned, the proceeds of the forward sale or purchase are expected to be more than sufficient to enable the speculator to meet his obligations (5). There is thus, in principle, no absolute maximum to the total speculative supply or demand for forward foreign exchange.

The argument on the inelasticity of the extremities of the SS schecule rests on the risk implicit in speculation and on the psychological disposition of the speculators against risk. If the expected future spot rate is lower than the corresponding current forward rate, a speculator could always increase his expected future total wealth by increasing his sale forward of foreign exchange. However, by doing so, he would increase the risk attached to his future wealth if his expectations turn out to be wrong. The speculator is assumed to be risk-averter, in such a way that, when his speculative commitments -- and thus the risk attached to his future wealth -- increase, higher and higher speculative gains are necessary to induce him to increase them further. The inelasticity of the extremities of the SS schedule expresses this behaviour in a model of two currencies. If more than two currencies are introduced, the argument is reinforced by the fact that risk consideration will limit not only the global speculative commitments of each speculator, but also the share of each currency in the total speculative portfolio. When the share of a given currency becomes important, higher and higher expected gains on speculative transactions on that currency are necessary to induce the speculator to increase further the share of this currency in his speculative commitments and to accept the higher risk resulting from a less diversified portfolio.

This justification of the shape of the SS schedule, which is a necessary part of the Modern Theory of the Forward Exchange, also potentially provides the basis for a criticism of that theory in a world of multiple currencies. The portfolio diversificiation theory stresses the importance of the covariance of the returns on different assets for an efficient portfolio diversification. A positive covariance reduces the benefits of portfolio diversification, a negative covariance increases them. This consideration may justify speculators holding forward commitments in a currency even if the expected gains on those speculative commitments themselves are nil or even negative, if the unexpected deviations of the exchange rate of that currency from its expected value are generally in the opposite direction than those of another currency in which the speculator also holds commitments. Suppose, for example, that the exchange rate, in terms of the dollar, of the sterling pound and the German mark are known, or expected, to fluctuate generally in opposite directions around their expected values. Suppose further that the German mark is expected to appreciate by 4 percent within the next three months and the sterling to depreciate by 4 percent and that the premium on the three month forward mark is 6 percent, while the discount on the three month forward sterling is exactly 4 percent. By selling German marks forward, the speculator expects to gain the difference between the premium on the

forward mark and the rate of appreciation of the mark, i.e., 6% - 4% = 2%, and the speculator will thus be expected to sell some marks forward. Regarding the sterling pound, however, there is no speculative gains expected from either selling or buying it forward as the discount on the three month forward sterling exactly matches the expected depreciation of the sterling. Here appears the potential contradiction between the "Modern Theory" of the Forward Exchange and the Portfolio Theory. The principles of Portfolio Theory imply that, by buying sterling forward, the speculator can reduce the risk of his overall speculative position without any cost in terms of expected gains (6). Should his expectations about the appreciation of the German mark turn out to be wrong and the mark did not appreciate as much as expected or even depreciated on the spot market, his losses from his transactions in marks are likely to be partly offset by unexpected gains from his transactions on sterling because of the negative correlation between the movements of the exchange rates of these two currencies around their expected values. As the discount on the forward sterling is exactly equal to the corresponding expected rate of depreciation of sterling on the spot market, this risk-reducing combination of forward purchase of mark and forward sale of sterling does not imply any cost in terms of reduced expected gains. The portfolio theory applied to speculative commitments on the forward exchange market suggests

that a speculator who is not a risk lover will engage in forward transactions on some currencies even if the expected gain is zero. On the other hand, the "Modern Theory" of the Forward Exchange predicts that the speclators will not engage in any forward transactions in such currencies, as sterling in our example..

The principles of the portfolio theory are a consitutive element of the "Modern Theory", as we have seen in justifying the shape of the SS schedule. Consequently, a contradiction between these two theories would make the latter internally inconsistent. Any assumption necessary to reconciliate these two theories is thus an implicit part of the Modern Theory of the Forward Exchange itself.

The example developed above shows that net sales or purchases on the forward market are to be expected even if the forward premium is exactly equal to the expected rate of appreciation of a currency, if the covariance of the distributions of the rate of this currency and of another one which presents an opportunity for speculative profit is not nil.

The expected rates of appreciation of the various currencies is not directly observable and, consequently, the

deviations of the actual exchange rate from their expected values, nor the covariance of those deviations, are directly observable either. However, assuming rational expectations and a distribution of the errors normal and stable over time, the covariance of the deviations from expectations is equal to the covariance of the actual rate of appreciation or depreciation and may thus be measured empirically (7).

The above analysis shows that the "Modern Theory" of the Forward Exchange implies the absence of covariation between the "error" in the expectations concerning the future spot rates of the different currencies for which a forward market exists. Even if the covariance is zero, the portfolio theory suggests that diversification will reduce the risk and that any individual speculator may engage in speculative transactions leading to a net forward position on a currency for which the expected speculative gain is nil. However, the direction of the net position of each speculator -- seller or buyer -- does not matter in this case and it is reasonable to assume that the aggregate position of the speculators as a group results in no net forward commitments in such currencies. The principles of the Portfolio Theory are thus consistent with Modern Theory of the Forward Exchange when the covariances of the errors in predictions are nil. The proposition of the Modern Theory that the in intercept of the speculation schedule corresponds to the

expected future spot exchange rate is necessary to justify the specification of the reduced form equation estimated by the tests of that theory presented so far in the literature.

B. Trade

(a) Introduction

The discussion of the previous section dealt exclusively with speculation on the forward foreign exchange market. The SS schedule, however, must take into account the supply and demand of forward foreign exchange for all purposes other than interest arbitrage. Speculation is one of these purposes. Trade is another important purpose for which transactions are undertaken on the forward foreign exchange market. Economic actors engaged in international trade typically enter into contracts implying the payment of a given amount denominated in a foreign currency at a specified future date. Between the date of the contract and the date specified for payment, the exchange rate may fluctuate and reduce or even completely offset the profit expected by the importer (if the price of the foreign currency increases) or by the exporter (if the price of the foreign currency decreases) because their accounting and factor costs are usually denominated in the domestic currency. The traders can cancel that risk by buying or selling on the

forward market, at an exchange rate stipulated today, the given amount of foreign currency they will have to pay or to receive later (8). An importer can hedge himself by buying the foreign exchange; an exporter by selling it.

Even within the "Modern Theory of the Forward Exchange" itself, two different ways of dealing with the introduction of trade-induced transactions on the forward foreign exchange market have been proposed. The existence of two different theoretical approaches to this problem is usually not explicitly stressed in the literature, despite the facts that the two approaches are inconsistent, have different empirical content and should lead to different interpretations of the tests performed so far using the framework of the "Modern Theory".

(b) Trade hedging as a specific transaction

The first approach considers that the "normal" behaviour of the traders is to cover themselves on the forward foreign exchange market. The value of exports expressed in foreign currency, at the time the contract is finalized, represents a supply of forward exchange to be delivered on the day specified for the receipt of the export payment, and the amount of imports similarly represents a demand for forward foreign

exchange. The difference between the export and import contracts implying payment at a specified future date represents a net supply of forward foreign exchange for delivery on that date.

This balance must thus be added to the SS schedule if this schedule is to describe the net supply of forward foreign exchange resulting from other transactions than interest arbitrage. A positive balance -- net export -- would shift the speculative SS schedule to the right, a negative balance -- net import -- to the left.

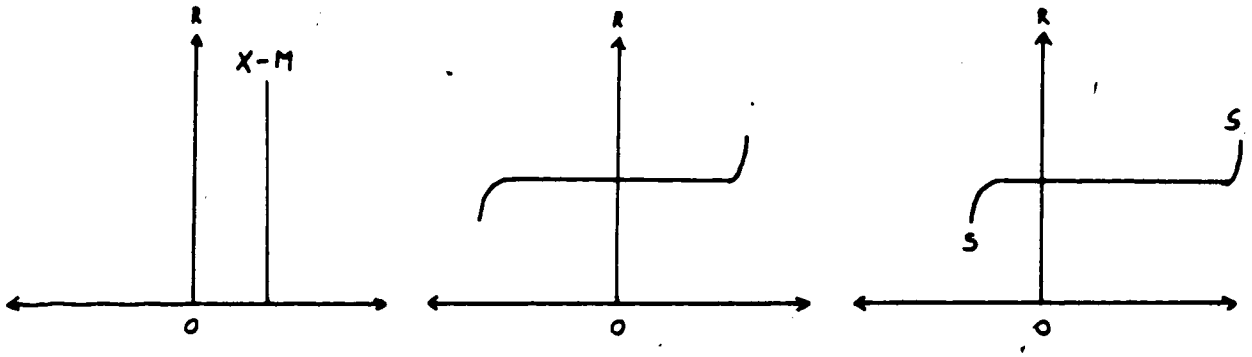
Some traders may decide not to hedge on the forward foreign exchange market. For example, if an exporter anticipates that the foreign currency will appreciate by more than the forward premium or will depreciate by less than the forward discount, he has an incentive to refrain from covering himself on the forward market. This possibility, however, does not change the argument of the previous paragraph. The decision of a trader not to hedge is analytically equivalent to a combination of two decisions: A decision to hedge his commercial position on the forward market and an offsetting decision to speculate on the forward market. Provided that the speculative component of the SS schedule includes the speculative position on the traders who refrain to hedge, the

entire balance of the export and import contracts implying payments at a specified future date, whatever hedged or not, must be added to the SS schedule to express the net supply of foreign exchange on the forward market for delivery at the relevant date.

The inclusion in the SS schedule of the demand and supply of forward foreign exchange arising from trade poses the question of the dependence of the level of import expenditures and the export receipts in foreign currency on the level of the forward foreign exchange.

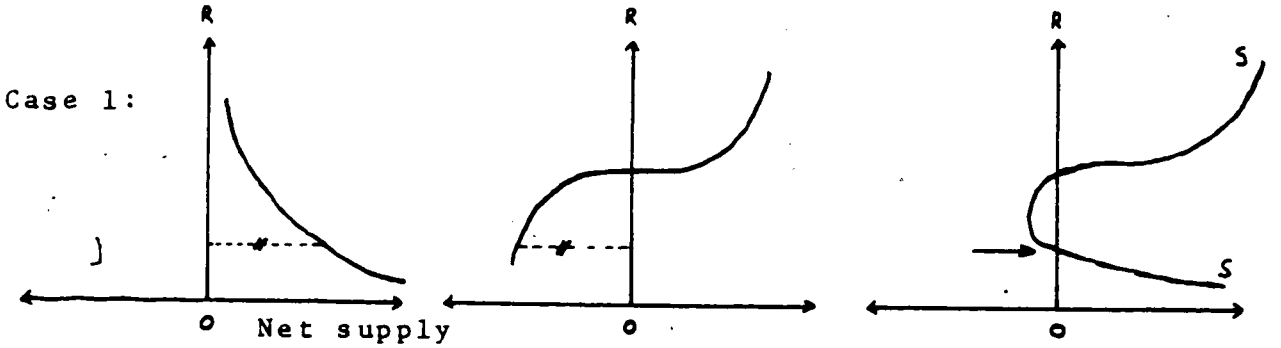
The simplest assumption, frequently found in the literature, is to assume that those transactions are exogeneous. The level of import expenditure and of export receipts in foreign currency is assumed not to depend on the current level of the forward foreign exchange. The "trade schedule" on the diagram is vertical and the new SS schedule is shown by adding the trade schedule to the speculation schedule, as in figure 2-2.

The justification of this assumption is the idea that, contrary to interest arbitrage and speculation transactions, import and export transactions need time to prepare and the decision involves a great number of variables. One of them is

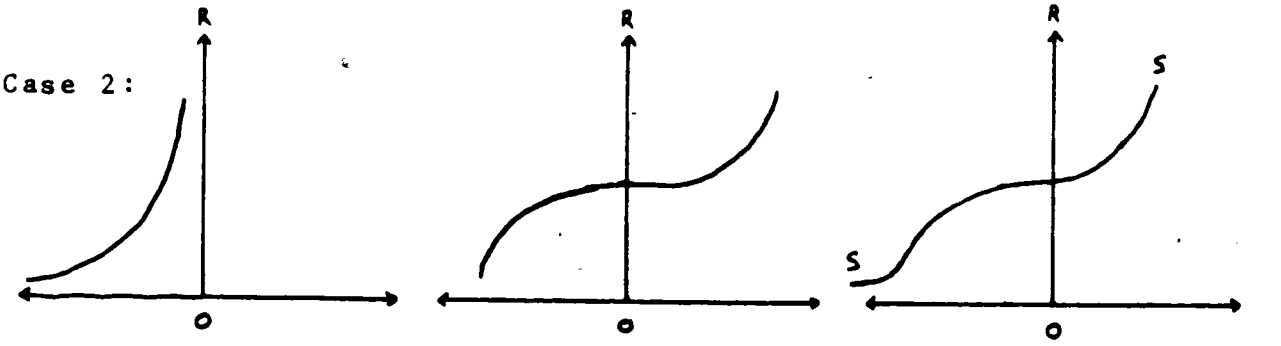


Trade | Speculation | Trade + Speculation

Figure 2-2



Trade: X > M | Speculation | Trade + Speculation: SS schedule of type 1



Trade: X < M | Speculation | Trade + Speculation: SS schedule of type 2

Figure 2-3

the level of exchange rate seen as "normal" by the economic actors. Fluctuations of the forward foreign exchange rate are considered to be of too small a weight among the set of variables involved to have any influence in the short run on the decision to import or to export -- and indeed, an import or export contract may be agreed upon by two parties without the actual forward rate at the time of the signature being known to them.

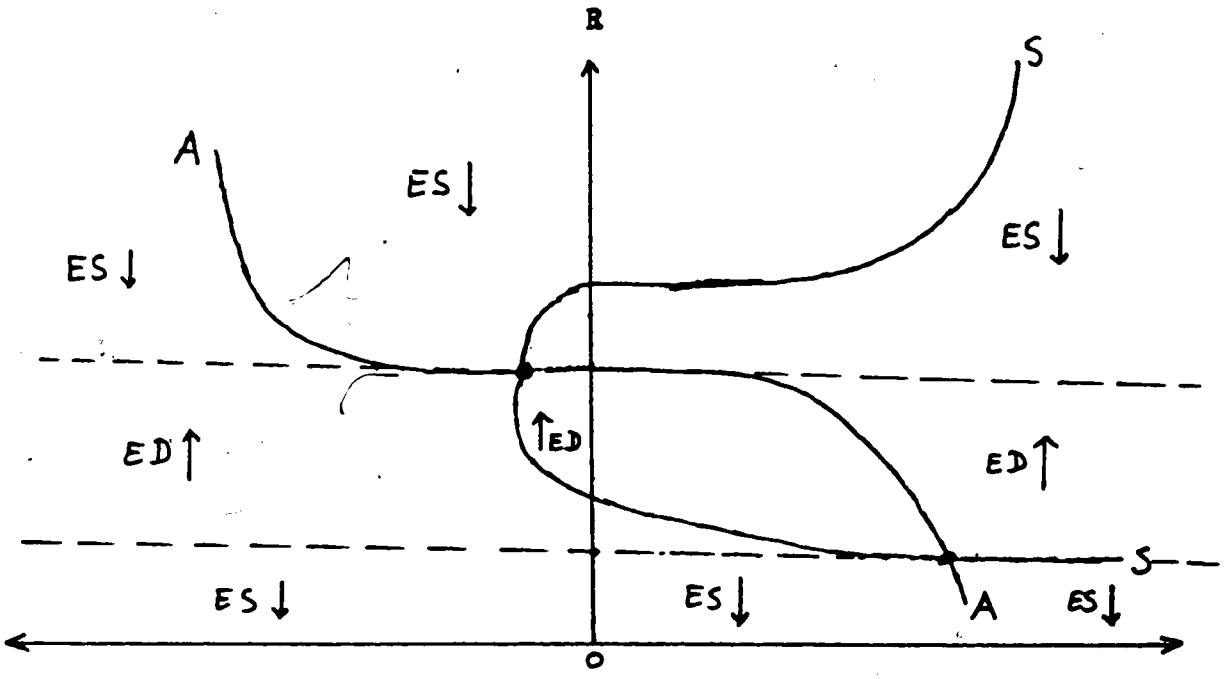
Even if we accept the idea that import and export decisions are independent of the current forward exchange rate, this is not a sufficient justification of the exogeneity of the net supply of forward foreign exchange for trade purposes. The currency in which the contracts are denominated is crucial (9). If all contracts are denominated in foreign currency, then indeed the assumption that trade decisions do not depend on the forward rate in the short run implies that trade-induced supplies and demands of foreign currency on the forward market are independent from the forward rate. If all contracts are denominated in the domestic currency, the same assumption implies on the contrary that the trade-induced net supply of foreign currency on the forward market has an elasticity of -1 with respect to the forward exchange rate. The trade schedule in this case is not a vertical line but an equilateral hyperbola tending asymptotically towards the axis, as shown in the following diagrams.

In this case, the SS schedule, resulting from the summation of the trade schedule and the speculation schedule may exhibit an unusual shape, specially in the case where exports are greater than imports (see diagrams of figure 2-3).

In the case where exports are greater than imports, two different equilibrium positions appear possible on the forward market, as shown on the diagram of figure 2-4.

However, if we accept the traditional dynamic assumptions that the price of foreign exchange on the forward market falls in case of excess supply and rises in case of excess demand, we see from the diagram that the lower equilibrium position is unstable. If we rule out instability, we may thus concentrate on the first equilibrium position which lies on the portion of the SS schedule which exhibits the traditional shape.

For most countries, at a given moment in time, import and export invoices are partly in domestic currency, partly in a foreign currency. The currency in which international contracts are denominated greatly depends on traditional and institutional factors. The U.S. dollar, for example, is widely used, even for transactions between non-American actors, in the denomination of contracts involving homogeneous products for which there are organized markets (10). However, to the



- net demand of forward foreign exchange for arbitrage purposes (AA)
- net supply of forward foreign exchange for speculation and trade-hedging purposes (SS)

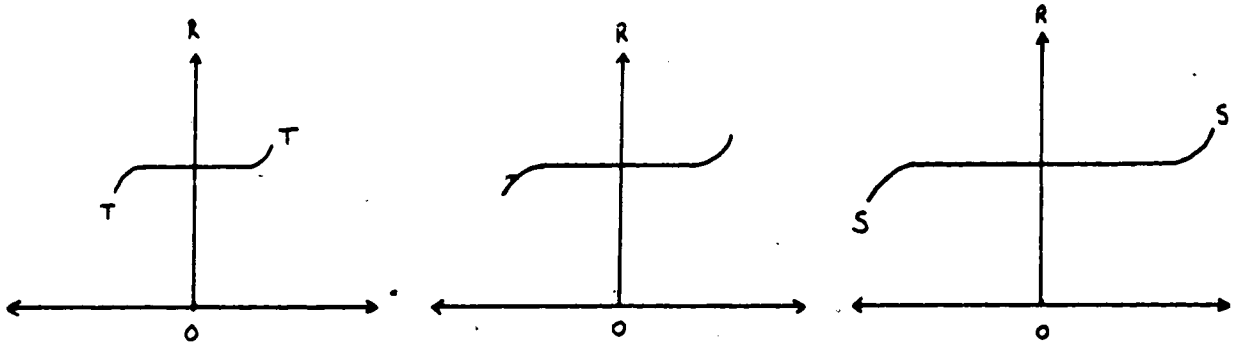
Figure 2-4

extent that the invoicing is made by the exporters, we may expect that, except in the case of countries whose trade consists mainly of those homogeneous products, payment obligations related to international trade are denominated in the currency of the exporters more often than in the currency of the importers. If this is so, the typical case would be the case of a trade schedule in the shape of a downward sloping hyperbola tending asymptotically towards the abscissa on one end and towards a vertical axis in the negative quadrant on the other end, and the SS schedule of type 1 should be the standard case. The real world phenomenon preventing the supply curve of forward foreign exchange for trade and speculation purpose to be backward bending in the short run is probably an elastic range of the speculation schedule relatively large compared to the net trade flows and the fact that, at levels of the forward rate significantly lower than the expected future spot rate, exporters would have a strong incentive not to hedge.

The above discussion rests on the assumption that trade decisions do not depend significantly on the level of the forward foreign exchange rate, assumption which may be judged reasonable in the very short run. The corresponding framework is thus suitable to analyze the short-run effects of, for example, an exogeneous intervention of the Central Bank on the market. If, however, this exogeneous intervention is not a

short-run phenomenon itself, we may be interested in its longer run effects on the forward foreign eexchange market. In this case, the trade decisions will depend on the level of the forward foreign exchange. Assuming that the traditional Marshall-Lerner condition is met in the long run, the trade schedule will be downwards sloping. The central portion of this schedule will be relatively elastic as changes of the exchange rates around the equilibrium change the relative competitiveness of different countries in various export markets and will change the share of the different countries in the world market. However, the extremities of the schedule will be more inelastic. Once the effect of variations of exports and imports through variations in the share of the country in the world market has been exhausted, further increase or reduction of exports and imports will depend only on the effect of the price variations on the size of the market. The diagrams of figure 2-5 illustrate this trade schedule and its effect on the aggregate SS schedule.

It should be noted that, in this longer run framework, the currency in which the contracts are denominated is irrelevant for the shape of the trade schedule as, in the long run, the economic actors adjust the amounts denominated in whatever currency given the exchange rate. The effects resulting from the denomination in a given currency are only short run effects

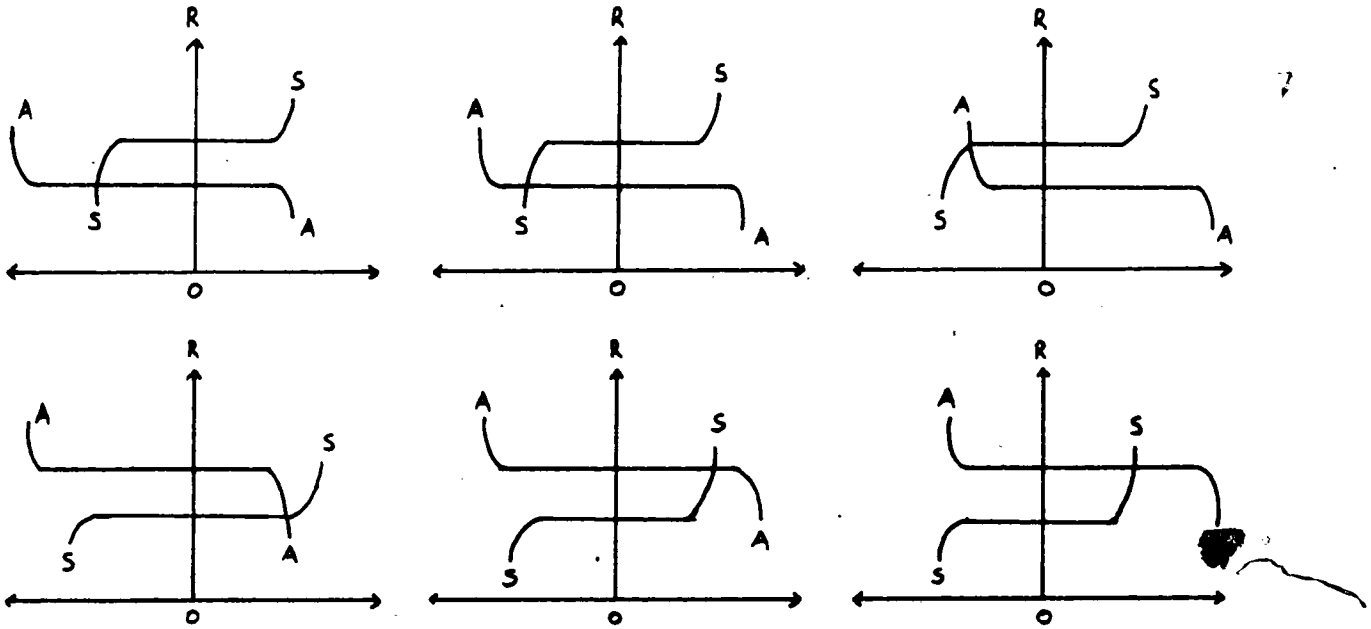


net supply of forward foreign exchange from trade

from speculation

from trade and speculation

Figure 2-5



balance of trade surplus: increases the probability of deviations from covered interest parity in favour of investments in domestic currency

balance of trade equilibrium

balance of trade deficit: increases the probability of deviations from covered interest parity in favour of investments in foreign currency

Figure 2-6

arising either from the impossibility to make such adjustments on existing contracts when unexpected fluctuations of the exchange rate happen to occur or, in the case of oligopolistic competition, from the uncertainty surrounding the reactions of competitors to unilateral changes in the pricing policy.

As can be seen from the diagrams of figure 2-5, integrating trade into the SS schedule maintains the general shape of this curve as discussed in the section devoted to speculation. In the diagram, we have assumed implicitly that speculators consider that the most likely future spot rate is the rate at which the balance of trade would be in equilibrium, as both the trade schedule and the speculation schedule intersect the vertical axis at the same value of the forward exchange rate. This of course needs not to be the case. Should it be different, we may have a "stairs-like" SS shecule, but this modification has no consequence whatsoever on the uniqueness and the stability of the market equilibrium as long as the arbitrage schedule has the previously described shape. One very important difference is introduced however by this possibility: The SS schedule doesnot necessarily intersect the vertical axis at the expected future spot rate, but may intersect it at any forward rate comprised between the expected future spot rate, at which the speculation-induced net supply of forward foreign exchange equals zero, and the rate at which

the trade balance is in equilibrium, for which the trade-induced net supply of forward foreign exchange is zero. Contrary to the prediction of the simplest version of the model of the Modern Theory, the equilibrium forward rate, in this approach, will thus lies within a limit bounded by the two most extreme of those 3 variables: the expected future spot rate, the rate at which the balance of trade is in equilibrium and the interest parity rate.

(c) Trade hedging and interest arbitrage

As stated in the introductory paragraphs of the section devoted to trade, there are two different approaches, within the "Modern Theory" of the forward exchange, to the trade-induced supplies and demands on the forward foreign exchange market. The first one, which has just been analyzed above, considers that those supplies and demands must be added to the schedule of the net supply of forward foreign exchange for other purposes than covered interest arbitrage. The second approach suggests on the contrary that trade-induced demands and supplies of forward foreign exchange do not require special consideration as they are already included in the arbitrage schedule.

The argument goes as follows. Suppose an importer has to pay his imports in foreign currency in three months from today. To cover his exchange risk, he may buy the required amount today on the forward market, at the specified exchange rate. However, another hedging procedure is available. The importer could borrow the necessary amount in domestic currency at today's interest rate, exchange it for foreign currency immediately at the current spot exchange rate and buy an earning asset in foreign currency whose maturity corresponds to the date the import payment is due. This combination of transactions does not involve any future spot exchange rate and is thus free of exchange risk. The choice between the two hedging procedures will depend on their relative cost. If the 90-days forward rate is equal to the rate corresponding to the covered interest parity, the two procedures are the same. If the forward rate is lower than that value and in the absence of transaction costs, it will be cheaper for the importers to cover themselves by buying the foreign currency on the forward foreign exchange market -- but the exporters will cover themselves by borrowing foreign currency and buying an earning asset in domestic currency, without any transaction on the forward foreign exchange market. If, on the other hand, the forward rate is higher than the rate corresponding to the covered interest arbitrage parity, the importers will not engage in any transactions on the forward foreign exchange

market, but the exporters will sell their future receipts in foreign currency on this market. Thus, exporters and importers in this approach, behave exactly as other interest arbitragers, buying forward when the forward rate is below the covered interest parity rate and selling forward when it is above that rate (11).

There is however an asymetry. Only importers buy forward when the forward rate is above the covered interest parity rate and only exporters sell when it is below this level. As a consequence of the inclusion of trade-induced interest arbitrage, the AA schedule will shift to the left in cases where exports are greater than imports and to the right in the opposite case. In consequence the model predicts then, ceteris paribus, in periods of balance of trade surplus, the deviations from the interest parity would not be distributed normally but are likely to be biased in favour of the investments in domestic currency, as illustrated by the diagrams of figure 2-6. In that respect, the two approaches to the introduction of trade in the framework of the "Modern Theory" of the Foreign Exchange are not qualitatively different.

The important conclusion of this comparison of the 2 alternative approaches taken to analyze the trade-related transactions on the forward foreign exchange market is the

difference they introduce in the construction and the interpretation of the tests of the "Modern Theory". As we have seen, the first approach suggests that the equilibrium forward foreign exchange must lie within the limits set by three rates: the covered interest parity rate, the expected future spot rate and the rate at which trade would be in balance. The second approach, on the contrary, suggests that the equilibrium forward exchange rate will lie only between the covered interest parity rate and the expected future spot rate.

Because of the greater simplicity of the second approach in terms of empirical research, most tests performed in the framework of the "Modern Theory" have used so far this second approach, implicitly assuming that traders behave as interest arbitragers. Whether they do behave as interest arbitragers or not is an empirical question which has not yet been investigated as such.

C. Other Transactions

We have discussed so far three kinds of transactions: covered interest arbitrage, speculation on the future spot exchange rate and international trade. Two other categories of transactions involve the forward foreign exchange market: The various arbitrages on exchange rates (geographical arbitrage

between two financial centers, triangular arbitrage involving more than two currencies) and the speculation on future forward exchange rate. We will now discuss the effect of those additional categories of transactions on the equilibrium forward rate.

(a) Arbitrage on exchange rates

The existence of arbitrage is important as it enables us to assume that, after allowance for transactions costs, there is only one price for each currency (12). However, neither the geographic arbitrage nor the triangular abitrage modifies the analysis. Such transactions do not imply any net demand or supply for any currency on the foreign exchange market, except for the amount representing the profit of the transactions which, because of the very existence of arbitragers, is very small proportionally to the arbitrage flows themselves and can be neglected. Thus, triangular arbitrage transactions on the forward foreign exchange market do not modify by themselves net supply and demand shcedules (13).

(b) Speculation on future forward exchange rates

The speculation on the forward foreign exchange market is usually analyzed in terms of the present forward exchange rate

and the expected future spot exchange rate, as we have done so far. The options facing the speculator are however much broader. The speculator does not need to get out of his speculative position by buying or selling the relevant currency on the spot market at the date of delivery. He can take his gain at any time between the date of the initial contract and the delivery date by entering into an offsetting transaction on the forward market for the same delivery date as soon as the corresponding forward rate is lower than the rate at which he sold forward initially. For example, a speculator expecting a depreciation of sterling and having sold forward sterling in January at $2.00 for delivery in July may take his gain by buying the sterling forward in April if at that time the three-month forward rate of sterling is, say, $1.85.

The possibility to speculate by combining two offsetting forward transactions contracted at two different moments in time but for the same delivery date, without any operation on the spot market at that date, has an important implication: The expected future spot rate is not the only key variable determining speculators' decisions. Speculators can decide to speculate on a future forward rate, following exactly the same principles than when speculating on the future spot rate. They will thus sell forward foreign exchange if the current forward exchange rate is higher than the expected value of a future

forward rate for contracts involving the same delivery date, and buy forward in the opposite case. If, for example, speculators anticipate that, in three months, the three-month forward exchange rate for sterling will be lower than the present forward exchange for six-month contracts, they expect to make a speculative gain by selling sterling today on the six month forward foreign exchange market and buying sterling forward three months later on the three month forward market. Their expectations regarding the future spot exchange rate six months ahead is irrelevant to determine the expected gain from that set of transactions. The expected future spot rate may be relevant however to the final decisions of the speculators as it may provide an alternative speculative opportunity they will take into account in composing their speculative portfolios.

The schedules describing the net supply and demand on the forward foreign exchange market arising from speculation on the future forward exchange rates are analogous to the schedule discussed in the paragraphs dealing with speculation on the future spot rate. The intercepts of those schedules will represent the expected future forward rates, assuming that the covariance of the errors in predictions on corresponding markets for various currencies are nil (14).

There are in principle a large number of such schedules for any given forward foreign exchange market as, for any given delivery date, there are potentially a number of future forward rates equal to the number of working days between the current date and the delivery date, because in any of those days forward contracts could be negociated for the delivery date. In fact, however, organized markets suitable for speculation, i.e. presenting enough depth to avoid any single transaction influencing significantly the relevant exchange rate, are only a few. For example, on the three-month forward sterling market, the only significant opportunity for speculation on the future forward rates in normal circumstances is provided by the one month forward markets to be held one month and two months later.

The global speculation schedule on a given forward market will thus be the summation of two components: The schedule describing speculation on the future spot rate and the schedules describing speculation on the future forward rates. The diagram of figure 2-7 illustrates this global speculation schedule in the case where only one schedule describing speculation on the future forward rate is relevant.

In this diagram, the SS schedule represents the demand and supply of foreign exchange resulting from speculation on the

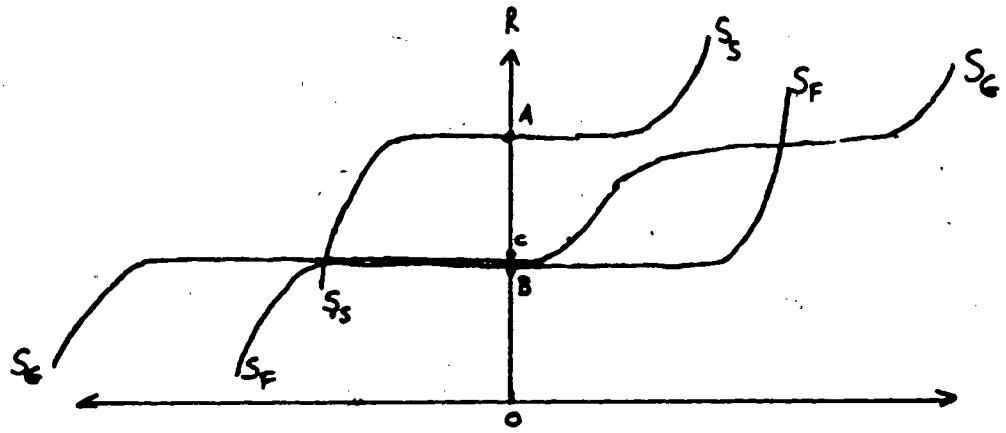

R
S_S
S_F
S_G
A
C
B
S_S
S_F
S_G
O
Net supply of forward foreign exchange by speculators

Figure 2-7

future spot exchange rate and the SF schedule represents the demand and supply resulting from speculation on the future forward rate. OA corresponds to the expected future spot rate and OB to the expected future forward rate.

The schedule SG represents the net supply and demand resulting from both kinds of speculation and is the horizontal sum of the two other schedules. Its intercept, OC, is a weighted average of the expected future spot rate and of the expected future forward rate.

This discussion has an important implication for the assessment of the empirical tests of the "Modern Theory" of the forward foreign exchange rate which are based on the assumption that the intercept of the schedule describing the demand and supply of foreign exchange for other purposes than covered interest arbitrage is the expected future spot rate: Those tests are based on an incomplete specification of the speculation schedule (15).

The relative weight of the expected future spot rate and of the expected future forward rate in the determination of the zero-speculation forward rate cannot be determined a priori. They will depend on the relative expected profitability if the two categories of speculaton and on the relative degree of

confidence the speculators attach to their anticipations. The distinction between the two categories of speculation is, however, really relevant only if the expected future spot rate and the expected future forward rate are indeed different. As will be shown in the next chapter, in the short run, the evolution of the interest rates and of the spot exchange rates may be governed by different factors. According to the "Modern Theory" of the forward market itself, the forward exchange rate depends on the interest differential between two currencies on one hand and on the present spot exchange and the expected future spot rates on the other hand. If the Modern Theory is correct and if economic actors behave in a way consistent with the rational expectations hypothesis, the expectations concerning the future spot and forward rates should be different in the short run.

An important factor to take into consideration when making short- run predictions about the exchange rates and the interest rates is the institutional exchange rate regime prevailing and the actual way monetary authorities behave within this institutional framework. A forecast of the future forward rate based on the Modern Theory requires a forecast of the spot rate at the same future date as an ingredient to compute the interest parity rate by adding to it the premium or discount necessary to offset the interest rate differential.

In a regime of flexible change rates where the exchange rates do fluctuate widely, previsions regarding the evolution of the spot rate are probably the main task of the speculators and the distinction between future spot rate and future forward rate is secondary. In a fixed exchange rates regime where the monetary authorities do adopt policies consistent with he fixity of the exchange rates on the contrary, the main and most profitable activity of the speculators could be to forecast future forward rates, whose fluctuations will be wider than the fluctuations of the spot rates and where the anticipations could be formed on the basis of the covered interest parity theory and of the knowledge that a relatively more expansionist monetary policy in any country will have to be offset later by a relatively more restrictive monetary policy in order to preserve the fixity of the exchange rates.

Section 3: Conclusions

The discussion of this chapter may be summarized as follows.

1. The equilibrium on the forward foreign exchange market obtains when, at the forward exchange rate, the net demand of forward foreign exchange for covered arbitrage

purposes is matched by the net supply of forward foreign exchange for other purposes.

2. The demand of forward foreign exchange for covered interest arbitrage purposes as a function of the forward exchange rate may be formalized by a downwards sloping demand curve whose intercept corresponds to the covered interest parity rate.

3. Under certain assumptions regarding the hedging behaviour of the economic actors engaged in international trade and the independence of the forecasting errors by the speculators on different currencies, the net supply of forward exchange for other purposes than interest arbitrage may be formalized by an upwards sloping supply curve whose intercept is a weighted average of the expected future spot rate at maturity and of the expected future forward rates during the intermediate period.

The 2 next chapters will assess the theoretical and empirical relevance of the Modern Theory. Chapter III will discuss the legitimacy of the fundamental assumption on which the partial equilibrium model of the Modern Theory rests: The possibility of a divergence between the interest rate differential and the expected relative rate of appreciation or

depreciation of the two relevant currencies, divergence which contradicts the Fisherian theory of the interest rate. Chapter IV will then present a test based on the reduced form of the Modern Theory to answer the question: Does the Modern Theory of the Forward Foreign Exchange Rate successfully explains the observed discrepancies between the effective forward rate and the covered interest parity rate?

FOOTNOTES OF CHAPTER II

(1) The classic references on that theory are Spraos (1953), Tsiang (1959) and Grubel (1966).

(2) Although this shape of the AA schedule is standard in the literature, a noticeable exception is found in the doctrine of the "Cambist School" which rejects this framework altogether as irrelevant and misleading. The doctrine of the Cambist School rests critically on the assumption that there is no inter-bank market for forward foreign exchange distinct from the market for currency swaps. Whether this assumption is correct or not is an empirical question. See Prissert and Coulbois (1974).

(3) According to Aliber (1973), this risk, which he calls the "political risk", explains the failure of the interest parity to prevail between different financial centers. According to his findings, the interest parity theory applies only to deposits denominated in different currencies but held in the same financial center.

(4) S. Easton pointed out to me that a forward contract can be interpreted as an exchange of options by the two parties, the option being defined as "a security giving the right to buy or sell an asset, subject to certain conditions, within a specified period of time" (Black and Scholes (1973), p.637). The seller of the foreign currency sells to the buyer the option to purchase the foreign currency at the given rate at a specified date and receives in exchange the option to sell the same currency at the specified date and exchange rate. From a legal point of view, a sale of foreign exchange on the forward market implies a firm commitment for both parties to sell and buy the specified currency and leaves no room for any "option". Nevertheless, from an economic point of view, the distinction between firm sale of forward foreign exchange and swap of options is irrelevant because both set of transactions have the same outcome: Depending on the evolution on the exchange rate for the specified currency, one of the 2 options will be profitable and will be exercised: The owner of the option to sell the foreign exchange at the specified forward rate will exercise his option if that rate is greater than the spot rate, and the owner of the option to buy will do so in the opposite case.

There are two implications to this interpretation of the transactions on the forward foreign exchange market.

First, the premium or the discount on the forward rate may be interpreted as the deviations of the relative price of the 2 options from unity. Thus, the literature

on the pricing of options becomes potentially relevant to the analysis of the forward markets (on the literature on the pricing of options, see Black and Scholes (1973)).

Second, the market for options on foreign exchange does exist already implicitly in the forward foreign exchange market, but is still at the primitive stage of barter: as the market is organized today, "options buy options but money doesnot". A natural development of the present situation would thus be the evolution of a segment of the forward foreign exchange market into a market for options to buy and sell foreign exchange at various dates.

(5) Banks will usually require from their customers speculating on forward foreign exchange a deposit corresponding to a small fraction of the total commitment, in which case the total speculative commitment of those customers is indeed limited by their initial wealth or credit. Such a rule however does not apply to the direct participants on the inter-bank foreign exchange market.

(6) Had we made the assumption of a positive rather than a negative covariance between mark and sterling, the speculator could reach the same result by selling sterling forward rather than buying it.

(7) Proof: Let Ai represent the actual rate of appreciation of the currency i in a given length of time, and let an asterisk designate the corresponding expectation. Then the rational expectations hypothesis implies that:

$$A_i = A_i^* + \varepsilon_i \quad \text{and} \quad E(A_i) = A_i^* \quad \text{for all } i$$

where ε_i is a random term assumed normally distributed. Thus

$$\begin{aligned} cov(A_1, A_2) &= E\left\{[A_1 - E(A_1)][A_2 - E(A_2)]\right\} \\ &= E[(A_1 - A_1^*)(A_2 - A_2^*)] \\ &= E(\varepsilon_1 \varepsilon_2) \\ &= cov(\varepsilon_1, \varepsilon_2) \end{aligned}$$

Note that the assumption embodied in the first equation together with the assumption that expectations about the rate of appreciation of a given currency are stable over time are consistent with the hypothesis that exchange rates follow a random walk around a trend. This view thus allows a reconciliation of the view that exchange rates follow random walk processes with the more traditional view that some well-known facors, which do not necessarily fluctuate randomly over a certain period of time, such as relative rates of inflation between countries, determine the fundamental tendency in the evolution of exchange rates or balance of payments surpluses and deficits.

(8) Trade hedging on the forward foreign exchange market is often compared to an insurance. Yeager (1967), p.264, criticizes this traditional comparison. The principle of insurance is to spread out the unavoidable losses from accidents among a large number to reduce the individual risk. The situation on the forward foreign exchange market is of a completely different nature. Difference between the forward exchange rate specified for delivery at a given date and the spot rate at the same date may be interpreted at the same time as a loss for one transactor (say, the buyer) and a gain for his counterpart (say, the seller). There is thus no aggregate risk to be "spread out" through an insurance mechanism.

(9) See Magee (1973).

(10) See Grassman (1973).

(11) Taking into account the transaction costs modifies slightly the analysis. Hedging through borrowing and lending in the appropriate currencies require two transactions and hedging through a forward contract requires only one transaction. The two methods of hedging are thus not completely equivalent, the former being in all likelihood more costly than the latter when the market forward rate is equal to the interest parity rate. When the market forward rate is in the neighbourhood of the interest parity rate, both exporters and importers will thus typically hedge on the forward market, in conformity with the view developed at the beginning of the paragraph (b) supra.

(12) The existence of arbitrage and the resulting consistency between cross rates, after allowance for transaction costs, is important as it provides the basis for a method of measuring the transaction costs on the foreign exchange markets. This novel method is due to Frenkel and Levich (1975). See Chapter V below.

(13) This analysis shows that triangular arbitrage transactions on the forward foreign exchange market does not involve a change in the net supply or demand for the forward committments in the relevant currency. Nevertheless, the possibility of triangular arbitrage on the forward market is not irrelevant. Spraos (1953) has shown that, provided cross-spot rates are consistent, covered interest parity between any set of currencies implies that the cross-forward rates are also consistent. This result implies that, where triangular arbitrage exists, the covered interest arbitrage schedules between assets denominated in those currencies are interdependent and,

as argued by Grubel (1966), all those schedules are more elastic since markets are deepened.

(14) See the discussion in the section devoted to speculation on the future spot rate.

(15) To the best of my knowledge, this incomplete specification results not from an oversight of the importance of the expected future forward rate in the existing literature on the Modern Theory by the authors perfcrming the empirical tests but, fundamentally, from the absence of any discussion of the role of the expected future forward rate in that literature.

CHAPTER III: A MACROECONOMIC MODEL OF EXCHANGE RATE DETERMINATION CONSISTENT WITH THE MODERN THEORY

Section 1: Introduction

The Modern Theory of the forward foreign exchange rate is a partial equilibrium theory. As such, it must at least be consistent with a broader macroeconomic framework for the analysis of the exchange rate and interest rate movements.

The simplified macroeconomic models which incorporate the exchange rates, interest rates and expectations regarding the future exchange rates consistently assume that the difference in nominal interest rates among countries is necessarily equal to the expected rate of appreciation of their currencies against each other (1). Such assumption makes the Modern Theory model meaningless because this assumption implies the equality of the interest parity forward exchange rate and of the expected future spot rate.

This critical assumption is central to the recent models of exchange rate determination based on Dornbusch's (1976) novel mechanism. Assuming that arbitrage equalizes the yield on bonds throughout the world, Dornbusch predicts that a lower

rate of interest induced by an expansionary policy will be offset by expected capital gains resulting from an appreciation of the country's currency on the foreign exchange market. The appreciation of a country's currency after an increase in the money supply, in a model consistent in the long run with the purchasing power parity and with the quantity theory of money, can be brought only by an instantaneous fall of the exchange rate below its new equilibrium level: This overshooting is then followed by a gradual increase of the exchange rate towards its equilibrium level, justifying expectations that the domestic currency's exchange rate will appreciate.

This mechanism does not have a general validity, for two reasons. First, this mechanism of exchange rate determination overlooks the existence of a forward market of foreign exchange. Given the existence of this market, the instantaneous equalization of the yield on bonds can be produced by an adjustment of the forward exchange rate rather than by an immediate adjustment of the spot rate. Only if the forward premium is assumed always identical to the expected rate of appreciation of the spot rate will the existence of the forward foreign exchange market be consistent with Dornbusch's (1976) analysis. The validity of this additional assumption is an empirical question for which the evidence is still inconclusive (2). Second, the empirical evidence suggests

several instances of alternative adjustment mechanisms, as we will argue in the third section of this chapter.

The purpose of this chapter is to present a simple alternative macroeconomic model of exchange rate determination. The model will be designed to reveal the kind of mechanisms and markets interactions likely to yield short run discrepancies between the interest rate differential and the expected rate of appreciation or depreciation of a country's currency, thus making the Modern Theory relevant as an explanation of the forward foreign exchange rate. The model will furthermore be consistent with the purchasing power parity theory and with the Fisherian theory of the nominal interest rate.

The chapter is organized in four sections. Following this introductory section, section 2 develops the model. Section 3 presents some empirical evidence to determine the relevance of the alternative adjustment mechanisms implied by Dornbusch (1976) and by the model of section 2. The last section summarizes the conclusions.

Section 2: The Model

A. General Features of the Model

The essential features of the model are a high degree of substitutability between real assets and domestic financial assets and a slower adjustment speed in the goods market relative to asset markets (3). As will be seen in due course, the adjustment process following an unforeseen increase in the money supply in the standard case of fixed real output involves an immediate increase in the price level, which will overshoot its new long run equilibrium level, to maintain the money market and the domestic capital markets in equilibrium. This increases the price of domestic goods relative to foreign goods. As a result, through time, demand pressure progressively weakens in the domestic market for goods and increases in the foreign market for goods, simultaneously pushing the exchange rate up and the price level down. At the same time, to maintain the equilibrium on the domestic assets markets, the nominal interest rate, which had immediately fallen as a result of the overshooting of the price level, starts rising.

The model may thus account for such phenomena as (1) divergent short run movements of the price level and of the

exchange rate as a result of unexpected monetary disturbances -- in sharp contrast with the trend behaviour; (2) temporary deteriorations in the competitive position of domestic goods relative to foreign goods as a result of unexpected increases of the money supply; and (3) divergence between the direction of the interest rate differential and the rate of depeciation of the domestic currency on the foreign exchange market during the adjustment process(4). This latter phenomenon is of special interest since other models in the literature tend to overlook this possibility (5).

B. Description of the Model (6).

This model is a model of the short run. Its primary function is to analyze the effects of unforeseen disturbances in the money market on the exchange rate and the price level. We will assume that the long run rate of growth of the money supply is known and constant (7). We will focus on the adjustment mechanisms which bring the economy back to the equilibrium trend after an unexpected once-for-all change in the money supply.

We will use the traditional symplifying assumption of the "small country" which means that our economy is facing a given level of the foreign interest rate and a given price of the

foreign goods in foreign currency. Domestic output and foreign output are assumed to be imperfect substitutes, at least in the short run. This may arise because of physical characteristics specific to each output, or because of more subtle properties: the goodwill linking local producers and consumers, or the unobservable differences in ancilliary services (maintenance, know-how) which may depend on the proximity of the producer.

Real and financial domestic assets, on the contrary, will be perfect substitutes from the point of view of the wealth holders. This ensures the permanent equalization of the expected yields of these two categories of assets in real terms. The question of the degree of substituability between domestic and foreign assets in the short run, i.e. the degree of "capital mobility" will be left open. The test presented in Chapter IV will suggest answers to this empirical question, which will not be dealt further here. The model of the present chapter is consistent either with an immediate adjustment of the forward exchange rate to maintain permanently the covered arbitrage margin at zero or with a complete lack of substituability which generates positive or negative covered arbitrage margins during the adjustment process following a disturbance (8).

(a) Substituability between Domestic Bonds and Real Assets.

Physical assets and financial earning assets denominated in domestic currency are assumed to be perfect substitutes for wealth holders. Arbitrage between these two categories of assets means that their expected yields are always equal (9). The nominal interest rate will thus be equal to the marginal physical productivity of capital, or real interest rate, plus a premium corresponding to the expected rate of depreciation of the domestic monetary unit in terms of the domestic output:

$$(1) \qquad r = r^* + z$$

where r is the nominal interest rate on bonds in the country,
r* is the real interest rate, exogeneous in the model,
z is the expected rate of inflation, defined as the rate of change of the price of the domestic output.

The expectations formation process is described by equation (2) : A current price level lower than the long run equilibrium level generates expectations of an acceleration of inflation above its trend and, inversely, when the current price level is above the long run equilibrium, economic actors expect the rate of inflation to fall below its trend :

$$(2) \quad z = z^* + \varsigma (\bar{p} - p)$$

where $\bar{p}$ is the logarithm of the price level corresponding to the equilibrium trend,

p is the logarithm of the current price level of the domestic output

z^* is the steady state rate of inflation.

It will be shown later that this expectations formation process is consistent with rational expectations (10).

We note that, as shown by equations (2) and (1) respectively, the model also predicts that in the long run, where $p = \bar{p}$, the expected rate of inflation is the long run rate of inflation and that the difference between nominal and real rates of interest will be equal to this long run rate of inflation :

$$(1') \quad r = r^* + z^*$$

The model is thus consistent, in the long run, with the Fisherian theory of the nominal interest rate (11).

(b) The Money Market.

Stock equilibrium in the money market requires the money supply and the money demand to be equal. The demand for real balances is assumed to depend on the real income, the nominal interest rate and on the expected rate of depreciation of the domestic currency the foreign exchange markets (12). Thus the money market equilibrium condition may be written as equation (3):

$$(3) \qquad m - q = -\mu x - \lambda r + \varphi y$$

where q is the logarithm of the price level relevant to convert nominal balances into real balances,

m is the logarithm of the money stock,

x is the expected rate of depreciation of the domestic currency on the foreign exchange markets,

y is the logarithm of the real income (13), exogeneous.

The appropriate price index is assumed to be a weighted average of domestic and import prices, such as in equation (3'):

$$(3') \qquad q = \alpha p + (1 - \alpha) e$$

where the price of imported goods in terms of the foreign currency does not appear because we assume it to be equal to one by a convenient choice of the units.

Deviation of the expected rate of depreciation of the domestic currecy from its trend is assumed to be proportional to the discrepancy between the final equilibrium level of the exchange rate and the current level of the exchange rate, both expressed in logarithms :

$$(2') \qquad x = x^* + \theta (\bar{e} - e)$$

where e and $\bar{e}$ are the logarithms of the current level of the exchange rate and the logarithm of the exchange rate corresponding to the equilibrium trend, the exchange rate being expressed as the price of one unit of foreign exchange in terms of domestic currency,

and where x^* is the steady state rate of depreciation of the domestic currency on the foreign exchange markets.

Combining equations (1) and (3') yields the equation characterizing the situation where the money market clears and arbitrage equalizes the expected returns on domestic bonds and real assets :

$$(4) \quad q - m = -\varphi y + \lambda r^* + \lambda\zeta(\bar{p} - p) + \mu\theta(\bar{e} - e) + \lambda z^* + \mu x^*$$

In the long run where $p = \bar{p}$ and $e = \bar{e}$, (4) may be written as

$$(5) \quad \bar{q} = m + \lambda r^* - \varphi y + \lambda z^* + \mu x^*$$

where $\bar{q}$ is the logarithm of the deflator of nominal money balances corresponding to the equilibrium trend.

Assuming no change in the physical productivity of capital through time, we may express this relationship in terms of long run rates of growth :

$$(5') \quad \dot{\bar{q}} = \dot{m} - \varphi \dot{y} .$$

The model thus predicts that, in the long run, if the income elasticity of the demand for money is unity, the rate of inflation is equal to the difference between the rate of growth of the nominal money stock and the rate of growth of output (14).

Combining (5) and (3') and substituting into (4) the resulting value of π yields a relationship between the current and trend values of the exchange rate and of the price level

which must hold when the money market clears and arbitrage equalizes the expected return from domestic bonds and real assets:

$$(6) \qquad \dot{e} = \bar{e} - \frac{1}{\mu\theta + 1 - \alpha}\left[(\alpha + \lambda\sigma)(p - \bar{p})\right] = \bar{e} - \frac{\alpha + \lambda\sigma}{\mu\theta + 1 - \alpha}(p - \bar{p})$$

or

$$(6') \qquad p = \bar{p} + (\bar{e} - e)\frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\sigma} = \bar{p} - \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\sigma}(e - \bar{e}).$$

Those relationships will be useful later, when we will describe the adjustment path of the price level and of the exchange rate through time.

(c) The Goods Market and the Relative Price Adjustment.

The demand for domestic output depends on the relative price of domestic and foreign goods, the real income and the expected real cost of credit, measured by the difference between the nominal rate of interest and the expected rate of inflation.

We assume the following specification:

$$(7) \qquad \ln D = u + \delta(e - p) + \gamma y - \sigma(i - \dot{z})$$

where D is the demand for domestic output,

u is a shift parameter

e-p represents the relative price of domestic and foreign goods, assuming the price of foreign goods equal to unity (15).

The demand for domestic output increases when the relative price of foreign goods increases, when real income increases or when the real cost of credit falls.

The key assumption of the model is equation (8), describing the adjustment of the relative price of foreign and domestic goods in case of disequilibrium in the goods market. Equation (8) postulates that the deviation of the rate of change of the exchange rate from the long run trend -- thus the rate of increase of the relative price of domestic goods in terms of foreign goods -- is proportional to the excess demand for domestic output:

$$(8) \quad \dot{e} - x^* = -\pi \ln \frac{D}{Y} = \pi \left[u + \delta (e-p) + (\gamma - 1) y - \sigma (i - z) \right].$$

According to equation (8), the rate of change of the exchange rate corresponds to its long run trend at the current price level, if demand for domestic output is exactly equal to

the domestic output. If, at the current price level, demand exceeds output, the exchange rate will tend to fall below its trend value, making the foreign goods less expensive and reducing the excess demand on the domestic market. And if the demand for output falls short of output, the exchange rate will increase relative to its trend value, increasing the demand for domestic output and decreasing the demand for foreign goods.

This dynamic assumption is justified by the view that adjustment in the assets markets is quicker than in the market for current output and by our assumption that there is complete substitutability between domestic bonds and real assets. After each monetary distrubance, the price level adjusts immediately in such a way that the expected rate of change in the price level exactly matches the difference between the new nominal rate of interest necessary to maintain equilibrium on the money market and the physical productivity of capital. As these adjustments in the assets markets are assumed to be more rapid than the adjustments in the market for output, the new price level determined by the equilibrium in the assets markets causes a disequilibrium in the output market. As the assets markets reach the equilibrium more quickly than the markets for current outputs, domestic or foreign, an excess demand for domestic output tends to be matched by a excess supply for foreign goods, and inversely. The movement of the exchange

rate slowly brings the terms of trade back to equilibrium. This short run movement continues until full equilibrium is reached again.

In our model, the dynamic mechanism expressed by equation (8) rests on a disequilibrium in the goods markets. There is a disequilibrium in these markets when, at the current prices, income and anticipations, demand will not be permanently equal to the supply for goods. However, equation (8), which expresses the rate of change of the relative price of foreign and domestic goods as a stable function of other variables, may be interpreted as a reduced form giving the relative price at which the goods markets temporarily clear given implicit additional constraints on the behaviour of the optimizing economic actors in the short run. This interpretation -- which is indeed the most straightforward way to give economic content to equation (8) -- implies that all combinations of variables for which the assets markets clear and equation (8) simultaneously holds represent temporary equilibria.

Note that the trend value of the exchange rate implied by (8) is:

$$(9) \qquad \bar{e} = \bar{p} + \frac{1}{\delta}\left[\sigma r^* + (1-\gamma)\, y - u\right]$$

which shows that in the long run the exchange rate exhibits the traditional property of homogeneity of degree one with respect to the price level (16). Thus, the model is consistent in the long run with the purchasing power parity.

We have shown previously that it is also consistent with the Fisherian theory of the interest rate. It is worth stressing these two important results because it is sometimes argued that, as interest rate differentials and the rate of depreciation are determined by the same cause, the rate of inflation, they cannot diverge and the "Modern Theory" of the forward exchange rate is irrelevant. The point of this model is precisely to show that the Fisherian theory and the purchasing power theory, as theories of the long run, are not inconsistent with adjustment mechanisms generating short run discrepancies between interest rate differentials and rate of depreciation or appreciation of a currency.

Using the expression (9) for the trend value of the exchange rate, the definition of the expected rate of inflation given by (2), and equation (6') describing the relationship between price level and exchange rate imposed by the equilibrium on the money market and the domestic bonds market, the dynamic exchange rate equation (8) can be rewritten as:

$$(10) \qquad \dot{e} - x^* = -w(e - \bar{e})$$

$$(11) \qquad \text{where} \qquad w = \pi\delta\left(1 + \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\sigma}\right) > 0.$$

Equation (10) shows that the rate of change of the exchange rate will converge to the long run equilibrium trend. As w is positive, the stability condition of the dynamic path of the exchange rate is met.

The exchange rate adjustment equation in (10) can be solved to give the gap between actual and equilibrium value of the exchange rate (expressed in logarithm) at any time t for a given set of initial values:

$$(12) \qquad e(t) - \bar{e}(t) = (e_0 - \bar{e}_0)\,\varepsilon^{-wt}$$

which shows that for any initial discrepancy between the actual and the equilibrium exchange rates, the exchange rate will converge uniformly towards the equilibrium trend at the rate w, which must be positive. Equation (12) can be rewritten to express the present value of the exchange rate (in logarithm):

$$(12') \qquad e(t) = \bar{e}_0 + x^* t + (e_0 - \bar{e}_0)\,\varepsilon^{-wt}$$

Similarly, substituting (12) into (6'), we have an expression for the price level:

$$(13) \quad p(t) - \bar{p}(t) = \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\beta} (e_0 - \bar{e}_0) \varepsilon^{-wt} .$$

Equation (13) shows that the price level will converge to its long run equilibrium trend. The price level will increase more quickly than its trend if the exchange rate is initially below its equilibrium trend value and conversely if the exchange rate initially exceeds its equilibrium trend value.

(d) Equilibrium Price and Exchange Rate.

The adjustment process of the economy can be illustrated by the figures 3-1 and 3-1', in which we assume, for the sake of expositional simplicity, that in the long run price stability prevails, in such a way that the long run equilibrium price level is a constant (17).

At every point in time the money market clears and the expected yield between domestic bonds and real assets are equalized by arbitrage. As we have shown in the previous paragraphs, this implies a relationship between prices and the spot exchange rate given by equation (6), drawn as the negatively sloped TT schedule in figures 3-1 and 3-1' (18).

The schedule $\dot{e} = 0$ shows combinations of price levels and exchange rates for which the goods market and the money market are simultaneously in equilibrium (19). This schedule may be

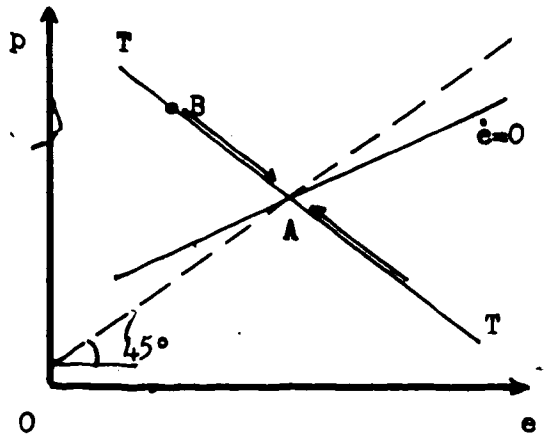


Figure 3-1

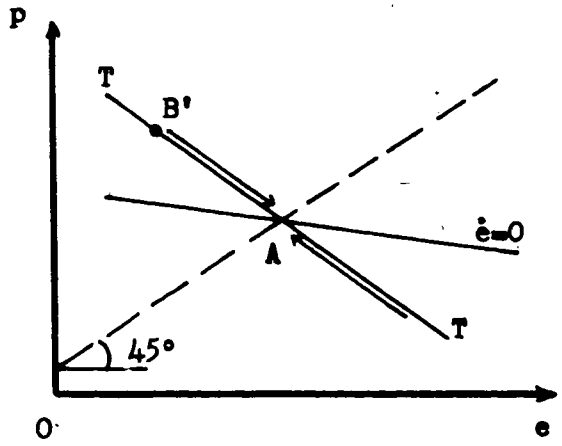


Figure 3-1'

positively sloped or negatively sloped. Starting from a position of full equilibrium, a rise in the exchange rate has two effects. First it represents a decrease in the relative price of domestic output and, as such, it creates an excess demand for domestic goods. Simultaneously, it generates expectations of an appreciation of the domestic currency, as domestic currency is now undervalued relative to its full equilibrium value. These expectations generate an increase in the demand for money which is offset by an increase in the nominal rate of interest, for a given level of real income, if the money market clears. The higher level of the interest rate, ceteris paribus, would reduce the demand for domestic

goods. If this effect of a higher exchange rate on the demand for domestic output is stronger than its relative price effect, then the price level will have to fall to reduce further the relative price of domestic goods and increase the demand. In that case, the schedule $\dot{e} = 0$ will be downwards sloping, as shown in figure 3-1'. If, on the contrary, the relative price effect of the higher exchange rate is stronger than its deflationary effect via the higher nominal rate of interest, then the equilibrium on the market for domestic goods will require an offsetting increase of the price level. However, the required increase in the price level will be less than proportional, as the higher nominal interest rate and the expected subsequent fall of the domestic price level choke off the excess demand for domestic goods. This case is illustrated in figure 3-1, where the schedule $\dot{e} = 0$ is positively sloped but flatter than a 45 degree line.

In both cases, the schedule $\dot{e} = 0$ divides the space in two areas: Assuming that the money market clears, we have an excess supply of domestic goods above the schedule so that this area will be characterized by a tendency of the exchange rate to increase; and we have an excess demand of domestic goods below the schedule, so that this area is characterized by a falling exchange rate.

The adjustment process towards the equilibrium price and exchange rate implicit in the model can now be described with the help of figure 3-1: For any given exchange rate, the price level and the nominal interest rate adjust instantaneously to clear the money and bonds markets. We are thus continuously on the TT schedule, with money market equilibrium and equality of expected yields from domestic bonds and real assets. The goods market equilibrium, on the contrary, is not instantaneous. The possible disequilibrium in the domestic goods market, however, is crucial in determining the movement of the economy by inducing a falling or rising relative price between domestic and foreign goods through changes in the exchange rate. Consider, for example, an initial position of the economy at point B in figure 3-1, or B' in figure 3-1'. The nominal rate of interest is low because economic actors expect the price level to fall, as it is temporarily above its full equilibrium level. Despite the high price level and the low nominal interest rate, there is no excess demand on the money market, as the economic actors expect the domestic currency to depreciate on the foreign exchange market, due to its temporary overvaluation. The real rate of interest is fixed at the level given by the productivity of capital through arbitrage between bonds and real assets and is thus at its equilibrium level. However, the price of domestic output is so high relatively to the price of foreign goods that there is an excess supply on

the market for domestic goods. This excess supply produces an increase of the exchange rate which gradually reduces the excess supply of domestic goods. Thus, through time, the economy moves from B (or B') toward A (or A'), where the goods market is in equilibrium and the price level and the exchange rate stay at their long run equilibrium levels (20).

C. Compatibility of the Model with the Rational Expectations Hypothesis.

The process of formation of expectations regarding the evolution of the price level and of the exchange rate is described by the equations (2) and (3'): The difference between the expected rate of inflation and the steady state rate of inflation, determined by the relative rates of growth of the money supply and of the national product, is assumed proportional to the gap between the value of the price level corresponding to the long run equilibrium trend and its actual value, in logarithms. Similarly, the difference between the expected rate of depreciation of the domestic currency and its long run rate of depreciation, determined by the long run rate of inflation, is proportional to the gap between the trend value and the actual value of the exchange rate, in logarithms, at any given moment in time. The equations are repeated here for convenience:

$$(2). \quad z - z^* = \varsigma(\bar{p} - p)$$

$$(3) \quad x - x^* = \theta(\bar{e} - e) .$$

Taking the derivative with respect to time of equation (4), describing simultaneously the money market equilibrium and the result of the arbitrage between domestic bonds and real assets, we can see that a necessary condition for those expectation formation processes to yield expectations which are consistent with the actual evolution of the exchange rate and the price level is that:

$$(14) \quad \theta = \varsigma \qquad (21).$$

On the other hand, we have shown that the deviatons of the actual rate of depreciation of the domestic currency from its long run rate of depreciation are also proportional to the gap between trend value and actual value of the logarithm of the exchange rate:

$$(10) \quad \dot{e} - x^* = -w(e - \bar{e}) \quad \text{where} \quad w \equiv \pi\delta\left(1 + \frac{\mu\theta_{+1} - \alpha}{\alpha + \lambda\varsigma}\right).$$

The expectations regarding the exchange rate will thus be consistent with the model if $\theta = w$.

Accordingly, expectations will be consistent with the model if the following relationships hold:

$$(14') \quad \theta \equiv \zeta = w \equiv \pi\delta\left(1 + \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\zeta}\right)$$

which can be expressed as a polynomial equation of second degree in θ, which has the following positive root:

$$(15) \quad \theta = \frac{-\alpha + \pi\delta(\lambda+\mu) + \sqrt{[\alpha - \pi\delta(\lambda+\mu)^2 + 4\lambda\pi\delta}}{2\lambda}.$$

This equation gives the rate at which the economy will converge to the long-run equilibrium along the perfect foresight path when the expectations are formed according to the process described by the equation (2) and (3'). The direction of the relationship between the size of the four relevant parameters and the rate of convergence of the economy along the perfect foresight path is complex. However, in the circumstances where the elasticity of the demand for money with respect to the interest rate (λ) is higher than the elasticity with respect to the expected rate of depreciation of the domestic currency on the foreign exchange market (μ), the rate

of convergence of the economy along the perfect foresight path will be higher when the elasticity of demand for the domestic output with respect to the relative price and the rate at which the exchange rate reacts to an excess demand on that market are higher (22).

The important conclusion of this paragraph is not so much the precise relationship between the parameters and the speed at which the economy converges towards the full equilibrium than the demonstration that the model and, particularly, the hypotheses regarding the expectations formation are indeed consistent with the rational expectations hypothesis.

D. The Effects of a Change in the Money Supply.

In this paragraph, we study the adjustment process to a once for all change in the money supply which is not accompanied by a change in the long run rate of growth of the money supply. This disturbance may be represented by a shift of the curve depicting the evolution of the money supply through time, as in figure 3-2.

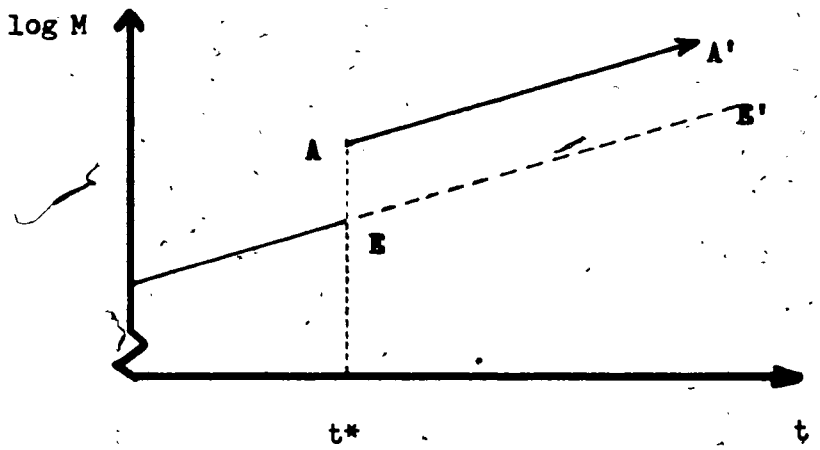


Figure 3-2

The slope of the curve of figure 3-2 indicates the rate of growth of the money stock on this semi-logarithmic diagram. The disturbance shown on the diagram is a once for all increase of the money stock at the time t*. Before t*, the public expected that the money supply at time t* would correspond to the point E. As a result of an unexpected disturbance, the actual money stock at t* happens to correspond to point A. Knowing, ex post, the actual money stock at t*, the public revise their anticipation. As we assume that the public correctly perceive the disturbance as a one for all increase of the money stock and not as a change of the rate of growth of the money supply through time, the new expectations regarding the evolution of the money supply in the future will be on the path AA' rather than on the path EE' depicting the expectations formed before the occurence of the disturbance at t*. If no new disturbance occurs, the new expectations will be correct.

We have seen already, when commenting on equations (5) and (5'), that such a disturbance will increase, proportionally to the increase in the money supply, the values of the price level and the exchange rate corresponding to the long-run equilibrium trend, and that the long run rate of inflation will stay constant. The object of the present paragraph is to analyze the adjustment process. As we will see, although both the price level and the exchange rate eventually increase proportionally, the adjustment process requires that they move in opposite direction for some period of time, justifying expectations of a depreciating domestic currency on the foreign exchange market in periods of time where the price level is falling and inversely.

Consider figure 3-3, where we assume again, for the sake of expositional simplicity, that in the long run, price stability prevails. The economy is initially at point A. This equilibrium is characterized by a price level $\bar{p}$ and an exchange rate $\bar{e}$. The equilibrium price level is determined, according to (5), by the nominal quantity of money, the income, the real rate of interest and the expected long run rates of inflation and of depreciaton of the currency on the foreign exchange market (both assumed zero here); and the equilibrium exchange rate is determined, according to (9), by the price level and the demand for domestic goods. The schedule TT, which

represents equation (6'), shows the combinations of price levels and exchange rates for which arbitrage between domestic bonds and real assets and equilibrium on the money market obtain simultaneously, at the initial money stock. The full equilibrium lies at the intersection of this schedule with

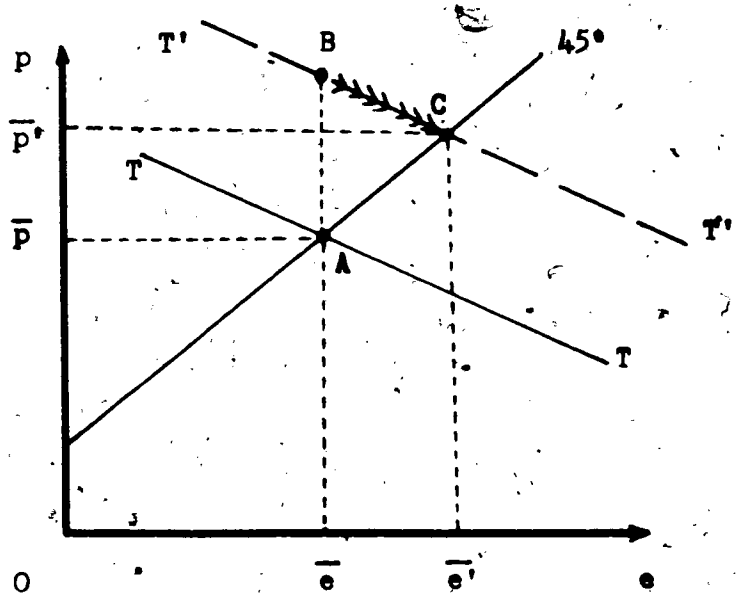


Figure 3-3

the 45 degree line expressing equation (9), along which the relative version of the purchasing power parity holds.

A once and for all increase in the nominal quantity of money causes an excess supply on the money market at the initial price level and exchange rate. To maintain the equilibrium on the money market, for any given level of the

exchange rate, the price level should be higher. The TT schedule shifts thus upwards to T'T'. The new full equilibrium will be at C, determinging a new long run price level $\bar{p}'$ and exchange rate $\bar{e}'$, the increase of those 2 variables being proportional to the increase of the money supply.

The adjustment process by which this new full equilibrium will be reached is the following. At the initial level of the prices and of the exchange rate, the increase in the money supply creates a disequilibrium not only on the money market but also on the markets for domestic bonds and real assets, as expectations of price increases towards the new equilibrium level decrease the real yield of bonds at the initial nominal rate of interest. As the excess supply of money prevents the nominal interest rate from rising, the effect of the immediate arbitrage is to increase the price of real assets and, hence, the price level. Should the prices reach the new full equilibrium level, there would be no more expectations of rising price and, at the initial nominal interest rate, arbitrage would stop. However, because of the expected depreciation of the currency on the foreign exchange market, the excess supply of money persists, which tends to reduce the nominal rate of interest. The arbitrage between bonds and real assets will thus continue and the price level will "overshoot" its long run equilibrium level until the expectations of

subsequent price decreases make arbitrage between bonds and real assets not profitable at the lower level of interest rate necessary to restore the equilibrium on the money market (23). As we assume that equilibrium on those money and bonds markets are restored immediately, contrary to what happens to the goods market which adjusts more slowly, according to equation (8), the economy moves instantaneously from A to a temporary position at B. At the price level corresponding to B, there is an excess supply of domestic output because its price is too high relatively to the price of foreign goods. This disequilibrium causes the exchange rate to increase according to equation (8), as the flows of international trade adjust progressively to the new relative prices. As the exchange rate moves closer to its long run equilibrium level, expectations of further depreciation weaken, the demand for money increases, the price level falls and, as a result of anticipations of a slower further decrease in price, the nominal rate of interest increases back towards its long run level.

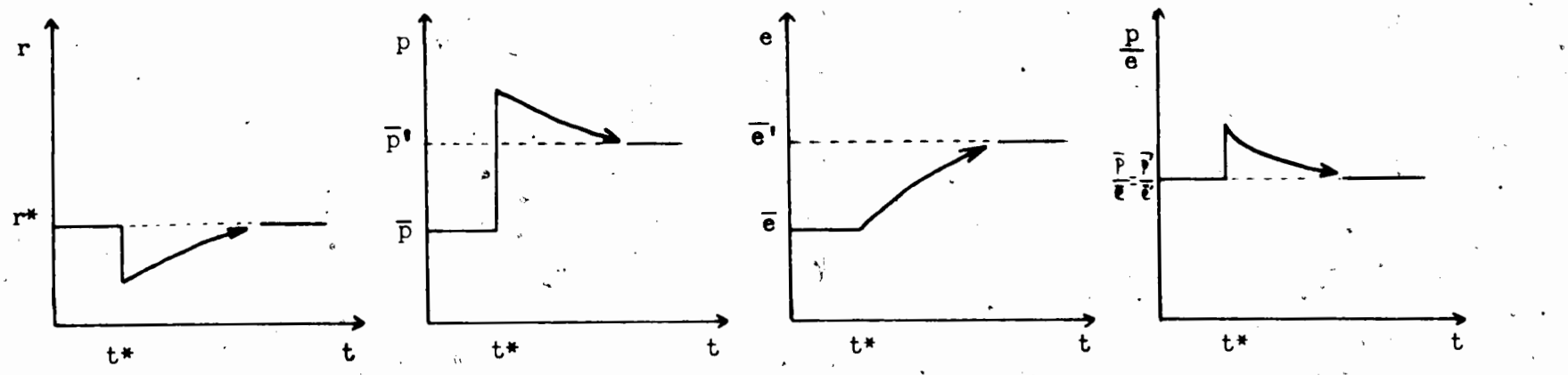
To summarize, an increase in the money supply above its expected growth trend causes, in this model, the following sequence of events:

First, as the money and the domestic bonds markets adjust immediately, the nominal interest falls and the price level

increases. This increase is more than proportional to the increase in the money supply and generates expectations of a subsequent fall in the price level. These anticipations are such that the real rate of interest is constant. Second, the spot exchange rate increases through time as the flows of international trade adjust to the higher relative price of domestic goods and simultaneously the price level starts falling and the nominal interest rate increases. This process will continue until the full equilibrium is reached again, at a price level and an exchange rate which merely reflect the increase in he monimal quantity of money. The diagrams of figure 3-4 show the time-paths of the key variables predicted by our model after a once for all increase of the money supply and contrast them with the predictions of Dorbusch (1976).

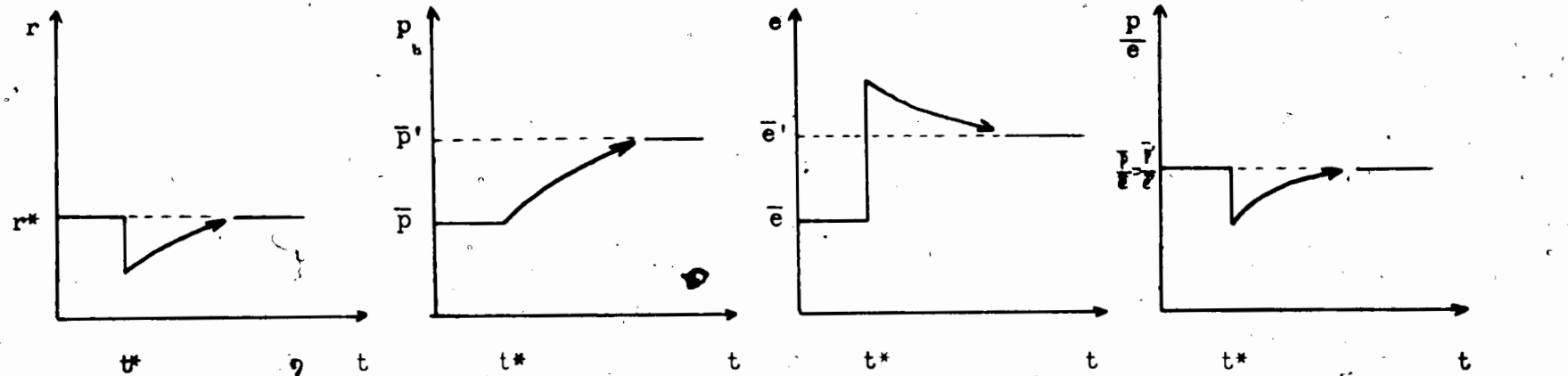
The important implication of this analysis for our purpose -- the study of the forward foreign exchange rate -- is that, during a transitory adjustment period between two long run equilibria, the model predicts simultaneously, in case of monetary expansion above the anticipated long run rate of growth of the money supply:

- a lower level of nominal interest rate than in the Rest of the World
- a depreciation of the domestic currency on the foreign exchange markets.



nominal domestic interest rate | price of domestic output | exchange rate (price of 1 unit of foreign c.) | relative price of domestic and foreign output

(A) Predictions of the model developped in Chapter III



nominal domestic interest rate | price of domestic output | exchange rate (price of 1 unit of foreign c.) | relative price of domestic and foreign output

(B) Predictions of Dornbusch (1976)

Figure 3-4

Effects of an Unexpected Once For All Increase of the Money Supply

Thus, during the adjustment process, the forward exchange rate cannot simultaneously be such that neither international interest arbitrage nor speculation are unprofitable. The analysis of the interaction of arbitrage and speculation for the determination of the forward foreign exchange rate is precisely the subject of the "Modern Theory of the Forward Foreign Exchange Rate", which keeps thus all its relevance despite the validity of the Fisherian theory of the nominal rates of interest and of the purchasing power theory in the long run.

This implication of our model is absent from Dornbusch's original model. As this implication is crucial to justify the framework provided by the Modern Theory to analyze the forward foreign exchange rate, we will devote the next section to a test aiming at assessing the respective relevance of those 2 alternative models. We will then, in Chapter IV, test directly the ability of the Modern Theory of the forward foreign exchange rate to account for the covered arbitrage margin on the U.K. - U.S. and the Canada - U.S. pairs of 3 month Treasury Bills.

Section 3: Empirical Evidence: Monetary Disturbances and Deviations from Purchasing Power Parity.

A. Description of the Test.

In both Dornbusch's model and in the modified model presented in section 2, a monetary shock generates a temporary change in the relative price of domestic and foreign output. The direction of the change, however, is crucially different in each model, as can be seen from figure 3-4. In Dornbusch (1976), an expansionary shock first decreases the relative price of domestic output by inducing a depreciation of the exchange rate. This lower relative price creates then an excess demand for domestic output. Thereafter, the excess demand is progressively resorbed by an increase of the domestic price level which eventually offsets the exchange rate depreciation and restores the initial relative price between domestic and foreign output. In the modified model of section 2, on the contrary, the expansionary shock first increases the price of domestic output relative tc foreign output. This increase of the relative price of domestic output generates a downwards pressure on the domestic currency on the foreign exchange markets as international trade progressively adjusts to the new relative prices, until the movements of the exchange rate offsets the change in the domestic price level resulting from the monetary shock.

This difference in the adjustment mechanism implicit in the two models provides the basis for a test comparing their empirical relevance. The test has been performed by running a regression of the logarithm of the relative price level between two countries on the logarithms of the deviations of the money supply from its "normal" or "expected" value in each country. The "normal" value of the money stock has been computed not only from the time trend, following the line of the theoretical model presented in section 2, but also from an autoregressive projection, to give an indication of the sensitivity of the model to a different specification of the expectations formation mechanism. The regression is a polynomial distributed lags regression based on quarterly data, with lags covering two years. Dornbusch's model predicts that the distribution of the coefficients corresponding to the money supply in the country under analysis should initially be negative and then return to zero, possibly along a cyclical path. The coefficients corresponding to the money supply in the foreign country -- the United States in our test -- should initially be positive. The alternative model developed in the first section of this chapter predicts the opposite distribution of the coefficients. According to both models, the coefficients should return to zero after some time, as in neither of them the monetary disturbances cause permanent deviations from the purchasing power parity.

In addition to the United States, which has been used as the reference country, we have decided to use data from the 10 next most important western countries according to their share in the world trade as computed by the International Monetary Fund for the initial definition of the Special Drawing Right basket: Germany, United Kingdom, France, Japan, Canada, Italy, Netherlands, Belgium, Sweden and Australia. In addition, we decided to add in our sample Iran because the share of this country in the world trade has recently become of the same order of magnitude as a result of the increase in the price of crude oil, and Switzerland because of the importance of this country as a financial center (24).

The period covered by the lags has been set at 2 years because previous work indicates that such a length of time appears to be consistent with the relative version of the purchasing power parity (25).

The data cover the period 1959 I to 1977 IV. 1959 has been chosen as the starting point because it is the first year for which the currencies of the main European countries became fully convertible for current transactions (26).

The period has been divided in two sub-periods to take into account the transformation of the exchange regime in the

seventies and to allow for possible differences in the way monetary shocks affect the relative price levels depending on the international monetary system in force. As the dissolution of the Bretton Woods system has been a gradual process, the choice of the division date is a matter of judgement and is to a certain extent arbitrary. We decided to divide the period at the fourth quarter of 1972, which was the last quarter characterized by relatively orderly conditions on the foreign exchange markets under the old rules of Bretton Woods, although certain currencies, like the pound sterling and the Canadian dollar, were already floating (27). During the next quarter, the second devaluation of the U.S. dollar since the suspension of the gold convertibility of that currency in August, 1971 and a general redefinition of the parities of the main monetary units did not succeed in preventing a major crisis from developing. This crisis caused the closing of the foreign exchange markets for a period of over 2 weeks. From then on, for all practical purposes, the regime of fixed exchange rates for the western world as a whole was abandoned, although 5 more years have been necessary to reconciliate the law with the practice (28). The two sub-periods for which the test has been performed are thus 1959 I - 1972 IV, i.e. the Bretton Woods era, and 1973 I - 1977 IV, i.e. the recent period of managed floating.

The results are reported in the Appendix II, which presents for each country of the sample a representative pattern of adjustment of the relative price level. The multiplicity of the regressions obtained for each country as a result of our using both M1 and M2 as a measure of the money stock and of our computing the "normal" or "expected" money stock alternatively from the time trend or from an autoregressive projection sometimes introduced variations in the results. We had thus to exercise some judgement in selecting the representative adjustment pattern. Noticeable deviations from that pattern are signaled by a note. Occasionally, it will be impossible to draw definitive conclusions from the test for a given country. Nevertheless, the results were usually broadly consistent, whatever the concept of money stock or the expectations formation mechanism used in the regressions. This consistency is especially noticeable for Germany and Italy, two countries for which our data concerning the money stock are fairly homogeneous and, more interestingly, exhibit a particularly regular trend. These two countries are thus especially suitable to test the two models discussed in section 2, both of which assume that the long run rate of growth of the money supply is constant.

B. The Results.

(a) Temporary Character of the Deviations from Purchasing Power Parity Resulting from Monetary Disturbances.

An interesting result of our computations is that the curve of the coefficients of the lagged variables in all the regressions but a very few -- and in all but two of the 24 representative regressions reported in the Appendix II -- suggests that there is a tendency to return to purchasing power parity.

For none of the 12 countries of the sample can we find a consistent set of regressions suggesting a tendency towards a permanent deviation from the purchasing power parity as a result of a monetary disturbance, although the evidence for the Netherlands during the period of flexible exchange rates is ambiguous. Except in the case of the Netherlands, the only discordant notes arise from individual regressions exhibiting a diverging distribution of the coefficients. Those regressions are usually insignificant in terms of the F test and in terms of the individual t values and strongly contrast with the convergent evidence provided by the other regressions for the same country. In our judgement, a few such freak occurences are a natural result from the large number of stochastic

adjustments we tried. The case of the Netherlands is different: Several regressions yield a distribution of the coefficients diverging progressively from the horizontal axis. However, these regressions are poor in terms of the F test. The coefficients of the 2 best regressions in terms of the F test show a tendency to return towards the horizontal axis after 2 years -- but the last coefficients are nevertheless still significantly different from zero. This evidence suggests to us that, in the Netherlands, under the regime of managed floating exchange rates, monetary disturbances generated deviations from the purchasing power parity which were possibly temporary but persisted for periods longer than 2 years. For a few other countries, the deviations from purchasing power parity are also still significant after a period of two years despite the tendency to return towards the initial relative price level. Iran is the clearest illustration of such a case. A lag of two years appears thus to be in some cases too short to reestablish the initial situation after a monetary disturbance.

To sum up, we conclude that, with the exception of the Netherlands, the empirical evidence supports the contention of both Dornbusch's model and the alternative model of section 2 that monetary disturbances cause deviations from the purchasing power parity which are only temporary although these deviations may sometimes persist for more than 2 years.

(b) The 2 Alternative Adjustment Paths of the Relative Price Levels.

We will now examine the test's implications regarding the respective relevance of the two alternative dynamic assumptions which distinguish from each other Dornbusch's model and the model developed in section 2. The case of Germany gives us the opportunity to present first an overview of the findings. We will then proceed to review the results in more details for each of the two sub-periods characterized by different exchange rate regimes.

i) Overview: The case of Germany.

The case of Germany is typical: The indications provided by the whole set of regressions are unanimous -- although they are usually not significant in terms of the F test -- and the results for most of the other countries of the sample are to a large extent consistent with the pattern found for Germany. For Germany, we can draw unambiguously the following conclusions:

1. During the era of managed floating, the empirical evidence is consistent with an adjustment process a la Dornbusch, whatever the origin -- domestic or foreign

-- of the monetary disturbance: an increase of the money supply in Germany over its trend value initially decreases the relative price level in Germany, as implied by Dornbusch's model, in which the exchange rate depreciates initially more quickly than the prices increase; and, symmetrically, a similar disturbance in the United States generates initially an increase of the price level in Germany relatively to the United States, when the prices are expressed in the same currency.

2. For the era of fixed exchange rates, the empirical evidence is consistent with an adjustment a la Dornbusch after a domestic disturbbance originating in the United States and with the alternative adjustment process embodied in the model presented in section 2 in case of a domestic monetary disturbance.

ii) The period of fixed exchange rates: Importance of the origin of the monetary disturbance.

The asymmetry of the adjustment process depending on the origin of the monetary disturbance during the era of fixed exchange rates is noteworthy. The support to the idea that monetary disturbances originating within the United States generates the evolution of the relative price levels implied by

Dornbusch's model is very strong: The results for Australia, Japan, France, Germany, the Netherlands, Sweden and Switzerland unanimously support this hypothesis despite the multiplicity of the regressions tried for each country. If we exclude Belgium, Iran and the United Kingdom for which the evidence is ambiguous in this respect, only 2 countries, Canada and Italy, yield results supporting the alternative adjustment process (29).

When the monetary disturbance is originating within the domestic economy, the regressions for most countries show that the alternative adjustment process prevails. If we except Sweden, Switzerland and the U.K., for which the results in this respect are sensitive to changes in specification, only Italy yielded results suggesting the adjustment a la Dornbusch.

The adjustment a la Dornbusch rests on a high degree of volatility of the exchange rates in case of monetary shocks. The finding that the alternative adjustment process, resting on reaction of the prices faster than the reaction of the exchange rates, prevails in most cases after a domestic monetary disturbance in a regime of "fixed but adjustable" exchange rates, is not surprising. On the other hand, that the adjustment a la Dorbusch appears to have prevailed to such an extent during the "fixed" exchange rates era in case of monetary disturbances in the United States despite the narrow

margins of flexibility of the exchange rates around the parities during most of the period under consideration is somewhat puzzling (30). Those margins seem in fact to have been broad enough to enable the fluctuations of the exchange rates to allow for expected capital gains or losses large enough to compensate interest rate differnetials in case of monetary disturbances occurring in the United States. The explanation probably lies in the leading role of the United States' interest rate for the determination of the interest rates elsewhere in the world under the regime of fixed exchange rate. Thus, while a monetary shock in another country was likely to create a relatively large uncovered interest rate differential between this country and the rest of the world, the effect of a monetary shock in the United States was mainly on the world level of the interest rates. The accompanying interest rate differential, if any, could be of an order of magnitude consistent with the permissible fluctuations of the exchange rates around the parity (31).

iii) The period of managed floating: Relevance of both adjustment processes.

For seven out of the twelve countries of the sample, we observe the time-path of the relative price levels predicted by Dornbusch's model. This pattern characterized the cases of

Germany, Italy, France, the Netherlands, Switzerland, the United Kingdom, and to some extent, Japan (32).

The evidence for Canada and, to some extent, Iran and Australia suggest that the alternative adjustment process, resting on a faster adjustment of the prices, prevails for those countries, whatever the origin of the monetary disturbance (33). In the case of Iran, the policy of the monetary authorities who, in fact, continued to peg the iranian ryial to the U.S. dollar during most of the period under consideration easily account for that result.

For the last 2 countries of the sample, Sweden and Belgium, the test yielded regressions characterized by a low F and a wide range of inconsistent results, suggesting that the models may not be appropriate to analyze the effect of monetary disturbances in those countries (34). The "representative regressions", nevertheless, suggest that an adjustment a la Dornbusch prevails when the disturbance originates in the United States but that the alternative adjustment process applies in case of a domestic disturbance, for Sweden, and that the alternative adjustment prevails in either case for Belgium.

Section 4: Summary and Conclusions.

The evidence presented above shows the relevance of the monetary disturbances -- as measured by the deviations from the trend of the money supply or from an autoregressive adjustment -- to account for the evolution of the relative price levels between countries and for temporary deviations from the purchasing power parity. As a result, the approach taken by the models presented in the second section of this chapter appears more appropriate than alternative monetarist models, based on the law of one price, to analyze the adjustment processes following a monetary disturbance.

The implications of the test are thus not limited to our initial question about the relevance of the "Modern Theory of the Forward Exchange Rate" as an explanation of non zero covered arbitrage margin. Our findings have however specific implications for the answer to that question.

As argued at the beginning of this chapter, the possibility of a divergence between the interest rate differential and the expected rate of appreciation or depreciation of the 2 corresponding currencies is a necessary condition of the validity of the "Modern Theort" approach. Dornbusch's model, contrary to the alternative model

presented in this chapter, precludes such divergence. Hence the importance, for our purpose, to determine which model is consistent with the observed facts, in various circumstances.

Although individual countries may differ somewhat from this pattern, our findings are that, typically, in the recent regime of managed floating exchange rates, the adjustment process following monetary disturbances is consistent with Dornbusch's model, and that in the previous parity regime, the adjustment process is consistent either with Dornbusch's model or with the alternative model depending on the origin of the disturbance: a monetary disturbance originating in the United States typically is followed by an adjustment a la Dornbusch and a domestic disturbance is followed by the alternative adjustment process. The following table summarizes the findings for the individual countries of the sample.

The findings suggest thus that, as a rule -- with possibly important exceptions, in the case of some individual countries -- the "Modern Theory of the Forward Foreign Exchange rate" is not an appropriate framework in which to analyze the forward foreign exchange market under the present exchange rate regime (35)..

Table 3-1: Model consistent with the observed adjustment path of the relative price level between 12 countries and the United States following a monetary disturbance.

Country	Parity Regime (1959 I - 1972 IV) Origin of the disturbance: Domestic		U.S.A.		Appropriateness of the M.T.	Managed Floating (1973 I - 1977 IV) Exchange Rate Regime Origin of the disturbance: Domestic		U.S.A.		Appropriateness of the M.T.
	Dornbusch	Alternative Model	Dornbusch	Alternative Model		Dornbusch	Alternative Model	Dornbusch	Alternative Model	
Australia		X	X		A		X	?	?	A
Belgium		X	?	?	A	?	?	?	?	?
Canada		X		X	A		X		X	A
France	?	?	X		?	X		X		N
Germany		X	X		A	X		X		N
Iran		X	?	?	A		X	?	?	A
Italy	X			X	A	X		X		N
Japan		X	X		A	?	?	X		?
Netherlands		X	X		A	X		X		N
Switzerland	?	?	X		?	X		X		N
Sweden	?	?	X		?	?	?	?	?	?
United Kingdom	?	?	?	?	?	X		X		N

Note: A stands for "appropriate" and N for "not appropriate".

In the parity exchange rate regime, on the contrary, the approach suggested by that theory is potentially meaningful: divergences between interest rates differentials and expected rate of appreciation or depreciation of the various currency are not precluded by the one model of section 2 which is consistent with the reported adjustment processes. The occurrence of such divergences is an empirical question. We now proceed, in Chapter IV, to test directly the empirical relevance of the Modern Theory.

ANNEX TO CHAPTER III: THE EQUATIONS OF THE MODEL

A. Substitutability real assets - domestic bonds:

(1) $r = r^* + z$

interest rate = marginal productivity of capital (exogeneous) + expected rate of inflation.

(2) $z = \zeta(\bar{p} - p) + z^*$

expectations formation; $\bar{p}$ is the long run equilibrium price level, in log; p is the current price level of domestic output, in log.; z^* is the long run rate of inflation, defined as $\dot{\bar{p}}$.

B. The money market:

(3) $-\mu x - \lambda r + \varphi y = m - q$

where x and r are levels and y, m and q are logarithms. Thus (3) is but the log of:

$$\frac{M}{Q} = Y^{\varphi} \cdot \varepsilon^{-\lambda r - \mu x}$$

where ε stands for the Naperian constant and M, Q and Y are levels.

where (2') $x = \theta(\bar{e} - e) + x^*$ x is the expected depreciation rate of the domestic currency unit, and $\bar{e}$ and e are the log of the long run equilibrium exchange rate and the log of the current exchange rate, respectively;

and (3') $q = \alpha p + (1 - \alpha)e$ the deflator of marginal money balances is a weighted average of the price of the domestic output and of the price of the foreign output.

(4) $q - m = -\varphi y + \lambda r^* + \lambda z^* + \lambda\zeta(\bar{p} - p) + \mu\theta(\bar{e} - e) + \mu x^*$ The money market clears and the returns on real assets and domestic bonds are equalized by arbitrage.

(5) $\bar{q} = m + (\lambda r^* - \varphi y + \lambda z^* + \mu x^*)$ as in the long run $p = \bar{p}$ and $e = \bar{e}$. Thus $\bar{Q}$ is homogeneous of degree 1 with respect to M.

(6) $e = \bar{e} - \frac{1}{\mu\theta + 1 - \alpha}(\alpha + \lambda\zeta)(p - \bar{p}) = \bar{e} - \frac{\alpha + \lambda\zeta}{\mu\theta + 1 - \alpha}(p - \bar{p})$

(6') $p = \bar{p} + (\bar{e} - e)\frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\zeta} = \bar{p} - \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\zeta}(e - \bar{e})$

} substituting (5) into (4)

C. The goods market and the relative price adjustment:

(7) $\ln D = u + \delta(e - p) + \gamma y - \sigma(r - z)$ demand function.

(8) $\dot{e} - x^* = -\pi \ln \frac{D}{Y} = -\left\{\pi\left[u + \delta(e - p) + (\gamma - 1)\, y - \sigma(r - z)\right]\right\}$

(9) $\bar{e} = \bar{p} + \frac{1}{\delta}\left[\sigma r^* + (1 - \gamma)\, y - u\right]$ long run implication of (8).

Thus, $\bar{e}$ is homogeneous of degree 1 with respect to $\bar{p}$.

(10) $\dot{e} - x^* = -w(e - \bar{e})$ substituting (9), (2) and (6') into (8)

(11) where $w \equiv \left(1 + \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\zeta}\right) > 0$

The exchange rate adjustment equation (8) can be solved to yield:

(12) $e(t) - \bar{e}(t) = (e_o - \bar{e}_o)\, \varepsilon^{-wt}$

(12') $e(t) = \bar{e}_o + x^* t + (e_o - \bar{e}_o)\, \varepsilon^{-wt}$

(13) $p(t) - \bar{p}(t) = -\frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\zeta}(e_o - \bar{e}_o)\, \varepsilon^{-wt}$ substituting (12) into (6').

D. Consistency with rational expectations:

Conditions:

(14) $\theta = \zeta$ using the derivative of (4) with respect to time and assuming perfect foresight.

(14') $\theta = w \equiv \pi\delta\left(1 + \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\zeta}\right)$ see (10).

(15) $\therefore \theta = \frac{-\alpha + \pi\delta(\lambda+\mu) + \sqrt{[\alpha - \pi\delta(\lambda+\mu)]^2 + 4\lambda\pi\delta}}{2\lambda}$

E. Impact effect of monetary policy:

Taking the derivative of (4) or (6') with respect to m and keeping ϵ constant:

(16) $\frac{dp}{dm} = 1 + \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\zeta}$

With consistent expectations: Substitute (15) for θ and ζ in (16).

FOOTNOTES OF CHAPTER III

(1) This assumption is central to Dornbusch (1976). See also Mathieson (1977) and Bilson (1978). Giddy (1976) provides a theoretical justification for that assumption which rests on a double arbitrage: Arbitrage between comparable domestic and foreign financial earning assets, on one hand, and arbitrage between speculations on the spot and on the forward foreign exchange markets.

(2) See Cornell (1977).

(3) The general structure of this model is similar to Dornbusch (1976). The contents of the 2 models are however very different, as in Dornbusch's model the continuous equality between interest rate and expected rates of depreciation, which we will not assume to hold in our model, play the essential role in the dynamics of the price level and the exchange rate after an increase in the money supply.

(4) Dornbusch's (1976) model can also account for the first phenomenon (divergence between price and exchange rate short run movements) but not for the third one (divergence in the short run between interest rate differentials and rate of dipreciation of the domestic currency on the foreign exchange market). Regarding the second phenomenon, Dornbusch's model predicts, in contrast to ours, that the unexpected increase in the money supply will decrease the price of domestic goods relative to foreign goods.

(5) See however Aliber (1976) which presents a systematic classification of the sources of international monetary diequilibrium.

(6) To facilitate the comparison with Dornbusch (1976) and make the differences in substance more obvious, we will use, as far as possible, the same presentation, and use identical symbols to represent identical concepts. Whenever convenient, comparable equations will be identified by the same number. For the convenience of readers of the numerate variety, the model, stripped of its wordy coat, is repeated in the Annex.

(7) The possibility of a fully anticipated growth trend of the money supply, with its implications for the rate of inflation and the nominal rate of interest, is absent from Dornbusch (1976).

(8) The forward foreign exchange market will not be explicity integrated in the model: the purpose of the model is to provide a broader framework describing short-run

evolutions of the interest rate and expected future spot rate, on which the model of the "Modern Theory" may be consistently grafted.

(9) We assume that storage costs are high enough to preclude speculative profit opportunities from holding inventories of consumption goods.

(10) See infra, paragraph C.

(11) The distinction between short run and long run in this context is not identical to the more traditional distinction between equilibrium and disequilibrium, for the following reasons:
- First, the adjustment process towards the long run equilibrium is sometimes analysed in the literature as a succession of "temporary equilibria" (see for example Kouri (1976)) characterized by the clearing of all markets although clearing prices or quantities exchanged may vary through time as other endogeneous variables change: For example, the stock of wealth, as in Kouri's model, or the expectations formed by the economic actors may change through time in such a way that corresponding changes in various prices may be required for the markets to clear continuously.
- Second, it is possible to conceive disequilibrium cases where the nominal interest rate is indeed equal to the sum of the real rate of interest and of the actual rate of inflation but in which the markets are not cleared.

(12) See for example Calvo and Rodriguez (1977).

(13) An alternative expression for (3) would be

$$\frac{M}{Q} = Y^{\varphi} \varepsilon^{-\lambda r - \mu \pi}$$

where M, Q and Y are the money stock, the deflator of nominal money balances and the real income, and where ε stands for the neperian constant (the symbol e will be reserved for the exchange rate).

(14) This long run relationship will hold whatever the price index used to measure the rate of inflation, as can be seen by taking the derivatives of equation (9) and (3') with respect to time to obtain $\dot{p} = \dot{q}$.

(15) By a convenient choice of the units, we assume that the price level in the Rest of the World is equal to one, in

such a way that its logarithm is zero. Note however that the dimension of this price level must not be overlooked in the dimensional analysis of (7).

(16) Equation (9) is obtained by substituting in (8) the trend values x^*, $\bar{e}$ and $\bar{p}$ for $\dot{e}$, e and p, as is appropriate for the long run. Note that equation (9), equation (5) and equation (3') imply that P as well as Q is homogeneous of degree one with respect to M.

(17) If the long run rate of inflation is not zero, the same diagram can be used if we replace p and e by $p_t / \varepsilon^{x^* t}$ and $e_t / \varepsilon^{x^* t}$ respectively on the axes.

(18) The slope of TT in the space p - e is given by differentiating equation (6') to yield

$$dp = - \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\varsigma} de .$$

Projecting the locus TT is the space q-e yields a curve which may be either negatively or positively sloped but whose slope is lower than +1: Differentiating (3') and substituting the above equation for dp yields:

$$dq = \left[1 - \frac{\alpha (\mu\theta + 1 - \alpha)}{\alpha + \lambda\varsigma} \right] de .$$

(19) Putting $\dot{e} = 0$ in equation (8) and assuming long run price stability, we obtain the following price equation when substituting for the nominal rate of interest its value given by the money market equilibrium condition (3):

$$(13') \quad p = \frac{1}{\varkappa} \left\{ \left[\lambda\delta - \sigma(\mu\theta + \gamma' - \alpha) \right] e + \sigma \left[m - \varphi y + \mu\theta\bar{e} \right] + \lambda \left[\sigma\varsigma\bar{p} + (\gamma - 1) y + u \right] \right\}$$

where $\varkappa \equiv \alpha\sigma + \varsigma\delta + \lambda\sigma\varsigma$.
The slope of this curve in the space p,e will be less than +1. It will be positive if $\lambda\delta > \sigma(\mu\theta + 1 - \alpha)$ and negative otherwise.

(20) As can be seen from this paragraph, the stability of the model requires that, if the slope of the schedule $\dot{e} = 0$ is negative, this curve be less steep than the TT curve: For a given increase of the exchange rate and keeping the money market in equilibrium, the reduction of the price level necessary to maintain the equality between expected yield of domestic bonds and real assets must be greater than the reduction of the price level necessary to maintain the equilibrium on the market for domestic output. Algebraically, the stability condition, derived from (6') and (13'), is:

$$\frac{\lambda\delta - \sigma(\mu\theta + 1 - \alpha)}{\alpha\sigma + \lambda\delta + \lambda\sigma\varsigma} > -\frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\varsigma}.$$

(21) From (4) we have $\dot{q} - \dot{m} = -\lambda\varsigma(\dot{p} - \dot{\bar{p}}) - \mu\theta(\dot{e} - \dot{\bar{e}})$.

As $\dot{m} = \dot{\bar{p}} = \dot{\bar{e}} = z^* = x^*$ and $\dot{q} = \alpha\dot{p} + (1-\alpha)\dot{e}$, we have

$$\dot{e} - x^* = -\frac{\alpha + \lambda\varsigma}{\mu\theta + 1 - \alpha}(\dot{p} - z^*).$$

Consistency of the expectations with the actual evolution of the exchange rate and the price level determined by the model thus requires that

$$\theta(e - \bar{e}) \equiv -\frac{\alpha + \lambda\varsigma}{\mu\theta + 1 - \alpha}\varsigma(p - \bar{p}).$$

Given equation (6), we can write

$$\theta\frac{\alpha + \lambda\varsigma}{\mu\theta + 1 - \alpha}(p - \bar{p}) = \frac{\alpha + \lambda\varsigma}{\mu\theta + 1 - \alpha}\varsigma(p - \bar{p})$$

or $\theta = \varsigma$.

(22) This is apparent when considering this alternative formulation of (15):

$$\theta = \frac{-\alpha + \pi\delta(\lambda + \mu) + \sqrt{\alpha^2 + \pi^2\delta^2(\lambda+\mu)^2 + 2\alpha\lambda\pi\delta - 2\alpha\mu\pi\delta + (1-\alpha)4\pi\delta\lambda}}{2\lambda}$$

(23) The impact effect of the monetary expansion is given by the derivative of (4) or (6') with respect to m, keeping e constant:

$$\frac{dp}{dm} = 1 + \frac{\mu\theta + 1 - \alpha}{\alpha + \lambda\varsigma}.$$

(24) Saudi Arabia would qualify, as Iran, to join the sample, but data were not available.

(25) Lee (1976).

(26) See the annual Report of the Bank for International Settlements, 1959, pp. 184, 188-189.

(27) Canada ceased to guarantee that the 1% margin around the parity would be defended from June 1, 1970. The Pound has been floating since June 1972.

(28) The new Articles of Agreement of the International Monetary Fund, abrogating the parity system devised in Bretton Woods, are in force de jure since the first of April, 1978, only.

(29) The results for Iran are sensitive both to the measure of the money stock and to the method used to compute the "normal" value of the money supply. For Belgium, the adjustment a la Dornbusch prevails in all cases except when the concept of M1 is used both for Belgium and the United States. Given that during the period under consideration, Belgium was characterized by a double foreign exchange market consisting of an official market for current account transactions, on which the exchange rate was fixed, and a free market for the other transactions, the case of Belgium is inadequate to test the models discussed in this chapter, which assume a unique exchange rate for each currency. For the United Kingdom, the regressions yield an adjustment a la Dornbusch when M2 is used to measure the money stock in the United States and the alternative adjustment when M1 is used. We are unable to provide a sensible hypothesis accounting for this difference.

(30) The Articles of Agreement of the International Monetary Fund imposed a margin of 1% around the parity. Up to 1971, most European countries used to maintain their exchange rates within narrower margins, usually .75% around the parity. In 1971 and thereafter, several countries prevailed themselves of margins of 2.25% around the parities or even let their currency float for short periods of time.

(31) In case of a fluctuation band of 1% around the parity, the maximum change of the value of a currency in terms of dollars between any 2 points in time, if there is no modification of the parity, is 2%. The yield of the corresponding capital gains or losses, expressed on a per annum basis, depends of course on the length of the period in which the relevant change occurs.

(32) The "representative regressions" for Japan and the United Kingdom show a pattern a la Dornbusch. In the case of both countries, the evidence is very strong for the case of a monetary disburbance originating in the United States, but the results concerning the effect of a domestic monetary disturbance appear less robust. For Japan, they appear to be highly sensitive to changes in specification. For the United Kingdom, one regression whose quality in terms of R2, F and D.W. is comparable to the "representative equation" presents a pattern

consistent with the alternative adjustment process. The choice of the "representative regression" has been based on the additional evidence provided by the other regressions of acceptable quality.

(33) For Australia, the empirical evidence provided by all the regressions we tried unanimously supports the hypothesis of an adjustment a la Dornbusch in case of a domestic monetary disturbance. The results concerning the effect of a monetary disturbance originating in the United States, on the other hand, are somewhat sensitive to the specification. The representative regression presented in Appendix II is however much better, in terms of R2, F and Durbin Watson ccefficients that the alternative regressions (even after correction for autocorrelation).

(34) As noted earlier, the existence of a double foreign exchange market in Belgium makes the model discussed here inappropriate for this ccuntry.

(35) The most noticeable exception is Canada, for which more evidence will be presented in Chapter IV.

CHAPTER IV : TEST OF THE MODERN THEORY.

Section 1 : Introduction.

Several authors have used the framework provided by the Modern Theory of the Forward Foreign Exchange Rate to assess empirically the importance of speculation in the determination of the forward exchange rate. The equation they estimated is a reduced form of this theory, expressing the equilibrium forward rate as a weighted average of the interest parity forward exchange rate and the corresponding expected future spot exchange rate. The following table 4-1 summarizes the findings of these studies.

As can be seen from the table 4-1, the Canadian dollar has been the favorite subject of investigation by these authors, especially during the period when it was floating (1953 -1960). Despite the fact that these studies were dealing with the same market, their findings regarding the importance of speculation are not unanimous. The results seem sensitive to the estimation method applied in each case and/or to the hypothesis concerning the expectations formation mechanism. One important conclusion that can be drawn from this set of studies, however, is that the interest parity does not appear to be the sole determinant of the forward rate. Even in McCallum's (1977)

TABLE 4-1

Summary of Empirical Tests
Based on the Reduced Form of the
"Modern Theory of Forward Exchange Rate"

(Forward rate explained by the parity rate and the expected future spot rate).

Author and Countries	Exch. Rate Fixed	Exch. Rate Flexible	Speculation Coeff.	Expectations formation	Data
Stein (1965) Canada U.S.A. U.K.	x	x	no estimate, but interest parity is an insufficient explanation of forward rate.	none (difference between spot and expected future spot rate is exogeneous)	-monthly average of daily rates, 1958-1962
Stoll (1968) Canada-U.S.A.	x x	x	Significant but small	adaptative	-weekly data, 1959-64
U.K.-U.S.A.	x		Significant	adaptative	-weekly data, 1959-64
Kesselman (1971) Canada-U.S.A.		x	Significant and large	extrapolative regressive and function of -reserves -relative prices	-weekly and monthly data, 1953-1960
Haas (1974) Canada-U.S.A.		x	Significant		-monthly and quaterly data, 1953-1960
McCallum (1977) Canada-U.S.A.		x	Not significant	"rational expectations"	-as in Kesselman

study, which found the coefficient of the expected future spot rate to be small and not significantly different from zero, the coefficient of the interest parity forward rate is different from unity.

The rest of this chapter is divided in two sections. The next section -- section 2 -- discusses the econometric procedure that will be used for the test : This procedure is similar to the procedure first advocated in the context of the Modern Theory of the Forward Exchange Rate by McCallum (1977), although the specification of the equation we estimate will sometimes be different (1). Section 3 briefly describes the data and report the results of the test performed for Canada and for the United Kingdom, contrasting the periods of floating exchange rates with the period of the parity exchange rates system. The last section concludes the chapter by summarizing the findings.

Section 2 : The Econometric Procedure.

Assuming that trade-hedgers behave like interest-arbitragers, and taking linear functional relationships, we may summarize chapter II by the following system of equations :

$$(1) \quad R = a^* + aA + \varepsilon$$

$$(2) \quad R = s^* + sB + \varepsilon'$$

$$(3) \quad R = v^* + vC + \varepsilon''$$

$$(4) \quad A = B + C$$

where R is the current forward foreign exchange rate,

A is the net demand for forward foreign exchange for arbitrage purpose,

B and C are the net supplies of forward foreign exchange induced by speculation on the future spot rate and on the future forward rate, respectively,

and $\varepsilon, \varepsilon'$ and ε'' are random deviations with the traditional properties.

Equation (1) thus expresses the net demand for forward foreign exchange for interest arbitrage purpose as a downward sloping function of the current forward rate. Equations (2) and (3) express the net supplies of forward foreign exchange for speculative purposes. Equation (4) is the equilibrium condition in the forward foreign exchange market under consideration.

According to the Modern Theory, the intercept a* of the arbitrage function is the forward parity rate and the intercepts s* and v* of the speculation functions are the relevant expected future rates. We have seen in Chapter II that, to be consistent with the principles of the portfolio theory, these hypotheses regarding the speculative schedules require a zero covariance between the prediction errors regarding the appreciation rate of the different currencies on the spot or on the forward markets for a given maturity date.

It will be convenient to rewrite the system (1) to (4) according to the following conventions: The operator E_t will denote expectations, the subscript indicating the date at which the expectation is formed. The symbol R_t^{t+i} will designate the forward exchange rate, expressed as the number of units of domestic currency corresponding to one unit of foreign currency, prevailing at time t for delivery at time t + i. The symbol S_t designates the spot exchange rate prevailing at time t. Thus, for example, $E_t(S_{t+2})$ represents the spot rate expected at time t to prevail 2 periods later, and $E_1(R_2^3)$ represents the value of the forward rate expected in period one to prevail during the period 2 for contracts maturing in period 3. The symbol $(R_t^{t+i})^*$ represents the interest parity forward rate:

$$(R_t^{t+i})^* \equiv S_t \frac{1 + \beta_t^i}{1 + \alpha_t^i}$$

where d_t^i and f_t^i are the domestic and foreign interest rates at the date t on comparable assets arriving at maturity i periods later. Those interest rates are not expressed on an annual basis, but on the basis of a length of time corresponding to i period. These writing convention are somewhat cumbersome so the subscripts and superscripts will be dropped when they can be omitted without causing ambiguity.

We can rewrite the system (1) to (4) for a two-period forward market as:

$$(1') \quad R_t^{t+2} = (R_t^{t+2})^* + a\,A_t + \varepsilon$$

$$(2') \quad R_t^{t+2} = E_t(S_{t+2}) + s\,B_t + \varepsilon'$$

$$(3') \quad R_t^{t+2} = E_t(R_{t+1}^{t+2}) + v\,C_t + \varepsilon''$$

$$(4') \quad A_t = B_t + C_t$$

whose reduced form is

$$R_t^{t+2} = \frac{vs}{vs - va - sa}(R_t^{t+2})^* - \frac{va}{vs - va - sa}E_t(S_{t+2}) - \frac{sa}{vs - va - sa}E_t(R_{t+1}^{t+2}) + \frac{vs - va\varepsilon' - sa\varepsilon''}{vs - va - sa}.$$

which can be written as

$$(5) \quad R_t^{t+2} = \alpha_1 (R_t^{t+2})^* + \alpha_2 E_t(s_{t+2}) + \alpha_3 E_t(R_{t+1}^{t+2}) + \eta_t$$

where $\alpha_1 + \alpha_2 + \alpha_3 = 1$.

This reduced form is the traditional reduced form used by the other tests of the Modern Theory, except that we have an additional variable: the expected future forward rate (2).

If it was possible to observe without error the "explanatory" variables, an ordinary least square regression could provide unbiased estimates of the coefficients of the reduced form, from which consistent (i.e., asymptotically unbiased) estimates of the ratios of the structural parameters could be derived (3).

The forward rate corresponding to the covered interest parity can be computed from the spot exchange rate and the interest rates on comparable earning assets denominated in the 2 currencies under consideration, variables which are observable. The expectations regarding the future exchange rates, however, are not directly observable.

Three possible categories of solutions to obtain an operational measurement of past expectations can be used:

projection based on the historical time series of the variable for which expectations are measured, assuming either adaptative expectations, extrapolative expectations, or a combination of both hypotheses; computation of equilibrium values of the relevant variable from the reduced form of an economic model, given the past and current values of the exogeneous variables; estimate the expected values by the corresponding actual values, assuming "rational expectations".

In this test, we decided to reject the solution provided by the projection of historical values of the exchange rates, despite its operational convenience, because of its lack of theoretical content. The second method, based on the reduced form of a theoretical model, implicitly requires an estimate of the exogeneous variables in the future and thus displaces the problem of estimating inobservable future variables without solving it. In addition, using this procedure would make it impossible to interpret the outcome of the test in terms of the "Modern Theory" alone. The test would indeed be a test of the joint hypothesis consisting of the Modern Theory of the forward exchange rate, on one hand, and of the model used to generate the expectations, on the other hand. We decide thus to use an estimate of the expected values of the relevant variables based on the "rational expectations hypothesis". In addition to its operational simplicity, this solution presents the advantage of

being consistent with the traditional axiom of rationality of the economic actors as it implies that no publicly available information indicating profit opportunities is left unexploited.

Assuming "rational expectations", we may divide the value of actual exchange rate at a given date t+1 into 2 components: The first element is the expected value of this exchange rate implied by all the available information on the state of the world at time t, and the second element is the deviation from that value resulting from new information becoming available during the interval between t and t+i. As this new information is by nature unpredictable at time t, it occurs randomly and we may assume that the deviations it generates from the previously expected values are normally distributed with a zero mean (4).

Thus we write:

$$(6) \qquad S_{t+j} = E_t(S_{t+j}) + \mu_t$$

$$(7) \qquad R_{t+i}^{t+j} = E_t(R_{t+i}^{t+j}) + v_t \qquad \text{with } j > i$$

where μ_t and v_t are assumed uncorrelated with the variables which determine the relevant expectations.

This approach to the measurement of expectations allows us to rewrite the reduced form (5) as:

$$(8) \quad R_t^{t+2} = \alpha_1 (R_t^{t+2})^* + \alpha_2 S_{t+2} + \alpha_3 R_{t+1}^{t+2} + \gamma_t$$

where $$\gamma_t \equiv \eta_t - \alpha_2 \mu_t - \alpha_3 \nu_t \qquad (5).$$

All the variables appearing in this equation are observable. However, as can be seen from equations (6) and (7), the disturbance γ_t will not be uncorrelated with the variables S_{t+2} and R_{t+1}^{t+2} and, consequently, the ordinary least square estimators of the coefficients would be biased and inconsistent. The instrumental variables estimation technique can be used to obtain consistent estimates of the coefficients of the reduced form, provided instrumental variables correlated with the explanatory variables but not with the disturbance are available.

The "rational expectations hypothesis" implies that the error in forecasting is not correlated with the variables contained in the stock of information already available at the time expectation is formed. It follows thus from this hypothesis and from equations (6) and (7) that if such variables, or combination of them, are correlated with S_{t+2}

and R_{t+i}^{t+j}, they will also be correlated with $E_t(S_{t+j})$ and $E_t(R_{t+i}^{t+j})$. Such variables, or combinations of them, are thus potentially legitimate instrumental variables for our purpose.

We will thus use as instrumental variables for S_{t+2} and R_{t+1}^{t+2} in the estimation of equation (8) a constructed variable obtained by regressing S_{t+2} and R_{t+1}^{t+2}, respectively, on the forward parity rate and on current and lagged values S_θ and $R_{\theta-1}^{\theta}$ where $\theta \leqslant t$, t being the date at which the expectations are formed. Such a procedure is seemingly close to the traditional technique based on an adaptative expectations model, an extrapolative expectation or a broader economic model and using past values of variables to estimate unobservable "expectations". There is however a fundamental difference as, in our framework, the resulting variable does not need to be interpreted as an "expectation" and, accordingly, the validity of the test will not be jeopardized if the equation used to construct the variable does not correctly describe the process of expectations formation: Altough the estimators of the coefficients of the reduced form will be the same in both cases, the tests of significance will be based on different residuals and will not rely on the assumption that the instrumental variable measures the original variable (6).

Section 3: Empirical Evidence: United Kingdom and Canada

A. The Data

The test described in the previous section has been performed for the United Kingdom and for Canada, with the United States as the country of reference. We used weekly data covering the period 1960-1977 (7). Separate regressions have been run for the period of floating exchange rates and for the period of fixed exchange rates.

We have discussed in the previous section our procedure to measure the expected future spot rate and the expected future forward rate, variables which are not directly observable. We will return to this subject later, when discussing the implications of our results. The remaining explanatory variable, the interest parity forward exchange rate, can be computed from the actual spot exchange rate, the domestic interest rate and the foreign interest rate. These variables are directly observable, but the multiplicity of the existing pairs of interest rates available requires us to make a choice regarding the appropriate empirical counterpart of "the" domestic and foreign interest rates of the theoretical model (8).

As widely recognized, the essential characteristic of the conceptual interest rates of the model is that both the domestic and the foreign interest rates are similar in all respects except the exchange risk resulting from the fact that the corresponding assets are denominated in different currencies. Thus, interest rates on earnings assets whose risk characteristics vary not only because they are denominated in different currencies but also because different debtors typically represent different default risks are inappropriate to test the relevance of the Modern Theory of the Forward Exchange Rate. Most earning assets, including debts of financial intermediaries whose operations are concentrated on a domestic market, belongs to that category. On the other hand, interest rates on liquid debt of governments, denominated in the national currency, and short term debt issued by leading banks whose portfolios are internationally diversified closely approximate the concept of interest rate implicit in the theoretical model of the Modern Theory. Thus, Treasury Bills rates or rates on deposits in eurocurrencies are the closest empirical approximation of the theoretical concept of "interest rate" of the model. Empirical work on the Modern Theory of the Forward Foreign Exchange and on the Interest Rate Parity typically uses one of these two categories of interest rates (9).

The institutional characteristics of the market for euro-deposits and euro-loans are such that the tendency towards covered interest rate parity is very strong between interest rates on deposits denominated in various currencies with eurobanks (10). Indeed, in normal circumstances, swaps of currencies and lending or borrowing of the corresponding currencies on the euro-deposits market have identical effects on the foreign exchange position and the liquidity position of the eurobanks, in such a way that for any bank the two sets of transactions are perfect substitutes. For example, a bank in London which has accepted a three month deposit in dollars may hedge itself either by granting a three month loan in dollars or by selling dollars spot for another euro-currency or for sterling and buying forward an equivalent amount of dollars for delivery in three months. Although currency swaps -- i.e., buying or selling currencies -- are in principle transactions of a different nature than lending and borrowing, currency swaps -- and, thus, the forward sector of the foreign exchange market -- have developed recently tc such an extent as a result of interest rate arbitrage by the eurobanks that some analysts suggest that interest rate differentials on euro-deposits in various currencies and the swap rates (11) are intrinsically identical (12). A less extreme view according to which the swap rates and the interest rates on eurocurrency deposits are distinct concepts but are simultaneously determined is shared

by most authors on the subject (13). In any case, there is a concensus in the literature that interest rates on euro-currencies (other than the eurodollars) cannot be considered as exogenous and consequently it would be inappropriate to use the interest rates on eurocurrencies to compute the interest parity forward rate for the purpose of the test set up in the previous sections (14). We will rather use the Treasury Bill Rates, following in this a common practice in the empirical literature of the Modern Theory of Forward Rate (15).

B. The Results

The following tables summarize the results. As the strong colinearity between the expected future spot rate and the expected future forward rate, rather than the possible irrelevance of speculation, could account for insignificant coefficients for those variables when they are introduced together in the same regression, we present here separate regressions using alternatively the expected future spot rate and the expected future forward rate as the speculative variable (16). The regressions incorporating both speculative variables are reported in Appendix V (17). For each country, we present the regressions computed on the untransformed variables (equations (1) to (4)) and also the regressions on

the logarithms (equations (5) to (8)), giving the relevant elasticities. Both specifications yield almost identical results, except in one case (equation 8 of table 4-3) where the transformation in logarithm greatly increases the standard error of the coefficients.

1) Canada

The results of the test for Canada are reported in table 4-2. Those results are strikingly consistent with the prediction of the model that the sum of the coefficients must be equal to unity: in all cases, the sum of the estimated coefficients is very close to unity, despite the fact that no constraint was imposed to that effect, and the observed deviations from unity are not significantly different from zero according to the t test (18). For none of the three subperiods retained in our analysis is the coefficient of the interest parity forward rate significantly different from unity, nor is the coefficient of the expected future rate significantly different from zero. The estimates of the coefficients appear very accurate in the case of both periods of floating exchange rate, as their standard deviations are very small. For both periods, the results are almost identical to each other and they are furthermore very similar to the results reported by

Table 4-2 Canada/U.S.A.

Dependent Variable: 90-day forward exchange rate

	Exchange Regime	Constant	Parity Rate*	Expected future spot rate	Expected future forward rate	ρ	DW	Number of observations	R^2	Standard error of the regression
Variables in Absolute Values										
(1)	Parity Regime	-0.1225 (-0.30)	0.8724 (7.35)	0.2576 (0.60)	-	0.98	2.33	420	0.946	0.0008
(2)	First period of floating exchange rate	-0.0021 (-0.25)	0.9875 (52.20)	0.0155 (0.92)	-	0.77	2.11	106	0.999	0.0006
(3)	Second period of floating exchange rate	0.0191 (1.57)	0.9813 (22.47)	-0.0007 (-0.014)	-	0.75	2.30	383	0.996	0.0008
(4)		-0.0063 (-0.38)	0.9314 (14.63)	-	0.0761 (1.14)	0.71	2.36	174	0.996	0.0019
Variables in Logs.										
(5)	Parity Regime	0.0088 (0.28)	0.8770 (7.36)	0.2676 (0.58)	-	0.98	2.33	420	0.945	0.0009
(6)	First period of floating exchange rate	0.0009 (2.92)	0.9888 (53.33)	0.0138 (0.85)	-	0.76	2.11	106	0.999	0.0006
(7)	Second period of floating exchange rate	-0.0003 (-1.06)	0.9814 (22.51)	-0.0008 (-0.02)	-	0.74	2.29	383	0.996	0.0014
(8)		0.0012 (1.96)	0.9348 (14.99)	-	0.0705 (1.09)	0.70	2.34	174	0.996	0.0019

* None of the coefficients of the parity rate are significantly different from unity, even at the level 10%, according to the t test.

McCallum (1977) for the periods 1953-1960 and 1953-1962 (19). The empirical evidence thus suggests that, during periods of floating exchange rates in Canada, the forward exchange rate is determined by the arbitrage on interest rates (20). The evidence of the period corresponding to the parity exchange rate regime is not inconsistent with this view but, given the large standard errors of the estimated coefficients, no definitive conclusion can be drawn for this period (21).

2) The United Kingdom

(i) Relevance of speculation as a determinant of the forward exchange rate under the parity regime.

For the United Kingdom, the estimated coefficients, which are reported in table 4-3, show important differences between the period characterized by the parity exchange rates regime and the period of floating exchange rates. For the parity regime period, the coefficient of the expected future exchange rate is small relatively to the coefficient of the interest-parity rate, but it is significantly different from zero. Furthermore, the coefficient of the interest-parity rate is significantly different from unity. The test thus suggests that, during the period of the parity exchange rates regime, in the case of the Pound, speculation has been responsible for

Table 4-3: United Kingdom/U.S.A.

Dependent Variable: 90 day forward exchange rate

	Exchange Rate Regime	Constant	Parity Rate	Expected future spot rate	Expected future forward rate	ρ	DW	Number of observations	R^2	Standard error of the regression
Variables in Absolute Values										
(1)	Parity Regime	-0.0741 (-3.72)	0.9375 * (30.59)	0.08996 (2.68)	-	0.82	2.16	636	0.9991	0.0055
(2)		-0.0781 (-3.67)	0.8880 ** (32.20)	-	0.1409 (4.73)	0.83	2.08	636	0.9990	0.0060
(3)	Floating Exchange Rates	-0.0410 (-0.524)	0.9117 (5.261)	0.1053 (0.508)	-	0.92	2.33	274	0.9996	0.0060
(4)		+0.0175 (0.179)	1.0618 (4.478)	-	-0.0730 (-0.259)	0.84	2.29	274	0.9997	0.0050
Variables in Logs										
(5)	Parity Regime	-0.0295 (-3.84)	0.9378 * (28.39)	0.0918 (2.53)	-	0.82	2.17	636	0.9990	0.0023
(6)		-0.0313 (-3.76)	0.8822 ** (29.44)	-	0.1493 (4.61)	0.83	2.09	636	0.9988	0.0025
(7)	Floating Exchange Rates	-0.0154 (-0.61)	0.9190 (5.22)	0.0981 (0.47)	-	0.91	2.41	274	0.9996	0.0029
(8)		0.0297 (0.18)	1.4812 (0.63)	-	-0.5278 (-0.20)	0.94	1.83	274	0.9979	0.0068

* Significantly different from 1 at the 10% level.

** Significantly different from 1 at the 1% level.

deviations of the covered arbitrage margin from zero, as predicted by the "Modern Theory of the Exchange Rate", although the weight of interest arbitrage was predominant in the determination of the forward exchange rate: The elasticity of the forward exchange rate with respect to the interest parity rate is about .9 and the elasticity with respect to the expected future rates is .1 only. For the period of flexible exchange rate, on the contrary, the estimated coefficients of the expected future exchange rates are not significantly different from zero and the coefficients of the interest parity forward exchange rate are never significantly different from unity. It is thus not possible to reject the hypothesis that, during the recent period of flexible exchange rates, speculation did not cause any systematical deviations of the forward exchange rate from the value corresponding to the interest rate parity (22).

(ii) The nature of speculation on the forward foreign exchange market.

A comparison of the estimated coefficients of the expected future spot rate and the expected future forward rate for the period corresponding to the parity regime -- i.e. for the period during which speculation played a significant role in the determination of the forward exchange rate -- sheds some

light on the nature of speculation characterizing this period. The coefficient of the expected future forward rate is greater than the coefficient of the expected future spot rate and, more importantly, the standard deviation of the estimated coefficient of the expected future forward rate is smaller than that of the coefficient of the expected future spot rate. This evidence suggests that the expected future forward rates are a better proxy to measure speculative activity on the forward foreign exchange market than the expected future spot rate: Speculation on the future forward rate, whose relevance for the Modern Theory of the Forward Exchange Rate has been discussed in Chapter II, is not only a theoretical possibility but appears also to be empirically relevant. Surprisingly, all empirical tests of the Modern Theory have focussed so far only on the speculation on the future spot rate.

Two reasons explain the prevalence of the speculation on the future forward exchange rate over the speculation on the future spot rate under the parity exchange rate regime:

1. During normal circumstances when no changes in the parity are expected, the fluctuations of the forward exchange are potentially much larger than the fluctuations of the spot rate, whose movements are legally maintained by the monetary authorities within a band of not exceeding 1%

around the parity. The speculative gains per unit committed in the speculative transactions are thus potentially greater in case of speculation on the future forward rate and minor errors in the forecast will not wipe out entirely the expected profits. In the limit case where spot exchange rates are strictly maintained at the parity, speculation on the future forward rate would be the only meaningful form of speculation on the forward foreign markets, except when a modification in parity is expected.

2. It is relatively easy to forecast changes in the interest rate differential between two countries by assessing what their respective economic policies are likely to be in the future, on the basis of available information on the balance of payments of each country and on their position on the trade cycle. In addition, as the test has shown, interest arbitrage is the main determinant of the forward premium or discount and a forecast of the future interest rate differential can thus be readily used to form a forecast of the future premium or discount on the forward foreign exchange markets. If the institutional arrangements are such that in the future exchange rates will be kept approximately at their present level, as is the case in a parity regime, then it is easy to form a forecast of the relevant future forward exchange rate on the basis of the expected forward premium or discount. In

a regime of flexible exchange rates, on the contrary, in addition to the fact that it is more difficult to predict the changes in interest rates as the monetary authorities have more freedom in the choice of their policy instruments, a correct forecast of the future premium or discount on the forward foreign exchange market is not sufficient to predict correctly the corresponding future forward rate because the same forward premium or discount is consistent with any forward rate, depending on the value of the spot rate which will obtain at the relevant date.

(iii) Two findings contrary to the pedictions of the model.

The model of the Modern Theory tested in this Chapter predicts that the constant term of the reduced form is zero and that the sum of the coefficients of the independent variables is equal to unity. For the regime of fixed exchange rate in the United Kingdom, the T test indicates that, at a level of significance of 1%:

1. The constant terms of the regressions are significantly different from zero.
2. The sum of the coefficients of the independent variables is significantly different from unity, although the deviations are relatively small (23).

With a risk of error inferior to 1%, we may thus reject the hypothesis that, for the pound sterling during the period under consideration, the observed discrepancies between our estimates and the prediction of the model result merely from random disturbances. It is thus reasonable to assume that those discrepancies are the systematic consequence of some factors neglected by the model we tested. In the following paragraphes, we suggest possible explanations for those discrepancies.

The constant terms of the regressions run for the United Kingdom under the parity regime of foreign exchange rates are of an order of magnitude which is not negligible: About 3% of the spot rate. Such results may indicate that importers and exporters, or a proportion of them, cover themselves systematically on the foreign exchange market (24). However, it is unlikely that this traditional argument is the correct explanation in the case at hand, for two reasons:

1. Assume that the exchange rate for which trade would be in balance is relatively constant during the period under consideration, for example at a level close to the new parity of the Pound decided in november 1967. Then, if the forward exchange rate was indeed a weighted average of the balanced trade rate, of the interest parity forward rate and of the expected

future rates, the constant term would be positive and the sum of the other coefficients would be smaller than unity. As can be seen from table 4-3, this is in fact not the case: The sum of those coefficients is slightly larger than unity, and significantly so according to the t test.

2. In the absence of speculation, trade by itself could not reasonably be expected to produce deviations from the covered interest parity of an order of magnitude of 3% per quarter (12% per year).

With a risk of error inferior to 1%, we may thus reject the hypothesis that, for the pound sterling during period under consideration, the observed discrepancies between our estimates and the prediction of the model result merely from random disturbances. It is thus reasonable to assume that those discrepancies are systematic consequence of some factors neglected by the model tested. In the following paragraphes, we suggest possible explanations for those discrepancies.

A more satisfactory explanation is found in the argument that the interest rate is not the only component of the yield of British Treasury Bills for their holders. First, for banks in all countries, holding a certain amount of the debt issued by the government undoubtedly is necessary to maintain the

goodwill of the authorities towards the banks and their privileges. This is probably more so in the United Kingdom than in other countries given the traditional importance of the "gentlemen's agreements" between the Treasury, the Bank of England, and the London Clearing Banks in the elaboration of the institutional rules and in the implementation of the monetary policy (25). Second, and more importantly, Treasury Bills are eligible for inclusion in the cash and "liquid assets" portfolio that the Clearing Banks were required to hold in proportion of 28% of their assets from 1955 up to the credit reform of September 1971 (26). Thus, during that period, when deciding between an investment in a Treasury Bill or an alternative investment in another earning asset not eligible for inclusion among the "liquid assets", the Clearing Banks have to compare not only the direct yields of both investment but also the possibility of generating additional income by substituting the Treasury Bill for cash in the required 28% reserve of cash and liquid assets and by investing the equivalent amount (27). These two reasons lead to an actual yield on U.K. Treasury Bills held by Clearing Banks superior to the nominal yield expressed by the interest rate. If the elastic range of the arbitrage schedule of those banks is larger than the elastic range of the arbitrage schedule of the other wealthholders, the difference between actual and nominal yields on the U.K. Treasury Bill for the Clearing Banks

implies that, for the period corresponding to the fixed exchange rate regime, the equilibrium forward rate will be lower than the parity rate even if the parity rate and the expected future rates are equal. This is precisely what the negative constant terms reported on table 4-3 indicate.

The second fact inconsistent with the theoretical model, i.e. the fact that the sum of the coefficients is significantly larger than one under the parity regime and occasionally under floating exchange rate, as suggested by equation (4), may indicate a specification error. The existence of official intervention provides a plausible explanation to the extent that official purchases of domestic currency on the forward foreign exchange market are a substitute to higher domestic interest rate as an instrument to reduce capital outflows: We can then expect official purchases of domestic currency forward to be negatively correlated with the interest parity rate. As the government's forward purchase of the domestic currency, ceteris paribus, results in a lower forward exchange rate, the negative correlation between interest parity rate and official purchases of the domestic currency implies that the specification of the equation estimated in this chapter implies an upward bias in the estimator of the coefficient of the interest parity rate for the periods where the monetary authorities did intervene on the forward foreign exchange market to support the Pound (28).

C. Autocorrelation and Measurement of Expected Exchange Rates.

Whatever the country or the period under consideration, all regressions exhibit a strong autocorrelation: the coefficient is confined between 0.82 and 0.94 for the United Kingdom and between 0.70 and 0.98 for Canada. This autocorrelation is not necessarily the result of the influence of a missing variable or of an error in the specification of the functional form of the regression, as is usual. The method used to measure the expected future exchange rates and the assumptions on which it is based indeed imply the existence of positive autocorrelation of the residuals. In the following discussion, we will argue in terms of the expected future spot rate, but the same reasoning applies to the case of the expected future forward rate.

We have seen that the error term of the estimated equations is $\gamma_t \equiv \eta_t - \alpha_2 \mu_t - \alpha_3 v_t$ (29)

where μ_t and v_t represent the gap between the expected future exchange rates and their actual future values. Thus, from equation (6), we see that

$$\mu_t = S_{t+j} - E_t(S_{t+j})$$

We argued in the first section of this chapter that μ_t was randomly distributed, with an expected value of zero, as

implied by the assumption that the expectations regarding the future exchange rates are formed under the basis of all information available at the time they are formed. Of course, as new information becomes available, the actors will revise their forecast on the basis of the new information, until eventually the actual exchange rate is known without error.

Let use define i_{t+j} as the new information becoming available during the "day" t + j, where i is positive when the new information implies, ceteris paribus, that the future exchange rates will be higher than forecasted so far and is negative in the opposite case (30). We can then express the initial forecast error μ_t as a function of all the new information becoming available during each of the T days between the date of the initial forecast and the date t + T for which the forecast is made. Thus

$$(9) \quad \mu_t = f(i_{t+1}, i_{t+2}, \ldots i_{t+T})$$

with all first partial derivatives positive. Similarly,

$$(10) \quad \mu_{t+1} = f(i_{t+2}, i_{t+3}, \ldots i_{t+T}, i_{t+T+1}).$$

As can be seen from (9) and (10), the errors of two consecutive forecasts of the future spot rates T periods later will systematically be the result of the same causes, except for the information becoming available during the first period -- i.e.

during the length of time between the two forecasts -- and during the last period -- i.e. during the two dates for which the forecasts were made. As in our empirical work we used weekly data and focussed on the 90 days forward foreign exchange market, 86% of the information accounting for the error of either of two consecutive forecasts of the future spot rate must be expected to cause errors in both these forecasts, and 80% of the new information accounting for the error of either of two consecutive forecasts of the future one month forward rate two months later must be expected to cause errors in both forecasts (31). If the main component of the error term in the equation (8) we estimated is the error resulting from measuring the expectations by the actual, realized values of the corresponding exchange rate rather than the error of the theoretical specification (5), we would expect a level of autocorrelation of an order of magnitude equivalent to what we observe in Tables 4-2 and 4-3.

The interest of this analysis is not only to provide an explanation for the observed auto-correlation, but also to suggest a correction to improve our measure of the expected future exchange rates for the period of fixed exchange rates. The correction suggested by the analysis is to add to the realized spot rate a proportion of the ratio of residuals of the regression (1) for the period t - 1 over the estimated

coefficient of the expected future spot rate. A corrected series of the expected future forward rate can be generated following a similar precedure using regression (2). Given the potential value of series of indenpendent estimates of expected future exchanges rates for researchers engaged in the analysis of short term capital movements and of speculation on the foreign exchange markets, we record in Appendix VI a series of expected spot and forward exchange rates of the pound sterling generated according to this procedure for the period corresponding to the parity regime. We limited our computations to the case of the pound sterling under the parity regime because only this case is characterized by a coefficient of the expected future rates significantly different from zero.

D. An Unsolved Problem: The Non Zero UK -USA Covered Arbitrage Margins under Floating Exchange Rates

The following Table 4-4 records the average covered arbitrage margin and its variance, both in absolute value or in algebraic terms. Of special interest is the mean of the series in absolute values, which measures the average deviation from the interest parity, and the variance of the series in algebraic values, which is an indication of the variability of the covered arbitrage margin.

Table 4-4: Mean and variance of the covered arbitrage margin, 1960-1977

		MEAN (series in algebraic values)	VARIANCE (series in algebraic values)	MEAN(*) (series in absolute values)	VARIANCE (series in absolute values)
CANADA	First period of floating	0.2455	0.1146	0.3313	0.0646
	Parity regime period	0.0531	0.2987	0.3950	0.1451
	Second period of floating	-0.1199	0.7550	0.6543	0.3401
U.K.	Parity regime period	-0.2594	2.2358	0.8017	1.6594
	Floating exch. rate period	-1.3588	2.6017	1.5343	2.0652
	Parity regime, before the devaluation of Nov. 1967	0.1321	0.2821	0.3766	0.1575
	Parity regime, after the devaluation of Nov. 1967	-0.9298	4.8818	1.5298	3.3999

* This mean is conceptually similar to the "minimum gross profit to activate arbitrage" estimated by Branson (1969). The only differences are that Branson arbitrarily used monthly averages of weekly data observations of interest rate differentials and forward premia before computing the mean of their difference in absolute value and that he excluded observations corresponding to speculative periods in the case of the U.K.

For Canada, the means of the covered arbitrage margin in absolute values are small, as are the variances. This finding adds additional support to the proposition that arbitrage is the sole determinant of the forward rate, as suggested by the results already reported in Table 4-2. The observed discrepancies may be readily explained by unavoidable measurement error (32). For the United Kingdom on the contrary, the average deviation from the interest parity and its variance are much larger, especially during the period which followed the devaluation of the Pound in November 1967 and during the recent period of floating exchange rates. The observed large deviations from interest parity after the devaluation of November 1967 are consistent with the results of our test, which indicated that speculation was a factor whose influence of the forward exchange rate was significant under the parity exchange rate regime for the United Kingdom (33). The large deviations observed during the period of floating exchange rate, however, are still to be explained. In the next chapter, we complement the experiment performed here by a test aiming at explaining the large deviations from interest parity observed during the period of floating of the Pound by the transactions costs on the foreign exchange markets.

Section 4: Summary and Conclusions.

After an introduction summarizing the findings of previous tests reported in the existing literature, we have stated, in section 2, the equation formalizing the "Modern Theory of the Forward Exchange Rate", according to which the forward exchange rate is determined by the interaction of interest arbitrage and speculation, and we have justified the econometric technique used. The two distinguishing features of the test are:

1. the use of the expected future forward rate as well as of the expected future spot rate, when data were available;
2. the use of the actual, realized exchange rates, together with an instrument variable, as a measurement of the corresponding exchange rate, following McCallum (1977).

In section 3, we have discussed the choice of the relevant interest rates to be used empirically and we presented the results of the test for the United Kingdom and Canada, distinguishing the periods of floating exchange rate and the periods of fixed exchange rate. The results are on the whole remarkably consistent with the prediction of the model, except in the case of the pound sterling under the parity regime for which small but significant discrepancies between the estimated coefficients and their theoretical values were observed. Nevertheless, except for the case of the Pound under the parity

exchange rate regime, there is no evidence that speculation is a significant factor in the determination of the forward rate and that the "Modern Theory of the Forward Exchange Rate" is superior to the earlier Covered Interest Parity Theory. In the case of the Pound under the parity exchange rate regime, on the contrary, speculation, and particularly speculation on expected future forward rates, appears to have had a significant effect on the forward exchange rates, demonstrating the relevance of the Modern Theory in that specific instance.

The test left unexplained the large covered arbitrage margins between U.S. Treasury Bills and U.K. Treasury Bills which have occurred during the period of floating of the exchange rate of the Pound. In the next chapter we will inquire whether the transaction costs on the foreign exchange markets are empirically relevant to account for those large deviations.

FOOTNOTES OF CHAPTER IV

(1) McCallum, like the other authors who have presented tests of the Modern Theory, does not include the expected future forward rate among the explanatory variables determining the forward rate. For a justification of the inclusion of this variable, see our discussion in Chapter II.

(2) McCallum (1977) has shown that even if the spot rate, implicit in R*, is not exogeneous but simultaneously determined with the forward rate, the parity forward rate may be expressed as a function of exogeneous and predetermined variables only. Equation (5) is thus really a reduced form.

McCallum has also shown that if traders hedge on the forward market rather than as arbitragers the reduced form may exhibit a constant term. If, furthermore, the balance of trade depends on the current level of the forward rate, then the sum of the coefficient will be smaller than 1.

(3) The system being underidentified, we could not derive estimates of the structural parameter. Estimating ratios of those parameters is however sufficient to compare the relative influence of interest arbitrage, speculation on the future spot rate and speculation on the future forward rate in the forward foreign exchange market.

(4) The procedure described here to measure exchange rate anticipations and to construct an appropriate instrumental variable has been applied already by McCallum (1977). The model developped in Chapter III is consistent with rational expectations and there is thus no contradiction between this procedure and our reasoning of Chapter III.

(5) γ_t being a linear combination of normally distributed variables is itself normally distributed. See Goldberger (1964), page 106.

(6) The identity of the estimators of the coefficients in both cases can be proved as follows:
Define the predicted values from a regression of X on Z as

$$\hat{X} = Z(Z'Z)^{-1}Z'X$$

where X are the original variables and Z is the matrix of the instruments. The estimators of the coefficients of a regression of y on $\hat{X}$ is then:

$$\hat{b} = (\hat{X}'\hat{X})^{-1}\hat{X}'y$$

$$= ((X'Z)(Z'Z)^{-1}Z'Z(Z'Z)^{-1}Z'X)^{-1}(X'Z)(Z'Z)^{-1}Z'y$$

$$= (Z'X)^{-1}((Z'Z)(X'Z)^{-1}(X'Z)(Z'Z)^{-1})Z'y$$

$$= (X'Z)^{-1}Z'y.$$

Thus $\hat{b}$ is identical to the instrumental variables estimator. The residuals will be different depending on the specification of the model: Should $\hat{X}$ be the matrix of the explanatory variables, the residual would be $e = Y - b\hat{X}$; but if X is the matrix of the explanatory variables, the residuals will be $e = Y - \hat{b}X$.

(7) The sources of the data are given in the Appendix III.

(8) Einzig (1967), Chapter 11, reviews the main pairs of short-term interest rates which may be relevant to arbitragers.

(9) The Treasury Bills Rates have been used by Branson (1969), Haas (1974), McCallum (1977), Kesselman (1971), Stein (1965), Stoll (1968) and Pippenger (1978), who also used commercial paper rates; the euro-currency rates have been used by Aliber (1973) and Frenkel and Levich (1975 and 1977); Grubel (1966) has used the Treasury Bills Rates (U.S. and U.K.), the three month banker's prime acceptance rates, the three month finance paper rate (U.S.), the three month prime commercial paper rate (U.K.) and the day to day rates (U.K.).

(10) See Aliber (1973) and Frenkel and Levich (1975).

(11) The swap rate is defined as the difference between the forward and the spot exchange rate of the corresponding currencies, expressed as a yield per annum.

(12) This view characterizes the "Cambist School." A detailed institutional analysis within the framework of the Cambist school is found in Prissert (1977). Prissert and Coulbois (1976) draw the theoretical implications of this view and contrasts them with the implications of the "Modern Theory". For a discussion see Schep and Smits (1976).

(13) For a theoretical model of the eurocurrency markets and their interaction with the forward exchange and national money markets, see Herring and Marston (1977), chapter 4, or Herring and Marston (1976). For descriptive exposition of the subject, see Einzig and Quinn (1977), chapters 7 and 15. The behaviour of the dealers actually

engaged in these transactions, as reported by Herring and Marston (1976), p. 140, illustrates the inherent simultaneity in the relationship between the forward rate and Eurocurrency rates: "In a series of interviews we conducted at a major New York Bank, we found that Eurocurrency and forward-exchange traders each based quotations in their own market on rates established in the other market. Foreign-exchange traders said that Eurocurrency rate differentials determined the forward rates that they quoted, while Eurocurrency traders said that forward exchange rates determined differentials between non-dollar Eurocurrency rates and the Eurodollar rate."

(14) A quotation from Einzig and Quinn (1977), p. 46, summarizes the consensus: " (...) more often than not, Euro-sterling rates are determined by the interplay of forward rates and Euro-dollar rates. They are the effect rather than the cause of changes in forward rates and never the cause of changes in Euro-dollar rate. There has always been a certain degree of reciprocity in the relationship between interest parities and forward rates, the latter influencing the other in some measure as well as being influenced by them. But the extent to which changes in Euro-sterling rates are the effect of changes in forward rates is much more pronounced than the extent to which forward rates normally affect national interest rates".

(15) See Kesselman (1971), Haas (1974), Stein (1965), Stoll (1968), Pippenger (1978), McCallum (1977).

(16) Regressing the expected future spot rate on the expected future forward rate and on the interest parity forward rate typically yields a coefficient of the speculative variable equal to 1 and the coefficient of the parity forward rate equal to zero (see Appendix IV). This suggests that omitting the expected future spot rate
1) does not bias the estimator of the coefficient of the forward parity rate;
2) increases the estimator of the coefficient of the expected future forward rate by an amount equal to the coefficient of the expected future spot rate in the correct specification. The coefficient of the expected future forward rate must thus be interprated as expressing the effect on the forward exchange rate of speculation on the future spot and forward rates together and not the specific effect of speculation on the future forward reates. Similar regressions using the future forward rate as dependent variables yield positive coefficients different unity, suggesting that estimates

based on an equation omitting this variable will be biased upwards if speculation on the future forward exchange rate does play a role in determining the current equilibrium forward rate. As discussed below, no evidence has been found of a significant effect of speculation on the forward rate except in the case of the Pound under the fixed exchange rate regime.

For a discussion of the specification errors, see Goldberger (1964), p. 196.

(17) For Canada, data on the one month forward exchange rate were available only for the most recent period.

(18) For Canada, the t values of the deviations of the sum of the coefficients from unity are:

0.296	for equation 1
0.363	for equation 2
-1.620	for equation 3
0.435	for equation 4
0.308	for equation 5
0.321	for equation 6
-1.655	for equation 7
0.336	for equation 8

(19) See McCallum, tables 1 and 2. McCallum used monthly data.

(20) Pippenger (1978), applying spectral analysis to weekly data covering the periods 1959-1964 (arbitrage on Treasury Bills) and 1971-1975 (arbitrage on commercial paper) found the elasticity of the arbitrage schedule is infinite in the long run but is low in the short run. The evidence reported here suggests that this elasticity is very high even in the short run, at least during the periods of floating exchange rates.

(21) A traditional argument is that both the interest rate differential and the expected rate of depreciation or appreciation of the relevant currencies are simultaneously determined by the expected rate of inflation, and that the specification of the equation suggested by the Modern Theory is characterized by a strong colinearity among the independent variables. We have argued in Chapter III that this argument does not apply in the case of Canada.

(22) In 1975 already, McKinnon stressed that an important characteristic of the recent experience of the floating exchange rate regime was a large degree of variability of the exchange rates induced not by destabilizing speculation but by the lack of speculation for horizons over 2 days and by the resulting inability of the forward

foreign exchange market to produce any stabilizing influence. See McKinnon (1975), pp. 1-5.

(23) For the United Kingdom, the t values of the deviations of the sum of the coefficients are:

3.370	for equation 1
3.610	for equation 2
0.461	for equation 3
2.323	for equation 4
3.575	for equation 5
3.714	for equation 6
0.510	for equation 7
0.013	for equation 8

(24) See section 2 of Chapter II and section 2 of the present chapter. See also Van Belle (1973).

(25) The marginal yield in terms of goodwill of an additional U.K. Treasury Bill in the British banks portfolio is of course difficult to estimate.

(26) For a description of the monetary institutions and policies of the United Kingdom, see Hodgeman (1974), Chapter 7. On the combined cash and liquid assets ratio to deposits, see pp. 163-164.

(27) Indeed, under the influence of the Radcliffe Report, the monetary authorities in the United Kingdom considered that the crux of the monetary and credit policy was the control of the Treasury Bills portfolio of the banks. For a description and a critique of the monetary policy in the United Kingdom from 1958 to 1974, see Sine (1975), Chapter 1.

(28) See Goldberger (1964), p. 196.

(29) See equation (8) in section 2.

(30) We assume thus that a given new information affects the forecast for all future exchange rates, whatever their dates, in the same direction, although possibly to a different extent.

(31) The average proportions of information accounting for errors in both consecutive forecasts of any exchange rate expected to prevail T weeks later is

$$P = \frac{(T+1)-2}{T+1}.$$

Thus, for forecasts related to the future spot rate expected to obtain 13 weeks later, P = 0.86 and for forecasts related to the future one month forward rate

expected to prevail 9 weeks later, P = 0.80. The correlograms of the "forecasting errors", using alternatively the spot or the forward rates as predictors of the future spot rate, are consistent with this explanation of the origin of the observed autocorrelation. Those correlograms are reported in Appendix V.

(32) As pointed out by Pippenger (1978), p. 190, "unless exchange rates and interest rates refer not only to the same day but also to the same time of day, measurement error results (....) If observations are separated by a few hours, there might be some impact for even weekly not covered yields." Other explanations of deviations from interest parity suggested by Pippenger are sluggishness in portfolio adjustment, transaction costs or official intervention on the markets.

(33) An indirect confirmation of this finding of ours is provided by Frenkel and Levich (1977). Testing the alternative hypothesis that deviations from covered interest parity are due only to transaction costs, they found, p. 1217, that only less than 37% of the covered arbitrage margins between U.K. and U.S. Treasury Bills for the period January 1968 - December 1969 fall within the "neutral band" defined by the transaction costs. For the period preceding the devaluation of the Pound and for the period July 1973 - May 1975, the corresponding percentage is about 85%.

CHAPTER V: COVERED ARBITRAGE MARGIN AND TRANSACTION COSTS

Section 1: Introduction

The idea that some minimum covered interest differential sufficient to cover the cost of the transfers is necessary to induce arbitragers to move funds from one financial center to another is as old as the covered interest parity theory itself(1). Several authors have proposed estimates of the treshold value of the covered arbitrage margin at which interest arbitrage starts to operate. Those estimates are based either on the experience the authors have acquired through their contacts with the economic agents actually involved in foreign exchange transactions or on a statistical analysis of published data on exchange rates and interest rates(2). The following table 5-1 summarizes those estimates:

Table 5-1

Minimum covered arbitrage margin
necessary to activate interest arbitrage.

Authors	Treshold, in % per annum.
Keynes(1924)	0.50
Einzig(1961)	0.03. - 0.07
Holmes and Schott(1965)	0.25
Branson(1969)	0.18
Frenkel and Levich(1975)	0.58 - 0.60(3)

Recently, Frenkel and Levich(1977) have suggested that the transaction costs on the foreign exchange markets are not stable through time: Their estimates for the trnasaction costs on the foreign exchange markets during the "turbulent" period July 1973 - May 1975 are 7 or 8 times as high as the trnasaction costs obtaining during the "quiet" period January 1962 - November 1967. This instability may explain the differences between the various estimates suggested in the literature and also suggests that the magnitude of the covered arbitrage margin consistent with the absence of profitable arbitrage opportunities may vary depending on the

circumstances. The purpose of this chapter is to examine whether the large deviations form interest parity between U.K. and U.S. 90-day Treasury Bills observed during the period of floating of the Pound (June 1972 - December 1977), period during which speculation on the foreign exchange markets did not appear to have been a significant factor of the determination of the forward exchange rate(4), can be accounted for by the existence of transaction costs.

The plan of the chapter is as follows: After this introduction, we describe, in section 2, the methods used so far to estimate the transaction costs implied by arbitrage on Treasury Bills and we discuss the appropriateness of those methods for our purpose. In the next section, we present some empirical evidence suggesting that transaction costs are indeed relevant, to some extent, to explain deviations from interest parity. The last section summarizes the conclusions.

Section 2: Methods to Estimate Transaction Costs.

Two different methods to estimate the transaction costs associated with interest arbitrage are found in the literature. They have been proposed by Branson(1969) and by Frenkel and Levich(1975).

A) Branson's Method: Estimation from Deviations from Interest Parity.

For Branson(1960), "some minimum covred interest differential must exist before arbitragers will move funds from one currency into another, essentially because each such transaction must net enough to cover the costs of transfers, such as brokerage fees"(5). Accordingly, Branson interprates deviations from covered interest parity during periods identified a priori as non speculative as evidence of the existence of transaction costs(6). He then estimates the magnitude of those transaction costs by computing the mean of the absolute values of the difference between the interest rate differential and the forward premium or discount, where the interest rate differential and the forward penium are monthly averages of weekly data expressed in percent per annum. The estimates were computed both for the U.S.-U.K. 90-day Trasury

Bills arbitrage and for the U.S.-Canada 90-day Trasury Bills arbitrage. In both cases, the transaction costs estimate was 0.18 per cent per annum.

Branson's paper is important as it represents the first attempt in the literature to provide an estimate of the transaction costs based on statistical evidence rather than on personnal judgement and on the authority of Keynes and Einzig (7). Nevertheless, we see two limitations to his method.

First, by basing his computations of the covered arbitrage margins on monthly averages of weekly data rather than on the weekly data themselves, Branson underestimates the absolute size of the covered arbitrage margins and, thus, of their means (8).

Second, Branson's approach cannot be used to provide the estimate necessary to test the hypothesis that observed covered arbitrage margins are accounted for by transaction costs as, in his method, the estimate of the transaction costs is computed from the observed covered arbitrage margins. What is needed for our purpose is an method to estimate the transaction costs independently of the observed covered arbitrage margins.

B) Frenkel and Levich's Method: Estimation from Deviations from Triangular Arbitrage.

Frenkel and Levich(1975) have devised a method to estimate transaction costs independently of the observed covered arbitrage margins. They reason that the transaction costs involved by covered interest arbitrage are the sum of two elements: The transaction costs on the security market, which, following Demsetz(1968), they estimate as 2.5 times the ask-bid spread for the relevant security (9), and the transaction costs of 2 transactions on the foreign exchange markets -- one on the spot and the other of the forward market. Their contribution consists in a novel method to estimate transaction costs on the foreign exchange markets.

The principle of the method is simple. Assume the transaction costs are proportional to the amounts involved and that they are equal for the leading currencies. Let this proportion of the transaction costs be α and denote the price of the currency I in terms of the currency J by the symbol R(I,J). The possibility of arbitrage will ensure that the cost of a direct exchange of one currency for another -- for example, a purchase of dollars with sterling pounds -- is not greater than the cost of the same exchange though a triangular arbitrage involving a third currency, say the German Mark, because if it

was greater there would be no demand for dollars against sterling and the excess supply would reduce the exchange rate $R(\$,£)$.

Thus: $R(\$,£)(1+\alpha) \leq R(\$,DM)(1+\alpha) \times R(DM,£)(1+\alpha)$

which implies that $\alpha \geq \dfrac{R(\$,£) - R(\$,DM) \times R(DM,£)}{R(\$,DM) \times R(DM,£)}$

Similarly, arbitrage ensures that the revenue of selling dollars for pounds is not smaller than the same exchange through triangular arbitrage involving the German mark because if it were smaller, there would be no supply of dollars for pounds and the excess demand would increase the exchange rate $R(\$,£)$.

Thus: $\dfrac{R(\$,£)}{(1+\alpha)} \geq \dfrac{R(\$,DM)}{(1+\alpha)} \cdot \dfrac{R(DM,£)}{(1+\alpha)}$

which implies that $\alpha \geq \dfrac{R(\$,DM) \cdot R(DM,£) - R(\$,£)}{R(\$,£)}$

The difference, expressed in percentage, between the exchange rate between two currencies and the rate corresponding to the same transaction performed through a third currency -- which would be equal in the absence of transaction costs -- thus represents a lower limit to the transaction costs on foreign exchange markets.

The knowledge of this lower limit could allow us to state without risk of error that transaction costs are a sufficient explanation to deviations from covered interest arbitrage if these deviations fall within the limits implied by those estimates of the transaction costs. If, however, the deviations happen to fall outside of those limits, no conclusion is possible as our estimate of the transaction costs are only a lower limit. Frenkel and Levich (1975) and (1977) propose to solve this problem by computing a time series of those lower limits for a relatively homogeneous period and considering the highest of those figures (after excluding the extreme values, to be conservative) as the estimate of the transaction costs for the period.

Section 3: Criticism of Frenkel and Levich's Procedure, Alternative Method and Empirical Evidence.

This ingenious method presents however two drawbacks: First, it uses time series despite the lack of stability of the transaction costs through time and second, as we will argue, it overestimates the actual transaction costs for the banks engaged on the foreign exchange market.

Despite the evidence of the lack of stability of the transaction costs on the foreign exchange market through time(10), Frenkel and Levich's method uses a time series of deviations from triangular arbitrage between 3 currencies to estimate transaction costs. Taking the maximum value of such a series (even after discarding extreme values to be conservative) leads to an overestimation of the transaction costs during most of the period under review. More importantly, such method does not enable us to trace the fluctuations of the transaction costs within each period and to discover whether such fluctuations are associated with equivalent fluctuations of the covered arbitrage margins as the theory predicts if arbitrage is active.

An alternative method, very close to the method followed by Frenkel and Levich, is available to overcome the problem arising from the time instability of the transaction costs: Assuming that the transaction costs for different leading currencies are the same (11) and that some triangular arbitrage involving as intermediate currency at least one currency of the sample occurs, one can estimate the transaction costs for any date by taking the highest value of the observed deviations from the triangular arbitrage parity among the currencies of the sample (12). This method can be applied successively to data corresponding to different dates to generate a time series

of estimates of the transaction costs of the foreign exchange market.

Following this method, we have estimated the transaction costs on the spot foreign exchange market for the 21 dates for which we observed specially large deviations from the covered interest parity -- more than 4% per annum -- between U.K. and U.S. during the recent period of floating of the Pound(13). The results are reported in column 3 of table 5-2.

Our second criticism of Frenkel and Levich's procedure to estimate transaction costs on the foreign exchange market is that the suggested procedure does not take into account the fact that the special position of the banks on the foreign exchange market enable them to buy and purchase foreign exchange for interest arbitrage purpose at a lower cost than other participants in the market. The transaction cost on the foreign exchange market may be divided into two components: The first component represents the value of the real resources used up in the transaction process itself, like the labour provided by the staff of the cambist department of the banks and the telecommunication expenses. This component is the transaction costs sensu sticto. The second component represents the remuneration required by a dealer to compensate him for the risk he supports as a result of his readiness to

Table 5-2

Covered Arbitrage Margin and Estimates of the Transaction Costs

Date (day, month, year)	Covered Arbitrage Margin (in % per quarter) UK/USA	Method 1: Estimation on the basis of the maximum discrepancies of cross rates of 5 currencies*		Method 2: Estimation on the basis of the discrepancies between the quotations of the DM in London and Zurich	
	(1)	(2) Transact. costs on the foreign exchange markets (in %)	(3) Total transact. costs of covered arbitrage (in %)	(4) Transact. costs on the foreign exchange markets (in %)	(5) Total transact. costs of covered arbitrage (in %)
29-10-76	-1.62855	0.127714	0.285327	0.050198	0.130279
25-01-74	-1.32252	0.144833	0.319565	0.019063	0.068252
01-02-74	-1.57024	0.252415	0.534729	0.034090	0.090080
08-02-74	-1.66796	0.239523	0.508945	0.051256	0.132413
15-02-74	-1.37634	0.177592	0.385083	0.152190	0.334279
22-02-74	-1.09836	0.490185	1.01029	0.096732	0.223364
01-03-74	-1.00866	0.486692	1.00328	0.004458	0.038815
08-03-74	-1.63983	0.466648	0.963197	0.048836	0.127571
15-03-74	-1.54608	0.280056	0.590011	0.155557	0.341013
22-03-74	-1.24384	0.243596	0.517091	0.183426	0.396751
29-03-74	-1.62380	0.221083	0.472065	0.047748	0.125395
05-04-74	-1.26220	0.291266	0.612433	0.088424	0.206747
11-04-74	-1.32466	0.250674	1.00328	0.133086	0.296071
19-04-74	-1.08897	0.402707	0.835314	0.146233	0.322365
13-12-74	-1.10177	0.520069	1.07004	0.269861	0.569623
03-01-75	-1.17544	0.288885	0.447669	0.208885	0.447869
23-04-76	-1.48622	0.071255	0.172410	0.071255	0.172410
01-10-76	-1.08001	0.149955	0.329809	0.149955	0.329809
08-10-76	-1.08558	0.228848	0.487595	0.059064	0.148029
15-10-76	-1.73994	0.124306	0.278511	0.016742	0.063384
22-10-76	-1.12574	0.054025	0.137949	0.054025	0.137949
MEAN	-1.36070	0.298682	0.647265	0.0971959	0.221288
VARIANCE	0.061084	0.0194282	0.0776969	0.0050481	0.0201984

* Note: 4 extreme values have been excluded from the sample.

buy or sell foreign exchange at the quoted prices (14). As Frenkel and Levich correctly remark, this component tends to increase the ask-bid spreads during periods of uncertainty (15). However, they fail to consider that this component of the transaction costs does not apply to the dealer himself when he purchases from the public a given amount of foreign currency for his own use rather than in his capacity of intermediary between a seller and a potential buyer on the foreign exchange market. This is precisely the situation in which the major banks engaged in interest arbitrage are found, as they are simultaneously foreign exchange dealers. Consequently, only the first component of the transaction costs -- i.e. only the cost of real resources used up in the transaction process -- are relevant to explain the deviations from the covered interest parity.

No method exists so far in the literature to estimate directly this first component of the transaction costs. Frenkel and Levich's procedure may however provide the basis for an approximation, as we shall now explain.

The second component of the transaction costs -- the risk compensating remuneration of the dealer -- is likely to vary from currency to currency, as the exchange risk supported by the dealer depends on the depth of the market and on the

predictability of the monetary policy in the relevant countries. The first components of the transaction costs, on the contrary, are probably similar for the main currencies traded on the market. Assuming that geographic and triangular arbitrage are in fact necessary to maintain the consistency between cross-exchange rates throughout the world, it is again possible to interpret the observed discrepancies between quotations in different centers for the same currency as a measure of the transaction costs. The variability of the exchange risk depending on the currency, the transaction costs related to the currency for which those discrepancies are lower provide a closer approximation of the component of the transaction costs common to all major currencies and representing the cost of the real resources used in the transaction process, as opposed to the total cost including both this component and the risk-compensating remuneration of the dealer.

Following this reasoning, we have computed the discrepancies between the quotations of 5 currencies in London and Zurich for the 21 dates mentioned above. The means and variances of those discrepancies, in absolute values, are reported below:

Table 5-3

Discrepancies between Exchange Rate Quotations in London and Zurich (dates as in Table 5-2)

	Mean (in percent)	Variance	Coefficient of variation
U.S. Dollar	0.168858	0.0399228	0.236428
Deutche Mark	0.097194	0.0050481	0.051938
French Franc	0.183466	0.0310474	0.169227
Dutch Guilder	0.148013	0.0147201	0.099451
Belgian Franc	0.388317	0.670845	1.727571

From our sample, it appears that the currency for which the discrepancies are the smallest is the Deutche Mark. Furthermore, this is also the currency for which the discrepancies present the smallest dispersion around the mean. According to the argument of the previous paragraph, among the 5 series of discrepancies for the currencies of the sample, the discrepancies recorded for the Deutche Mark are the closest approximation of the cost of the real resources actually used up in the transaction process. We present therefore in the

column (4) of table 5-2 the series of the discrepancies between the quotations of the D.M. in London and Zurich as the estimates of the transaction costs, sensu sticto, on the foreign exchange markets.

Table 5-2 presents in addition two series of estimates of the total transaction costs involved by a covered interest arbitrage operation. To obtain those estimates we have multiplied by 2 the transaction costs on the spot market and have added to the result Frenkel and Levich's estimate of the transaction costs on the market for 90-day Treasury Bills (16).

Our estimates of the transaction costs on the foreign exchange markets, reported in column 2 or 4 of table 5-2, are of the same order of magnitude as the estimates reported by Frenkel and Levich (1977). As expected, however, the means of our estimates are lower than Frenkel and Levich's figures.

A comparison of columns 3 and 5 with column 1 shows that the transaction costs are smaller than the observed deviations form the covered interest parity, whatever the method of estimation (17).

This finding, however, is not sufficient to discard transaction costs as irrelevant. We have found in the previous

chapter an indication that U.K. Treasury Bills yield to their holders some non financial returns. In that case, a perfect arbitrage between the total returns -- financial and non financial -- of the U.S. and U.K. Treasury Bills must produce a negative covered arbitrage margin on U.K. Treasury Bills, this negative margin being equal to minus the non financial marginal return on the U.K. Treasury Bills. The question then arises: Are transaction costs responsible for deviations from that value of the covered arbitrage margin matching the difference between non financial returns of the 2 assets? In the remaining part of this chapter, we will devise a test aiming at answering this question.

Consider first the effect of the existence of the transaction costs implied by covered interest arbitrage on the net demand for forward foreign exchange for arbitrage purpose in the diagram of figure 5-1 (18). In this diagram, R represents the actual interest parity forward rate and we assume to start with that the only return on the assets under consideration is their interest rate. In the absence of transaction costs, the net demand of forward exchange, the A'A' schedule, assumed in this diagram to be perfectly elastic, intersects the vertical axis at R. If the transaction costs amount to RT, the net demand for forward foreign exchange for arbitrage purpose becomes MM': There will be no demand for

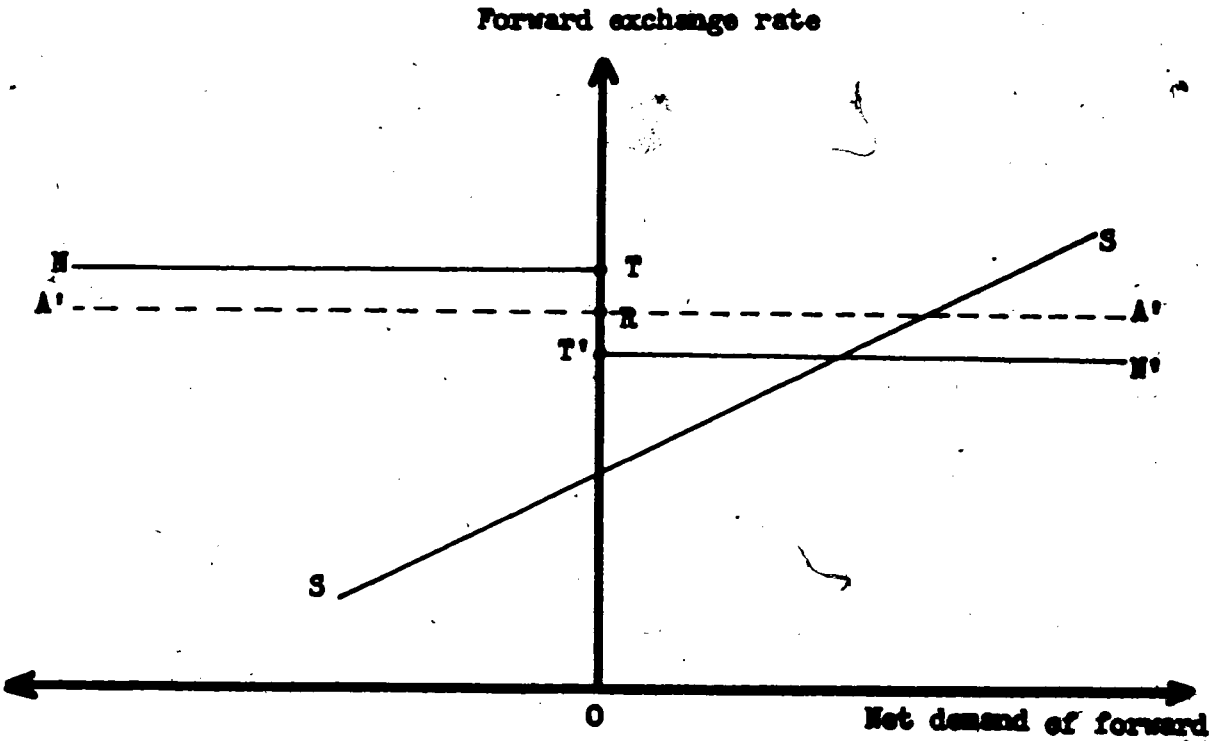


Figure 5-1

Interest rate is the only yield on both assets.

arbitrage purpose unless the forward rate is at T, inferior to the parity rate by an amount equal to the transaction costs; and there will be no supply for arbitrage purpose unless the forward rate is superior to the parity rate by the same amount. The equilibrium on the forward exchange market obtaining at the rate for which the net demand for arbitrage purpose is equal to the net supply for other purposes -- mainly speculation --, the deviations from the parity rate will be exactly equal to the transaction costs, except in the cases where the net supply SS intersects the vertical axis at the parity rate or within a distance from the parity inferior to the transaction costs.

For the sake of simplicity in the exposition, let us refer to the foreign currency as the Pound and to the domestic currency as the Dollar. This simple geometrical model then suggests that the extreme negative values of the covered arbitrage margin in favor of New york will be observed somewhere on the T'N' portion of the arbitrage schedule, and similarly the extreme values of the covered arbitrage margin in favor of London will be observed on the NT portion. In both cases, if the arbitrage schedule is perfectly elastic, the covered arbitrage margin, in absolute value, will be exactly equal to the transaction costs. The model thus implies that a regression of a sample of extreme values of the covered arbitrage margin, expressed in absolute value, on the

transaction costs must produce a coefficient of the transaction costs not significantly different from unity. This implication could provide a test of the hypothesis that transaction costs are the only cause of deviations from covered interest parity, but, as we shall now show, it is inadequate if transaction costs are not the only factor causing deviations.

Suppose now that, in addition to the interest, the assets demoninated in Pound yield also some indirect returns to their holders, for example in terms of goodwill from the monetary authorities or in terms of additional lending opportunities resulting from the elegibility of these assets to meet some reserve requirements for a bank (19). In that case, the arbitrage schedule, in the absence of transaction costs, will intersect the vertical axis in figure 5-2 at a forward rate P such that the covered total returns on the 2 relevant assets are equal. The rate P can be thought of as the forward rate for which the "true" covered return parity between the relevant assets prevails. However, the forward rate R for which the covered interest returns are equal will be higher as the interest rate differential underestimates the actual return on the sterling-demoninated asset. The difference between P and R, the "true" and the "apparent" forward parity rates, is equal to the difference in returns other than the interest rate yielded by both assets.

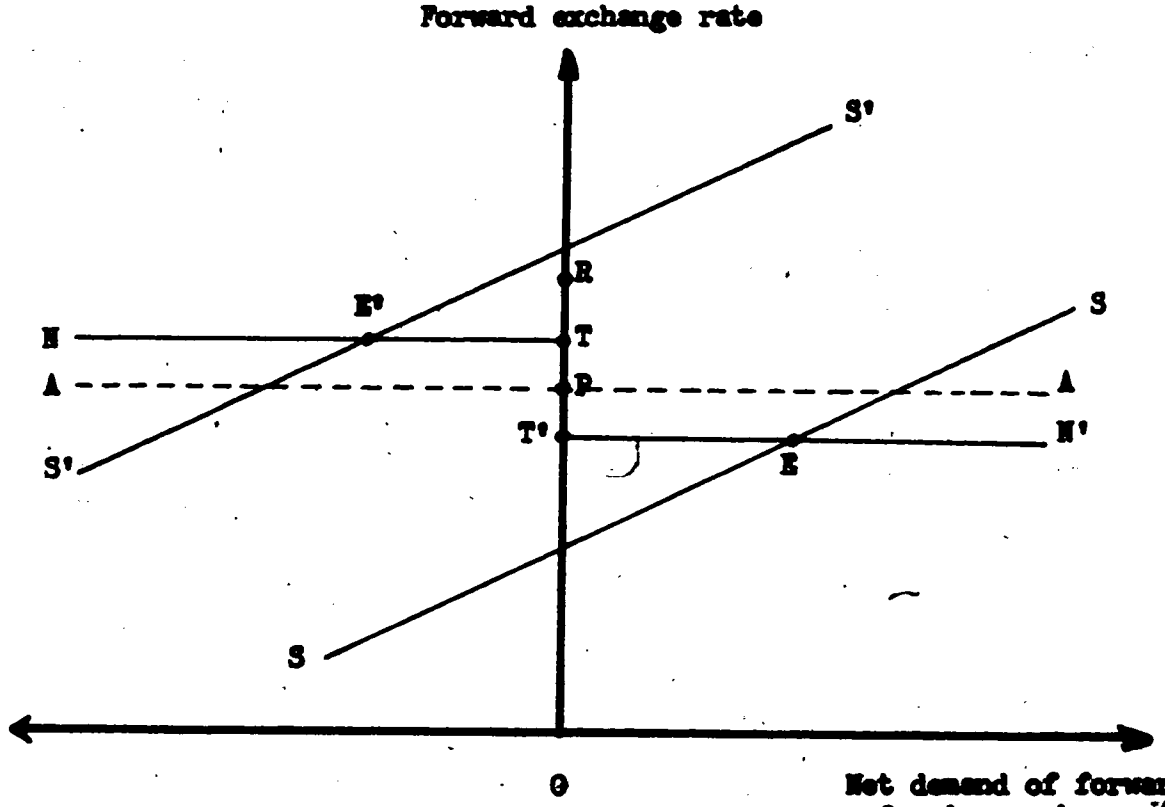


Figure 5-2

The sterling denominated asset yields some implicit returns in addition to the explicit interest rate.

Consider now the effect of the transaction costs on the size of the extreme values of the covered interest arbitrage margin. If the position of the speculative schedule SS is such that the market is at equilibrium at point E on figure 5-2, then the transaction costs increase the absolute value of the negative covered arbitrage margin. If on the other hand equilibrium obtains at E' as a result of the positon of the speculative schedule at S'S', then transaction costs decrease the absolute value of the negative covered arbitrage margin. The effects of transaction costs on the size of the observed covered arbitrage margin thus depends on the position of the speculative schedule.

As can be seen from figure 5-2, the crucial factor is the position of the intersection of the SS schedule -- i.e. the value of the expected future spot rate(20) -- relatively to the neutral band delimited by the transaction costs around the forward rate P, for which covered total returns on both assets are equalized. The position of P, unfortunately, is not observable as the non-interest-rate components of the return on the 2 assets are not known. Nevertheless, if the expected future spot rate is higher than the interest parity rate R, it is a fortiori higher than P. In these circumstances, we must thus expect that the existence of transaction costs will reduce by an equivalent amount the absolue value of the observed covered arbitrage margin.

To take advantage of this implication to test the model, we have identify, among the 21 dates of the recent period of floating of the Pound characterized by extreme values of the covered arbitrage margin against London, the 15 dates for which the forward parity rate -- R in our figure 2 -- was actually lower than the spot exchange rate prevailing 13 weeks later, which we use here, as we did in Chapter IV, as a proxy for the expected future spot rate. For those 15 dates, we regressed the covered arbitrage margin (expressed in per cent per quarter) on the 2 estimates of the transaction costs reported in columns 3 and 5 of table 5-2. The results are reported below:

Table 5-4

Dependent Variable : Absclute value of the covered arbitrage margin (in % per quarter)

Explanatory variable: Transaction costs

	Constant	Coefficient of the transaction costs from col. (3)	Coefficient of the transaction costs from col. (5)	R2	F	D.W.	Standard error of the regression
Equation (1)	+1.439	-0.075	-	0.01	0.08	1.53	0.2436
	(+7.97)	(-0.29)					
Equation (2)	+1.651	-	-1.050*	0.47	11.69**	2.04	0.1773
	(+18.54)		(-3.42)				

Figures in brackets are T-values.

*Not significantly different from unity, according to the T test.

**F significant at the 1% level.

The results presented in table 5-4 show that the regression using the estimates of the transaction costs based on the first method is not significant, according to the F test. The second equation, on the contrary, is significant. The coeficient of the transaction costs, in that equation, is significantly different from zero, has the expected sign and is close to unity. The constant is significant and may be interpreted as an estimate of the average return, other than the interest rate, yielded by the U.K. Treasury Bills at the relevant dates.

Section 4: Conclusions

The results reported in Table 5-4 suggest two conclusions. First, the second method of estimating the transaction costs on foreign exchange markets appear to be more appropriate in the context of interest arbitrage. Contrary to the alternative method inspired by Frenkel and Levich (1975), this second method aims at providing an estimate of the cost of the real resources actually used up in the transaction process, and excluding, as far as possible, that component of the "transaction costs" which represents a mere compensation for risk-bearing by the foreign exchange dealer. Our findings thus

support the argument that this traditional component of the transaction costs on the foreign exchange market does not apply to the dealer himself and is irrelevant to explain deviations from the covered interest parity as the same banks are simultaneously acting as interest arbitragers and foreign exchange dealers .

Second, as seen from the results reported for equation 2, transaction costs do indeed have the expected effect of hindering a perfect arbitrage between the returns of two assets. Nevertheless, as can be seen from a comparison of column 1 and column 5 of Table 5-2, transaction costs cannot provide a complete explanation for the large deviations from covered interest parity which have been observed for the 21 dates recorded on that table: The mean of the covered arbitrage margins for those dates was -1.381 and the mean of the total transaction costs estimated by the second method amounts to 0.224 only. As in the test performed in Chapter IV we found no evidence of a significant effect of speculation on the forward exchange rates of the Pound during the recent period of floating exchange rate, the need for a model able to provide a testable explanation for the large deviations from covered arbitrage margins on the U.K. - U.S. pair of Treasury Bills still persists.

FOOTNOTES OF CHAPTER V

(1) See Keynes (1923), p.128.

(2) Keynes (1923), p.128, Holmes and Schott (1965), p.55, and Einzig (1961), p.167, belong to the first category, Branson (1969) and Frenkel and Levich (1975) to the second one.

(3) Frenkel and Levitch (1975) estimates are in fact 0.145 - 0.150 percent of the amount of the transactions. As they correctly point out, pp.331-332, transactions costs have no time dimension. Should the transaction costs on the forward foreign exchange market and on the security markets be the same watheaver the maturity of the forward contracts and of the securities, the same number would measure the transaction costs of arbitrage on 90-day Treasury Bills and the transaction costs of arbitrage on 1 year securities, as the numbers of transactions in the same in both cases. Nevertheless, to compare transactions costs with the yield of the covered margin on arbitrage on 90 day Trasury Bills expressed as an annual yield, it is necessary, for consistency, to multiply the number of transactions, and thus the transactions costs, by four. Branson, Holmes and Schott, Einzig and Keynes all deal with arbitrage between short-term investments such as 90 day Tresury Bills but express explicitely their estimates of the transactions costs on a "per annum" basis. Thus, contrarily to Frenkel and Levich's statement (p.331), their own estimates are rather close to Keynes' (1923) estimate of 0.50 per annum and higher than the estimates proposed by Branson, Holmes and Schott and Einzig. For more estimates defined for different periods, see also Frenkel and Levich (1977).

(4) See Chapter IV.

(5) Branson (1969), p.1028.

(6) To identify a priori the "speculative periods", Branson use external information provided by Katz (1964) and Stein (1965). Grubel (1966) also used external information, provided by comments from the financial press, to identify periods in which speculators were active. See Grubel (1966), p. 63.

(7) Despite of the wide attention received by Keynes' "estimate" of 0.5% per annum, it is clear from the original text that Keynes provided this number for the purpose of a mere didactic example. See Keynes (1923), p.128.

(8) Compare Branson's estimate of 0.18 per cent per annum with our findings presented in the table 4-3 of Chapter IV. Excluding the "turbulent" periods corresponding to the recent floating exchange rates experience and to the post devaluation years for the U.K., we found that the means of the covered arbitrage margins in absolute value were bounded by 0.3313 per cent per annum (Canada, first period of floating) and 0.395 per cent per annum (Canada, parity regime period). For a proof of the underestimation involved in Branson's procedure, see Appendix VII.

(9) Based on data for U.S. 90-day Treasury Bills for the period January 1962 - November 1967, the estimate they provide is 0.019 per cent. See Frenkel and Levich (1975), p. 330. In a later work (Frenkel and Levich, 1977), they prefer to use 1.25 times the ask-bid spread as arbitrage on short-term security usually required a single transaction on the security market rather than a "round trip" transcation. See Frenkel and Levich (1977), p.1214 and p.1216.

(10) See Frenkel and Levich (1977), p. 1215.

(11) Evidence from Frenkel and Levich (1977), p. 1215, shows that the estimates of the transaction costs according to their method are relatively insensitive to the choice of the intermediate currency used in the triangular arbitrage.

(12) In other words, we apply Frenkel and levich's procedure to cross-section data rather than to time series data.

(13) See Appendix VIII. The currencies included in our sample are the currencies for which cross exchange rates are published by the Financial Times of London: U.S. dollar, U.K. Pound, Deutch Mark, French Franc, Swiss Franc, Dutch Guilder and Belgian Franc. Computations are based on closing quotations in London and Zurich. Zurich has been selected over New York in our experiment to avoid the introduction of discrepancies arising from the important difference in geographic time between New York and the European markets.

(14) Banks engaged on the foreign exchange market are in fact very different from brokers, because they are committed to buy or purchase foreign exchange at the quoted rates before having found a counterpart for an offsetting transaction. During the interval between the instant when they commit themselves, say, to purchase 1 million Dutch Guilders from a correspondant and the instant where they are able to sell it, they incur an exchange risk.

Note that, when a participant in the market is asked to quote the rates for a transaction in a given currency, he is generally informed by his potential counterpart of the amount involved but not of the nature -- sale or purchase -- of the contemplated transaction.

(15) See Frenkel and Levich (1977), p. 1215. See also Allen (1977) for a formal demonstration based on the profit-maximizing behaviour of the foreign exchange dealers.

(16) The transaction costs on the foreign exchange markets are multiplied by 2 as covered interest arbitrage involves one transaction on the spot market and an offsetting transaction on the forward market. As Frenkel and Levich have found no significant difference between transaction costs on the spot and the forward markets for the period July 1973 - May 1975, we assume those costs to be equal. For the Treasury Bills market, Frenkel and Levich's estimate for the same period is 0.0299 percent. See Frenkel and Levich (1977), p. 1216.

(17) However, the inclusion of the 4 extreme values which have been excluded for the construction of the estimates reported in column 2 would have produced 3 observations where the transaction costs exceed the covered arbitrage margin.

(18) See Branson (1969), p. 1030. The presentation of the diagram has been modified to be consistent with the presentation of Chapter II.

(19) See our discussion of the empirical evidence concerning the pound sterling in the section 3 of Chapter IV.

(20) See Chapter II.

CHAPTER VI: CONCLUSIONS

The conclusions of the 4 substantive chapters of the thesis have already been reported in each relevant chapter. The following propositions summarize those conclusions:

1- The Modern Theory of the Forward Foreign Exchange Rate predicts that the equilibrium forward rate for delivery at a given date T is a weighted average the covered interest parity rate and of the expected future spot and forward foreign exchange rates for delivery at the same date T.

2- Despite its partial equilibrium nature and its focussing on the effects of the discrepancies between the covered interest parity rate and the expected future exchange rates, the Modern Theory is consistent with the Fisherian theory of the interest rate and with the traditional doctrine that in the long run the interest rate differential and the expected relative rate of appreciation or depreciation of 2 currencies are both equal to the difference between the expected rates of inflation in the 2 relevant countries.

3- According to our test based on the reduced form equation of the Modern Theory and on the rational expectations hypothesis, speculation had a significant effect on the forward rate of the pound sterling during the period of the parity exchange rate regime, but we were unable to find a significant effect of speculation on the forward rate of the pound during the recent period of floating exchange rate nor on the forward rate of the Canadian dollar.

4- Transaction costs have the expected effect on the covered arbitrage margin but are of too small an order of magnitude to account for the large deviations from covered interest parity between U.K. and U.S. 90-day Treasury Bills which were observed during the recent period of floating exchange rate. Covered arbitrage margins ovserved for the Canada - U.S. pair of 90-day Treasury Bills are of the same order of magnitude as the transaction costs.

Does the model of the Modern Theory of the forward foreign exchange rate successfully explain deviations from covered interest parity?

Only in the case of the pound sterling under the parity regime is the model of the Modern Theory superior to the simple model of the covered interest parity theory, as this is the only instance where we found evidence of a significant effect of speculation on the forward rate. For Canada, the observed covered arbitrage margins are of an order of magnitude which can be explained by transaction costs. For the United Kingdom however, the evidence suggests that neither model, in their elementary formulation, fully explains the forward exchange rate. The significant constant term found in the estimation of the reduced form equation of the Modern Theory in the case of the pound under the parity regime and the large covered arbitrage margins observed from time to time during the period of floating exchange rate of the pound indicate that a important factor has been neglected.

In this thesis, we suggest that the discrepancies between the evidence and the predictions of the model of the simple formulations of the Modern Theory and of the covered interest parity theory arise from the U.K. Treasury Bills yielding to their holders some additional returns other that the explicit interest rate. These returns, it is suggested, result from the institutional arrangements concerning the monetary policy in the United Kingdom, and in particular from the role of the Treasury Bills as reserve assets for the banks.

At this stage, this explanation should still be considered as an hypothesis. To provide an independent test of this hypothesis is outside of the scope of this thesis. Nevertheless, we evidence we have presented in Chapter V is consistent with the implications of this hypothesis concerning the effect of the transaction costs on the size of the observed covered arbitrage margins. This consistency represents by itself an indirect test of its relevance.

APPENDIX I

COVERED ARBITRAGE MARGINS ON THE 90 DAY TREASURY BILLS: CANADA/USA AND UK/USA

For each of the two pairs of Treasury bills, the table consists of 6 columns. The first column is a mere identification number. The second column indicates the date of the observation by giving the year (2 first digits) and the week within that year (2 last digits) for which the observation was recorded. The next two columns show the interest rates on the 90 day Treasury bills for Canada or the United Kingdom and for the United States. The last column shows the corresponding covered arbitrage margin, expressed on an annual basis.

The source of the data is given in Appendix III.

A/ The Canada/USA Pair

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE CANADA	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE CANADIAN DOLLAR	COVERED ARBITRAGE MARGIN ON CANADIAN T. BILLS
1.00000	6001.00	5.01000	4.66000	-0.760798	-0.807901
2.00000	6002.00	4.70000	4.45000	-0.570133	-0.331356
3.00000	6003.00	4.54000	4.26000	-0.270167	-0.232595E-02
4.00000	6004.00	4.49000	3.91000	-0.460675	0.950019E-01

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE CANADA	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE CANADIAN DOLLAR	COVERED ARBITRAGE MARGIN ON CANADIAN T. BILLS
5.0000	6005.00	4.04000	3.90000	-0.530122	0.138839
6.0000	6006.00	4.13000	3.66000	-0.460031	0.467045
7.0000	6007.00	4.50000	3.97000	-0.460157	0.470209E-01
8.0000	6008.00	4.30000	4.11000	-0.380308	-0.710207E-02
9.0000	6009.00	4.46000	3.84000	-0.340067	0.205596
10.0000	6010.00	4.23000	3.83000	-0.529930	0.456601E-01
11.0000	6011.00	3.93000	3.40000	-0.530152	-0.401934E-01
12.0000	6012.00	3.33000	2.76000	-0.530252	0.212795E-01
13.0000	6013.00	2.35000	2.88000	-0.270261	-0.202268
14.0000	6014.00	3.17000	2.92000	-0.150049	0.922695E-01
15.0000	6015.00	3.50000	3.50000	0.396638E-01	0.396638E-01
16.0000	6016.00	3.42000	3.22000	0.393647E-01	0.174734
17.0000	6017.00	3.99000	3.18000	0.0	0.369109E-02
18.0000	6018.00	2.76000	3.05000	-0.401143E-01	-0.322525
19.0000	6019.00	2.62000	3.30000	0.0	-0.662639
20.0000	6020.00	2.93000	3.55000	0.239781	-0.362570
21.0000	6021.00	2.95000	3.25000	0.395716E-01	-0.251832
22.0000	6022.00	2.86000	2.94000	0.239753	0.161978
23.0000	6023.00	2.80000	2.80000	0.159570	0.159570
24.0000	6024.00	2.65000	2.17000	0.279930	0.747539
25.0000	6025.00	2.92000	2.34000	0.159570	0.723115
26.0000	6026.00	3.00000	2.08000	0.0	0.893204
27.0000	6027.00	3.10000	2.23000	0.0	0.843841
28.0000	6028.00	3.17000	2.40000	0.0	0.746341
29.0000	6029.00	3.14000	2.30000	-0.350250	0.444942
30.0000	6030.00	2.86000	2.14000	-0.390127	0.270966
31.0000	6031.00	2.77000	2.13000	-0.400361E-01	0.582654
32.0000	6032.00	2.85000	2.16000	0.0	0.670880
33.0000	6033.00	2.61000	2.32000	-0.402831E-01	0.242341
34.0000	6034.00	2.21000	2.46000	-0.230287	-0.474881
35.0000	6035.00	1.37000	2.54000	0.229511	-0.329478
36.0000	6036.00	2.05000	2.50000	0.159532	-0.281430
37.0000	6037.00	2.01000	2.55000	0.349684	-0.159970
38.0000	6038.00	1.65000	2.44000	0.389574	-0.387603
39.0000	6039.00	1.67000	2.34000	0.349740	-0.309255
40.0000	6040.00	2.16000	2.43000	0.389605	0.125314
41.0000	6041.00	2.41000	2.59000	0.349575	0.193371
42.0000	6042.00	2.61000	2.21000	0.119639	0.703300
43.0000	6043.00	2.47000	2.12000	0.395383E-01	0.865021
44.0000	6044.00	3.15000	2.18000	0.119488	1.05987
45.0000	6045.00	3.14000	2.38000	-0.160310	0.576553
46.0000	6046.00	3.40000	2.44000	-0.240358	0.688076
47.0000	6047.00	3.68000	2.37000	-0.490355	0.773149
48.0000	6048.00	3.66000	2.31000	-0.470167	1.02223
49.0000	6049.00	3.62000	2.26000	-0.820045	0.492444
50.0000	6050.00	3.91000	2.20000	-0.390313	0.970559
51.0000	6051.00	3.38000	2.22000	-0.990126	0.131948
52.0000	6052.00	3.18000	2.11000	-0.680341	0.356682
53.0000	6101.00	3.27000	2.22000	-0.490174	0.526579
54.0000	6102.00	3.11000	2.23000	-0.370111	0.483327
55.0000	6103.00	3.15000	2.25000	-0.620310	0.252205
56.0000	6104.00	2.98000	2.16000	-0.430229	0.366042
57.0000	6105.00	3.06000	2.29000	-0.310107	0.437030
58.0000	6106.00	3.03000	2.33000	-0.310279	0.369135
59.0000	6107.00	2.80000	2.40000	-0.120142	0.268963
60.0000	6108.00	3.04000	2.52000	-0.180184	0.324476
61.0000	6109.00	3.14000	2.55000	-0.120243	0.451796
62.0000	6110.00	3.14000	2.39000	0.596281E-01	0.786795
63.0000	6111.00	3.09000	2.38000	0.119457	0.856676
64.0000	6112.00	3.21000	2.22000	-0.180083	0.779126
65.0000	6113.00	3.14000	2.41000	-0.901614E-01	0.617614
66.0000	6114.00	3.18000	2.36000	-0.599878E-01	0.734740
67.0000	6115.00	3.27000	2.32000	-0.240257	0.679661
68.0000	6116.00	3.25000	2.23000	-0.360019	0.627875
69.0000	6117.00	3.21000	2.25000	-0.430133	0.500009
70.0000	6118.00	3.15000	2.15000	-0.489999	0.479463
71.0000	6119.00	3.13000	2.20000	-0.550284	0.351490
72.0000	6120.00	3.09000	2.33000	-0.550121	0.187099
73.0000	6121.00	3.10000	2.41000	-0.490155	0.179099
74.0000	6122.00	3.07000	2.32000	-0.550335	0.177326
75.0000	6123.00	2.99000	2.34000	-0.430176	0.200954
76.0000	6124.00	2.95000	2.29000	-0.490320	-0.236786
77.0000	6125.00	2.90000	2.29000	0.249847	0.454725
78.0000	6126.00	2.52000	2.26000	-0.190001	0.636085E-01
79.0000	6127.00	2.58000	2.28000	-0.509989	-0.217534
80.0000	6128.00	2.57000	2.23000	-0.129990	0.201491
81.0000	6129.00	2.58000	2.18000	-0.129990	0.259950
82.0000	6130.00	2.50000	2.22000	-0.120020	0.153151
83.0000	6131.00	2.47000	2.28000	-0.189997	-0.457764E-02
84.0000	6132.00	2.49000	2.36000	0.129689	0.256530
85.0000	6133.00	2.53000	2.49000	0.0	0.390130E-01
86.0000	6134.00	2.46000	2.46000	0.0	0.0
87.0000	6135.00	2.42000	2.33000	0.0	-0.107612
88.0000	6136.00	2.27000	2.29000	0.0	-0.195565E-01
89.0000	6137.00	2.31000	2.29000	0.119774	0.139322
90.0000	6138.00	2.37000	2.26000	0.598688E-01	0.167323
91.0000	6139.00	2.54000	2.24000	0.598871E-01	0.352456
92.0000	6140.00	2.52000	2.30000	0.0	0.214593
93.0000	6141.00	2.52000	2.34000	0.119774	0.295350
94.0000	6142.00	2.44000	2.26000	0.119774	0.295487
95.0000	6143.00	2.45000	2.29000	0.119774	0.275947
96.0000	6144.00	2.42000	2.25000	0.129695	0.295677
97.0000	6145.00	2.29000	2.17000	0.249839	0.171630
98.0000	6146.00	2.32000	2.54000	0.449735	0.234723
99.0000	6147.00	2.37000	2.54000	0.449739	0.283674
100.0000	6148.00	2.45000	2.34000	0.259768	0.171920
101.0000	6149.00	2.57000	2.57000	0.598778E-01	0.598778E-01
102.0000	6150.00	2.67000	2.57000	0.598720E-01	0.157271
103.0000	6151.00	2.67000	2.56000	0.189959	0.491311
104.0000	6152.00	2.93000	2.63000	0.598843E-01	0.351345
105.0000	6201.00	3.02000	2.70000	-0.600093E-01	0.250610
106.0000	6202.00	2.98000	2.78000	-0.129997	0.642158E-01
107.0000	6203.00	3.02000	2.71000	-0.319983	-0.190697E-01
108.0000	6204.00	3.03000	2.64000	-0.260018	0.118513
109.0000	6205.00	3.00000	2.71000	-0.130010	0.151944
110.0000	6206.00	2.95000	2.70000	-0.190015	0.520218E-01
111.0000	6207.00	3.00000	2.81000	-0.260040	-0.755537E-01
112.0000	6208.00	3.10000	2.67000	-0.260000	0.157072
113.0000	6209.00	3.14000	2.66000	-0.130010	0.335777
114.0000	6210.00	3.01000	2.73000	-0.190009	0.818092E-01
115.0000	6211.00	3.01000	2.73000	0.598737E-01	0.331698
116.0000	6212.00	3.03000	2.66000	0.129699	0.488817

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117.000	6213.00	3.05000	2.71000	0.0	0.329937
118.000	6214.00	3.02000	2.67000	0.0	0.339741
119.000	6215.00	2.98000	2.75000	-0.600048E-01	0.163339
120.000	6216.00	3.03000	2.70000	-0.190019	0.130276
121.000	6217.00	3.00000	2.71000	-0.190009	0.915455E-01
222.000	6218.00	3.12000	2.72000	-0.430011	-0.421130E-01
123.000	6219.00	3.17000	2.64000	-0.299987	0.213729
124.000	6220.00	3.29000	2.68000	-0.200005	0.390566
125.000	6221.00	3.42000	2.68000	-0.339994	0.375535
126.000	6222.00	3.44000	2.66000	-0.270010	0.488050
127.000	6223.00	3.54000	2.64000	-0.540001	0.329229
128.000	6224.00	3.84000	2.69000	-0.699999	0.497473
129.000	6225.00	4.79000	2.70000	-1.89999	0.944710E-01
130.000	6226.00	5.30000	2.80000	-1.75002	0.628152
131.000	6227.00	5.28000	2.89000	-1.95000	0.520139
132.000	6228.00	5.31000	2.94000	-2.02000	0.249060
133.000	6229.00	5.36000	2.95000	-2.02000	0.267395
134.000	6230.00	5.32000	2.88000	-2.15001	0.166742
135.000	6231.00	5.25000	2.82000	-1.87998	0.428811
136.000	6232.00	5.12000	2.84000	-1.77999	0.407982
137.000	6233.00	4.92000	2.83000	-2.01000	-0.180101E-01
138.000	6234.00	4.99000	2.80000	-1.94998	0.135937
139.000	6235.00	4.82000	2.78000	-2.21999	-0.273799
140.000	6236.00	4.94000	2.80000	-1.74999	0.289268
141.000	6237.00	4.85000	2.75000	-1.61002	0.392844
142.000	6238.00	4.93000	2.75000	-2.00999	0.675869E-01
143.000	6239.00	4.86000	2.74000	-1.94999	0.717497E-01
144.000	6240.00	4.81000	2.74000	-1.75001	0.724993
145.000	6241.00	4.60000	2.74000	-1.68001	0.981934E-01
146.000	6242.00	4.12000	2.72000	-1.54000	-0.195397
147.000	6243.00	4.17000	2.72000	-1.14002	0.251933
148.000	6244.00	4.06000	2.69000	-1.14001	0.176539
149.000	6245.00	3.99000	2.80000	-0.940009	0.208333
150.000	6246.00	3.54000	2.80000	-0.869999	-0.155299
151.000	6247.00	3.73000	2.80000	-0.739981	0.156579
152.000	6248.00	3.63000	2.88000	-0.669995	0.923323E-01
153.000	6249.00	3.72000	2.82000	-0.669982	0.197739
154.000	6250.00	3.75000	2.82000	-0.530004	0.366382
155.000	6251.00	3.85000	2.85000	-0.599994	0.362933
156.000	6252.00	3.82000	2.88000	-0.599999	0.343943
157.000	6301.00	3.83000	2.86000	-0.599989	0.334231
158.000	6302.00	3.72000	2.86000	-0.799994	0.291615E-01
159.000	6303.00	3.78000	2.89000	-0.870010	-0.124259E-01
160.000	6304.00	3.68000	2.91000	-0.870011	-0.127341
161.000	6305.00	3.58000	2.91000	-0.600003	0.468402E-01
162.000	6306.00	3.60000	2.93000	-0.599990	0.467281E-01
163.000	6307.00	3.56000	2.90000	-0.469999	0.167312
164.000	6308.00	3.55000	2.86000	-0.400019	0.266326
165.000	6309.00	3.57000	2.87000	-0.799992	-0.124121
166.000	6310.00	3.52000	2.86000	-0.739982	-0.102423
167.000	6311.00	3.54000	2.85000	-0.799998	-0.133588
168.000	6312.00	3.52000	2.88000	-0.529985	0.882542E-01
169.000	6313.00	3.55000	2.90000	-0.670003	-0.422870E-01
170.000	6314.00	3.51000	2.89000	-0.260004	0.338922
171.000	6315.00	3.38000	2.88000	-0.369984	0.113669
172.000	6316.00	3.50000	2.87000	-0.259997	0.348698
173.000	6317.00	3.60000	2.87000	-0.260016	0.444617
174.000	6318.00	3.53000	2.87000	-0.429995	0.207502
175.000	6319.00	3.26000	2.89000	-0.200004	0.158314
176.000	6320.00	3.21000	2.88000	0.0	0.319736
177.000	6321.00	3.15000	2.93000	0.0	0.213282
178.000	6322.00	3.13000	2.97000	0.0	0.155144
179.000	6323.00	3.22000	2.97000	0.598746E-01	0.302076
180.000	6324.00	3.12000	2.96000	0.0	0.155160
181.000	6325.00	3.13000	2.96000	0.129682	0.294523
182.000	6326.00	3.14000	2.97000	0.598680E-01	0.224693
183.000	6327.00	3.19000	3.01000	0.199882	0.374318
184.000	6328.00	3.28000	3.19000	0.598875E-01	0.147029
185.000	6329.00	3.32000	3.15000	0.0	0.164537
186.000	6330.00	3.32000	3.18000	-0.270010	-0.134508
187.000	6331.00	3.35000	3.21000	-0.199989	-0.645265E-01
188.000	6332.00	3.46000	3.27000	-0.399998	-0.216352
189.000	6333.00	3.55000	3.31000	-0.330015	-0.982428E-01
190.000	6334.00	3.62000	3.35000	-0.260008	-0.559568E-03
191.000	6335.00	3.62000	3.38000	-0.330007	-0.983905E-01
192.000	6336.00	3.66000	3.32000	-0.330015	-0.201899E-02
193.000	6337.00	3.66000	3.34000	-0.130009	0.178693
194.000	6338.00	3.67000	3.38000	0.598876E-01	0.339621
195.000	6339.00	3.45000	3.34000	-0.599897E-01	0.463425E-01
196.000	6340.00	3.56000	3.42000	0.0	0.135188
197.000	6341.00	3.46000	3.42000	0.598680E-01	0.985302E-01
198.000	6342.00	3.46000	3.47000	0.598680E-01	0.502022E-01
199.000	6343.00	3.47000	3.43000	0.598743E-01	0.985329E-01
200.000	6344.00	3.52000	3.46000	0.0	0.579603E-01

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201.000	6345.00	3.56000	3.53000	-0.299982E-01	-0.102969E-02
202.000	6346.00	3.57000	3.52000	0.0	0.482767E-01
203.000	6347.00	3.57000	3.48000	0.0	0.868979E-01
204.000	6348.00	3.54000	3.47000	0.0	0.676073E-01
205.000	6349.00	3.51000	3.49000	0.297477E-01	0.145567
206.000	6350.00	3.57000	3.44000	0.0	0.772424E-01
207.000	6351.00	3.64000	3.51000	0.297444E-01	0.155179
208.000	6352.00	3.71000	3.59000	0.598750E-01	0.262362
209.000	6401.00	3.66000	3.51000	0.0	0.148704
210.000	6402.00	3.71000	3.52000	0.0	0.183203
211.000	6403.00	3.66000	3.52000	-0.400069E-01	-0.950504E-01
212.000	6404.00	3.65000	3.49000	-0.700247E-01	-0.843408E-01
213.000	6405.00	3.66000	3.48000	-0.700216E-01	0.103623
214.000	6406.00	3.68000	3.49000	0.0	0.183256
215.000	6407.00	3.69000	3.50000	-0.399853E-01	0.143253
216.000	6408.00	3.69000	3.51000	-0.399981E-01	0.132597
217.000	6409.00	3.81000	3.56000	-0.399940E-01	0.200831
218.000	6410.00	3.79000	3.52000	-0.399940E-01	0.220147
219.000	6411.00	3.76000	3.53000	-0.399983E-01	0.181667
220.000	6412.00	3.79000	3.52000	0.0	0.260141
221.000	6413.00	3.79000	3.52000	0.698017E-01	0.329943
222.000	6414.00	3.76000	3.50000	0.396720E-01	0.290250
223.000	6415.00	3.73000	3.44000	0.999271E-01	0.379099
224.000	6416.00	3.59000	3.45000	0.697942E-01	0.195307
225.000	6417.00	3.61000	3.43000	0.999296E-01	0.273658
226.000	6418.00	3.60000	3.43000	0.697835E-01	0.233876
227.000	6419.00	3.59000	3.47000	0.396677E-01	0.155509
228.000	6420.00	3.60000	3.45000	0.139995	0.284782
229.000	6421.00	3.57000	3.45000	0.139992	0.255855
230.000	6422.00	3.54000	3.46000	0.139979	0.217245
231.000	6423.00	3.44000	3.45000	0.199867	0.190194
232.000	6424.00	3.45000	3.46000	0.269696	0.260010
233.000	6425.00	3.49000	3.46000	0.269677	0.298666
234.000	6426.00	3.50000	3.45000	0.329969	0.378278
235.000	6427.00	3.49000	3.46000	0.269684	0.298673
236.000	6428.00	3.47000	3.45000	0.269688	0.289017
237.000	6429.00	3.52000	3.39000	0.139949	0.265579
238.000	6430.00	3.52000	3.43000	0.169729	0.256669
239.000	6431.00	3.59000	3.44000	0.139992	0.284793
240.000	6432.00	3.67000	3.47000	-0.140015	-0.529052E-01
241.000	6433.00	3.74000	3.48000	-0.340007	-0.893797E-01
242.000	6434.00	3.71000	3.48000	-0.339996	-0.118224
243.000	6435.00	3.70000	3.48000	-0.210013	-0.213796E-02
244.000	6436.00	3.71000	3.48000	-0.299981	-0.782096E-01
245.000	6437.00	3.72000	3.50000	-0.269987	-0.578783E-01
246.000	6438.00	3.75000	3.52000	-0.200003	-0.216845E-01
247.000	6439.00	3.86000	3.52000	-0.199990	-0.649322E-01
248.000	6440.00	3.83000	3.53000	-0.199994	-0.103497
249.000	6441.00	3.59000	3.56000	-0.199990	-0.171029
250.000	6442.00	3.59000	3.56000	-0.200002	-0.171042
251.000	6443.00	3.59000	3.56000	-0.200006	-0.171046
252.000	6444.00	3.62000	3.53000	-0.199991	-0.113137
253.000	6445.00	3.62000	3.54000	-0.200006	-0.122801
254.000	6446.00	3.59000	3.56000	-0.170014	-0.141054
255.000	6447.00	3.60000	3.59000	-0.130000	-0.120347
256.000	6448.00	3.78000	3.79000	-0.269998	-0.279634
257.000	6449.00	3.77000	3.76000	-0.130002	-0.120365
258.000	6450.00	3.74000	3.80000	-0.700135E-01	-0.127849
259.000	6451.00	3.77000	3.84000	-0.700191E-01	-0.137476
260.000	6452.00	3.76000	3.84000	-0.700238E-01	-0.147125
261.000	6453.00	3.74000	3.80000	-0.140020	-0.197857
262.000	6501.00	3.71000	3.77000	-0.140004	-0.197858
263.000	6502.00	3.73000	3.74000	-0.199987	-0.209628
264.000	6503.00	3.63000	3.81000	-0.269993	-0.443688
265.000	6504.00	3.62000	3.83000	-0.270008	-0.472671
266.000	6505.00	3.63000	3.89000	-0.229984	-0.480883
267.000	6506.00	3.61000	3.89000	-0.700191E-01	-0.340263
268.000	6507.00	3.62000	3.94000	0.139988	-0.168832
269.000	6508.00	3.67000	3.97000	0.0	-0.209360
270.000	6509.00	3.69000	3.93000	0.999205E-01	-0.131539
271.000	6510.00	3.63000	3.91000	0.169736	-0.100457
272.000	6511.00	3.56000	3.90000	0.409697	0.813850E-01
273.000	6512.00	3.54000	3.86000	0.669956	0.300897
274.000	6513.00	3.52000	3.91000	0.539775	0.163036
275.000	6514.00	3.50000	3.90000	0.469967	0.894940E-01
276.000	6515.00	3.54000	3.91000	0.469950	0.112600
277.000	6516.00	3.59000	3.92000	0.399765	0.812016E-01
278.000	6517.00	3.71000	3.90000	0.339885	0.156681
279.000	6518.00	3.71000	3.87000	0.199865	0.648990E-01
280.000	6519.00	3.72000	3.88000	0.199883	0.456222E-01
281.000	6520.00	3.76000	3.88000	0.269691	0.154040
282.000	6521.00	3.84000	3.85000	0.269695	0.260064
283.000	6522.00	3.89000	3.82000	0.339884	0.407262
284.000	6523.00	3.88000	3.79000	0.409679	0.496317
285.000	6524.00	3.87000	3.77000	0.469970	0.566244
286.000	6525.00	3.85000	3.74000	0.409695	0.515616
287.000	6526.00	3.83000	3.80000	0.269677	0.298571
288.000	6527.00	3.87000	3.84000	0.269698	0.298581
289.000	6528.00	3.87000	3.82000	0.139985	0.188122
290.000	6529.00	3.92000	3.79000	0.139994	0.265089
291.000	6530.00	3.96000	3.78000	-0.199997	-0.268542E-01
292.000	6531.00	3.99000	3.82000	-0.700064E-01	0.934709E-01
293.000	6532.00	4.00000	3.81000	0.139988	0.322680
294.000	6533.00	3.98000	3.81000	0.0	0.161493
295.000	6534.00	3.99000	3.83000	-0.140008	0.138531E-01
296.000	6535.00	4.00000	3.84000	-0.339993	-0.186146
297.000	6536.00	4.03000	3.87000	-0.539998	-0.386196
298.000	6537.00	3.99000	3.86000	-0.399999	-0.276987
299.000	6538.00	3.98000	3.94000	-0.610019	-0.571550
300.000	6539.00	4.06000	3.99000	-0.540007	-0.472738
301.000	6540.00	4.00000	3.98000	-0.599994	-0.580762
302.000	6541.00	4.03000	3.99000	-0.670001	-0.631551
303.000	6542.00	4.08000	4.01000	-0.740002	-0.672745
304.000	6543.00	4.07000	4.03000	-0.669395	-0.631559
305.000	6544.00	4.08000	4.04000	-0.599990	-0.591558
306.000	6545.00	4.11000	4.05000	-0.669989	-0.612357
307.000	6546.00	4.08000	4.07000	-0.809988	-0.800380
308.000	6547.00	4.06000	4.04000	-0.669982	-0.698811

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312.000	6548.00	4.08000	4.10000	-0.810003	-0.829218
313.000	6549.00	4.38000	4.31000	-0.610011	-0.542948
314.000	6550.00	4.44000	4.40000	-0.664993	-0.631693
315.000	6551.00	4.42000	4.44000	-0.739987	-0.759141
316.000	6552.00	4.41000	4.45000	-0.670001	-0.708312
317.000	6601.00	4.47000	4.52000	-0.809999	-0.857859
318.000	6602.00	4.49000	4.58000	-0.670001	-0.765714
319.000	6603.00	4.54000	4.56000	-0.740002	-0.759133
320.000	6604.00	4.51000	4.53000	-0.540007	-0.559145
321.000	6605.00	4.53000	4.61000	-0.490017	-0.566550
322.000	6606.00	4.54000	4.63000	-0.449998	-0.536089
323.000	6607.00	4.53000	4.63000	-0.369989	-0.465655
324.000	6608.00	4.54000	4.64000	-0.500012	-0.595668
325.000	6609.00	4.55000	4.57000	-0.400016	-0.419146
326.000	6610.00	4.57000	4.64000	-0.150006	-0.216947
327.000	6611.00	4.52000	4.61000	-0.150002	0.503412E-01
328.000	6612.00	4.49000	4.46000	-0.400059E-01	0.369948
329.000	6613.00	4.50000	4.49000	0.0	0.390848
330.000	6614.00	4.53000	4.53000	0.0	0.381206
331.000	6615.00	4.56000	4.64000	-0.600089E-01	0.244863
332.000	6616.00	4.57000	4.62000	-0.149939	0.183429
333.000	6617.00	4.54000	4.61000	-0.149993	0.164473
334.000	6618.00	4.58000	4.65000	-0.170002	0.144344
335.000	6619.00	4.57000	4.59000	-0.169998	0.192010
336.000	6620.00	4.56000	4.62000	-0.170013	0.153919
337.000	6621.00	4.58000	4.61000	-0.190001	0.162447
338.000	6622.00	4.56000	4.53000	-0.220009	0.189670
339.000	6623.00	4.54000	4.54000	-0.170002	0.211168
340.000	6624.00	4.53000	4.47000	-0.219994	0.218394
341.000	6625.00	4.58000	4.31000	0.0	0.543478
342.000	6626.00	4.67000	4.43000	-0.110006	0.309562
343.000	6627.00	4.54000	4.63000	0.0	0.295407
344.000	6628.00	4.56000	4.88000	0.396510E-01	0.115870
345.000	6629.00	4.52000	4.85000	0.396596E-01	0.106377
346.000	6630.00	4.89000	4.66000	0.0	0.219277
347.000	6631.00	4.86000	4.81000	0.396681E-01	0.873510E-01
348.000	6632.00	4.92000	4.88000	0.189955	0.228080
349.000	6633.00	4.96000	5.06000	0.279984	0.184709
350.000	6634.00	4.97000	4.99000	0.396596E-01	0.206061E-01
351.000	6635.00	4.89000	5.04000	0.896248E-01	-0.533827E-01
352.000	6636.00	4.87000	5.16000	0.896345E-01	-0.186898
353.000	6637.00	4.92000	5.42000	0.409689	-0.668650E-01
354.000	6638.00	4.88000	5.47000	0.319662	-0.281254
355.000	6639.00	4.87000	5.30000	0.319655	-0.903756E-01
356.000	6640.00	4.96000	5.34000	0.409696	0.476528E-01
357.000	6641.00	4.98000	5.45000	0.409677	-0.380281E-01
358.000	6642.00	5.41000	5.31000	0.369635	0.839475E-01
359.000	6643.00	5.05000	5.21000	0.239939	0.876306E-01
360.000	6644.00	5.08000	5.29000	0.279981	0.801334E-01
361.000	6645.00	5.08000	5.38000	0.259758	-0.257383E-01
362.000	6646.00	5.05000	5.32000	0.409687	0.152666
363.000	6647.00	5.04000	5.25000	0.409687	0.209703
364.000	6648.00	5.01000	5.13000	0.369688	0.255353
365.000	6649.00	5.00000	5.14000	0.409673	0.276340
366.000	6650.00	4.94000	5.88000	0.329967	-0.565783
367.000	6651.00	4.82000	5.77000	0.259764	-0.646551
368.000	6652.00	4.83000	5.79000	0.149912	-0.765856
369.000	6701.00	4.81000	5.74000	-0.799965E-01	-0.132093E-01
370.000	6702.00	4.76000	4.77000	-0.190014	-0.199560
371.000	6703.00	4.66000	4.68000	-0.319991	-0.339100
372.000	6704.00	4.53000	4.58000	-0.409991	-0.457825
373.000	6705.00	4.51000	4.44000	-0.429998	-0.363019
374.000	6706.00	4.49000	4.50000	-0.350005	-0.359575
375.000	6707.00	4.48000	4.58000	-0.190008	-0.285721
376.000	6708.00	4.44000	4.59000	-0.149992	-0.291615
377.000	6709.00	4.37000	4.35000	0.0	-0.191630E-01
378.000	6710.00	4.24000	4.33000	0.149901	0.635620E-01
379.000	6711.00	4.12000	4.21000	0.219724	0.132186
380.000	6712.00	3.98000	4.11000	0.129683	0.465824E-02
381.000	6713.00	4.03000	4.09000	0.169739	0.112063
382.000	6714.00	3.96000	3.88000	0.169731	0.246684
383.000	6715.00	3.86000	3.86000	-0.100016	-0.100016
384.000	6716.00	3.86000	3.75000	-0.399858E-01	0.659256E-01
385.000	6717.00	3.91000	3.68000	-0.129995	0.913511E-01
386.000	6718.00	3.93000	3.65000	-0.170012	0.994003E-01
387.000	6719.00	4.02000	3.63000	-0.170015	0.204913
388.000	6720.00	4.06000	3.52000	-0.899907E-01	0.428941
389.000	6721.00	4.11000	3.45000	-0.150005	0.483940
390.000	6722.00	4.14000	3.37000	-0.280010	0.459379
391.000	6723.00	4.23000	3.40000	-0.219997	0.576319
392.000	6724.00	4.32000	3.56000	-0.299988	0.420540
393.000	6725.00	4.24000	3.35000	-0.219997	0.633802
394.000	6726.00	4.18000	3.82000	-0.219994	0.125562
395.000	6727.00	4.17000	4.19000	-0.210009	-0.229209
396.000	6728.00	4.13000	4.10000	-0.369993	-0.341184
397.000	6729.00	4.20000	4.20000	-0.579982	-0.579982
398.000	6730.00	4.29000	4.10000	-0.710000	-0.505276
399.000	6731.00	4.22000	4.13000	-0.649992	-0.563636
400.000	6732.00	4.23000	4.13000	-0.750000	-0.654058
	6733.00	4.23000	4.17000	-0.969999	-0.912834
	6734.00	4.22000	4.34000	-0.970004	-1.08514
	6735.00	4.22000	4.33000	-0.970000	-1.07555

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401.000	6736.00	4.26000	4.27000	-1.03000	-1.03959
402.000	6737.00	4.36000	4.36000	-1.14002	-1.14002
403.000	6738.00	4.39000	4.55000	-1.18000	-1.33327
404.000	6739.00	4.67000	4.37000	-1.22000	-0.933389
405.000	6740.00	4.65000	4.47000	-0.899998	-0.727996
406.000	6741.00	4.79000	4.58000	-1.15998	-0.959582
407.000	6742.00	4.84000	4.53000	-1.44000	-1.18431
408.000	6743.00	4.85000	4.50000	-1.44000	-1.10619
409.000	6744.00	4.82000	4.56000	-1.01001	-0.761969
410.000	6745.00	4.82000	4.62000	-0.899999	-0.709196
411.000	6746.00	4.65000	4.57000	-0.900008	-0.632960
412.000	6747.00	5.27000	4.76000	-0.910001	-0.125532
413.000	6748.00	5.33000	4.93000	-0.170005	0.209755
414.000	6749.00	5.45000	4.89000	-0.320002	0.211056
415.000	6750.00	5.69000	4.98000	-0.499988	0.171783
416.000	6751.00	5.84000	4.92000	-0.480004	0.389231
417.000	6752.00	5.82000	4.98000	-0.489998	0.303803
418.000	6801.00	5.79000	4.95000	-0.319989	0.474038
419.000	6802.00	5.67000	5.03000	-0.850003	-0.244344
420.000	6803.00	5.66000	5.02000	-1.73999	-1.13427
421.000	6804.00	6.08030	4.87000	-1.30000	-0.159389
422.000	6805.00	6.15000	4.91000	-1.20000	3.623665E-01
423.000	6806.00	6.40000	5.01000	-1.46000	-0.153610
424.000	6807.00	6.40000	4.93000	-1.28000	3.101581
425.000	6808.00	6.54000	4.96000	-1.41001	0.730066E-01
426.000	6809.00	6.60000	5.00000	-1.50001	0.925064E-03
427.000	6810.00	6.61000	5.06000	-1.61999	-0.166098
428.000	6811.00	6.65000	5.33000	-2.389999	-1.15229
429.000	6812.00	6.78000	5.21000	-1.66999	-0.199673
430.000	6813.00	6.75000	5.14000	-1.68999	-0.181793
431.000	6814.00	6.83000	5.23000	-1.51000	-0.197050
432.000	6815.00	6.66000	5.37000	-1.38003	-0.170554
433.000	6816.00	6.72000	5.50000	-1.47001	-0.326834
434.000	6817.00	6.79000	5.49000	-1.52999	-0.312651
435.000	6818.00	6.79000	5.44000	-1.61999	-0.355827
436.000	6819.00	6.71000	5.52000	-1.25000	-0.138830
437.000	6820.00	6.72000	5.75000	-1.21000	-0.301079
438.000	6821.00	6.76000	5.70000	-1.38001	-0.387125
439.000	6822.00	6.73000	5.65000	-1.35999	-0.348098
440.000	6823.00	6.73000	5.62000	-1.90001	-0.852999
441.000	6824.00	6.57000	5.64000	-0.910003	-0.373367E-01
442.000	6825.00	6.46000	5.32000	-0.840007	0.230816
443.000	6826.00	6.35000	5.26000	-0.949981	0.749362E-01
444.000	6827.00	6.31000	5.35000	-1.01000	-0.106976
445.000	6828.00	6.17000	5.33000	-1.14002	-0.348832
446.000	6829.00	5.93000	5.27000	-1.50999	-0.886940
447.000	6830.00	5.83000	5.17000	-1.61000	-0.986353
448.000	6831.00	5.82000	4.86000	-1.52000	-0.612797
449.000	6832.00	5.71000	4.98000	-1.54001	-0.811605
450.000	6833.00	5.67000	5.07000	-1.19000	-0.622191
451.000	6834.00	5.57000	5.10000	-1.15001	-0.704805
452.000	6835.00	5.32000	5.18000	-1.02000	-0.887068
453.000	6836.00	5.44000	5.20000	-0.890004	-0.662387
454.000	6837.00	5.42000	5.25000	-0.790003	-0.628744
455.000	6838.00	5.43000	5.11000	-0.969988	-0.685439
456.000	6839.00	5.54000	5.06000	-0.860020	-0.405216
457.000	6840.00	5.49000	5.19000	-0.650000	-0.365612
458.000	6841.00	5.46000	5.25000	-0.410004	-0.210877
459.000	6842.00	5.47000	5.30000	-0.450017	-0.288833
460.000	6843.00	5.50000	5.37000	-0.630004	-0.506781
461.000	6844.00	5.40000	5.42000	-0.620006	-0.639981
462.000	6845.00	5.45000	5.41000	-0.689987	-0.652054
463.000	6846.00	5.50000	5.38000	-0.479988	-0.366239
464.000	6847.00	5.50000	5.41000	-0.539996	-0.456688
465.000	6848.00	5.50000	5.48000	-0.319989	-0.301031
466.000	6849.00	5.54000	5.62000	-0.299987	-0.375788
467.000	6850.00	5.63000	5.88000	-0.809986	-0.646661
468.000	6851.00	5.96000	6.00000	-0.830008	-0.593259
469.000	6852.00	6.04000	6.15000	-0.550017	-0.538078
470.000	6901.00	6.15000	6.11000	-0.240004	-0.202321
471.000	6902.00	6.27000	6.08000	-0.199982E-01	0.158791
472.000	6903.00	6.18000	6.01000	-0.129988	0.301173E-01
473.000	6904.00	6.16000	6.12000	-0.229986	-0.971070E-01
474.000	6905.00	6.18000	6.19000	-0.699982E-01	-0.174452E-01
475.000	6906.00	6.08000	6.15000	-0.999817E-01	-0.105971
476.000	6907.00	6.01000	6.04000	-0.189911	0.102745
477.000	6908.00	6.03000	6.00000	-0.279980	0.232823
478.000	6909.00	6.24000	6.11000	-0.409712	0.528641
479.000	6910.00	6.45000	6.05000	-0.479908	0.805672
480.000	6911.00	6.43000	5.99000	-0.419886	0.893203
481.000	6912.00	6.43000	5.95000	-0.609946	1.04095
482.000	6913.00	6.37000	5.92000	-0.739865	1.16272
483.000	6914.00	6.36000	6.05000	-0.819756	1.11122
484.000	6915.00	6.43000	6.12000	0.609959	0.901230
485.000	6916.00	6.49000	6.17000	0.649682	0.950141
486.000	6917.00	6.39000	6.07000	0.739656	1.04044
487.000	6918.00	6.62000	5.91000	0.859820	1.52574
488.000	6919.00	6.60000	5.92000	1.07992	1.71782
489.000	6920.00	6.51000	6.06000	1.11997	1.54247
490.000	6921.00	6.48000	5.98000	1.20964	1.67921
491.000	6922.00	6.50000	6.08000	1.37975	1.77412
492.000	6923.00	6.60000	6.38000	1.59987	1.84377
493.000	6924.00	6.88000	6.73000	1.29965	1.43999
494.000	6925.00	6.89000	6.53000	1.63992	1.97671
495.000	6926.00	6.89000	6.08000	1.40990	2.16769
496.000	6927.00	6.91000	6.80000	1.59987	1.70276
497.000	6928.00	7.13000	6.93000	1.63993	1.82662
498.000	6929.00	7.19000	7.00000	1.11997	1.48313
499.000	6930.00	7.39000	7.07000	1.11998	1.41796
500.000	6931.00	7.36000	7.01000	0.819762	1.16577
501.000	6932.00	7.36000	6.94000	0.779711	1.17092
502.000	6933.00	7.38000	6.86000	0.689673	1.17393
503.000	6934.00	7.42000	6.86000	0.689683	1.21100
504.000	6935.00	7.42000	6.99000	0.879867	0.880164
505.000	6936.00	7.49000	7.02000	0.609955	1.08720
506.000	6937.00	7.48000	7.03000	0.609966	1.02865
507.000	6938.00	7.51000	7.10000	0.389861	0.771221
508.000	6939.00	7.53000	7.03000	0.389840	0.854827

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509.000	6940.00	7.53000	6.97000	0.513940	1.04073
510.000	6941.00	7.45000	6.38000	0.609949	1.04736
511.000	6942.00	7.40000	6.99000	0.559984	0.941735
512.000	6943.00	7.38000	6.95000	0.189955	0.590402
513.000	6944.00	7.38000	6.98000	0.198319E-01	0.392341
514.000	6945.00	7.43000	7.09000	-0.408057E-01	0.276480
515.000	6946.00	7.43000	7.14000	-0.138005	0.139939
516.000	6947.00	7.48000	7.31000	0.896314E-01	0.247800
517.000	6948.00	7.50000	7.49000	0.896218E-01	0.989239E-01
518.000	6949.00	7.51000	7.56000	0.196510E-01	0.117520E-01
519.000	6950.00	7.53000	7.72000	0.896279E-01	-0.870667E-01
520.000	6951.00	7.53000	7.80000	0.896218E-01	-0.161471
521.000	6952.00	7.53000	7.78000	0.896245E-01	-0.142869
522.000	6953.00	7.57000	7.98000	-0.400009E-01	-0.421148
523.000	7001.00	7.58000	7.86000	-0.170010	-0.430282
524.000	7002.00	7.56000	7.73000	-0.170010	-0.337375
525.000	7003.00	7.53000	7.80000	-0.269998	-0.521090
526.000	7004.00	7.52000	7.85000	-0.330002	-0.636922
527.000	7005.00	7.57000	7.50000	0.697975E-01	0.134871
528.000	7006.00	7.47000	7.19000	0.279976	0.540514
529.000	7007.00	7.39000	6.74000	0.649635	1.25490
530.000	7008.00	7.38000	6.82000	0.559992	1.08150
531.000	7009.00	7.31000	6.81000	0.499725	0.965665
532.000	7010.00	7.22000	6.70000	0.519923	1.00491
533.000	7011.00	7.09000	6.56000	0.529845	1.02475
534.000	7012.00	6.76000	6.11000	0.649623	1.25846
535.000	7013.00	6.76000	6.30000	0.459654	0.890527
536.000	7014.00	6.61000	6.31000	0.299814	0.581214
537.000	7015.00	6.40000	6.34000	0.598859E-01	0.116277
538.000	7016.00	6.52000	6.47000	0.499592E-01	0.968989E-01
539.000	7017.00	6.55000	6.85000	-0.299992	-0.581550
540.000	7018.00	6.49000	6.53000	-0.399921E-01	-0.775543E-01
541.000	7019.00	6.31000	6.69000	-0.380012	-0.737458
542.000	7020.00	6.26000	6.68000	-0.420000	-0.815257
543.000	7021.00	6.28000	6.87000	-0.590003	-1.14514
544.000	7022.00	5.69000	6.80000	-1.11001	-2.16025
545.000	7023.00	5.69000	6.66000	-0.989988	-1.92669
546.000	7024.00	5.71000	6.67000	1.78985	0.861706
547.000	7025.00	5.76000	6.35000	1.48962	0.931755
548.000	7026.00	5.77000	6.40000	1.25999	0.664354
549.000	7027.00	5.71000	6.53000	1.32979	0.550087
550.000	7028.00	5.81000	6.37000	1.27982	0.560195
551.000	7029.00	5.47000	6.23000	0.929621	0.209037
552.000	7030.00	5.58000	6.31000	0.329962	-0.399619
553.000	7031.00	5.62000	6.42000	0.609958	-0.147478
554.000	7032.00	5.58000	6.48000	0.779723	-0.110934
555.000	7033.00	5.47000	6.27000	0.689686	-0.688241E-01
556.000	7034.00	5.37000	6.22000	0.489802	-0.316879
557.000	7035.00	5.37000	6.17000	0.389876	-0.559191
558.000	7036.00	5.39000	6.35000	0.699625	-0.481277
559.000	7037.00	5.27000	6.08000	0.669856	-0.995946E-01
560.000	7038.00	5.29000	5.74000	0.699635	0.222244
561.000	7039.00	5.26000	5.80000	0.939927	0.426912
562.000	7040.00	5.27000	6.01000	1.09976	0.796810
563.000	7041.00	5.21000	5.86000	0.979973	0.362160
564.000	7042.00	5.08000	5.71000	0.329963	-0.269580
565.000	7043.00	4.84000	5.79000	0.409683	-0.496460
566.000	7044.00	4.87000	5.44000	0.429913	-0.113617
567.000	7045.00	4.74000	5.46000	0.489789	-0.197627
568.000	7046.00	4.49000	5.10000	0.569900	-0.138678E-01
569.000	7047.00	4.25000	5.00000	0.489802	-0.229623
570.000	7048.00	4.36000	4.87000	0.649628	0.160935
571.000	7049.00	4.42000	4.80000	0.609946	0.246031
572.000	7050.00	4.15000	4.68000	0.609966	0.293723
573.000	7051.00	4.29000	4.78000	0.0	-0.469844
574.000	7052.00	4.33000	4.80000	-0.120017	-0.570510
575.000	7101.00	4.44000	4.69000	-0.299984	-0.539356
576.000	7102.00	4.53000	4.35000	-0.630018	-0.457818
577.000	7103.00	4.44000	4.06000	-0.830004	-0.466159
578.000	7104.00	4.60000	4.08000	-1.10999	-0.612860
579.000	7105.00	4.71000	3.97000	-1.02999	-0.323279
580.000	7106.00	4.71000	3.62000	-1.05000	-0.902843E-02
581.000	7107.00	4.47000	3.37000	-1.00999	0.429420E-01
582.000	7108.00	3.94000	3.33000	-1.08998	-0.503108
583.000	7109.00	3.86000	3.28000	-0.879987	-0.321543
584.000	7110.00	3.43000	3.16000	-0.179995	-0.112185
585.000	7111.00	2.95000	3.30000	0.379929	0.399587E-01
586.000	7112.00	2.99000	3.32000	0.339992	-0.180420
587.000	7113.00	3.06000	3.58000	0.319668	-0.186893
588.000	7114.00	2.98000	3.78000	0.399764	-0.377086
589.000	7115.00	3.05000	3.84000	0.519926	-0.227285
590.000	7116.00	2.97000	3.70000	0.529633	-0.220688
591.000	7117.00	2.95000	3.93000	0.809849	-0.182070
592.000	7118.00	3.08000	3.74000	1.66967	1.02939
593.000	7119.00	2.99000	3.98000	1.30996	0.348697
594.000	7120.00	2.89000	4.28000	1.20963	-0.141333
595.000	7121.00	2.97000	4.26000	1.16995	-0.828819E-01
596.000	7122.00	2.99000	4.18000	1.29966	0.144209
597.000	7123.00	3.00000	4.56000	1.26990	-0.248662
598.000	7324.00	3.02000	4.81000	1.55981	0.177717
599.000	7125.00	3.12000	4.76000	1.55982	-0.305595E-01
600.000	7126.00	3.33000	5.14000	1.09977	-0.651896

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE CANADA	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE CANADIAN DOLLAR	COVERED ARBITRAGE MARGIN ON CANADIAN T. BILLS
601.000	7127.00	3.47000	5.33000	1.26991	-0.527716
602.000	7128.00	3.48000	5.37000	1.38969	-0.436750
603.000	7129.00	3.45000	5.28000	1.22982	-0.489149
604.000	7130.00	3.42000	5.20000	1.34963	-0.175173
605.000	7131.00	3.43000	5.23000	1.21994	-0.128420
606.000	7132.00	3.42000	5.10000	1.33970	0.204215
607.000	7133.00	3.75000	4.49000	1.12990	0.416643
608.000	7134.00	3.70000	4.55000	1.12990	0.310224
609.000	7135.00	3.80000	4.42000	1.21992	0.622618
610.000	7136.00	3.73000	4.59000	1.25999	0.401746
611.000	7137.00	3.77000	4.68000	1.13982	0.262884
612.000	7138.00	3.90000	4.87000	1.04979	0.308689
613.000	7139.00	3.95000	4.52000	0.749964	0.201623
614.000	7140.00	3.81000	4.45000	0.419983	-0.196529
615.000	7141.00	3.83000	4.35000	0.259768	-0.241050
616.000	7142.00	3.83000	4.34000	0.396609E-01	-0.684068
617.000	7143.00	3.39000	4.33000	0.396726E-01	-0.840490
618.000	7144.00	3.29000	4.09000	0.119760	-0.635468
619.000	7145.00	3.24000	4.11000	0.239927	-0.602771
620.000	7146.00	3.26000	4.06000	0.439817	-0.334927
621.000	7147.00	3.23000	4.36000	0.599667	-0.494975
622.000	7148.00	3.31000	4.41000	0.579832	-0.271808
623.000	7149.00	3.23000	4.01000	0.619741	-0.135853
624.000	7150.00	3.10000	3.98000	0.639640	-0.213901
625.000	7151.00	3.09000	3.78000	0.559641	-0.109678
626.000	7152.00	3.14000	3.70000	0.719818	0.176866
627.000	7201.00	3.26000	3.45000	0.519928	0.335926
628.000	7202.00	3.17000	3.09000	0.399767	0.477109
629.000	7203.00	3.17000	3.29000	0.319650	0.203336
630.000	7204.00	3.31000	3.34000	0.199987	0.170849
631.000	7205.00	3.46000	3.24000	-0.799922E-01	0.132650
632.000	7206.00	3.35000	2.83000	-0.480091	-0.349116E-01
633.000	7207.00	3.40000	2.97000	-0.919937	-0.508136
634.000	7208.00	3.39000	3.22000	-1.00001	-0.835588
635.000	7209.00	3.34000	3.40000	-1.07939	-1.09934
636.000	7210.00	3.33000	3.53000	-1.28001	-1.47356
637.000	7211.00	3.48000	3.78000	-0.760001	-1.98991
638.000	7212.00	3.53000	3.69000	-0.759998	-1.91543
639.000	7213.00	3.47000	3.80000	-0.760124	-1.97906
640.000	7214.00	3.56000	3.72000	-0.800273	-1.94773
641.000	7215.00	3.63000	3.78000	-0.800353	-1.98509
642.000	7216.00	3.56000	3.48000	-1.04034	-0.963088
643.000	7217.00	3.54000	3.48000	-1.20006	-1.14211
644.000	7218.00	3.53000	3.44000	-1.28014	-1.19321
645.000	7219.00	3.54000	3.55000	-1.40003	-1.40969
646.000	7220.00	3.61000	3.72000	-1.72014	-1.82631
647.000	7221.00	3.66000	3.67000	-1.72027	-1.72992
648.000	7222.00	3.65000	3.77000	-1.79939	-1.91577
649.000	7223.00	3.62000	3.78000	-1.36024	-1.51465
650.000	7224.00	3.49000	3.85000	-0.720190	-1.06805
651.000	7225.00	3.45000	3.93000	-0.100239	-0.564231
652.000	7226.00	3.42000	3.91000	-0.200181	-0.673978
653.000	7227.00	3.48000	3.96000	-0.402061E-01	-0.504064
654.000	7228.00	3.41000	3.94000	0.194391E-01	-0.493024
655.000	7229.00	3.33000	3.85000	0.239873	-0.263168
656.000	7230.00	3.38000	3.80000	0.119584	-0.286684
657.000	7231.00	3.40000	3.74000	-0.160319	-0.489140
658.000	7232.00	3.34000	3.77000	0.0	-0.416103
659.000	7233.00	3.36000	3.80000	0.0	-0.425696
660.000	7234.00	3.38000	4.07000	0.0	-0.667442
661.000	7235.00	3.41000	4.48000	-0.401271E-01	-1.07484
662.000	7236.00	3.46000	4.65000	0.596633E-01	-1.09054
663.000	7237.00	3.46000	4.61000	0.0	-1.11154
664.000	7238.00	3.49000	4.60000	0.393113E-01	-1.03316
665.000	7239.00	3.54000	4.48000	0.199530	-0.708334
666.000	7240.00	3.49000	4.62000	0.159805	-0.932088
667.000	7241.00	3.45000	4.78000	0.279755	-1.00589
668.000	7242.00	3.48000	4.68000	0.794260E-01	-1.08022
669.000	7243.00	3.48000	4.65000	0.393307E-01	-1.09155
670.000	7244.00	3.47000	4.63000	-0.801312E-01	-1.20123
671.000	7245.00	3.50000	4.64000	0.996347E-01	-1.00181
672.000	7246.00	3.53000	4.69000	0.119597	-1.00085
673.000	7247.00	3.53000	4.77000	0.159683	-1.03804
674.000	7248.00	3.62000	4.82000	0.119482	-1.03860
675.000	7249.00	3.62000	4.98000	0.259759	-1.05273
676.000	7250.00	3.59000	4.97000	0.239916	-1.09226
677.000	7251.00	3.53000	5.09000	0.419807	-1.08700
678.000	7252.00	3.58000	5.05000	0.439501	-0.979691
679.000	7301.00	3.64000	5.05000	0.519840	-0.840638
680.000	7302.00	3.66000	5.19000	0.679523	-0.796457
681.000	7303.00	3.69000	5.42000	0.959776	-0.706658
682.000	7304.00	3.80000	5.67000	1.07967	-0.721869
683.000	7305.00	3.84000	5.69000	1.35989	-0.421700
684.000	7306.00	3.83000	5.30000	1.47943	0.636501E-01
685.000	7307.00	3.79000	5.31000	1.73959	0.275098
686.000	7308.00	3.82000	5.44000	1.77959	0.219193
687.000	7309.00	3.96000	5.68000	2.05993	0.405444
688.000	7310.00	4.05000	5.76000	2.38949	0.706054
689.000	7311.00	4.18000	6.04000	2.30951	0.528134
690.000	7312.00	4.31000	6.21000	2.30380	0.488301
691.000	7313.00	4.39000	6.22000	2.51989	0.766852
692.000	7314.00	4.37000	6.14000	2.15961	0.272093
693.000	7315.00	4.63000	6.12000	1.47968	0.556164E-01
694.000	7316.00	4.72000	6.12000	1.57961	0.242712
695.000	7317.00	4.82000	6.13000	1.67993	0.430172
696.000	7318.00	4.89000	6.16000	1.53988	0.329087
697.000	7319.00	4.86000	6.04000	1.29936	0.174065
698.000	7320.00	5.06000	6.22000	1.47943	0.375200
699.000	7321.00	5.06000	6.46000	1.47943	0.14[illegible]
700.000	7322.00	5.07000	6.87000	1.11394	-0.593208
701.000	7323.00	5.11000	7.02000	1.37969	-0.437457
702.000	7324.00	5.29000	7.07000	1.47957	-0.210995
703.000	7325.00	5.31000	7.16000	1.59974	-0.156982
704.000	7326.00	5.33000	7.29000	1.57943	-0.281325
705.000	7327.00	5.47000	7.87000	1.69969	-0.575037
706.000	7328.00	5.47000	7.59000	1.67981	-0.330242
707.000	7329.00	5.55000	8.05000	2.26939	-0.991543E-01
708.000	7330.00	5.59000	8.15000	2.67957	0.550995E-01

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709.000	7331.00	5.86000	8.18000	2.63946	0.254448
710.000	7332.00	5.82000	8.78000	2.97958	0.101279
711.000	7333.00	5.82000	8.47000	2.68956	0.185305
712.000	7334.00	5.95000	8.45000	2.65960	0.279996
713.000	7335.00	6.00000	8.53000	2.67940	0.193006
714.000	7336.00	6.04000	8.77000	2.25981	-0.314691
715.000	7337.00	6.25000	8.75000	2.05393	-0.293015
716.000	7338.00	6.26000	8.00000	1.88978	0.252289
717.000	7339.00	6.29000	6.94000	1.36984	0.758305
718.000	7340.00	6.26000	7.36000	1.40990	0.378700
719.000	7341.00	6.29000	7.08000	0.453652	-0.283598
720.000	7342.00	6.30000	6.98000	0.795919E-01	-0.560108
721.000	7343.00	6.30000	6.99000	-0.700032	-1.34914
722.000	7344.00	6.33000	7.39000	-0.280180	-1.30558
723.000	7345.00	6.33000	8.01000	-0.601700E-01	-1.68016
724.000	7346.00	6.25000	7.51000	0.179529	-1.00635
725.000	7347.00	6.23000	7.74000	0.213669	-1.20177
726.000	7348.00	6.22000	7.32000	0.299835	-0.735751
727.000	7349.00	6.23000	7.55000	-0.599994	-1.84258
728.000	7350.00	6.17000	7.49000	-0.219994	-1.46328
729.000	7351.00	6.17000	7.21000	-0.180021	-1.15958
730.000	7352.00	6.15000	7.36000	-0.110163	-1.25006
731.000	7401.00	6.13000	7.38000	-0.401428E-01	-1.21794
732.000	7402.00	6.10300	7.75000	-0.200116	-1.75525
733.000	7403.00	6.10000	7.75000	-0.350198	-1.90533
734.000	7404.00	6.08000	7.92000	-0.330024	-2.06456
735.000	7405.00	6.04000	7.42000	-0.403014E-01	-1.34170
736.000	7406.00	5.99000	6.99000	-0.200124	-1.14361
737.000	7407.00	5.95000	7.00000	-0.350068	-1.34110
738.000	7408.00	5.95000	6.94000	-0.330197	-1.26460
739.000	7409.00	5.92000	7.51000	-0.200287	-1.70142
740.000	7410.00	5.87000	7.66000	-0.800909E-01	-1.67488
741.000	7411.00	6.01000	7.74000	0.249712	-1.38221
742.000	7412.00	6.17000	8.02000	0.489615	-1.25287
743.000	7413.00	6.36000	8.34000	0.419858	-1.44174
744.000	7414.00	6.66000	8.55000	-0.120320	-1.89230
745.000	7415.00	6.84000	8.45000	-0.160057	-1.85736
746.000	7416.00	7.13000	7.94000	-0.540010	-1.23970
747.000	7417.00	7.59000	8.32000	-0.330245	-1.00875
748.000	7418.00	7.81425	8.80767	0.231327	-0.877456
749.000	7419.00	7.80164	8.60055	-0.127352	-0.868440
750.000	7420.00	8.28493	8.01863	-0.169420	0.765069E-01
751.000	7421.00	8.44274	7.56493	0.575754E-01	0.866983
752.000	7422.00	8.51178	8.00877	0.363765	0.787322
753.000	7423.00	8.54137	8.00877	0.715575	0.662267
754.000	7424.00	8.51178	9.43288	0.355101	0.427895
755.000	7425.00	8.56110	7.89041	0.633070	1.25086
756.000	7426.00	8.63014	7.59452	1.45322	2.40656
757.000	7427.00	8.64986	7.80164	1.53449	2.31518
758.000	7428.00	8.70304	7.39726	1.98864	2.19333
759.000	7429.00	8.72877	7.99890	0.920622	1.59189
760.000	7430.00	8.94575	7.35781	1.88165	3.33920
761.000	7431.00	8.97534	8.01863	1.66256	2.54047
762.000	7432.00	8.97534	9.14301	1.25418	1.10032
763.000	7433.00	8.92603	8.87671	1.75092	1.79620
764.000	7434.00	8.96548	9.65589	1.83608	1.20248
765.000	7435.00	8.98520	9.14301	1.53093	1.38613
766.000	7436.00	8.99507	9.46849	2.54326	2.10890
767.000	7437.00	8.96548	9.38959	1.00103	0.611818
768.000	7438.00	8.92740	7.10137	0.446465	2.03249
769.000	7439.00	8.91753	6.92383	0.615043	2.35529
770.000	7440.00	8.78794	7.10137	0.305626	1.85596
771.000	7441.00	8.52164	7.87068	-0.307214E-01	0.569122
772.000	7442.00	8.52164	7.89041	-0.348528E-01	0.546813
773.000	7443.00	8.37370	7.69315	-0.292226	0.335738
774.000	7444.00	8.19616	7.87068	-0.425399	-0.124575
775.000	7445.00	8.06734	7.68329	-0.659786E-01	0.289961
776.000	7446.00	7.65370	7.23945	0.150808E-01	0.399877
777.000	7447.00	7.37753	7.56493	-0.540438	-0.714959
778.000	7448.00	7.38740	7.66356	-0.135957	-0.393123
779.000	7449.00	7.36767	7.54521	0.143546	-0.218061E-01
780.000	7450.00	7.30849	7.43671	0.357463E-01	-0.837405E-01
781.000	7451.00	7.18027	6.93370	0.822969E-01	0.278354
784.000	7452.00	7.02247	6.99288	0.416808	0.244857
783.000	7501.00	6.85342	6.98356	0.148683	0.157905
784.000	7502.00	6.75616	6.57863	-0.358104	-0.191805
785.000	7503.00	6.58849	6.51945	-0.531510	-0.466736
786.000	7504.00	6.18411	5.61205	0.892704	1.43144
787.000	7505.00	6.31233	5.71068	0.481078	1.04700
788.000	7506.00	6.28274	5.60219	0.680249	1.12057
789.000	7507.00	6.32219	5.62192	0.641428	1.30006
790.000	7508.00	6.25315	5.47397	0.600827	1.33145
791.000	7509.00	6.17425	5.55288	0.442808	1.02804
792.000	7510.00	6.19397	5.93753	0.641123	0.882605
793.000	7511.00	6.17425	5.39507	-1.47421	-0.740319
794.000	7512.00	6.18411	5.34575	0.160153	0.949684
795.000	7513.00	6.24329	5.51342	0.604686	1.29166
796.000	7514.00	6.32219	5.60219	0.405968	1.08315
797.000	7515.00	6.35178	5.73041	0.382513	0.966771
798.000	7516.00	6.35178	5.41479	0.101892E-01	0.891215
799.000	7517.00	6.49986	5.69096	-0.122944	0.627273
800.000	7518.00	6.75616	5.51342	-0.132368	1.03172

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801.000	7519.00	6.83507	5.42466	-0.451584	0.868592
802.000	7520.00	6.87452	5.08931	-1.60548	0.648985E-01
803.000	7521.00	6.74630	5.26685	-1.71594	-0.329986
804.000	7522.00	6.77589	5.20767	-0.763696	0.705006
805.000	7523.00	6.92383	5.22740	-1.26875	0.317841
806.000	7524.00	6.84493	4.87233	-1.32436	0.521869
807.000	7525.00	6.80548	5.20767	-1.04671	0.449288
808.000	7526.00	6.80548	6.00657	-0.623856	0.124343
809.000	7527.00	7.01260	6.00657	-0.319444	0.620658
810.000	7528.00	7.05205	6.05589	-0.321198	0.609344
811.000	7529.00	7.15068	6.03616	-0.376628	0.663515
812.000	7530.00	7.24931	6.20384	-0.616831	0.357921
813.000	7531.00	7.33808	6.26301	-0.789622	0.211950
814.000	7532.00	7.48603	6.46027	-0.325911	0.628402
815.000	7533.00	7.34521	6.47014	-1.15991	-0.160265
816.000	7534.00	7.95370	6.50959	-1.69843	-0.635657
817.000	7535.00	7.86219	6.44055	-1.06944	0.157009
818.000	7536.00	8.16657	6.35178	-1.91974	-0.241966
819.000	7537.00	8.26521	6.48000	-1.63633	0.125895E-01
820.000	7538.00	8.27507	6.42082	-1.24903	0.463499
821.000	7539.00	8.29477	6.42082	-1.55721	0.173228
822.000	7540.00	8.34411	6.50959	-0.962841	0.730394
823.000	7541.00	8.29479	6.25315	-1.07678	0.808488
824.000	7542.00	8.20603	5.97699	-2.52103	-0.461036
825.000	7543.00	8.03753	5.75014	-2.15344	0.181160E-01
826.000	7544.00	8.04822	5.45425	-2.03318	-0.167576
827.000	7545.00	8.16657	5.52329	-2.59634	-0.152618
828.000	7546.00	8.32438	5.36548	-1.96162	0.799906
829.000	7547.00	8.39342	5.45425	-2.64645	0.651283E-01
830.000	7548.00	8.40329	5.56274	-2.83500	-0.274642
831.000	7549.00	8.43288	5.61205	-3.21490	-0.613457
832.000	7550.00	8.41315	5.60219	-3.18286	-0.590041
833.000	7551.00	8.45260	5.45425	-3.19351	-0.628837
834.000	7552.00	8.48219	5.34575	-2.85887	0.323315E-01
835.000	7601.00	9.52164	5.23726	-3.25082	-0.224343
836.000	7602.00	8.52164	5.05973	-3.95022	-0.760148
837.000	7603.00	9.45260	4.85260	-3.77070	-0.451280
838.000	7604.00	8.43288	4.78356	-3.92052	-0.555010
839.000	7605.00	8.47233	4.67507	-3.64304	-0.142365
840.000	7606.00	8.51178	4.92164	-3.53571	-0.227187
841.000	7607.00	8.54137	4.85260	-3.85144	-0.452952
842.000	7608.00	8.61041	4.90192	-4.63411	-1.21961
843.000	7609.00	8.66959	4.89205	-3.41973	0.564394E-01
844.000	7610.00	8.73863	5.22740	-4.00417	-0.775109
845.000	7611.00	8.96548	5.01041	-4.25557	-0.625911
846.000	7612.00	8.97534	4.98082	-4.76518	-1.09965
847.000	7613.00	8.96548	4.87233	-4.98762	-1.23124
848.000	7614.00	8.94575	5.03014	-5.13785	-1.54375
849.000	7615.00	8.83726	4.92164	-4.72255	-1.12487
850.000	7616.00	8.81753	4.80329	-4.74124	-1.05227
851.000	7617.00	8.85699	4.79342	-4.64013	-0.907191
852.000	7618.00	8.86685	4.88219	-3.94844	-0.288321
853.000	7619.00	8.83726	4.94137	-4.12751	-0.547949
854.000	7620.00	8.83726	5.14849	-3.59307	-0.203822
855.000	7621.00	8.76822	5.44438	-3.00611	0.497628E-01
856.000	7622.00	8.81753	5.52329	-3.26808	-0.140771
857.000	7623.00	8.85699	5.55288	-3.04900	-0.137205E-01
858.000	7624.00	8.87671	5.46411	-3.39643	-0.262062
859.000	7625.00	8.87671	5.41479	-3.38384	-0.208173
860.000	7626.00	8.84712	5.34575	-2.55521	0.661570
861.000	7627.00	8.85699	5.41479	-3.90720	-0.745075
862.000	7628.00	8.87671	5.36548	-4.08399	-0.859025
863.000	7629.00	8.87671	5.04000	-3.75188	-0.227976
864.000	7630.00	8.88657	5.25699	-3.43434	-0.100976
865.000	7631.00	8.94575	5.18794	-3.85490	-0.405648
866.000	7632.00	8.99507	5.23726	-4.27023	-0.822543
867.000	7633.00	8.99507	5.18794	-3.98530	-0.492372
868.000	7634.00	8.96548	5.17808	-4.29624	-0.820456
869.000	7635.00	9.00493	5.10904	-4.15890	-0.584844
870.000	7636.00	8.98520	5.12877	-4.26744	-0.728944
871.000	7637.00	8.96548	5.14849	-3.74950	-0.246566
872.000	7638.00	8.98520	5.12877	-3.96159	-0.423090
873.000	7639.00	8.98520	5.05973	-3.76460	-0.162748
874.000	7640.00	8.99522	5.10904	-3.54807	0.852680E-02
875.000	7641.00	8.97534	5.04986	-3.69476	-0.925837E-01
876.000	7642.00	8.97534	4.89205	-4.21607	-0.469088
877.000	7643.00	8.92603	4.87233	-4.31457	-0.593056
878.000	7644.00	8.88657	4.90192	-7.92207	-4.26262
879.000	7645.00	8.89644	4.80329	-4.10256	-0.343807
880.000	7646.00	8.87671	4.94137	-4.12078	-0.506290
881.000	7647.00	8.76822	4.83288	-2.35203	1.26607
882.000	7648.00	8.47233	4.64548	-0.287455	3.24050
883.000	7649.00	8.50192	4.42849	-3.85117	-0.969315E-01
884.000	7650.00	8.49205	4.44822	-3.75730	-0.299835E-01
885.000	7651.00	8.43288	4.33973	-4.77614	-1.00132
886.000	7652.00	8.03836	4.31014	-2.88414	0.566688
887.000	7653.00	8.02849	4.34959	-3.43230	-0.268068E-01
888.000	7701.00	7.93890	4.52712	-1.71284	1.50181
889.000	7702.00	7.98904	4.52712	-2.29727	-0.914698E-01
890.000	7703.00	7.93973	4.66521	-2.98116	0.524979E-01
891.000	7704.00	7.92986	4.80329	-3.90695	-1.01009
892.000	7705.00	7.82411	4.74411	-2.69096	-0.149736E-01
893.000	7706.00	7.58521	4.64548	-2.97467	-0.278382
894.000	7707.00	7.55507	4.62575	-1.55287	1.17068
895.000	7708.00	7.58521	4.74411	-1.08760	1.51698
896.000	7709.00	7.55507	4.68493	-2.83149	0.237038
897.000	7710.00	7.58521	4.63562	-3.31690	-0.611480
898.000	7711.00	7.52548	4.65538	-3.22395	-0.654687
899.000	7712.00	7.47616	4.60603	-2.55266	0.117829
900.000	7713.00	7.43671	4.54685	-1.82298	0.866847
901.000	7714.00	7.42685	4.61589	-3.02843	-0.108200
902.000	7715.00	7.42685	4.52712	-2.88648	-0.107422
903.000	7716.00	7.45644	4.48767	-2.30906	0.457107
904.000	7717.00	7.47616	4.39890	-2.98496	-0.121755
905.000	7718.00	7.49589	4.77370	-2.31654	0.215825
906.000	7719.00	7.15068	5.02027	-1.68890	0.299339
907.000	7720.00	7.02247	5.13863	-1.43249	0.327738
908.000	7721.00	6.95342	5.04986	-0.806102	0.973703

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE CANADA	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE CANADIAN DOLLAR	COVERED ARBITRAGE MARGIN ON CANADIAN T. BILLS
909.000	7722.00	6.98301	5.05973	-1.24488	0.552866
910.000	7723.00	6.99288	5.12877	-1.31594	0.426338
911.000	7724.00	6.96329	5.05973	-1.34102	0.438622
912.000	7725.00	6.93370	5.05973	-1.03125	0.721211
913.000	7726.00	6.97315	5.02027	-1.64620	0.179379
914.000	7727.00	7.00274	5.13863	-1.64620	0.959148E-01
915.000	7728.00	7.02247	5.20767	-1.42142	0.274296
916.000	7729.00	7.01260	5.27671	-1.49080	0.331332
917.000	7730.00	7.04219	5.44438	-1.38930	0.703394
918.000	7731.00	7.05205	5.40493	-1.47330	0.647154E-01
919.000	7732.00	7.07178	5.58247	-1.50889	-0.117936
920.000	7733.00	7.08164	5.59233	-1.42718	-0.363541E-01
921.000	7734.00	7.07178	5.56274	-1.71397	-0.308594
922.000	7735.00	7.04219	5.62192	-1.21177	0.115061
923.000	7736.00	7.00274	5.67123	-1.07388	0.170485
924.000	7737.00	7.00274	5.31781	-0.637223	0.326705
925.000	7738.00	6.96329	6.02630	-0.386113	0.489876
926.000	7739.00	7.00274	5.87836	-0.300589	0.750208
927.000	7740.00	7.02247	6.20384	-0.347945	0.416970
928.000	7741.00	7.07178	6.42082	-0.131676	0.476290
929.000	7742.00	7.12110	6.14466	-0.445429	0.466099
930.000	7743.00	7.14082	6.10520	-0.796136	0.170399
931.000	7744.00	7.14082	6.25315	-0.931776	-0.103267
932.000	7745.00	7.15068	6.22356	-0.310695	0.554556
933.000	7746.00	7.17041	6.12493	-0.665462	0.310068
934.000	7747.00	7.14082	6.10520	-0.621115	0.345480
935.000	7748.00	7.16055	6.04548	-0.398923	0.604309
936.000	7749.00	7.12110	6.13479	-0.218757	0.701978
937.000	7750.00	7.08164	6.08548	-0.438408E-01	0.886444
938.000	7751.00	7.04219	6.18411	-0.437709E-01	0.757860
939.000	7752.00	7.07178	6.22356	-0.175019	0.617178

B/ The UK/USA Pair.

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
1.00000	6001.30	3.70000	4.59000	0.614522	-0.243722
2.00000	6002.30	3.73000	4.42000	0.586101	-0.790874E-01
3.00000	6003.00	4.49000	4.16000	0.156944	0.472763
4.00000	6004.30	4.49000	3.85000	-0.285827E-01	0.574404
5.00000	6005.00	4.49000	3.80000	-0.128472	0.531879
6.00000	6006.30	4.49000	3.81300	-0.256954	0.393827
7.00000	6007.00	4.48000	4.00000	-0.213958	0.245450
8.00000	6008.00	4.49000	4.13000	-0.9999296-01	0.244538
9.00000	6009.00	4.48000	3.60000	-0.199692	0.642574
10.0000	6010.00	4.52000	3.61000	-0.313677	0.556970
11.0000	6011.00	4.55000	3.39000	-0.470432	0.639084
12.0000	6012.00	4.56000	2.75000	-0.641197	1.08987
13.0000	6013.00	4.56000	2.92000	-2.14330	-0.574820
14.0000	6014.00	4.59000	3.09000	-0.924673	0.509499
15.0000	6015.00	4.60000	3.45000	-0.797150	0.302776
16.0000	6016.00	4.59000	3.30300	-0.839717	0.393671
17.0000	6017.00	4.59000	3.09000	-0.882822	0.550910
18.0000	6018.00	4.61000	3.03000	-0.811731	0.698641
19.0000	6019.00	4.59000	3.35000	-0.712496	0.397983
20.0000	6020.00	4.50000	3.20000	-0.698539	0.545481
21.0000	6021.00	4.50000	3.13300	-0.685046	0.625961
22.0000	6022.00	4.50000	2.60000	-0.713928	1.10425
23.0000	6023.00	4.55000	2.47000	-0.828406	1.15107
24.0000	6024.00	4.42000	2.28000	-1.04241	1.19425
25.0000	6025.00	5.60000	2.36000	-1.73963	1.32856
26.0000	6026.00	5.49000	2.16000	-1.79570	1.36100
27.0000	6027.00	5.46000	2.31000	-1.82327	1.16364
28.0000	6028.00	5.33000	2.31000	-1.99379	0.873390
29.0000	6029.00	5.31000	2.30000	-2.25025	0.598755
30.0000	6030.00	5.36000	2.15000	-2.00805	1.03865
31.0000	6031.00	5.42000	2.10000	-1.85140	1.29791
32.0000	6032.00	5.39000	2.11000	-1.93475	1.17750
33.0000	6033.00	5.39000	2.35000	-1.94928	0.935245
34.0000	6034.00	5.39000	2.42000	-2.13437	0.683736
35.0000	6035.00	5.39000	2.54000	-2.13437	0.569872
36.0000	6036.00	5.39000	2.53000	-2.20375	0.509979
37.0000	6037.00	5.39000	2.45000	-2.32959	0.460445
38.0000	6038.00	5.33000	2.45000	-2.11914	0.615122
39.0000	6039.00	5.52000	2.26000	-1.96338	1.12608
40.0000	6040.00	5.42000	2.45000	-1.93537	0.881930
41.0000	6041.00	5.39000	2.45000	-1.97903	0.810607
42.0000	6042.00	5.18000	2.04000	-1.73403	1.25133
43.0000	6043.00	4.93000	2.04000	-1.56287	1.19134
44.0000	6044.00	4.72000	2.17000	-1.53425	0.900812
45.0000	6045.00	4.70000	2.41000	-1.64764	0.539557
46.0000	6046.00	4.50000	2.34000	-1.40773	0.659260

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
47.0000	6047.00	4.50000	2.35000	-1.15186	0.905562
48.0000	6048.00	4.47000	2.26000	-1.03862	1.07692
49.0000	6049.00	4.34000	2.18000	-0.394853	1.67130
50.0000	6050.00	4.19000	2.21000	-1.01166	0.888712
51.0000	6051.00	4.19000	2.14000	-0.969378	0.959730
52.0000	6052.00	4.19000	2.14000	-0.899041	1.06852
53.0000	6101.00	4.14000	2.25000	-0.997502	0.864480
54.0000	6102.00	4.13000	2.24000	-0.968894	0.846143
55.0000	6103.00	4.03000	2.24000	-0.911892	0.808767
56.0000	6104.00	4.03000	2.14000	-0.855127	0.961656
57.0000	6105.00	4.00000	2.26000	-0.709391	0.873687
58.0000	6106.00	4.10000	2.35000	-0.813915	0.952089
59.0000	6107.00	4.10000	2.35000	-0.914405	0.851599
60.0000	6108.00	4.05000	2.50000	-1.01556	0.663115
61.0000	6109.00	4.32000	2.47000	-1.02983	0.743559
62.0000	6110.00	4.32000	2.49000	-1.62877	0.421303
63.0000	6111.00	4.35000	2.30000	-1.54369	3.2994008E-01
64.0000	6112.00	4.35000	2.26000	-2.21612	-0.213241
65.0000	6113.00	4.35000	2.37000	-2.11605	-0.218590
66.0000	6114.00	4.35000	2.25000	-1.85781	0.145066
67.0000	6115.00	4.32000	2.27000	-1.54368	0.421423
68.0000	6116.00	4.35000	2.19000	-0.229887	1.84107
69.0000	6117.00	4.26000	2.25000	-1.78824	0.101992
70.0000	6118.00	4.22000	2.18000	-1.80224	0.174350
71.0000	6119.00	4.16000	2.19000	-1.74582	0.145506
72.0000	6120.00	4.22000	2.28000	-1.61861	0.242834
73.0000	6121.00	4.28000	2.40000	-1.71920	0.436411E-01
74.0000	6122.00	4.28000	2.35000	-1.96346	-0.112572
75.0000	6123.00	4.32000	2.34000	-2.15059	-0.252580
76.0000	6124.00	4.35000	2.29000	-2.43958	-0.445452
77.0000	6125.00	4.38000	2.27000	-3.19907	-1.17761
78.0000	6126.00	4.38000	2.24000	-3.67242	-1.62221
79.0000	6127.00	4.38000	2.28000	-4.30704	-2.29516
80.0000	6128.00	4.41000	2.20000	-3.80645	-1.68983
81.0000	6129.00	4.47000	2.15000	-2.54458	-0.723951
82.0000	6130.00	5.54000	2.17000	-3.68146	0.120285
83.0000	6131.00	5.41000	2.26000	-3.51163	-0.116186E-01
84.0000	6132.00	5.29000	2.39000	-4.03813	-0.368924
85.0000	6133.00	5.35000	2.43000	-4.06687	-0.390926
86.0000	6134.00	6.47000	2.34000	-3.82305	0.550776E-01
87.0000	6135.00	5.35000	2.33000	-3.92006	-0.140082
88.0000	6136.00	5.29000	2.27000	-3.98433	-0.202225
89.0000	6137.00	6.35000	2.26000	-4.12362	0.277823
90.0000	6138.00	6.32000	2.22000	-3.89579	-0.395031E-01
91.0000	6139.00	6.35000	2.23000	-3.83720	0.368052E-01
92.0000	6140.00	5.92000	2.27000	-3.42430	0.216380E-01
93.0000	6141.00	5.80000	2.25000	-3.22494	0.359344E-01
94.0000	6142.00	5.80000	2.27000	-2.95421	0.382273
95.0000	6143.00	5.55000	2.28000	-2.77029	0.327773
96.0000	6144.00	5.24000	2.25000	-2.72910	0.112023
97.0000	6145.00	5.24000	2.40000	-2.68541	0.131817E-01
98.0000	6146.00	5.24000	2.50000	-2.41515	0.188427
99.0000	6147.00	5.24000	2.53000	-2.55731	0.177517E-01
100.000	6148.00	5.21000	2.50000	-2.84775	-0.271949
101.000	6149.00	5.18000	2.54000	-2.70348	-0.193500
102.000	6150.00	5.18000	2.58000	-2.84623	-0.374279
103.000	6151.00	5.21000	2.57000	-2.59318	-0.839109E-01
104.000	6152.00	5.21000	2.64000	-2.49269	-0.499554E-01
105.000	6201.00	5.27000	2.70000	-2.63322	-0.391882
106.000	6202.00	5.27000	2.72000	-2.61757	-0.195225
107.000	6203.00	5.15000	2.67000	-2.46101	-0.102471
108.000	6204.00	5.09000	2.63000	-2.53246	-0.191607
109.000	6205.00	5.09000	2.66000	-2.48857	-0.176269
110.000	6206.00	5.27000	2.69000	-2.61510	-0.164258
111.000	6207.00	5.37000	2.81000	-2.59981	-0.170275
112.000	6208.00	5.37000	2.69000	-2.52895	0.144701E-01
113.000	6209.00	5.37000	2.65000	-2.55690	0.244761E-01
114.000	6210.00	4.96000	2.74000	-2.35804	-0.242949
115.000	6211.00	4.74000	2.70000	-2.39954	-0.451860
116.000	6212.00	4.32000	2.65000	-2.06144	-0.460599
117.000	6213.00	4.29000	2.74000	-1.91908	-0.442285
118.000	6214.00	4.22000	2.70000	-1.81963	-0.361175
119.000	6215.00	4.19000	2.70000	-1.88960	-0.459518
120.000	6216.00	4.13000	2.70000	-1.67694	-0.303661
121.000	6217.00	3.97000	2.71000	-1.43646	-0.224575
222.000	6218.00	3.92000	2.71000	-1.27988	-0.115527
123.000	6219.00	3.83000	2.64000	-0.995552	0.150553
124.000	6220.00	3.73000	2.65000	-0.952726	0.894387E-01
125.000	6221.00	3.67000	2.67000	-0.683161	0.381439
126.000	6222.00	3.64000	2.67000	-0.683373	0.252559
127.000	6223.00	3.64000	2.61000	-0.697953	0.295871
128.000	6224.00	3.61000	2.70000	-0.825805	0.524887E-01
129.000	6225.00	3.73000	2.69000	-0.754575	0.248022
130.000	6226.00	3.79000	2.87000	-0.769160	0.117245
131.000	6227.00	3.76000	2.89000	-0.783872	0.546016E-01
132.000	6228.00	3.76000	2.95000	-0.826470	-0.458229E-01
133.000	6229.00	3.83000	2.89000	-0.854836	0.509089E-01
134.000	6230.00	3.76000	2.97000	-0.841517	0.216232
135.000	6231.00	3.70000	2.81000	-0.727017	0.131228
136.000	6232.00	3.64000	2.80000	-0.712893	0.976050E-01
137.000	6233.00	3.64000	2.81000	-0.727445	0.734044E-01
138.000	6234.00	3.64000	2.80000	-0.571150	0.239348
139.000	6235.00	3.64000	2.79000	-0.613979	0.206168
140.000	6236.00	3.61000	2.75000	-0.571238	0.258798
141.000	6237.00	3.58000	2.75000	-0.455621	0.315692
142.000	6238.00	3.58000	2.73000	-0.536980	0.263642
143.000	6239.00	3.51000	2.72000	-0.499784	0.263427
144.000	6240.00	3.50000	2.73000	-0.529556	0.215406
145.000	6241.00	3.48000	2.74000	-0.642476	0.726385E-01
146.000	6242.00	3.64000	2.69000	-0.542584	0.374050
147.000	6243.00	3.71000	2.71000	-0.585915	0.497408
148.000	6244.00	3.73000	2.76000	-0.585651	0.549470
149.000	6245.00	3.67000	2.79000	-0.557151	0.501342
150.000	6246.00	3.67000	2.81000	-0.600028	0.429528
151.000	6247.00	3.61000	2.81000	-0.34[illegible]11	0.429716
152.000	6248.00	3.58000	2.84000	-0.399304	0.315061
153.000	6249.00	3.51000	2.82000	-0.456327	0.210275
154.000	6250.00	3.48000	2.82000	-0.470596	0.167209
155.000	6251.00	3.49000	2.87000	-0.556463	0.330223E-01
156.000	6252.00	3.61000	2.89000	-0.442552	0.261984
157.000	6301.00	3.45000	2.86000	-0.427982	0.142342
158.000	6302.00	3.36000	2.85000	-0.427572	0.961746E-01

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
159.000	6303.00	3.36000	2.82000	-0.456187	-0.146502E-02
160.000	6304.00	3.36000	2.91000	-0.555970	-0.120593
161.000	6305.00	3.32000	2.91000	-0.688826	-0.288003
162.000	6306.00	3.36000	2.93000	-0.670709	-0.254687
163.000	6307.00	3.29000	2.90000	-0.927547	-0.549969
164.000	6308.00	3.29000	2.86000	-0.699284	-0.292981
165.000	6309.00	3.29000	2.87000	-0.713725	-0.307103
166.000	6310.00	3.26000	2.86000	-0.800012	-0.412641
167.000	6311.00	3.26000	2.85000	-1.17144	-0.774381
168.000	6312.00	3.27000	2.88000	-1.21457	-0.452538
169.000	6313.00	3.41000	2.90000	-1.28596	-0.600640
170.000	6314.00	3.41000	2.89000	-1.11392	-0.419005
171.000	6315.00	3.54000	2.88000	-1.77095	-1.13351
172.000	6316.00	3.54000	2.87000	-1.11400	-0.466906
173.000	6317.00	3.61000	2.87000	-0.814371	-0.100154
174.000	6318.00	3.61000	2.87000	-0.696171	0.281162E-01
175.000	6319.00	3.58000	2.89000	-0.685864	-0.197117E-01
176.000	6320.00	3.61000	2.88000	-0.671619	-0.629824E-01
177.000	6321.00	3.61000	2.93000	-0.686101	-0.125768
178.000	6322.00	3.56000	2.97000	-0.500199	0.695193E-01
179.000	6324.00	3.54000	2.97000	-0.571476	-0.209634E-01
180.000	6324.00	3.61000	2.96000	-0.614553	-0.832035E-01
181.000	6325.00	3.58000	2.96000	-0.471559	0.127013
182.000	6326.00	3.58000	2.97000	-0.499956	0.889617E-01
183.000	6327.00	3.67000	3.01000	-0.414203	0.222433
184.000	6328.00	3.67000	3.19000	-0.357151	0.105856
185.000	6329.00	3.64000	3.15000	-0.570659E-01	0.415724
186.000	6330.00	3.64000	3.18000	-0.285925	0.157919
187.000	6331.00	3.64000	3.21000	-0.285884	0.129014
188.000	6332.00	3.64000	3.27000	-0.285874	-0.251049E-01
189.000	6333.00	3.58000	3.31000	-0.143041	0.117628
190.000	6334.00	3.58000	3.35000	-0.100032	0.122019
191.000	6335.00	3.58000	3.38000	-0.114386	0.787018E-01
192.000	6336.00	3.58000	3.32000	0.0	0.251014
193.000	6337.00	3.58000	3.34000	-0.143174E-01	0.217388
194.000	6338.00	3.62000	3.38000	-0.428097E-01	0.188807
195.000	6339.00	3.54000	3.34000	-0.114386	0.787765E-01
196.000	6340.00	3.46000	3.42000	-0.171519	-0.113535
197.000	6341.00	3.48000	3.42000	-0.286045	-0.228062
198.000	6342.00	3.41000	3.47000	-0.271719	-0.136596
199.000	6343.00	3.61000	3.43000	-0.199999	-0.262700E-01
200.000	6344.00	3.53000	3.46000	-0.199999	-0.359535E-01
201.000	6345.00	3.61000	3.53000	-0.171648	-0.944353E-01
202.000	6346.00	3.61000	3.52000	-0.185671	-0.988063E-01
203.000	6347.00	3.61000	3.48000	-0.959312E-01	0.255399E-01
204.000	6348.00	3.61000	3.47000	-0.157377	-0.222550E-01
205.000	6349.00	3.64000	3.49000	-0.128616	0.161154E-01
206.000	6350.00	3.61000	3.49000	-0.114564	0.125521E-02
207.000	6351.00	3.61000	3.51000	-0.859320E-01	0.105842E-01
208.000	6352.00	3.61000	3.50000	-0.143079	-0.369114E-01
209.000	6401.00	3.61000	3.51000	-0.214625	-0.118108
210.000	6402.00	3.51000	3.52000	-0.285806	-0.198942
211.000	6403.00	3.61000	3.52000	-0.271359	-0.184495
212.000	6404.00	3.61000	3.49000	-0.314518	-0.198699
213.000	6405.00	3.61000	3.48000	-0.371803	-0.246333
214.000	6406.00	3.64000	3.49000	-0.371641	-0.226909
215.000	6407.00	3.64000	3.50000	-0.400356	-0.265274
216.000	6408.00	3.64000	3.51000	-0.372066	-0.246632
217.000	6409.00	4.16000	3.56000	-0.657505	-0.814674E-01
218.000	6410.00	4.16000	3.52000	-0.571796	0.426440E-01
219.000	6411.00	4.16000	3.53000	-0.614742	-0.990283E-02
220.000	6412.00	4.16000	3.52000	-0.686060	-0.716199E-01
221.000	6413.00	4.16000	3.52000	-0.686085	-0.716445E-01
222.000	6414.00	4.16000	3.50000	-0.714532	-0.808916E-01
223.000	6415.00	4.16000	3.44000	-0.728946	-0.377013E-01
224.000	6416.00	4.16000	3.45000	-0.714584	-0.329395E-01
225.000	6417.00	4.16000	3.43000	-0.728524	-0.276780E-01
226.000	6418.00	4.16000	3.43000	-0.728718	-0.278719E-01
227.000	6419.00	4.16000	3.47000	-0.742830	-0.803865E-01
228.000	6420.00	4.25000	3.45000	-0.743018	0.243676E-01
229.000	6421.00	4.25000	3.45000	-0.757136	0.102506E-01
230.000	6422.00	4.25000	3.46000	-0.743255	0.145403E-01
231.000	6423.00	4.32000	3.45000	-0.615292	0.218681
232.000	6424.00	4.32000	3.48000	-0.572390	0.251998
233.000	6425.00	4.32000	3.46000	-0.543805	0.280503
234.000	6426.00	4.34000	3.45000	-0.429793	0.423187
235.000	6427.00	4.34000	3.46000	-0.501384	0.342013
236.000	6428.00	4.34000	3.45000	-0.287303E-01	0.824250
237.000	6429.00	4.44000	3.39000	-0.530671	0.474692
238.000	6430.00	4.50000	3.43000	-0.717223	0.305702
239.000	6431.00	4.50000	3.44000	-0.674084	0.348271
240.000	6432.00	4.50000	3.47000	-0.502340	0.483407
241.000	6433.00	4.50000	3.48000	-0.645796	0.330282
242.000	6434.00	4.50000	3.49000	-0.603150	0.372928
243.000	6435.00	4.50000	3.48000	-0.574630	0.401448

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
244.000	6436.00	4.50000	3.48000	-0.574671	0.401407
245.000	6437.00	4.50000	3.50000	-0.474233	0.482705
246.000	6438.00	4.50000	3.52000	-0.732900	0.204900
247.000	6439.00	4.50000	3.52000	-0.704198	0.233603
248.000	6440.00	4.50000	3.53000	-0.718640	0.209590
249.000	6441.00	4.53000	3.56000	-0.747317	0.180667
250.000	6442.00	4.53000	3.56000	-0.905559	0.224044E-01
251.000	6443.00	4.53000	3.56000	-0.662516	0.654480E-01
252.000	6444.00	4.59000	3.53000	-0.806382	0.209309
253.000	6445.00	4.53000	3.54000	-0.862286	0.648107E-01
254.000	6446.00	4.51000	3.55000	-0.891134	0.368301E-01
255.000	6447.00	4.62000	3.59000	-0.991921	-0.740451E-02
256.000	6448.00	4.41000	3.79000	-2.63618	-0.174009
257.000	6449.00	4.41000	3.76000	-2.49325	-0.288582E-02
258.000	6450.00	4.41000	3.80000	-2.68061	-0.227831
259.000	6451.00	4.41000	3.84000	-2.60899	-0.193798
260.000	6452.00	4.41000	3.84000	-2.72354	-0.308348
261.000	6453.00	4.41000	3.80000	-2.63783	-0.185054
262.000	6501.00	4.44000	3.77000	-2.58083	-0.723705E-01
263.000	6502.00	4.44000	3.74000	-2.70870	-0.172055
264.000	6503.00	4.41000	3.81000	-2.49317	-0.497837E-01
265.000	6504.00	4.38000	3.83000	-2.64958	-0.252517
266.000	6505.00	4.32000	3.83000	-2.49049	-0.204034
267.000	6506.00	4.32000	3.83000	-2.48624	-0.203589
268.000	6507.00	4.32000	3.74000	-2.86045	-0.622126
269.000	6508.00	4.29000	3.67000	-2.80560	-0.622991
270.000	6509.00	4.26000	3.93000	-2.74850	-0.555765
271.000	6510.00	4.20000	3.81000	-2.53598	-0.379572
272.000	6511.00	4.35000	3.90000	-2.72354	-0.419821
273.000	6512.00	4.35000	3.86000	-3.08252	-0.741196
274.000	6513.00	4.35000	3.91000	-2.93812	-0.643806
275.000	6514.00	4.32000	3.90000	-2.91916	-0.643016
276.000	6515.00	4.29000	3.91000	-2.45945	-0.220289
277.000	6516.00	4.26000	3.92000	-2.28702	-3.91033
278.000	6517.00	4.20000	3.90000	-2.31479	-0.149066
279.000	6518.00	4.13000	3.87000	-1.97237	0.157096
280.000	6519.00	4.13000	3.88000	-1.90121	0.218829
281.000	6520.00	4.10000	3.88000	-1.74483	0.347537
282.000	6521.00	4.20000	3.85000	-2.44912	-0.238308
283.000	6522.00	4.49000	3.88000	-1.74633	-0.163239
284.000	6523.00	4.42000	3.80000	-1.61780	-0.718066E-01
285.000	6524.00	4.42000	3.77000	-1.93441	-0.369237
286.000	6525.00	4.39000	3.74000	-1.60473	-0.391150E-01
287.000	6526.00	4.36000	3.80000	-1.88300	-0.382360
288.000	6527.00	4.42000	3.84000	-1.79184	-0.293071
289.000	6528.00	4.46000	3.82000	-1.83489	-0.279798
290.000	6529.00	4.46000	3.79000	-1.93524	-0.351899
291.000	6530.00	4.46000	3.74000	-2.06297	-0.469950
292.000	6531.00	4.46000	3.82000	-2.43687	-0.881778
293.000	6532.00	4.36000	3.81000	-2.46517	-0.994027
294.000	6533.00	4.36000	3.81000	-2.52276	-1.05162
295.000	6534.00	4.39000	3.81000	-2.43696	-0.956740
296.000	6535.00	4.36000	3.84000	-2.56436	-1.12168
297.000	6536.00	4.36000	3.87000	-2.03253	-0.618333
298.000	6537.00	4.36000	3.86000	-1.85801	-0.443315
299.000	6538.00	4.36000	3.84000	-1.70017	-0.352414
300.000	6539.00	4.27000	3.99000	-1.34161	-0.125688
301.000	6540.00	4.24000	3.98000	-1.31270	-0.115438
302.000	6541.00	4.30000	3.99000	-1.22747	0.165939E-01
303.000	6542.00	4.30000	4.01000	-1.18456	0.405140E-01
304.000	6543.00	4.27000	4.03000	-1.25569	-0.777693E-01
305.000	6544.00	4.33000	4.04000	-1.29436	-0.596361E-01
306.000	6545.00	4.33000	4.05000	-1.29851	-0.832787E-01
307.000	6546.00	4.33000	4.07000	-1.21279	-0.165501E-01
308.000	6547.00	4.24000	4.09000	-1.07028	0.224600E-01
309.000	6548.00	4.24000	4.10000	-1.02803	0.552044E-01
310.000	6549.00	4.33000	4.31000	-0.970858	-0.247264E-02
311.000	6550.00	4.36000	4.43000	-0.970791	-0.596291E-01
312.000	6551.00	4.36000	4.44000	-0.856864	0.163333E-01
313.000	6552.00	4.36000	4.45000	-1.04193	-0.178225
314.000	6601.00	4.36000	4.52000	-1.02721	-0.229945
315.000	6602.00	4.36000	4.58000	-0.998492	-0.258173
316.000	6603.00	4.36000	4.56000	-0.898824	-0.159522
317.000	6604.00	4.36000	4.53000	-0.770395	0.173808E-01
318.000	6605.00	4.39000	4.61000	-0.799106	-0.589977E-01
319.000	6606.00	4.42000	4.63000	-0.858467	-0.107103
320.000	6607.00	4.42000	4.63000	-0.856527	0.570571E-02
321.000	6608.00	4.45000	4.64000	-0.924445	-0.160307
322.000	6609.00	4.45000	4.57000	-1.04345	-0.208927
323.000	6610.00	4.45000	4.64000	-1.00108	-0.232939
324.000	6611.00	4.45000	4.61000	-0.958520	-0.161933
325.000	6612.00	4.45000	4.46000	-0.858908	0.799261E-01
326.000	6613.00	4.45000	4.49000	-0.901781	0.862354E-02
327.000	6614.00	4.45000	4.53000	-0.858817	0.136352E-01
328.000	6615.00	4.45000	4.64000	-0.844510	-0.763731E-01
329.000	6616.00	4.49000	4.62000	-0.758843	0.658805E-01
330.000	6617.00	4.49000	4.61000	-0.787299	0.469036E-01
331.000	6618.00	4.49000	4.65000	-0.701515	0.947698E-01
332.000	6619.00	4.49000	4.59000	-0.716084	0.137778
333.000	6620.00	4.52000	4.62000	-0.630228	0.222691
334.000	6621.00	4.52000	4.61000	-0.601408	0.250708
335.000	6622.00	4.52000	4.53000	-0.602848	0.336170
336.000	6623.00	4.55300	4.54000	-0.717088	0.239798
337.000	6624.00	4.55000	4.47000	-0.573883	0.449859
338.000	6625.00	4.61000	4.31000	-0.602350	0.628594
339.000	6626.00	4.61000	4.43000	-0.573634	0.543684
340.000	6627.00	4.67000	4.63000	-0.731665	0.252531
341.000	6628.00	4.50000	4.88000	-1.46377	0.573578E-01
342.000	6629.00	4.50000	4.85000	-1.37552	0.173774
343.000	6630.00	4.53000	4.66000	-1.24808	0.207293
344.000	6631.00	4.53000	4.81000	-1.77811	-0.163545
345.000	6632.00	4.53000	4.88000	-1.57743	-0.285740E-01
346.000	6633.00	4.53000	5.06000	-0.975392	0.404500
347.000	6634.00	4.57000	4.99000	-1.00419	0.474404
348.000	6635.00	4.60000	5.04000	-1.06186	0.401595
349.000	6636.00	4.63000	5.15000	-0.881218	0.488828
350.000	6637.00	4.60000	5.42000	-0.803145	0.303798
351.000	6638.00	4.60000	5.47000	-0.831398	0.228639
352.000	6639.00	4.60000	5.30000	-0.902705	0.316807
353.000	6640.00	4.52000	5.34000	-0.802211	0.309562
354.000	6641.00	4.44000	5.45000	-0.730402	0.199700
355.000	6642.00	4.47000	5.31000	-0.459458	0.631351

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
356.000	6643.00	6.35000	5.41000	-0.616147	0.[illegible]86
357.000	6644.00	6.38000	5.29000	-0.601467	0.422961
358.000	6645.00	6.38000	5.38000	-0.701716	0.238311
359.000	6646.00	6.57000	5.32000	-1.43292	-0.259993
360.000	6647.00	6.60000	5.25000	-0.847347	0.779069
361.000	6648.00	6.57000	5.13000	-0.467157	0.844067
362.000	6649.00	6.53000	5.14000	-0.659781	0.645015
363.000	6650.00	6.57000	5.09000	-0.601619	0.525296E-01
364.000	6651.00	6.57000	5.27000	-0.630997	0.264658E-01
365.000	6652.00	6.35000	5.27000	-0.716760	-0.190197
366.000	6701.00	6.29000	4.74000	-0.544584	0.913591
367.000	6702.00	6.29000	4.77000	-0.616169	0.730347
368.000	6703.00	6.13000	4.68000	-0.644850	0.693510
369.000	6704.00	5.95000	4.69000	-0.701827	0.591235
370.000	6705.00	5.79000	4.44000	-0.772520	0.503594
371.000	6706.00	5.83000	4.50000	-0.744212	0.512521
372.000	6707.00	5.89000	4.58000	-0.715675	0.521458
373.000	6708.00	5.89000	4.69000	-1.56120	-0.333515
374.000	6709.00	5.93000	4.35000	-0.758490	0.639981
375.000	6710.00	5.77000	4.33000	-0.571680E-01	1.26696
376.000	6711.00	5.75000	4.21000	-0.672364	0.597178
377.000	6712.00	5.49000	4.11000	-0.886588	0.421594
378.000	6713.00	5.44000	4.09000	-0.800848	0.479501
379.000	6714.00	5.46000	3.88000	-0.843198	0.636317
380.000	6715.00	5.30000	3.86000	-0.842895	0.524623
381.000	6716.00	5.28000	3.75000	-0.900318	0.552950
382.000	6717.00	5.33000	3.68000	-0.943249	0.505213
383.000	6718.00	5.12000	3.65000	-0.800255	0.598147
384.000	6719.00	5.09000	3.63000	-0.743630	0.645656
385.000	6720.00	5.09000	3.52000	-0.672444	0.821513
386.000	6721.00	5.13000	3.45000	-0.629823	0.968199
387.000	6722.00	5.12000	3.37000	-0.658753	1.00601
388.000	6723.00	5.12000	3.40000	-0.372385	1.26384
389.000	6724.00	5.12000	3.56000	-0.444015	1.04002
390.000	6725.00	5.12000	3.35000	-0.401447	1.28234
391.000	6726.00	5.12000	3.82000	-0.429978	0.806704
392.000	6727.00	5.18000	4.12000	-0.272439	0.668804
393.000	6728.00	5.21000	4.13000	-0.358650	0.496353
394.000	6729.00	5.21000	4.20000	-0.674713	0.245272
395.000	6730.00	5.21000	4.10000	-0.602933	0.452200
396.000	6731.00	5.21000	4.13000	-0.574383	0.452136
397.000	6732.00	5.21000	4.13000	-0.617678	0.405941
398.000	6733.00	5.14000	4.17000	-0.631675	0.309748
399.000	6734.00	5.14000	4.34000	-0.703894	0.758713E-01
400.000	6735.00	5.14000	4.33000	-0.775486	-0.508451E-02
401.000	6736.00	5.14000	4.27000	-0.804537	0.229317E-01
402.000	6737.00	5.14000	4.36000	-0.747290	-0.542152E-02
403.000	6738.00	5.24000	4.55000	-0.675443	-0.197949E-01
404.000	6739.00	5.33000	4.37000	-0.661114	0.250307
405.000	6740.00	5.33000	4.47000	-0.646587	0.169895
406.000	6741.00	5.33000	4.58000	-0.733164	-0.211157E-01
407.000	6742.00	5.58000	4.53000	-0.948467	0.460404E-01
408.000	6743.00	5.58000	4.52000	-0.862317	0.160604
409.000	6744.00	5.73000	4.56000	-1.10685	-0.259399E-03
410.000	6745.00	6.10000	4.62000	-1.30803	0.848797E-01
411.000	6746.00	6.26000	4.57000	-2.35773	-0.767286
412.000	6747.00	7.43000	4.76000	-1.14044	1.31766
413.000	6748.00	7.33000	4.93000	-1.12403	1.11207
414.000	6749.00	7.32000	4.99000	-2.49263	-0.228377
415.000	6750.00	7.27000	4.99000	-4.79840	-2.66360
416.000	6751.00	7.24000	4.92000	-4.57970	-2.39809
417.000	6752.00	7.24000	4.93000	-2.80872	-0.683043
418.000	6801.00	7.24000	4.95000	-2.60771	-0.454061
419.000	6802.00	7.21000	5.03000	-2.49025	-0.456862
420.000	6803.00	7.14000	5.02000	-2.78911	-0.627749
421.000	6804.00	7.14000	4.87000	-2.88761	-0.586512
422.000	6805.00	7.38000	4.81000	-2.40630	-0.129299E-01
423.000	6806.00	7.32000	5.01000	-2.52266	-0.370220
424.000	6807.00	7.21000	4.93000	-2.67130	-0.444636
425.000	6808.00	7.29000	4.96000	-2.81106	-0.439371
426.000	6809.00	7.24000	5.03000	-3.29923	-1.21045
427.000	6810.00	7.15000	5.06000	-6.85492	-4.90428
428.000	6811.00	7.15000	5.33000	-10.0418	-8.34320
429.000	6812.00	7.03000	5.21000	-5.16255	-3.48955
430.000	6813.00	6.95000	5.14000	-6.66099	-4.96861
431.000	6814.00	6.93000	5.23000	-4.82333	-3.26112
432.000	6815.00	6.97000	5.37000	-4.47707	-2.98223
433.000	6816.00	6.97000	5.53000	-3.78165	-2.40744
434.000	6817.00	6.90000	5.49000	-4.47234	-3.15335
435.000	6818.00	6.94000	5.44000	-4.04185	-2.63919
436.000	6819.00	6.92000	5.52000	-4.80192	-3.49253
437.000	6820.00	6.74000	5.75000	-5.52896	-4.41618
438.000	6821.00	7.01000	5.70000	-6.35799	-5.11535
439.000	6822.00	7.06000	5.85000	-7.21646	-5.89944
440.000	6823.00	7.03000	5.82000	-6.12452	-4.80713

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
441.000	6824.00	7.00000	5.64000	-4.52610	-3.25507
442.000	6825.00	7.03000	5.32000	-4.36315	-2.76547
443.000	6826.00	7.03000	5.26000	-5.45620	-3.80244
444.000	6827.00	7.03000	5.35000	-5.43970	-1.97005
445.000	6828.00	7.03000	5.33000	-3.26177	-1.61929
446.000	6829.00	7.03000	5.27000	-2.55903	-0.914586
447.000	6830.00	6.90000	5.17000	-2.03825	-0.419310
448.000	6831.00	6.90000	4.86000	-2.08985	-0.140126
449.000	6832.00	6.78000	4.94000	-2.17202	-0.448851
450.000	6833.00	6.74000	5.07000	-2.39040	-0.816633
451.000	6834.00	6.72000	5.10000	-2.41154	-0.893544
452.000	6835.00	6.76000	5.18000	-2.68464	-1.18624
453.000	6836.00	6.74000	5.20000	-0.772000	0.707478
454.000	6837.00	6.69000	5.25000	-2.51389	-1.16418
455.000	6838.00	6.66000	5.13000	-2.09277	-0.843494
456.000	6839.00	6.69000	5.09300	-1.75777	-0.414918
457.000	6840.00	6.36000	5.12000	-1.38915	-0.289113
458.000	6841.00	6.35000	5.25000	-1.40626	-0.371944
459.000	6842.00	6.35000	5.30000	-12.0827	-11.00953
460.000	6843.00	6.38000	5.37000	-1.10404	-0.154619
461.000	6844.00	6.43000	5.42000	-0.953994	-0.501299E-02
462.000	6845.00	6.41000	5.41000	-0.903641	0.361206E-01
463.000	6846.00	6.44000	5.38000	-2.18159	-1.18572
464.000	6847.00	6.66000	5.41000	-3.02468	-1.65273
465.000	6848.00	6.66000	5.48000	-3.19552	-2.07921
466.000	6849.00	6.69000	5.62000	-4.61541	-3.61351
467.000	6850.00	6.63000	5.98000	-5.60412	-4.90375
468.000	6851.00	6.63000	6.05333	-4.19403	-3.67822
469.000	6852.00	6.63000	6.15300	-3.58888	-3.13872
470.000	6901.00	6.63000	6.11300	-3.18755	-2.69989
471.000	6902.00	6.63000	6.08000	-3.08534	-2.56954
472.000	6903.00	6.66000	6.01000	-2.94957	-2.34015
473.000	6904.00	6.60000	6.12000	-2.66219	-2.21191
474.000	6905.00	6.58000	6.15000	-2.52686	-2.12340
475.000	6906.00	6.60000	6.15300	-2.54303	-2.12989
476.000	6907.00	6.63000	6.06000	-2.18862	-1.74743
477.000	6908.00	6.63000	6.08000	-1.90719	-1.48477
478.000	6909.00	6.66000	6.17000	-2.64001	-2.28337
479.000	6910.00	6.68000	6.05000	-3.43285	-2.21065
480.000	6911.00	7.64000	6.99000	-3.18126	-1.64837
481.000	6912.00	7.58000	6.94000	-2.82618	-1.25613
482.000	6913.00	7.61000	6.92000	-2.80701	-1.23652
483.000	6914.00	7.60000	6.94000	-2.48912	-1.04960
484.000	6915.00	7.63000	6.92000	-2.73775	-1.33480
485.000	6916.00	7.63000	6.97000	-2.73767	-1.38107
486.000	6917.00	7.63000	6.97000	-3.29639	-1.84698
487.000	6918.00	7.63000	6.91000	-6.11480	-4.01674
488.000	6919.00	7.64000	6.92000	-9.39989	-7.40196
489.000	6920.00	7.63000	6.86000	-8.12431	-6.66651
490.000	6921.00	7.67000	6.99000	-7.30243	-5.73292
491.000	6922.00	7.67000	6.98000	-6.77949	-5.30275
492.000	6923.00	7.66000	6.94000	-4.53851	-3.31243
493.000	6924.00	7.71000	6.73000	-4.18367	-3.27382
494.000	6925.00	7.71000	6.63000	-4.01677	-2.92123
495.000	6926.00	7.58000	6.04000	-3.24572	-1.85141
496.000	6927.00	7.58000	6.02000	-3.21385	-2.48880

497.000	6928.00	7.78000	6.93000	-2.95986	-2.17122
498.000	6929.00	7.68000	7.00000	-2.91146	-1.87996
499.000	6930.00	7.64000	7.07200	-2.41012	-1.88058
500.000	6931.00	7.64000	7.01000	-2.57632	-1.99103
501.000	6932.00	7.64000	6.94000	-2.87678	-2.22046
502.000	6933.00	7.64000	6.86200	-7.55591	-6.83428
503.000	6934.00	7.64000	6.86000	-8.41174	-7.68711
504.000	6935.00	7.64000	6.99000	-8.23042	-7.62656
505.000	6936.00	7.58000	7.02000	-9.04381	-8.52327
506.000	6937.00	7.59000	7.03000	-7.51186	-7.00062
507.000	6938.00	7.59700	7.13000	-5.73604	-5.28986
508.000	6939.00	7.64000	7.03000	-4.86884	-4.30214
509.000	6940.00	7.57000	6.97000	-2.89796	-2.04818
510.000	6941.00	7.55000	6.98000	-2.51231	-1.98232
511.000	6942.00	7.61300	6.99000	-1.47174	-0.895590
512.000	6943.00	7.61000	6.95000	-1.28687	-0.673544
513.000	6944.00	7.61000	6.98000	-1.20153	-0.618086
514.000	6945.00	7.59000	7.09000	-0.817652	-0.362176
515.000	6946.00	7.58000	7.14000	-0.650933	-0.241935
516.000	6947.00	7.59000	7.31000	-0.667760	-0.416784
517.000	6948.00	7.59000	7.49000	-0.417136	-0.333477
518.000	6949.00	7.61000	7.56000	-0.183563	-0.137098
519.000	6950.00	7.58000	7.72000	-0.333930	-0.463965
520.000	6951.00	7.55000	7.90000	-0.383904	-0.616354
521.000	6952.00	7.55000	7.78000	-0.333421	-0.547275
522.000	6953.00	7.45000	7.98000	-0.549837	-0.800569
523.000	7001.00	7.43000	7.86000	-0.183364	-0.[illegible]3625
524.000	7002.00	7.40000	7.73000	-0.350041	-0.[illegible]7303
525.000	7003.00	7.37000	7.80000	-0.566405	-0.[illegible]089
526.000	7004.00	7.37000	7.85000	-0.366276	-0.[illegible]328
527.000	7005.00	7.43000	7.50000	-0.499191	-0.564350
528.000	7006.00	7.46000	7.19000	-0.549129	-0.297873
529.000	7007.00	7.44000	6.74000	-0.399152	0.270865
530.000	7008.00	7.49000	6.82000	-0.565082	0.542322E-01
531.000	7009.00	7.27000	6.81000	-0.449096	-0.202712E-01
532.000	7010.00	7.21000	6.70000	-0.465521	0.101808E-01
533.000	7011.00	7.15000	6.56000	-0.532088	0.185419E-01
534.000	7012.00	7.06000	6.11000	-0.515294	0.372059
535.000	7013.00	6.96000	6.30000	-0.415472	0.201582
536.000	7014.00	6.93000	6.31000	-0.548535	0.312838E-01
537.000	7015.00	6.80000	6.36000	-0.382358	-0.138455
538.000	7016.00	6.70000	6.47000	-0.240357	-0.337986E-01
539.000	7017.00	6.70000	6.55000	-0.415716	-0.556297
540.000	7018.00	6.66000	6.53000	-0.282752	-0.160870
541.000	7019.00	6.69000	6.49000	-0.299503	-0.299803
542.000	7020.00	6.72000	6.68000	-0.483271	-0.448790
543.000	7021.00	6.72000	6.87000	-0.399975	-0.540531
544.000	7022.00	6.72000	6.80000	-0.266803	-0.341766
545.000	7023.00	6.75000	6.58000	-0.100039	-0.344650E-01
546.000	7024.00	6.81000	6.47000	-0.166949E-01	0.114379
547.000	7025.00	6.72000	6.35000	-0.100282	0.248420
548.000	7026.00	6.72000	6.40000	0.183801	0.483650
549.000	7027.00	6.69000	6.53000	-0.317719	-0.167752
550.000	7028.00	6.75000	6.37000	-0.502220	-0.146247
551.000	7029.00	6.66000	6.23000	-0.385191	0.179597E-01
552.000	7030.00	6.73000	6.31000	-0.133863	0.231648

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
553.000	7031.00	6.69000	6.42000	-0.167230	0.859401E-01
554.000	7032.00	6.70000	6.38000	-0.301413	-0.952269E-01
555.000	7033.00	6.69000	6.27000	0.284784	0.679448
556.000	7034.00	6.69000	6.22000	-0.839193	-0.398663
557.000	7035.00	6.69000	6.37000	-0.839193	-0.539258
558.000	7036.00	6.69000	6.35000	-2.58280	-2.26412
559.000	7037.00	6.69000	6.08000	-2.12883	-1.55708
560.000	7038.00	6.69000	5.74000	-1.00567	-0.115238
561.000	7039.00	6.69000	5.80000	-0.938649	-0.104456
562.000	7040.00	6.69000	6.01000	-1.32459	-0.687231
563.000	7041.00	6.69000	5.86000	-1.13981	-0.361851
564.000	7042.00	6.69000	5.71000	-0.987908	-0.692575E-01
565.000	7043.00	6.69000	5.79000	-0.886524	-0.430583E-01
566.000	7044.00	6.69000	5.44000	-0.919470	0.252149
567.000	7045.00	6.69000	5.46000	-1.13836	0.145159E-01
568.000	7046.00	6.69000	5.10000	-0.836945	0.653355
569.000	7047.00	6.69000	5.00000	-0.920476	0.663552
570.000	7048.00	6.69000	4.87000	-0.703090	1.00279
571.000	7049.00	6.69000	4.80000	-0.786722	0.984766
572.000	7050.00	6.69000	4.68000	-0.635810	1.24815
573.000	7051.00	6.69000	4.78000	-0.835562	0.954672
574.000	7052.00	6.69000	4.90000	-0.852049	0.919439
575.000	7101.00	6.69000	4.69000	-0.950930	0.923660
576.000	7102.00	6.66000	4.35000	-1.46358	0.702180
577.000	7103.00	6.66000	4.06000	-2.32220	0.115456
578.000	7104.00	6.66000	4.08000	-2.79544	-0.376536
579.000	7105.00	6.66000	3.97000	-2.50339	0.216465E-01
580.000	7106.00	6.66000	3.62000	-3.06234	-0.212158
581.000	7107.00	6.67000	3.37000	-3.43911	-0.409092
582.000	7108.00	6.63000	3.33000	-3.16518	-0.776434E-01
583.000	7109.00	6.70000	3.28000	-3.62196	-0.416711
584.000	7110.00	6.72000	3.16000	-3.27332	0.443916E-01
585.000	7111.00	6.57000	3.30000	-3.17424	-0.105838
586.000	7112.00	6.57000	3.32000	-2.86039	0.159246
587.000	7113.00	6.64000	3.58000	-2.32027	0.549195
588.000	7114.00	5.67000	3.78000	-2.54839	-0.759807
589.000	7115.00	5.70000	3.82000	-2.67880	-0.900184
590.000	7116.00	5.58000	3.70000	-2.12257	-0.351933
591.000	7117.00	5.55000	3.93000	-2.09962	0.564902
592.000	7118.00	5.55000	3.74000	-1.22348	0.491349
593.000	7119.00	5.52000	3.98000	-1.12468	0.334760
594.000	7120.00	5.52000	4.28000	-1.14077	0.343657E-01
595.000	7121.00	5.66000	4.26000	-0.843714	0.481291
596.000	7122.00	5.52000	4.18000	-1.09124	0.178658
597.000	7123.00	5.53000	4.56000	-1.14077	-0.221597
598.000	7124.00	5.53000	4.81000	-0.925889	-0.243618
599.000	7125.00	5.53000	4.76000	-0.843261	-0.113610
600.000	7126.00	5.53000	5.14000	-0.777101	-0.407537
601.000	7127.00	5.53000	5.33000	-0.579003	-0.417865
602.000	7128.00	5.56000	5.37000	-0.347192	-0.167200
603.000	7129.00	5.56000	5.28000	-0.843261	-0.578009
604.000	7130.00	5.56000	5.20000	-0.628318	-0.287280
605.000	7131.00	5.53000	5.23000	-0.396783	-0.112503
606.000	7132.00	5.63000	5.10000	0.165363	0.667114
607.000	7133.00	5.73000	4.49000	0.0	1.17280
608.000	7134.00	5.73000	4.55000	0.759703	1.84769
609.000	7135.00	4.89000	4.42000	1.70558	2.15366
610.000	7136.00	4.72000	4.59000	1.05588	1.18002
611.000	7137.00	4.72000	4.68000	1.71467	1.75287
612.000	7138.00	4.77000	4.67000	3.46376	3.55921
613.000	7139.00	4.77000	4.52000	1.79955	2.03817
614.000	7140.00	4.73000	4.45000	1.97503	2.24238
615.000	7141.00	4.63000	4.35000	1.94436	2.21197
616.000	7142.00	5.53000	4.38000	0.224502	1.31424
617.000	7143.00	4.53000	4.30000	-0.593884	-0.373851
618.000	7144.00	4.51000	4.06000	0.160353	0.590934
619.000	7145.00	4.51000	4.11000	0.561345	0.944083
620.000	7146.00	4.49000	4.06000	1.15466	1.56618
621.000	7147.00	4.47000	4.36000	2.16530	2.27059
622.000	7148.00	4.29000	4.21000	3.04047	3.11718
623.000	7149.00	4.19000	4.01000	1.95316	2.12592
624.000	7150.00	4.35000	3.98000	2.20878	2.56335
625.000	7151.00	4.41000	3.78000	1.17712	1.78051
626.000	7152.00	4.41000	3.70000	0.626791	1.30680
627.000	7201.00	4.32000	3.45300	1.17595	2.00992
628.000	7202.00	4.29000	3.09000	1.31836	2.46899
629.000	7203.00	4.31000	3.29000	0.588445	1.56630
630.000	7204.00	4.29000	3.34000	0.307625E-01	0.941685
631.000	7205.00	4.29000	3.24000	-0.169070	0.837739
632.000	7206.00	4.32000	2.89000	-0.306962	1.06382
633.000	7207.00	4.32000	2.77000	-0.445634	0.868462
634.000	7208.00	4.31000	2.22000	-0.230129	0.814833
635.000	7209.00	4.32000	3.40000	-0.490771	0.372125
636.000	7210.00	4.29000	3.53000	0.181838	0.910576
637.000	7211.00	4.29000	3.78000	0.168455	0.657476

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
638.000	7212.00	4.27000	3.69000	0.306785	0.863033
639.000	7213.00	4.26000	3.80000	-0.916939E-01	0.349511
640.000	7214.00	4.27000	3.72000	0.229759	0.757236
641.000	7215.00	4.27000	3.78000	0.275759	0.745691
642.000	7216.00	4.23000	3.48000	-0.306953E-01	0.750258
643.000	7217.00	4.21000	3.48000	-0.153371E-01	0.685171
644.000	7218.00	4.19000	3.44300	-0.153114	0.548525
645.000	7219.30	4.20000	3.55000	-0.183494	0.440307
646.000	7220.00	4.20000	3.72000	-0.351991	0.108662
647.000	7221.00	4.24000	3.67000	-0.459136	0.876797E-01
648.000	7222.00	4.34000	3.77000	-0.428789	0.117502
649.000	7223.00	4.78000	3.79000	-0.382843	0.571538
650.000	7224.00	5.46000	3.85000	-1.21823	0.308412
651.000	7225.00	5.54000	3.93000	-7.10046	-5.57497
652.000	7226.00	5.56000	3.91000	-4.08440	-2.52251
653.000	7227.00	5.41000	3.98000	-2.70167	-1.32609
654.000	7228.00	5.34000	3.94000	-2.93872	-1.60948
655.000	7229.00	5.67000	3.85000	-3.42700	-1.70466
656.000	7230.00	5.69000	3.80000	-3.26523	-1.47698
657.000	7231.00	5.71000	3.74000	-3.42700	-1.56341
658.000	7232.00	5.69000	3.77000	-3.18039	-1.36376
659.000	7233.00	5.69000	3.80000	-2.12134	-0.333085
660.000	7234.00	5.75000	4.07000	-2.38647	-0.797812
661.000	7235.00	5.91000	4.48000	-2.59713	-1.34017
662.000	7236.00	5.26000	4.65000	-2.59915	-1.08400
663.000	7237.00	6.55000	4.61000	-2.74565	-0.924904
664.000	7238.00	6.61000	4.60000	-2.87473	-0.989354
665.000	7239.00	6.53000	4.45000	-2.77577	-0.851433
666.000	7240.00	6.53000	4.62000	-2.31213	-0.519206
667.000	7241.00	6.60000	4.78000	-2.54860	-0.841287
668.000	7242.00	6.62000	4.68000	-2.50616	-0.686617
669.000	7243.00	6.83000	4.65000	-2.72569	-0.712581
670.000	7244.00	6.74000	4.63000	-2.72790	-0.751131
671.000	7245.00	6.77000	4.64000	-2.97745	-0.982503
672.000	7246.00	6.76000	4.69000	-2.38246	-0.443534
673.000	7247.00	6.94000	4.77000	-2.80783	-0.870356
674.000	7248.00	7.05000	4.82000	-2.89612	-0.812977
675.000	7249.00	7.37000	4.98000	-2.90044	-0.674492
676.000	7250.00	7.33000	4.97000	-3.40796	-1.20913
677.000	7251.00	8.32000	5.09000	-3.66185	-0.679944
678.000	7252.00	8.19000	5.05000	-3.40636	-0.504061
679.000	7301.00	8.17000	5.35000	-3.14548	-0.261134
680.000	7302.00	8.15000	5.19000	-3.40084	-0.663902
681.000	7303.00	8.09000	5.42000	-3.45103	-0.989890
682.000	7304.00	8.01000	5.67000	-3.55689	-1.39042
683.000	7305.00	8.02000	5.69000	-3.88182	-1.74293
684.000	7306.00	7.98000	5.30000	-2.84820	-0.366260
685.000	7307.00	7.96000	5.31000	-3.78053	-1.32591
686.000	7308.00	7.95000	5.44000	-3.22588	-0.900729
687.000	7309.00	8.01000	5.64000	-2.73370	-0.576491
688.000	7310.00	8.11000	5.76000	-3.71713	-1.54342
689.000	7311.00	7.99000	6.04000	-3.34477	-1.53904
690.000	7312.00	7.87000	6.21000	-3.06638	-1.52749
691.000	7313.00	7.83000	6.22000	-2.66459	-1.17150
692.000	7314.00	7.77000	6.34000	-2.41649	-1.08959
693.000	7315.00	7.35000	6.12000	-1.93355	-0.787763
694.000	7316.00	7.45000	6.12000	-1.93121	-0.693629
695.000	7317.00	7.56000	6.13000	-2.00977	-0.680278
696.000	7318.00	7.56000	6.14000	-2.00760	-0.706000
697.000	7319.00	7.26000	6.04030	-0.875271	0.262151
698.000	7320.00	7.15000	6.22000	-1.79518	-0.927236
699.000	7321.00	7.08000	6.46000	-1.25099	-0.671978
700.000	7322.00	7.04000	6.47000	-1.32143	-1.10396
701.000	7323.00	7.06000	7.02000	-1.38749	-1.36013
702.000	7324.00	6.93000	7.07000	-1.31708	-1.44881
703.000	7325.00	6.90000	7.16000	-1.32000	-1.56322
704.000	7326.00	6.86000	7.29000	-1.54742	-1.94982
705.000	7327.00	6.76000	7.87000	-2.63876	-3.67847
706.000	7328.00	6.85000	7.59000	-1.96553	-2.65809
707.000	7329.00	9.26000	8.05000	-2.15747	-1.96349
708.000	7330.00	10.7400	8.15000	-4.01046	-1.67185
709.000	7331.00	10.6300	8.18000	-2.90374	-0.689151
710.000	7332.00	10.7600	8.76000	-4.47034	-2.66463
711.000	7333.00	10.7800	8.47000	-4.10881	-2.02360
712.000	7334.00	10.8300	8.45000	-4.63126	-2.48383
713.000	7335.00	10.8250	8.53000	-4.39105	-2.32484
714.000	7336.00	10.8400	8.77000	-4.84389	-2.67833
715.000	7337.00	10.8000	8.75030	-5.30783	-3.45765
716.000	7338.00	10.8300	8.00000	-4.70404	-2.15067
717.000	7339.00	10.7900	8.94000	-4.47159	-0.996581
718.000	7340.00	10.7400	7.36000	-3.48012	-0.427926
719.000	7341.00	10.6700	7.09000	-3.29481	-0.809336E-01
720.000	7342.00	10.5600	6.98000	-3.85886	-0.620796
721.000	7343.00	10.5400	6.99000	-4.01983	-0.888318
722.000	7344.00	10.4600	7.39000	-3.77696	-0.997670
723.000	7345.00	10.5700	8.01000	-3.32786	-1.01259
724.000	7346.00	12.2400	7.51000	-8.02735	-0.813159
725.000	7347.00	12.3100	7.74000	-5.77608	-1.76699
726.000	7348.00	12.2800	7.32000	-8.48852	-1.84999
727.000	7349.00	12.3200	7.55000	-8.66767	-1.42007
728.000	7350.00	12.2970	7.49000	-7.79391	-3.51384
729.000	7351.00	12.2900	7.21000	-6.66664	-2.14294
730.000	7352.00	12.2500	7.36000	-6.46665	-2.11030
731.000	7401.00	12.0400	7.38000	-7.46737	-3.38813
732.000	7402.00	12.0400	7.75000	-7.88115	-4.02215
733.000	7403.00	11.9800	7.75000	-7.46015	-3.76869
734.000	7404.00	11.9600	7.92000	-8.81236	-5.29010
735.000	7405.00	11.8200	7.42000	-10.2159	-6.28097
736.000	7406.00	11.8000	6.99000	-10.9742	-6.67183
737.000	7407.00	11.7500	7.00000	-9.78594	-5.58538
738.000	7408.00	11.6600	6.94000	-8.62084	-4.39344
739.000	7409.00	11.7700	7.51000	-11.0381	-7.22666
740.000	7410.00	11.7700	7.66000	-10.2365	-6.88933
741.000	7411.00	11.7500	7.74000	-9.77270	-6.10433
742.000	7412.00	11.8000	8.02080	-8.35640	-4.97534
743.000	7413.00	11.8200	8.34000	-9.60734	-6.19519
744.000	7414.00	11.4900	8.55000	-7.68581	-5.04888
745.000	7415.00	11.3100	8.45000	-7.86806	-5.29966
746.000	7416.00	11.3000	7.94000	-7.37477	-4.38895
747.000	7417.00	11.3300	8.32000	-5.04854	-2.34486
748.000	7418.00	11.6088	8.80767	-5.81279	-3.10304
749.000	7419.00	11.6088	8.60095	-3.61847	-0.923146

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750.000	7420.00	11.6088	8.01863	-3.98013	-0.763412
751.000	7421.00	11.3425	7.56493	-2.66180	0.730917
752.000	7422.00	11.3425	8.00877	-3.00166	-0.756550E-02
753.000	7423.00	11.3425	8.00877	-2.83160	0.162498
754.000	7424.00	11.3425	8.43288	-3.84435	1.23116
755.000	7425.00	11.3425	7.89041	-4.79877	-1.69937
756.000	7426.00	11.3425	7.59452	-2.76027	0.605870
757.000	7427.00	11.3721	7.80164	-2.47752	0.728325
758.000	7428.00	11.3129	7.39726	-1.20674	2.31093
759.000	7429.00	11.2833	7.99890	-1.67177	1.27960
760.000	7430.00	11.3129	7.35781	-1.28730	2.26581
761.000	7431.00	11.3129	8.01863	-1.51001	1.44944
762.000	7432.00	11.3425	8.14301	-1.68567	0.289726*
763.000	7433.00	11.3425	8.47671	-2.36937	-0.154802
764.000	7434.00	11.3721	9.65589	-2.44568	-0.904748
765.000	7435.00	11.3721	9.14301	-2.07121	-0.6977466E-01
766.000	7436.00	11.3425	9.46849	-1.29843	0.384644
767.000	7437.00	11.2142	9.38559	-2.07642	-0.435755
768.000	7438.00	11.0860	7.10137	-2.59057	0.996432
769.000	7439.00	11.0860	6.92383	-3.55373	0.193092
770.000	7440.00	11.0860	7.10137	-2.96117	0.625836
771.000	7441.00	11.0466	7.87068	-3.51368	-0.653514
772.000	7442.00	10.9874	7.89041	-2.88118	-0.907860E-01
773.000	7443.00	11.0170	7.69315	-3.60163	-0.607446
774.000	7444.00	11.0860	7.87068	-4.06939	-1.17493
775.000	7445.00	11.0860	7.68329	-4.28259	-1.21943
776.000	7446.00	11.0860	7.83945	-4.66296	-1.20026
777.000	7447.00	11.0560	7.56493	-5.03165	-1.86195
778.000	7448.00	11.0860	7.66356	-4.76362	-1.68270
779.000	7449.00	11.0860	7.54521	-4.31138	-1.12392
780.000	7450.00	11.0860	7.43671	-7.69221	-4.40708
781.000	7451.00	11.0560	6.93370	-7.13044	-3.39250
782.000	7452.00	11.0860	6.99288	-6.73331	-3.04865
783.000	7501.00	11.0860	6.94356	-8.43083	-4.70177
784.000	7502.00	10.8986	6.57863	-7.14571	-3.25026
785.000	7503.00	10.6323	6.51945	-4.50293	-0.785325
786.000	7504.00	10.3759	5.61205	-4.35710	-0.410862E-01
787.000	7505.00	10.2378	5.71068	-5.45765	-1.35096
788.000	7506.00	10.1490	5.60219	-5.80810	-1.68020
789.000	7507.00	9.96164	5.62192	-5.96738	-2.02080
790.000	7508.00	9.85315	5.47397	-5.81892	-1.83253
791.000	7509.00	9.85315	5.55288	-6.22507	-2.31050
792.000	7510.00	9.73479	5.93753	-6.14884	-2.68844
793.000	7511.00	9.62630	5.39507	-5.84200	-1.98231
794.000	7512.00	9.43890	5.34575	-5.05392	-1.31380
795.000	7513.00	9.41918	5.51342	-5.03471	-1.46518
796.000	7514.00	9.34027	5.60219	-4.68692	-1.26816
797.000	7515.00	9.34027	5.73041	-4.89154	-1.59004
798.000	7516.00	9.32055	5.41479	-4.54433	-0.973573
799.000	7517.00	9.29096	5.69096	-5.69602	-2.40206
800.000	7518.00	9.51781	5.51342	-6.42389	-2.76751
801.000	7519.00	9.52767	5.42466	-6.67386	-2.92776
802.000	7520.00	9.49808	5.08931	-6.18426	-2.18792
803.000	7521.00	9.49805	5.26685	-4.55714	-0.692929
804.000	7522.00	9.49808	5.20767	-5.01731	-1.09906
805.000	7523.00	9.43890	5.22740	-4.56084	-0.702570
806.000	7524.00	9.43890	4.87233	-4.67618	-0.983462
807.000	7525.00	9.43890	5.20767	-4.48436	-0.620084
808.000	7526.00	9.54740	6.00657	-3.90560	-0.673265
809.000	7527.00	9.54740	6.00657	-2.69381	0.538420
810.000	7528.00	9.49805	6.05589	-2.52758	0.616029
811.000	7529.00	9.48822	6.03616	-3.12360	0.292978E-01
812.000	7530.00	10.5140	6.20384	-3.60990	0.290199
813.000	7531.00	10.5041	6.26301	-4.31870	-0.480743
814.000	7532.00	10.5633	6.46027	-4.28955	-0.548542
815.000	7533.00	10.5337	6.47014	-3.56479	0.111527
816.000	7534.00	10.5337	6.50959	-3.11479	0.525628
817.000	7535.00	10.4745	6.44055	-3.37287	0.278623
818.000	7536.00	10.3562	6.35178	-3.26075	0.367846
819.000	7537.00	10.4153	6.48000	-3.09449	0.469644
820.000	7538.00	10.4153	6.42082	-3.21109	0.406631
821.000	7539.00	10.5830	6.42082	-3.40690	0.264965
822.000	7540.00	11.5693	6.50959	-3.99089	0.944165
823.000	7541.00	11.5101	6.25315	-4.54536	0.169002
824.000	7542.00	11.5595	6.97699	-4.86374	0.140284
825.000	7543.00	11.6088	5.75014	-5.40930	-0.160039
826.000	7544.00	11.5496	5.45425	-4.88412	0.600126
827.000	7545.00	11.4115	5.52329	-4.64606	0.639050
828.000	7546.00	11.2044	5.36548	-4.99236	0.658252
829.000	7547.00	11.1551	5.45425	-4.92431	0.204403
830.000	7548.00	11.1058	5.56274	-4.74800	0.240957
831.000	7549.00	11.1058	5.61205	-4.51588	0.428988
832.000	7550.00	11.0071	5.60219	-4.59672	0.272276
833.000	7551.00	10.9690	5.45425	-5.46559	-0.581637
834.000	7552.00	10.7409	5.36575	-4.84446	0.2734096-01

IDENTIFICATION NUMBER	DATE (Year, Week)	INTEREST RATE U.K.	INTEREST RATE U.S.A.	FORWARD PREMIUM ON THE POUND	COVERED ARBITRAGE MARGIN ON UK T.BILLS
835.000	7601.00	10.5830	5.23726	-4.83954	-0.537968E-02
836.000	7602.00	10.3759	5.05973	-4.80547	0.109501E-01
837.000	7603.00	10.3759	4.95260	-4.73096	0.273108
838.000	7604.00	9.91233	4.78356	-5.04139	-0.375155
839.000	7605.00	9.36000	4.67507	-4.98419	-0.700233
840.000	7606.00	8.80767	4.92164	-3.83065	0.408134E-01
841.000	7607.00	8.87671	4.85260	-4.18852	-0.492494
842.000	7608.00	8.82740	4.90192	-3.63478	-0.277081E-01
843.000	7609.00	8.64000	4.49205	-3.53083	-0.809479E-01
844.000	7610.00	8.51178	5.22740	-4.42734	-1.40058
845.000	7611.00	8.51178	5.01041	-5.70671	-2.47999
846.000	7612.00	8.49205	4.98082	-5.93607	-2.69986
847.000	7613.00	8.44274	4.87233	-4.32990	-1.03747
848.000	7614.00	8.51178	5.03014	-4.69090	-1.48236
849.000	7615.00	8.51178	4.92164	-5.91738	-2.60886
850.000	7616.00	8.51178	4.80329	-4.84915	-1.43155
851.000	7617.00	10.0603	4.79342	-10.7303	-5.94490
852.000	7618.00	10.0110	4.85215	-5.55475	-0.892698
853.000	7619.00	10.0110	4.94137	-5.74274	-1.13448
854.000	7620.00	9.96164	5.14849	-7.32884	-2.95172
855.000	7621.00	11.1058	5.44438	-5.18744	-0.919552E-01
856.000	7622.00	11.1058	5.52329	-5.69178	-0.667313
857.000	7623.00	11.0466	5.55288	-5.70905	-0.761848
858.000	7624.00	11.0466	5.46411	-5.82738	-0.800239
859.000	7625.00	11.0466	5.41479	-6.62160	-1.55005
860.000	7626.00	11.1059	5.34575	-7.73827	-2.55402
861.000	7627.00	10.9973	5.41479	-7.65495	-2.62557
862.000	7628.00	10.9973	5.36548	-7.84531	-2.77150
863.000	7629.00	10.9973	5.04000	-7.71154	-2.34451
864.000	7630.00	10.9973	5.25699	-7.20474	-2.03319
865.000	7631.00	10.9973	5.18794	-6.94198	-1.70823
866.000	7632.00	10.9479	4.23726	-7.10423	-1.95705
867.000	7633.00	10.9973	5.18794	-7.62748	-2.39373
868.000	7634.00	10.9973	5.17808	-7.25028	-2.00765
869.000	7635.00	11.0466	5.10904	-7.68154	-2.33485
870.000	7636.00	11.0466	5.12877	-8.23463	-2.90551
871.000	7637.00	12.6743	5.14849	-9.49238	-2.81338
872.000	7638.00	12.6740	5.12877	-8.88139	-2.18489
873.000	7639.00	12.5655	5.05973	-8.91760	-2.24970
874.000	7640.00	12.5655	5.10904	-10.9441	-4.32004
875.000	7641.00	14.6762	5.04986	-12.7367	-4.34234
876.000	7642.00	14.6762	4.89205	-19.4917	-8.95978
877.000	7643.00	14.7353	4.87233	-13.0993	-4.50297
878.000	7644.00	14.7353	4.90192	-15.0847	-6.51421
879.000	7645.00	14.6288	4.80329	-10.5942	-2.02419
880.000	7646.00	14.5677	4.94137	-10.3157	-1.91341
881.000	7647.00	14.3112	4.83288	-10.0715	-1.77977
882.000	7648.00	14.3112	4.64548	-10.9124	-2.45678
883.000	7649.00	14.3112	4.42849	-10.7002	-2.05473
884.000	7650.00	14.3112	4.44822	-10.7662	-2.13801
885.000	7651.00	14.0449	4.33973	-9.64566	-1.13567
886.000	7652.00	14.0449	4.31014	-10.2876	-1.75166
887.000	7653.00	13.8871	4.34959	-10.1264	-1.75183
888.000	7701.00	13.5123	4.52712	-9.59894	-1.68332
889.000	7702.00	13.5123	4.52712	-9.29900	-1.38338
890.000	7703.00	12.8811	4.66521	-7.78025	-0.501893
891.000	7704.00	11.3849	4.80329	-7.46978	-1.14038
892.000	7705.00	11.3622	4.74411	-7.73924	-1.79639
893.000	7706.00	11.3129	4.64548	-8.83175	-2.84196
894.000	7707.00	11.0466	4.62575	-8.27894	-2.49684
895.000	7708.00	10.8986	4.74411	-7.67248	-2.12277
896.000	7709.00	10.7901	4.68493	-7.69501	-2.18441
897.000	7710.00	10.4252	4.63562	-8.74796	-1.50496
898.000	7711.00	9.44877	4.65534	-6.37967	-2.00006
899.000	7712.00	9.43890	4.60603	-5.61223	-1.19618
900.000	7713.00	8.83726	4.54685	-4.30394	-0.361895
901.000	7714.00	8.58082	4.61589	-4.18840	-0.536809
902.000	7715.00	8.50192	4.52712	-4.77171	-1.10837
903.000	7716.00	8.04822	4.48767	-3.81714	-0.521810
904.000	7717.00	7.53534	4.39890	-3.37319	-0.466535
905.000	7718.00	7.45644	4.77370	-3.09603	-0.599448
906.000	7719.00	7.43671	5.02027	-2.28003	-0.308990E-01
907.000	7720.00	7.37753	5.13863	-2.95764	-0.872561
908.000	7721.00	7.46630	5.04986	-4.19206	-1.94351
909.000	7722.00	7.48603	5.05973	-4.58701	-2.32969
910.000	7723.00	7.47616	5.12877	-4.83699	-2.36288
911.000	7724.00	7.48603	5.05973	-4.09377	-1.83645
912.000	7725.00	7.49589	5.05973	-3.90787	-1.64159
913.000	7726.00	7.48603	5.02027	-3.30235	-1.00833
914.000	7727.00	7.49589	5.13863	-3.68164	-1.45878
915.000	7728.00	7.49589	5.20767	-4.48856	-2.35991
916.000	7729.00	7.51562	5.27671	-3.76812	-1.68572
917.000	7730.00	7.33808	5.14438	-2.18717	-0.422929
918.000	7731.00	6.83507	5.04493	-1.81488	-0.478238
919.000	7732.00	6.50959	5.58247	-1.33432	-0.443862
920.000	7733.00	6.43068	5.59233	-1.14934	-0.361639
921.000	7734.00	6.43068	5.56274	-1.21466	-0.401182
922.000	7735.00	6.31233	5.62192	-0.987309	-0.337981
923.000	7736.00	6.59233	5.67123	-0.114668	-0.189301
924.000	7737.00	5.46411	5.91781	0.436238	0.604272E-02
925.000	7738.00	5.43452	6.02630	0.278527	-0.285751
926.000	7739.00	5.29644	5.87836	0.803273	-0.493747E-01
927.000	7740.00	4.75397	6.20384	1.81909	0.435030
928.000	7741.00	4.38904	6.42082	2.39550	0.449147
929.000	7742.00	4.44822	6.14466	1.64534	0.211506E-01
930.000	7743.00	4.46795	6.10620	2.11482	0.847584
931.000	7744.00	4.45808	6.25315	1.97169	0.253227
932.000	7745.00	4.42849	6.22356	2.22087	0.501926
933.000	7746.00	4.46795	6.12493	1.94796	0.361830
934.000	7747.00	6.44065	6.10620	-8.442254E-01	0.270827
935.000	7748.00	6.50989	6.08548	-8.197637	0.200853
936.000	7749.00	6.35178	6.13479	0.844665	0.750662
937.000	7750.00	6.41096	6.08548	0.301884	0.607675
938.000	7751.00	6.33205	6.18411	0.492621	0.631757
939.000	7752.00	6.30247	6.22356	0.666380	0.740606

APPENDIX II

EFFECT OF MONETARY DISTURBANCES ON THE RELATIVE PRICE LEVELS BETWEEN 12 COUNTRIES AND THE UNITED STATES - EMPIRICAL EVIDENCE

This annex presents the results of the test discussed in chapter II. We used a polynomial distributed lags regression, based on a polynome of degree 3, to estimate the following equation:

$$P = C + a_i \sum_{i=0}^{8} D_{t-i} + b_i \sum_{i=0}^{8} U_{t-i} + \varepsilon$$

where P is the logarithm of the ratio of the domestic price level over the price level in the United States, measured in the same currency. The ratio is expressed as an index, base 1959I = 1.00

C is a constant

D is the deviation of the logarithm of the domestic stock from its "normal" value

U is a similar variable for the United States

No constraint other than the degree of the polynome has been imposed on the coefficients.

The "normal", or "expected", values of the logarithm of the money stock have been computed on the basis of the time-trend and, alternatively, on the basis of an autoregressive projection. For each country, the trend has been computed by a regression over time. Seasonal variations have been taken into account through the use of dummy variables corresponding to each quarter. If necessary, a

correction for autocorrelation has been made, using the Cochrane-Orcutt iterative method. Different regressions have been run for subperiods whenever the plot of the time series of the logarithm of the money stock showed changes in the trend. The table on the next page records the dates deemed to involve a change in the trend for specific countries. The autoregressive projection is based on a polynomial distributed lags regression, with 9 lags and a polynome of degree 4.

The data used are quarterly data published by the International Monetary Fund in the printed edition of International Financial Statistics. Dummy variables have been used in case of breaks in the homogeneity of the data in any series.

As explained in chapter II, the test covers two subperiods: 1959I to 1972IV and 1973I to 1977IV.

For each country and for each subperiod, 8 regressions have been run: Both the concepts of M1 and M2 have been used for the domestic money stock and for the U.S. money stock, and the deviations have been computed with reference to the trend and with reference to the autoregressive projection. We present in this annex only one "representative" regression by country for each subperiod. To select the "representative" regression, we had to exercise some judgement, using the information provided by the F test, the R^2, the Durbin Watson coefficients and the level of significance of individual estimated coefficients. The characteristics of each representative regression and the corresponding results are reported on the following pages. When relevant, a note signals the possible sensitivity of the distribution of the coefficients to changes in specification.

We present first the regressions for the period-1959I - 1972IV and second the regressions for the period 1973I = 1977IV. The countries appear in alphabetic order. For each regression the first diagram depicts the distribution of the coefficients of the deviations of the domestic money stock, in logarithm (D_{t-i}), and the second diagram depicts the distribution of the coefficients of the deviations of the U.S. money stock, in logarithm (U_{t-i}). Whenever a correction for autocorrelation has been done, using the Cochrane Orcutt iterative method, the value of ρ is reported first. All regressions for which no ρ is reported are ordinary least squares regressions.

BREAKS IN THE TREND OF THE MONEY STOCK

Australia	1961II	1972II	
Belgium	1960IV	1972I	
Canada	1960III	1967IV	1969IV
France	1963IV	1969IV	
Germany	-		
Iran	1961II	1969I	1974II
Italy	1972IV		
Japan	1963IV	1973III	
Netherlands	1972I		
Sweden	1969I		
Switzerland	1967I	1971IV	
United Kingdom	1971III	1973III	
United States	-		

AUSTRALIA, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock in Australia and M2 as the definition of the money stock in the United States. Deviations are computed with reference to the time-trend.

ρ = 1.00

R-SQUARED = 0.8468

F-STATISTIC(8, 37) = 25.6059

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.3851

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.791119E-02

STANDARD ERROR OF THE REGRESSION = 0.146229E-01

CONSTANT = -0.67

T = -1.19

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2551E-01	0.1534	0.1662	
1	0.1628	0.1707	0.9535	
2	0.2446	0.1961	1.247	
3	0.2812	0.1973	1.425	
4	0.2825	0.1931	1.463	
5	0.2586	0.1962	1.318	
6	0.2197	0.1963	1.119	
7	0.1758	0.1759	0.9998	
8	0.1371	0.1669	0.8211	

MEAN LAG = 4.23103

STANDARD ERROR = 2.67663

SUM OF LAG COEFFICIENTS = 1.78770

STANDARD ERROR = 1.26520

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.3035	0.1192	2.545	
1	0.3853	0.1416	2.721	
2	0.4660	0.1798	2.591	
3	0.5302	0.1885	2.813	
4	0.5624	0.1896	2.966	
5	0.5474	0.1946	2.813	
6	0.4697	0.1888	2.487	
7	0.3139	0.1488	2.110	
8	0.6465E-01	0.1151	0.5617	

MEAN LAG = 3.68578

STANDARD ERROR = 1.28372

SUM OF LAG COEFFICIENTS = 3.64297

STANDARD ERROR = 1.18939

AUSTRALIA, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the autoregressive projection.

Remark : - The pattern of the coefficients of U_{t-i} is sensitive to changes in specification.

R-SQUARED = 0.6472

F-STATISTIC(8, 11) = 2.82211

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.9722

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.109153E-01

STANDARD ERROR OF THE REGRESSION = 0.315009E-01

CONSTANT = 0.27

T = 25.21

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.3513	0.4162	0.8441	
1	0.3418	0.2284	1.496	
2	0.5344	0.2917	1.832	
3	0.8166	0.2947	2.770	
4	1.084	0.2916	3.717	
5	1.220	0.3398	3.589	
6	1.115	0.3823	2.910	
7	0.6605	0.3664	1.803	
8	-0.2555	0.4486	-0.5694	

MEAN LAG = 4.01568

STANDARD ERROR = 1.64776

SUM OF LAG COEFFICIENTS = 5.86678

STANDARD ERROR = 2.12117

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	1.000	0.5919	1.690	
1	-0.1396E-01	0.5850	-0.2386E-01	
2	-0.6113	0.6724	-0.9091	
3	-0.8726	0.5441	-1.604	
4	-0.8783	0.3982	-2.206	
5	-0.7092	0.4811	-1.474	
6	-0.4457	0.5945	-0.7498	
7	-0.1686	0.4998	-0.3373	
8	0.4161E-01	0.5242	0.7936E-01	

MEAN LAG = 5.43094

STANDARD ERROR = 4.25412

SUM OF LAG COEFFICIENTS = -2.65791

STANDARD ERROR = 2.23145

BELGIUM, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the time-trend.

Remark : - The pattern of the coefficients of U_{t-i} is sensitive to changes in specification.

ϱ = 0.96

R-SQUARED = 0.9294

F-STATISTIC(8, 37) = 81.1014

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.8101

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.7378066E-02

STANDARD ERROR OF THE REGRESSION = 0.141212E-01

CONSTANT = 0.15

T = 3.20

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.5461E-01	0.9796E-01	0.5575	
1	0.4449E-01	0.7956E-01	0.5592	
2	0.3654E-01	0.6329E-01	0.5774	
3	0.3021E-01	0.4896E-01	0.6171	
4	0.2494E-01	0.3653E-01	0.6828	
5	0.2017E-01	0.2604E-01	0.7735	
6	0.1535E-01	0.1754E-01	0.8729	
7	0.9905E-02	0.1064E-01	0.9313	
8	0.3290E-32	0.4765E-02	0.6908	

MEAN LAG = 2.49079

STANDARD ERROR = 3.30182

SUM OF LAG COEFFICIENTS = 0.239520

STANDARD ERROR = 0.372446

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2131	0.1200	1.776	
1	0.2154	0.1329	1.609	
2	0.3204	0.1684	1.902	
3	0.4743	0.1797	2.639	
4	0.6235	0.1810	3.448	
5	0.7144	0.1843	3.876	
6	0.6934	0.1771	3.915	
7	0.5069	0.1411	3.593	
8	0.1014	0.1135	0.8933	

MEAN LAG = 4.38601

STANDARD ERROR = 1.17335

SUM OF LAG COEFFICIENTS = 3.86286

STANDARD ERROR = 1.15613

BELGIUM, 1973 I - 1977 IV

This representative regression uses M2 as the definition of the money supply. Deviations are computed with reference to the time-trend.

Remark : - The patterns of the coefficients of D_{t-i} and U_{t-i} are sensitive to changes in specification.

R-SQUARED = 0.7910

F-STATISTIC(8, 11) = 8.20364

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.9228

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.247033E-01

STANDARD ERROR OF THE REGRESSION = 0.473894E-01

CONSTANT = 0.38

T = 21.10

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	1.559	1.231	1.266	
1	0.7448	0.6043	1.233	
2	0.7381	0.5704	1.294	
3	1.250	0.5716	2.187	
4	1.952	0.6512	3.058	
5	2.675	0.8324	3.213	
6	3.010	0.9228	3.262	
7	2.710	0.7806	3.471	
8	1.485	0.8601	1.726	

MEAN LAG = 4.71569

STANDARD ERROR = 1.38975

SUM OF LAG COEFFICIENTS = 16.1625

STANDARD ERROR = 5.70892

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.6467	0.8078	-0.8006	
1	-2.663	0.8203	-3.247	
2	-3.206	0.9179	-3.493	
3	-2.718	0.6347	-4.283	
4	-1.640	0.4339	-3.780	
5	-0.4126	0.7728	-0.5338	
6	0.5223	1.004	0.5203	
7	0.7238	0.7974	0.9073	
8	-0.2504	0.9159	-0.2734	

MEAN LAG = 1.91013

STANDARD ERROR = 1.49602

SUM OF LAG COEFFICIENTS = -10.2917

STANDARD ERROR = 2.50887

CANADA, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the time-trend.

$\rho = 0.93$

R-SQUARED = 0.8363

F-STATISTIC(8, 37) = 23.6342

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.1371

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.50A670E-03

STANDARD ERROR OF THE REGRESSION = 0.116789E-01

CONSTANT = -0.099

T = -3.90

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.3481E-01	0.5685E-01	-0.6119	
1	0.6544E-01	0.5769E-01	1.134	
2	0.1127	0.6728E-01	1.675	
3	0.1200	0.6967E-01	1.722	
4	0.1002	0.6970E-01	1.438	
5	0.6639E-01	0.7074E-01	0.9386	
6	0.3150E-01	0.6917E-01	0.4554	
7	0.8512E-02	0.5996E-01	0.1419	
8	0.1040E-01	0.5774E-01	0.1801	

MEAN LAG = 3.57123

STANDARD ERROR = 2.23673

SUM OF LAG COEFFICIENTS = 0.480310

STANDARD ERROR = 0.457745

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.1067E-01	0.1657	-0.6437E-01	
1	-0.2476	0.2514	-0.9849	
2	-0.3504	0.3192	-1.098	
3	-0.3499	0.3473	-1.008	
4	-0.2769	0.3554	-0.7790	
5	-0.1620	0.3522	-0.4601	
6	-0.3620E-01	0.3264	-0.1109	
7	0.6992E-01	0.2562	0.2729	
8	0.1255	0.1594	0.7874	

MEAN LAG = 2.13149

STANDARD ERROR = 8.69627

SUM OF LAG COEFFICIENTS = -1.23813

STANDARD ERROR = 2.17602

CANADA, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the autoregressive projection.

Remark : - The pattern of the coefficients of D_{t-i} is sensitive to changes in specification.

R-SQUARED = 0.7192

F-STATISTIC(8, 11) = 3.52120

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.8779

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.370615E-02

STANDARD ERROR OF THE REGRESSION = 0.183854E-01

CONSTANT = -0.033

T = -6.05

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(+) AND ST'D. ERROR BAND(+)
0	-0.2114	0.1766	-1.204	
1	0.1698E-01	0.1840	0.9227E-01	
2	0.2156	0.2179	0.9893	
3	0.3702	0.2166	1.709	
4	0.4673	0.1947	2.400	
5	0.4932	0.1749	2.820	
6	0.4343	0.1669	2.601	
7	0.2769	0.1690	1.639	
8	0.7488E-02	0.2119	0.3534E-01	

MEAN LAG = 5.07143

STANDARD ERROR = 2.46696

SUM OF LAG COEFFICIENTS = 2.06999

STANDARD ERROR = 1.24144

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(+) AND ST'D. ERROR BAND(+)
0	-0.5359	0.3574	-1.499	
1	-0.7642	0.5845	-1.308	
2	-0.9810	0.7307	-1.343	
3	-1.160	0.7034	-1.649	
4	-1.275	0.6224	-2.049	
5	-1.301	0.5969	-2.179	
6	-1.211	0.6079	-1.992	
7	-0.9768	0.5425	-1.806	
8	-0.5812	0.4525	-1.262	

MEAN LAG = 4.18254

STANDARD ERROR = 1.95715

SUM OF LAG COEFFICIENTS = -8.78916

STANDARD ERROR = 3.68482

FRANCE, 1959 I - 1972 IV

This representative regression uses M2 as the definition of the money stock. Deviations are computed with reference to the time-trend.

Remark : The pattern of the coefficients of D_{t-i} is sensitive to changes in specification.

$\rho = 0.79$

R-SQUARED = 0.8638

F-STATISTIC(8, 37) = 29.3346

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.0884

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.133965E-01

STANDARD ERROR OF THE REGRESSION = 0.190281E-01

CONSTANT = 0.12

T = 8.31

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.1214	0.2617	0.4637	
1	0.1578	0.2516	0.6274	
2	0.1188	0.2741	0.4336	
3	0.3006E-01	0.2702	0.1112	
4	-0.8281E-01	0.2770	-0.2990	
5	-0.1941	0.3084	-0.6293	
6	-0.2780	0.3220	-0.8635	
7	-0.3090	0.2802	-1.103	
8	-0.2412	0.2630	-0.9932	

MEAN LAG = 9.66498

STANDARD ERROR = 14.3519

SUM OF LAG COEFFICIENTS = -0.697037

STANDARD ERROR = 1.67335

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.4181	0.2100	1.982	
1	0.4347	0.2131	2.040	
2	0.5251	0.2541	2.066	
3	0.6436	0.2622	2.455	
4	0.7467	0.2562	2.914	
5	0.7907	0.2520	3.137	
6	0.7320	0.2377	3.080	
7	0.5270	0.1907	2.764	
8	0.1322	0.1726	0.7655	

MEAN LAG = 3.93974

STANDARD ERROR = 1.25617

SUM OF LAG COEFFICIENTS = 4.94804

STANDARD ERROR = 1.61506

FRANCE, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the time-trend.

R-SQUARED = 0.8138

F-STATISTIC(8, 11) = 1.45288

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.8388

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.256993E-01

STANDARD ERROR OF THE REGRESSION = 0.483352E-01

CONSTANT = 0.35

T = 15.83

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.9111	0.6988	-1.304	
1	-1.138	0.5661	-2.004	
2	-1.332	0.6437	-2.069	
3	-1.488	0.7213	-2.051	
4	-1.570	0.7860	-1.990	
5	-1.591	0.8438	-1.886	
6	-1.531	0.8480	-1.806	
7	-1.378	0.7712	-1.788	
8	-1.121	0.7320	-1.532	

MEAN LAG = 4.17187

STANDARD ERROR = 2.17077

SUM OF LAG COEFFICIENTS = -12.0524

STANDARD ERROR = 5.91986

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	1.040	0.7330	1.419	
1	0.7421	0.7857	0.9448	
2	0.4790	0.9762	0.4907	
3	0.2597	0.9473	0.2737	
4	0.9160E-01	0.8969	0.1021	
5	-0.1536E-01	0.9555	-0.1607E-01	
6	-0.5291E-01	0.9913	-0.5338E-01	
7	-0.1238E-01	0.8241	-0.1502E-01	
8	0.1149	0.8438	0.1362	

MEAN LAG = 1.24062

STANDARD ERROR = 8.50497

SUM OF LAG COEFFICIENTS = 2.64630

STANDARD ERROR = 5.46930

GERMANY, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock in Germany and M2 as the definition of the money stock in the United States. Deviations are computed with reference to the time-trend.

ρ = 0.98

R-SQUARED = 0.9523

F-STATISTIC(8, 37) = 92.3603

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.3909

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.894045E-02

STANDARD ERROR OF THE REGRESSION = 0.155444E-01

CONSTANT = 0.35

T_t = 3.26

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.4896E-01	0.1531	-0.3197	
1	0.3473E-01	0.1973	0.1760	
2	0.8220E-01	0.2261	0.3636	
3	0.1036	0.2274	0.4563	
4	0.1037	0.2208	0.4698	
5	0.9040E-01	0.2226	0.4062	
6	0.7106E-01	0.2192	0.3242	
7	0.5101E-01	0.1870	0.2822	
8	0.4256E-01	0.1631	0.2671	

MEAN LAG = 4.72449

STANDARD ERROR = 6.60077

SUM OF LAG COEFFICIENTS = 0.534530

STANDARD ERROR = 1.34122

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2341	0.1304	1.795	
1	0.8966E-01	0.1586	0.5652	
2	0.1414	0.2038	0.6936	
3	0.3062	0.2194	1.396	
4	0.5010	0.2230	2.246	
5	0.6428	0.2243	2.866	
6	0.6484	0.2121	3.057	
7	0.4349	0.1673	2.600	
8	-0.8063E-01	0.1270	-0.6347	

MEAN LAG = 4.38623

STANDARD ERROR = 1.85355

SUM OF LAG COEFFICIENTS = 2.91766

STANDARD ERROR = 1.41290

GERMANY, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the time-trend.

R-SQUARED = 0.6342

F-STATISTIC(8, 11) = 2.38343

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.9759

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.2118468E-01

STANDARD ERROR OF THE REGRESSION = 0.4308047E-01

CONSTANT = 0.51

T = 36.63

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-1.973	0.6834	-2.886	
1	-1.075	0.5236	-2.053	
2	-0.6812	0.4772	-1.428	
3	-0.8315	0.4181	-1.918	
4	-0.7644	0.3601	-2.123	
5	-0.9192	0.3492	-2.632	
6	-0.9347	0.3516	-2.658	
7	-0.6500	0.3377	-1.925	
8	0.9598E-01	0.4978	0.1928	

MEAN LAG = 2.83772

STANDARD ERROR = 1.54953

SUM OF LAG COEFFICIENTS = -7.83280

STANDARD ERROR = 3.16964

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	1.506	0.6798	2.215	
1	1.187	0.8247	1.403	
2	0.4802	0.9207	0.4890	
3	-0.4293	0.8270	-0.5021	
4	-1.261	0.9023	-1.398	
5	-1.880	1.160	-1.621	
6	-2.082	1.310	-1.989	
7	-1.675	1.114	-1.504	
8	-0.4646	0.8273	-0.5617	

MEAN LAG = 0.98284

STANDARD ERROR = 6.03812

SUM OF LAG COEFFICIENTS = -4.67103

STANDARD ERROR = 5.21367

IRAN, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock in Iran and M2 as the definition of the money stock in the United States. Deviations are computed with reference to the time-trend.

Remark : - The pattern of the coefficients of U_{t-i} is sensitive to changes in specification.

$\hat{\rho}$ = 0.58

R-SQUARED = 0.7868

F-STATISTIC(8, 37) = 14.6022

DURBIN-WATSON STATISTIC (ADJ. FOR 8 GAPS) = 1.8616

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.309917E-01

STANDARD ERROR OF THE REGRESSION = 0.289416E-01

CONSTANT = 0.11

T = 9.58

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2830E-01	0.2348	0.1205	
1	0.2102	0.2253	0.9328	
2	0.3508	0.2631	1.332	
3	0.4482	0.2690	1.666	
4	0.5015	0.2694	1.861	
5	0.5091	0.2815	1.808	
6	0.4695	0.2850	1.647	
7	0.3816	0.2570	1.484	
8	0.2432	0.2743	0.8866	

MEAN LAG = 4.83214

STANDARD ERROR = 2.28469

SUM OF LAG COEFFICIENTS = 3.14183

STANDARD ERROR = 1.72444

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2917	0.2647	1.102	
1	0.4491	0.2228	2.019	
2	0.6915	0.2688	2.573	
3	0.9844	0.2560	3.846	
4	1.133	0.2475	4.579	
5	1.183	0.2743	4.313	
6	1.020	0.2891	3.527	
7	0.5882	0.2377	2.398	
8	-0.2459	0.2707	-0.9083	

MEAN LAG = 3.89119

STANDARD ERROR = 1.69044

SUM OF LAG COEFFICIENTS = 6.63484

STANDARD ERROR = 1.53437

IRAN, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the time-trend.

Remark : - The pattern of the coefficients of U_{t-i} is sensitive to changes in specification.

R-SQUARED = 0.9443

F-STATISTIC(8, 11) = 23.3006

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.1906

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.9587066E-02

STANDARD ERROR OF THE REGRESSION = 0.295220E-01

CONSTANT = 0.30

T = 39.02

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(•) AND ST'D. ERROR BAND(+)
0	0.2737	0.1294	2.116	
1	0.7310	0.1011	7.227	
2	1.084	0.1151	9.415	
3	1.330	0.1281	10.38	
4	1.468	0.1421	10.33	
5	1.494	0.1579	9.461	
6	1.407	0.1679	8.383	
7	1.205	0.1699	7.090	
8	0.8848	0.1979	4.472	

MEAN LAG = 4.47345

STANDARD ERROR = 0.493709

SUM OF LAG COEFFICIENTS = 9.87769

STANDARD ERROR = 1.02787

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(•) AND ST'D. ERROR BAND(+)
0	-6.696	0.5219	-1.283	
1	-3.337	0.6734	-4.956	
2	-8.719	0.7418	-7.709	
3	-7.612	0.6784	-11.22	
4	-8.816	0.7108	-12.40	
5	-9.129	0.8829	-10.34	
6	-8.349	0.9909	-8.425	
7	-6.273	0.8569	-7.329	
8	-2.701	0.6134	-4.403	

MEAN LAG = 4.45068

STANDARD ERROR = 0.408908

SUM OF LAG COEFFICIENTS = -82.6062

STANDARD ERROR = 4.30422

ITALY, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the time-trend.

ϱ = 0.71

R-SQUARED = 0.8912

F-STATISTIC(8, 37) = 37.8838

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.0811

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.103810E-01

STANDARD ERROR OF THE REGRESSION = 0.167502E-01

CONSTANT = .0.11

T = 10.98

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.4014E-01	0.1713	0.2343	
1	-0.3773	0.1607	-2.348	
2	-0.5332	0.1825	-2.922	
3	-0.4998	0.1723	-2.900	
4	-0.3498	0.1605	-2.177	
5	-0.1544	0.1703	-0.9077	
6	0.1258E-01	0.1794	0.7008E-01	
7	0.7969E-01	0.1629	0.4892	
8	-0.2559E-01	0.1983	-0.1291	

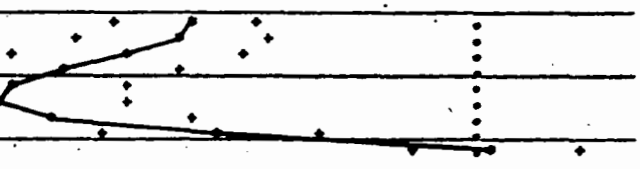
MEAN LAG = 2.59215

STANDARD ERROR = 2.74528

SUM OF LAG COEFFICIENTS = -1.80772

STANDARD ERROR = 0.993021

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.9483	0.2441	-3.885	
1	-0.9897	0.3154	-3.137	
2	-1.165	0.3872	-3.007	
3	-1.382	0.4064	-3.401	
4	-1.552	0.4178	-3.716	
5	-1.583	0.4391	-3.605	
6	-1.385	0.4393	-3.152	
7	-0.8684	0.3697	-2.348	
8	0.6274E-01	0.2581	0.2431	



MEAN LAG = 3.61535

STANDARD ERROR = 1.19066

SUM OF LAG COEFFICIENTS = -9.80822

STANDARD ERROR = 2.57668

ITALY, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock in Italy and M2 as the definition of the money stock in the United States. Deviations are computed with reference to the time-trend.

ρ = 0.39

R-SQUARED = 0.8635

F-STATISTIC(8, 11) = 8.69952

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.0186

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.110038E-01

STANDARD ERROR OF THE REGRESSION = 0.316282E-01

CONSTANT = 0.06

T = 6.60

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(•) AND ST'D. ERROR BAND(+)
0	-0.7949	0.3646	-2.180	
1	-0.7686	0.1853	-4.149	
2	-0.5204	0.2062	-2.524	
3	-0.1501	0.1904	-0.7881	
4	0.2424	0.1638	1.480	
5	0.5573	0.1840	3.029	
6	0.6946	0.2078	3.343	
7	0.5544	0.2191	2.578	
8	0.3731E-01	0.4018	0.92848-01	

MEAN LAG = -66.9970

STANDARD ERROR = 109.072

SUM OF LAG COEFFICIENTS = -0.147818

STANDARD ERROR = 1.43894

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(•) AND ST'D. ERROR BAND(+)
0	1.183	0.5979	1.979	
1	1.873	0.4485	4.180	
2	1.921	0.5502	3.492	
3	1.515	0.4372	3.466	
4	0.8477	0.3314	2.557	
5	0.1110	0.4482	0.2476	
6	-0.5030	0.5239	-0.9601	
7	-0.8023	0.4048	-1.972	
8	-0.5981	0.8230	-0.7231	

MEAN LAG = 0.146833

STANDARD ERROR = 1.82204

SUM OF LAG COEFFICIENTS = 5.58253

STANDARD ERROR = 2.18352

JAPAN, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock in Japan and M2 as the definition of the money stock in the United States. Deviations are computed with reference to the time-trend.

$\rho = 0.975$

R-SQUARED = 0.9713

F-STATISTIC(8. 37) = 156.465

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.0311

NUMBER OF OBSERVATIONS = 44

SUM OF SQUARED RESIDUALS = 0.186718E-01

STANDARD ERROR OF THE REGRESSION = 0.199129E-01

CONSTANT = 0.50

T = 4.92

i	COEFFICIENT (β_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2524	0.1432	1.763	
1	0.3488	0.1452	2.403	
2	0.3624	0.1679	2.158	
3	0.3190	0.1782	1.790	
4	0.2447	0.1805	1.355	
5	0.1655	0.1790	0.9247	
6	0.1075	0.1693	0.6347	
7	0.9656E-01	0.1476	0.6540	
8	0.1588	0.1483	1.071	

MEAN LAG = 3.12711

STANDARD ERROR = 2.22894

SUM OF LAG COEFFICIENTS = 2.05857

STANDARD ERROR = 1.24364

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2988	0.1603	1.864	
1	0.2941	0.1858	1.583	
2	0.3883	0.2358	1.819	
3	0.4556	0.2485	1.833	
4	0.5500	0.2491	2.208	
5	0.6057	0.2522	2.402	
6	0.5869	0.2417	2.428	
7	0.4576	0.1906	2.401	
8	0.1820	0.1546	1.177	

MEAN LAG = 4.16687

STANDARD ERROR = 1.61782

SUM OF LAG COEFFICIENTS = 3.78984

STANDARD ERROR = 1.86672

JAPAN, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock in Japan and M2 as the definition of the money stock in the United States. Deviations are computed with reference to the autoregressive projection.

Remark : - The pattern of the coefficients of D_{t-i} is sensitive to changes in specification.

$\rho = 0.89$

R-SQUARED = 0.9526

F-STATISTIC(8, 11) = 27.6604

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.2457

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.127012E-01

STANDARD ERROR OF THE REGRESSION = 0.3398022E-01

CONSTANT = 1.11

T = 13.20

i (D_{t-i})	COEFFICIENT	ST°D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST°D. ERROR BAND(+)
0	1.136	0.4541	2.501	
1	1.272	0.5462	2.329	
2	1.157	0.6311	1.833	
3	0.8792	0.6593	1.333	
4	0.5280	0.6664	0.7923	
5	0.1924	0.6703	0.2870	
6	-0.3841E-01	0.6480	-0.5928E-01	
7	-0.7535E-01	0.5599	-0.1346	
8	0.1707	0.4465	0.3823	

MEAN LAG = 1.89711

STANDARD ERROR = 3.46598

SUM OF LAG COEFFICIENTS = 5.22098

STANDARD ERROR = 4.56921

i (U_{t-i})	COEFFICIENT	ST°D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST°D. ERROR BAND(+)
0	1.062	0.6923	1.535	
1	3.235	1.187	2.725	
2	4.026	1.340	3.006	
3	3.798	1.204	3.154	
4	2.909	0.9760	2.981	
5	1.721	0.8695	1.979	
6	0.5936	0.9006	0.6591	
7	-0.1128	0.8439	-0.1337	
8	-0.3784E-01	0.5947	-0.6362E-01	

MEAN LAG = 2.63997

STANDARD ERROR = 1.30401

SUM OF LAG COEFFICIENTS = 17.1938

STANDARD ERROR = 5.89603

NETHERLANDS, 1959 I - 1972 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the autoregressive projection.

$\rho = 0.83$

R-SQUARED = 0.9788

F-STATISTIC(8, 28) = 162.569

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.0408

NUMBER OF OBSERVATIONS = 37

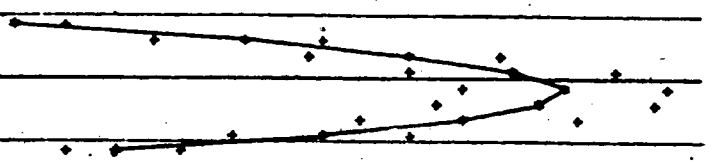
SUM OF SQUARED RESIDUALS = 0.433365E-02

STANDARD ERROR OF THE REGRESSION = 0.124408E-01

CONSTANT = 0.23

T = 11.75

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.8169E-01	0.1040	0.7858	
1	0.5077	0.1004	3.166	
2	0.8221	0.1910	4.305	
3	1.023	0.1926	5.311	
4	1.110	0.1919	5.784	
5	1.081	0.2008	5.382	
6	0.9337	0.2034	4.591	
7	0.6675	0.1728	3.862	
8	0.2806	0.1098	2.555	



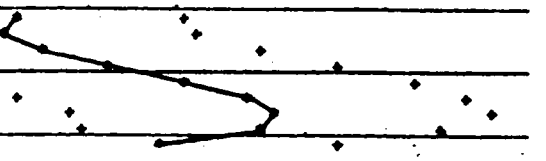
MEAN LAG = 4.23900

STANDARD ERROR = 0.759637

SUM OF LAG COEFFICIENTS = 6.80749

STANDARD ERROR = 1.16131

i	COEFFICIENT (V_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.2705	0.1892	1.430	
1	0.2587	0.2159	1.198	
2	0.3027	0.2561	1.182	
3	0.3793	0.2681	1.415	
4	0.4684	0.2650	1.756	
5	0.5377	0.2572	2.091	
6	0.5732	0.2400	2.389	
7	0.5485	0.2061	2.661	
8	0.4406	0.2073	2.126	



MEAN LAG = 4.89858

STANDARD ERROR = 1.71797

SUM OF LAG COEFFICIENTS = 3.77674

STANDARD ERROR = 1.62982

NETHERLANDS, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock. Deviations are computed with reference to the time-trend.

R-SQUARED = 0.7120

F-STATISTIC(8, 11) = 3.39965

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.9037

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.2673852-01

STANDARD ERROR OF THE REGRESSION = 0.493029E-01

CONSTANT = 0.65

T = 53.98

i	COEFFICIENT (γ_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-1.683	0.5830	-3.230	
1	-1.260	0.4707	-2.676	
2	-0.8907	0.4542	-1.961	
3	-0.6901	0.4065	-1.698	
4	-0.5718	0.3359	-1.702	
5	-0.4498	0.2819	-1.595	
6	-0.2380	0.2483	-0.9586	
7	0.1496	0.2226	0.6718	
8	0.7990	0.3636	2.198	

MEAN LAG = 0.722335

STANDARD ERROR = 1.68031

SUM OF LAG COEFFICIENTS = -5.03463

STANDARD ERROR = 2.49331

i	COEFFICIENT (v_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	1.775	0.8754	2.028	
1	0.5469	1.334	0.4101	
2	-1.156	1.373	-0.8419	
3	-2.983	1.057	-2.823	
4	-4.584	1.031	-4.448	
5	-5.610	1.505	-3.728	
6	-5.709	1.853	-3.081	
7	-4.531	1.657	-2.734	
8	-1.727	1.038	-1.665	

MEAN LAG = 5.70895

STANDARD ERROR = 1.48249

SUM OF LAG COEFFICIENTS = -23.9776

STANDARD ERROR = 5.76933

SWEDEN, 1959 I - 1972 IV

This representative regression uses M2 as the definition of the money stock. Deviations are computed with reference to the time-trend.

Remark : - The pattern of the distribution of the coefficients of D_{t-i} is sensitive to the method used to compute the "normal" value of the money stock. All regressions using the time trend yield a similar pattern. The F coefficients are significant for both categories of regressions but are superior when the trend is used.

ϱ = 0.96

R-SQUARED = 0.9660

F-STATISTIC(8, 37) = 131.215

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.1212

NUMBER OF OBSERVATIONS = 46

SUM OF SQUARED RESIDUALS = 0.583773E-02

STANDARD ERROR OF THE REGRESSION = 0.125609E-01

CONSTANT = 0.28

T = 6.38

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.1330	0.1608	-0.8284	
1	-0.5632	0.2344	-2.403	
2	-0.7231	0.2649	-2.767	
3	-0.7085	0.2468	-2.852	
4	-0.5565	0.2141	-2.614	
5	-0.3500	0.2079	-1.684	
6	-0.1480	0.2147	-0.6893	
7	-0.2026E-01	0.1920	-0.1055	
8	-0.3387E-01	0.1437	-0.2357	

MEAN LAG = 2.90834

STANDARD ERROR = 1.72634

SUM OF LAG COEFFICIENTS = -3.25041

STANDARD ERROR = 1.27916

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.8110E-01	0.1137	0.7132	
1	0.2932	0.1408	1.798	
2	0.4504	0.1757	2.818	
3	0.6380	0.1967	3.244	
4	0.7781	0.2045	3.806	
5	0.8352	0.2066	4.043	
6	0.7728	0.1925	4.014	
7	0.5545	0.1467	3.781	
8	0.1481	0.1028	1.414	

MEAN LAG = 4.44402

STANDARD ERROR = 1.09749

SUM OF LAG COEFFICIENTS = 4.50928

STANDARD ERROR = 1.26789

SWEDEN, 1973 I - 1977 IV

This representative regression uses M2 as the definition of the money stock in Sweden and M1 as the definition of the money stock in the United States. Deviations are computed with reference to the autoregressive projection.

Remark : - The results are very sensitive to changes in specification. F is very poor in all cases.

R-SQUARED = 0.6398

F-STATISTIC(8, 11) = 2.44213

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.5970

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.170682E-01

STANDARD ERROR OF THE REGRESSION = 0.393510E-01

CONSTANT = 0.40

T = 26.41

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-0.1779	0.2804	-0.6344	
1	0.4962	0.1965	2.526	
2	0.6845	0.2238	3.058	
3	0.5428	0.2134	2.570	
4	0.2496	0.1939	1.287	
5	-0.5035E-01	0.2008	-0.2507	
6	-0.1859	0.2069	-0.9178	
7	-0.7459E-02	0.1870	-0.4009E-01	
8	0.6524	0.2935	2.243	

MEAN LAG = 3.76781

STANDARD ERROR = 2.33807

SUM OF LAG COEFFICIENTS = 2.21181

STANDARD ERROR = 1.25743

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	1.764	0.8209	2.173	
1	1.398	0.8157	1.714	
2	0.8805	0.7924	1.111	
3	0.2966	0.5747	0.5160	
4	-0.2886	0.3433	-0.8405	
5	-0.8056	0.4439	-1.824	
6	-1.201	0.6254	-1.921	
7	-1.398	0.6080	-2.300	
8	-1.336	0.5908	-2.261	

MEAN LAG = 42.7135

STANDARD ERROR = 14.2666

SUM OF LAG COEFFICIENTS = -0.675098

STANDARD ERROR = 1.59078

SWITZERLAND, 1959 I - 1972 IV

9

This representative regression uses M2 as the definition of the money stock. Deviations are computed with reference to an autoregressive projection.

$\rho = 0.96$

R-SQUARED = 0.9842

F-STATISTIC(8, 28) = 218.411

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.1331

NUMBER OF OBSERVATIONS = 37

SUM OF SQUARED RESIDUALS = 0.162013E-02

STANDARD ERROR OF THE REGRESSION = 0.760670E-02

CONSTANT = 0.20

T = 6.26

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(+) AND ST'D. ERROR BAND(+)
0	-0.8374E-01	0.7466E-01	-1.125	
1	0.1702E-01	0.5456E-01	0.3120	
2	0.5604E-02	0.6837E-01	0.8196E-01	
3	-0.7932E-01	0.6441E-01	-1.179	
4	-0.1859	0.5608E-01	-3.308	
5	-0.2810	0.6145E-01	-4.573	
6	-0.3205	0.7272E-01	-4.407	
7	-0.2618	0.7390E-01	-3.540	
8	-0.6289E-01	0.8193E-01	-0.7676	

MEAN LAG = 5.28961

STANDARD ERROR = 1.61799

SUM OF LAG COEFFICIENTS = -1.24874

STANDARD ERROR = 0.347300

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(+) AND ST'D. ERROR BAND(+)
0	0.2249	0.7008E-01	3.209	
1	0.3090	0.7467E-01	4.138	
2	0.4158	0.8443E-01	4.800	
3	0.5231	0.9131E-01	5.729	
4	0.6088	0.9319E-01	6.533	
5	0.6505	0.9257E-01	7.028	
6	0.6262	0.8329E-01	7.518	
7	0.5137	0.6501E-01	7.902	
8	0.2906	0.8936E-01	3.252	

MEAN LAG = 4.34236

STANDARD ERROR = 0.822690

SUM OF LAG COEFFICIENTS = 4.16274

STANDARD ERROR = 0.580665

SWITZERLAND, 1973 I - 1977 IV

This representative regression uses M2 as the definition of the money stock. Deviations are computed with reference to an autoregressive projection.

Remark : - Although the pattern of the distribution of the coefficients of U_{t-i} is consistent for all regressions, the significance of the sign of the first coefficient is sensitive to the specification. Note that the selected representative regression is better than the alternative regressions in terms of R^2, F and D.W.

R-SQUARED = 0.8179

F-STATISTIC(8, 11) = 6.17373

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.7566

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.248508E-01

STANDARD ERROR OF THE REGRESSION = 0.475307E-01

CONSTANT = 0.55

T = 23.91

1 COEFFICIENT ST'D. ERROR T-STATISTIC PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)

	(D_{t-i})		
0	-4.106	1.182	-3.474
1	-2.142	1.418	-1.510
2	-0.5972	1.658	-0.3602
3	0.5419	1.728	0.3136
4	1.288	1.713	0.7516
5	1.653	1.652	1.000
6	1.651	1.473	1.121
7	1.293	1.059	1.221
8	0.5931	0.7762	0.7641

MEAN LAG = 283.192

STANDARD ERROR = 139.579

SUM OF LAG COEFFICIENTS = 0.174237

STANDARD ERROR = 10.3655

COEFFICIENT ST'D. ERROR T-STATISTIC PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)

0	2.035	0.8976	2.267
1	-1.609	0.6594	-2.441
2	-3.223	0.9509	-3.389
3	-3.309	1.022	-3.238
4	-2.370	1.031	-2.299
5	-0.9094	1.117	-0.8143
6	0.5692	1.192	0.4774
7	1.563	1.077	1.452
8	1.569	0.8688	1.806

MEAN LAG = 0.897343

STANDARD ERROR = 5.32166

SUM OF LAG COEFFICIENTS = -5.68386

STANDARD ERROR = 5.71186

UNITED KINGDOM, 1959 I - 1972 IV.

This representative regression uses M2 as the definition of the money stock. Deviations are computed with reference to an autoregressive projection.

Remarks: 1. Regressions using M1 for the money stock in the United Kingdom have not been tried, for lack of data.

2. The pattern of the coefficients of D_{t-i} is sensitive to the choice between M1 and M2 as the definition of the money stock in the United States.

$\rho = 0.91$

R-SQUARED = 0.8731

F-STATISTIC(8. 28) = 24.0753

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 1.9392

NUMBER OF OBSERVATIONS = 37

SUM OF SQUARED RESIDUALS = 0.193320E-01

STANDARD ERROR OF THE REGRESSION = 0.262760E-01

CONSTANT = 0.046

T = 0.94

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(+) AND ST'D. ERROR BAND(+)
0	-0.2673	0.3609	-0.8240	
1	-0.8388	0.3857	-2.175	
2	-0.9897	0.4339	-2.271	
3	-0.6571	0.4436	-1.482	
4	-0.5725	0.4587	-1.248	
5	-0.2503	0.4897	-0.5112	
6	-0.1046E-01	0.4894	-0.2138E-01	
7	0.2815E-01	0.3988	0.7061E-01	
8	-0.2537	0.2767	-0.9166	

MEAN LAG = 2.67919

STANDARD ERROR = 3.35015

SUM OF LAG COEFFICIENTS = -4.03749

STANDARD ERROR = 3.68809

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(+) AND ST'D. ERROR BAND(+)
0	0.3913	0.3221	1.215	
1	0.5970	0.3481	1.715	
2	0.7408	0.4067	1.822	
3	0.8211	0.4301	1.909	
4	0.8360	0.4371	1.913	
5	0.7840	0.4391	1.785	
6	0.6631	0.4215	1.573	
7	0.4716	0.3702	1.274	
8	0.2078	0.3708	0.5610	

MEAN LAG = 3.76377

STANDARD ERROR = 2.23140

SUM OF LAG COEFFICIENTS = 5.51284

STANDARD ERROR = 3.66592

UNITED KINGDOM, 1973 I - 1977 IV

This representative regression uses M1 as the definition of the money stock in the United Kingdom and M2 as the definition of the money stock in the United States. Deviations are computed with reference to the time-trend.

Remark : - Although the pattern of the coefficients of D_{t-i} is fairly robust, one good regression yielded the opposite distribution.

R-SQUARED = 0.8388

F-STATISTIC(8. 11) = 7.14209

DURBIN-WATSON STATISTIC (ADJ. FOR 0 GAPS) = 2.1981

NUMBER OF OBSERVATIONS = 20

SUM OF SQUARED RESIDUALS = 0.8816548-02

STANDARD ERROR OF THE REGRESSION = 0.2459898-01

CONSTANT = 0.13

T 8.39

i	COEFFICIENT (D_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	-1.048	0.7578	-1.383	
1	-1.111	0.4529	-2.453	
2	-1.380	0.3504	-3.853	
3	-1.488	0.3298	-4.095	
4	-2.013	0.3943	-5.106	
5	-2.262	0.5281	-4.285	
6	-2.341	0.6663	-3.513	
7	-2.161	0.7773	-2.788	
8	-1.637	0.9239	-1.772	

MEAN LAG = 4.81710

STANDARD ERROR = 1.42128

SUM OF LAG COEFFICIENTS = -15.6042

STANDARD ERROR = 4.82428

i	COEFFICIENT (U_{t-i})	ST'D. ERROR	T-STATISTIC	PLOT OF THE LAG DISTRIBUTION(*) AND ST'D. ERROR BAND(+)
0	0.6327	0.4324	1.463	
1	0.7610	0.4310	1.766	
2	0.4670	0.4891	0.9548	
3	-0.8074E-01	0.3584	-0.2241	
4	-0.7122	0.3820	-2.023	
5	-1.260	0.5658	-2.212	
6	-1.254	0.6948	-2.230	
7	-1.426	0.5405	-2.842	
8	-0.7064	0.5405	-1.307	

MEAN LAG = 0.42867

STANDARD ERROR = 3.38148

SUM OF LAG COEFFICIENTS = -3.87718

STANDARD ERROR = 2.64249

APPENDIX III

SOURCE OF THE DATA USED IN THE TEST OF CHAPTER IV

The following table reports the source of the data used in the test of chapter IV. Except when indicated otherwise, all data are weekly data recorded on Fridays or on the previous business day if Friday is a holiday.

INTEREST ON 90-DAYS TREASURY BILLS.

U.S.: From January 1960 up to April 1974: federal Reserve Bulletin. Data recorded on Fridays (for comparison with U.K.) and on Thursdays (for comparison with Canada) for the period January 1960 - December 1962.

From May 1974 up to December 1977: Bank of England Quarterly Review. Note: The data published by the the Bank of England are expressed as a yield for a year of 365 days. We have transformed those data to make them consistent with the presentation of the federal reserve bulletin, which expresses the yields on the basis of a year of 360 days.

U.K.: Same source as for the U.S.A.

Canada: From January 1960 up to April 1974: Federal Reserve Bulletin. Note: data recorded on Thursdays from January 1960 to December 1962.

From May 1974 up to December 1977: Bank of Canada Review. Note: Data recorded on Thursdays.

SPOT EXCHANGE RATES:

U.K. and Canada: Wall Street Journal.

90-DAY FORWARD EXCHANGE RATES:

U.K.: Wall Street Journal.

Canada: From January 1960 up to April 1974: Federal Reserve Bulletin. Note: forward exchange rates recorded on Thursdays, expressed as a percentage per annum, for the period January 1960 - December 1962.

From May 5, 1974 up to September 2, 1977: Globe and Mail of Toronto.

From September 9, 1977 up to December 30, 1977: Wall Street Journal.

30-DAY FORWARD EXCHANGE RATES.

U.K.: Wall Street Journal

Canada: From May 5, 1974 up to September 2, 1977: Globe and Mail of Toronto.

From September 9, 1977 up to December 30, 1977: Wall Street Journal.

APPENDIX IV

REDUCED FORM OF THE MODERN THEORY: ADDITIONAL ESTIMATIONS AND COLINEARITY BETWEEN INDEPENDENT VARIABLES

The first two tables in this Appendix report the estimations of the reduced form of the Modern Theory as developed in Chapter IV. Because of the strong colinearity between the independent variables, the estimated coefficients, although unbiased, are not accurate. The sign of one of the speculative variables is even consistently contrary to the sign predicted by the theory.

To overcome the colinearity problem, the regressions reported in Chapter IV have omitted alternatively each of the two speculative variables of the reduced form. The two last tables of this Appendix report the results obtained by regressing the omitted variable on the other independent variables of the reduced form.

Table A 4-1: Estimation of the Reduced Form of the Modern Theory, Canada/USA

Period: May 1974-December 1977 (floating exchange rate)

Dependent Variable: 90-day forward exchange rate

	Constant	Parity Rate*	Expected future spot rate	Expected future forward rate	ρ	DW	Number of observations	R^2	Standard error of the regression
(1) Variables in absolute values	0.0005 (0.03)	1.0226 (19.69)	-0.1814 (-1.68)	0.1590 (1.38)	0.66	2.12	174	0.994	0.0022
(2) Variables in logarithms	0.0007 (1.20)	1.0254 (20.67)	-0.1749 (-1.65)	0.1494 (1.35)	0.65	2.12	174	0.995	0.002

* None of the coefficients of the parity rate are significantly different from unity, even at the level 20%, according to the t test.

Table A 4-2: Estimations of the Reduced Form of the Modern Theory , UK/USA

Period: January 1960-December 1977

Dependent Variable: 90 day forward exchange rate

Exchange Rate Regime	Constant	Parity Rate*	Expected future spot rate	Expected future forward rate	ρ	DW	Number of observations	R^2	Standard error of the regression
Variables in Absolute Values									
(1) Parity Regime	-0.0773 (0.16)	0.9130 (3.10)	-2.9690 (-0.35)	3.0274 (0.37)	0.78	1.56	636	0.9041	0.0582
(2) Floating Exchange Rates	0.0476 (0.85)	1.2122 (9.08)	0.0458 (0.17)	-0.2843 (-1.13)	0.90	1.99	274	0.9993	0.0082
Variables in Logs									
(3) Parity Regime	0.0392 (2.64)	0.9226 (2.64)	-3.3255 (-0.35)	3.3632 (0.37)	0.79	1.57	636	0.8793	0.0253
(4) Floating Exchange Rates	0.0177 (0.73)	1.2411 (7.63)	0.0425 (0.16)	-0.3127 (-1.16)	0.91	1.98	274	0.9992	0.0042

*None of the coefficients of the parity rate are significantly different from unity at the 10% level, according to the t test.

Table A 4-3: Colinearity between spot rate or 1 month forward rate and the other independent variables: Canada/USA

Period: May 1976-December 1977 (floating exchange rate)

	Dependent Variable	Constant	Parity Rate*	Spot rate 1 month later	Previous 1 month forward rate	DW	Number of observations	R^2	Standard error of the regression
(1)	Spot Rate	0.0182 (0.64)	-0.0193 (-0.32)	-	1.0001* (18.54)	0.33	179	0.89	0.0117
(2)	1 Month forward rate	-0.0079 (-0.34)	0.3460 (8.29)	0.6613 (18.56)	-	0.39	179	0.92	0.0096

* Not significantly different from unity at the 10% level. The argument that the presence of auto-correlation suggested by the low DW results in an underestimation of the standrad errors of the coefficient reinforces this conclusion.

Table A 4-4: Colinearity between spot rate or 1 month forward rate and the other independent variables: UK/USA

Dependent Variables:		Exchange Rate Regime	Constant	Parity Rate*	Spot rate 1 month later	Previous 1 month forward rate	DW	Number of observations	R^2	Standard error of regression
spot rate	(1)	Parity regime	0.0472 (2.65)	-0.0282 (-1.16)	-	1.0108* (42.17)	0.42	651	0.97	0.0311
	(2)	Floating Exchange Rates	0.0429 (2.19)	-0.1278 (-3.67)	-	1.1081 (31.69)	0.42	275	0.98	0.0452
1 month forward rate	(3)	Parity Regime	0.0185 (-1.22)	0.2816 (16.13)	0.7251 (42.17)	-	0.49	651	0.98	0.0264
	(4)	Floating Exchange Rate	-0.0153 (-0.965)	0.2957 (13.31)	0.7101 (31.69)	-	0.47	275	0.99	0.0362

*Not significantly different from unity, even at the 10% level. The argument that the presence of autocorrelation suggested by the low DW results in an underestimation of the standard errors of the coefficients reinforces this conclusion.

APPENDIX V

AUTOCORRELATIONS AND CORRELOGRAMS OF FORECASTING ERRORS

This Appendix reports the autocorrelations and the correlograms of the forecasting errors of the future spot rate expected to prevail 13 weeks later for the Canadian dollar and the pound sterling. The current spot rate and the current 30-day forward rate have been used alternatively as predictors. As for the regression analysis of Chapter IV, our data are weekly data for the period January 1960-December 1977. A description of the program used for the computations is found in Nelson (1973).

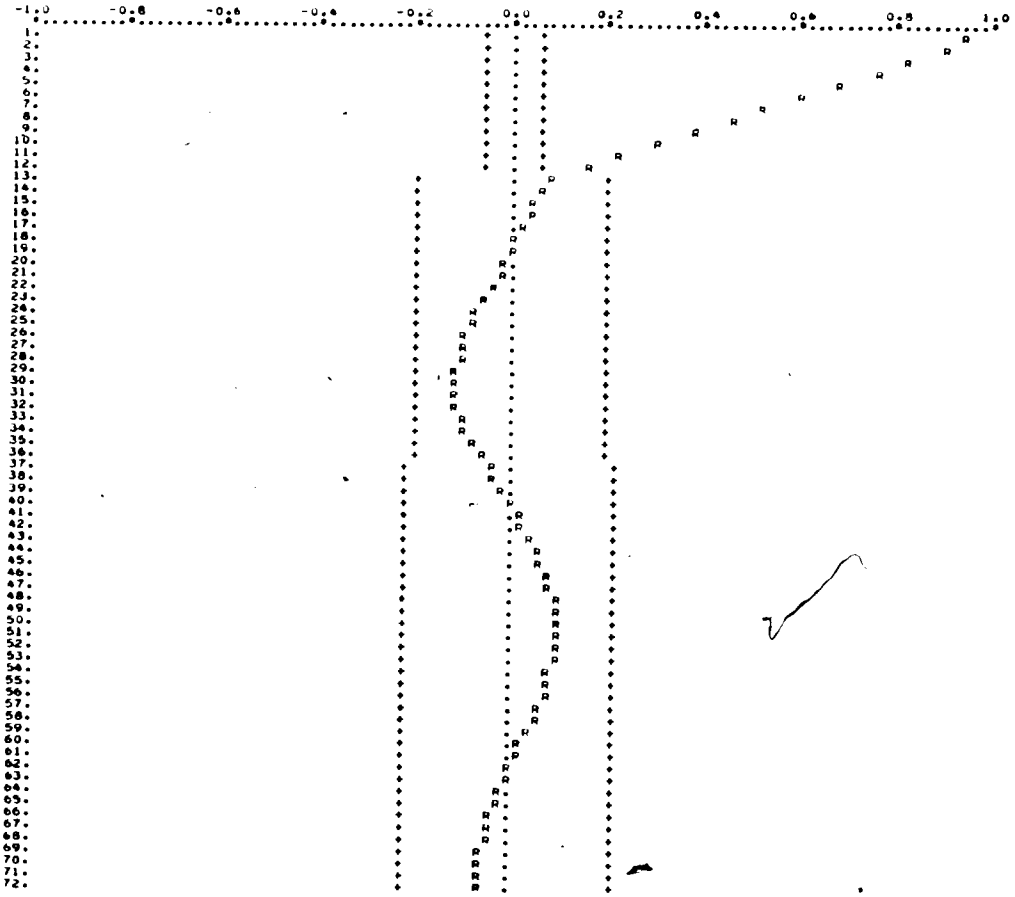
In all cases, the autocorrelations are significantly different from zero up to the 12th lag and insignificant thereafter. This finding is consistent with the hypothesis of Chapter IV, that the observed autocorrelation results from the information becoming randomly available during the 12 overlapping weeks comprised in the intervals separating the date of the prediction from the date for which the forecast is made for two consecutive forecasts.

AUTOCORRELATION AND PARTIAL AUTOCORRELATION FUNCTIONS OF THE FORECASTING ERRORS OF THE CANADIAN DOLLAR, 1960-1977

PREDICTOR : CURRENT SPOT RATE.

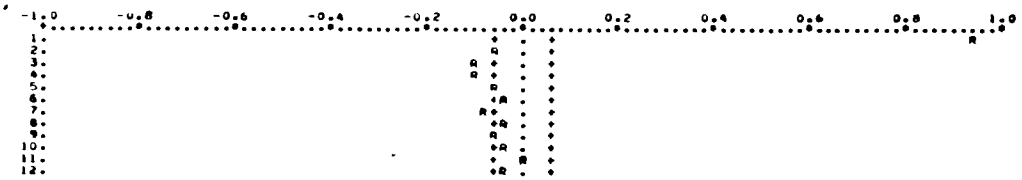
DIFFERENCE $(1-B)^0(1-B^{12})^0$ VAR = 0.5566E-02	LAGS	AUTOCORRELATIONS												EST. STD ERROR FOR ROs
	1-12	0.95	0.89	0.83	0.76	0.68	0.61	0.53	0.45	0.37	0.29	0.22	0.16	0.03
	13-24	0.09	0.07	0.05	0.03	0.02	0.01	-0.00	-0.02	-0.03	-0.04	-0.06	-0.07	0.10
	25-36	-0.08	-0.09	-0.10	-0.11	-0.11	-0.11	-0.11	-0.11	-0.10	-0.09	-0.08	-0.07	0.10
	37-48	-0.05	-0.03	-0.02	-0.00	0.01	0.03	0.04	0.05	0.07	0.08	0.09	0.10	0.11
	49-60	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.06	0.04	0.03	0.11
	61-72	0.02	0.01	-0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05	-0.06	-0.06	-0.06	0.11

AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^0$



DIFFERENCE $(1-B)^0(1-B^{12})^0$	LAGS	PARTIAL AUTOCORRELATIONS												EST. STD ERROR FOR ROs
	1-12	0.95	-0.07	-0.11	-0.10	-0.06	-0.04	-0.08	-0.04	-0.06	-0.04	0.01	-0.04	0.03

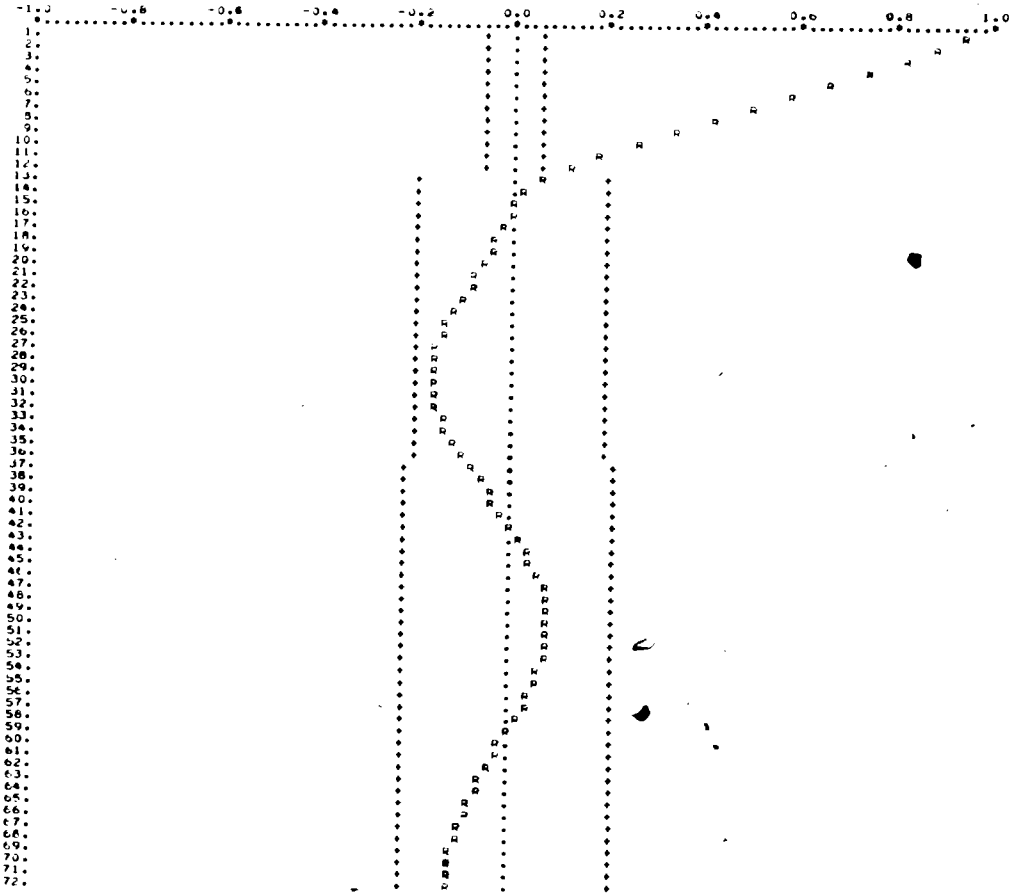
PARTIAL AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^0$



AUTOCORRELATION AND PARTIAL AUTOCORRELATION FUNCTIONS OF THE FORECASTING ERRORS OF THE CANADIAN DOLLAR, 1960-1977
PREDICTOR : FORWARD EXCHANGE RATE.

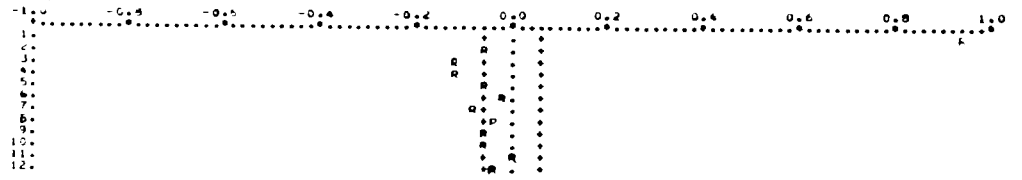
DIFFERENCE	LAGS	AUTOCORRELATIONS												EST. STD ERROR FOR ROs
$(1-B)^0(1-B^{12})^1$	1-12	0.95	0.89	0.82	0.75	0.67	0.59	0.51	0.43	0.36	0.26	0.19	0.12	0.03
VAR = 0.5682E-02	13-24	0.05	0.03	0.01	-0.01	-0.02	-0.04	-0.05	-0.06	-0.07	-0.09	-0.10	-0.12	0.10
	25-36	-0.13	-0.14	-0.15	-0.16	-0.16	-0.16	-0.16	-0.15	-0.15	-0.14	-0.12	-0.10	0.10
	37-48	-0.08	-0.07	-0.05	-0.03	-0.01	0.00	0.02	0.03	0.05	0.06	0.07	0.08	0.11
	49-60	0.08	0.09	0.08	0.06	0.07	0.07	0.06	0.05	0.03	0.02	0.00	-0.02	0.11
	61-72	-0.03	-0.04	-0.05	-0.06	-0.08	-0.09	-0.10	-0.10	-0.11	-0.11	-0.11	-0.11	0.11

AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^1$



DIFFERENCE	LAGS	PARTIAL AUTOCORRELATIONS												EST. STD ERROR FOR ROs
$(1-B)^0(1-B^{12})^1$	1-12	0.95	-0.06	-0.12	-0.12	-0.08	-0.03	-0.08	-0.04	-0.05	-0.05	0.01	-0.04	0.03

PARTIAL AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^1$

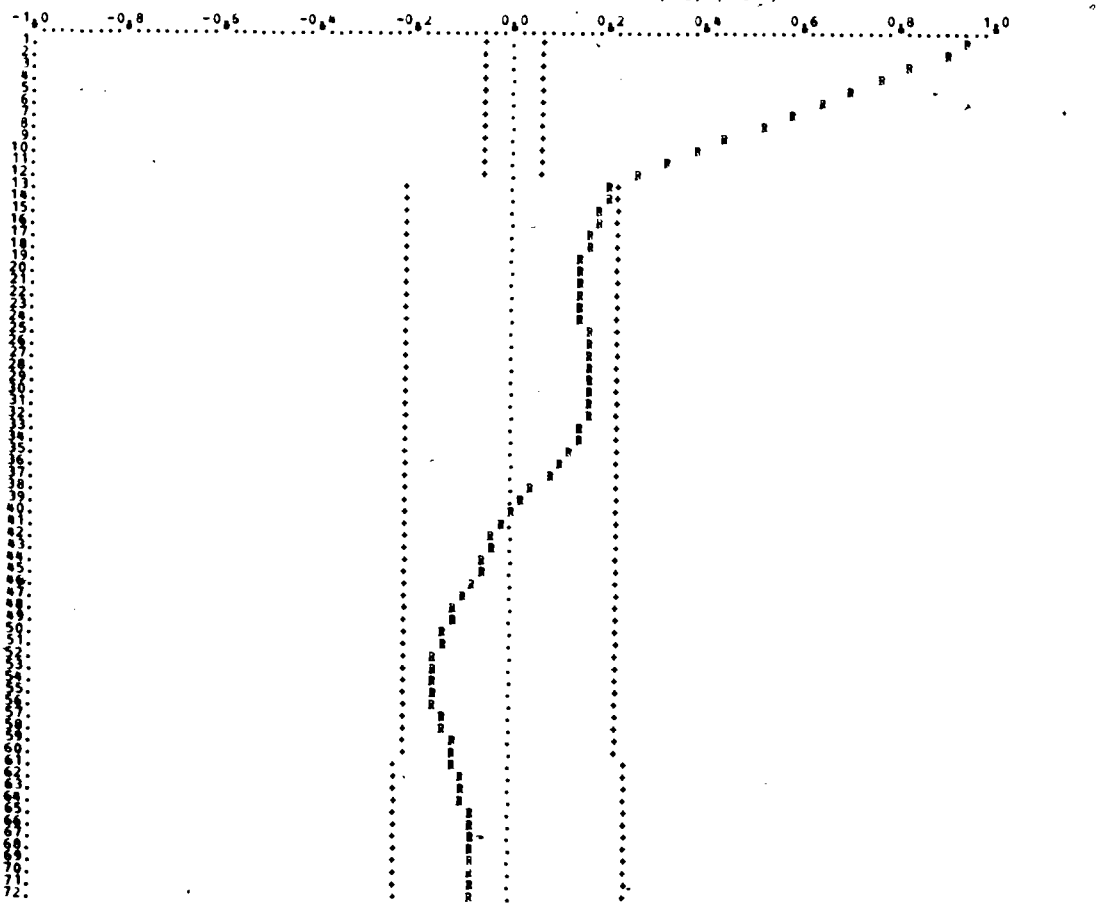


AUTOCORRELATION AND PARTIAL AUTOCORRELATION FUNCTIONS OF THE FORECASTING ERRORS OF THE POUND STERLING, 1960-1977

PREDICTOR : CURRENT SPOT RATE.

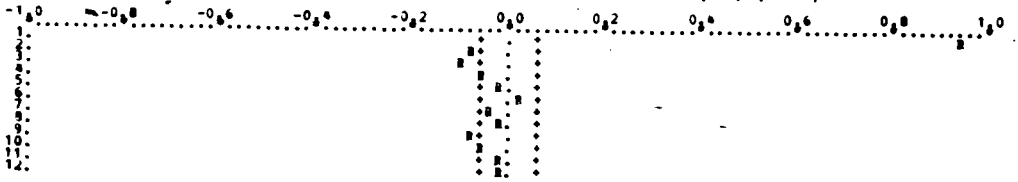
DIFFERENCE $(1-B)^0(1-B^{12})^1$ VAR = 0.3022E-03	LAGS	AUTOCORRELATIONS												EST. STD ERROR FOR ROW
	1-12	0.95	0.88	0.83	0.76	0.69	0.63	0.57	0.51	0.45	0.38	0.32	0.26	0.03
	13-24	0.20	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.13	0.14	0.14	0.11
	25-36	0.15	0.16	0.16	0.17	0.17	0.17	0.16	0.16	0.15	0.14	0.12	0.10	0.11
	37-48	0.07	0.05	0.03	0.01	-0.01	-0.03	-0.04	-0.06	-0.07	-0.08	-0.10	-0.11	0.11
	49-60	-0.13	-0.14	-0.15	-0.16	-0.16	-0.17	-0.16	-0.15	-0.15	-0.14	-0.13	-0.12	0.11
	61-72	-0.11	-0.10	-0.10	-0.09	-0.09	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.07	0.12

AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^1$



DIFFERENCE $(1-B)^0(1-B^{12})^1$	LAGS	PARTIAL AUTOCORRELATIONS												EST. STD ERROR FOR ROW
	1-12	0.95	-0.08	-0.10	-0.06	-0.03	0.02	-0.05	-0.02	-0.08	-0.06	-0.01	-0.03	0.03

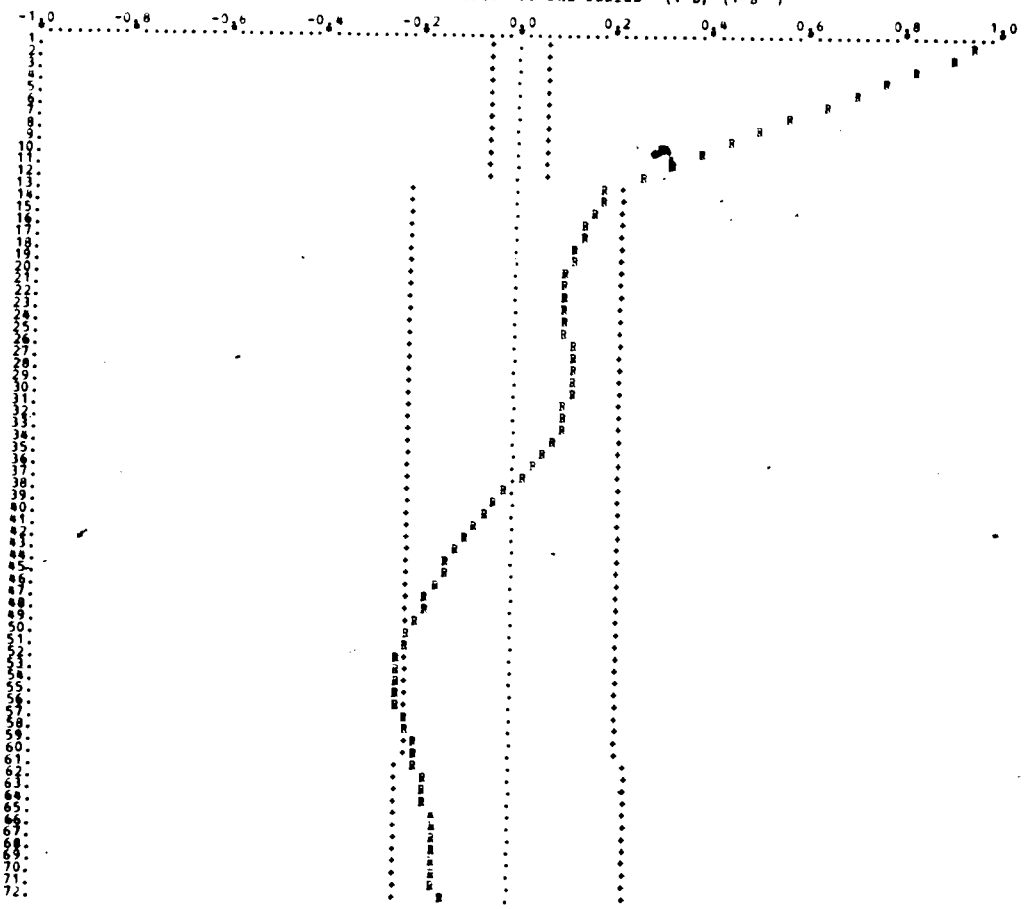
PARTIAL AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^1$



AUTOCORRELATION AND PARTIAL AUTOCORRELATION FUNCTIONS OF THE FORECASTING ERRORS OF THE POUND STERLING, 1960-1977
PREDICTOR : FORWARD EXCHANGE RATE.

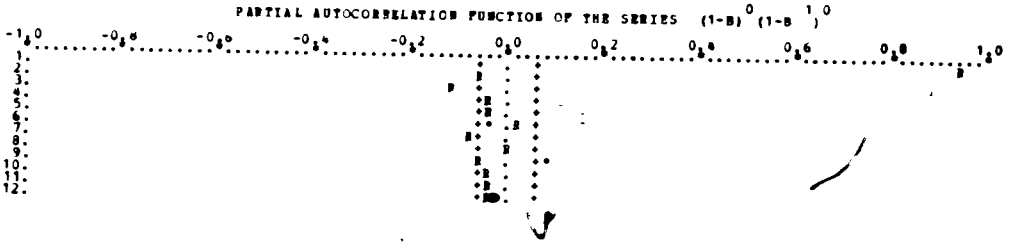
DIFFERENCE $(1-B)^0(1-B^{12})^1$	LAGS	AUTOCORRELATIONS												EST. STD ERROR FOR ROW
VAR = 0.202E-03	1-12	0.95	0.89	0.83	0.76	0.69	0.63	0.57	0.50	0.44	0.38	0.31	0.25	0.03
	13-24	0.19	0.17	0.16	0.15	0.14	0.13	0.11	0.10	0.09	0.09	0.09	0.10	0.11
	25-36	0.11	0.11	0.11	0.12	0.12	0.11	0.11	0.10	0.09	0.08	0.06	0.04	0.11
	37-48	-0.01	-0.02	-0.04	-0.07	-0.09	-0.10	-0.12	-0.13	-0.14	-0.16	-0.17	-0.19	0.11
	49-60	-0.20	-0.21	-0.22	-0.23	-0.24	-0.24	-0.24	-0.23	-0.23	-0.22	-0.21	-0.20	0.11
	61-72	-0.19	-0.19	-0.18	-0.17	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.15	-0.14	0.12

AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^1$



DIFFERENCE $(1-B)^0(1-B^{12})^1$	LAGS	PARTIAL AUTOCORRELATIONS												EST. STD ERROR FOR ROW
	1-12	0.95	-0.07	-0.12	-0.05	-0.04	0.03	-0.08	-0.00	-0.07	-0.05	-0.03	-0.04	0.03

PARTIAL AUTOCORRELATION FUNCTION OF THE SERIES $(1-B)^0(1-B^{12})^1$



APPENDIX VI

CONSTRUCTED SERIES OF EXPECTED EXCHANGE RATES FOR THE POUND STERLING APRIL 22, 1960 - JUNE 23, 1972

This appendix consists of 2 tables. The first table presents the series of expected future spot and forward rates constructed according to the method described in the paragraph C of section 3 of Chapter IV. The second table presents the results of 4 regressions similar to those presented in chapter IV but using our new estimates of the expected future rates.

The first table contains 6 columns. Column (1) lists an identification number. Column (2) lists the dates at which the expectations are formed: The number 6409, for example, designates the Friday of the 9th week of the year 1964. Column (4) lists the constructed series of expected future spot rates: For example, on line 217, column (4) indicates that the spot rate expected on the Friday of the 9th week of 1964 to prevail 13 weeks later was 2.75414 Dollars for a Pound. Column (3) shows the value of the exchange rate which did actually obtain 13 weeks later: 2.7982 Dollars for one Pound. The 2 last

columns give a similar information for the 30 day forward exchange rate: Column (6) shows our estimate of the 30 day forward rate expected to prevail 9 weeks after the date recorded in column (2), at which the expectations were formed, and column (5) shows the rate which actually obtained after 9 weeks.

The second table of this appendix should be compared with the table 3 reported in Chapter IV. If our argument concerning the origin of the autocorrelation observed in the regressions of Chapter IV is correct, the estimated coefficients of the Modern Theory presented in this annex for the period April 22, 1960 - June 23, 1972 should be more accurate than the results reported in table 2 of Chapter IV for the period corresponding to the parity exchange rate regime. In fact, we do observe a smaller standard deviation for all the estimated coefficients based on the new series. However, as the validity of the method used to produce the results reported in this annex presupposes that our explanation of the observed autocorrelation is correct, they do not provide an independent test of our assumption nor of the underlying model. They are valuable as estimates of the equation of the Modern Theory, not as a test.

Table A6-1: Series of Expected Future Exchange Rates of the Pound, April 28, 1960–June 23, 1972

ID. Number	Date (Year, Week)	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
16.0000	6016.00	2.80900	2.79945	2.80130	2.80019
17.0000	6017.00	2.80890	2.80500	2.80310	2.80404
18.0000	6018.00	2.80900	2.81488	2.80390	2.80981
19.0000	6019.00	2.81180	2.82592	2.80330	2.81257
20.0000	6020.00	2.81120	2.80306	2.80320	2.80061
21.0000	6021.00	2.81120	2.81232	2.80430	2.80661
22.0000	6022.00	2.81120	2.81611	2.80500	2.80809
23.0000	6023.00	2.81340	2.84730	2.80730	2.82703
24.0000	6024.00	2.81600	2.85120	2.80630	2.82564
25.0000	6025.00	2.81250	2.84733	2.80500	2.82582
26.0000	6026.00	2.81160	2.85990	2.80520	2.83321
27.0000	6027.00	2.81090	2.86257	2.80720	2.83695
28.0000	6028.00	2.80980	2.85063	2.80990	2.83150
29.0000	6029.00	2.81390	2.83716	2.80780	2.81562
30.0000	6030.00	2.81500	2.81726	2.80740	2.80570
31.0000	6031.00	2.81530	2.84463	2.80630	2.82247
32.0000	6032.00	2.81560	2.86154	2.80450	2.83212
33.0000	6033.00	2.81280	2.85208	2.80900	2.83510
34.0000	6034.00	2.81270	2.83887	2.81020	2.82285
35.0000	6035.00	2.81120	2.82138	2.81070	2.81217
36.0000	6036.00	2.80900	2.81326	2.81080	2.80749
37.0000	6037.00	2.80730	2.81077	2.80910	2.80466
38.0000	6038.00	2.80580	2.80886	2.80970	2.80609
39.0000	6039.00	2.80340	2.81567	2.80780	2.80793
40.0000	6040.00	2.80700	2.85329	2.80620	2.82748
41.0000	6041.00	2.80720	2.83470	2.80460	2.81742
42.0000	6042.00	2.80740	2.82949	2.80330	2.81382
43.0000	6043.00	2.80640	2.85857	2.80150	2.83332
44.0000	6044.00	2.80260	2.85246	2.80450	2.83662
45.0000	6045.00	2.80180	2.83659	2.80490	2.82361
46.0000	6046.00	2.80010	2.81302	2.80540	2.80995
47.0000	6047.00	2.79620	2.81651	2.80440	2.81179
48.0000	6048.00	2.79630	2.83566	2.80090	2.81929
49.0000	6049.00	2.79940	2.84868	2.79970	2.82685
50.0000	6050.00	2.79900	2.86263	2.79750	2.84646
51.0000	6051.00	2.79770	2.83052	2.79340	2.81356
52.0000	6052.00	2.79750	2.83502	2.79350	2.81690

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
53.0000	6101.00	2.79890	2.84205	2.79440	2.82246
54.0000	6102.00	2.79810	2.82933	2.79280	2.81446
55.0000	6103.00	2.79660	2.82749	2.79030	2.81281
56.0000	6104.00	2.79600	2.82598	2.79150	2.81496
57.0000	6105.00	2.79630	2.83582	2.79490	2.82269
58.0000	6106.00	2.79490	2.82655	2.79470	2.81397
59.0000	6107.00	2.79230	2.82960	2.79270	2.81458
60.0000	6108.00	2.79180	2.82379	2.79160	2.80986
61.0000	6109.00	2.79090	2.80918	2.79230	2.80144
62.0000	6110.00	2.79000	2.81408	2.79090	2.80254
63.0000	6111.00	2.78740	2.79321	2.78900	2.79031
64.0000	6112.00	2.78840	2.77026	2.78780	2.77356
65.0000	6113.00	2.78830	2.75351	2.78650	2.76261
66.0000	6114.00	2.78620	2.75126	2.78450	2.76171
67.0000	6115.00	2.78480	2.77547	2.78090	2.77531
68.0000	6116.00	2.78480	2.79392	2.78000	2.78837
69.0000	6117.00	2.79300	2.80198	2.77910	2.84535
70.0000	6118.00	2.80200	2.78275	2.77560	2.77112
71.0000	6119.00	2.80340	2.78137	2.77620	2.77751
72.0000	6120.00	2.80310	2.77742	2.77830	2.77727
73.0000	6121.00	2.80340	2.78279	2.78700	2.78664
74.0000	6122.00	2.80610	2.77494	2.79260	2.77837
75.0000	6123.00	2.81100	2.76445	2.79360	2.76589
76.0000	6124.00	2.81300	2.75290	2.79330	2.75429
77.0000	6125.00	2.81330	2.73637	2.79440	2.74495
78.0000	6126.00	2.81450	2.69233	2.79660	2.72150
79.0000	6127.00	2.81510	2.66343	2.80100	2.70565
80.0000	6128.00	2.81560	2.61948	2.80290	2.67510
81.0000	6129.00	2.81640	2.65755	2.80420	2.69843
82.0000	6130.00	2.81570	2.71763	2.80500	2.73744
83.0000	6131.00	2.81430	2.77529	2.80710	2.77474
84.0000	6132.00	2.81520	2.77404	2.80760	2.77446
85.0000	6133.00	2.81560	2.75163	2.80890	2.76204
86.0000	6134.00	2.81540	2.75024	2.80820	2.75959
87.0000	6135.00	2.80930	2.77244	2.80720	2.77692
88.0000	6136.00	2.81120	2.76831	2.80530	2.77275
89.0000	6137.00	2.81080	2.76500	2.80970	2.77378
90.0000	6138.00	2.80750	2.75833	2.80840	2.76938
91.0000	6139.00	2.80820	2.77720	2.80050	2.77257
92.0000	6140.00	2.80970	2.78376	2.80370	2.78625
93.0000	6141.00	2.81180	2.78384	2.80300	2.78350
94.0000	6142.00	2.81180	2.78341	2.80110	2.78357
95.0000	6143.00	2.81170	2.80599	2.80270	2.80140

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
96.0000	6144.00	2.81300	2.80345	2.80230	2.79747
97.0000	6145.00	2.81460	2.78927	2.80530	2.79151
98.0000	6146.00	2.81560	2.78334	2.80560	2.78627
99.0000	6147.00	2.81530	2.79390	2.80440	2.79265
100.000	6148.00	2.81600	2.78378	2.80700	2.78913
101.000	6149.00	2.81600	2.76104	2.80780	2.77176
102.000	6150.00	2.81690	2.76815	2.80930	2.77725
103.000	6151.00	2.81350	2.75221	2.80930	2.76841
104.000	6152.00	2.81350	2.77178	2.80980	2.77866
105.000	6201.00	2.81360	2.77469	2.81020	2.78072
106.000	6202.00	2.81520	2.75502	2.81070	2.76777
107.000	6203.00	2.81460	2.76696	2.80860	2.77482
108.000	6204.00	2.81230	2.77113	2.80910	2.78104
109.000	6205.00	2.81270	2.76760	2.80960	2.77739
110.000	6206.00	2.81250	2.76884	2.81050	2.77945
111.000	6207.00	2.81280	2.77093	2.81040	2.77981
112.000	6208.00	2.81150	2.76972	2.80970	2.77974
113.000	6209.00	2.80950	2.78036	2.80970	2.78743
114.000	6210.00	2.80820	2.78169	2.81030	2.78879
115.000	6211.00	2.80950	2.76718	2.81090	2.77904
116.000	6212.00	2.80930	2.75305	2.81040	2.77040
117.000	6213.00	2.80860	2.75040	2.80830	2.76711
118.000	6214.00	2.80650	2.75029	2.80640	2.76814
119.000	6215.00	2.80770	2.75852	2.80750	2.77428
120.000	6216.00	2.80780	2.75222	2.80780	2.77072
121.000	6217.00	2.80550	2.75965	2.80680	2.77572
222.000	6218.00	2.80560	2.76569	2.80470	2.77673
123.000	6219.00	2.80500	2.77234	2.80550	2.78421
124.000	6220.00	2.80500	2.78986	2.80580	2.79477
125.000	6221.00	2.80250	2.78372	2.80488	2.79069
126.000	6222.00	2.80210	2.80364	2.80370	2.80342
127.000	6223.00	2.80140	2.79389	2.80330	2.79671
128.000	6224.00	2.80120	2.79618	2.80350	2.79797
129.000	6225.00	2.80120	2.78169	2.80150	2.78701
130.000	6226.00	2.80120	2.79389	2.80070	2.79539
131.000	6227.00	2.80100	2.78519	2.80040	2.79032
132.000	6228.00	2.80250	2.78173	2.80030	2.78667
133.000	6229.00	2.80240	2.77474	2.79980	2.78308
134.000	6230.00	2.80050	2.77893	2.80010	2.78744
135.000	6231.00	2.80130	2.79069	2.79960	2.79216
136.000	6232.00	2.80160	2.78490	2.80060	2.79014

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
137.000	6233.00	2.80170	2.78235	2.80140	2.78845
138.000	6234.00	2.80300	2.78203	2.80010	2.78553
139.000	6235.00	2.80350	2.79066	2.80050	2.79217
140.000	6236.00	2.80380	2.78817	2.80080	2.79048
141.000	6237.00	2.80390	2.79096	2.80060	2.79189
142.000	6238.00	2.80380	2.79436	2.80220	2.79560
143.000	6239.00	2.80210	2.78934	2.80270	2.79272
144.000	6240.00	2.80410	2.79286	2.80260	2.79239
145.000	6241.00	2.80590	2.78988	2.80240	2.79024
146.000	6242.00	2.80550	2.77975	2.80210	2.78530
147.000	6243.00	2.80560	2.79904	2.80020	2.79533
148.000	6244.00	2.80410	2.81694	2.80300	2.81154
149.000	6245.00	2.80340	2.80858	2.80500	2.80582
150.000	6246.00	2.80320	2.80620	2.80450	2.80214
151.000	6247.00	2.80340	2.80209	2.80430	2.79957
152.000	6248.00	2.80280	2.80221	2.80260	2.79911
153.000	6249.00	2.80090	2.79387	2.80200	2.79572
154.000	6250.00	2.80020	2.78828	2.80180	2.79206
155.000	6251.00	2.80000	2.78601	2.80180	2.79061
156.000	6252.00	2.80000	2.77761	2.80130	2.78467
157.000	6301.00	2.80130	2.79240	2.79920	2.79093
158.000	6302.00	2.80090	2.78466	2.79690	2.78721
159.000	6303.00	2.80110	2.78091	2.79670	2.78687
160.000	6304.00	2.80070	2.77649	2.79630	2.78411
161.000	6305.00	2.80000	2.76856	2.79870	2.78205
162.000	6306.00	2.79930	2.75691	2.79820	2.77179
163.000	6307.00	2.79960	2.75951	2.79690	2.77176
164.000	6308.00	2.80000	2.74065	2.79920	2.76293
165.000	6309.00	2.80040	2.75787	2.79870	2.77153
166.000	6310.00	2.80090	2.75620	2.79800	2.76990
167.000	6311.00	2.80010	2.74717	2.79830	2.76525
168.000	6312.00	2.80060	2.72472	2.79880	2.75008
169.000	6313.00	2.80100	2.74445	2.79960	2.76235
170.000	6314.00	2.80160	2.73538	2.79970	2.75594
171.000	6315.00	2.80160	2.74726	2.79880	2.76326
172.000	6316.00	2.80090	2.70062	2.79990	2.73557
173.000	6317.00	2.80040	2.74353	2.80000	2.76235
174.000	6318.00	2.80080	2.76751	2.80070	2.77760
175.000	6319.00	2.80090	2.77510	2.80090	2.78205
176.000	6320.00	2.80020	2.77097	2.80050	2.77922
177.000	6321.00	2.79910	2.76796	2.79990	2.77757
178.000	6322.00	2.79800	2.76410	2.80030	2.77632
179.000	6323.00	2.79800	2.77773	2.80040	2.78438
180.000	6324.00	2.79760	2.77184	2.79980	2.78045
181.000	6325.00	2.79800	2.76818	2.79930	2.77694

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
182.000	6326.00	2.79800	2.78145	2.79780	2.78525
183.000	6327.00	2.79790	2.77917	2.79810	2.78528
184.000	6328.00	2.79790	2.78807	2.79760	2.79027
185.000	6329.00	2.79800	2.78110	2.79790	2.78680
186.000	6330.00	2.79810	2.80057	2.79770	2.79864
187.000	6331.00	2.79810	2.78373	2.79740	2.78764
188.000	6332.00	2.79800	2.78209	2.79740	2.78708
189.000	6333.00	2.79830	2.77296	2.79770	2.78162
190.000	6334.00	2.79810	2.78131	2.79780	2.78691
191.000	6335.00	2.79720	2.78030	2.79780	2.78642
192.000	6336.00	2.79690	2.77740	2.79770	2.78391
193.000	6337.00	2.79700	2.78864	2.79800	2.79118
194.000	6338.00	2.79670	2.78594	2.79000	2.78136
195.000	6339.00	2.79680	2.78468	2.79700	2.79409
196.000	6340.00	2.79760	2.77843	2.79670	2.78357
197.000	6341.00	2.79890	2.76701	2.79690	2.77653
198.000	6342.00	2.79890	2.75860	2.79680	2.77154
199.000	6343.00	2.79810	2.76355	2.79680	2.77518
200.000	6344.00	2.79790	2.77104	2.79730	2.78016
201.000	6345.00	2.79810	2.77080	2.79840	2.78046
202.000	6346.00	2.79750	2.76646	2.79830	2.77731
203.000	6347.00	2.79490	2.76421	2.79760	2.77667
204.000	6348.00	2.79820	2.77742	2.79730	2.78180
205.000	6349.00	2.79800	2.77089	2.79740	2.77956
206.000	6350.00	2.79800	2.77335	2.79680	2.78023
207.000	6351.00	2.79850	2.77301	2.79430	2.77779
208.000	6352.00	2.79840	2.77296	2.79740	2.78321
209.000	6401.00	2.79910	2.77073	2.79700	2.77830
210.000	6402.00	2.79870	2.76504	2.79680	2.77566
211.000	6403.00	2.79890	2.76114	2.79690	2.77348
212.000	6404.00	2.79980	2.76280	2.79680	2.77389
213.000	6405.00	2.80010	2.76095	2.79760	2.77357
214.000	6406.00	2.79980	2.75720	2.79720	2.77037
215.000	6407.00	2.79960	2.75858	2.79750	2.77187
216.000	6408.00	2.79980	2.75615	2.79830	2.77047
217.000	6409.00	2.79820	2.75414	2.79860	2.76921
218.000	6410.00	2.79550	2.76426	2.79820	2.77598
219.000	6411.00	2.79510	2.77384	2.79810	2.78106
220.000	6412.00	2.79430	2.77003	2.79800	2.77892
221.000	6413.00	2.79140	2.76410	2.79600	2.77474

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
222.000	6414.00	2.79150	2.76653	2.79460	2.77494
223.000	6415.00	2.78830	2.76300	2.79450	2.77601
224.000	6416.00	2.78840	2.76817	2.79360	2.77652
225.000	6417.00	2.78860	2.76874	2.79120	2.77524
226.000	6418.00	2.78880	2.76957	2.79100	2.77776
227.000	6419.00	2.78750	2.76826	2.79100	2.77812
228.000	6420.00	2.78750	2.76588	2.78750	2.77239
229.000	6421.00	2.78600	2.77080	2.78710	2.77874
230.000	6422.00	2.78420	2.76944	2.78740	2.77892
231.000	6423.00	2.78400	2.77009	2.78750	2.77791
232.000	6424.00	2.78320	2.78085	2.78630	2.78302
233.000	6425.00	2.78360	2.78381	2.78490	2.78373
234.000	6426.00	2.78330	2.78455	2.78320	2.78384
235.000	6427.00	2.78310	2.79202	2.78300	2.78892
236.000	6428.00	2.78350	2.78745	2.78200	2.78484
237.000	6429.00	2.78280	2.81535	2.78190	2.80323
238.000	6430.00	2.78280	2.79339	2.78190	2.78852
239.000	6431.00	2.78530	2.78526	2.78170	2.78151
240.000	6432.00	2.78310	2.78327	2.78200	2.78351
241.000	6433.00	2.78290	2.79333	2.78060	2.78697
242.000	6434.00	2.78280	2.78364	2.78100	2.78228
243.000	6435.00	2.79180	2.79457	2.78360	2.78531
244.000	6436.00	2.79150	2.78764	2.78110	2.78063
245.000	6437.00	2.79050	2.78676	2.78100	2.78246
246.000	6438.00	2.79020	2.79202	2.78040	2.78480
247.000	6439.00	2.79050	2.77515	2.78130	2.77515
248.000	6440.00	2.79020	2.77626	2.78440	2.77848
249.000	6441.00	2.78990	2.77458	2.78210	2.77252
250.000	6442.00	2.79100	2.77433	2.78240	2.77382
251.000	6443.00	2.79160	2.76354	2.78120	2.76542
252.000	6444.00	2.79280	2.76698	2.78170	2.76869
253.000	6445.00	2.79460	2.77827	2.78230	2.77615
254.000	6446.00	2.79600	2.76909	2.78360	2.77061
255.000	6447.00	2.79650	2.76529	2.78560	2.76949
256.000	6448.00	2.79440	2.75985	2.79620	2.77639
257.000	6449.00	2.79430	2.75500	2.78870	2.75537
258.000	6450.00	2.79170	2.76322	2.78970	2.76936
259.000	6451.00	2.79050	2.74927	2.78900	2.75803
260.000	6452.00	2.79000	2.75181	2.78660	2.75753
261.000	6453.00	2.79080	2.74586	2.78700	2.75541
262.000	6501.00	2.79520	2.75727	2.78430	2.75713
263.000	6502.00	2.79730	2.76275	2.78210	2.76147
264.000	6503.00	2.79820	2.75613	2.77870	2.75644
265.000	6504.00	2.79940	2.76482	2.78110	2.76733
266.000	6505.00	2.79860	2.75076	2.78650	2.76329
267.000	6506.00	2.79800	2.75497	2.79090	2.76663

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
268.000	6507.00	2.79670	2.75503	2.79220	2.76525
269.000	6508.00	2.79290	2.72585	2.79230	2.74751
270.000	6509.00	2.79430	2.72918	2.79290	2.74676
271.000	6510.00	2.79370	2.73164	2.79280	2.74883
272.000	6511.00	2.79160	2.73983	2.79250	2.75423
273.000	6512.00	2.79150	2.73820	2.78650	2.74572
274.000	6513.00	2.79110	2.71702	2.79090	2.74145
275.000	6514.00	2.79060	2.72358	2.79120	2.74276
276.000	6515.00	2.79020	2.72608	2.78820	2.74243
277.000	6516.00	2.79040	2.75486	2.78850	2.76408
278.000	6517.00	2.79200	2.52795	2.78720	2.62408
279.000	6518.00	2.79050	2.75923	2.78730	2.76818
280.000	6519.00	2.79080	2.77994	2.78670	2.77966
281.000	6520.00	2.79060	2.78308	2.78690	2.78253
282.000	6521.00	2.79040	2.79055	2.78800	2.78796
283.000	6522.00	2.79190	2.75261	2.78500	2.75722
284.000	6523.00	2.79440	2.75967	2.78500	2.76519
285.000	6524.00	2.79860	2.76733	2.78480	2.76846
286.000	6525.00	2.79970	2.74473	2.78500	2.75516
287.000	6526.00	2.80300	2.76813	2.78570	2.76916
288.000	6527.00	2.80370	2.74405	2.79010	2.75887
289.000	6528.00	2.80290	2.74813	2.79460	2.76304
290.000	6529.00	2.80300	2.74946	2.79620	2.76103
291.000	6530.00	2.80400	2.74584	2.80060	2.76118
292.000	6531.00	2.80320	2.73753	2.80040	2.75348
293.000	6532.00	2.80350	2.71142	2.80020	2.73568
294.000	6533.00	2.80380	2.70450	2.80030	2.73173
295.000	6534.00	2.80360	2.70027	2.80140	2.73025
296.000	6535.00	2.80230	2.70509	2.80020	2.73189
297.000	6536.00	2.80270	2.69687	2.80040	2.72737
298.000	6537.00	2.80250	2.72998	2.80110	2.75033
299.000	6538.00	2.80160	2.74336	2.80120	2.76012
300.000	6539.00	2.80300	2.75149	2.80040	2.76357
301.000	6540.00	2.80380	2.76771	2.80080	2.77654
302.000	6541.00	2.80460	2.76893	2.80100	2.77735
303.000	6542.00	2.80450	2.77615	2.80010	2.78108
304.000	6543.00	2.80410	2.77746	2.80100	2.78384
305.000	6544.00	2.80360	2.77031	2.80200	2.77999
306.000	6545.00	2.80290	2.77070	2.80290	2.78017
307.000	6546.00	2.80270	2.76975	2.80310	2.77887
308.000	6547.00	2.80090	2.77260	2.80290	2.78152
309.000	6548.00	2.79820	2.77390	2.80210	2.78267

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
310.000	6549.00	2.79660	2.77589	2.80120	2.78296
311.000	6550.00	2.79540	2.77276	2.80090	2.78168
312.000	6551.00	2.79360	2.76826	2.79940	2.77811
313.000	6552.00	2.79410	2.77467	2.79620	2.77882
314.000	6601.00	2.79390	2.76239	2.79460	2.77279
315.000	6602.00	2.79380	2.75971	2.79370	2.77184
316.000	6603.00	2.79300	2.75771	2.79250	2.77091
317.000	6604.00	2.79380	2.76672	2.79230	2.77649
318.000	6605.00	2.79340	2.77544	2.79280	2.78327
319.000	6606.00	2.79250	2.76979	2.79220	2.77895
320.000	6607.00	2.79220	2.76673	2.79170	2.77647
321.000	6608.00	2.79150	2.77326	2.79270	2.78208
322.000	6609.00	2.79050	2.76128	2.79250	2.77329
323.000	6610.00	2.78910	2.75596	2.79160	2.76957
324.000	6611.00	2.79040	2.75606	2.79150	2.76739
325.000	6612.00	2.78970	2.75811	2.79110	2.76912
326.000	6613.00	2.78970	2.77291	2.78960	2.77627
327.000	6614.00	2.78830	2.76727	2.78800	2.77340
328.000	6615.00	2.78720	2.76759	2.78980	2.77672
329.000	6616.00	2.79130	2.76695	2.78860	2.77059
330.000	6617.00	2.79040	2.77123	2.78930	2.77743
331.000	6618.00	2.78940	2.77023	2.78710	2.77438
332.000	6619.00	2.78950	2.77404	2.78380	2.77473
333.000	6620.00	2.78850	2.77505	2.78770	2.78233
334.000	6621.00	2.78830	2.78099	2.78680	2.78153
335.000	6622.00	2.78740	2.78228	2.78550	2.78205
336.000	6623.00	2.78700	2.78673	2.78720	2.78702
337.000	6624.00	2.78950	2.78257	2.78770	2.78117
338.000	6625.00	2.79060	2.79569	2.78700	2.78935
339.000	6626.00	2.79160	2.80651	2.78510	2.79428
340.000	6627.00	2.79180	2.80065	2.78550	2.79314
341.000	6628.00	2.79260	2.78208	2.78830	2.78312
342.000	6629.00	2.79160	2.76710	2.78910	2.77156
343.000	6630.00	2.79100	2.77709	2.79050	2.77971
344.000	6631.00	2.79160	2.77961	2.78980	2.77806
345.000	6632.00	2.79260	2.75599	2.79200	2.76534
346.000	6633.00	2.79130	2.76263	2.79130	2.76861
347.000	6634.00	2.79050	2.79016	2.78960	2.78510
348.000	6635.00	2.79080	2.79563	2.79070	2.79023
349.000	6636.00	2.78970	2.78888	2.79070	2.78562
350.000	6637.00	2.79020	2.79581	2.79010	2.78870
351.000	6638.00	2.78940	2.78444	2.78900	2.78281
352.000	6639.00	2.79040	2.78198	2.79020	2.78269

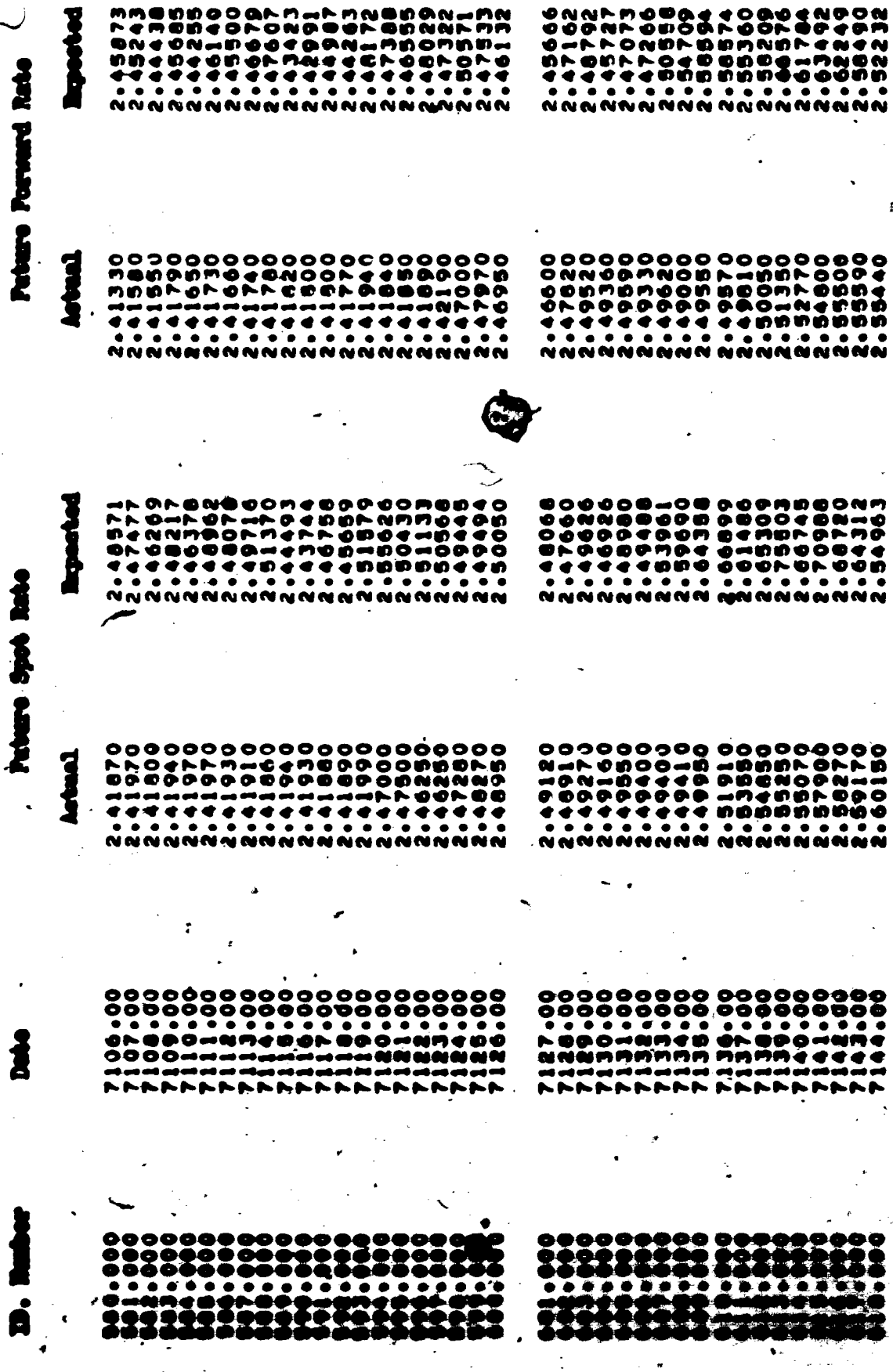
ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
353.000	6640.00	2.79020	2.78701	2.78840	2.78374
354.000	6641.00	2.79090	2.78734	2.78930	2.78609
355.000	6642.00	2.79100	2.78074	2.78780	2.78052
356.000	6643.00	2.79270	2.80919	2.78920	2.79978
357.000	6644.00	2.79540	2.79889	2.78970	2.79154
358.000	6645.00	2.79460	2.79418	2.78930	2.78990
359.000	6646.00	2.79410	2.78320	2.78940	2.78365
360.000	6647.00	2.79260	2.74933	2.79050	2.76270
361.000	6648.00	2.79430	2.81815	2.79340	2.80662
362.000	6649.00	2.79590	2.82385	2.79260	2.80686
363.000	6650.00	2.79650	2.80851	2.79220	2.79751
364.000	6651.00	2.79760	2.77236	2.79120	2.77494
365.000	6652.00	2.79750	2.76912	2.79280	2.77549
366.000	6701.00	2.79860	2.75715	2.79460	2.76808
367.000	6702.00	2.80050	2.82741	2.79540	2.80989
368.000	6703.00	2.79900	2.81311	2.79560	2.80264
369.000	6704.00	2.79900	2.81202	2.79590	2.80132
370.000	6705.00	2.79910	2.80655	2.79670	2.79889
371.000	6706.00	2.79730	2.80058	2.79950	2.79822
372.000	6707.00	2.79560	2.80051	2.79660	2.79473
373.000	6708.00	2.79460	2.80126	2.79640	2.79622
374.000	6709.00	2.79290	2.74485	2.79740	2.76126
375.000	6710.00	2.79250	2.80881	2.79610	2.79975
376.000	6711.00	2.79220	2.84998	2.79440	2.82621
377.000	6712.00	2.78990	2.80536	2.79380	2.79994
378.000	6713.00	2.79020	2.79686	2.79140	2.79140
379.000	6714.00	2.78920	2.79930	2.79180	2.79619
380.000	6715.00	2.78860	2.80989	2.79150	2.80213
381.000	6716.00	2.78620	2.80203	2.78930	2.79714
382.000	6717.00	2.78620	2.80479	2.78990	2.79945
383.000	6718.00	2.78540	2.80658	2.78920	2.79973
384.000	6719.00	2.78470	2.80689	2.78830	2.79997
385.000	6720.00	2.78580	2.81059	2.78500	2.79821
386.000	6721.00	2.78450	2.81845	2.78560	2.80731
387.000	6722.00	2.78520	2.82886	2.78500	2.81126
388.000	6723.00	2.78420	2.82856	2.78370	2.81064
389.000	6724.00	2.78360	2.84509	2.78480	2.82326
390.000	6725.00	2.78320	2.83095	2.78310	2.81172
391.000	6726.00	2.78350	2.84535	2.78310	2.82090
392.000	6727.00	2.78350	2.81566	2.78260	2.80250
393.000	6728.00	2.78260	2.80592	2.78200	2.79696
394.000	6729.00	2.78320	2.80848	2.78210	2.79792
395.000	6730.00	2.78300	2.78028	2.78220	2.77976
396.000	6731.00	2.78300	2.79096	2.78270	2.78673
397.000	6732.00	2.78280	2.79033	2.78140	2.78457
398.000	6733.00	2.78240	2.78692	2.78110	2.78310
399.000	6734.00	2.42040	2.41970	2.70400	2.70318
400.000	6735.00	2.42010	2.70227	2.78050	2.83373

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
401.000	6736.00	2.40730	2.68499	2.77860	2.76551
402.000	6737.00	2.40080	2.69016	2.77300	2.76180
403.000	6738.00	2.40200	2.69471	2.41760	2.40976
404.000	6739.00	2.40680	2.69755	2.41730	2.70388
405.000	6740.00	2.40830	2.71210	2.40060	2.69792
406.000	6741.00	2.40960	2.70719	2.38600	2.69418
407.000	6742.00	2.40950	2.69349	2.39000	2.70220
408.000	6743.00	2.41040	2.69873	2.40090	2.71210
409.000	6744.00	2.41060	2.70535	2.40240	2.70902
410.000	6745.00	2.41040	2.69467	2.40460	2.70318
411.000	6746.00	2.41080	2.70047	2.40330	2.70274
412.000	6747.00	2.40480	2.63938	2.40350	2.66826
413.000	6748.00	2.40070	2.55526	2.40610	2.50930
414.000	6749.00	2.39250	2.53896	2.40450	2.49850
415.000	6750.00	2.39000	2.46165	2.40420	2.44330
416.000	6751.00	2.40200	2.33820	2.39770	2.34696
417.000	6752.00	2.40210	2.34358	2.39290	2.35758
418.000	6801.00	2.40500	2.44344	2.37250	2.40508
419.000	6802.00	2.40290	2.45239	2.35500	2.41352
420.000	6803.00	2.40110	2.45296	2.38950	2.46356
421.000	6804.00	2.39680	2.44067	2.38360	2.42267
422.000	6805.00	2.39480	2.44489	2.39560	2.44129
423.000	6806.00	2.39070	2.47419	2.39450	2.45053
424.000	6807.00	2.38750	2.45463	2.39410	2.43874
425.000	6808.00	2.38440	2.44470	2.38950	2.42856
426.000	6809.00	2.38340	2.43771	2.38800	2.42356
427.000	6810.00	2.38380	2.40527	2.38150	2.39562
428.000	6811.00	2.38620	2.20055	2.37550	2.25989
429.000	6812.00	2.38360	2.00678	2.36690	2.13434
430.000	6813.00	2.38270	2.27950	2.36520	2.31791
431.000	6814.00	2.38280	2.19898	2.37180	2.27359
432.000	6815.00	2.39120	2.30273	2.37940	2.33816
433.000	6816.00	2.39130	2.31031	2.37760	2.33883
434.000	6817.00	2.39410	2.34383	2.37170	2.35393
435.000	6818.00	2.39390	2.29816	2.37350	2.33172
436.000	6819.00	2.39400	2.32557	2.38570	2.35915
437.000	6820.00	2.39280	2.27553	2.38700	2.31796
438.000	6821.00	2.38860	2.22042	2.39160	2.28752
439.000	6822.00	2.38390	2.17948	2.39050	2.25594
440.000	6823.00	2.38320	2.13937	2.39040	2.22848
441.000	6824.00	2.38680	2.20333	2.38880	2.26553
442.000	6825.00	2.38930	2.28882	2.38470	2.31882
443.000	6826.00	2.38960	2.31223	2.37960	2.33196
444.000	6827.00	2.38990	2.25521	2.37860	2.29812
445.000	6828.00	2.38930	2.24533	2.37220	2.28693
446.000	6829.00	2.39020	2.37952	2.38510	2.39285

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
447.000	6830.00	2.39100	2.41814	2.38620	2.40806
448.000	6831.00	2.39000	2.44507	2.38770	2.42791
449.000	6832.00	2.39020	2.45888	2.38760	2.43420
450.000	6833.00	2.38350	2.43745	2.38200	2.41967
451.000	6834.00	2.38050	2.41924	2.38970	2.41962
452.000	6835.00	2.38580	2.42051	2.38880	2.40603
453.000	6836.00	2.38290	2.39472	2.38880	2.39353
454.000	6837.00	2.38400	2.50120	2.37750	2.44830
455.000	6838.00	2.38440	2.40058	2.36950	2.39658
456.000	6839.00	2.38520	2.41995	2.37930	2.41609
457.000	6840.00	2.38440	2.44203	2.37290	2.41660
458.000	6841.00	2.38550	2.45101	2.37400	2.42819
459.000	6842.00	2.38680	2.44661	2.37680	2.42694
460.000	6843.00	2.38910	1.86147	2.37980	2.05086
461.000	6844.00	2.39040	2.46018	2.37990	2.43419
462.000	6845.00	2.39080	2.46714	2.38060	2.43943
463.000	6846.00	2.39380	2.47220	2.38220	2.44207
464.000	6847.00	2.39080	2.39614	2.38420	2.39529
465.000	6848.00	2.39400	2.36375	2.38580	2.36956
466.000	6849.00	2.38930	2.34689	2.38650	2.36447
467.000	6850.00	2.38900	2.26534	2.39070	2.31268
468.000	6851.00	2.39180	2.19889	2.38870	2.26338
469.000	6852.00	2.39400	2.26590	2.38840	2.30836
470.000	6901.00	2.39430	2.29431	2.38080	2.32060
471.000	6902.00	2.39590	2.31919	2.38310	2.34404
472.000	6903.00	2.39620	2.32582	2.38660	2.35082
473.000	6904.00	2.39050	2.33300	2.38870	2.35865
474.000	6905.00	2.38260	2.33814	2.39060	2.36513
475.000	6906.00	2.38300	2.35063	2.39050	2.36751
476.000	6907.00	2.38790	2.35552	2.39110	2.36848
477.000	6908.00	2.38820	2.37381	2.38280	2.37470
478.000	6909.00	2.38960	2.38775	2.36290	2.36907
479.000	6910.00	2.38850	2.34349	2.34700	2.34373
480.000	6911.00	2.39030	2.34728	2.37140	2.37868
481.000	6912.00	2.39000	2.37606	2.37460	2.38100
482.000	6913.00	2.39080	2.40007	2.37960	2.39886
483.000	6914.00	2.38970	2.40058	2.38250	2.39970
484.000	6915.00	2.39190	2.41421	2.38430	2.40619
485.000	6916.00	2.38910	2.39480	2.38520	2.39661
486.000	6917.00	2.39000	2.39566	2.38710	2.39642
487.000	6918.00	2.39100	2.36728	2.38620	2.37370
488.000	6919.00	2.39150	2.18976	2.38900	2.26073
489.000	6920.00	2.38130	2.02735	2.38750	2.15940
490.000	6921.00	2.38240	2.10099	2.38920	2.20527
491.000	6922.00	2.38140	2.15018	2.38960	2.23700
492.000	6923.00	2.38390	2.17770	2.38930	2.25251
493.000	6924.00	2.38550	2.28575	2.38630	2.29968

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
494.000	6925.00	2.38490	2.28701	2.35930	2.31492
495.000	6926.00	2.38260	2.30425	2.36440	2.33765
496.000	6927.00	2.38650	2.36880	2.36600	2.37249
497.000	6928.00	2.38830	2.33231	2.37330	2.35681
498.000	6929.00	2.39160	2.35266	2.37550	2.36540
499.000	6930.00	2.39310	2.36596	2.37360	2.37048
500.000	6931.00	2.39670	2.36881	2.38230	2.38153
501.000	6932.00	2.39710	2.36071	2.35500	2.34363
502.000	6933.00	2.39630	2.34692	2.39020	2.39337
503.000	6934.00	2.39590	2.09055	2.39200	2.19781
504.000	6935.00	2.39690	2.04581	2.39530	2.17030
505.000	6936.00	2.39610	2.04716	2.39640	2.17051
506.000	6937.00	2.39740	2.00120	2.39580	2.13906
507.000	6938.00	2.39770	2.08422	2.39510	2.19323
508.000	6939.00	2.39920	2.17867	2.39760	2.25620
509.000	6940.00	2.40120	2.23225	2.39710	2.28669
510.000	6941.00	2.39870	2.35355	2.39770	2.36954
511.000	6942.00	2.40080	2.36183	2.39830	2.37286
512.000	6943.00	2.40150	2.42206	2.39980	2.41413
513.000	6944.00	2.40270	2.43564	2.40010	2.42189
514.000	6945.00	2.40410	2.44124	2.39970	2.42568
515.000	6946.00	2.40360	2.45379	2.40060	2.43641
516.000	6947.00	2.40550	2.46228	2.40120	2.44008
517.000	6948.00	2.40730	2.45279	2.40220	2.43450
518.000	6949.00	2.40470	2.45394	2.40320	2.43863
519.000	6950.00	2.40590	2.46762	2.40260	2.44370
520.000	6951.00	2.40530	2.44892	2.40570	2.43700
521.000	6952.00	2.40670	2.44268	2.40660	2.43037
522.000	6953.00	2.40650	2.44596	2.40450	2.43090
523.000	7001.00	2.40620	2.42188	2.40570	2.41948
524.000	7002.00	2.40640	2.44413	2.40480	2.43076
525.000	7003.00	2.40640	2.44102	2.40620	2.43146
526.000	7004.00	2.40600	2.42405	2.40600	2.41982
527.000	7005.00	2.40550	2.43301	2.40520	2.42550
528.000	7006.00	2.40470	2.44688	2.40600	2.43583
529.000	7007.00	2.40120	2.45820	2.40650	2.44404
530.000	7008.00	2.40150	2.49354	2.40620	2.46379
531.000	7009.00	2.40060	2.48175	2.40490	2.45650
532.000	7010.00	2.39850	2.47464	2.40530	2.45389
533.000	7011.00	2.39920	2.47941	2.40120	2.45123
534.000	7012.00	2.39650	2.47620	2.40170	2.45485

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
535.000	7013.00	2.39300	2.49495	2.40100	2.46640
536.000	7014.00	2.39170	2.48718	2.39980	2.46022
537.000	7015.00	2.38960	2.47661	2.40020	2.45545
538.000	7016.00	2.38870	2.46845	2.39820	2.44802
539.000	7017.00	2.39090	2.47719	2.39570	2.45096
540.000	7018.00	2.39060	2.44640	2.39190	2.43133
541.000	7019.00	2.38820	2.46548	2.38980	2.44541
542.000	7020.00	2.38700	2.45830	2.38910	2.44133
543.000	7021.00	2.38330	2.44554	2.39150	2.43675
544.000	7022.00	2.38330	2.44371	2.39140	2.43194
545.000	7023.00	2.38500	2.45578	2.38890	2.43581
546.000	7024.00	2.38630	2.47120	2.38700	2.44511
547.000	7025.00	2.38630	2.47867	2.38320	2.44845
548.000	7026.00	2.38640	2.48428	2.38320	2.45397
549.000	7027.00	2.38600	2.49481	2.38000	2.45692
550.000	7028.00	2.38660	2.45942	2.38390	2.44001
551.000	7029.00	2.38890	2.46104	2.38460	2.43637
552.000	7030.00	2.39090	2.46958	2.38560	2.44185
553.000	7031.00	2.39220	2.48221	2.38420	2.44869
554.000	7032.00	2.38930	2.47020	2.38520	2.44579
555.000	7033.00	2.38970	2.46176	2.38770	2.43962
556.000	7034.00	2.39000	2.50315	2.38980	2.46560
557.000	7035.00	2.38890	2.44080	2.39060	2.42426
558.000	7036.00	2.39000	2.43526	2.38750	2.41590
559.000	7037.00	2.39030	2.34139	2.38890	2.36035
560.000	7038.00	2.39320	2.38312	2.38910	2.38445
561.000	7039.00	2.39390	2.45994	2.38890	2.43399
562.000	7040.00	2.39770	2.46386	2.38980	2.43563
563.000	7041.00	2.40520	2.43635	2.39050	2.41533
564.000	7042.00	2.41150	2.45445	2.39250	2.42823
565.000	7043.00	2.41810	2.47304	2.39260	2.43813
566.000	7044.00	2.41540	2.46754	2.39580	2.44365
567.000	7045.00	2.41650	2.48750	2.40150	2.45718
568.000	7046.00	2.41930	2.47471	2.40450	2.44520
569.000	7047.00	2.41640	2.50441	2.40960	2.46975
570.000	7048.00	2.41860	2.50964	2.40860	2.46485
571.000	7049.00	2.41970	2.52674	2.40820	2.47619
572.000	7050.00	2.41940	2.52514	2.40850	2.47678
573.000	7051.00	2.41920	2.53967	2.40880	2.48603
574.000	7052.00	2.41350	2.51988	2.40930	2.47812
575.000	7101.00	2.41720	2.52679	2.41250	2.48018
576.000	7102.00	2.41900	2.52793	2.41190	2.47938
577.000	7103.00	2.41950	2.51890	2.41250	2.47694
578.000	7104.00	2.41950	2.48954	2.40800	2.45469
579.000	7105.00	2.41950	2.46611	2.41280	2.45006


Future Forward Rate
Expected
Actual
Future Spot Rate
Expected
Actual
Date
ID. Number

ID. Number	Date	Future Spot Rate		Future Forward Rate	
		Actual	Expected	Actual	Expected
[illegible]	7145.00	2.60600	2.60300	2.58190	2.58842
[illegible]	7146.00	2.60400	2.61666	2.58430	2.58012
[illegible]	7147.00	2.60580	2.68560	2.59130	2.60789
[illegible]	7148.00	2.60780	2.69694	2.60060	2.63824
[illegible]	7149.00	2.64120	2.78056	2.60500	2.66991
[illegible]	7150.00	2.61100	2.67811	2.60320	2.64122
[illegible]	7151.00	2.60750	2.73475	2.60540	2.67202
[illegible]	7152.00	2.61680	2.70898	2.60650	2.65019
[illegible]	7201.00	2.61000	2.66914	2.64240	2.66988
[illegible]	7202.00	2.60900	2.71343	2.61260	2.63498
[illegible]	7203.00	2.60980	2.75901	2.60950	2.69251
[illegible]	7204.00	2.61160	2.70944	2.61680	2.67118
[illegible]	7205.00	2.61100	2.67587	2.61120	2.64202
[illegible]	7206.00	2.61320	2.67800	2.61080	2.64857
[illegible]	7207.00	2.61400	2.69246	2.61000	2.65865
[illegible]	7208.00	2.61300	2.67691	2.61180	2.65174
[illegible]	7209.00	2.61200	2.67626	2.61070	2.64986
[illegible]	7210.00	2.61160	2.65181	2.61270	2.63771
[illegible]	7211.00	2.59400	2.68672	2.61310	2.67999
[illegible]	7212.00	2.53500	2.60964	2.61200	2.64929
[illegible]	7213.00	2.44600	2.57936	2.61170	2.65525
[illegible]	7214.00	2.44300	2.62466	2.61150	2.64213
[illegible]	7215.00	2.45000	2.65439	2.59160	2.63328
[illegible]	7216.00	2.45100	2.64844	2.51000	2.56726
[illegible]	7217.00	2.45000	2.64687	2.43500	2.55989
[illegible]	7218.00	2.45100	2.64590	2.43650	2.62240
[illegible]	7219.00	2.45250	2.63909	2.44220	2.62183
[illegible]	7220.00	2.45120	2.63047	2.44300	2.61482
[illegible]	7221.00	2.44710	2.60840	2.44350	2.60295
[illegible]	7222.00	2.44880	2.61146	2.44400	2.60129
[illegible]	7223.00	2.44690	2.60942	2.44700	2.60439
[illegible]	7224.00	2.44750	2.63787	2.44800	2.61868
[illegible]	7225.00	2.43500	2.59839	2.44260	2.58936

Table A6-2 : Equation of the "Modern Theory"

estimated on the basis of the constructed series of Table A6-1.

Dependent Variable: 90 day forward exchange rate

		Constant	Parity Rate*	Expected future spot rate	Expected future forward rate	ϱ	DW	Number of observations	R^2	Standard error of the regression
Equation in absolute values	(1)	-0.0682 (-11.64)	0.9661 (50.58)	0.0592 (2.88)	-	0.24	2.05	635	0.9991	0.0056
	(2)	-0.0743 (-19.46)	0.9117 (93.63)	-	0.1158 (11.32)	0.05	1.95	635	0.9991	0.0058
Equation in logarithms	(3)	-0.0260 (-11.65)	0.9703 (44.70)	0.0558 (2.41)	-	0.26	2.07	635	0.9990	0.0023
	(4)	-0.0286 (-20.18)	0.9111 (92.13)	-	0.1177 (11.39)	0.01	1.94	635	0.9989	0.0024

T values in brackets.

* When underlined twice, the estimated coefficient is significantly different from unity at the 1 % level, according to the t test; underlined once, it is significantly different from unity at the 10 % level.

APPENDIX VII

UNDERESTIMATION OF THE DEVIATIONS FROM COVERED INTEREST PARITY IN COMPUTATIONS USING MONTHLY AVERAGES OF WEEKLY DATA

Let X_i and Y_i be respectively the interest rate differential favor of the domestic country and the premium of a unit of foreign currency on the forward foreign exchange market, expressed as a yield per annum,

let i refer to the i^{th} weekly observation of the month under consideration

and let n be the number of weekly observations in that month.

Define the covered arbitrage margin $c_i \equiv X_i - Y_i$.

Define $c \equiv \sum_{i=1}^{n} \frac{X_i}{n} - \sum_{i=1}^{n} \frac{Y_i}{n}$

Thesis : $|c| \leq \sum_{i=1}^{n} \frac{|c_i|}{n}$

Proof : $c_i \equiv X_i - Y_i$

$$\sum_{i=1}^{n} \frac{c_i}{n} = \sum_{i=1}^{n} \frac{X_i - Y_i}{n} + 2 \sum_{i=1}^{n} a_i \frac{X_i - Y_i}{n}$$

where $a_i \equiv 0$ if $X_i \geqslant Y_i$

and $a_i \equiv -1$ if $X_i < Y_i$

Note that by construction :

$$0 \leqslant 2 \sum_{i=1}^{n} a_i \frac{X_i - Y_i}{n} \leqslant 2 \sum_{i=1}^{n} \frac{|c_i|}{n} \qquad (1)$$

$$\sum_{i=1}^{n} \frac{c_i}{n} = c + 2 \sum_{i=1}^{n} a_i \frac{X_i - Y_i}{n} \qquad (2)$$

Rearranging the terms and using inequality (1) yields :

$$c = \sum_{i=1}^{n} \frac{|c_i|}{n} - 2 \sum_{i=1}^{n} a_i \frac{X_i - Y_i}{n} \geqslant - \sum_{i=1}^{n} \frac{|c_i|}{n} \qquad (3)$$

If $c > 0$, (2) implies that $|c| < \frac{\sum_{i=1}^{n} |c_i|}{n}$.

If $c \quad 0$, (3) implies that $|c| \leqslant \frac{\sum_{i=1}^{n} |c_i|}{n}$.

Thus $|c| \leqslant \frac{\sum_{i=1}^{n} c_i}{n}$.

Q.E.D.

APPENDIX VIII

FORMULAS USED FOR THE COMPUTATION OF THE DEVIATIONS FROM TRIANGULAR AND GEOGRAPHIC PARITY

The discrepancies between the quotations of foreign currency i in London and Zurich have been computed as the positive value among these 2 expressions:

$$a = \frac{R(i, LONDON) - R(i, ZURICH) \times R(SF, LONDON)}{R(i, ZURICH) \times R(SF, LONDON)}$$

$$b = \frac{R(i, ZURICH) \times R(SF, LONDON) - R(i, LONDON)}{R(i, LONDON)}$$

where R(i, LONDON) is the value of the currency i quoted in London;

R(i,ZURICH) is the value of the currency i quoted in Zurich;

SF refers to the Swiss Franc.

Exchange rates are the midpoint of the quotations reported on the cross exchange rates table of the Financial Times of London.

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