NBER WORKING PAPER SERIES

THE INTERNATIONAL FINANCIAL MARKET AND U.S. INTEREST RATES

David G. Hartman

Working Paper No. 598

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge MA 02138

December 1980

I wish to thank Martin Feldstein, Jeffrey Sachs and David Lipton for their helpful comments on an earlier draft. This research is part of the National Bureau of Economic Research project in Research on Capital Formation and programs in Financial Markets and Monetary Economics and International Studies; the author is grateful for their support. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper #598
December 1980

The International Financial Market and U.S. Interest Rates

ABSTRACT

This paper examines the linkages between the Eurodollar and U.S. domestic financial markets. Despite the fact that these markets are characterized by rapid arbitrage of interest rate differentials, it is shown that using weekly data allows the isolation of significant fluctuations being transmitted between markets in both directions. That is, financial markets in the U.S. are affected significantly by foreign events and the Eurodollar market is significantly affected by events occurring in the U.S.

Since a moderate amount of arbitrage occurs within a week's time and because there is no way to determine the source of any disturbances which affect both interest rates simultaneously, it is impossible to reach precise conclusions about the causes of historical variation in the rates. However, this paper provides evidence that at most forty percent of the variation in Eurodollar interest rates over the 1975-1978 period can be traced to domestic U.S. sources and that between about one-fifth and two-thirds of the variation in domestic rates can be traced to foreign sources.

David G. Hartman
National Bureau of Economic
Research
1050 Massachusetts Avenue
Cambridge, Massachusetts 02138

(617) 868-3925

and

Department of Economics
Harvard University

The International Financial Market and U.S. Interest Rates.

The extent of international financial market integration is an issue of major importance to governments attempting to pursue independent economic policies. The study of markets for short-term assets is most relevant to the ability of governments to successfully implement monetary and fiscal policies.[1] However, the implications for other government policies, such as those designed to spur real capital formation, may be important as well.

Two lines of inquiry have provided evidence of international financial market linkage. There have been numerous studies of the interest sensitivity of financial flows between nations. From these studies, one can obtain some indication of how closely capital mobility can be expected to link national markets. More direct insights into the extent of world financial market integration have been gained through comparison of yields on similar assets across national markets. The results of both types of study have been summarized as verifying the existence of significant linkages between financial markets, while not indicating levels of asset substitutability across markets which would be required to rule out the possibility of domestic policy having impacts on domestic interest rates.[2]

To apply these results to policy-making in a given country, particularly the United States, further information is required. Specifically, it is essential to determine more about the mechanism which links financial markets. In much of the literature examining both capital flows and the relationships between interest rates on assets in different nations, the U.S. market is assumed to be sufficiently large that effects on the U.S. from outside markets can be ignored. This proposition, if valid, would imply that the U.S. could pursue independent policies regardless of the

true extent of financial market integration. The determination of the precise nature of foreign effects on the U.S. would be a difficult task, involving development of a model of the international financial market with a great deal more structure than those which presently exist.

This paper sets a less ambitious goal than determining the role of the U.S. in the international financial market. What will be done is to test the basic hypothesis behind so much of the existing work in this area: that the causal link between short-term interest rates in the U.S. and abroad runs in one direction only. Rejection of this hypothesis will imply that interest rates in the U.S. cannot be taken, either by policy-makers in the U.S. or by those studying international financial markets, as unaffected by events occurring outside the U.S.

Our examination of this issue is restricted to the relationship between the U.S. market and the Eurodollar market. The Eurodollar market has the clearest link with the U.S. domestic market and also is the most direct vehicle for financial market integration. This methodology isolates only those foreign effects on U.S. interest rates which are transmitted through the Eurodollar market. However, the loss of power which results from testing this simple model is more than offset by the advantages of using Eurodollar interest rates. By examining the direction of impacts between domestic interest rates and the Eurodollar rate, we are able to largely eliminate the usual problem of comparing yields on assets with different risks due to the currencies of denomination and the differing characteristics of the transactors.

The application of a variant of the Sims-Granger methods of testing causality to weekly interest rates forms the basis of the analysis. These tests suggest not only that changes in domestic interest rates have

significant effects on the Eurodollar rate, but also that changes in the Eurodollar rate which originate outside the U.S. have a significant impact on domestic interest rates. That is, the Eurodollar market is not simply a reflection of the U.S. domestic market but is influenced by external factors which also have substantial impacts in the U.S. It is also shown that the international effects on the domestic market have become more significant in the last four years than they were previously.

The significance of these conclusions is somewhat surprising given the impression of most observers that in these particular markets, differences in interest rates are arbitraged within a matter of hours rather than the days or weeks required if a pattern of cause is to be detected. It is shown in this paper that unanticipated week-to-week changes in Eurodollar and domestic rates are only moderately correlated. The correlation is sufficiently strong, however, that it causes difficulties when it comes to estimating what part of the variation in domestic rates may be traced to occurrences abroad.

While our results do not provide a complete answer to such policy questions as the degree to which U.S. financial conditions are controllable through use of monetary policy, they do imply that the potential for external effects on U.S. short-term interest rates should not be ignored. Before presenting this evidence, we will briefly review the literature on capital market integration which motivates the present study.

I. The Evidence on Integration of Financial Markets

The significance attached to the growth of the international financial market is reflected in a large and growing literature. While the literature is important as a basis for the present discussion, this summary will be brief because of the recent publication of several extensive surveys.[3]

The earliest studies verify the interest sensitivity of capital flows into and out of the U.S. Because the emphasis of the work has been placed on explaining capital flows themselves as a component of the balance of payments and because of the time periods commonly used in estimation (at the latest up to the early 1970s), it has been quite natural to assume that U.S. short-term interest rates are not, in turn, affected by the flows of capital.[4] The results generally point to an interest-sensitivity of capital flows, but far from the infinite elasticity which would be exhibited by completely integrated markets.

A second source of information is the relationship among interest rates in different markets. Several studies of interest rate correlations have been performed, concluding generally that financial markets are "simultaneously integrated and segmented," being influenced significantly by regional factors but also by important "world effects" (Aliber (1978)).[5]

The development of the large and competitive external (Euro)markets performing the function of linking national financial markets has allowed recent studies to take a more structural approach. In particular, by studying the relationship between domestic interest rates and Eurodollar rates, one can determine whether there are significant barriers on the U.S. side to transmission of interest rate effects. The advantages of using

Eurodollar rates in the comparison include the absence of exchange risk and also the similarity of the transactors in the two markets. The results of this line of research have been summarized by Min as showing that "the Eurodollar interest rate is largely determined by the U.S. rate for comparable securities."[6] It seems curious that no attention has been paid to possible impacts on domestic interest rates occurring through the offshore market, particularly since effects of foreign interest rates on the Eurodollar rate have been confirmed.[7]

Initially, only the effects of foreign interest rates on the Eurodollar rate were examined; but more recently, Herring and Marston (1977) have developed a simultaneous equations model of the Eurodollar market and the various European domestic financial markets. Their work verifies the significance of the effect of the Eurodollar rate on European domestic financial markets as well. Since U.S. interest rates are included as a factor determining the Eurodollar rate, the impact of U.S. interest rate changes on European interest rates has been verified.

In all of these studies, interest rates in the U.S. are taken as given, i.e., unaffected by events in the rest of the world. While the assumption may have been quite reasonable during the period of study (for example, Herring and Marston use data up to 1971), concern over foreign impacts on U.S. financial markets would now seem appropriate in light of reduced barriers to and observed increases in international financial transactions. It is to the empirical examination of those impacts that we now turn.

II. The Method of Testing for Foreign Effects on U.S. Short-Term Interest Rates

To gain insights into the connection between foreign financial markets and U.S. financial markets, the temporal relationship between U.S. short-term interest rates and the Eurodollar rate for similar assets is examined, using the vector autoregression method of testing for causality discussed, for example, by Sargent (1978).[8] The use of the Eurodollar interest rate is intended to detect the occurrence of events outside the U.S. which affect the Eurodollar rate and are transmitted to the U.S.

As Figure 1 shows, there can be little doubt that monthly values of domestic short-term interest rates and the three-month Eurodollar interest rate move in close harmony. It seems clear that a very powerful arbitrage process must be present in at least one of the markets. The tests to be performed here utilize weekly data to indicate the market(s) in which the necessary adjustment occurs.

The empirical tests to be performed follow from the description of interest rate determination given by equations (1.1) and (1.2).

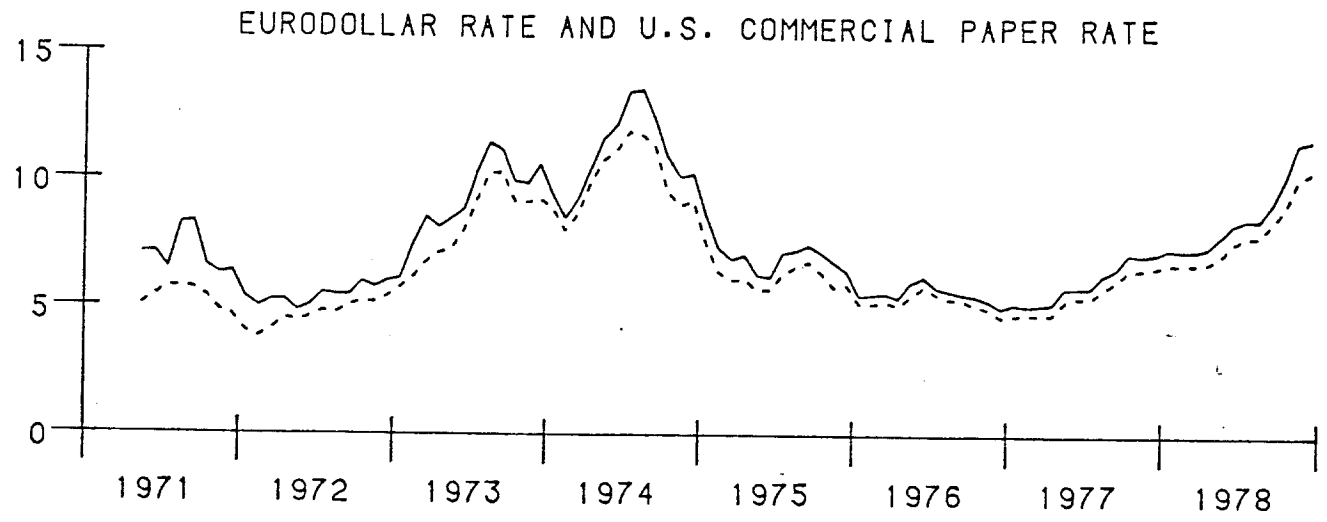
$$r_t = \sum_{i=1}^{m} \alpha_i r_{t-i} + \sum_{j=1}^{n} \beta_j r_{t-j}^{*} + \varepsilon_t \qquad (1.1)$$

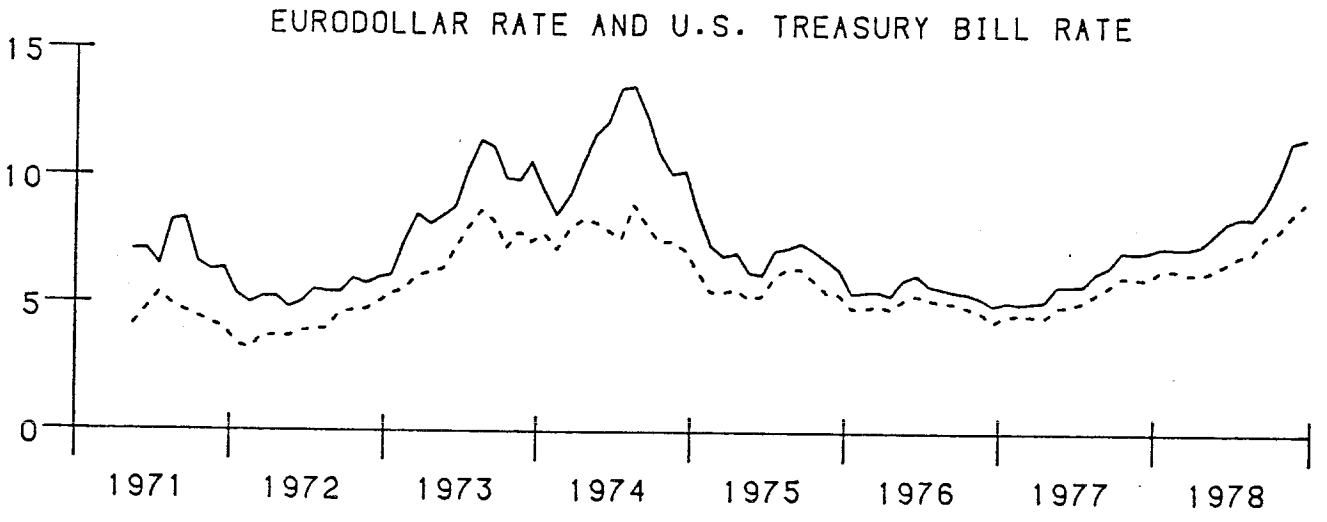
$$r_t^{*} = \sum_{i=1}^{m^*} \alpha_i^{*} r_{t-i} + \sum_{j=1}^{n^*} \beta_j^{*} r_{t-j}^{*} + \varepsilon_t^{*} \qquad (1.2)$$

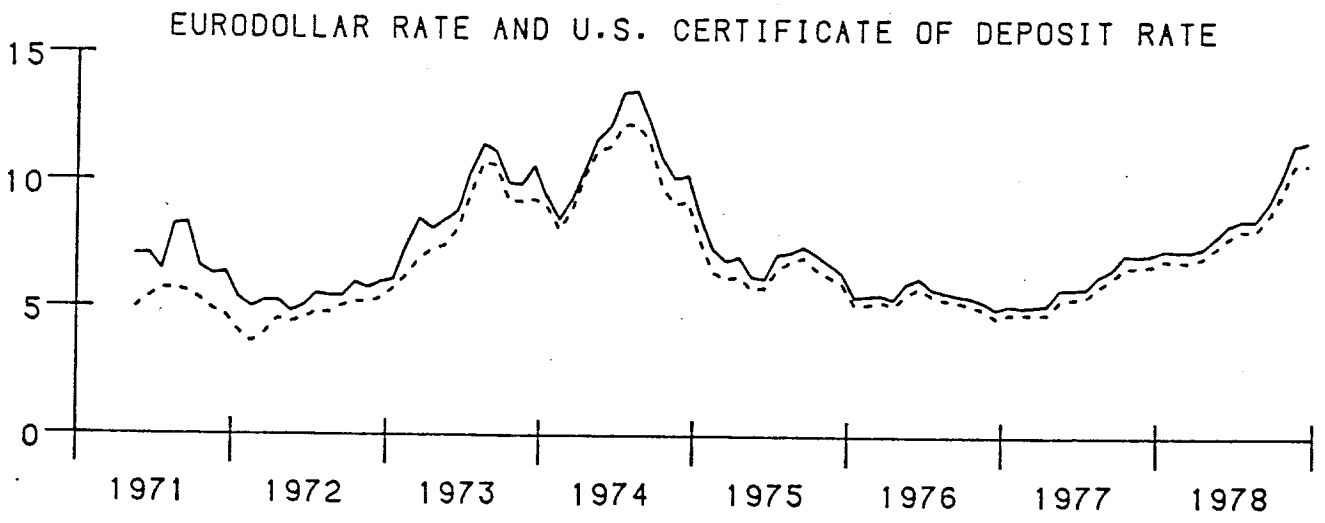
This model describes the domestic interest rate (r_t) as being determined by previous values of the domestic rate, previous values of the foreign (Eurodollar) rate (r_t^{*}), and other factors represented by ε_t. Similarly, the foreign interest rate depends on previous values of both rates and other events affecting the foreign rate, ε_t^{*}.

An influence of previous foreign interest rate changes on the domestic

FIGURE 1


EURODOLLAR RATE AND U.S. COMMERCIAL PAPER RATE
15
10
5
0
1971
1972
1973
1974
1975
1976
1977
1978


EURODOLLAR RATE AND U.S. TREASURY BILL RATE
15
10
5
0
1971
1972
1973
1974
1975
1976
1977
1978


EURODOLLAR RATE AND U.S. CERTIFICATE OF DEPOSIT RATE
15
10
5
0
1971
1972
1973
1974
1975
1976
1977
1978

interest rate would be implied by rejection of the null hypothesis that the β's equal 0. Similarly a rejection of the α^*'s equaling 0 implies a domestic interest rate effect on offshore interest rates.

Given the close connection between prior movements in Eurodollar and domestic rates, this test is a very conservative one. For example, the existence of a foreign influence on the domestic market is most difficult to detect when using the foreign rate variable which is likely to exert its influence most quickly. One could conduct tests utilizing other foreign interest rates, but the controversial issue of how forward exchange premia are determined would become crucial. It is hoped that weekly data on Eurodollar and domestic rates display sufficient independent variation that conclusive tests can be made.

In a similar vein, it is likely that ε_t and ε_t^* will display substantial contemporaneous correlation, as interest rate influences are transmitted to both markets within the period of observation. While this factor makes more difficult the job of assessing the sources of variation in r_t and r_t^*, it does not call into question any significant results we obtain.

What could invalidate our causal interpretation of hypothesis testing based on least squares estimation of (1.1) and (1.2) are instances of non-independence of the right-hand variables and the ε's or ε^*'s. For instance, this study is particularly concerned with the influence of lagged foreign rates on the domestic rate. A serious bias toward rejection of the null hypothesis would occur if domestic disturbances first affected Eurodollar rates and then domestic rates. That is, if ε_t were not independent of the lagged r^*'s, the procedure would falsely interpret domestic influences as having originated abroad. The idea that domestic events

would first affect interest rates outside the country is at odds with usual notions of interest arbitrage in these markets and seems sufficiently implausible that is will be disregarded here. However, care must be exercised in choosing an interest rate for study, since any impediments to adjustment in one market could lead to misleading conclusions.

A choice of major importance in this work is, therefore, the selection of a domestic U.S. interest rate for comparison to the short-term Eurodollar rate. Two domestic money market rates often cited as most representative of financial market conditions are the rate on three-month Treasury bills and the short-term commercial paper rate.[9] Most previous studies of the Eurodollar interest rate have compared it to the U.S. Treasury bill rate. As Dufey and Giddy (1978) point out, the nature of the investors and particularly the borrower in the Treasury bill market are so different from the transactors in the Eurodollar market that such comparisons are highly suspect. For this reason, we follow the lead of Herring and Marston (1977) in relating the Eurodollar deposit rate and the U.S. commercial paper rate.

It is equally important that any non-stationery components of the r_t and r_t^* series not be allowed to influence the estimates. So, a linear trend variable is included in our estimation equations. Also, since our tests could be highly sensitive to the presence of serial correlation in the residuals, our estimations will be performed in both level and first-difference forms.

In summary, then, tests will be performed both for U.S. domestic effects on the Eurodollar rate and for foreign effects on the U.S. commercial paper rate. In both cases, reduction in the power of the test, due to its inability to distinguish the direction of any effects which

occur contemporaneously, is a concern. Specifically, considering the Eurodollar rate rather than the ultimate source of foreign disturbances affecting the domestic market could make significant results more difficult to obtain. This consideration, of course, serves only to strengthen any significant causal links which are discerned. The test could be biased toward rejection of the hypothesis of no foreign effects on domestic interest rates only if disturbances in the U.S. first affect the Eurodollar rate and then domestic interest rate.

III. The Effect of Foreign Events on U.S. Short-Term Interest Rates

The test of U.S. financial market effects on the Eurodollar interest rate will be discussed first. When the three-month Eurodollar rate (REURO) is regressed on its own values lagged up to four weeks and four lagged values of the weekly 90 to 119-day commercial paper rate (RCP) over the 1971 to 1978 period, the result shown as the first column of Table 1 is obtained.[10] In particular, a highly significant role is established for the lagged values of RCP. Thus, the result confirms the findings of previous researchers that changes in short-term interest rates in the U.S. have a highly significant effect on the Eurodollar rate.

Of greater importance here is the test for foreign effects on the U.S. money market, reported as the second column of Table 1. The test confirms a significant effect ($F_{4,389} = 5.09$) of the Eurodollar rate on the domestic commercial paper rate. Therefore, we reject, with a high degree of confidence, the hypothesis which forms the basis for much recent empirical investigation of the international financial market--that U.S. interest rates are unaffected by events occurring abroad. This result is all the more convincing, since the time period producing the first set of results in Table 1 includes much of the first half of the 1970s, during which the markets were apparently not so closely tied.

There are several reasons to believe that the relationship between Eurodollar and domestic interest rates may have become more significant in recent years. The U.S. government imposed restrictions on capital outflows which did not end until early 1974. These restrictions, which were specifically designed to isolate the U.S. capital market, should have reduced the significance of foreign effects. Also of potential importance is the size of the Eurodollar market, which has increased rapidly since 1971.

TABLE 1

VECTOR AUTOREGRESSION RESULTS

Interval	(1971:19 - 1978)		(1971:19 - 1974)		(1975 - 1978)	
Dependent Variable	REURO	RCP	REURO	RCP	REURO	RCP
Coefficients						
RCP(-1)	.389 (.113)	1.379 (.058)	.147 (.173)	1.320 (.084)	.933 (.149)	1.237 (.085)
RCP(-2)	.080 (.184)	-.271 (.094)	.482 (.281)	-.151 (.137)	-.592 (.215)	-.432 (.123)
RCP(-3)	-.384 (.181)	-.166 (.093)	-.506 (.282)	-.226 (.138)	-.161 (.211)	-.034 (.120)
RCP(-4)	.112 (.107)	.052 (.055)	.157 (.171)	.021 (.083)	.095 (.130)	.021 (.074)
REURO(-1)	1.027 (.058)	.128 (.030)	1.040 (.083)	.103 (.041)	.863 (.084)	.272 (.048)
REURO(-2)	-.239 (.078)	-.121 (.040)	-.270 (.115)	-.104 (.056)	-.254 (.104)	-.129 (.059)
REURO(-3)	.134 (.079)	.014 (.040)	.164 (.114)	.035 (.056)	.082 (.105)	-.024 (.060)
REURO(-4)	-.109 (.059)	-.022 (.030)	-.188 (.084)	-.025 (.041)	.069 (.089)	.042 (.050)
TIME	-.0003 (.0001)	4.33×10^{-5} (7.65×10^{-5})	-.0017 (.0011)	.0011 (.0006)	.0004 (.0003)	.0009 (.0002)
R^2	.984	.995	.982	.996	.984	.993
S.E.	.279	.143	.338	.165	.196	.111
F Tests	Test for significance of lagged RCPs: $F_{4,389} = 12.83$	Test for significance of lagged REUROs: $F_{4,389} = 5.09$	Test for significance of lagged RCPs: $F_{4,180} = 6.84$	Test for significance of lagged RCPs: $F_{4,180} = 1.74$	Test for significance of lagged RCPs: $F_{4,199} = 11.30$	Test for significance of lagged REUROs: $F_{4,199} = 8.59$
Critical Value for these F tests (.01 significance level) = 3.48						

Standard errors are shown in parentheses. Data on the 3-month Eurodollar rate (REURO) and the U.S. 90-119 day commercial paper rate (RCP) are from The Treasury Bulletin, various issues.

When the entire period is divided into two intervals of approximately four years each, we find that the causal impacts across markets are more significant during 1975-1978 than previously. The insignificance of the external effects on the domestic market in the earlier period could, of course, be attributed to the magnitude and nature of the Eurodollar rate fluctuations rather than any difference in market structure from the later period. So, a test was also performed to determine if the set of REURO coefficients in the RCP equation changed between the two periods. A significant change was, in fact, verified, with the $F_{4,385}$ value equaling 3.70.

Detailed examination of the effects of changes ("innovations") in the Eurodollar rate on the domestic interest rate is quite difficult using the coefficient estimates shown in Table 1, since it is the dynamic interaction of both interest rates that is of concern. To illustrate the nature of this interdependence through time, Figure 2 displays a moving average representation of the results; that is, the graph shows the dynamic responses of both interest rates to a .1 percentage point innovation in REURO.[11]

A .1 percentage point rise in the Eurodollar rate is followed immediately by both a substantial rise in the domestic interest rate and a significant dissipation of the initial impact on the Eurodollar rate, as arbitrage takes place. The maximum effect on the domestic interest rate is sixty percent the size of the initial disturbance abroad and occurs within seven weeks. By that time, over eighty-five percent of the initial divergence between interest rates has been arbitraged by the increase in the domestic rate and a decline in twenty-five percent from the original change in the Eurodollar rate.

Figure 3, similarly, shows the adjustments to a .1 percentage point

FIGURE 2
EFFECT OF A .1 PERCENTAGE POINT INNOVATION
IN THE EURODOLLAR RATE

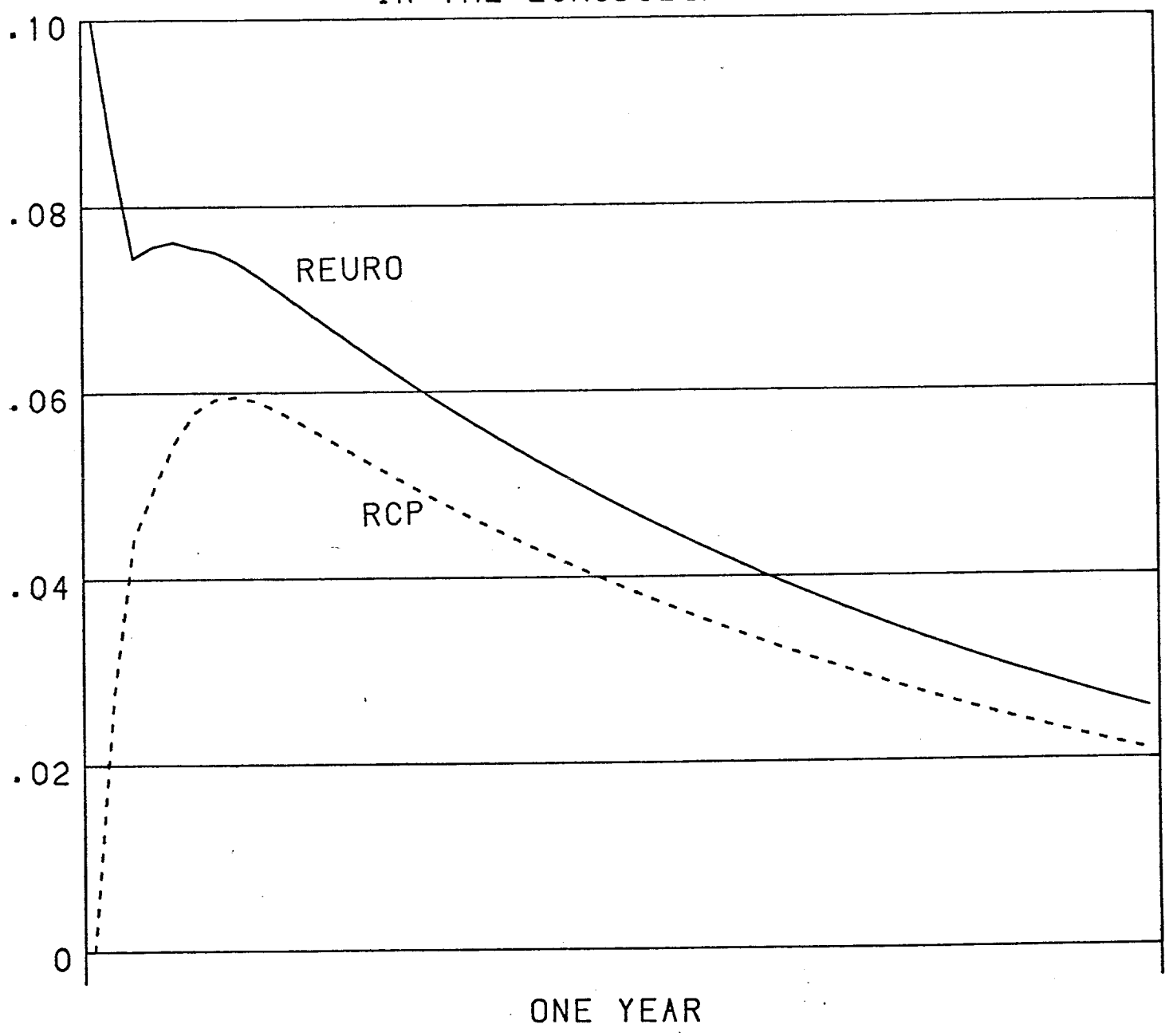
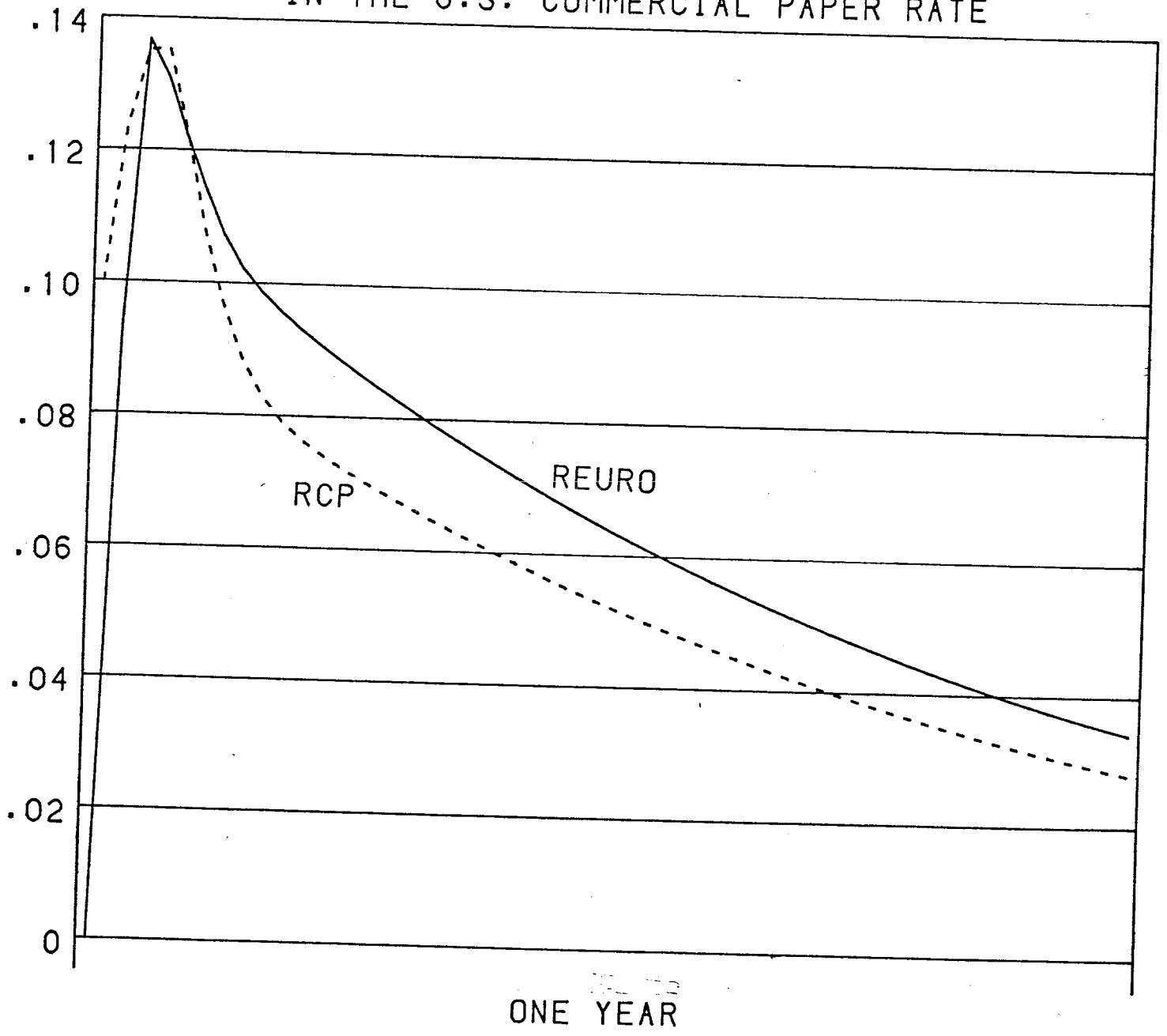


FIGURE 3
EFFECT OF A .1 PERCENTAGE POINT INNOVATION
IN THE U.S. COMMERCIAL PAPER RATE



innovation in the U.S. domestic interest rate, RCP. The response of the Eurodollar rate is both substantial and rapid. Both REURO and RCP have risen by nearly .14 percentage points at the end of two weeks.

The moving average representations of the interest rate adjustment process can also be used to separate the sources of unexpected variation in REURO and RCP during the 1975-78 period. If the innovations in REURO and RCP (ε_t and ε_t^* in equations (1.1) and (1.2)) were independent, the separation would be straightforward. However, to the extent that there are non-independent disturbances in the two interest rate equations, an ambiguity arises. That is, when interest arbitrage occurs too quickly, there is no way to detect which market generated a disturbance.

As Sargent (1978) suggests, one way to deal with this ambiguity is to study extreme cases. First, the sources of unexpected variation in REURO and RCP are calculated, assuming that all disturbances common to the two markets actually originated in the domestic market, being reflected in both REURO and RCP within one period. This procedure, which gives the results shown in the first two columns of Tables 2 and 3, generates a variance decomposition, which attributes the greatest possible percentage to disturbances in the domestic rate.[12] Of course, the unexpected variation of each interest rate depends on the number of weeks ahead for which the forecast is being made; and the decompositions differ as shown. However, the steady-state patterns of influences on interest rates are approximated by those of forecasts only a few weeks in the future.

Attributing all of the correlated portion of the disturbances to the Eurodollar market, instead, produces the decompositions shown in the last two columns of Tables 2 and 3.

TABLE 2

SOURCES OF UNANTICIPATED VARIANCE IN EURODOLLAR RATE

Number of Weeks Ahead for which Forecast is Made	Percentage of Variance in Eurodollar Rate Forecast Error Attributable to Disturbances in Two Rates			
	Maximum Attribution to Commercial Paper Rate		Maximum Attribution to Eurodollar Rate	
	Commercial Paper Rate	Eurodollar Rate	Commercial Paper Rate	Eurodollar Rate
1	28.47 %	71.53 %	0 %	100.00 %
2	41.69	58.31	11.56	88.44
3	43.50	56.50	15.19	84.81
4	43.39	56.61	15.03	84.97
5	42.86	57.14	15.08	84.92
6	42.52	57.48	14.77	85.23
7	42.25	57.75	14.40	85.60.
8	42.01	57.99	14.23	85.77
9	41.87	58.13	14.15	85.85
10	41.64	58.34	14.07	85.93
15	41.22	58.78	14.10	85.90

TABLE 3

SOURCES OF UNANTICIPATED VARIANCE IN THE COMMERCIAL PAPER RATE

Number of Weeks Ahead for Which Forecast is Made	Percentage of Variance in Commercial Paper Rate Forecast Error Attributable to Disturbances in Two Rates			
	Maximum Attribution to Commercial Paper Rate		Maximum Attribution to Eurodollar Rate	
	Commercial Paper Rate	Eurodollar Rate	Commercial Paper Rate	Eurodollar Rate
1	100.00 %	0 %	59.16 %	40.84 %
2	87.88	12.12	42.78	57.22
3	84.34	15.66	39.60	60.40
4	83.88	16.12	39.26	60.74
5	83.35	16.65	38.40	61.60
6	82.93	17.07	37.93	62.07
7	82.61	17.39	37.23	62.77
8	82.45	17.55	36.39	63.61
9	82.24	17.76	36.11	63.89
10	82.06	17.94	35.84	64.16
15	81.68	18.32	35.90	64.10

Since the correlation between residuals from the REURO and RCP equations equals .577, the two methods of allocating these disturbances between the two markets will produce significantly different conclusions. From the comparison given in Table 2, for example, we can conclude only that somewhere between about 14 percent and 42 percent of the variation in the Eurodollar rate can eventually be traced to domestic sources. Similarly any portion from about 18 to about 64 percent of the variation in the commercial paper rate can be attributed to foreign sources, as shown by the figures in Table 3.

So, although the regression results verify significant links in both directions between Eurodollar and domestic interest rates, the evidence on the ultimate sources of variation in these rates over time is not very precise. From even these results, however, we can draw some important conclusions. First, the analysis indicates that at most about forty percent and possibly a good deal more of the variation in Eurodollar interest rates can be traced to events in the U.S. financial market. Since previous studies verified the influence of foreign interest rates as well as U.S. interest rates on the Eurodollar rate, it is only the magnitude of our conclusion which was unanticipated. Similarly, the possibility of some foreign influence on U.S. financial markets is well recognized. But the finding that at least about one-fifth, and perhaps as much as two-thirds, of the variance in an important domestic interest rate is attributable to foreign events is surprising.

IV. Additional Verification

To further verify these results, several additional experiments have been performed.[13] First, since the choice of a maximum four-week lag is quite arbitrary, other lag specifications were tested. The addition of either four or eight extra lags, while having no negative effect on the basic conclusions, provided no additional information to warrant their inclusion. Experiments with monthly data also confirmed that the results reported here include sufficient lags to capture the essential features of the process.

Secondly, the analysis was performed using the three-month U.S. Treasury bill rate as an alternative indicator of domestic money market conditions. While somewhat suspect as a basis for comparison with the Eurodollar rate, as discussed above, the Treasury bill rate is often used as a sensitive barometer of the domestic money market. Also, since the Treasury bill rate has been so commonly used in previous studies of the international financial market, use of that interest rate provides evidence more directly comparable with the existing literature. As Table 4 shows, the results of the causality tests are very similar to those previously obtained using RCP. Significant effects of changes in the Eurodollar rate on the U.S. Treasury bill rate are verified. So, our results suggest that previous international studies which have taken the Treasury bill rate as given have neglected a significant reverse chain of causality running from events abroad to U.S. money market conditions.

The similarity of conclusions using different domestic interest rates is quite reassuring since observation errors in the domestic rate could cause a bias toward the finding that foreign events influence the domestic

TABLE 4

RESULTS USING U.S. TREASURY BILL RATE

	1971-1978	1971-1974	1975-1978
F test for significance of lagged RTB on REURO	$F_{4,407}$ = 11.363	$F_{4,198}$ = 3.961	$F_{4,199}$ = 15.913
F test for significance of lagged REURO on RTB	$F_{4,407}$ = 3.482	$F_{4,198}$ = .880	$F_{4,199}$ = 6.096

Critical value for these F tests (.01 significance level) = 3.48

Data are from The Treasury Bulletin, various issues.

rate.[14] Verification of the test results using a different domestic rate reinforces the previous conclusions, unless various domestic rates are subject to similar measurement errors.

Finally, as mentioned above, our significance tests have been based on the assumption that the errors in the basic equations are not serially correlated. Rather than test for serial correlation in the presence of lagged dependent variables, the equations were reestimated in first difference form. The results of this estimation are summarized in Table 5. Since the conclusions are in no crucial way different from those reported in Table 1, we can, with a fair degree of confidence, rule out serial correlation bias in F statistics as the cause of our significant test results.

TABLE 5

RESULTS USING FIRST DIFFERENCES

	(1971:20-1978)	(1971:20-1974)	(1975-1978)
F test for significance of lagged ΔRCP on ΔREURO	$F_{4,388} = 7.166$	$F_{4,179} = 4.103$	$F_{4,199} = 10.185$
F test for significance of lagged ΔREURO on ΔRCP	$F_{4,388} = 5.045$	$F_{4,179} = 1.809$	$F_{4,199} = 7.645$

Critical value for these F tests (.01 significance level) = 3.48

Data are from The Treasury Bulletin, various issues.

V. Summary and Conclusions

In summary, the results presented here point to the Eurodollar market and the domestic U.S. money market being closely linked and characterized by rapid adjustments to exogenous events affecting either financial market. Despite the speed of these adjustments, we have been able, by using weekly data, to isolate significant effects being transmitted between markets in both directions. That is, financial markets in the U.S. are affected to a significant degree by events occurring outside the country, and the Eurodollar market is significantly affected by events occurring in the U.S. It is clear that this impact of external factors on the U.S. market is a relatively recent phenomenon. No significant effect can be discerned in the period 1971-1974, while the impact is highly significant in the 1975-1978 period. Also, further tests detect an important change in the structure of these markets between the two periods.

The fact that a moderate amount of arbitrage occurs within a week's time means that we cannot reach precise conclusions about the causes of historical variation in domestic and Eurodollar interest rates. However, we can conclude that at most about forty percent of the variation in Eurodollar rates over the 1975-1978 period can be traced to domestic sources and that between about one-fifth and two-thirds of the variation in domestic interest rates can be traced to foreign sources.

These results are intended only to demonstrate the importance of external impacts on the U.S. financial market. Since we have considered only the causal links which characterize the markets for domestic and offshore dollar-denominated assets, further analysis is required before specific policy conclusions can be drawn. However, a clear implication

is that the U.S. financial market is not so insulated as is ordinarily assumed. It also seems clear that the structural models of international financial markets, which assume that the U.S. is unaffected by external events, could give very misleading results if used to study recent experience.

Footnotes

[1]For an extensive analysis of these issues, see Dornbusch (1980).

[2]See Aliber (1978).

[3]The literature of international financial market integration is reviewed in Aliber (1978). Lee (1977) summarizes the major work on capital flows. Min (in Appendix 1 of Dufey and Giddy (1978)), examines recent empirical research on the Eurodollar market, which will be of particular interest here.

[4]Models of interest-sensitive capital flows can be found in Branson (1968), Branson and Hill (1971), and Kwack and Schink (1975). More recently, Kenen (1978) has developed a model of the balance of payments which is integrated with a domestic U.S. model through the trade sector. Again, U.S. interest rates are assumed to be free of direct influence from abroad.

[5]Logue, Salant, and Sweeney (1976), for example, examine government bond yields in the U.S., France, West Germany, the Netherlands, Sweden, Switzerland, and the United Kingdom, finding a highly significant "common factor."

[6]Dufey and Giddy (1978), Appendix 1.

[7]Confirmation that Eurodollar rates are affected by European interest rates has been provided by Kwack (1971), Mills (1973), Argy and Hodjera (1973), and Min (1976).

[8]The procedure to be used here is a variation of the Granger (1969) "causality" test. The results and their interpretation are subject to the usual qualifications, as will be discussed below. An analysis of the limitations of these tests is given by Zellner (1979).

[9]The most obvious domestic interest rate to relate to the Eurodollar deposit rate would be the domestic rate paid on three-month certificates of deposit (CDs). Unfortunately, Regulation Q interest rate ceilings imposed in the U.S. in the early part of the period under study could cause difficulties of comparability. On the borrowing side, the natural domestic rate to use, the prime lending rate, is an inadequate reflection of the cost of borrowing because of other requirements placed on borrowers, particularly in tight periods. (These arguments are advanced by Dufey and Giddy (1978)). Since the Eurodollar market is largely free of such distortions, the commercial paper or Treasury bill rate would seem to provide for better comparability and be less likely to result in the bias discussed above.

[10]The beginning of the period corresponds to the first observation available for RCP.

[11]For purposes of illustrating the process implied by our model estimates, these figures are drawn for disturbances unique to either REURO or RCP. In fact, the residuals in the two equations of our model are not independent. That is, some component of disturbances to REURO are observed to affect RCP also. So, the response to actual disturbances will be a combination of the responses to innovations in REURO and also RCP.

[12]The technique of decomposition is discussed in Sargent (1978).

[13]The sensitivity to specification error of tests such as the ones carried out here is discussed by Jacobs, Leamer and Ward (1979).

[14]See Jacobs, et. al. (1979).

References

Aliber, Robert Z., "The integration of National Financial Markets: A Review of Theory and Findings," Weltwirtschaftliches Archiv, Band 114, Heft 3, 1978, pp. 448-479.

Argy, Victor and Zoran Hodjera, "Financial Integration and Interest Rate Linkages in Industrial Countries, 1958-71," IMF Staff Papers, Vol. 20, 1973, pp. 1-77.

Branson, W.H., Financial Capital Flows in the U.S. Balance of Payments, Contributions to Economic Analysis, 50, North-Holland, Amsterdam, 1968.

_____ and Raymond D. Hill, Jr., Capital Movements in the OECD Area, An Econometric Analysis, OECD Economic Outlook, Occasional Studies, OECD Publications, Paris, 1971.

Dornbusch, Rudiger, Open Economy Macroeconomics, Basic Books, New York, 1980.

Dufey, Gunter and Jan H. Giddy, The International Money Market, Prentice-Hall, Englewood Cliffs, N.J., 1978.

Granger, C.W.J., "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," Econometrica, Vol. 27, No. 3, July 1968, pp. 424-438.

Herring, Richard J. and Richard C. Marston, National Monetary Policies and International Financial Markets, Contributions to Economic Analysis, 104, North-Holland, Amsterdam, 1977.

Jacobs, Rodney L., Edward E. Leamer, and Michael P. Ward, "Difficulties With Testing for Causation," Economic Inquiry, Vol. 17, July, 1979, pp. 401-413.

Kenen, Peter B., A Model of the U.S. Balance of Payments, Lexington Books, Lexington, Massachusetts, 1978.

Kwack, Sung, "The Structure of International Interest Rates: An Extension of Hendershott's Tests," Journal of Finance, September, 1971, pp. 897-900.

_____ and George R. Schink, "A Disaggregated Quarterly Model of United State Trade and Capital Flows, Simulations and Tests of Policy Effectiveness," in: The Brookings Model, Perspective and Recent Developments, Ed. by G. Fromm and L. Klein, Amsterdam, 1975.

Lee, Chung, H., "A Survey of the Literature on the Determinants of Foreign Portfolio Investments in the United States," Weltwirtschaftliches Archiv, Band 113, Heft 3, 1977, pp. 552-569.

Logue, Dennis E., Michael A. Salant, and Richard J. Sweeney, "International Integration of Financial Markets: Survey, Synthesis, and Results," in: Carl C. Stern, John H. Makin, and Dennis E. Logue (Eds.) Eurocurrencies and the International Monetary System, American Enterprise Institute, Washington D.C., 1976, pp. 91-137.

Mills, Rodney H., "Structural Change in the Eurodollar Market: Evidence from a Two-Equation Model," Board of Governors of the Federal Reserve System Discussion Paper No. 33, November 1, 1973.

Min, Sangkee, Determinants of Interest Differential Between the U.S. and Eurodollar Credit Markets--An Empirical Investigation, Ph.D. Dissertation, The University of Michigan, 1976.

Sargent, Thomas, J., "Estimation of Dynamic Labor Demand Schedules Under Rational Expectations," Journal of Political Economy, Volume 86, Number 6, December 1, 1978, pp. 1009-1044.

Zellner, A., "Causality and Econometrics," in Three Aspects of Policy and Policymaking: Knowledge, Data and Institutions, K. Brunner and A.H. Meltzer eds., Carnegie-Rochester Conference Series, Vol. 10, North-Holland, Amsterdam, 1979, pp. 9-54.