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PROBLEMS IN THE THEORY AND EMPIRICAL ESTIMATION OF INTERNATIONAL CAPITAL MOVEMENTS

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THE goal of our paper is to elucidate some of the important problems currently at issue in the theoretical conceptions and empirical estimations of international capital movements. Following our introductory remarks, we discuss the theoretical orientation of models of capital movements, contrasting what we call activity models and transactor models. We then indicate some of the important considerations that affect the choice of explanatory variables for particular capital items. After that there is a discussion of problems arising in the empirical estimation of capital movements plus whatever implications may be drawn for formulating economic policy.

We should like to emphasize at the outset that our paper does not by any means offer the last word on many of the problems touched upon and that we offer no new empirical evidence. While many of our remarks may appear critical, they should not be interpreted as denigrating the work that has been done to date. Rather, we hope that our discussion will stimulate a search for continued improvement in the theoretical design and empirical implementation of models of capital movements.

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INTRODUCTION

THE study of capital-account relationships involves many more difficulties than does a study of the current account.[1] Most of these difficulties arise from the fact that capital movement is a monetary, not a real, phenomenon. For example, the relative stability of tastes will assure the relative stability of the import and export demand for goods and services as a function of price. Certain capital movements, in contrast, will be influenced significantly by changes in expectations regarding rates of return, thereby suspending the usual dependence on observed returns. It is also true that nonprice allocative variables such as credit rationing and capital controls will have a much more important impact on capital movements than is the case for the current account.

Analysis of capital movements is further complicated by certain special characteristics of the foreign-exchange and credit markets that must be taken into account in constructing theoretical models. To illustrate, the forward-exchange market may vary considerably at times in terms of its depth and availability, depending upon commercial-bank practices, government regulations, and the nature of speculative activity. Banks and other creditors may attempt to discriminate among borrowers on the basis of credit worthiness, in which case the loanable-funds market will be fragmented and thus not amenable to aggregative analysis. Credit rationing by banks may also occur, with the result that some customers may be denied servicing altogether. In this event, the suspension of the normal supply-and-demand mechanism will pose great analytical difficulties.

The foregoing remarks presage the numerous difficulties that beset the analysis of capital movements. Let us now turn to some of the theoretical problems at issue in this analysis.

[1] See Edward E. Leamer and Robert M. Stern, *Quantitative International Economics*, Boston, 1970, Chaps. 2–4, for an extended discussion of the theory and empirical measurement of current and capital-account relationships.

THEORETICAL PROBLEMS OF INTERNATIONAL CAPITAL MOVEMENTS

THEORETICAL models of economic systems are ordinarily constructed by categorizing the set of relevant economic exchanges into more-or-less homogeneous subsets. Each subset is analyzed individually, and the resulting independent parts are put together to form a model. Two general principles of categorization may be used to establish these subsets. The first requires us to categorize events according to the activity that is occurring—say, consumption or investment. The second principle requires a categorization according to the transactor involved—say, households or business firms.

Historically, most economic models have started out with an activity orientation, which has given way to a transactor orientation as minor and major flaws were discovered in these activity models. Current theoretical and empirical analysis of international capital transactions is, for the most part, oriented towards activities. We will discuss below several reasons why the shift to a transactor orientation might be better.

ACTIVITY MODELS

Most existing models of international capital transactions are based upon a set of independent activities, which are categorized typically into short-term (consisting of trade, interest arbitrage, and forward-market speculation) and long-term (consisting of portfolio and direct investment). In the case of capital movements, concern over the balance of payments leads to concern over capital *flows*. This leads, naturally enough, to the consideration of various capital-flow activities within the activity framework. Thus, at least until the mid-1960's, models of the foreign-exchange market included capital-flow items that were thought to respond primarily to interest-rate differentials. This was true not only of the early empirical studies of short-term capital

movements, typified especially by Kenen's work,[2] but of the theoretical literature as well, particularly in Mundell's development of the assignment problem.[3]

The activities framework constructed for capital flow was increasingly subjected to attack as it became questionable whether one could identify any transactors who might conceivably behave as implied by the flow equations. Accordingly, more sophisticated activity models were developed, in which speculation and interest arbitrage, especially, were combined into a single activity–portfolio adjustment.[4] Moreover, commercial traders were allowed to acquire bank-financing for their operations in the context of a portfolio model. The logical conclusion of this approach was, therefore, to view all capital movements, including long-term transactions, as arising from the adjustment of portfolios. Thus, capital-flow activities were replaced by portfolio adjustment or capital-stock activities.

The portfolio view, which is now widely accepted,[5] suggests that the concrete specifications required for empirical analysis may be constructed in two comparatively easy steps. First, a decision must be made regarding the assets which substitute for the particular asset under examination. The corresponding rates of return are then to be included in the asset-demand equation. Secondly, one must define precisely the wealth variable that is relevant to the particular asset.

[2] See Peter B. Kenen, "Short-Term Capital Movements and the U.S. Balance of Payments," in *The United States Balance of Payments*, Hearings before the Joint Economic Committee, Washington, 1963.

[3] See Robert A. Mundell, *International Economics*, New York, 1968, especially pp. 217–71.

[4] An excellent example of such a model is to be found in the work of Jay H. Levin, *Forward Exchange and Internal-External Equilibrium*, Ann Arbor, 1970. This formed the basis of our own earlier treatment of capital movements (see Edward E. Leamer and Robert M. Stern, *op. cit.*, Chap. 4).

[5] At least judging from the works of William H. Branson, *Financial Capital Flows in the United States Balance of Payments*, Amsterdam, 1968; Ralph C. Bryant and Patric H. Hendershott, "Capital Flows in the U.S. Balance of Payments: The Japanese Experience, 1959–1967" (in process); John E. Floyd, "International Capital Movements and Monetary Equilibrium," *American Economic Review*, September, 1969; Herbert G. Grubel, "Internationally Diversified Portfolios," *American Economic Review*, December, 1968; C. H. Lee, "A Stock-Adjustment Analysis of Capital Movements: The United States–Canadian Case," *Journal of Political Economy*, July/August, 1969; Jay H. Levin, *op. cit.*; Norman C. Miller and Marina v. N. Whitman, "A Mean-Variance Analysis of U.S. Portfolio Investment," *Quarterly Journal of Economics*, May, 1970; and Thomas D. Willett and Francesco Forte, "Interest Rate Policy and External Balance," *Quarterly Journal of Economics*, May, 1969.

This presumably is straightforward, depending only upon the level of aggregation being employed.

Since the pendulum seems to have swung now so much in favor of the portfolio-adjustment view of activities, it is appropriate to consider whether this view has any important drawbacks. In our judgment, there are at least two worth mentioning. The first stems from the static conception of portfolio adjustment, in which net worth is taken as given. This may enable portfolio models to explain, say, the ratio of foreign to domestic assets, but such models will reveal very little about the scale of portfolio-holdings. The point is that capital flows may be more the result of decisions that influence net worth than of the allocation of net worth among potential assets.[6] The second drawback is that it appears doubtful that the complex activities occurring in any economy operate to bring about a portfolio balance in the aggregate. This is not merely an aggregation problem, since if all units were operating under portfolio-balance rules, there would exist a weighting scheme for the wealth items that would produce an accurate portfolio-adjustment equation for the aggregate. Rather, what we are asserting is that there are some important economic transactors that do not behave, at least in the short run, according to portfolio-adjustment prescripts.

One difficulty with activity models, therefore, is that they lead us into thinking that corresponding to each activity there exists an identifiable transactor behaving in the specified way. This simply may not be so, for transactors cannot be identified strictly on the basis of such activities as commercial trade, arbitrage, speculation, and long-term investment.

A second difficulty with activity models is the lack of independence of the various activities being undertaken. This suggests that activities may not form useful separate units for analytical purposes. It seems logically superior to begin by making the various transactors, themselves, the focus of the analysis, and then proceeding to analyze their activities. In actuality, this is what the stock models have done,

[6] Two further comments on this point are appropriate. Portfolio models tend to ignore the impact of policy on the growth rates of the net-worth variables and therefore tend to give misleading policy implications. In addition, the seemingly important question of repatriation of earnings is not handled very well within the portfolio framework, since it is more a question of whether to consume, or to save, earnings than a question of allocation of net worth.

since their superiority over flow models can be established only by an implicit appeal to the behavior of the relevant transactors. Consequently, we consider that stock models mark an important step in the right direction in their focus on transactors, although these models may not be applicable to transactors of all kinds.

TRANSACTOR MODELS

It is interesting to note that transactor-oriented models are comparatively rare in international financial analysis, whereas such models are commonplace in domestic analysis. In constructing a transactor model of capital movements, we should separate the relevant economic decision-making units according to how homogeneous or diverse the decision procedures are within and between groups. A categorization of transactors which may be relevant to the international transactions of any given country is as follows:

1. Nonfinancial corporations
2. Commercial banks
3. Other institutional investors
4. Government and official institutions
5. Households

Let us examine briefly some of the salient behavioral characteristics of the various transactors to see in what ways they may differ with regard to decision procedures.

Nonfinancial corporations are primarily concerned with production and sales, both at home and abroad. In order to carry out this primary function, firms will have to accumulate capital stock. The portion of this stock located abroad is, of course, what we designate as direct investment. The financing of the accumulation may be effected by way of bank loans, new security issues, or retained earnings. Each of these methods will have a direct, or indirect, impact on international capital transfers. Firms will also hold liquid assets at home and abroad for transactions and speculative purposes. Funds held in liquid form will compete against other demands, such as dividends and capital ac-

cumulation. Moreover, some firms will extend commercial credit to other firms as a sales inducement.

Given the complexity of the firm's decisions and the fact that there will surely be important constraints upon firm behavior in the short run, it is difficult to see how the attainment of a long-run portfolio balance can be anything but a rather distant objective. By eschewing the portfolio view of firm behavior, we may be able to focus more directly on the factors that determine the size—rather than simply the allocation—of a firm's net worth.

Commercial banks, whose principal activities consist of accepting demand and time deposits and allocating the incoming funds to a set of potential assets, may—in contrast to business firms—appropriately be viewed in a portfolio-adjustment context. In this regard, however, Hester and Pierce have suggested that the ease of acquisition and disposal varies considerably among assets.[7] Unusual deposits (withdrawals) are likely to have an initial impact on the most easily acquired (disposed of) assets. With the passage of time, this impact will be spread more evenly among the financial assets to achieve portfolio balance. It should be noted that the formulation of the adjustment process amounts to much more than simply adding lagged variables, since it must allow for the important short-run constraints affecting bank behavior.

International capital movements associated with banks are the result of deposits by foreign banks, business firms, and governments, and of deposits in foreign banks, loans to foreign firms, and claims on foreign governments (e.g., treasury bills). The various loans and government-security holdings can be accommodated easily in the portfolio-balance framework. The interbank deposits present some theoretical problems, however. These deposits are designed to facilitate the clearing process. Thus, for example, a foreign firm wishing to discharge a dollar obligation will have its bank perform the transaction by drawing down the firm's account and drawing a check on the bank in the United States. In the absence of a dollar demand deposit, funds would have to be transferred through the foreign-exchange market or by way of a dollar loan. The dollar demand deposit thus serves a convenience function and may be thought of as representing a transactions demand

[7] See Donald D. Hester and James C. Pierce, "Cross Section Analysis and Bank Dynamics," *Journal of Political Economy*, July/August, 1968.

which responds primarily to the level of transactions in dollars. It is noteworthy in this connection that banks in the United States do not hold deposits of similar magnitude in foreign banks, since the level of American transactions in foreign currencies is comparatively small.

The third group of transactors is composed of *other institutional investors,* including life-insurance companies, savings and loan associations, pension funds, nonprofit foundations, universities, and so on. These institutions behave in a fashion analogous to the commercial banks, accepting inflows and allocating the incoming funds to potential portfolio investments. They must be distinguished from banks, however, since they do not ordinarily accept demand deposits or grant commercial credit. Moreover, their portfolio profiles are considerably different from commercial-bank profiles. Thus, for example, increases in demand deposits will not engender additional foreign long-term portfolio claims, while similar flows into life insurance companies will.

Governments and official institutions form a fourth class of transactors. A portfolio-adjustment view of such transactors is not clearly plausible, inasmuch as there appears to be no obvious way to specify the wealth variable. Total claims on foreigners suggests itself. But such claims are certainly influenced by changes in government policy and may therefore be exogenous. Furthermore, allocation of claims among gold and other assets may be more a function of a country's world trading position, especially vis-à-vis the United States and changes in the political climate affecting the dollar, than of expected returns.[8]

Households form a residual category, including all units that are not identified above. These units are unimportant here, since, ordinarily, they do not hold significant amounts of foreign claims.

The foregoing sketches of some of the behavioral characteristics of different transactors are meant to illustrate three important points. In the first place, there is significant variation in asset preferences among transactors. It is important to take this variation into account, especially when there is any sizeable wealth redistribution among them. This is essentially a problem of aggregating different decision-making units. Secondly, short-run constraints upon behavior vary considerably

[8] See Helmut A. Hagemann, "Reserve Policies of Central Banks and Their Implications for U.S. Balance of Payments Policy," *American Economic Review,* March, 1969, for a recent study of central bank behavior that corroborates this view.

from transactor to transactor, and appropriate decision models vary as well. This means that it will be extremely difficult to construct a single comprehensive model of the capital account capable of capturing all of the structural characteristics of the different transactors. Thirdly, when individual transactors engage in multiple activities, the implicit interdependent decision-making will require a joint analysis of all of the interdependent activities for the transactors in question. Viewed in this light, disaggregation based on activities may be misleading insofar as activities that are presumed to be independent may not, in fact, be so.

The bulk of the research to date on international capital movements has sought to explain these movements by analysis of a set of hypothetical activities. This approach is deficient, since transactors cannot readily be identified to correspond to the different activities hypothesized, and since activities do not form naturally independent units of analysis. Consequently, generation of appropriate models must be based upon the behavioral considerations that are most pertinent to the actual transactors, themselves.

CHOICE OF EXPLANATORY VARIABLES

It should be evident from the preceding discussion that a variety of explanatory variable sets may be chosen for different models of capital movements. We shall now discuss some of the theoretical issues involved in this choice. We have just argued that the appropriate starting point for model construction is to consider the set of relevant transactors. However, since such transactor models have yet to be constructed, we shall divide our discussion according to the traditional activities of short-term capital, portfolio investment, and direct investment. Nevertheless, our intention is still to draw upon those insights offered by a transactor orientation. We trust that in time it will be possible to integrate many of the points adduced here into explicit transactor models.

1. Short-Term Capital. Three main categories of explanatory variables are relevant in explaining short-term capital movements. These

are: (*a*) return variables; (*b*) trade variables; and (*c*) wealth variables. We shall discuss each of them in turn.

Risk factors aside, the competition between two assets will generally center upon the return associated with each one. A more-or-less acceptable restriction on the nature of this competition is to constrain asset-demand relations to be functions of return differentials rather than of the returns appraised individually. Taking this for granted, a more difficult question arises concerning whether to use the covered or uncovered return differentials in explaining short-term capital movements. If covered differentials are used, it is with the assumption that forward cover is available at the quoted market rate. If uncovered differentials are used, additional costs such as margin requirements intervene when arbitrageurs seek to cover their holdings, and these costs effectively prevent them from obtaining forward contracts.

In fact, the appropriate differential probably depends on the characteristics of the period under study. In very stable periods marked by the absence of pressure on the exchange-rate limits, forward cover will be relatively cheap but unneeded. The discrepancy between covered and uncovered differentials would be relatively small at such times. In less stable periods marked by expectations of exchange-rate adjustments and significant speculation in forward markets, the desire for forward cover will be greater. In the least stable periods, forward cover may become either relatively expensive because of increased margin requirements, or banks may ration it in some form. This suggests that the presence or absence of exchange-market pressures will be the determining factor affecting the need for, and cost of, forward covering. Since an uncovered asset may be thought of as a covered asset together with an offsetting speculative position in the forward market, we may regard all assets as covered in the forward market. Thus, asset demand will depend on the return on covered assets and on the expected return to speculation, an alternative portfolio choice. This implies that the best procedure might be to use the covered differential together with some variable that will reflect any additional cost of forward-covering, and a similar variable reflecting returns to forward-market speculation. If these latter variables are impossible to construct, we may, instead, divide the data periods into normal and abnormal groups—a procedure to be discussed more thoroughly below.

A large amount of short-term capital movement is connected with the financing of international trade. In view of this close link between the trade and capital accounts, a question arises concerning the propriety of using the level or changes in exports and imports, their sum, or their difference, in explaining the relevant capital movements. Banks and corporations are, of course, the two main sources of credit for the financing of private commercial trade. As far as banks are concerned, the link between trade flows and the volume of credit supplied seems tenuous. Banks will be accumulating claims on foreigners on the basis of returns to such claims. It is by no means clear how aggregative trade flows are linked with returns from the standpoint of banks, although such flows may have some bearing upon how banks evaluate risk factors such as capital controls. In addition, banks may grant credit related to trade flows as a service to foster good customer relations.

A much clearer link exists between trade flows and corporate willingness to lend. Extensions of credit will be made by corporations to foreign customers primarily as an enticement for sales. Increases in exports will therefore tend to be associated with increases in the credit outstanding. However, assuming that the corporation has profit objectives, credit extensions are properly linked with the profits from the sale, not the sale itself. Higher-profit sales are likely to be associated with much greater credit extensions than lower-profit sales of the same volume. Furthermore, there may be a strong causal relationship going the other way, with credit extension influencing sales.[9]

Just as there is no clear-cut link from exports to credit supply *to* foreigners, credit demand *by* foreigners is not straightforwardly related to exports. A foreign firm engaged in importing will have certain inventory needs. Credit to finance those inventories may be obtained from domestic sources, foreign sources, or through internal cash flows. It is probably true that smaller, less-well-established importing firms are likely to rely more on external sources of funds than do larger, well-established firms. We might expect, therefore, to observe relatively large credit extensions when new markets are being opened up, as, say, in the case of Japanese trade in the late 1950's and early 1960's. In contrast, increases in exports to more mature markets may engender

[9] In such a case, an ordinary least-squares regression of credit extensions on sales will be subject to simultaneity bias. More will be said about this below.

somewhat less credit demand, since importing firms in such circumstances may have greater access to internal financing. Pinches on internal funds will, of course, reestablish the link between imports and credit demands. However, just as in the case of credit supply, credit demand is properly linked to profits, not sales. One further point of interest is that the link between credit demand and sales may be broken if the credit extension is used to finance additional real investment or portfolio accumulation. The desire to obtain credit for these purposes naturally depends on the return involved.

While we have discussed the well-known but questionable link between short-term claims on foreigners and exports, it should be noted that there is a possible link between such claims and imports. That is, importers—and/or the banks with whom they deal—may hold balances in the foreign currency for transactions purposes. Import increases will therefore stimulate larger transactions balances and, thus, larger claims on foreigners. In the case of the United States, importers will not need such balances since imports are commonly financed in terms of dollars. Firms and banks in other countries which undertake trade denominated in dollars will maintain transactions balances in banks in the United States, both for trade with the United States and for trade with other countries.

Our discussion suggests that merchandise-trade variables are not well suited to explain credit extensions, because they may reflect only indirectly the profitability motivations of the transactors on both the supply and demand sides, and because the direction of causation is unclear. However, lacking information relating to profitability, it may be necessary to rely on some measure of sales for explanatory purposes. Whether exports and/or imports should be used will depend upon the circumstances under study. What should be emphasized is that the primary variable for explaining trade-financing should be expressed in terms of *changes* in sales rather than level of sales.[10] The reason for this is that rapid growth in sales, which reflects favorable profit opportunities, will engender increases in trade credit. When sales

[10] It should be pointed out that the position taken here departs from the traditional one, in which the stock of trade credit was related to the flow of goods. The traditional view, which was essentially ad hoc, was developed within an activity framework, which, as we have argued, obscures the relevant behavioral characteristics of banks and corporations in the case of trade credit.

and profit opportunities level off, there will be a tendency for firms to rely more on internal financing and domestic credit sources. The result will be an evening off, and perhaps even a decline, in the use of foreign credits.

Wealth variables comprise the third variety of important variables for explaining short-term capital movements, especially in the context of a model of portfolio adjustment. On the most highly aggregative level, wealth may be defined to include capital stock, plus government debt, plus net claims on foreigners. Such a definition may not be particularly revealing, however, insofar as it fails to represent accurately the behavioral constraints on the relevant economic transactors. As we have argued previously, models of capital movements should focus on the behavior of unique transactors and seek to identify the wealth and other constraints that influence such behavior. Thus, for example, we noted that while banks may regard their deposit flows as given when making asset choices, they may allocate demand and time deposits to generally different assets. Furthermore, unexpected deposit variation is most likely to have an initial impact on the more liquid assets. We also observed that corporations may have important cash-flow and other constraints in the short run; and that given the complexity of corporate decisions, a portfolio-equilibrium view of corporate behavior seems inadequate.

2. Portfolio Investment. To the extent that purchases of foreign bonds and equities represent short-term investments, the points made earlier with respect to employing uncovered, or covered, return differentials would be applicable. Exchange-rate expectations may be less important, however, for strictly long-term investment, although the timing of this investment might be sensitive to such expectations. Since it seems quite appropriate to use a portfolio model for this kind of investment, the choice of the wealth variable should closely reflect those constraints which are most binding on the behavior of the transactors involved.

3. Direct Investment. In pursuing profits or sales goals, corporations are required to make a great number of intertwined decisions, one of which is the quantity of direct investment. A superficial view has direct

investment depending upon expected returns to the investment, expected returns to alternative uses of funds, and the availability of funds. Unfortunately, each of these three items depends in a very complicated fashion on the other decisions which the firm has made or is making. Returns to the investment depend upon current and projected export sales. Alternative uses of funds include dividends, domestic investment, postponed investments, and so on. Sources of funds include internal cash flows and external borrowing. The problem is further complicated by the impact of current investment decisions on future flexibility.

The construction of a theoretical model that deals with all of these problems is clearly outside the range of this paper. However, we wish to reiterate our position that a portfolio-adjustment view of the corporation, and of direct investment, is not particularly revealing. In the first place, it tends to ignore all of the short-run financial constraints upon the behavior of the firm. Secondly, it can easily lead to a definition of returns that ignores the complex interrelationships in the decisions of the firm. Thirdly, it ignores the fact that the investment decision is fundamentally a question of whether to increase net worth, not a question of how to allocate a given net worth.

EMPIRICAL PROBLEMS IN ESTIMATING INTERNATIONAL CAPITAL MOVEMENTS

HAVING set forth various theoretical considerations important to the construction of models of international capital movements, we turn now to several significant problems in the empirical implementation of the models. These problems are concerned generally with how best to represent the behavioral characteristics subsumed in the different models, and how to handle some purely statistical matters. We shall deal in particular with the following: (1) measuring expected returns and risk; (2) handling of speculative activity; (3) capital controls and credit rationing; (4) disaggregation schemes; (5) data inadequacy; (6) lag structure; (7) functional form; and (8) simultaneity.

MEASURING EXPECTED RETURNS AND RISK

Since the expected returns and risk variables used in most theoretical descriptions of asset accumulation are ordinarily unobservable, it is necessary to adopt some procedure that will make these concepts operational. We can either seek proxy variables to represent expected returns and risk, or else construct models of expectations-formation concerning these phenomena. It may be possible, in addition, to identify time periods separately on the basis of important changes in expectations that affect behavior.

Uncertainty over returns stemming from the holding of foreign debt instruments is associated primarily with the possibility of devaluation and/or capital controls. The proxy variables sought should, therefore, reflect pressure on the authorities induced by balance-of-payments difficulties. Expected returns and risks of equities and direct investments may also be affected by such balance-of-payments considerations, but will, furthermore, depend upon business-climate variables.[11]

An alternative to using proxy variables is to construct a model of expectations-formation. Ordinarily, this involves the assumption that expected future returns/risk are a constant function of current and historical values of the rates in question. This assumption is clearly inapplicable to the spot rate in a pegged-exchange-rate system, although it may be acceptable in this system when applied to the forward rate and to returns to equities and direct investment.[12]

A further alternative is to identify turbulent periods in which changes in expectations had an important effect upon behavior. This may be done by exploring the regression residuals in an interest-parity model, as Stein did,[13] assuming that large residuals from interest

[11] See Norman C. Miller and Marina v. N. Whitman, *op. cit.*, for a more extensive discussion of proxy variables for returns/risk which relate to portfolio investment. Their model included the lagged value of the U.S. balance-of-payments liquidity deficit and deviations of U.S. GNP from trend. They also experimented, unsuccessfully, with changes in aggregate exchange reserves of selected foreign countries, the ratio of forward and spot rates, and a ratio of the spot rate in period $t + 1$ to the spot rate in period t.

[12] Branson, *op. cit.*, is especially noteworthy in his effort to incorporate expectations into his model.

[13] See Jerome L. Stein, "International Short-Term Capital Movements," *American Economic Review*, March, 1965.

parity reflected a suspension of the normal behavior pattern in favor of speculation. Rather than concentrating on the residuals, however, it might be preferable, as will be discussed more fully below, to separate the data on an a priori basis into "normal" and "speculative" periods and perform regression analysis separately on each set of data.

SPECULATIVE ACTIVITY

It is well known that in a system of pegged exchange rates, speculative activity may fundamentally alter the nature of the foreign-exchange markets. During periods of substantial speculative activity, the forward market may dry up, existing credit lines may be curtailed and new ones denied, credit rationing may become more prevalent, inventory speculation may become pronounced, and so forth. In such circumstances, expectations may increase so much in importance that they dominate behavior. This means that the behavior relations applicable during a "normal" period may be effectively suspended, since responses will be swamped by expectational forces that are not fully incorporated in the usual empirical models of capital movements. What is suggested, then, is that we separate "normal" from "speculative" periods according to the absence or presence of expectations concerning exchange-rate changes outside the official limits.

If normal periods dominate the sample, the speculative eras could be treated as outliers and discarded. Unfortunately, there is no sound statistical way of doing this without a great deal of effort. Still, the inconvenience does not justify a resort to ad hoc procedures which are potentially dangerous from the standpoint of data interpretation. In this regard, we have already taken note of Stein's construction of a speculative-pressure variable based on the residuals of a regression of the forward premium on the uncovered interest-rate differential.[14] This procedure was criticized in separate comments on Stein's work by Heckerman and Laffer,[15] who contended that the residuals may reflect other things besides speculative pressure.[16]

[14] *Ibid.*

[15] See Donald G. Heckerman, Arthur B. Laffer, et al., "International Short-Term Capital Movements: Comments," *American Economic Review*, June, 1967.

[16] Stein's procedure may be all the more questionable since, as Jay H. Levin has pointed

An alternative to Stein's approach would be to identify periods of exchange-market turbulence on some a priori basis. One such possibility would be to seek out expert opinion concerning periods during which currencies were felt to be especially affected by substantial speculative transactions. Rather than relying on informed judgment, it might be preferable to use data on forward exchange rates. Theoretical considerations suggest that speculative confidence in the limits of spot exchange rates in the pegged-rate system will be reflected by infinitely elastic speculative activity in the forward market at these limits. The forward rate may move outside the limits only if speculators lack confidence in the government's willingness and ability to maintain the spot rate and if there is no official counter-speculation to peg the forward rate.[17] A reasonably objective method for separating speculative from normal periods might be a division based on whether or not the forward rate for a given period lay inside or outside the official support limits designated for the spot rate.[18]

In order to evaluate how this criterion performed, in Chart 1 we plotted the ninety-day forward rates for the pound, mark, and French franc as a per cent of the official spot peg on an end-of-month basis for the period 1960–69 (September). The official spot support points are shown as 99 per cent and 101 per cent. The chart suggests that the pound was under speculative pressure to devalue periodically throughout the period. The speculative attack on the pound in 1961 was accompanied by opposite pressure on the mark. The years 1968 and 1969 were very turbulent, with pressure on all three currencies. We conclude, therefore, that empirical studies which include assets in the United Kingdom will necessarily have to deal with the speculation problems more or less throughout the 1960's. Analysis of the mark and

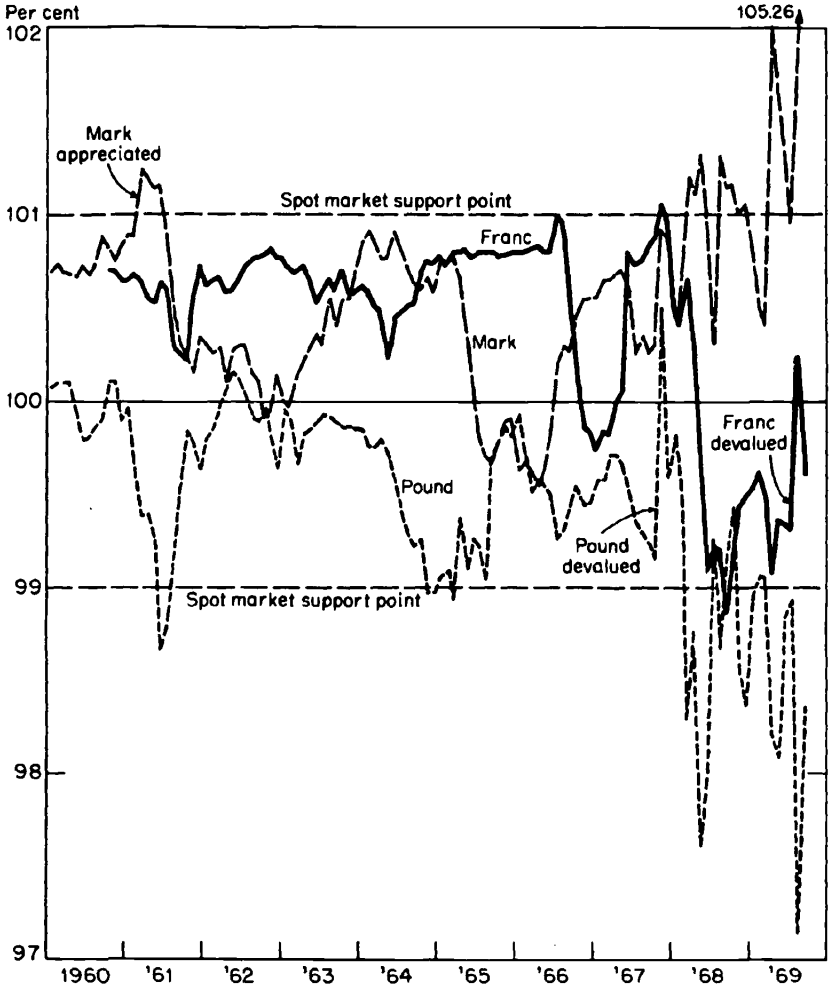
out in private discussion, Stein's model of the foreign-exchange market makes inadequate provision for hedging by traders in the forward market and does not clearly distinguish the stock of investor short-term capital which represents covered-interest arbitrage.

[17] Note that Stein's analysis implicitly assumes the forward rate to be determined by interest-arbitrage considerations. We, however, regard the forward rate as being determined primarily by speculative activity, at least outside the support points.

[18] It might be thought that dummy variables could be introduced to handle these speculative occurrences in a single analysis, rather than separating the time periods. Dummy variables would not do the job, however, because the assumption would still be made that the usual explanatory variables were applicable, when, in fact, they may not be during speculative periods.

CHART 1

Ninety-Day Forward Rates (End of Month) of Pound Sterling, Mark, and French Franc 1960–69
(*per cent of spot peg*)



SOURCE: International Monetary Fund, *International Financial Statistics*, various issues.

the franc will have to deal with speculation particularly in 1968 and 1969. As is suggested above, these points in the series of data might best be analyzed separately. (See Tables 1, 2, and 3.)

CAPITAL CONTROLS AND CREDIT RATIONING

We have already mentioned that controls and credit rationing will have an impact on capital movements. When controls result in the reduction of effective returns, a suitable variable may be introduced to take this into account. However, when controls take the form of quotas, the model may have to be abandoned altogether, since the observed points in the series of data may bear no relationship to the true underlying demand or supply schedule being estimated. This is also the case when credit rationing occurs.

The presence of capital controls and credit rationing thus poses very serious difficulties, since the relationships that we usually formulate are predicated on the assumption that they will correspond with the observed data. It is possible to assume, as Bryant and Hendershott have done,[19] that the effect of capital controls is to reduce the observed quantity by a proportion depending on the existing controls. Their rationale for doing so was that the capital controls in question were voluntary, and that the observed responses to other stimuli were reduced but not eliminated. To proceed in this way requires, of course, much detailed knowledge of the controls and their effects, and there may not be any straightforward way to allow quantitatively for the reductions in responses. This is an unfortunate situation since—particularly in the case of capital movements—interferences of various kinds may well be the rule and not the exception.

DISAGGREGATION SCHEMES

Capital assets of varying maturities are issued and acquired in many different countries by many different transactors. The potential

[19] See Ralph C. Bryant and Patric H. Hendershott, *op. cit.*

TABLE 1

Ninety-Day Forward Rate: Pound Sterling (1960–69)
(*per cent of spot peg*)

	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
January	98.96	99.82	99.58	99.93	99.06	99.84	99.96	99.80	99.96	100.07
February	99.06	99.45	99.58	99.75	99.09	99.75	99.89	99.86	99.60	100.09
March	99.06	98.28	99.71	99.51	98.93	99.75	99.66	99.98	99.38	100.09
April	98.20	98.76	99.71	99.58	99.38	99.80	99.82	100.07	99.39	100.09
May	98.08	97.60	99.66	99.55	99.09	99.73	99.84	100.16	99.24	99.91
June	98.85	98.02	99.53	99.49	99.26	99.58	99.89	100.11	98.66	99.78
July	98.93	99.27	99.35	99.26	99.22	99.40	99.93	100.02	98.79	99.80
August	97.13	98.67	99.29	99.31	99.04	99.29	99.91	99.91	99.22	99.87
September	98.36	99.14	99.24	99.46	99.71	99.22	99.88	99.89	99.55	99.89
October		99.43	99.15	99.55	99.80	99.26	99.86	99.96	99.84	100.11
November		98.54	100.50[a]	99.44	99.86	98.97	99.86	99.79	99.78	100.11
December		98.36	99.58	99.46	99.82	98.97	99.84	99.64	99.64	99.89

SOURCE: Calculated from International Monetary Fund, *International Financial Statistics*, various issues.
[a] Devaluation.

TABLE 2

Ninety-Day Forward Rate: German Mark (1960–69)
(*per cent of spot peg*)

	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
January	100.81	100.50	100.55	99.63	100.76	100.86	100.00	100.30	100.89	100.70
February	100.50	100.45	100.65	99.68	100.76	100.91	99.98	100.25	100.89	100.75
March	100.40	101.21	100.65	99.63	100.78	100.85	100.15	100.28	101.24 [a]	100.69
April	102.01	101.11	100.68	99.55	100.65	100.76	100.23	100.10	101.19	100.69
May	101.65	101.32	100.70	99.65	100.30	100.76	100.40	100.27	101.14	100.67
June	101.34	101.01	100.60	99.85	100.05	100.91	100.45	100.30	101.16	100.73
July	100.96	100.30	100.25	100.20	99.80	100.81	100.40	100.30	100.88	100.68
August	101.96	101.32	100.35	100.30	99.70	100.73	100.55	100.15	100.45	100.74
September	105.26	101.14	100.25	100.27	99.67	100.63	100.40	100.10	100.30	100.89
October		101.16	100.30	100.45	99.80	100.60	100.55	99.90	100.25	100.82
November		101.01	100.93	100.55	99.90	100.67	100.55	99.95	100.15	100.75
December		101.06	100.91	100.55	99.92	100.58	100.70	100.15	100.35	100.84

SOURCE: Calculated from International Monetary Fund, *International Financial Statistics,* various issues.
[a] Appreciation.

TABLE 3

Ninety-Day Forward Rate: French Franc (1960–69)
(per cent of spot peg)

	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
January	99.53	100.49	99.74	100.80	100.78	100.63	100.76	100.61	100.65	
February	99.63	100.41	99.85	100.80	100.73	100.59	100.71	100.65	100.69	
March	99.49	100.67	99.82	100.82	100.80	100.51	100.69	100.67	100.65	
April	99.07	100.32	100.02	100.84	100.80	100.50	100.73	100.59	100.55	
May	99.37	[a]	100.05	100.80	100.82	100.22	100.65	100.59	100.53	
June	99.35	99.08	100.80	100.80	100.76	100.45	100.51	100.65	100.65	
July	99.31	99.23	100.73	101.00	100.80	100.48	100.59	100.73	100.59	
August	100.25 [b]	99.19	100.75	100.96	100.80	100.51	100.67	100.76	100.28	
September	99.60	98.86	100.84	100.55	100.80	100.52	100.59	100.76	100.26	
October		99.17	100.87	100.10	100.78	100.69	100.71	100.77	100.22	100.71
November		99.44	101.04	99.86	100.78	100.76	100.57	100.82	100.55	100.71
December		99.50	100.96	99.83	100.80	100.73	100.57	100.76	100.73	100.65

SOURCE: Calculated from International Monetary Fund, *International Financial Statistics*, various issues.

[a] Not quoted.

[b] Franc devalued.

for disaggregation is, therefore, substantial. The simplest rule that can be stated in this regard is that if a certain category of capital movements is theoretically important, disaggregation should be carried at least as far as that category. Whether disaggregation should be carried even further involves the questions of whether a better understanding or a clearer explanation would be obtained, and how one deals with the vectors of variables describing microunits, which are implicit in the aggregate relation.

One ordinarily argues that the returns from disaggregation will be greatest when distinctly different responses can be isolated for the transactors in question. This assumes, however, that we employ the usual index-number solution to the problem of how to handle the long vectors of microvariables in the relationships specified, in which case we would be assuming, in effect, that all responses were identical within the category chosen. If this were not in fact true, a specification error would have been made and further disaggregation might be in order. While the procedure just described is a common one, it is by no means satisfactory. That is, it is possible to construct index numbers that do not assume identical responses.[20] Moreover, treating the issue as a specification error overlooks important statistical questions concerning the proliferation of data points as disaggregation is pursued further.

Unfortunately, there is no way to resolve all of the statistical issues involved in choosing disaggregation schemes. For this reason, ad hoc procedures must be employed. It might be reasonable to continue disaggregating as long as improved (or perhaps only different) estimates of the aggregative relationship are obtained, given the budget constraint upon research resources.

INADEQUACY OF DATA

We have already noted that micromodels of asset accumulation will ordinarily contain several different exogenous variables on rates of return, many of which will enter implicitly into the relevant aggre-

[20] This involves determining the proper weights to be used. See Edward E. Leamer and Robert M. Stern, *op. cit.*, Chap. 2, Appendix, for a discussion of this matter in the context of estimating import-demand functions.

gate relationships. Consequently, the total number of explanatory variables may be rather large. At the same time, however, substitutions between assets are likely to be sufficiently important so that no return variable may move independently of the others. We will thus be faced with an extreme case of data inadequacy in the form of a large collinear set of explanatory variables. This is an unfortunate occurrence because it makes for great difficulties in interpreting the data.

Multicollinearity plagues much econometric work, capital movements being no exception. This may, nevertheless, be an appropriate place to register our strong disapproval of the common practice for dealing with multicollinearity: fitting the equation, discarding the variables that are "not significant statistically," and then refitting the equation. This procedure is undesirable on two counts. In the first place, *statistical* significance must be carefully distinguished from *economic* significance. What is often forgotten is that an "insignificant" coefficient results from a combination of a small true coefficient and a large standard error, whereas multicollinearity is ordinarily associated with large standard errors. This means that a coefficient may be judged insignificant even when it is of substantial size. What must be emphasized is that terms such as *small* or *large* and *significant* or *insignificant* take on precise meaning only when put in a particular decision-making context. It is thus quite conceivable that an investigator who rejects "large" coefficients because they have "large" standard errors may be imposing an interpretation on the data that is, in fact, economically unwarranted.[21]

An additional objection to the refitting of equations in the manner cited is that such "specification searches" have no theoretical basis.[22]

[21] This can be illustrated by a simple example. Suppose that we were interested in reducing domestic interest rates by one per cent to stimulate the domestic economy. If this change induced, say, up to $5 million in capital outflow, we might be unconcerned. From $5 to $50 million, our concern might grow increasingly. And, maybe, after a $50 million outflow, we would discard the proposed interest-rate change altogether. In this example, an "insignificant" coefficient is one that leads to less than a $5 million outflow. This may be quite different from the conclusion to be drawn from a test based on statistical significance.

[22] That is, least-squares axioms allow only a single fit, and where specification searches based on the discarding of variables have been analyzed (as in Edward E. Leamer, "Inference with Non-Experimental Data: A Bayesian View," University of Michigan, Doctoral Dissertation (unpublished), 1970), they have been found detrimental to the validity

The only approach with established statistical validity is interpretation of the data directly from the full, unconstrained equation. While it is true that the presence of extreme multicollinearity implies fairly useless information about individual coefficients, there may, nonetheless, be useful information about sets of coefficients. In order to obtain that information, estimates could be calculated of sums, or averages, of coefficients and their standard errors.[23]

LAG STRUCTURE

Lagged variables will be required to reflect both the adjustment mechanism and the formation of expectations. A common procedure is to attempt to capture these effects simply by adding lagged explanatory or dependent variables to the basic model. This implicitly involves the assumption of a fixed but unknown response pattern. In the case of capital movements, this technique may be found lacking in at least two respects. One is that it makes little or no distinction between the two types of lags. Such a distinction could be important from a policy standpoint since, for example, expectations could be altered significantly by virtue of the announcement effects stemming from policy changes. It might be desirable, therefore, to employ explicit models of adjustment and expectations in order to be able to distinguish these influences from one another.[24]

of the data interpretation so afforded. It is not difficult to see why this is so. By constraining some of the coefficients to be zero, we force other correlated variables to take over the role played by the discarded variables. There would be a tendency, therefore, to overestimate the impact of the included variables and, of course, to underestimate the impact of the excluded ones.

A different search procedure than the one usually followed might be to constrain the coefficients in a way which is more or less justified on a priori grounds. In this case, we could construct an index number for the return variables, thereby implicitly assuming a relationship between the regression coefficients. Leamer is presently investigating this procedure in the context of empirically weighted price indexes constructed for use in estimating import-demand functions.

[23] One further possibility is to interpret the data by exploring multidimensional confidence intervals. See Edward E. Leamer and Robert M. Stern, *op cit.*, Chap. 2, for an illustrative example using income and price coefficients from an import-demand regression.

[24] Roger N. Waud in "Misspecification in the 'Partial Adjustment' and 'Adaptive Expectations' Models," *International Economic Review*, June, 1968, has pointed out that in simple models of partial adjustment and adaptive expectations, it may be impossible

Mechanical use of lagged variables also ignores potentially useful information concerning the determinants of the response pattern. One of our basic objections to portfolio-adjustment models is that they tend to ignore short-run constraints upon behavior which determine methods and speeds of adjustment. In some cases, these constraints may become so important that the long-run portfolio-balance considerations are barely reflected in the findings.

In constructing a model of expectations-formation, it is possible to allow for adaptations in the expectations. Such a model leads to a set of fixed weights on past observations.[25] This is not a completely acceptable procedure, since the extent to which future projections are adjusted in the light of the discrepancy between current projection and current observation is not a fixed fraction but depends instead upon current and past information. Also, risk factors, as well as expectations, will be adjusted in response to current evidence. To the extent that his projections come to fruition, an investor may justifiably gain confidence in his ability to project, and shift his portfolio to more risky assets. Clearly the problem of expectations-formation is in need of further study.[26]

to identify the two elements separately. Edgar L. Feige in "Expectations and Adjustments in the Monetary Sector," *American Economic Review*, May, 1967, has shown, however, that more complex models permit such identification.

[25] See *ibid.* for a discussion of adaptive expectations models.

[26] A Bayesian view of expectations-formation could prove useful. Suppose, for example, that an investor establishes a subjective multivariate normal distribution on a vector of future returns, r. At time t, he will have observed the first t elements in r, say r_1. He then updates his subjective measure on the remaining elements, say r_2, according to Bayes Rule, $p(r_2|r_1) = p(r_1, r_2)/p(r_1)$. In the case of the multivariate normal distribution (see Howard Raiffa and Robert Schlaifer, *Applied Statistical Decision Theory*, Boston, 1961, p. 250) with mean $m = [m_1, m_2]$ and variance

$$V = \begin{bmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{bmatrix},$$

the updated measure on r_2 is also multivariate normal with mean $m_2 + V_{21}V_{11}^{-1}(r_1 - m_1)$ and variance $V_{22} - V_{21}V_{11}^{-1}V_{12}$, indicating that the discrepancy between the projection m_1 and outcome r_1 is used to update the mean on r_2 according to a set of fixed weights $V_{21}V_{11}^{-1}$. The discrepancy does not affect the variance. This is precisely what the usual adaptive expectations-model assumes.

Other models of expectations within the Bayesian framework will not reduce to the usual adaptive expectations-model, however. For example, the investor may regard the set of returns to be a sample from a normal process with mean m, variance σ^2, and autocorrelation coefficient ρ. The observations r_1 will provide information about all parameters. Although the updated projection is rather complicated, it is clearly not the simple adaptive expectations-projection.

CHOICE OF FUNCTIONAL FORM

The use of simple linear-regression techniques requires that the hypothetical relationship be linear in its parameters. Within that linear class, there is an infinite variety of functional forms from which to choose. Economic theory often provides little, if any, basis for choice, and researchers commonly select linear or log-linear forms, perhaps considering the problem unimportant for the inferences and decisions to follow. However, in the case of asset accumulation, economic theory does suggest a more restrictive class of functional forms.

A general asset-demand function relates the stock of assets A to a set of scale variables W (which determine the portfolio size) and to a set of preference variables r (which determine the allocation of the portfolio among competing assets), $A = f(r, W)$. The associated capital flow at a fixed interest rate is $F = dA/dt = (\partial f/\partial W)dW/dt$. Policy analysis will, of course, be concerned with the flow induced by a change in interest rates, $dF/dr = (\partial^2 f/\partial W \partial r)dW/dt$. Functional forms such as $A = g(r) + h(W)$, which constrain $\partial^2 f/\partial W \partial r$ to zero, also constrain the flow induced by interest-rate policy to zero, thus presupposing the answer to an important policy question. Since portfolio increases are almost certainly allocated among assets according to the constellation of interest rates, such forms should be avoided. The very popular form $A = f(r)W$, on the other hand, remains acceptable.

SIMULTANEITY

The spot and forward exchange rates and the interest rate will not necessarily be fixed independently of variations—especially those in the size of the large capital items. There may also be other demand-and-supply interactions (particularly in the extension of trade credit) that make for ambiguities in the direction of causation. Quite clearly, theoretical models will have, and should have, simultaneous elements. It is well known that the presence of such simultaneity implies biases in the estimated coefficients, the extent of the biases depending upon both the seriousness of the simultaneity and the stability of the relationship being analyzed. In order to plot a course relative to this issue,

we must ask not only if simultaneity is present, but also if there might be more pressing problems than the necessity of perfecting estimating techniques to handle the simultaneity. In our judgment, in the case of capital movements, it is premature to worry too much about sophisticated statistical techniques to handle simultaneity. There are, indeed, other more important problems to be resolved, not the least of which is the specification of a model which is itself appropriate.

THE EMPIRICAL EVIDENCE

THE study of international capital movements should be a prelude to coping with certain important questions of economic policy. Thus, for example, we might want to know how the balance of payments is affected by changes in monetary and fiscal policies, whether selective capital controls are effective, what the impact will be of official counter-speculation in the forward market, how changes in domestic policies will affect other countries, how their policies will affect us, and so on. While there is an abundance of theoretical literature dealing directly with questions such as the foregoing, this recognition is, unfortunately, much less prevalent in the empirical literature. Many empirical studies of capital movements have aimed primarily at justification of a particular model, rather than at drawing policy implications regarding the model parameters from the available empirical evidence. Moreover, the evidence in many studies is summarized in a confusing manner which makes it very difficult to reach meaningful conclusions.

We thought that it would be useful to survey the empirical literature on movements of short-term and portfolio capital for the United States and Canada in any event, with two fairly simple but important questions in mind: what effect would a one per cent change in interest rates have on the capital accounts, and what is the impact of the merchandise-trade variables on these accounts? We were not able to make a comparable survey for direct investment, the existing studies being rather limited in number and scope.

INTEREST-RATE IMPACTS

Tables 4 and 5 contain summaries of the evidence regarding the impact of a one per cent change in interest rates on capital movements of various kinds for the United States and Canada. We have taken the regression estimates of the interest-rate coefficient noted in the individual studies as the best guess at the impact of interest-rate adjustments. Where an interest rate was reported to be not significant statistically, we assumed that the investigator had concluded that it had a zero effect.[27] No reference is given in Tables 4 and 5 to studies in which the regression results did not lend themselves easily to the question being posed, or in which the investigator excluded the particular relationship from his analysis.[28] One important caveat must be noted with regard to these tables: they ignore the other repercussions of the interest-rate change which considerably dampen the effect of the assumed policy. That is, other explanatory variables such as foreign interest rates and forward-exchange rates are assumed to be unaffected by the interest-induced capital flows.

It will be observed that stock and flow effects are distinguished in Table 4. The reason for this is that in a stock model there will be a stock adjustment to an interest-rate change and a continuing flow effect. The flow effect results from an altered allocation of the assumed increments to any scale variables. Not all of the stock models shown embody a flow effect. As noted earlier, there are certain functional forms that constrain the flow effect to zero. Branson's use of a linear form is a case in point.[29] Some of the results cited are based only on flow models which assume that the induced capital flows will continue indefinitely. This arrangement is not very plausible; the results in question have to be interpreted as some combination of stock and flow effects.

Some interesting points emerge from Table 4. There are evidently substantial differences in the estimates based upon Branson's quarterly and monthly models. He had no ready explanation for these differ-

[27] Note, however, as discussed earlier, that we regard this use of significance tests to be inappropriate.

[28] Note also that the coverage of the capital items may differ between studies.

[29] William H. Branson, *op. cit.*

TABLE 4

Summary of Estimated Effects of a One Per Cent Per Annum Increase in Interest Rates upon the Capital Account of the United States
(*millions of dollars*)

Capital Item [a]	Source of Estimate [b]	Stock Effect [c]	Flow Effect [c]
U.S. claims			
Short-term:			
Total	Branson	−468	0
	Branson [d]	−253	0
	Kenen [e]		−270
	Prachowny		−170
	Laffer	0	0
	Laffer		0
Banking claims	Stein	−27	0
	Stein		−69
Claims on Japan	Bryant and Hendershott	−600	−25
Long-term:			
Total	Branson	−315	0
	Branson [d]	−800	0
	Miller-Whitman	−1,073	−21
	Prachowny		−124
Claims on Canada	Lee	−1,619	−20
Bank loans	Branson	0	0
U.S. liabilities			
Short-term:			
Total	Branson	260	0
	Branson [d]	540	0
	Kenen [e]		260
	Laffer	0	0
	Laffer		0
Banking liabilities	Stein	0	0
	Stein		46
Long-term:			
Total	Branson	693	0
	Branson [d]	2,000	0
	Prachowny		100

Notes to Table 4.

NOTE: Flow effects are given per quarter.

[a] Coverage of the items noted may not be exactly comparable in different studies.

[b] Based upon results contained in: William H. Branson, *Financial Capital Flows in the United States Balance of Payments*, Amsterdam, 1968; Peter B. Kenen, "Short-Term Capital Movements and the U.S. Balance of Payments," *The United States Balance of Payments*, Hearings before the Joint Economic Committee, Washington, 1963; Martin F. J. Prachowny, *A Structural Model of the U.S. Balance of Payments*, Amsterdam, 1969; Arthur B. Laffer, "Short-Term Capital Movements and the Voluntary Foreign Credit Restraint Program" (in process); Jerome L. Stein, "International Short-Term Capital Movements," *American Economic Review*, March, 1965; Ralph C. Bryant and Patric H. Hendershott, "Capital Flows in the U.S. Balance of Payments: The Japanese Experience, 1959–1967" (in process); Norman C. Miller and Marina v. N. Whitman, "A Mean-Variance Analysis of U.S. Foreign Portfolio Investment," *Quarterly Journal of Economics* (forthcoming); C. H. Lee, "A Stock-Adjustment Analysis of Capital Movements: The United States–Canadian Case," *Journal of Political Economy*, July/August, 1969.

[c] Calculated at point of sample means, excluding feedbacks.

[d] Estimated with monthly data.

[e] Calculated on the assumption that regressions not reported showed zero interest-rate effects.

ences, but believed the results of the quarterly model to be the more reasonable. It can also be seen that the results of the flow models tend to lie within the range of the comparable stock and flow effects based on stock models. We may note, finally, that the relatively large estimates of interest rates for the two items, disaggregated by country in the works of Bryant and Hendershott, and Lee, suggest that a component of a capital item is more sensitive to interest rates than is the entire item, itself. At first glance, this appears to bear upon the problem of disaggregation, suggesting that effort could be expended profitably in disaggregating the capital items by country. However, there may also be an important element of data misinterpretation, caused by the highly collinear data set required at that level of disaggregation.[30]

[30] To illustrate, assume that country 1's (U.S.) asset demand (A_1) for the claims of country 2 (Canada) will depend upon returns (r) in countries 1, 2, and 3 (U.K.), subject to country 1's wealth constraint (W_1):

$$A_1 = A_1(r_1, r_2, r_3, W_1).$$

If the capital instruments of countries 2 and 3 are good substitutes from the point of

TABLE 5

Summary of Estimated Effects of a One Per Cent Per Annum Increase in Canadian Interest Rates upon the Capital Account of Canada
(*millions of Canadian dollars*)

Capital Item	Source of Estimate [a]	Flow Effect
Canadian liabilities		
Short-term:		
Total	Rhomberg	183
Net Canadian capital movements (claims − liabilities)		
Short-term:		
Total	Helliwell et al.	−102
	Arndt	−125
Long-term:		
Total	Helliwell et al.	−177
Canada–U.S.	Rhomberg	−149

NOTE: Flow effects are given per quarter.

[a] Based upon results contained in: Rudolf R. Rhomberg, "A Model of the Canadian Economy Under Fixed and Fluctuating Exchange Rates," *Journal of Political Economy*, February, 1964; John F. Helliwell et al., "The Structure of RDX1," Bank of Canada, Staff Research Studies No. 3, Ottawa, July, 1969; Sven W. Arndt, "International Short Term Capital Movements: A Distributed Lag Model of Speculation in Foreign Exchange," *Econometrica*, January, 1968.

view of country 1 investors, then the marginal responses to r_2 and r_3 will be very large. At the same time, the three rates may be highly collinear and the usual search procedure of discarding insignificant variables could well lead to a form such as:

$$A_1/W_1 = a + b(r_2 - r_1).$$

The misspecification involved in such a form necessarily provides biased estimates. In the case of the impact of country 1's (U.S.) rate, there is a presumption of overestimation. This is, in fact, precisely what C. H. Lee, *op. cit.*, did. In an equation in which the U.S., Canadian, and U.K. interest rates were used separately, the impact of the U.S. rate was but a fraction of the implied value in his misspecified relation. This argument does not apply to Ralph C. Bryant and Patric H. Hendershott, *op. cit.*, who did not fit such a constrained form.

In view of the apparent dearth of reliable results for the component capital items listed in Table 4, it must be concluded that we are still much in the dark with regard to the over-all balance-of-payments effects of an interest-rate increase by the United States.[31] Clearly, much remains to be done. The situation for Canada is no better. It can be seen in Table 5 that all of the three studies cited have employed a flow model,[32] and that the two sets of flow results for the net movement of Canadian short-term and long-term capital are reasonably close to one another. These results may not be reliable for policy purposes, however, in view of the theoretical objections pertaining to a flow model.

IMPACTS OF MERCHANDISE TRADE

The evidence concerning the impact of merchandise-trade flows on capital movements is summarized for the United States in Table 6. The sparseness of entries, compared with Table 4, is indicative of the exclusion of trade credit influences in many empirical studies. Branson's results showed that an assumed $100 million increase in the quarterly flow of exports from the United States will induce a $90 million increase in the stock of short-term claims held by the United States in the form of trade credit. His comparable figure, using monthly data, was only a third as large. Prachowny's results indicated that the assumed increase in exports from the United States would generate a continuing flow of claims against foreigners equal to $21 million per

[31] It may, nevertheless, be of interest to note William H. Branson's conclusion, *op. cit.*, p. 160, that a one per cent change in the U.S. interest rate, inclusive of feedback effects, would result in a net capital inflow of $2.5 billion based on his quarterly model, and a $3.0 billion inflow based on his monthly model. These are presumably total stock effects, since he has constrained the flow effect to be zero. The flow equations in Martin F. J. Prachowny, *A Structural Model of the U.S. Balance of Payments*, Amsterdam, 1969, pp. 119–20, suggest that a one per cent interest-rate change will improve the U.S. balance of payments by $161.2 million in the first quarter, but that this improvement will not be perpetuated when the lag structure of the model is taken into account. Such evidence as the foregoing is, in our judgment, too meager for use in formulating policy decisions for the balance of payments.

[32] This is the case, also, with the work by Stanley W. Black, "Theory and Policy Analyses of Short-term Movements in the Balance of Payments," *Yale Economic Essays*, Spring, 1968. Since his model involved a number of complex interactions, it was not possible to derive a simple interest-rate effect for inclusion in Table 5.

TABLE 6

Summary of Estimated Effects of a $100 Million Increase Per Quarter in Merchandise-Trade Flows upon the Capital Account of the United States
(*millions of dollars*)

Capital Item	Source of Estimate [a]	Exports	Imports	Trade Balance
U.S. claims				
Short-term:				
Total	Branson	94		
	Branson [b]	30		
	Prachowny	11 [c]		
	Laffer			32 [c]
Claims on Japan	Bryant and Hendershott [d]			
U.S. liabilities				
Short-term:				
Total	Branson		72	
	Branson [b]		112	
	Laffer		50 [e]	

[a] See references cited in Table 4.
[b] Fit with monthly data.
[c] Per quarter.
[d] Constrained to unitary elasticity.
[e] With respect to world exports.

quarter. Laffer's results, also based on a flow model, implied that an increase in the trade balance of the United States of the given amount would increase short-term claims of the United States by about one-third on a continuing basis. Bryant and Hendershott did not measure the influence of exports on trade credit, since they constrained the relationship to be of unitary elasticity. The results for short-term liabilities of the United States can be interpreted in a similar manner.

The results in Table 6 are thus very sketchy, indicating that much remains to be done here as well.[33] This is especially the case since we

[33] In this instance, the only result that we can report for Canada comes from Sven W. Arndt (see reference in Table 5), who estimated from a flow equation that a $100 million increase in Canada's trade balance would induce a $41 million reduction in the quarterly flow of Canadian net short-term capital.

consider the relationships underlying Table 6 to have been misspecified. That is, the stock of trade credit implied by a fixed flow of goods is not likely to be very large. Rather, credit extension is related to increases in the flow of goods associated with the profit possibilities of new and rapidly expanding markets, and with the limitations experienced by new firms—especially with regard to their ability to generate internal cash flows and to borrow domestically.

DIRECT INVESTMENT

We have already indicated that the theoretical analysis of direct investment is still very much in its infancy. It is not surprising, therefore, that most of the quantitative work that has been done to date, except perhaps for Stevens',[34] is rather impressionistic and ad hoc.[35]

IMPLICATIONS FOR FURTHER RESEARCH

IN GENERAL, we conclude that both the theoretical and empirical analysis of international capital movements require considerable improvement before an adequate understanding of these phenomena can be claimed. We have suggested that theoretical views of capital flows of all varieties can be improved by an explicit analysis of the transactors involved. Perhaps the greatest shortcoming of the usual activity framework is the failure to recognize the importance and complexity of national and international corporations.

The absence of an appropriate theory has led empirical workers to ad hoc and questionable specifications of their models in several instances. We must, therefore, view these empirical results with con-

[34] Guy V. G. Stevens, "Fixed Investment Expenditures of Foreign Manufacturing Affiliates of U.S. Firms: Theoretical Models and Empirical Evidence." *Yale Economic Essays*, Spring, 1969.

[35] See, for example, the equations fitted in the studies for the U.S. by Martin F. J. Prachowny, *op. cit.*, and Anthony E. Scaperlanda and Laurence J. Mauer, "The Determinants of U.S. Direct Investment in the EEC." *American Economic Review*, September, 1969. For Canada, see John F. Helliwell, et al. and Rudolf R. Rhomberg (references cited in Table 5).

siderable skepticism. In addition, there are numerous empirical problems which could profit by further work. We have tried to catalogue these problems and, wherever possible, to indicate possible solutions.

We began by noting that our paper does not purport to offer the last word on the problems discussed, and that we have made no empirical estimates of our own. Rather, our primary objective has been to elucidate the most important problems in a way that may stimulate efforts toward their solution. Too often, researchers, rushing to the data, have either failed to identify, or chosen to ignore, many theoretical and empirical problems. Such premature use of the strictly limited data forces empirical work to assume an hypothesis-generating role rather than the much more important role of selecting among alternative hypotheses.[36]

[36] See Edward E. Leamer, *op. cit.*, for an extended discussion of this point.