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The Estimation of International Capital Movements

Chapter 2 provided a discussion of the demand relationships that determine the international flow of goods and services. In this chapter we shall complete our analysis of the determinants of the balance of payments by discussing the nature, causes, and measurement of international capital flows. The present state of econometric inquiry into the capital account is in sharp contrast with the current account. The theoretical aspects of the current account are comparatively well developed and the import/export demand relations involved are highly standardized. Moreover, there are numerous studies of the current account that provide generally good statistical results. In contrast, the theory of capital-account relationships is not well formalized and there exists considerable leeway in the choice of explanatory variables. Furthermore, there are but a handful of econometric studies of capital flows, most of which provide generally poor statistical results.

The explanation for the relative intractability of the capital account can be found in the fundamental differences in the relationships involving real and monetary phenomena. The flow of goods and services is subject to the very powerful economic forces governing supply and demand of tangible items. The relative stability of tastes will assure the relative stability of the demand for goods as a function of price. Significant instability in tastes is most unlikely to occur, so that tastes may ordinarily be neglected in the demand functions. Capital flows, on the other hand, will be influenced importantly by changes in tastes for the alternative securities. The desire to hold a security will be a function of the expected rate of return, not the market rate. This expected return is determined subjectively by the investor and involves a decision that may be quite short-lived. Capital flows consequently may result more from changes in tastes for securities (i.e., expected yields) than from changes in the observed market returns. Theoretical and empirical analysis of security holdings will need to deal with this fact accordingly by developing hypotheses on the formation of expectations. We can anticipate that the

isolation of such psychological influences will be somewhat more difficult than the isolation of income and price effects in the analysis of the demand for real goods and services.

The principal role played by nonprice allocative variables forms a second source of difficulty for econometric study of the capital accounts. In our discussion of the demand for imports/exports, we mentioned the role of the capacity utilization variable in reflecting the use of queues to limit sales as an alternative to price increases. A similar phenomenon influences the flow of capital. The bank-lending rate may be set at some low figure while at the same time the bank turns away potential borrowers. Such borrowers may then look to foreign sources for funds. However, this cannot be thought of as a queue phenomenon, since waiting in line will not assure servicing. Rather, credit rationing reflects a suspension of the normal demand-and-supply mechanism. Markets are not cleared and the observed price-quantity point will not reflect the hypothesized ex ante demand.

A third source of difficulty is the important impact of institutions and institutional changes on capital flows. The impact of the institutional environment on the flow of real goods is likely to be minor when compared with its impact on capital flows. Restrictions on capital movements may be quite subtle and highly variable. A firm knowledge of the institutions surrounding the flow of capital will surely be an important element in any study of capital flows that is to be taken seriously.

Keeping the foregoing points in mind, let us now turn directly to the issues involved in measuring the determinants of the capital account. Our discussion will be divided into two sections. The first section provides a very general and comparatively lengthy theoretical description of international capital flows of all varieties, followed by presentation of a framework for analyzing particular capital flows. Our theoretical discussion is developed at some length because the lack of an explicit theory has led to improper specifications of the underlying behavioral relationships in many published empirical studies. In the second section we will discuss the empirical application of the theoretical model, dealing particularly with the concrete choice of explanatory variables.

THE THEORY OF INTERNATIONAL CAPITAL MOVEMENTS

The theory of international capital movements is currently in considerable turmoil. Traditionally, models of international capital transactions have been based upon a set of independent activities, typically trade, interest arbitrage, and forward market speculation. Capital movement, according to this view,

is a flow phenomenon; that is, the flow of capital is related to levels of other variables such as interest-rate differentials. Flow models of capital movements have recently come under considerable attack. They imply, for instance, that in a static world, with fixed interest rates, investors will continue to accumulate claims on foreigners indefinitely. The inadequacy of such an assumption has led to the construction of stock models of capital movements, based upon portfolio-adjustment assumptions, according to which the stock of claims on foreigners is related to levels of variables such as interest-rate differentials and net worth.

Although the current stock models are clearly preferable to flow models of international capital movements, they are not wholly adequate either. Before discussing several shortcomings of these models, let us consider one in some detail. According to the stock models, the international flow of capital results from the decisions of individual investors who allocate their net worth among the alternative investment opportunities. This allocation is very similar to the allocation of income to various consumable commodities. In the case of the investor, net worth is allocated to investment opportunities to provide high yield and low risk.[1] The mixture of expected return and risk will depend on the investor's preferences. Assuming two alternative types of investments and one type of credit, we may write the following expression

$$K = K(\mu_k, \sigma_k, \mu_c, \sigma_c, \mu_b, \sigma_b, W) \tag{4.1}$$

to indicate that the investment in asset K will depend on the expected return to K, μ_k; the risk associated with K, σ_k; the return μ_c and risk σ_c of the alternative investment; the expected cost and cost-variability (say, from default) of borrowing, μ_b and σ_b; and net worth W.[2] We can expect that increases in return μ_k and decreases in risk σ_k will be associated with increased holdings of K. Similarly, reductions in return and increments to risk of the substitute will induce increases in the allocation of funds to K. We would generally expect W to have a positive effect on the holdings of K just as income has a positive effect on the demand for real goods. However, in perverse cases, increases in net worth may be associated with reductions in the holdings of a security. This is analogous to the inferior good in real demand analysis.

In addition to the opportunity to purchase securities, the investor may be able to issue securities himself or equivalently obtain bank loans to secure additional funds. Increases in the rate and risk of borrowing, μ_b and σ_b, will stimulate reductions in the holdings of K. For example, increases in the rate at which credit can be obtained to finance inventories will result in the reduction of inventory holdings.

[1] The investor may dislike uncertainty or he may value losses of income much more highly than additions and therefore guard against such loss by avoiding risky investments.

[2] The risk variables may or may not be associated with the standard errors of subjective probability distributions. They are meant to be simply what the investor states about the risk quite apart from any sophisticated ideas concerning what risk is or should be.

We have already suggested by the use of the borrowing variables μ_b and σ_b that our hypothesized investor may issue securities (borrow) as well as purchase them. For example, banks may be characterized as borrowing short-term funds in order to finance long-term lending. The supply of securities or equivalently the demand for credit may also be described by Equation (4.1) with minor modifications of the explanatory variables. That is, the supply of security K will depend on the expected interest payment μ_k and the variability of that payment (say, from default) σ_k; similar variables for a substitute credit source, μ_c and σ_c; the return and risk that are expected when the funds are allocated to some investment opportunity, μ_b and σ_b; and net worth W.

Equation (4.1) has been used to describe the desired stock of assets and, with a slight modification, the desired stock of liabilities. The observed capital flow corresponds to a change in the stock of these assets/liabilities that is induced by a change in the explanatory variables on either the demand or supply side. A complete empirical examination of international capital movements will thus require estimated equations for both the demand and supply of securities. The theory we will discuss presently will concentrate primarily on the demand side. The supply of securities will result from conditions internal to each country and an examination of the supply side would require us to discuss internal monetary relations. We will therefore assume that internal conditions in each country determine the prevailing interest rates and that the flow of capital results from demanders seeking securities at the internally determined rates. But in any event, if desired, the general equation (4.1) may be applied to domestic monetary relations, and a full model of the international monetary system can be constructed within the same framework.

The foregoing very general description of the capital decision is meant to describe the demand and supply of funds embodied in all capital instruments, including short-term and long-term, portfolio, and direct investments. Before discussing the selection of the variables that appropriately reflect the risks and returns of specific types of instruments, let us consider two important shortcomings of the portfolio-adjustment view of capital movements. 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 this leaves undetermined the scale of portfolio holdings. In many cases, capital movements may be more the result of decisions that influence the size of net worth rather than the allocation of net worth among potential assets. To put this in another way, the portfolio-adjustment models provide only a partial explanation of capital movements.

The second drawback concerns the excessive simplicity of the model. In effect, it asserts the obvious: investments are chosen on the basis of risk and return. This tends to obscure the true complexity of the investment decision.

The formation of expectations regarding risks and returns is a very complicated phenomenon. In addition, short-term constraints on various transactors may be so severe that long-run portfolio-balance considerations are secondary in determining behavior. With these limitations in mind, let us resume our discussion of the portfolio-adjustment model.

The Stock-Flow Problem We have already mentioned the fact that the traditional view of international capital movements is based upon a *flow* model in which the flow of capital (the change in the stock) is related to interest-rate variables. The portfolio-adjustment model we have just discussed relates the *stock* of capital to interest-rate and net worth variables. Still a third view would have us believe that some capital flows result from stock decisions and others from flow decisions.[3]

There should be no room for confusion on this point. Careful consideration of the behavior of the relevant transactors implies that the portfolio and credit decisions and direct investment are *stock* phenomena. The desired *stock* of claims against foreigners is related to the return, risk, and net worth variables. In a static world there would be no capital flow as portfolios would be fully adjusted to the desired levels.

Of course, a growing net worth will be allocated to the investment opportunities according to the levels of the yields. This is sometimes confusedly referred to as a flow, when in fact it is a stock adjustment to the change in net worth. We should also observe that if we neglect the net worth variable, then the data may be more amenable to a flow description. This can be taken to be the principal reason why such investigators as Kenen [18], Black [3], and Stein [29] have had considerable success with flow equations. Another possible explanation lies in the adjustment-lag structure.

Although the capital movements necessarily result from a stock decision, it is unlikely that actual stocks are instantaneously adjusted to the desired levels. The lag between a change in an independent variable and recognition of that change, the lag between recognition and action, the time spent in queues waiting to be serviced by creditors, and transactions costs will all tend to delay the adjustment of the actual stock of credit to the desired stocks.

There is a possibility that although the capital movement is actually a stock phenomenon, it may appear to be a flow due to the nature of the response lag.[4] This will be the case when the adjustment is spread evenly over a large number of periods. Thus, suppose that the actual stock Y_t is related to explanatory variables as follows

$$Y_t = k + \sum_{i=0}^{\infty} \alpha_i X_{t-i} \tag{4.2}$$

[3] These issues pertain especially to the works of Bell [2], Kenen [18], and Stein [29].
[4] This point is made by Hendershott in [29].

Then the flow $Y_t - Y_{t-1}$ is given by

$$Y_t - Y_{t-1} = \alpha_o X_t + \sum_{i=0}^{\infty} (\alpha_{i+1} - \alpha_i) X_{t-i-1} \tag{4.3}$$

If the values of α are such that $\alpha_{i+1} \simeq \alpha_i$ for all i, then Equation (4.3) becomes

$$Y_t - Y_{t-1} \simeq \alpha_o X_t \tag{4.4}$$

that is, the *flow* is related to the *level* of the explanatory variable. Thus, we see that a stock phenomenon may appear to be a flow phenomenon when the adjustment to the desired stock is rather evenly spread over many periods.

Our general description of the capital decision will now need to be specified more precisely for certain subcategories of assets. In the remainder of this section we will discuss the selection of the variables that appropriately reflect the risks and returns of specific types of investments and their close substitutes.

Short-Term Portfolio Investment [5] We will discuss the theory of short-term capital movements in the context of a two-country world. For convenience, we will call the domestic country America and the foreign country England. An American investor seeking to purchase a foreign security for investment purposes would first buy pounds at the going rate and subsequently purchase the foreign security. At the maturity date of the security he would receive the principal and interest earnings in pounds, which would be redeemed for dollars through the foreign exchange market. If the exchange rate could not change during the maturity period, then the investor would be assured of earning the foreign interest rate in his own currency, dollars. If, however, the price of pounds were to fall substantially during the maturity period, the domestic investor would be left holding relatively cheap pounds and his investment may have yielded a net loss in terms of dollars. The need to insure against such a loss can be met by means of a transaction in the market for forward pounds. Thus, for example, when a 90-day English security is purchased, the American investor would simultaneously assume a contract to sell the pounds in 90 days at the currently quoted forward rate, thereby insuring against any loss (or gain) from a fluctuation in the exchange rate. Such a transaction is referred to as covered interest arbitrage to indicate that the underlying motive is interest earnings and that the possibility of exchange loss is "covered" by the forward contract.

[5] Several theoretical descriptions of short-term capital movements exist in the literature. The one presented here is essentially a modification of the work of Levin [23], which is based on a theoretical analysis of portfolio selection in the context of the foreign exchange market.

While there are quite naturally several markets for forward pounds of varying contract date, we will assume for the present that only 90-day forward foreign exchange is available. Similarly the domestic and foreign securities are assumed to have 90-day maturities. The following notation will be employed:

R_s = the current spot rate; the dollar price of one pound delivered today.
R_f = the current forward rate; the dollar price today of one pound to be delivered in 90 days.
i_a = the American 90-day interest rate.
i_e = the English 90-day interest rate.
p_e = the pound price of English goods.
p_a = the dollar price of American goods.

Three opportunities for investment are available to the domestic investor. He may purchase domestic securities; he may purchase foreign securities with the exchange risk covered in the forward market; or he may speculate in the forward market. Speculation in the forward market involves the acquisition of contracts to buy (sell) foreign exchange in 90 days in the hope that the future spot rate will be higher (lower) than the current forward rate. When the contract becomes due, the speculator sells (buys) pounds in the spot market to discharge (obtain) the foreign exchange obtained (necessitated) by his contract. An alternative investment opportunity, uncovered interest arbitrage, involves the purchase of a foreign security without a cover in the forward market. We will think of such a transaction as being covered interest arbitrage with a simultaneous and equal speculative purchase of a forward contract.[6] Accordingly, uncovered interest arbitrage will be implicitly examined by considering covered arbitrage and speculation.

The domestic investor will allocate his net worth W_a among the alternative investment opportunities in an effort to achieve high yield and low risk. The holding of English assets acquired by the covered interest-arbitrage transaction is given by

$$A_a = A_a(\overset{+}{\mu_e}, \overset{-}{\sigma_e}, \overset{-}{\mu_a}, \overset{+}{\sigma_a}, \overset{-}{\mu_s}, \overset{+-}{\sigma_s}, \overset{+}{W_a}) \tag{4.5}$$

where μ_e and μ_a are the expected yields of the foreign and domestic securities and μ_s is the expected yield from speculation, while σ_e, σ_a, σ_s are the risks associated with these investments. The influences of these independent variables are given by the signs above them.

[6] Suppose for example that an investor transfers \$1 through the spot market to obtain a foreign security worth $1/R_s$ pounds. This transaction is equivalent to a \$1 transfer through the spot market covered in the forward market by a sale of forward pounds equal to $(1/R_s)(1 + i_e)$ combined with a forward speculative purchase of $(1/R_s)(1 + i_e)$ pounds. The investor who engages in uncovered arbitrage will do so only if both the covered arbitrage and the speculative position are expected to yield a return.

Increases in the covered return to foreign securities μ_e, and decreases in the risk of holding them σ_e will induce shifts out of the domestic securities and into the foreign securities, that is, increases in the arbitrage stock demand A_a. The domestic return μ_a and risk σ_a will have just the opposite effect on A_a. The signs on μ_s and σ_s are not so obvious since there is no monetary constraint on the speculative position similar to the portfolio-size constraint on purchases of domestic and foreign assets. However, an increase in the return on the speculative position will be accompanied by an increased speculative position and therefore increased total risk. To economize on risk elsewhere, the investor may shift out of the relatively risky foreign asset and into the domestic security, and consequently reduce A_a. The sign on σ_s is somewhat more ambiguous. Increases in the speculative risk will be associated with a reduction in the speculative position. Whether this will be translated into changes in the arbitrage demand is unclear. Except in the perverse case of the inferior security, the influence of the wealth variable W will be positive.

The expected return variables in Equation (4.5) may be defined somewhat more concretely. For the moment we will assume that the security is denominated in the foreign currency. The return on covered interest arbitrage μ_e can be calculated as follows. The domestic investor will use one dollar to purchase $1/R_s$ in pounds, buy a foreign security of that value, and assume a forward contract to sell $(1 + i_e)/R_s$ pounds in 90 days at the rate R_f. In 90 days the foreign security will yield $(1 + i_e)/R_s$ pounds, just enough to meet the contract assumed earlier. That contract will provide $(1 + i_e)R_f/R_s$ dollars, for a nominal rate of return of $(1 + i_e)R_f/R_s - 1$. But this is not an entirely riskless investment. In the first place, there is a possibility that exchange controls will be implemented by the foreign country. There is also the possibility that the security will have to be sold before maturity to finance domestic transactions. Finally, the security may be sold before maturity to switch funds to domestic securities to take advantage of increases in yields. These considerations imply: [7]

$$\mu_e = \frac{(1 + i_e)R_f}{R_s} - 1 + \bar{v}_e \tag{4.6}$$

and

$$\sigma_e = \sigma_e(v_e) \tag{4.7}$$

where $\bar{v}_e$ is the expected influence of the three considerations mentioned above on the rate of return, and $\sigma_e(v_e)$ reflects the variability or risk associated with that return.

The domestic security will yield an interest rate of i_a if held to maturity. As with the foreign asset, there is a possibility of switching into a higher-

[7] Balances for transactions purposes may be considered by adjusting these yields to include the convenience rendered by the liquid balance.

yielding asset, this time the foreign security. In addition, the domestic security may have to be liquidated to finance transactions. We have, therefore,

$$\mu_a = i_a + \bar{v}_a \tag{4.8}$$

and

$$\sigma_a = \sigma_a(v_a) \tag{4.9}$$

with $\bar{v}_a$ and $\sigma_a(v_a)$ defined to reflect the variability of the rate of return associated with the factors discussed above.

A speculative contract to sell one pound in 90 days at the current forward rate R_f will yield a profit of $(R_f - R_s^{90})$ dollars in 90 days, where R_s is the spot rate in 90 days. The expected return will not depend on the actual spot rate in 90 days, but rather on the expected future spot rate, $\overline{R_s}^{90}$. Thus we have

$$\mu_s = | R_f - \overline{R_s}^{90} | \tag{4.10}$$

and

$$\sigma_s = \sigma_s(R_s^{90}) \tag{4.11}$$

where $\overline{R_s}^{90}$ is the expected future spot rate and $\sigma_s(R_s^{90})$ reflects the investor's confidence that the future rate will actually conform with his expectations.

To this point the form of the function in Equation (4.2) has been left arbitrary. One form in particular has received considerable attention in both theoretical and empirical discussions of short-term capital flows. That is, the arbitrage demand A_a has been taken to depend on the expected yields only through the difference in those yields, the covered interest differential $\mu_e - \mu_a$

$$A_a = A_a(\mu_e - \mu_a, \sigma_e, \sigma_a, \mu_s, \sigma_s, W_a) \tag{4.12}$$

Furthermore, it has been assumed that American investors will hold English securities only when the expected yield on the English securities exceeds the expected yield on the competing American security; that is, $A_a = 0$ when $\mu_e - \mu_a \leq 0$.[8] This restriction just noted ignores the possibility of risk reduction through portfolio diversification, a principle that may induce the securing of a relatively low-yield asset. Moreover, a restriction such as this, being essentially empirical in character, should not be imposed upon the data unless there exists overwhelming support for it on a priori grounds.

[8] If slight increases in μ_e over μ_a bring forth a flood of American investors seeking English securities, and if English investors behave symmetrically, the forward and spot rates will adjust to maintain the equality of the yields, $\mu_e = \mu_a$. In the absence of the uncertainty terms, this becomes

$$\frac{(1 + i_e)R_f}{R_s} - (1 + i_a) = 0$$

which can be manipulated [neglecting $i_e(R_f - R_s)/R_s$], to yield the familiar "interest parity condition"

$$\frac{R_f - R_s}{R_s} = i_a - i_e$$

relating the forward premium to the interest rate differential.

The selection of yields in Equations (4.6) and (4.7) has been based on the assumption that the foreign security is denominated in the foreign currency. In some cases the security will be denominated in dollars, and the risk of exchange-rate fluctuation is transferred to the security seller. For example, American banks may issue dollar-denominated loans to foreign customers. In this case, the appropriate yield variable in the supply-of-funds equation will be the yield quoted in the contract, while the yield variable in the demand-for-funds equation (supply of securities) will include the adjustment necessary to cover in the forward exchange market.

It may be noted parenthetically that what we have just said departs from our earlier-stated intention of concentrating on the demand-for-securities equation rather than the supply. We do so because the roles of the two equations have been reversed. While before, the borrowing rate was thought to be essentially internally determined and the international capital movement resulted from investors' seeking out of foreign investment opportunities, we now have the lending rate being internally determined with borrowers seeking out loanable funds. The only theoretical or empirical difference is the question of who undertakes the international exchange of capital or who bears the exchange risk, and what the appropriate return variables to use in the demand and supply equations consequently are.

The equations just discussed describe the American demand for English securities, or equivalently the American supply of funds to English borrowers. With minor obvious modifications the same equations can describe the demand for American securities by English investors.

Speculation We have just described speculation as the acquisition of forward contracts to buy (sell) foreign exchange in anticipation that the future spot rate will be higher (lower) than the current forward rate. The expected yield from such a transaction is given by Equation (4.10) as the absolute difference between the current forward rate and the expected future spot rate.

It should be emphasized that speculation does not directly involve the flow of capital since no securities are transferred between countries by such a transaction. However, speculative activity may influence the movement of capital in three different ways. First of all, the holding of foreign securities by domestic investors described by Equation (4.5) is directly influenced by the return and risk associated with speculative transactions. Thus, for example, in periods when the expected return to speculation is high, investors may shift out of foreign securities and into domestic securities. Secondly, speculative activity will influence the forward rate and consequently the

covered return on foreign securities. For example, a speculative attack on the pound will involve the sale of forward pounds in anticipation of a fall in the spot rate (a devaluation of the pound). The sale of forward pounds will depress the forward rate and consequently the covered return on English securities μ_e. This will make English securities less attractive to American investors and a capital flight from English securities will occur. Finally, the speculative activity may influence the expected return and risk variables. Periods of considerable speculative activity associated with large expected returns and low risk to speculation are likely to be accompanied by the fear of capital controls and therefore a reduction in the expected return and an increase in the risk associated with the foreign security. This will also serve to make the foreign security less attractive.

If our only concern were to estimate the demand-for-capital equation (4.5), then there would be no reason to discuss a speculative function. The considerations in the paragraph above could at most influence our choice of explanatory variables. However, a complete model of the balance of payments will properly include the forward exchange rate as an endogenous variable. Speculative activity will have an important impact on that forward rate and should be included in the model. Our discussion of speculation is thus included in this chapter not because it represents a capital movement directly, but rather because it is part of the general portfolio decision which includes the acquisition of foreign securities.

The speculative purchases or sales of forward pounds by American investors is given by

$$S_a = \text{sign}\,(\overline{R}^{90} - R_f) \times S_a(\overset{+}{\mu_s}, \overset{-}{\sigma_s}, \overset{-}{\mu_e}, \overset{+}{\sigma_e}, \overset{-}{\mu_a}, \overset{+}{\sigma_a}, \overset{+}{W_a}) \qquad (4.13)$$

where the signs above the variables indicate their influence on S_a. The first term, sign $(\overline{R}^{90} - R_f)$, indicates the sign of the difference between the expected future spot rate and the current forward rate and will determine whether the investor is buying or selling forward pounds. If the expected future spot rate exceeds the current forward rate, this first term will be positive, indicating a demand for forward pounds. If the reverse is true, the term will become negative and the speculative position will be composed of contracts to sell or supply pounds. The scale of the speculative position will be determined by the second term. The explanatory variables are defined by Equations (4.5) to (4.11), and the signs above them follow from the discussion of Equation (4.1).[9]

Parenthetically, we should note that we have implicitly assumed that forward contracts are available without cost. In fact, bankers and brokers

[9] This discussion will be amended somewhat when a "margin" is required to assume a forward contract, since the margin requirement reduces the effective rate of return on speculation and also introduces the speculative position into the portfolio-size constraint.

may either require a margin on the contract or deny the contract altogether. This considerably complicates our theory, particularly since the margin requirement and the extent of rationing may vary considerably, depending on the turbulence in the foreign exchange markets. When margins are required, both the return on covered interest arbitrage and the return on forward market speculation will be reduced by an amount depending on the extent and terms of the margin requirement. When forward market contracts are unavailable, only uncovered arbitrage will be possible and the foregoing theory will have to be appropriately amended.

Trade Credit and Trade Arbitrage The second main type of short-term capital movement consists of trade credit, loans issued ostensibly for the financing of international trade. In the course of their business dealings, traders will have an opportunity to borrow funds from one country and invest them in another. In some cases, funds are supplied by the exporter or the exporter's bank to allow the importer a temporary delay in payment for goods received. That is, funds are borrowed from the exporting country and invested in inventories in the importing country. This flow is appropriately called trade credit. In other cases, the funds may appear to be financing trade in this fashion when in fact they are invested in portfolio securities. This is a pure interest arbitrage transaction involving borrowing in one country at a relatively low interest rate and investing at a higher rate in another country. It is appropriately termed trade arbitrage. Other individuals may desire to undertake a similar transfer of funds, but will be unable to secure the foreign loans with the ease that traders can. We will consider the case of trade arbitrage first.

Let us assume that there is no time required for the shipment of goods between the countries and that the importers are able to forecast sales with perfect accuracy. In this case, there is no need for inventory since the importers will arrange to have the goods delivered on precisely the same day as they are sold. There is thus no need for commercial credit. The American importer may pay for the goods by purchasing pounds on the spot market. Alternatively he may have "hedged" earlier against the possibility of exchange-rate fluctuation through a forward contract to buy pounds assumed 90 days before the transfer of funds was required. Neither of these transactions involves the flow of capital. However, the importer may make a profit if he can obtain credit. He may delay payment for the goods by borrowing funds from an English bank at the rate i_e. In this case, the P_e pounds necessary to pay the English exporter are supplied by a bank in the foreign country. The American importer purchases a forward contract to buy $P_e(1 + i_e)$ pounds in 90 days at the rate R_f to meet his obligation with the bank. A total of $P_e(1 + i_e)R_f/(1 + i_a)$ dollars is used to purchase American securities, which in 90 days will yield $P_e(1 + i_e)R_f$ dollars, just enough to meet the forward

contract to buy pounds. This transaction yields him a current savings of $P_e[R_s - (1 + i_e)R_f/(1 + i_a)]$ dollars.

This transaction consists of an immediate payment for the imports through the spot market and a simultaneous pure interest arbitrage transaction involving borrowing from the English bank and purchasing an American security. Funds that may appear to be financing trade are in fact going into American securities. According to our general model of the portfolio decision, the demand for such credit (supply of securities) will be given by

$$\mathrm{Cr}_e^a = \mathrm{Cr}_e^a(\mu_e, \sigma_e, \mu_c, \sigma_c, \mu_a, \sigma_a, W_a) \tag{4.14}$$

to denote that the demand for English credit (in dollars) by American importers depends on the cost and cost variability of that credit and alternative credit, μ_e, σ_e, μ_c, σ_c; the rate and variability of return to be gained from that credit, μ_a, σ_a; and the net worth of the American importer, W_a. The natural definitions for μ_e and μ_a are

$$\mu_e = \frac{(1 + i_e)R_f}{R_s} - 1 \qquad \text{(nominal cost of credit)} \tag{4.15}$$

$$\mu_a = i_a$$

The possibility of exchange control affecting capital flows associated with merchandise trade is very remote, and σ_e and σ_a may be taken therefore to be zero.

One may wonder whether Equation (4.14) is an accurate representation of the demand for trade arbitrage funds. When $\mu_e < \mu_a$, each dollar secured is expected to yield a net return. It would appear that traders would desire as much credit as there is available. On the other hand, Equation (4.14) suggests that traders may spend more time seeking out arbitrage funds when the spread between μ_e and μ_a is large. Similarly, the trader's net worth W_a may influence his search for arbitrage funds. Of course, both of these possibilities may prove to be unimportant empirically.

There will also be a flow of funds associated with American exports, or English imports. The English importer may anticipate the required payment and borrow from his bank $P_a/R_s(1 + i_a)$ pounds. These funds are used to purchase $P_a/(1 + i_a)$ dollars of American securities, which in 90 days would be worth just the amount required to purchase the American goods. As before, this is a combination of a trade decision and a portfolio decision. The portfolio decision can be described as

$$\mathrm{Cr}_e^e = \mathrm{Cr}_e^e(\mu_e, \sigma_e, \mu_c, \sigma_c, \mu_a, \sigma_a, W_e) \tag{4.16}$$

to denote that the demand for English credit (in pounds) by English importers depends on the factors already mentioned. The natural definitions in this case are

$$\mu_e = i_e$$

$$\mu_a = \frac{(1 + i_a)R_s}{R_f} - 1 \qquad \text{(nominal cost of credit)} \tag{4.17}$$

$$\mu_c = \mu_a$$

$$\sigma_c = \sigma_a = \sigma_e \simeq 0$$

We have stated that trade arbitrage may be thought to involve jointly the trade flow and the pure interest arbitrage financed by the credit source. Now any investor, regardless of whether he is an importer or not, has the opportunity of engaging in the pure interest-arbitrage transaction. He needs no funds of his own as banks (or other creditors) extend credit to finance the interest arbitrage. The profit to be made is limited only by the amount of credit available. There are, however, two important distinctions between the trader and the nontrader. The first has already been mentioned and concerns the risk variable. Trade arbitrage is appropriately thought to be a riskless investment opportunity. Exchange control is unlikely to affect capital flows associated with export and import trade. Accordingly both the trader and his credit sources will be much more willing to engage in pure interest arbitrage than a nontrader and his creditors. Moreover, the credit source may not realize that he is supporting pure interest arbitrage. The second distinction applies only to the case when funds are being sought by a nonresident. The trader will have close contacts with foreign sources of credit not available to other nonresidents. Accordingly, we will assume that credit is available only to traders.

If as suggested above, traders seek all the credit that is available for trade arbitrage, the flow of funds will be completely determined by the willingness of creditors to supply funds. According to our portfolio selection theory, the supply of credit by English creditors to American importers is given by

$$\mathrm{Cr}_e^a = \mathrm{Cr}_e^a(\mu_k, \sigma_k, \mu_c, \sigma_c, \mu_b, \sigma_b, W_e) \tag{4.18}$$

where μ_k, σ_k reflect the return from the credit; μ_c, σ_c reflect returns to alternative investments; μ_b, σ_b reflect the cost of borrowing; and W_e is the net worth of the English creditor. In the event that the credit source is also an exporter, the return from that credit should include the profit rate on the exports induced by the credit extension. The risk that capital controls will affect the return can be thought to be zero up to some level of credit that increments with the level of English exports. Accordingly, English exports may be an explanatory variable.

An equation identical to (4.18) will describe the extension of credit by English banks to English importers. In this case the return μ_k will necessarily not include any profit rate. In addition the risk term should include English imports and not exports.

Finally, let us consider the case when the capital flow is used to finance inventories of the traded good, that is, when it is trade credit. We must discard the assumption that there is no time required for shipment and no uncertainty with regard to sales. Both of these considerations will lead to the holding of inventory. The former requires inventories in the holds of ships in transit and the latter requires inventories on hand. Such inventories will be financed by commercial credit. The source of that credit will depend on the nominal interest rates. American importers will look to English banks when

$$\frac{(1 + i_e)R_f}{R_s} - 1 < i_a \tag{4.19}$$

that is, when the nominal interest rate is lower in England than in America or when the covered interest differential exceeds zero. The demand for such credit will increment with the return to inventory holdings.

Domestic industries will also have need for funds to finance inventories. If those funds are most cheaply secured abroad, then there will be a natural desire on the part of all domestic industries to seek foreign sources of credit. However, the same considerations that deter nontraders from pure interest arbitrage financed by commercial banks will also deter domestic industries from using foreign funds to finance inventories. These considerations are the risk associated with capital controls and the lack of close business contacts with foreign creditors. Nonetheless, some short-term credit may be extended to finance trade strictly external to the lending country, and a variable reflecting returns to such inventories might be taken into account.

Only minor adjustments are needed to include the inventory factor. The amount of credit demanded by American importers from English sources [Equation (4.14)] will have to include a return-to-inventory variable. This simply reflects the fact that the return from the investment of the loan will be the return to inventory when that loan is used to finance inventories rather than arbitrage. The supply-of-credit equation (4.18) may also be affected by the inventory factor. Credit extended to finance inventories of exported goods is likely to generate significantly more exports and hence more profit than similar extensions of credit for arbitrage.[10] Accordingly the return to credit extended for inventory purposes will far exceed the return to arbitrage credit.

[10] This point will also apply to the flow of real goods. The extension of credit for inventories is likely to have a prime impact on the value of the international flow of goods, since presumably without credit no flow could occur. A rather small extension of credit for inventories may beget large increases in trade flows. The extension of credit for trade abritrage, on the other hand, is likely to have a marginal impact on the international flow of goods. Such arbitrage credit will provide a source of additional profit to the trader, which may be passed on to the consumer in the form of lower prices, thereby inducing a greater volume of sales and a larger flow of goods. The import/export functions used by Levin [23] in his model of the foreign exchange market include this influence.

Long-Term Portfolio Investment Credit instruments are divided in practice somewhat arbitrarily into long-term and short-term categories with a maturity date of one year as the borderline. For our purposes, however, the distinction between short- and long-term capital flows is not to be sharply drawn, although of course the explanatory variables may have to be adjusted to apply specifically to the long-term instruments.

One important distinction between long- and short-term capital that deserves emphasis concerns liquidity and risk. Long-term securities will be somewhat less liquid than short-term securities. But this amounts to little more than observing that long-term securities are not close substitutes for transactions balances. Related to this is the added risk associated with exchange controls, since as the maturity date moves into the future, the investor becomes less and less certain concerning the possibility of exchange control.

Another important feature of long-term investment may be the absence of a well-organized forward market. Although the investor may be able to obtain a forward cover for his investment, the cost of that cover may possibly be prohibitive. Long-term investment may therefore be conveniently thought to include an important speculative element.

The appropriate return variables to explain long-term bonds will be obvious since they have certain stated yields associated with them. The appropriate return variables to use with equities will not be obvious, however. The returns to equities are dividends and capital gains. In order to explain the acquisition of equities, we will have to understand the formation of expectations about dividends and capital gains. The appropriate choice of variables is discussed further in the next section.

It should be noted that the short-term interest rate may have an effect on long-term security acquisitions. The substitution between short- and long-term securities on the demand side may not be important, but the ability to borrow short-term funds at low interest rates may well induce significant additional long-term acquisitions. In terms of our general model described by Equation (4.1), this consideration is reflected in the borrowing variables, μ_b and σ_b.

Direct Investment Direct investment is distinguished from portfolio investment by the extent of control over the firm's decisions exercised by the investor. The returns to direct investment include a return for that decision making as well as a normal return for capital. Kindleberger [19, pp. 389–93] points out that direct investment will be preferred to portfolio investment only when the return for decision making or entrepreneurial wisdom is "abnormally" high. Otherwise the investor will prefer to allocate his entrepreneurial abilities elsewhere. He would then invest in either bonds or equity and sell or rent any patents the industry might need in addition to the capital funds.

Abnormal returns to entrepreneurial control will occur especially in industries that are monopolized and in cases where disequilibrium profits can be earned. Accordingly, we shall expect to find relatively large corporations with significant monopoly power and/or aggressive management engaging in direct investments. This description is consistent with Vernon's [34] theory of the product cycle. According to that theory, heavy expenditures for research and development occur in the United States and consequently new products are first marketed there. As the product matures, firms become more responsive to least-cost locations. One firm makes the decision to locate a subsidiary abroad. Other firms may follow not so much out of real economic incentives as from simple fear of the possibility of losing their competitive position due to competition from the foreign production. Such a fear need not and often does not have a basis in economic facts.

One point that should be clear is that a portfolio-adjustment view of direct investment is not particularly illuminating. The location of facilities abroad is one of a large number of intertwined decisions made by international corporations. The simplicity of the portfolio-adjustment model barely begins to explain such a process. Although adequate models of direct investment do not exist, there is a rather large literature on domestic investment that should form a useful starting point. It should be mentioned, however, that the empirical support of investment theories is notoriously weak. When we add the location factor required to explain direct investment, we should expect still weaker evidence.

This completes our theoretical discussion of the investment decision. We have considered a whole spectrum of investment opportunities ranging from short-term securities to equities and direct investment. As we move through this spectrum, expectations of future events become more and more important, and the specification of the proper explanatory variables becomes more and more difficult. In the next section, we will provide a discussion of the empirical application of our model, in which we will be forced to deal with the formation of expectations. Our theoretical discussion suggests that we will obtain the best fits for short-term capital and the worst fits for direct investment.

THE MEASUREMENT OF INTERNATIONAL CAPITAL MOVEMENTS [11]

There remain a fairly large number of problems that must be solved before our general model of international capital movements can be estimated. These problems are concerned generally with how best to represent the behavioral characteristics as yet unspecified and how to handle some purely statistical problems. We shall deal in particular with the following: (1) choice of net worth variable; (2) measuring expected returns and risk; (3) choice of trade variables; (4) handling of speculative activity; (5) capital controls and credit rationing; (6) disaggregation schemes; (7) lag structure; (8) functional form; and (9) simultaneity.

[11] The following discussion is based in large part on Leamer and Stern [21].

Choice of Net Worth Variable Net worth and other scale variables are presumably very important in determining capital movements, and their omission in many published empirical papers is a very serious shortcoming. This is analogous to excluding an income term in an import-demand equation. From the point of view of the private sector, net worth is private capital stock, plus net claims on foreigners, plus government debt. GNP may be an appropriate proxy. However, disaggregated equations should use a net worth item specific to the institutions and individuals who are undertaking the particular capital transaction. Furthermore, it seems very doubtful that corporations are behaving as implied by the portfolio-adjustment model and, therefore, aggregation that includes the corporate sector should be avoided.

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 to 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 in addition expectations will depend upon business-climate variables.[12]

An alternative to using proxy variables is to construct a model of expectations formation. Ordinarily, this involves the assumption that the expected future returns/risk are a constant function of current and historical

[12] See Miller and Whitman [24] for a more extensive discussion of proxy variables for returns/risk that relate to portfolio investment. Their model includes the lagged value of the U.S. balance-of-payments liquidity deficit and deviations of U.S. GNP from trend. They have 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.

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.[13]

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 [29], by assuming that large residuals from interest parity reflect a suspension of the normal behavior pattern in favor of speculation. In place of concentration on the residuals, however, a preferable approach, discussed more fully below, might be to separate the data on an a priori basis into "normal" and "speculative" periods and perform regression analysis separately on each data set.

On occasion researchers have used the domestic counterpart of the foreign investment as an explanatory variable, particularly in the case of direct investment.[14] The rationale is that the level of domestic investment reflects the appropriate yield variable. However, the comparatively good fits that are obtained should not be construed as an empirical solution to the problem since there still remains domestic investment to "explain." More important, this represents a confusion in the appropriate causal sequence that determines both foreign investment and domestic investment simultaneously. The impact of such a causal reordering on the implications of an estimated model has not as yet been analyzed.

Choice of Trade Variables Our theoretical analysis has indicated that credit extended to commercial traders is related to the profitability of the transaction from the points of view of both borrower and lender. Traditionally trade credit is related not to profit variables, but rather to imports or exports, i.e., sales. It is important to decide just what trade variables should be used to explain trade credit and to link those variables with the underlying profitability motivations.

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.

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.[15]

[13] Branson's work [6] is especially noteworthy for his attempt to incorporate expectations into his model.

[14] For examples, see Prachowny [26] and Rhomberg [27].

Just as there is no clear-cut link from exports to credit extensions to foreigners, credit demand by foreigners is not straightforwardly related to exports. A firm engaged in importing will have certain inventory needs. Credit to finance those inventories may be obtained from domestic sources or foreign sources, or through internal cash flows. It is probably the case that smaller, less well-established importing firms are likely to rely more on external sources of funds than larger, well-established firms. We might expect therefore to observe relatively large credit extensions when new markets are being opened up, as in the case of Japan in the late 1950's and early 1960's. In contrast, increases in exports to more mature markets may engender somewhat less credit demand since importing firms in such circumstances may have greater resort 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 U.S., importers will not need such balances since imports are commonly financed in terms of dollars. Firms and banks in other countries who undertake trade denominated in dollars will maintain transactions balances in U.S. banks both for trade with the U.S. and for extra-U.S. trade.

Our discussion suggests that merchandise trade variables are not well suited to explain credit extensions because they may only indirectly reflect the profitability motivations of the transactors on both the supply and demand sides and because the direction of causation is unclear. However, with

[15] 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.

lack of information relating to profitability, it may be necessary to rely on some measure of sales for explanatory purposes. It seems, however, that the primary variable for explaining trade financing should be expressed in terms of *changes* in sales rather than levels. The reason for this is that rapid growth in sales that reflects favorable profit opportunities will engender increases in trade credit. When sales 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 a leveling off and perhaps even a decline in the use of foreign credits.

Speculative Activity It is well known that, in a pegged exchange-rate system, 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 behavioral 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 therefore is that we separate "normal" from "speculative" periods according to the absence or presence of expectations concerning exchange-rate changes outside of the official limits.

If the normal periods dominated the sample, the speculative periods could be treated as outliers and discarded. There is no sound statistical way of doing this, however, without a great deal of effort. But this does not justify resorting to ad hoc procedures that are potentially dangerous from the standpoint of data interpretation. In this regard, we have already taken note of Stein's construction [29] of a speculative pressure variable based on the residuals of a regression of the forward premium on the uncovered interest-rate differential. This procedure has been criticized in separate comments on Stein's work by Heckerman and Laffer [29], who contend that the residuals may reflect other things besides speculative pressure.[16]

An alternative to Stein's approach would be to identify periods of exchange-market turbulence on some a priori basis. One such possibility is to consult expert opinion with regard to the periods when currencies are believed to have been especially affected by substantial speculative transactions. A preferable substitution for relying on informed judgment, however, might be the use of data on forward exchange rates. Theoretical considerations suggest that speculative confidence in the spot exchange-rate limits 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 counterspeculation to peg the forward rate.[17] A reasonably objective method for separating speculative from normal periods might then be founded on the basis of whether the forward rate for a given period lay inside or outside the official support limits designated for the spot rate.[18]

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

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 added to the equation without difficulty. However, when capital controls take the form of quotas, it may be better to discard the equation altogether. Consider, for example, Figure 4.1, with demand DD and supply SS of securi-

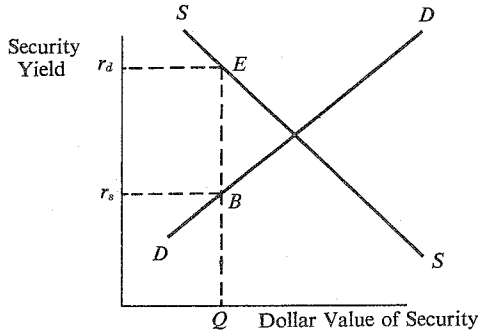

FIGURE 4.1

The Effect of Capital Controls

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

[18] See Leamer and Stern [21] for a graph in which the 90-day forward rates for the pound, mark, and French franc are plotted as a percent of the official spot peg on an end-of-month basis for the period 1960–69 (September). The graph 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. It would thus appear that empirical studies that include U.K. assets will necessarily have to deal with the speculation problems more or less throughout the 1960's. Analysis of the mark and the franc will have to deal with speculation particularly in 1968 and 1969. As suggested above, these data points might best be analyzed separately.

ties as a function of the security yield. The negative slope of SS expresses the relation that the supply of securities will vary inversely with the yield (i.e., cost) and that the demand for securities will vary directly with the yield (i.e., return). The imposition of a quota Q on security buyers (in the absence of credit rationing) will result in an equilibrium at E. The observed point will not fall on the demand-for-securities curve DD and thus will yield no information about that schedule. Capital controls may also be imposed by the capital-importing country. In this case the equilibrium point in Figure 4.1 will be at B on the DD curve, and no information about the SS schedule is disclosed.

A symmetric situation exists when credit rationing occurs. This is depicted in Figure 4.2. Credit suppliers (i.e., security buyers) may establish an

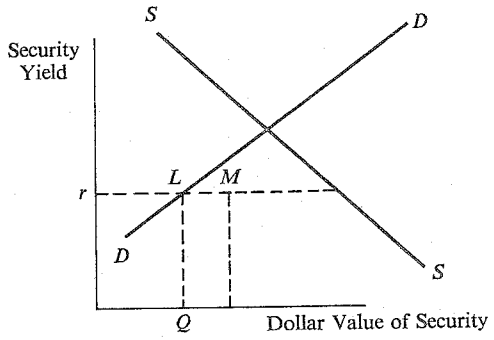

FIGURE 4.2

The Effect of Credit Rationing

arbitrarily low rate r and ration the forthcoming supply. The observed point L would lie on the demand-for-security schedule DD but not on the supply-of-security schedule SS. Worse yet, the existence of unsatisfied and complaining customers may induce credit suppliers to grant loans in excess of that indicated by DD, which is drawn on the assumption of equilibrium in the market. An equilibrium point M that lies on neither DD nor SS may thus result.

The statistical examination of economic relationships is predicated on the assumption that the observations may properly be thought to reflect those relationships. When such things as legal restrictions or rationing interfere

with these relationships, statistical fits that result may be meaningless. In the case of capital movements, such interferences may well be the rule and not the exception. An excellent study by Bryant and Hendershott [7] deals with the problem of capital controls by assuming that their effect is to reduce the observed quantity by a proportion dependent on the existing controls. They argue that the controls relevant to their study of U.S.–Japanese capital flows were voluntary in nature, and that the imposition of the controls reduced the observed responses to other stimuli but did not eliminate them. 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.

Level of Aggregation The problem of aggregation stems from the inherent complexity of the real world. There will be many different countries and in each there will be security offerings of many different maturities. Correspondingly, there will be interest rates and forward exchange rates of

TABLE 4.1

International Investment Position of the United States at Year-End 1967
(Billions of Dollars) †

	Western Europe	Canada	Latin American Republics	Other Foreign Countries	Total [a]
U.S. assets and investments abroad, total	35.4	29.4	20.7	31.7	122.3
Private investments	25.3	29.3	16.2	19.0	93.3
Long-term	22.6	28.1	13.1	14.2	81.4
Direct	17.9	18.1	10.2	10.8	59.3
Foreign dollar bonds	0.7	5.5	0.6	1.7	9.7
Other foreign bonds	0.1	0.7	0.2	0.1	1.1
Foreign corporate stocks	2.1	2.8	0.1	0.2	5.2
Banking claims	0.8	0.2	1.5	1.2	3.7
Other	1.0	0.8	0.5	0.2	2.4
Short-term assets and claims	2.7	1.2	3.1	4.8	11.8
Reported to banks	1.2	0.6	2.6	4.2	8.6
Other	1.5	0.6	0.5	0.6	3.2
U.S. Government credit and claims	10.1	—[b]	4.6	12.7	29.0

TABLE 4.1 (Cont.)

	Western Europe	Canada	Latin American Republics	Other Foreign Countries	Total [a]
Foreign assets and investments in the U.S., total	41.0	9.3	6.5	10.3	69.6
Long-term	20.2	5.3	2.5	3.0	32.0
Direct	7.0	2.6	0.2	0.2	9.9
Corporate stocks	10.5	2.5	1.3	1.1	15.5
Corporate and other bonds	1.4	—[b]	0.1	0.2	2.2
Other	1.3	0.2	1.0	1.5	4.4
Short-term assets and U.S. Government obligations	20.7	4.0	4.0	7.3	37.7
Private obligations	10.8	2.7	3.8	5.3	22.9
Reported by banks	9.8	2.4	3.7	5.0	21.2
Other	1.0	0.3	0.1	0.3	1.7
U.S. Government obligations	9.9	1.3	0.2	2.0	14.8
Marketable or convertible bonds or notes	1.3	0.7	—[b]	0.1	2.4
Bills and certificates	6.3	0.3	0.1	1.7	9.3
Other	2.3	0.3	—[b]	0.2	3.1

[a] Total includes international organizations and unallocated.
[b] Less than $500,000.
† Adapted from U.S. Department of Commerce, *Survey of Current Business*, 48 (October 1968), 20.

varying maturities. A significant problem thus confronts the researcher in selecting the appropriate level of aggregation. In making such a selection, one should apply the general principle that micro-response functions should be aggregated when the responses are similar. Returns from disaggregation will be greater when categories of distinctly different responses can be isolated. This suggests that some disaggregation by region will be profitable. Ideally one would disaggregate by motivation as well, thus distinguishing short-term portfolio, trade credit, and trade-arbitrage capital movements. In fact, however, it will be impossible ordinarily to obtain data disaggregated by motivation. The choice of explanatory variables should thus include variables associated with each motivation.

Some idea as to the nature and importance of various capital items for the United States can be gathered from Table 4.1. Many of the categories in

the table may be further disaggregated. For example, short-term banking claims on foreigners may be classified as in Table 4.2. Further disaggregation is possible by region, as well. It should be abundantly clear that a primary decision is required on the choice of aggregation. Unfortunately, the currently available studies provide relatively little insight into the problem.

TABLE 4.2

Short-Term Claims on Foreigners Reported by Banks in the United States at Year-End, 1967
(Billions of Dollars) ‡

Dollar loans		3.2
Official institutions	0.3	
Banks	1.6	
Others	1.2	
Dollar collections outstanding		1.5
Dollar acceptances		3.0
Other dollar claims		0.5
Foreign currency deposits and other claims		0.4
Total		8.6

‡ Adapted from Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin*, 54 (July 1968) A–81.

A problem related to aggregation is the construction of index numbers. A given semidisaggregated class of securities may require interest rates and forward exchange rates of varying maturities and regions. Collinearity in the movements of these rates is likely to impede estimation. Although this is a difficult problem, it is not a unique one. In trying in Chapter 2 to explain imports and exports, we were confronted with a similar phenomenon that involved many different countries and many different commodities. In that situation, we saw fit to construct index numbers, which we hoped would capture the essential features of the phenomenon.[19] Although the construction of index numbers is an appealing solution to this problem, it should be pointed out that no such index numbers exist in fact. This is the case especially since the requisite data for weighting purposes are just not available on a systematic basis. In the absence of such indexes, we will be forced to make an in-

[19] In the Appendix to Chapter 2, we saw that a weighting scheme for the price indexes depended fundamentally on small cross elasticities of demand for import goods. A similar situation exists with regard to capital flows. If changes in foreign rates of return are accompanied by substantial shifts among foreign securities, then it will be impossible to select useful weights for the construction of an interest-rate index.

formed judgment in choosing the appropriate explanatory variables for each capital item.[20]

Lag Structure Lagged variables will be required to reflect both the adjustment mechanism and also the formation of expectations. As discussed extensively in Chapter 2, it is a common procedure to attempt to capture these effects simply by adding lagged explanatory or dependent variables to the basic model. Implicitly this involves the assumption of a fixed but unknown response pattern. In the case of capital movements, this procedure 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.[21]

Mechanical use of lagged variables also ignores potentially useful information on the determinants of the response pattern. An important shortcoming of the portfolio-adjustment models is that they tend to ignore short-run constraints upon behavior that 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 behavior.

In the construction of a model of expectations formation, it is possible of course to allow for adaptations in the expectations. Such a model leads to a set of fixed weights on past observations.[22] 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 rather depends 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.

Choice of Functional Form We saw in Chapter 2 that the use of simple regression techniques requires that the hypothetical relationship be linear in

[20] At this point we would like to emphasize the illegitimacy of the often-used methodology of trying several different interest-rate variables, selecting the one that yields the best fit, and reporting only that one. Though the end product of such a procedure is not clear, what is clear is that the standard errors and R^2 that are reported tend to lose their meaning with each additional experiment.

[21] Waud [35] has pointed out that in simple models of partial adjustment and adaptive expectations, it may be impossible to identify the two elements separately. Feige [10] has shown, however, that more complex models allow such an identification.

[22] See Waud [35] or Feige [10] for a discussion of adaptive expectations models.

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 regarding the problem as 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 (that determine the portfolio size) and a set of preference variables r (that determine the allocation of the portfolio among competing assets), $A = f(r, W)$. The associated capital flow at a fixed interest rate is

$$F = \frac{dA}{dt} = \frac{\partial f}{\partial W}\frac{dW}{dt}$$

Policy analysis will of course be concerned with the flow induced by a change in interest rates

$$\frac{dF}{dr} = \frac{\partial^2 f}{\partial W \partial r}\frac{dW}{dt}$$

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 and thus presuppose the answer to an important policy question.[23] 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 $A = f(r)W$ of course remains acceptable.

Simultaneity The existence of another relationship affecting the variables in the capital equation was first pointed out by Stein [29]. The reader may recall that one of the conditions for unbiased least squares estimation is the independence of the explanatory variables and the disturbance term in the relationship. It is not difficult to show that an explanatory variable in the arbitrage function A is related to a disturbance to that relationship. Suppose that there is an increased desire by Americans to hold English securities unrelated to the levels of the explanatory variables.[24] Such a disturbance would be accompanied by a spot purchase of pounds and a forward sale to effect the purchase of the English security. These purchases will tend to raise the spot rate (if it is not at the upper limit of its allowable fluctuation) and lower the forward rate. But both these rates are explanatory variables and any disturbance to the relationship will cause the estimates of the coefficients in the arbitrage function to be biased. The bias will be small when the disturbances

[23] Branson's work [6] is a case in point.

[24] If one wishes, he may think of this disturbance as associated with some variable that has been inadvertently excluded from the least squares equation.

are small or when the spot and forward rates are influenced only slightly by the disturbances to the arbitrage function.[25]

Another element of simultaneity is exactly the same as the existence of a supply relationship in the analysis of import demand. That is to say, we have been discussing the demand for foreign securities as an increasing function of the return. There will also be a supply of foreign securities, which is a decreasing function of the return. The usual conclusions regarding bias in the estimates apply. The reader may consult Chapter 2 on this point.

While one should of course be concerned with the problem of simultaneity, as such authors as Stein [29], Black [3], and Branson [6] have been, there is some question as to whether this concern may be a bit premature given that the underlying structural relationships have been far from being appropriately specified. As a consequence, recent contributors such as Bryant and Hendershott [7], who use ordinary least squares and take great pains in setting forth their framework for analysis, are laying the groundwork for future work more effectively than authors of works relying on simultaneous models. The latter models will perhaps bear practical fruit at some later date, when the problem of simultaneity may be of greater relevance.

CONCLUSION

The explanation of international capital movements will be subject to a large number of difficulties. These include the impact of psychological variables, the subtle role played by institutions, the complexity of the financial markets, and some fairly common statistical problems. While these difficulties were evident in a number of the early studies of capital movements, they were perhaps of a lesser significance in comparison with the inadequate theoretical framework in many of these studies that resulted in improper specifications.

Although there are clear signs that the most recent work in this field is attempting to cope with some of the difficulties mentioned,[26] there is a large range of possible research activity still open. This includes in particular the generation of proxy variables, the selection of the net worth term and other appropriate constraints, and the role of the forward market. It is hoped that future research efforts will be brought fruitfully to bear on the vitally important subject of the capital account.

[25] There are a large number of other estimating methods which are available when a simultaneity problem such as this one occurs. The reader may consult, for example, Johnston [17] or Goldberger [12] for discussion of simultaneous equations methods. Stein [29] used reduced-form estimation via ordinary least squares. He did not present structural coefficients. That is, the coefficient on his interest rate reflects the total impact that an increase in the interest rate has on the capital flow, including implicitly the feedback effects of the increased arbitrage demand on spot and forward rates and consequently on the arbitrage demand.

[26] See Leamer and Stern [21] for a review of the empirical literature on capital movements.

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