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.\footnote{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.} 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

$$K = K(\mu_b, \sigma_b, \mu_e, \sigma_e, \mu_s, \sigma_s, W)$$  \hspace{1cm} (4.1)

\footnote{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.}

to indicate that the investment in asset \( K \) will depend on the expected return to \( K, \mu_e \), the risk associated with \( K, \sigma_e \); the return \( \mu_b \) and risk \( \sigma_b \) of the alternative investment; the expected cost and cost-variability (say, from default) of borrowing, \( \mu_b \) and \( \sigma_b \); and net worth \( W \).\footnote{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 can expect that increases in return \( \mu_b \) and decreases in risk \( \sigma_b \) 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, \( \mu_b \) and \( \sigma_b \), 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.

We have already suggested by the use of the borrowing variables \( \mu_b \) and \( \sigma_b \) 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 \( \mu_b \) and the variability of that payment (say, from default) \( \sigma_b \); similar variables for a substitute credit source, \( \mu_e \) and \( \sigma_e \); the return and risk that are expected when the funds are allocated to some investment opportunity, \( \mu_b \) and \( \sigma_b \); 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.\(^4\)

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

\[
Y_t = k + \sum_{i=0}^{m} \alpha_i X_{t-i}
\]

\(^3\) These issues pertain especially to the works of Bell [2], Kenen [18], and Stein [29].

\(^4\) This point is made by Hendershott in [29].

The Theory of International Capital Movements

Then the flow \(Y_t - Y_{t-1}\) is given by

\[
Y_t - Y_{t-1} = \alpha_0 X_t + \sum_{i=0}^{m} (\alpha_{i+1} - \alpha_i) X_{t-i-1}
\]

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

\[
Y_t - Y_{t-1} \approx \alpha_0 X_t
\]

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

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:

\[ R_e = \text{the current spot rate; the dollar price of one pound delivered today.} \]
\[ R_f = \text{the current forward rate; the dollar price today of one pound to be delivered in 90 days.} \]
\[ i_e = \text{the American 90-day interest rate.} \]
\[ i_f = \text{the English 90-day interest rate.} \]
\[ p_e = \text{the pound price of English goods.} \]
\[ p_s = \text{the dollar price of American goods.} \]

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. Accordingly, uncovered interest arbitrage will be implicitly examined by considering covered arbitrage and speculation.

The domestic investor will allocate his net worth \( W \) 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

\[ A_e = A_f(\mu_e, \sigma_e, \mu_e, \sigma_e, \mu_f, \sigma_e, W_E) \]  

(4.5)

where \( \mu_e \) and \( \mu_f \) are the expected yields of the foreign and domestic securities and \( \mu_e \) is the expected return from speculation, while \( \sigma_e, \sigma_f, \sigma_e \) 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 \( 1/R_e \) 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 \( 1/R_e(1 + i_e) \) combined with a forward speculative purchase of \( 1/(1 + i_f) \) 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.

7 Increases in the covered return to foreign securities \( \mu_e \) and decreases in the risk of holding them \( \sigma_e \) will induce shifts out of the domestic securities and into the foreign securities, that is, increases in the arbitrage stock demand \( A_e \). The domestic return \( \mu_e \) and risk \( \sigma_e \) will have just the opposite effect on \( A_e \). The signs on \( \mu_e \) and \( \sigma_e \) 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 \( A_e \). The sign on \( \sigma_e \) 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 \( \mu_e \) can be calculated as follows. The domestic investor will use one dollar to purchase \( 1/R_e \) in pounds, buy a foreign security of that value, and assume a forward contract to sell \((1 + i_e)/R_e \) pounds in 90 days at the rate \( R_f \). In 90 days the foreign security will yield \((1 + i_e)/R_e \) pounds, just enough to meet the contract assumed earlier. That contract will provide \((1 + i_f)R_f/R_e \) dollars, for a nominal rate of return of \((1 + i_e)R_f/R_e - 1 \). 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:

\[ \mu_e = \frac{(1 + i_e)R_f}{R_e} - 1 + \bar{e}_e \]

(4.6)

and

\[ \sigma_e = \sigma_e(e_e) \]

(4.7)

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

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

---

1 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,

$$\mu_a = i_a + \bar{\sigma}_a$$

(4.8)

and

$$\sigma_a = \sigma_a(\nu_a)$$

(4.9)

with \(\bar{\sigma}_a\) and \(\sigma_a(\nu_a)\) 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 \((R_f - R_{sf})\) 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, \(R_{sf}\). Thus we have

$$\mu_a = |R_f - R_{sf}|$$

(4.10)

and

$$\sigma_a = \sigma_a(R_{sf})$$

(4.11)

where \(R_{sf}\) is the expected future spot rate and \(\sigma_a(R_{sf})\) 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 \(\mu_a - \mu_s\)

$$A_a = A_a(\mu_a - \mu_s, \sigma_a, \sigma_s, \sigma_n, W_a)$$

(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 \(\mu_a - \mu_s \leq 0\). This restriction just noted ignores the possibility of risk-re

if slight increases in \(\mu_a\) over \(\mu_s\) 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, \(\mu_a = \mu_s\). In the absence of the uncertainty terms, this becomes

$$\frac{(1 + i_s)R_s}{R_a} - (1 + i_a) = 0$$

which can be manipulated (neglecting \(i(R_s - R_a)/R_a\)) to yield the familiar “interest parity condition”

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

relating the forward premium to the interest rate differential.
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 $\mu_e$. 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

$$S_s = \text{sign}(\bar{R}_F - R_f) \times S_0(\mu_e, \sigma_e, \mu_s, \sigma_s, W_2)$$  

(4.13)

where the signs above the variables indicate their influence on $S_s$. The first term, sign($\bar{R}_F - R_f$), 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).  

Parenthetically, we should note that we have implicitly assumed that forward contracts are available without cost. In fact, bankers and brokers 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 $R_f$. He then meets his obligation with the bank. A total of $P_e(1 + i_e)R_f/(1 + i_e)$ 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
$P_a R_a - (1 + i_e) R_f /(1 + i_e)$ dollars.

This transaction consists of an immediate payment for the imports
through the spot market and a simultaneous pure interest arbitrage trans-
action involving borrowing from the English bank and purchasing an Amer-
ican 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

\[
Cr_t = Cr_t(\mu_e, \sigma_e, \mu_a, \sigma_a, \mu_a, \sigma_a, W_a)
\]  

(4.14)
to denote that the demand for English credit (in dollars) by American im-
porters depends on the cost and cost variability of that credit and alter-
native credit, \(\mu_a, \sigma_a, \mu_e, \sigma_e\); the rate and variability of return to be gained from that
credit, \(\mu_e, \sigma_e\); and the net worth of the American importer, \(W_a\). The natural de-
definitions for \(\mu_e\) and \(\mu_a\) are

\[
\mu_e = \frac{(1 + i_e) R_f}{R_e} - 1 \quad \text{(nominal cost of credit)}
\]  

(4.15)
\[
\mu_a = i_a
\]

The possibility of exchange control affecting capital flows associated with
merchandise trade is very remote; and \(\sigma_e\) and \(\sigma_a\) 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 \(\mu_a < \mu_e\), 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 \(\mu_e\) and \(\mu_a\) 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 \(P_a / R(1 + i_e)\) pounds. These funds are used to
purchase \(P_a / R(1 + i_e)\) dollars of American securities, which in 90 days would
be worth just the amount required to purchase the American goods. As be-
fore, this is a combination of a trade decision and a portfolio decision. The
portfolio decision can be described as

\[
Cr_t = Cr_t(\mu_e, \sigma_e, \mu_a, \sigma_a, \mu_a, \sigma_a, W_a)
\]  

(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

\[
\mu_e = i_e
\]
\[
\mu_a = \frac{(1 + i_e) R_e}{R_f} - 1 \quad \text{(nominal cost of credit)}
\]  

(4.17)
\[
\mu_e = \mu_a
\]
\[
\sigma_e = \sigma_a = \sigma_e \approx 0
\]

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 ar-
bitrage 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 will-
ingness of creditors to supply funds. According to our portfolio selection
theory, the supply of credit by English creditors to American importers is
given by

\[
Cr_t = Cr_t(\mu_e, \sigma_e, \mu_a, \sigma_a, \mu_a, \sigma_a, W_a)
\]  

(4.18)
where \(\mu_e, \sigma_e\) reflect the return from the credit; \(\mu_a, \sigma_a\) reflect returns to alter-
native investments; \(\mu_a, \sigma_a\) reflect the cost of borrowing; and \(W_a\) 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 ex-
ports 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 \(\mu_a\) 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

\[
\frac{(1 + i_d)R}{R} - 1 < i_n
\]

(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 need 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 arbitrage, 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, \(\mu_b\) and \(\sigma_b\).

**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 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

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.

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.\textsuperscript{19}

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

\textsuperscript{19} 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 $t$.\textsuperscript{21}
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.  

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 concentra-
tion 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 di-
rect investment.  

The rationale is that the level of domestic investment re-

flects 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
which determines both foreign investment and domestic investment simul-

taneously. 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. Traditional-
young 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 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 cus-
tomers primarily as an enticement for sales. Increases in exports will there-
fore 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 influ-
encing sales.

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 these 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 there-
fore 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 con-
trast, 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
pursposes 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 under-
take 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 de-
mand sides and because the direction of causation is unclear. However, with

---

13 Branson’s work [6] is especially noteworthy for his attempt to incorporate expect-
ations into his model.

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

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 experiential 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 Hecker 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 sug-

\[ \text{Security Yield} \]

\[ S \]

\[ D \]

\[ r_e \]

\[ r_f \]

\[ Q \]

\[ \text{Dollar Value of Security} \]

**FIGURE 4.1**

The Effect of Capital Controls

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

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

*Note:* Only long-term for foreign countries.
TABLE 4.1 (Cont.)

<table>
<thead>
<tr>
<th>Western Europe</th>
<th>Canada</th>
<th>Latin American Republics</th>
<th>Other Foreign Countries</th>
<th>Total a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign assets and investments in the U.S., total</td>
<td>41.0</td>
<td>9.3</td>
<td>6.5</td>
<td>10.3</td>
</tr>
<tr>
<td>Long-term</td>
<td>20.2</td>
<td>5.3</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Direct</td>
<td>7.0</td>
<td>2.6</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Corporate stocks</td>
<td>10.5</td>
<td>2.5</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Corporate and other bonds</td>
<td>1.4</td>
<td>- b</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Other</td>
<td>1.3</td>
<td>0.2</td>
<td>1.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Short-term assets and U.S. Government obligations

<table>
<thead>
<tr>
<th></th>
<th>Dollar loans</th>
<th>Official institutions</th>
<th>Banks</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.7</td>
<td>4.0</td>
<td>4.0</td>
<td>7.3</td>
<td>37.7</td>
</tr>
<tr>
<td>10.8</td>
<td>2.7</td>
<td>3.8</td>
<td>5.3</td>
<td>22.9</td>
</tr>
<tr>
<td>9.8</td>
<td>2.4</td>
<td>3.7</td>
<td>5.0</td>
<td>21.2</td>
</tr>
<tr>
<td>1.0</td>
<td>0.3</td>
<td>0.1</td>
<td>0.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Total</td>
<td>Marketable or convertible bonds or notes</td>
<td>Dollar collections outstanding</td>
<td>Dollar acceptances</td>
<td>Other claims</td>
</tr>
<tr>
<td>9.9</td>
<td>1.3</td>
<td>0.2</td>
<td>2.0</td>
<td>14.8</td>
</tr>
<tr>
<td>1.3</td>
<td>0.7</td>
<td>- b</td>
<td>0.1</td>
<td>2.4</td>
</tr>
<tr>
<td>6.3</td>
<td>0.3</td>
<td>0.1</td>
<td>1.7</td>
<td>9.3</td>
</tr>
<tr>
<td>2.3</td>
<td>0.3</td>
<td>- b</td>
<td>0.2</td>
<td>3.1</td>
</tr>
</tbody>
</table>

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 interest rates will likely 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 were able to construct index numbers, which we hoped would capture the essential features of the phenomenon. 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 inclusion.

Eleven 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 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 $\frac{\partial^2 f}{\partial W \partial r}$ 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

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 t-statistics 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.

are small or when the spot and forward rates are influenced only slightly by the disturbances to the arbitrage function.\textsuperscript{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,\textsuperscript{26} there is a large range of possible research activity still open. This includes in particular the

\textsuperscript{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.

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

REFERENCES


