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THE OUTFLOW OF SHORT-TERM FUNDS FROM THE UNITED STATES: ADJUSTMENTS OF STOCKS AND FLOWS

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1 INTRODUCTION

IN THIS paper, we develop a two-equation model of short-term capital outflows from the United States, in which Americans' demand for short-term foreign assets and foreigners' supply to us of their liabilities are both determined by considerations of relative yield (in the case of foreign liabilities, relative cost) and relative risk. The reduced-form solution of this model is tested empirically (using quarterly data for 1959–1967), following Willett and Forte [24] and Miller and Whitman [19], by breaking the total capital flow into its "stock-adjustment" and "flow-adjustment" components.

A number of empirical studies of the short-term capital account have been conducted, most of them utilizing a single-equation approach which rests on the assumption, explicit or implicit, that American lenders' demand for foreign assets of this type is infinitely elastic; i.e., that Americans are willing to lend foreigners all they want to borrow at the going price. In this group are the studies of Bell [2], Kenen [14, 15], and Bryant and Hendershott [5]. Arndt [1] and Hawkins [11] use another variant of a single-equation approach by estimating *net* flows of short-term capital in the Canadian balance of payments, rather than developing separate equations for transactions conducted by Canadians and those conducted by foreigners.

In a pioneering study, Stein [21] has developed a theory of capital

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flows in which American short-term claims on foreigners are assumed to equal American holdings of foreign exchange, and vice versa for foreign short-term claims on us.[1] Using this "foreign-exchange market" approach to capital flows, he arrives at a reduced-form equation for American claims on foreigners by first solving a set of equations for the exchange rates consistent with simultaneous equilibrium in the spot and forward markets. He then substitutes the equilibrium spot rate into an expression that defines the current supply of foreign exchange to Americans as equal to their previous holdings, plus or minus the basic balance of payments of the United States (this latter depending on the equilibrium spot rate). The very low R^2's generated when Stein tested the model for flows of short-term capital might be due, in part, to the fact that the model does not contain an explicit behavior equation for the amount that foreigners wish to borrow from us. The problem is that although Stein's model is in simultaneous-equation form, he implicitly includes the foreign supply of assets to us in the aggregate basic-balance variable.

In a recent book which represents the most exhaustive investigation of the financial capital account of the United States to date, Branson [3] assumes implicitly that American short-term claims on foreigners are strictly of the "trade-credit" variety. His model utilizes a risk-and-return approach to derive a function for the supply of foreign assets to the United States. The American demand for such assets does not appear explicitly in the model. Branson, like Stein before him, solves a model of the foreign-exchange market to show that the equilibrium spot and forward exchange rates will depend on (among other things) the expected future spot rate. Again following the lead of Stein, Branson develops an empirical estimate of such expectations and uses this as one of many explanatory variables in his estimating equation. In empirical tests of this model for American short-term claims on foreigners, Branson obtained $\bar{R}^2$'s that range between .42 and .55.[2]

[1] Stein actually developed and tested two separate models, one of which was based on the assumption that interest-rate differentials determine capital *flows*, and the other on the more reasonable assumption that interest-rate differentials determine the *stock* of claims on foreigners.

[2] We are reporting here only on that portion of Branson's extensive work on the capital account of the United States that relates to this paper.

Our study differs from previous efforts in two important ways. First, we assume that the stock of short-term claims on foreigners is determined by the simultaneous interaction of the American demand for such assets and the foreign supply of same to us. These demand and supply functions are derived from utility-maximization assumptions for American creditors and foreign debtors, along Tobin-Markowitz lines [23], [17].[3] The foreign supply of assets to us will depend in part on the need to finance trade and in part on any of the other sundry reasons why a debtor may need money. Of particular interest is the fact that the American demand for foreign short-term assets (and, hence, the flow of short-term capital abroad) depends in part on the business cycle in the United States, a relationship which has found its way into recent macroeconomic models by H. G. Johnson [13] and Floyd [8], but which has been verified empirically only for flows of long-term portfolio capital by Miller and Whitman [19] and by Branson [3]. Second, the empirical tests here do not estimate the flow of capital with a single equation (as have all other studies) but follow the suggestion of Willett and Forte [24] and the study of long-term capital flow by Miller and Whitman [19] in dividing the total flow into two components. The first is the stock-adjustment component, which arises when changes in exogenous variables cause alterations in either the American creditors' desired ratio of short-term foreign assets to total assets in their portfolios, or in the foreign debtors' desired ratio of borrowings from America to total borrowings. The second is the flow-adjustment component, which arises when American creditors increase the total size of their portfolios and, hence, buy more foreign assets. When this technique of separating stock adjustment and flow adjustment is combined with the simultaneous-equation approach, geared to take account of risks and returns, the result is a theory of short-term

[3] Grubel [10] has pointed out that the "risk-return" approach is required in order to explain the simultaneous two-way flows of international capital observed in the world. Bryant and Hendershott [5] apply a Tobin-Markowitz model to the statistical investigation of Japanese short-term borrowing from the United States. A statistical investigation of long-term portfolio capital outflows from the United States to Canada, using the mean-variance framework, has recently been published by Lee [18]. A paper by the authors [19] applies this approach to the investigation of aggregate long-term portfolio investment by the United States. Levin [16] and Feldstein [7] also use the mean-variance approach in theoretical work on capital flows.

flows of capital that holds up much better under empirical testing than have previous efforts along these lines.

2 THE MODEL

A. DEMAND FOR SHORT-TERM FOREIGN ASSETS

In terms of a risk-and-return theory of portfolio selection, the ratio of foreign to total risky assets held in the portfolios of American investors depends on both relative rates of return and the relative riskiness associated with each group of risky assets—foreign and domestic. The expected rate of return, R_A^e, on a portfolio "A," containing both risky short-term foreign assets (K) and risky domestic assets (D), and the standard deviation of this rate of return can be expressed as

$$R_A^e = WR_K^e + (1 - W)R_D^e, \tag{1}$$

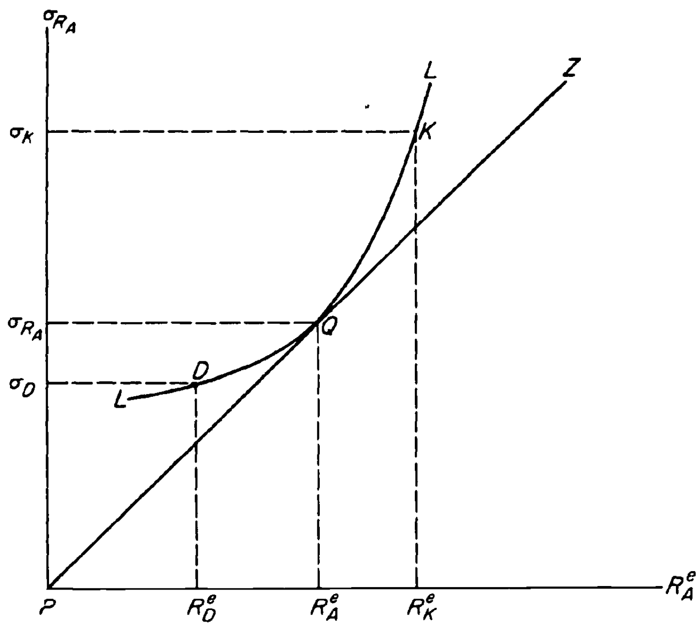
$$\sigma_{R_A} = [W^2\sigma_K^2 + (1 - W)^2\sigma_D^2 + 2W(1 - W)\Gamma\sigma_K\sigma_D]^{1/2}, \tag{2}$$

where W is the ratio of short-term foreign to total risky assets in the portfolio, i.e., $W = K/(K + D) = K/A$, and where R_K^e and R_D^e are the expected returns on short-term foreign assets and domestic risky assets, σ_K^2 and σ_D^2, are the variances of R_K^e and R_D^e, and Γ is the simple correlation coefficient between R_K^e and R_D^e.[4] (Definitions of all symbols are summarized in the Appendix.)

The determination of the desired combination of domestic and foreign assets, characterized by the parameters for risk and return given above, is presented very briefly here, since we have discussed it in detail elsewhere [19]. The locus of all efficient portfolio combinations, such that σ_{R_A} is a minimum for any given R_A^e, is indicated graphically by the opportunity locus LL in Figure 1. The optimum among this infinity of efficient combinations is determined by the point

[4] The mean-variance approach to the theory of portfolio choice requires one of two alternative assumptions: that investors' utility functions are quadratic, or that they view the range of probable outcomes from a financial investment in terms of a normal distribution. See Tobin [22].

FIGURE 1



of tangency between the LL locus and the capital-market line, PZ, which represents the locus of attainable combinations of risk and return from various portfolio combinations of risky and riskless assets.[5] At the equilibrium point Q, the marginal tradeoff between risk and return in the optimal bundle of risky assets is equated with the risk-return tradeoff between homogenous bundles from this optimal set of risky assets and the riskless asset.[6] Algebraically, the optimum W^* represented at Q is found by substituting (1) and (2) into the expression for the slope of the capital-market line, σ_{R_A}/R_A^e, and into the expression

[5] For a concise summary and critique of the Sharpe model [20], in which the concept of the capital market line is developed by applying Tobin's separation theorem, see Fama [6]. Note that the fact that the capital market line goes through the origin assumes that the riskless asset has zero yield, e.g., cash.

[6] Note that each investor may choose a different optimum position along PZ, but following Tobin's separation theorem [23], the optimum combination of risky assets, W^*, does not depend upon this final resting place. That is, W^* is independent of the ratio of risky to riskless assets in the investor's total portfolio.

for the slope of the opportunity locus, $(d\sigma_{R_A}/dW)/(dR^e_A/dW)$, equating these slopes, and solving for W^* to yield [7,8,9]

$$W^* = (\sigma_D^2 R^e + B)/(BR^e + c) = f(R^e_D, R^e_K, \sigma_D, \sigma_K); \quad (3)$$

$$R^e = (R^e_K - R^e_D)/R^e_D > 0 \text{ (for the relevant data); and} \begin{cases} f_2, f_3 > 0 \\ f_1, f_4 < 0 \end{cases} \quad (3a)$$

$$B = \sigma_D^2 - \Gamma\sigma_K\sigma_D > 0; \; c = \sigma_K^2 + \sigma_D^2 - 2\Gamma\sigma_K\sigma_D > 0. \quad (3b)$$

B. THE SUPPLY OF SHORT-TERM FOREIGN ASSETS TO AMERICANS

Just as the utility derived from lending can be expressed as a function of the expected return on a portfolio of assets and the variance ("risk") associated with that expected return, so can the disutility of borrowing be expressed as a function of the expected cost of borrowing, R^e_B, and the variance associated with it, σ_{R_B}. Such a one-parameter (ψ) quadratic function expressing disutility can be written as follows: [10]

$$DU = (1 + \psi)R_B + \psi(R_B^2), \quad (4)$$

and

$$E(DU) = (1 + \psi)R^e_B + \psi[\sigma_B^2 + (R^e_B)^2]. \quad (4')$$

On the assumption that ψ is a positive constant, this function yields a family of indifference curves of the type depicted in Figure 2. These curves are negatively sloped, implying that higher borrowing costs must be associated with a lower variance in these costs in order to keep the level of disutility constant. They are concave to the origin, implying an increasing marginal rate of substitution between risk and ex-

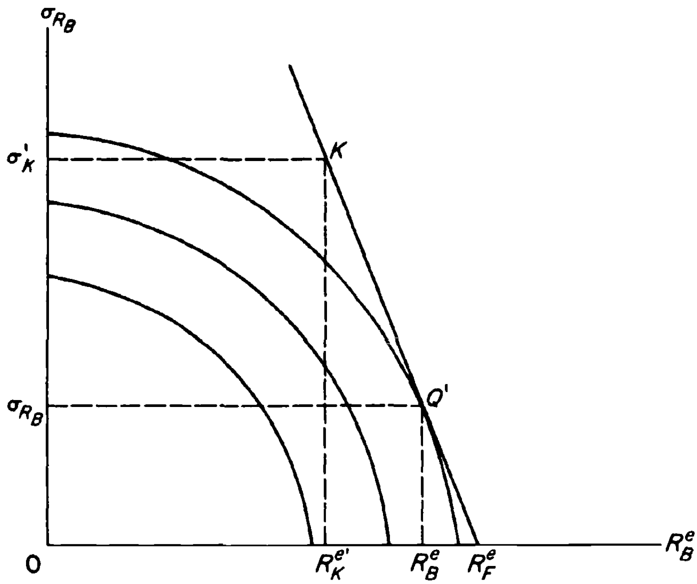
[7] This formulation is based in the simplifying assumption that r = constant.

[8] The $f_4 < 0$ holds when $R^e < 1/W^*$, a condition that is always fulfilled in this study.

[9] The B term could be either positive or negative, since an $R^e_K > R^e_D$ implies $\sigma_D < \sigma K$. If $B < 0$ (as when $r = 1$), then W^* could conceivably be negative, reflecting the fact that it might pay to go long in one asset and short in another when their yields are perfectly correlated. However, since we observe only positive W's in the data, we assume that $B > 0$, which insures that $W > 0$.

[10] Levin [16, Ch. 3], Branson [3, Ch. 2], and Bryant and Hendershott [5] have independently utilized an approach to the theory of foreign supply of assets similar to ours. Note that none of our conclusions would be changed if we used a two-parameter quadratic function.

FIGURE 2



pected borrowing costs. Finally, the indifference curves represent higher levels of disutility as one moves out from the origin.

The opportunity locus faced by each potential foreign borrower is depicted by the straight line connecting points R_F^e and K, representing the various combinations of borrowing from other foreigners (associated with an expected borrowing rate of R_F^e and zero variance) and borrowing from Americans (associated with an expected borrowing rate of $R_K^{e\prime}$ and a variance of $(\sigma'_K)^2$ in that rate). This variance is associated with the expected borrowing rate on loans from Americans for two reasons. First, there is the chance of an exchange gain or loss if the loan is denominated in dollars and the foreign borrowers do not cover in the forward market. Second, there is the possibility that borrowing from Americans could alienate or dry up home sources of credit for the foreign debtor. Thus, in order to keep his home lines of credit open, it is conceivable that the foreign debtor may never want to do all his borrowing from the United States.[11]

[11] Bryant and Hendershott argue [5, p. 7], that the variance associated with borrowing costs may lead to the diversification of liabilities even domestically.

Under these assumptions, the expected cost of borrowing on the borrower's total portfolio of liabilities, R_B^e, and the variance in that rate, σ_B, can be represented as

$$R_B^e = VR_K^{e'} + (1 - V)R_F^e, \text{ where } V \equiv K/L; \tag{5}$$

$$\sigma_B = V\sigma_K' \text{ (since } \sigma_F \equiv 0), \tag{6}$$

where L represents total liabilities of foreign debtors, and V is the ratio of borrowings from Americans to total borrowings.

The optimum ratio, V^*, of foreign short-term liabilities owed to Americans to total liabilities is that associated with point Q' in Figure 2, where the slope of the indifference curve, $d\sigma_B/dR_B^e$, is equal to the slope of the opportunity locus, $\sigma_K'/(R_K^{e'} - R_F^e)$. Substituting (5) and (6) into (4′) and differentiating totally to derive the first of these two slopes, setting it equal to the slope of the opportunity locus, and solving for V^*, gives

$$V^* = \frac{\left(\dfrac{1+\psi}{-2\psi} - R_F^e\right)}{\dfrac{(\sigma_K')^2}{R_K^{e'} - R_F^e} + (R_K^{e'} - R_F^e)} = g(R_K^{e'}, R_F^e, \sigma_K', \psi). \begin{cases} g_3, g_4 < 0; \\ g_1 < 0 \text{ and } g_2 > 0 \\ \text{if } \sigma_K' > (R_F^e - R_K^{e'}) \end{cases} \tag{7}$$

The stated algebraic condition required for the partial derivatives to have their expected signs ($g_1 < 0$ and $g_2 > 0$) can be represented in terms of Figure 2 by the requirement that point Q' be such that the equilibrium slope of the price line will have an absolute value greater than one. This condition is necessary to ensure that the well-known "perverse wealth effect" associated with quadratic preference functions (implying that risk-aversion increases as the net wealth level rises or net debt decreases) does not swamp the substitution effect stemming from the change in the relative costs of borrowing at home and abroad.[12] The satisfaction of this condition is assumed throughout the analysis in this paper and is supported by the empirical results.

Finally, we must explain the role of the shift-parameter, ψ. From (4′), above, the derivative of the slope of the indifference curve with respect to this parameter, $\delta\left(\dfrac{d\sigma_B}{dR_B^e}\right)\Big/\delta\psi$, is positive, implying a "flatten-

[12] For a discussion of this and other problems associated with the quadratic utility function, see Levin [16, Appendix B].

ing," or counterclockwise rotation, of each indifference curve as ψ increases. An increase in ψ, in other words, implies a greater weight given to the expected cost of borrowing, R_B^e, as compared to the weight given the variance in that cost, σ_B, in the borrower's disutility function. Since the expected cost of borrowing abroad is smaller, and the variance associated with this cost greater than for domestic borrowing, an increase in ψ implies a reduction in V^*, the desired ratio of foreign to total borrowing.

3 IMPLEMENTATION OF THE MODEL: THE ESTIMATING EQUATIONS

A. THE GENERAL FORM

The portfolio-balance approach to foreign investment implies that, at any point in time, the stock of short-term foreign assets held by American lenders K, is equal to $K = (W)(A)$, so that the observed capital flow, AK, over any time interval is equal to

$$\Delta K \equiv (\Delta W)(A) + (W)(\Delta A) \equiv FS + FF, \tag{8}$$

where the first term, FS, is defined as the *stock-adjustment* component and is the change in American holdings of foreign short-term assets caused by changes in the determinants of the portfolio ratio; and the second term, FF, is defined as the *flow-adjustment* component, or the steady-state flow which results from the need to maintain the desired portfolio ratio as the size of the portfolios of Americans increases. More precisely, with time subscripts added, we have

$$\begin{aligned} \Delta K_t &\equiv FS_t + FF_t, \\ FS_t &\equiv (\Delta W_t)(A_{t-1}), \text{ and} \\ FF_t &\equiv (W_{t-1})(\Delta A_t). \end{aligned} \qquad \left\{ \begin{aligned} \Delta K_t &\equiv K_t - K_{t-1} && (9) \\ \Delta W_t &\equiv W_t - W_{t-1} && (10) \\ \Delta A_t &\equiv A_t - A_{t-1} && (11) \end{aligned} \right.$$

In estimating the stock- and flow-adjustment components of the total flow of short-term capital, we require some relationship between the desired ratio, W^*, and the observed ratio, W. We postulate such a relationship in the form of a partial-adjustment model, assuming that asset-holders adjust their portfolio ratio in any given time-period by some fraction of the difference between the desired proportion of foreign assets, W_t^*, and the proportion held at the beginning of the period, W_{t-1}.[13] That is,

$$\Delta W_t = \phi(W_t^* - W_{t-1}) + \mu_t, \tag{12a}$$

where ϕ is the speed of adjustment, and

$$W_t = \phi W_t^* + (1 - \phi)W_{t-1} + \mu_t. \tag{12b}$$

The model described in Section 2 above generates not a desired stock of foreign assets in absolute terms but a desired portfolio *ratio* of foreign to total risky assets. When a linearized version of the resulting equation (12b) is utilized for estimating purposes, it carries an implicit assumption that the wealth elasticity of demand for such foreign assets is unity, when the total portfolio of risky assets, A, is taken as the appropriate measure of wealth.[14] We are assuming, in other words, that any increase in the scale-variable A will, ceteris paribus, increase the desired stock of foreign short-term assets in the same proportion. Furthermore, the formulation of the adjustment mechanism between actual and desired stocks given in (12a) and (12b), above, implies that this scale-adjustment, unlike adjustments to changes in the determinants of the desired portfolio-ratio, takes place without any lag, entirely within one quarter.[15]

To derive a reduced-form solution for our system, we first redefine W^* as $W_d^* = K_d^*/A$, the Americans' desired demand for foreign short-term assets as a fraction of all risky assets held by them. Then we transform the foreign debt ratio, $V^* = K_s^*/L$ (where K_s^* is foreign desired short-term borrowings from Americans) into $W_s^* = (L/A)(K_s^*/L) = K_s^*/A$, the foreign desired supply of short-term assets to us

[13] Experiments utilizing a distributed lag, rather than a one-period lag, version of the partial-adjustment model suggested that the latter assumption correctly reflects investors' behavior.

[14] See Bryant and Hendershott [5, pp. 10–12], for a discussion of this linear-homogeneity assumption in the mean-variance framework.

[15] In order to check for the possibility of a lag in the adjustment of W to changes in its denominator, A, the variable $\Delta A/A_{t-1}$ was included as an explanatory variable in a number of equations. It was never significantly different from zero; indeed, the t-ratio associated with it was always less than one. We are grateful to Patric Hendershott for this suggestion.

as a fraction of the total *American* portfolio. We then assume that L/A can be considered a constant over the time-period under consideration. This assumption is an arbitrary one, of course, but it is necessitated by the lack of direct information on the universe of foreign liabilities, L. Some indirect and very general evidence on the extent to which this assumption conforms with, or deviates from, reality may be inferred from the success or failure of the estimating equations based on it.

Next, assume that foreign debtors use a partial-adjustment process in adjusting to changes in the explanatory variables in (7) but adjust instantaneously to changes in L, so that we can write

$$V_t = \delta V_t^* + (1 - \delta)V_{t-1}, \tag{13a}$$

or

$$W_{s_t} = \delta W_{s_t}^* + (1 - \delta)W_{s_{t-1}}, \tag{13b}$$

since $W_{s_{t-k}} = (L/A)_{t-k}(V_{t-k})$ for all k, and $(L/A)_t$ is assumed to be constant for all t.

B. THE EXPLANATORY VARIABLES: DEMAND

In order to utilize equation (3) in developing an estimating equation for the portfolio-ratio, W, we require measurable proxies for the arguments of that function, R_D^e, R_K^e, σ_D, and σ_K. We have chosen the current yield on ninety-day U.S. Treasury bills as the proxy for R_D^e, the expected yield on domestic assets.

In acquiring a short-term foreign asset, the American potential lender has three choices: he can purchase foreign assets denominated in dollars, in which case the expected rate of return is the stated rate of interest on such loans, defined here as i_K; he can purchase an asset denominated in foreign currency and hedge by purchasing a forward contract, in which case his expected return depends on the relationship between the spot and forward rates of exchange, r_f/r_s (both in dollars per unit of foreign exchange), as well as on i_K; or he can purchase an asset denominated in foreign currency without hedging, in which case his expected rate of return depends not only on i_K but on the relationship between the present spot rate of exchange and the rate he expects to prevail at the time the asset matures, r_s^e/r_s. Thus, the expected rate of return on a portfolio of foreign assets can be expressed as

$$R_K^e = \alpha_1 i_K + \alpha_2[(r_f/r_s)(1 + i_K) - 1] + \alpha_3[(r_s^e/r_s)(1 + i_K) - 1], \quad (14)$$

where the α's represent the proportions of dollar-denominated, hedged-foreign-currency-denominated, and unhedged-foreign-currency-denominated assets, respectively, in the total portfolio of short-term foreign assets. In general functional form we have

$$R_K^e = \rho(i_K, r_s^e/r_s, r_f/r_s). \qquad \rho_1, \rho_2, \rho_3 > 0 \quad (15)$$

Note that i_K is not observable, but since i_K is determined endogenously in the model, it can be eliminated in the process of deriving a reduced-form equation for W. This, however, prevents us from estimating an equation for i_K and, consequently, we lack sufficient information to obtain empirical estimates of the coefficients in the behavior equations. Discussion of the proxies for r_s^e/r_s and r_f/r_s is postponed until later in this paper.

One of the basic assumptions of our model is that the riskiness of domestic assets, σ_D, is inversely correlated with deviations in the Gross National Product of the United States from its long-term trend. We have discussed the a priori reasons for postulating such a relationship, as well as the statistical evidence in support of it, elsewhere [19]. Here we simply hypothesize that one of the major determinants of the riskiness of American assets, taken as a whole, is the deviation of GNP from its long-run trend value in a given quarter.

Finally, since risk is a manifestation of imperfect information, the risk-estimate associated with an asset should diminish as information concerning the probable return on the asset increases. For this reason, we hypothesize that there has been a secular downward trend in σ_K, stemming from the increase in knowledge and communications, which symbolizes the gradual movement toward integration of international short-term capital markets since World War II. Finally, the Voluntary Credit Restraint program (VRP) imposed by the United States government in the second quarter of 1965 and expanded several times since then, can be assumed to have increased the riskiness of foreign lending because of considerable uncertainty about its application and enforcement. Furthermore, the VRP should also raise σ_K, because these restrictions prevent lenders from allocating their foreign portfolios in what they regard as an optimal manner; it is frequently asserted that these regulations have lowered the quality of foreign assets in American portfolios by discriminating against low-risk borrowers in the advanced countries. For VRP we use a dummy variable, which is zero until the first quarter of 1965 and unity from the second quarter of 1965 on.[16]

Substituting the various proxies just described for R_D^e, R_K^e, σ_D, and σ_K into (3), we have

$$W_d^* = F(i_K, r_s^e/r_s, r_f/r_s, R_D^e, Y, VRP, T). \qquad \begin{cases} F_1, F_2, F_3, F_7 > 0 \\ F_4, F_5, F_6 < 0 \end{cases} \quad (16)$$

If we now linearize, and transform the expression for W_d^* into one for W_d by means of the partial-adjustment mechanism of (12a) and (12b), the demand equations for W, the ratio of short-term foreign to total risky assets in the portfolios of American lenders, and for the change in that ratio, ΔW, are[17]

$$W_d = a_0 + \overset{+}{a_1} i_K + \overset{+}{a_2}(r_s^e/r_s) + \overset{+}{a_3}(r_f/r_s) + \overset{-}{a_4} R_D^e + \overset{-}{a_5} Y + \overset{-}{a_6} VRP + \overset{+}{a_7} T + (1 - \phi) W_{d_{t-1}}, \quad (17)$$

[16] The use of a dummy variable for VRP, along with the partial-adjustment assumption given in (12a), implies that the VRP did not exert its full effect immediately. This is consistent with the statements of A. Brimmer [4], who, as Assistant Secretary of Commerce for Economic Affairs, was the first administrator and "salesman" of the VFCR program.

[17] In order to obtain the expressions for each of the a_i coefficients, it is necessary to obtain linear approximations to each of our equations, notably (3) and (15), by using a Taylor's expansion for each, and dropping all higher-order terms. Define such expansions for (3) and (15) as (3′) and (15′). The discussion in the text implies (omitting the constant terms in Taylor's expansions)

$$\sigma_D = \sigma_D(Y) = \sigma_{D_1} Y,$$

and

$$\sigma_K = \sigma_K[VRP, T] = \sigma_{K_1} VRP + \sigma_{K_2} T. \qquad \begin{cases} \sigma_{D_1} < 0 \\ \sigma_{K_1} > 0 \\ \sigma_{K_2} < 0 \end{cases}$$

Substituting these two equations and (15′) into (3′), and then placing (3′) into (12b) and (12a), gives the following coefficients for equations (17) and (18)

$$a_1 = \phi f_2 \rho_1 > 0; \quad a_2 = \phi f_2 \rho_2 > 0; \quad a_3 = \phi f_2 \rho_3 > 0;$$
$$a_4 = \phi f_1 < 0; \quad a_5 = \phi f_3 \sigma_{D_1} < 0; \quad a_6 = \phi f_4 \sigma_{K_1} < 0;$$
$$a_7 = \phi f_4 \sigma_{K_2} > 0.$$

and

$$\Delta W_d = a_0 + \overset{+}{a_1} i_K + \overset{+}{a_2}(r_s^e/r_s) + \overset{+}{a_3}(r_f/r_s) + \overset{-}{a_4} R_D^e + \overset{-}{a_5} Y + \overset{-}{a_6} VRP + \overset{+}{a_7} T - \phi W_{d_{t-1}}, \quad (18)$$

where the expected sign of the effect of each explanatory variable's impact on W_d is given above that variable's coefficient.

C. THE EXPLANATORY VARIABLES: SUPPLY

From (7), and the additional assumption that L/A can be regarded as a constant, we have W_s^* as a function of $R_K^{e'}$, R_F^e, σ_K' and the shift-variable, ψ. σ_F, the variance associated with the costs of borrowing by foreigners in their own countries, is excluded because it is zero by assumption.

In determining the appropriate proxies for $R_K^{e'}$, the debtors' expected cost of borrowing in the American market, we must remember that the potential foreign borrower, like the potential American lender, has three alternatives. He can contract a loan from an American lender denominated in his own currency, in which case the expected cost is the going rate of interest on such loans, i_K.[18] He can make a contract denominated in dollars and hedge in the forward market, making the ratio between forward and spot exchange rates part of his expected borrowing costs. He can make a dollar-denominated contract without hedging, in which case his expected costs are a function of the relationship between the expected future spot rate and the present spot rate, r_s^e/r_s, as well as of i_K. Thus, the expected borrowing costs (in percentage terms) associated with his total liabilities to Americans can be expressed as

$$R_K^{e'} = \gamma_1 i_K + \gamma_2 \left[\frac{1}{r_s^e/r_s}(1 + i_K) - 1\right] + \gamma_3 \left[\frac{1}{r_f/r_s}(1 + i_K) - 1\right], \quad (19a)$$

[18] This formulation assumes that the nominal rate of interest, i_K, on loans from the United States is the same for dollar-denominated and foreign-currency-denominated liabilities of the same type, with any differences in expected costs among the three alternative ways of borrowing from the United States being reflected in the forward premium or discount and/or the expected change in the spot rate.

where, analogous with (14), the γ's represent the proportions of foreign-currency-denominated loans, unhedged dollar-denominated loans, and hedged dollar-denominated loans, respectively.[19] In general functional form, we have

$$R_K^{e'} = \Omega(i_K, r_s^e/r_s, r_f/r_s). \qquad \begin{cases} \Omega_1 > 0 \\ \Omega_2, \Omega_3 < 0 \end{cases} \tag{19b}$$

As a proxy for R_F^e, the expected cost of short-term money in the home markets of the short-term borrowers, we use a simple arithmetic average of representative short-term rates of interest in four major recipient countries. For Canada and the United Kingdom this rate is the Treasury bill rate; for Japan and West Germany it is the call money rate.[20]

Our implementation of the model is incomplete because we have no observable proxy for $(\sigma_K')^2$, the variance that foreign debtors associate with borrowing from Americans. There are reasons to believe that this variance, like that on the lenders' side, may bear some relationship to aggregate economic variables in the borrowers' home country,[21] but we have not been able, as yet, to specify the nature of these relationships in a testable form.

Finally, we must offer some economic interpretation of the shift-variable ψ, representing the relative importance assigned to expected cost as opposed to considerations of risk in the foreign borrowers' preference functions. Any increase in the need for dollars (as opposed to a need for funds in general) should increase the debtors' preference for borrowing from Americans; that is, decrease ψ. To test this hypothesis, we utilize here three alternative proxies of "the demand for dollar-import financing": exports from the United States; "net" exports from

[19] Note (a) that the relationship between these weights and those of equation (14), namely, the proportion of U.S. short-term foreign assets denominated in dollars, α_1, must equal the proportion of foreign liabilities denominated in dollars, $\gamma_2 + \gamma_3$, and vice versa; (b) that this formulation rests on the simplifying assumption that borrowers in the rest of the world do not contract foreign liabilities in any market other than that of the United States; and (c) that R_K^e in (14) would necessarily equal $R_K^{e'}$ in (14a) only if expectations were the same for creditors and debtors, and if all the γ's in (19a) and α's in (14) were equal to ⅓.

[20] We are grateful to Patric H. Hendershott of Purdue University for making the Japanese interest-rate series available to us.

[21] Bryant and Hendershott [5, pp. 32–33] suggest, for example, that the aggregate ratio of deposits to net worth for all Japanese banks is one of the determinants of their short-term foreign borrowing.

the United States, defined as exports minus American direct investment abroad (reflecting the assumption that exports associated with such investment are automatically financed and, therefore, generate no additional demand for short-term trade credit); and imports of the rest of the world (world imports as reported by the International Monetary Fund minus imports into the United States), on the assumption that much of the world's trade is financed by dollar loans from the United States. The hypothesis is, of course, that an increase in any of these proxies will decrease ψ and increase W_s^*. We shall refer to the trade variable as X.

Linearizing and making substitutions into (7) and (13b) analogous to those for (16) and (17), we derive the equations for W_s and ΔW_s:[22]

$$W_s = b_0 + \overset{-}{b_1} i_K + \overset{+}{b_2} r_S^e / r_s + \overset{+}{b_3} r_f / r_s + \overset{+}{b_4} R_F^e + \overset{+}{b_5} X + (\overset{+}{1} - \delta) W_{s_{t-1}}, \quad (20)$$

$$\Delta W_s = b_0 + \overset{-}{b_1} i_K + \overset{+}{b_2} r_S^e / r_s + \overset{+}{b_3} r_f / r_s + \overset{+}{b_4} R_F^e + \overset{+}{b_5} X - \overset{+}{\delta} W_{s_{t-1}}, \quad (21)$$

where δ is the speed-of-adjustment coefficient.

D. THE REDUCED-FORM ESTIMATING EQUATION

Although $W_s^* = W_d^*$ only under conditions of full equilibrium, W_s and W_d must, under the assumptions made here concerning the relationship between V and W_s, be equal during all observation periods. This fact enables us to derive an estimating equation for $W = W_s = W_d$ by solving equations (17) and (20) for i_K, setting the two expressions equal to each other, and then solving the resulting expression for W

[22] Again, use a truncated Taylor's expansion for (7) and (19b)—call them (7′) and (19b′)—then note that our discussion implies

$$\begin{aligned} \psi &= \psi(X) = \psi_1 X, \\ L/A &= k. \end{aligned} \qquad \begin{cases} \psi_1 < 0 \\ k = \text{constant} \end{cases}$$

Substitute these and (19b′) into (7′) and the resulting equation into (13b) (noting the transition from V^* to W_s^* given on page 262) to get the following coefficients for the b_i in (20) and (21):

$$b_1 = \delta k g_1 \Omega_1 < 0; \quad b_2 = \delta k g_1 \Omega_2 > 0; \quad b_3 = \delta k g_1 \Omega_3 > 0;$$

$$b_4 = \delta k g_2 R_F^e > 0; \quad b_5 = \delta k g_4 \psi_1 > 0.$$

($= W_s = W_d$). The resulting reduced-form equation for W, and the corresponding one for ΔW, are[23]

$$W = A_0 + \overset{+}{A_1} r_s^e/r_s + \overset{+}{A_2} r_f/r_s + \overset{-}{A_3} R_D^e + \overset{+}{A_4} R_F^e + \overset{-}{A_5} Y + \overset{-}{A_6} VRP + \overset{+}{A_7} X + \overset{+}{A_8} T + \overset{+}{A_9} W_{t-1}, \quad (22)$$

and

$$\Delta W = A_0 + \overset{+}{A_1} r_s^e/r_s + \overset{+}{A_2} r_f/r_s + \overset{-}{A_3} R_D^e + \overset{+}{A_4} R_F^e + \overset{-}{A_5} Y + \overset{-}{A_6} VRP + \overset{+}{A_7} X + \overset{+}{A_8} T + \overset{-}{A_9'} W_{t-1}, \quad (23)$$

where the signs over each of the coefficients have the meaning already described and are derived from the signs associated a priori with the coefficients of the underlying demand and supply equations.

The proxies used to represent the independent variables of equations (22) and (23) have been described in the two preceding sections. We must still, however, describe the measures used to calculate observed values of the dependent variable, W, the ratio of short-term foreign assets to total risky assets in the portfolios of American lenders. The numerator of W is K, the outstanding stock of short-term foreign assets held by American banks and nonfinancial institutions at the end of each quarter. Unfortunately, this series, as published, involves serious problems of comparability. The reporting coverage changed several times during the period under investigation, with a particularly sharp increase in the number of banks reporting taking place in 1964-

[23] The A_i coefficients in (22) and (23) are

$$A_0 = \frac{b_1 a_0 - b_0 a_1}{b_1 - a_1} \gtreqless 0, \quad A_1 = \frac{a_2 b_1 - b_2 a_1}{b_1 - a_1} > 0, \quad A_2 = \frac{a_3 b_1 - b_3 a_1}{b_1 - a_1} > 0.$$

$$A_3 = \frac{a_4 b_1}{b_1 - a_1} < 0, \quad A_4 = \frac{-a_1 b_4}{b_1 - a_1} > 0, \quad A_5 = \frac{a_5 b_1}{b_1 - a_1} < 0,$$

$$A_6 = \frac{a_6 b_1}{b_1 - a_1} < 0, \quad A_7 = \frac{-b_5 a_1}{b_1 - a_1} > 0, \quad A_8 = \frac{a_7 b_1}{b_1 - a_1} > 0,$$

$$A_9 = \frac{b_1(1-\phi) - a_1(1-\delta)}{b_1 - a_1} > 0, \quad A_9' = (A_9 - 1).$$

IV.[24] We have taken this problem into account by utilizing two alternative measures of K, and therefore of W, which represent the two extreme assumptions regarding the nature of the discontinuity involved. The first measure of W simply uses the published data without adjustment, making the implicit assumption that firms reporting for the first time are also holding short-term foreign assets for the first time. The second, or revised, measure of W uses a K series adjusted by a technique based on the assumption that the newly reporting firms would have increased the total stock of foreign short-term assets in all periods (prior to the one in which they first report) by the same proportion as they raise the total in the first period in which they do report.[25] It is highly probable that the truth lies somewhere between these extreme assumptions, but as we shall see, the qualitative nature of our regression results is not affected when we substitute the adjusted for the unadjusted K in the dependent variables W and ΔW.

The denominator, A, of W is the outstanding end-of-quarter stock, not of *all* risky assets held by American investors, but of a subset of such assets which, in our judgment, is representative of the universe of assets considered as alternatives by actual or potential holders of short-term foreign assets.[26] Actually, we have tested here two alternative subsets of the relevant universe of assets. The first, which places a relatively greater weight on short-term assets, includes short-term U.S. government securities and the "bank loans, n.e.c." and "other loans" categories of the flow-of-funds tables compiled by the Board of Governors of the Federal Reserve System. The second, more inclusive grouping, containing more long-term assets, consists of the foregoing plus long-term securities of the U.S. government, state and local

[24] Bryant and Hendershott [5, Appendix B] explain the reason for this jump: "When banks learned in February, 1965, that their allowable voluntary 'ceilings' for foreign assets would be expressed as a percentage of a base taken as their total foreign assets at end-December, 1964, the banks showed somewhat more interest in reporting their foreign assets carefully than they had shown in the past. . . . Total claims on all foreigners were increased by over 8 per cent in the December 1964 revisions."

[25] The difference between the unrevised and the revised figures for any period is that the totals for the former exclude, and those for the latter include, the value of assets held by institutions reporting for the first time. The adjustment technique used here is a special case of the one used by Bryant and Hendershott [5] and described in detail in their Appendix B.

[26] The reasons for using such a "representative subset," and the difficulties associated with its selection, are discussed in Miller and Whitman [19].

government securities, mortgages, and corporate and foreign bonds.

Obviously, the choice of *any* particular combination of assets as the denominator of W is somewhat arbitrary, since we do not know for certain what the actual or potential holders of short-term foreign assets regard as relevant alternatives; our choice of assets has been guided, however, by the fact that American banks hold most (70 per cent–80 per cent) of the American short-term claims on foreigners. Fortunately, the relationships suggested by our regression analysis are apparently not very sensitive to the precise specification of the relevant universe of risky assets.[27]

In summary, we have four measures of the portfolio ratio: W, WR, W', and WR'. The WR and WR' measures use the adjustment process for K described above. W uses the more inclusive denominator, while the denominator of W' is heavily weighted toward short-term assets.

4 EMPIRICAL RESULTS

A. REGRESSIONS FOR ΔW

We report in Table 1 a number of ordinary least-squares regression estimates of the reduced-form equation for ΔW, using several variants of the foreign-asset ratio, W, and several different proxies for a number of the explanatory variables described above. The coefficients and associated t-ratios in the corresponding equations for W are identical to those shown, except for that associated with W_{t-1}. We have chosen to report the equations for ΔW rather than those for W because we feel that R^2's associated with the latter are more meaningful; those associated with W are all over .98, as is often the case with time-series regression.

The adjusted coefficients of determination tend to be slightly higher

[27] Obviously, the *magnitude* of the coefficient associated with each explanatory variable will differ with different specifications of W, if for no other reason than that the magnitude of the dependent variable, W, itself varies.

TABLE 1

Regression Equations

Dependent Variable	Constant × 10^3	Time × 10^3	Y × 10^3	Y^* × 10^3	VRP × 10^3	R_F^e × 10^3	R_D^e × 10^3	$WIMP$ × 10^3	$NEXP$ × 10^3	EXP × 10^3	W_{t-1}	$\bar{R}^2$	DW
1 ΔW	4.71	.118	−.046		−.669	.228	−.337	.032			−.32	.76	2.46
	(1.76)	(1.74)	(2.69)		(3.10)	(1.67)	(3.72)	(1.94)			(4.74)		
2 ΔW	−.972	.043		−.043	−.718	.249	−.339	.032			−.29	.72	2.35
	(.70)	(.09)		(1.71)	(2.98)	(1.67)	(3.28)	(1.82)			(3.97)		
3 ΔW	4.99	.154	−.045		−.592	.356	−.264		.351		−.30	.80	2.44
	(2.27)	(3.26)	(2.85)		(3.35)	(3.57)	(3.15)		(3.11)		(4.84)		
4 ΔW	−.523	.043		−.048	−.616	.377	−.247		.381		−.25	.78	2.27
	(.65)	(2.07)		(2.18)	(3.24)	(3.57)	(2.63)		(3.24)		(4.32)		
5 ΔW	4.46	.130	−.040		−.727	.242	−.268			.485	−.30	.80	2.51
	(1.95)	(2.53)	(2.52)		(3.76)	(2.18)	(3.18)			(3.03)	(4.84)		
6 ΔW	−.578	.027		−.042	−.770	.250	−.255			.532	−.26	.78	2.40
	(.71)	(1.12)		(1.85)	(3.75)	(2.13)	(2.72)			(3.21)	(3.21)		
7 ΔWR	7.70	.160	−.064		−.698	.411	−.218	.035			−.41	.74	2.04
	(2.59)	(2.20)	(3.39)		(2.98)	(1.45)	(4.15)	(1.94)			(5.58)		
8 ΔWR	−.215	.004		−.059	−.742	.241	−.400	.035			−.33	.68	1.94
	(.13)	(.08)		(2.11)	(2.74)	(1.42)	(3.43)	(1.76)			(4.48)		
9 ΔWR	8.92	.220	−.066		−.588	.364	−.346		.302		−.41	.76	2.10
	(3.48)	(4.24)	(3.64)		(2.86)	(3.13)	(3.50)		(2.39)		(5.99)		
10 ΔWR	.717	.059		−.068	−.612	.392	−.316		.336		−.34	.71	1.94
	(.73)	(2.58)		(2.59)	(2.65)	(3.05)	(2.75)		(2.42)		(5.07)		
11 ΔWR	8.45	.200	−.062		−.697	.271	−.351			.404	−.41	.75	2.09
	(3.15)	(3.51)	(3.33)		(3.10)	(2.08)	(3.52)			(2.22)	(5.88)		
12 ΔWR	.671	.045		−.062	−.744	.280	−.323			.463	−.34	.70	2.00
	(.67)	(1.64)		(2.33)	(3.00)	(1.97)	(2.82)			(2.36)	(5.06)		

13 $\Delta W'$	20.8	.500	−.185		−2.61	.546	−1.14	.103			−.36	.69	2.39
	(2.17)	(2.06)	(3.00)		(3.38)	(1.11)	(3.48)	(3.38)			(5.11)		
14 $\Delta W'$	−1.40	.065		−.185	−2.68	.671	−1.14	.101			−.31	.64	2.29
	(.27)	(.35)		(2.01)	(3.08)	(1.25)	(3.02)	(1.55)			(4.28)		
15 $\Delta W'$	21.0	.597	−.181		−2.41	.943	−.880		1.34		−.33	.77	2.37
	(2.84)	(3.84)	(3.41)		(3.94)	(2.75)	(3.06)		(3.51)		(5.58)		
16 $\Delta W'$	−1.06	.161		−.204	−2.42	1.06	−.818		1.43		−.29	.74	2.23
	(.38)	(2.31)		(2.64)	(3.63)	(2.88)	(2.50)		(3.52)		(4.91)		
17 $\Delta W'$	19.8	.531	−.167		−2.84	.558	−.912			1.69	−.34	.74	2.51
	(2.46)	(3.00)	(2.96)		(4.13)	(1.41)	(3.02)			(2.98)	(5.42)		
18 $\Delta W'$	−.774	.119		−.182	−2.76	.622	−.864			1.84	−.30	.71	2.43
	(.25)	(1.39)		(2.24)	(3.25)	(1.48)	(2.54)			(3.09)	(4.86)		
19 $\Delta WR'$	40.5	.851	−.309		−2.45	.991	−1.77	.106			−.53	.64	2.15
	(2.91)	(2.51)	(3.50)		(2.20)	(1.39)	(3.77)	(1.25)			(5.40)		
20 $\Delta WR'$	3.03	.125		−.319	−2.44	1.18	−1.70	.102			−.45	.56	1.99
	(.40)	(.49)		(2.43)	(1.92)	(1.49)	(3.09)	(1.09)			(4.46)		
21 $\Delta WR'$	44.2	1.03	−.314		−2.11	1.44	−1.58		.901		−.54	.64	2.15
	(3.60)	(4.20)	(3.45)		(2.08)	(2.55)	(3.30)		(1.46)		(5.63)		
22 $\Delta WR'$	5.53	.274		−.344	−2.08	1.60	−1.43		1.05		−.45	.58	1.98
	(1.13)	(2.56)		(2.73)	(1.85)	(2.61)	(2.61)		(1.57)		(4.83)		
23 $\Delta WR'$	41.9	.949	−.301		−2.53	1.10	−1.57			1.40	−.53	.65	2.21
	(3.35)	(3.62)	(3.46)		(2.36)	(1.79)	(3.32)			(1.62)	(5.64)		
24 $\Delta WR'$	4.55	.210		−.324	−2.59	1.19	−1.43			1.64	−.45	.59	2.09
	(.96)	(1.66)		(2.59)	(2.19)	(1.79)	(2.66)			(1.78)	(4.88)		

NOTE: The first number in each block gives the magnitude of the A_i coefficient in equation (23) in the text. The number given in parentheses *is the t-value, which is significant here at the 5 per cent level* for values greater than 1.71 and at the 1 per cent level for t greater than 2.49. *WIMP*, *NEXP*, and *EXP* are rest of world imports, net U.S. exports, and U.S. exports respectively. (See the Appendix for the definitions and sources for all variables.) W_{t-1} refers to the lagged value of an appropriate measure of W, i.e., W_{t-1}, W'_{t-1}, WR_{t-1}, or WR'_{t-1}.

for the ratio with the more inclusive group of "alternative" domestic assets in the denominator, ΔW and ΔWR, than for $\Delta W'$ and $\Delta WR'$; and they are somewhat higher for the unrevised than for the revised series in each case, but in no case is the $\bar{R}^2$ difference substantial. The Durbin-Watson statistics, on the other hand, are more frequently closer to 2.0 in the case of the equations based on revised W's, suggesting that the procedure of adjusting for discontinuities has somehow served to destroy some of the correlation in the residuals. But, given the bias inherent in the Durbin-Watson statistic in equations of this type, we cannot make much of these differences.[28] In general, our results suggest that neither the particular arbitrary group of assets chosen to represent the alternatives considered by short-term foreign lenders, nor the unavoidable discontinuities in the data on stocks of short-term foreign claims, affect the basic nature of the reduced-form relationships suggested by our analysis.

Before discussing each of the explanatory variables in turn, we should note that all data used were without seasonal adjustment, and that quarterly dummy variables for the first three-quarters of each year were included in every equation. These coefficients have been omitted from Table 1 to save space, but they were always highly significant with negative coefficients. This is consistent with Branson's findings [3, p. 89] that the so-called "window-dressing" withdrawal of foreign short-term funds from America at the end of each year applies also to foreign borrowers. Evidently, foreign banks intending to borrow in the United States will, if possible, time their borrowings to occur at year-end.

The hypothesis that there is an inverse relationship between the proportion of short-term foreign assets which American investors want to hold in their portfolios and the state of the American economy, as measured by the deviation of GNP from its long-run trend (one of the central hypotheses of our model), is apparently corroborated by our regression results. Two variants of this measure were used: GNP itself, designated as Y, and a detrended measure of GNP, Y^*.[29] About

[28] The value of the Durbin-Watson statistic is biased toward 2 in equations which include the lagged value of an endogenous variable among the explanatory variables.

[29] The Y^* series represents deviations from a trend value of Y, calculated as Y minus the antilog of the estimated value of the dependent variable in the following regression equation: $\ln Y = at$, for the period 1959–1967.

the only difference the substitution of Y^* for Y makes is to reduce the significance of the constant term always and sometimes the significance of the coefficient associated with time, T. This effect on the coefficient of T is what we might expect, since when Y is used, T plays two roles in the equation: to detrend all the other explanatory variables, and to pick up any secular decrease in σ_K associated with increasing information and familiarity with short-term foreign investment. Since none of the other explanatory variables has as strong a positive time trend as Y, the substitution of Y^* eliminates much of the first role of T. The fact that its coefficient then becomes insignificant in some of the equations raises some question about the existence of a secular learning effect associated with short-term foreign investment.

All of the equations reveal the expected positive relationship between changes in W and foreign interest rates, as measured by an average of the short-term rates prevailing in each of four major recipient countries.[30] The t-ratio associated with the average rates of interest abroad does, however, fall below the 5 per cent significance level in several equations. We also find the expected negative relationship with the domestic short-term interest rate;[31] this coefficient is consistently significant at the 1 per cent level in a one-tailed test.[32]

Of the three variants of the proxy for the shift variable ψ: world imports, exports from the United States, and these exports net of American direct investment abroad, the latter two have the expected sign, and are significant at the 5 per cent level in most equations. World imports has the expected sign, but its t-value tends to be lower. The significance of net exports suggests that direct-investment outflows from the United States do indeed finance some part of its exports, whereas the inferiority of "world imports" raises some question about the importance of "third-party" trade-financing in American short-

[30] The Eurodollar rate, tested as an alternative proxy for borrowing costs in "the rest of the world," proved far less successful than the one used in the equations reported here. Kenen [14], who also found the Eurodollar rate surprisingly poor as an explanatory variable, suggests that this result may stem from the inaccuracy of published figures on the Eurodollar rate, particularly for the early years of its existence.

[31] An alternative proxy for American interest rates, the yield on corporate bonds, almost always turned out to be insignificant, whatever the variant of W used as the dependent variable.

[32] In cases where the expected sign of the relationship is known a priori, a one-tailed, rather than a two-tailed, test of significance is appropriate.

term lending abroad. But these subsidiary conclusions are highly tentative. The general pattern of relationships leaves little doubt, however, of the positive relationship between trade variables and the desired foreign-asset ratio.[33]

Conspicuous by their absence from Table 1 are any variables relating to the foreign-exchange market, namely r_f/r_s and r_s^e/r_s. The absence of r_f/r_s is due to the fact that the equilibrium value for r_f/r_s depends in part on domestic and foreign rates of interest, as well as on the expected future spot rate, r_s^e. (See, e.g., Branson [3, p. 10], Stein [21, p. 51], and Grubel [9, Chap. 6].) Thus, r_f/r_s does not belong as an explanatory variable in any regression equation that also contains American and foreign interest rates and r_s^e/r_s as explanatory variables.

The r_s^e/r_s variable is omitted from Table 1 because we could not find a proxy for r_s^e/r_s that had a statistically significant coefficient. We tried two approaches. First, we followed the lead of Branson [3, Chap. 3] by obtaining estimates, $\hat{r}_s^e/r_s$, of r_s^e/r_s. In doing this, we regressed r_s^e/r_s against American and foreign interest rates, exports and imports of the United States, and lagged values of r_s^e/r_s. The estimates $\hat{r}_s^e/r_s$ were then used as an explanatory variable in the regression equations for ΔW, but the coefficient of $\hat{r}_s^e/r_s$ was never significant. Similar results were obtained when we used the observed $r_{s_{t+1}}/r_{s_t}$ as a proxy for r_s^e/r_s, on the assumption that all spot rates are correctly anticipated.

One shortcoming of this technique for obtaining a proxy for r_s^e/r_s is that a regression equation of this nature can never generate an estimated $\hat{r}_s^e/r_s$ that anticipates a major change in the exchange rate if (ex post) such a change did not occur. Consequently, we tried an alternative approach, wherein variables that might reasonably be expected to influence expectations about exchange rates were substituted for r_s^e/r_s. Those other proxies were the balance of payments of the United States, measured on a liquidity basis and lagged one quarter, and changes in the combined international-reserve position of the four major recipient countries. Neither of these was successful. In conclusion, either we have not found the correct proxy for r_s^e/r_s or else exchange-rate expectations do not significantly affect the behavior of

[33] Regressions were also run which tested the hypotheses: (a) that trade credit may lead or lag behind the trade flows; and (b) that trade credit lasts longer than ninety days, i.e., that a moving sum of trade determines the stock of trade credit outstanding. Neither of these hypotheses was supported by the data.

American citizens and foreign debtors in the market for short-term loans from the United States.

The dummy variable for the Voluntary Credit Restraint program (VRP), which affects the riskiness of foreign assets, gave better results. It was always significant at the 5 per cent level, and usually at the 1 per cent level, with the expected *negative* sign. Finally, the coefficient of the lagged value of the dependent variable, W_{t-1}, is always highly significant, with the negative sign implied by our partial-adjustment hypothesis. In a structural equation, the absolute value of this coefficient is the "speed of adjustment," the proportion of the discrepancy between the desired and the actual W that is eliminated in any given quarter. In our reduced-form equation, the coefficient of W_{t-1} is a type of weighted average of the speeds of adjustment of the borrower and the lender, so that its absolute value lies between that of the speed-of-adjustment coefficient in the Americans' demand equation, ϕ, and that of the corresponding coefficient in the foreigners' supply equation, δ. The absolute value of this coefficient ranged from .25 to .54.[34]

If, as our theory implies, the equilibrium W^* depends on the levels of the explanatory variables in the American and foreign behavior equations, then the total change in W (from one equilibrium position to another) will depend on changes in these explanatory variables. Thus, in a growing world, if speeds of adjustment were very high, i.e., if $\phi = 1$ in (17) and $\delta = 1$ in (20), then the observed ΔW would depend on changes in the explanatory variables but not on W_{t-1}. If, however, the speeds of adjustment are low (as our regression coefficients for W_{t-1} suggest), then ΔW is determined by W_{t-1} and by the levels of the explanatory variables, rather than by changes in them. This does not, however, contradict the view that the portfolio decision (for both debtor and creditor) is essentially a stock phenomenon. If a once-for-all change in an explanatory variable took place in a situation of steady-

[34] The speeds of adjustment implied by these coefficients seem rather low for short-term capital transactions; such a puzzling long adjustment-lag has been noted by a number of investigators using estimating equations containing an autoregressive term. That these lags must be taken with more than a grain of salt is suggested by the fact that they are extremely sensitive to the period of observation. Typically, regressions based on quarterly data will imply slower speeds of adjustment than those based on monthly data, and those based on annual data yield even larger estimates of the adjustment lag.

state growth, the value of the resulting ΔW would (if we abstract from any time trend in W) gradually approach zero, since the negative influence of W_{t-1} in our regression equation (23) eventually would just cancel the positive influence of all the other explanatory variables.

B. ESTIMATING THE SHORT-TERM CAPITAL FLOW

Our model requires that we do not directly estimate the aggregate outflow of short-term capital from the United States, ΔK, but, rather, the stock-adjustment (FS) and flow-adjustment (FF) components taken separately. To do this, we calculate the *observed* values of FS and FF, using the observed values of W, ΔW, A, and ΔA, following (10) and (11) above. These values are given in Table 2 below. The mean of FF is \$132.8 million, while the algebraic mean of FS is \$109 million, which implies that on the average, the flow-adjustment component accounted for 55 per cent of the quarterly capital outflow. Note, however, that the mean of FS is low because FS has many negative values. The mean of the absolute values of FS is \$255.2 million, so that fluctuations in the total flow are determined primarily by FS.

Next, we calculated a series of *estimated* values, $\hat{FS}$ and $\hat{FF}$, using the observed values of A and ΔA—since these are determined exogenously—but the estimated values of $\Delta \hat{W}$ for each time-period yielded by the regression equation (4) in Table 1, and estimates of $\hat{W}$ from the corresponding equation for W. The resulting regression equations are

$$FF = \underset{(379.46)}{1.0006}\hat{FF}, \qquad \begin{cases} \bar{R}^2 = .999 \\ DW = 2.314 \end{cases} \tag{24}$$

and

$$FS = \underset{(13.8305)}{.9758}\hat{FS}, \qquad \begin{cases} \bar{R}^2 = .832 \\ DW = 2.223 \end{cases} \tag{25}$$

The coefficient of the independent variable is, in each case, positive, highly significant, and not significantly different from one, as is implied by our specification of the underlying model.

The final step is to see how well our theory and the regression equations that are derived from it explain the total quarterly flow of

TABLE 2

A Breakdown of Short-Term Capital Outflows from the United States, 1959–1967
(billions of dollars)

Period	$FS = A(\Delta W)$	$FF = W(\Delta A)$
1959–II	−.0145	.0749
III	−.1180	.0778
IV	.1944	.0629
1960– I	.0639	.0222
II	.1314	.0402
III	.4216	.0465
IV	.9315	.0728
1961– I	.1492	.0080
II	.3142	.0842
III	.0472	.1259
IV	.3726	.1411
1962– I	.2382	.0740
II	.0293	.1419
III	−.0080	.1337
IV	.1128	.1520
1963– I	−.0516	.0663
II	.3740	.1563
III	−.1875	.1178
IV	.2181	.1976
1964– I	.5611	.0777
II	.3678	.1993
III	.0529	.1672
IV	.9586	.2458
1965– I	−.4317	.1451
II	−.5071	.2201
III	−.3913	.1362
IV	−.0591	.2789
1966– I	−.2118	.1448
II	−.1074	.1680
III	−.2756	.1166
IV	.3879	.1953
1967– I	−.0118	.0948
II	.1199	.0937
III	−.1823	.2368
IV	.3277	.3314

short-term capital owned by residents of the United States. This is done in two ways: first, by adding our estimates of $\hat{FF}$ and $\hat{FS}$ together to form an estimate of the capital flow and regressing this sum against the observed flow; and second, by including $\hat{FF}$ and $\hat{FS}$ as separate variables in a regression equation with the actual flow. The results are

$$\Delta K = \underset{(17.0)}{.986}(\hat{FS} + \hat{FF}), \qquad \begin{cases} \bar{R}^2 = .838 \\ DW = 2.19 \end{cases} \tag{26}$$

and

$$\Delta K = \underset{(13.1)}{.971}\hat{FS} + \underset{(6.5)}{1.03}\hat{FF}. \qquad \begin{cases} \bar{R}^2 = .834 \\ DW = 2.19 \end{cases} \tag{27}$$

The results are virtually the same, with none of the regression coefficients differing significantly from unity.

C. SOME IMPLICATIONS OF CHANGES IN EXPLANATORY VARIABLES

This section attempts to suggest the relative effects of changes in the GNP of the United States, the U.S. Treasury bill rate, and foreign short-term interest rates on the quarterly flow of American short-term capital. This will be done, using the empirical results from equation (4) in Table 1, by first calculating the long-run effects of these three explanatory variables on W (by dividing each of the relevant regression coefficients by the coefficient of W_{t-1}) and then tracing the influence of this change in W on FF and FS. The resulting magnitudes give only the roughest type of estimates, since they fail to take into account the effects on FF and FS of changes in other explanatory variables that might be induced by changes in GNP and foreign or domestic rates of interest.

To find the effects of changes in R_F^e and R_D^e on capital flows, ΔK, we must compute

$$\delta(\Delta K)/\delta R_F^e = \delta FS/\delta R_F + \delta FF/\delta R_F$$
$$= (\delta \Delta W/\delta R_F)(\bar{A}) + (\delta W/\delta R_F)(\overline{\Delta A}) = 1.162 + .020,$$

and

$$\delta(\Delta K/\delta R_D^e) = \delta FS/\delta R_D + \delta FF/\delta R_D$$

$$= (\delta\Delta W/\delta R_D)(\bar{A}) + (\delta W/\delta R_D)(\overline{\Delta A}) = -.542 - .009.$$

The bars over A and ΔA indicate that we have taken their average values. Notice that an increase in the foreign rate of 1 per cent will ultimately increase the stock-adjustment component of the capital flow, FS, by \$1,162 million, and will increase the flow-adjustment component, FF, by \$20 million per quarter for each succeeding period. In contrast, an increase in the domestic rate of 1 per cent will eventually decrease FS by \$542 million and FF by \$9 million, the latter for each succeeding quarter. Finally, we have estimated the importance of a change in Y_t^* on capital flows and have found that

$$\delta(\Delta K)/\delta Y^* = \delta FS/\delta Y^* + \delta FF/\delta Y_t^* = -.148 + 0.$$

Thus, an increase of \$1 billion in the GNP of the United States will lower FS by a total of \$148 million and will have no significant effect on FF.[35] The domination of the stock-adjustment terms, noted in each of the three estimates just given, is consistent with the simulated findings of Willett and Forte [24] for short-term flows and with the estimated results of Miller and Whitman [19] for long-term portfolio flows.

APPENDIX: DEFINITIONS OF VARIABLES AND SOURCES OF DATA

R_A^e	Expected return on the portfolio of risky assets held by American investors who are actual or potential holders of short-term foreign assets
$\sigma_{R_A}^2$	Variance of R_A^e
R_D^e	Expected return on risky U.S. assets; approximated by

[35] The term $\delta FF/\delta Y^* = (\delta(W)/\delta Y^*)\Delta A + (\delta(\Delta A)/\delta Y^*)W = 0$ because the first term is negative and various regression estimates of $\delta(\Delta A)/\delta Y^*$ give a positive second term that, on the average, just cancels the first.

	the U.S. Treasury bill rate. Source: *International Financial Statistics*
σ_D^2	Variance of R_D^e
R_K^e	Expected return on foreign short-term assets, from the point of view of U.S. lenders
σ_K^2	Variance of R_K^e
$R_K^{e'}$	Expected cost of borrowing from the United States, from the point of view of foreign borrowers
$\sigma_K'^2$	Variance of $R_K^{e'}$
R_F^e	Expected cost of borrowing from foreign lenders, from the point of view of foreign borrowers; approximated by a simple arithmetic average of the following rates: Canada and United Kingdom, Treasury bill rate; Germany and Japan, call money rate. Sources: Canada, Germany, United Kingdom, *International Financial Statistics;* Japan, unpublished data provided by P. Hendershott
σ_F^2	Variance of $R_F^e = 0$
R_B^e	Total expected cost of borrowing for those foreign debtors who are actual or potential short-term borrowers from the U.S.
σ_B^2	Variance of R_B^e
K	End-of-quarter stock of short-term claims on foreigners held by American banks and nonfinancial insitutions. Source: *U.S. Treasury Bulletin*
D	Domestic risky assets held by U.S. investors
ΔK	Change in K; the quarterly net-outflow of short-term U.S. capital
A'	End-of-quarter stock of: short-term U.S. government securities; bank loans, n.e.c.; and other loans. Source: unpublished data of the Board of Governors of the Federal Reserve System, provided by S. Taylor and J. Berry of the Flow of Funds Section
A	A' plus end-of-quarter stock of: long-term U.S. government securities; state and local government securities; mortgages; and corporate and foreign bonds. Source: same as for A'

W	$= K/A$; $W' = K/A'$
WR & WR'	W and W', using the K adjusted for discontinuities by the procedure described in the text
L	Total liabilities of those foreign debtors who are actual or potential borrowers from the U.S. on a short-term basis
V	$= K/L$
W_d & W_s	The portfolio ratio demanded by American creditors and supplied by foreign debtors
W^* & V^*	Desired values of W and V
ϕ & δ	Speeds of adjustment for American investors and foreign debtors in reaching their optimum portfolios
i_K	Nominal rate of interest on short-term loans of U.S. capital to foreigners
ψ	Parameter in foreign debtors' disutility functions that shifts with the need for dollar loans for financing international trade
X	Theoretical measure of the trade that foreigners wish to finance via short-term loans from the United States; empirical proxies are *WIMP*, *EXP*, and *NEXP*
r_f/r_s	Ratio of the forward rate to the spot rate of exchange, in dollars per unit of foreign exchange
r_s^e/r_s	Ratio of the expected future spot rate to the current spot rate
FF	$= (W)(\Delta A) =$ the flow-adjustment component of the total capital flow
FS	$= (\Delta W)(A) =$ the stock-adjustment component of the total capital flow
$\hat{FF}$ & $\hat{FS}$	Estimated values of FF and FS
T	Time
Y	Quarterly U.S. GNP, not seasonally adjusted. Source: *Survey of Current Business*
Y^*	Deviations of Y from its time trend over the period 1959-I–1967-IV, calculated by method described in footnote 29
VRP	Dummy variable for U.S. Voluntary Credit Restraint program

WIMP	Rest of world imports = world imports minus U.S. imports; not seasonally adjusted. Source: *International Financial Statistics*
EXP	Merchandise exports from the United States; not seasonally adjusted. Source: *Survey of Current Business*
NEXP	*EXP* minus direct foreign investment by residents of the United States. Source: *Survey of Current Business*

REFERENCES

1. Arndt, Sven W., "International Short Term Capital Movements: A Distributed Lag Model of Speculation in Foreign Exchange." *Econometrica,* Vol. 36, No. 1 (January, 1968), pp. 59–70.
2. Bell, Philip W., "Private Capital Movements and the U.S. Balance of Payments," *Factors Affecting the U.S. Balance of Payments.* Washington, D.C., U.S. Government Printing Office, 1962, pp. 395–481.
3. Branson, William H., *Financial Capital Flows in the U.S. Balance of Payments.* Amsterdam, North-Holland Publishing Co., 1968.
4. Brimmer, Andrew F., "Direct Investment and Corporate Adjustment Techniques Under the Voluntary U.S. Balance of Payments Program." *Journal of Finance*, Vol. 21 (May, 1966), pp. 266–283.
5. Bryant, Ralph, and Hendershott, Patric H., "Financial Capital Flows in the U.S. Balance of Payments: An Explanatory Empirical Study." Mimeographed, August, 1969.
6. Fama, Eugene, "Risk, Return and Equilibrium: Some Clarifying Comments." *Journal of Finance,* Vol. 23, No. 1 (March, 1968), pp. 29–40.
7. Feldstein, Martin S., "Uncertainty and Forward Exchange Speculation." *Review of Economics and Statistics,* Vol. L, No. 2 (May, 1968), pp. 182–192.
8. Floyd, John E., "International Capital Movements and Monetary Equilibrium." *American Economic Review,* Vol. LIX, No. 4, Part 1 (September, 1969), pp. 472–491.
9. Grubel, Herbert G., *Forward Exchange, Speculation and the*

International Flow of Capital. Stanford, Stanford University Press, 1966.

10. ——— "Internationally Diversified Portfolios." *American Economic Review,* Vol. LVIII, No. 5 (December, 1968), pp. 1299–1314.
11. Hawkins, Robert G. "International Capital Movements Under Canada's Flexible Exchange Rate." Unpublished paper, 1967.
12. Hendershott, Patric H., "Recent Development of the Financial Sector of Econometric Models." *Journal of Finance,* Vol. 23, No. 1 (March, 1968), pp. 41–66.
13. Johnson, Harry G., "Some Aspects of the Theory of Economic Policy in a World of Capital Mobility," in Tullio Bagiotti, ed., *Essays in Honor of Marco Fanno.* Padua, 1966.
14. Kenen, Peter B., *Portfolio Capital and the United States Balance of Payments* (forthcoming).
15. ——— "Short-Term Capital Movements and the U.S. Balance of Payments," *U.S. Balance of Payments, Hearings,* Joint Economic Committee, 88th Congress, 1st Session. Washington, D.C., U.S. Government Printing Office, 1963, Part 1, pp. 153–191.
16. Levin, Jay H., "Forward Exchange and Internal-External Equilibrium." Seminar Discussion Paper No. 1, Research Seminar in International Economics, Department of Economics, University of Michigan, 1968.
17. Markowitz, Harry, *Portfolio Selection.* New York, John Wiley & Sons, 1959.
18. Lee, Chung Hoon, "A Stock-Adjustment Analysis of Capital Movements: The United States–Canadian Case." *Journal of Political Economy,* Vol. 77, No. 4, Part 1 (July/August, 1969), pp. 512–523.
19. Miller, Norman C., and Whitman, Marina v. N., "A Mean-Variance Analysis of United States Long-Term Portfolio Foreign Investment." *Quarterly Journal of Economics,* Vol. LXXXIV, No. 2 (May, 1970), pp. 175–196.
20. Sharpe, William F., "Capital Asset Prices: A Theory of Market Equilibrium." *Journal of Finance,* Vol. 19 (September, 1964), pp. 425–442.
21. Stein, Jerome, "International Short Term Capital Movements."

American Economic Review, Vol. 55, No. 1 (March, 1965), pp. 40–66.

22. Tobin, James, "Comment on Borch and Feldstein." *Review of Economic Studies,* Vol. 36 (January, 1969), pp. 13–15.
23. ——— "Liquidity Preference as Behavior Toward Risk." *Review of Economic Studies,* Vol. 25 (February, 1968), pp. 65–86.
24. Willett, Thomas D., and Forte, Francesco, "Interest Rate Policy and External Balance." *Quarterly Journal of Economics,* Vol. 83 (May, 1969), pp. 242–262.