NBER WORKING PAPER SERIES

# EXCHANGE RATES AND FOREIGN DIRECT INVESTMENT: AN IMPERFECT CAPITAL MARKETS APPROACH

Kenneth A. Froot

Jeremy C. Stein

Working Paper No. 2914

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 1989

We thank Geoff Carliner, Richard Caves, Rudi Dornbusch, Martin Feldstein, Jeff Frankel, Tim Luehrman, Rachel McCulloch, David Scharfstein, Larry Summers, seminar participants at Harvard University, and especially Julio Rotemberg for helpful discussions. We are also grateful to Joe Mullally for efficient research assistance, and to the Alfred P. Sloan and John Olin Foundations and the Division of Research, Harvard Business School for generous financial support. This paper is part of NBER's research programs in Financial Markets and Monetary Economics and in International Studies. Any opinions expressed are those of the authors not those of the National Bureau of Economic Research.

NBER Working Paper #2914
March 1989

# EXCHANGE RATES AND FOREIGN DIRECT INVESTMENT: AN IMPERFECT CAPITAL MARKETS APPROACH

## ABSTRACT

We examine the connection between exchange rates and foreign direct investment that arises when globally integrated capital markets are subject to informational imperfections. These imperfections cause external financing to be more expensive than internal financing, so that changes in wealth translate into changes in the demand for direct investment. By systematically lowering the relative wealth of domestic agents, a depreciation of the domestic currency can lead to foreign acquisitions of certain domestic assets. We develop a simple model of this phenomenon and test for its relevance in determining international capital flows.

Kenneth A. Froot
Sloan School of Management
Massachusetts Institute of Technology
Cambridge, MA 02139

Jeremy C. Stein
Harvard Business School
Harvard University
Cambridge, MA 02138

# Exchange Rates and Foreign Direct Investment: An Imperfect Capital Markets Approach

Kenneth A. Froot
Sloan School of Management,
Massachusetts Institute of Technology

Jeremy C. Stein
Harvard Business School

## 1. Introduction

The recent depreciation of the dollar has been accompanied by a dramatic increase in foreign direct investment (FDI) in the U.S. According to many business people and members of the press, the link between these two phenomena is an obvious one: a weak dollar makes certain U.S. assets seem cheap to foreigners, who hold their wealth in other currencies. This story is often told with either an implicit or explicit warning about the unfavorable welfare effects involved in such a "fire sale" of U.S. assets. A notable example is Malcolm Forbes' statement that "it's one thing for [foreigners] to buy U.S. Government bonds to finance our huge imbalances with them,... but its a whole and totally impermissible other thing for them to use their vast billions of dollars to buy great chunks of America's big businesses..."[1]

Most international economists dismiss the possibility of a relationship between foreign acquisitions and exchange rates. The typical counter-argument notes that in a world with mobile capital (which, increasingly, is the world we live in) expected returns on *all* international assets will be equalized. As the dollar declines relative to its long-run equilibrium value, the returns on all dollar assets will fall as well, and hence the prices of these assets will rise. There are no "steals" to be had by foreigners. An economist might ask, "if a German has an advantage purchasing a particular U.S. asset with marks,

[1] Tolchin (1988)

why can't an American with access to global capital markets borrow marks (at the same opportunity cost as the German) and avail himself of the same advantage?"

The usual implication drawn from a model with perfect capital mobility is that the individual components of the capital account are not connected to exchange rates. Of course, *total net* foreign investment is tied down by the trade balance; we must import exactly enough capital to offset our current account deficit. But the makeup of this capital account surplus – the relative magnitudes of gross inflows or outflows, or of portfolio versus direct investment – is not affected by the exchange rate. Thus, for example, the value of the dollar does not tell us whether a $100 billion current account deficit will be financed by foreign purchases of $100 billion of Treasury bonds, by purchases of $50 billion of bonds and $50 billion of real estate, or by foreign *sales* of $50 billion of U.S. bonds and *repurchases* of $150 billion of *foreign* assets held by Americans. According to the modern view of international capital markets (which dates back to Mundell, 1968), this indeterminacy arises because exchange rate movements cannot impart a systematic cost-of-capital advantage to either domestic or foreign investors. This is true for any type of investment, be it a passive portfolio investment in Treasury securities or a direct investment in an office building.

In keeping with this view, the modern theory of FDI since Hymer (1960), Kindlebeger (1969) and Vernon (1966) stresses that FDI occurs not because of cost-of-capital differences but because certain domestic assets are worth more under foreign control.[2] A German auto manufacturer, for example, may be able to manage more efficiently an existing plant than his U.S. counterpart, and would be willing to pay a price that exceeds the American's valuation. Under this *industrial organization* view of FDI, it makes no difference how the acquisition is financed, since both the American and the German have access to the same international capital market. And once again, there is no real role for the exchange rate: when the dollar depreciates the U.S. becomes a cheaper place for *any* firm to produce.

[2] See also Caves (1982) for a discussion of these views.

Depreciation does not alter foreigners' opportunities relative to those of Americans.

In spite of its logical appeal, the view that exchange rates are irrelevant to FDI is at odds with more than just casual empiricism. As an example, Figure 1 shows detrended inflows of FDI into the U.S. since 1973, along with a measure of the real value of the dollar. The relationship is visually striking, and a simple statistical test confirms this observation - a regression of detrended FDI (as a percentage of U.S. GNP) against the exchange rate implies that a 10 percent dollar depreciation is associated with additional FDI inflows of about $5 billion (with a standard error of less than $2 billion). Moreover, the correlation is not just a recent development. If the 1980's are excluded from the sample, the regression coefficient actually increases. As we will see later in the paper, these results are not extraordinary. Indeed, other researchers have produced similar results using a variety of data sets.[3]

In this paper, we offer a model of FDI which is capable of explaining the observed importance of exchange rates for direct investment. Our model has the common-sensical feature that increases in wealth stimulate agents' demand for investment. This effect is familiar in other contexts; indeed, it occupies a central position in some economists' explanations of important phenomena.[4]

More specifically, we build on the idea that when there are informational asymmetries about an asset's payoffs, it will be costly or impossible for entrepreneurs to finance that asset solely with externally-obtained funds. The more net wealth an entrepreneur can bring to such an "information intensive" investment, the lower will be his total cost of capital. The basic economic principles that generate costly external finance have been developed in a variety of specific formulations.[5] Several authors have underscored the macroeconomic

[3] Caves (1988), for example, examines a panel of investment inflows into the U.S. from fifteen individual source countries. He finds that the strength of a country's currency relative to the dollar is an important explanatory variable for that country's direct investment in the U.S. See also Ray (1988).

[4] The idea goes back at least as far as Irving Fisher (1933), who attributes much of the decline in investment during the great depression to wealth effects.

[5] These include the adverse selection models of Jaffee and Russell (1976), Stiglitz and Weiss (1981, 1983), Greenwald, Stiglitz and Weiss (1984) and Myers and Majluf (1984), as well as the costly-state-verification models of Townsend (1979), Gale and Hellwig (1985), and Williamson (1987a).

importance of these imperfections in a closed-economy setting.[6]

Once one accepts that there is a link between wealth positions and investment, the relationship between exchange rates and FDI follows immediately. To the extent that foreigners hold more of their wealth in non-dollar denominated form, a depreciation of the dollar increases the relative wealth position of foreigners and hence lowers their relative cost of capital. This allows them to bid more aggressively for assets.

The effect can be seen most easily using a stylized example. Imagine first that both a U.S. and a Japanese investor are bidding to buy an American office building. The building will produce an expected $100 million of rental revenues next year, and be worthless thereafter. Either investor can go to the same bank and get a mortgage loan on the same terms – the bank will lend at an interest rate of 10 percent, but for only up to 90 percent of the purchase price.[7] The U.S. investor has $7 million in cash available, and the Japanese investor has 1000 million yen. The exchange rate is 200 yen/dollar. Under this scenario, the U.S. investor wins the bidding, because he can make a $7 million downpayment and thus pay as high as $70 million for the building. The Japanese investor, on the other hand, has wealth of only $5 million, and so can bid just $50 million.

Now suppose the dollar depreciates to a value of 100 yen. The Japanese investor's dollar wealth increases to $10 million, and he wins the bidding. Thus the depreciation of the dollar has increased the relative wealth of the Japanese, and changed the outcome of the auction.

It should be emphasized that the "imperfection" that drives this result is an informational one, related to the nature of the asset being purchased. In the above example, capital is still perfectly mobile in the usual sense – the Japanese investor has access to the same external borrowing facilities as the U.S. investor. Furthermore, the imperfection will

[6] See Williamson (1987b), Bernanke and Gertler (1987, 1989) and Greenwald and Stiglitz (1988). The conclusion that wealth matters for investment has been supported in tests using aggregate data (Abel and Blanchard (1986)), micro data (Fazzari, Hubbard and Petersen (1988), Hoshi, Kashyap and Scharfstein (1988)), and in the field study research of Donaldson (1984). Gertler (1988) provides a useful survey of much of this material.

[7] The model of the next section shows how loan supply schedules that involve credit rationing of this sort emerge endogenously from informational imperfections.

not be of the same significance for all types of assets. A passive investment portfolio of stocks and bonds is not "information intensive" and thus can be readily financed almost exclusively with external funds. As a consequence, we would expect gross portfolio flows to be insensitive to exchange rates. This would not be true, however, for certain direct investments, where there are likely to be significant asymmetries of information.

The plausibility of our theory can be checked by noting that the effect of exchange rate changes on relative wealth positions is likely to be substantial compared to the effects of other shocks. For example, previous empirical work has found that corporate profits are a significant determinant of investment. Presumably, this is because such profits enhance corporate wealth and thereby improve companies' ability to finance their investments.[8] Yet over the period 1974-1986, return on net worth for U.S. manufacturing corporations had a standard deviation of only 2.3 percent per year. In contrast, the annual standard deviation of the real exchange rate over the same period was 13.5 percent. Thus, even if the typical foreign company holds only a fraction of its net worth in non-dollar form, the effect of currency shocks on the relative wealth of domestic and foreign companies can be of a greater order of magnitude than the effect of profitability shocks.[9]

The remainder of the paper is organized as follows. In section 2, we develop and then interpret a formal model that connects exchange rates, wealth positions, and FDI. The welfare properties of this model are studied in Section 3. Section 4 examines in some detail a number of alternative hypotheses that have been offered to explain the relationship shown in Figure 1. In section 5 we turn to the data, and argue that they favor our model over competing hypotheses. Section 6 concludes.

[8] See Abel and Blanchard (1986).

[9] The model below is vague about the precise interpretation of a company's existing "wealth." To be more clear, one needs to specify the informational attributes of assets already owned by the company. For example, if all a company's existing assets are free of informational asymmetries – it might own only Treasury bonds – then its wealth for our purposes is simply the difference between the market value of its assets and liabilities. More realistically, a company's existing assets will also be subject to some informational problems. Therefore, it will be unable to readily convert all its net worth into cash: its collateralizable wealth, or "financial slack," will be less than the value of its equity.

## 2. The Model

The model features an information asymmetry with regard to assets under an entrepreneur's direct control. We adopt Townsend's (1979) costly-state-verification approach, in which the asymmetry is ex-post, rather than ex-ante as in an adverse selection model: once the profit from the asset is realized, it is costlessly seen only by the asset's owners. External creditors must pay an amount $c$ if they want to observe the profit. This monitoring cost is what causes external finance to be more expensive than internal finance.

When $c > 0$, the optimal contract between creditors and borrowers will be a straight debt contract, with a required repayment of $D$. In those states of the world where profits exceed $D$, borrowers keep the difference. When profits fall below $D$, the creditors pay the monitoring cost, discover what profits are, and keep all of them. This can be interpreted as bankruptcy.[10]

Costly state verification is more literally applicable to small, privately-owned companies. Larger companies often issue public equity, which is inconsistent with the model. Nonetheless, we choose this approach for two reasons: First, it is extremely simple, and allows for an intuitive exposition of our basic ideas; and second, because a more complex adverse selection model would lead to the same qualitative results.[11]

### 2.1. Investment Opportunities

In our two period model, agents are risk-neutral, and they can allocate their first-period wealth across three types of investments. The first two investments are riskless one-period bonds available to all agents. There is a domestic asset that pays an interest rate $r$ in the domestic currency, and a foreign asset that pays $r*$ in the foreign currency. We assume that capital is perfectly mobile internationally. Because agents are risk-neutral,

[10] We assume that monitoring is a deterministic function of the state. If stochastic monitoring were possible, most of our results would still hold – only our welfare analysis would be affected. See also footnotes 16 and 21 below. To see that debt contracts are optimal under deterministic monitoring, note that payments can be linked to profits only in states where there is monitoring. (Without monitoring, the entrepreneur would claim the lowest possible level of profits, regardless of his return.) Intuitively, debt contracts conserve on monitoring costs; an equity contract, for example, would involve monitoring in all states.

[11] A comparison of Bernanke and Gertler's two papers (1989, 1987) makes this clear. In the latter, they show how the conclusion that "wealth matters" carries over from the costly-state-verification model they use in the former to a more complicated adverse selection model.

uncovered interest parity holds:

$$r - r* = \frac{E_1(e_2) - e_1}{e_1}, \tag{1}$$

where $e_1$ and $e_2$ are the period 1 and 2 exchange rates respectively. In order to tie down the model and simplify the notation, we assume that $E_1(e_2)$ is exogenous and equal to 1, and that $r*$ is exogenous and equal to zero. Thus we have $(1 + r) = 1/e$ as our simplified parity condition, where the unsubscripted $e$ refers to $e_1$.[12]

The final type of investment is a risky direct investment in the domestic country.[13] There are a large number of risky assets available, indexed by $i$. The $i$th asset can be managed by either a single domestic entrepreneur, who will realize a random profit (in the domestic currency) of $x_i^d$, or by a single foreign entrepreneur, whose profit in the domestic currency is $x_i^f$. An entrepreneur sees the realization of $x_i$ ex-post, but an external supplier of funds can only observe it at a cost of $c$.

Ex ante, it is common knowledge that $x_i^d$ is distributed uniformly on $[0, X_i^d]$, and similarly, that $x_i^f$ is distributed uniformly on $[0, X_i^f]$. The $X_i$'s, which are publicly observable, are a measure of the expected abilities of the entrepreneurs. Differences in $X_i^d$ and $X_i^f$ are intended to capture the idea that one entrepreneur may be better equipped to manage a particular asset than another, much as in the *industrial organization* view of FDI mentioned above. There is a population-wide distribution of abilities for both domestic and foreign entrepreneurs, described by the cumulative density functions $G^d(X_i^d)$ and $G^f(X_i^f)$. If, for example, we had $G^d(\ ) = G^f(\ )$ then domestic entrepreneurs would be more talented for half of the assets, and foreign entrepreneurs would be more talented for the other half. More generally, it might be the case that domestic entrepreneurs are more talented for a larger proportion of the assets. A strong way to express this would be if $G^d(\ ) < G^f(\ )$.

[12] In the analysis that follows, we hold $e_2$ constant, so all current exchange-rate changes are purely temporary. All our results continue to hold if we were instead to study exchange-rate changes with permanent components.

[13] We could easily obtain a model of two-way FDI by adding risky direct investment opportunities in the foreign country.

Finally, note that the existence of the riskless assets allows us to divorce our study of risky direct investment from the current account. Once FDI and the current account are determined, portfolio investment in the riskless assets will absorb the difference between the current account deficit and FDI.[14]

### 2.2. The Supply of Loans for Direct Investment

In a globally integrated capital market, both domestic and foreign entrepreneurs have access to the same loan opportunities when seeking to finance the risky investments. As noted above, the optimal financing contract will involve a loan amount $L$, and a required debt repayment $D$. In those states of the world where the payoff $x > D$, the lender receives $D$. When $x < D$, the lender pays the monitoring cost and keeps all the profit, for a net of $x - c$. Given our assumptions about the uniform distribution of $x$, the expected return to the lender for a given contracted $D$, denoted $R_D^L$, is:

$$R_D^L = D - \frac{D^2}{2X} - \frac{cD}{X}. \tag{2}$$

In order for the lender to receive an adequate return, it must be that $R_D^L = (1+r)L$. Figure 2 graphs the loan supply schedule that arises from this condition. As the figure shows, entrepreneurs can be credit rationed - they can never obtain a loan for more than $L_{\max} = \frac{(X-c)^2}{2X(1+r)}$. When $c = 0$, there is effectively no rationing, since the maximum loan amount equals $\frac{X}{2(1+r)}$, which is the entire expected present value of the asset. But for $c > 0$, an entrepreneur cannot finance the whole present value of the asset externally. If his wealth is sufficiently low, the credit constraint will bind. And even if the desired loan amount is less than $L_{\max}$, the implicit interest cost to the entrepreneur will exceed $r$, due to the deadweight costs associated with monitoring.

[14] The model can be described in purely real terms. Assume that there are two goods, sushi and hot dogs, which are produced exclusively in the foreign and domestic countries, respectively, using country-specific factors of production (i.e., oceans filled with good sushi fish, and wide open grazing land). The interest rates can be thought of as reflecting riskless production technologies, and the risky domestic investments as representing individual technologies for producing hot dogs. All consumption takes place in period 2, at which time both foreign and domestic residents allocate shares of their income to hot dogs and to sushi. The period-2 exchange rate is simply the price of sushi (relative to hot dogs). The period-1 exchange rate is the price of the oceans relative to grazing land, which is tied down by $e_2$ and the riskless production technologies. In this context, a permanent depreciation is generated through a positive shock to world demand for sushi. A temporary depreciation occurs when the relative efficiency of the riskless sushi technology improves (holding $e_2$ fixed). These depreciations will have the wealth effects described in the text, since residents' initial endowments are their country-specific factors of production.

### 2.3. Entrepreneurs' Wealth and Bidding Behavior

We now turn to the question of which entrepreneur - the domestic or the foreign one - will bid more for the $i$th asset. If $c$ were equal to 0, the answer would be simple. The entrepreneur with the higher ability for managing the asset would always prevail. That is, the domestic entrepreneur would end up with all those assets for which $X_i^d > X_i^f$. This is because with $c = 0$, internal funds are not necessary, and an entrepreneur can obtain the full value of the asset (under his management) from external sources.

Things are more complicated when $c > 0$. Now the wealth of the entrepreneurs matters. We assume that domestic entrepreneurs all enter the first period with wealth $w^d$, measured in the domestic currency. Foreign entrepreneurs all enter the first period with wealth $W^f$ measured in the foreign currency. As a normalization, we set $w^d = eW^f$.[15] Thus the domestic currency value of foreigners' wealth, denoted by $w^f$, equals $eW^f = w^d$. As the domestic currency depreciates, the wealth of foreign entrepreneurs rises relative to that of domestic entrepreneurs.

What is the price $P$ that can be offered by an entrepreneur with ability $X$ and domestic-currency wealth $w$? First, note that under no circumstances can $P$ ever exceed $L_{\max} + w$. Second, when an entrepreneur is not at this credit rationed corner solution, he will be willing to pay any price such that his net expected return equals what he could get by investing his wealth in the safe asset, $w(1 + r)$.

Given the distributional assumptions, the return to an entrepreneur who agrees to a contractual repayment of $D$, denoted by $R_D^E$, is given by:

$$R_D^E = \frac{D^2}{2X} - D + \frac{X}{2}. \tag{3}$$

When the entrepreneur is not credit rationed he will be willing to bid to the point where $R_D^E = (1+r)w$. Adding equations (2) and (3) together, and assuming that the entrepreneur

[15] The model can be mechanically extended to consider cross-sectional distributions of wealth for both domestic and foreign entrepreneurs. Also, it is not necessary that foreign wealth be held exclusively in the foreign currency. As long as foreigners hold more of their wealth in the foreign currency than do domestic agents, our results will continue to apply.

is not rationed, we obtain:

$$\frac{X}{2} - \frac{cD}{X} = (1+r)(L+w). \tag{4}$$

Since the reservation price $P$ is simply equal to $(L+w)$, we have

$$P = (1+r)^{-1}\Big(\frac{X}{2} - \frac{cD}{X}\Big). \tag{5}$$

This is the price offered by a non-rationed entrepreneur. It has an intuitive interpretation. The first term, $\frac{X}{2(1+r)}$, is simply the present value of the asset under the entrepreneur's management, and the second, $\frac{cD}{X}(1+r)^{-1}$, is the deadweight cost associated with the informational asymmetry. Equation (5) is not a reduced form, because of the endogeneity of $D$. However, $D$ can be substituted out by using (3), along with the fact that $R_D^E = (1+r)w$. This leads to:

$$P = (1+r)^{-1}\Big(\frac{X}{2} - c(1-(2w(1+r)/X)^{1/2})\Big). \tag{6}$$

Note that this solution is valid only when the entrepreneur is not credit constrained. The overall solution is of the following form:

**Proposition 1.**
(i) An entrepreneur with dollar wealth $w$ and ability $X$ has reservation price:

$$P(X,w,c) = \begin{cases} L_{\max} + w = \frac{(X-c)^2}{2X(1+r)} + w, & \text{if } 0 \le w \le \frac{c^2}{2X(1+r)} \quad \text{(Region 1)}; \\ (1+r)^{-1}\Big(\frac{X}{2} - c(1-(2w(1+r)/X)^{1/2})\Big), & \text{if } \frac{c^2}{2X(1+r)} < w \le \frac{X}{2(1+r)} \quad \text{(Region 2)}; \\ \frac{X}{2(1+r)}, & \text{if } \frac{X}{2(1+r)} < w \quad \text{(Region 3)}. \end{cases} \tag{7}$$

(ii) The entrepreneur's reservation price is a decreasing function of the costs of state verification, and an increasing function of both wealth and ability:

$$\frac{dP(X,w,c)}{dc} \le 0, \quad \frac{dP(X,w,c)}{dw} \ge 0, \quad \frac{dP(X,w,c)}{dX} > 0. \tag{8}$$

(iii) In the special case in which there are no agency costs, $c = 0$, the reservation price in (7) reduces to the expected present value of the asset,

$$P = \frac{X}{2(1+r)}, \tag{9}$$

which is independent of the entrepreneur's wealth.

Figure 3 illustrates the dependence of the entrepreneur's bid price on his wealth in (7). In Region 1, when $w \leq \frac{c^2}{2X(1+r)}$, the entrepreneur is at a credit-rationed corner solution, borrowing the maximum amount possible.[16] In this region, his bid price increases one-for-one with his wealth. In Region 2, when $\frac{c^2}{2X(1+r)} < w \leq \frac{X}{2(1+r)}$, the entrepreneur's bid still increases with his wealth, but at a slower rate. In this region incremental internal funds are used partially to raise the bid, but also partially to reduce the dependence on external funds and thereby lower the deadweight costs associated with them. Finally, in Region 3, the entrepreneur can pay for the whole value of the asset himself, so further increases in wealth do not affect his bid.

From part (iii) of the proposition it is easy to see that for assets which don't suffer from capital market imperfections, *all agents'* reservation prices rise proportionately when the exchange rate depreciates.[17] Exchange rate changes therefore do not confer a bidding advantage on domestic or foreign entrepreneurs. Thus the market prices of passive portfolio investments such as stocks and bonds (for which $c = 0$) will change proportionately with the exchange rate. In contrast, when $c > 0$, a domestic entrepreneur's reservation price rises less than proportionately when the dollar depreciates, because wealth constraints prevent him from upping his bid. However, regardless of the value of $c$, a foreigner's reservation price rises one-for-one with the exchange rate because the domestic-currency value of his wealth increases with it. Hence, for $c > 0$, foreigners' reservation prices rise relative to those of domestic entrepreneurs.

[16] If stochastic monitoring were possible, Region 1 would effectively disappear – entrepreneurs would always be able to borrow the value of the project net of agency costs.

[17] To see this, use (9) and (1) to get $P = \frac{X_t}{2}$. Prices change proportionately because the exchange rate change is temporary, and, hence, corresponds to a drop in the domestic discount rate.

## 2.4. Aggregate Foreign Direct Investment

Now that we have determined entrepreneurs' reservation values, we can calculate the fraction of all risky domestic assets acquired by foreigners. We assume that the $i$th asset is up for sale, and that it will be acquired by the (foreign or domestic) entrepreneur with the higher reservation price.[18] ,[19]

How is the outcome of the auction affected by the exchange rate? To see the answer, first let us write the domestic entrepreneur's reservation price as the function $P_i^d = d(X_i^d, w^d, c)$, and the foreigner's reservation price as $P_i^f = f(X_i^f, ew^d, c)$. Because reservation prices are strictly increasing in ability, we can invert the $f$ and $d$ functions. For example, the $i$th foreigner's ability is given $X_i^f = f^{-1}(P_i^f, ew^d, c)$. Ceteris paribus, entrepreneurs who bid higher prices have greater ability. We then have the following comparative-static results:

**Proposition 2.**

Define the probability that the domestic entrepreneur wins the $i$th auction as:

$$\phi_i(e,c) = \int_{X_i^d = d^{-1}(f(X_i^f, e, c), c)}^{\overline{X}^d} \int_{\underline{X}^f}^{\overline{X}^f} dG^d(X_i^d) dG^f(X_i^f). \tag{10}$$

(i) For $c > 0$, the probability, $\phi_i$, is a strictly declining function of the exchange rate,

$$\frac{d\phi_i(e,c)}{de} \leq 0 \tag{11}$$

. When $c = 0$, $\frac{d\phi_i(e,c)}{de} = 0$.

(ii) The effect of exchange rates on the acquisition probability, $\phi_i$, is stronger for larger values of $c$:

$$\frac{d^2\phi_i(e,c)}{de\ dc} > 0. \tag{12}$$

[18] Implicitly, we are assuming that the asset is initially owned by a third party, who no longer values it highly. This is equivalent to having the domestic entrepreneur owning it initially, and owing a debt $D$ against it such that $w^d = (1+r)^{-1}(\frac{X^d}{2} + \frac{D^2}{2X^d} - D)$. An alternative approach is that the asset does not yet exist, and that a start-up cost must be sunk to create it. Our qualitative conclusions in this section do not depend on which approach we take. This distinction does, however, have implications for the welfare results we discuss in the next section.

[19] Another detail that is unimportant in this section (but which may matter for the welfare analysis to follow) is the acquisition price, which will depend on the particular auction mechanism chosen. For example, in a second-price auction, the transaction price will be the second-highest reservation price. Our results, however, hold as long as the asset is acquired by the bidder with the highest reservation price.

Part (i) of the proposition formalizes the idea that dollar depreciation increases foreign wealth relative to domestic wealth, thereby raising the likelihood that the foreign reservation price will exceed the domestic price. Part (ii) simply says that the effect is stronger for more informationally intensive assets. Figure 4 illustrates the dependence of FDI on exchange rates for a variety of types of assets. Note that, as we have specified the model, all that matters for the proposition is that *domestic* entrepreneurs have limited wealth. Foreigners' reservation prices increase proportionately with the exchange rate change regardless of how much wealth they have.[20]

## 3. Welfare

While our above results regarding the exchange rate-FDI link are robust to variations in the model's assumptions, any welfare conclusions we might draw are less so. Still, the model can provide a useful starting point for thinking about the welfare consequences of FDI. It serves as a specific reminder of the theory of the second best: given that the economy suffers from one type of distortion (that induced by the monitoring cost $c$), it is not necessarily true that removing all others improves welfare. Thus it is at least theoretically possible that banning or impeding FDI could lead to higher domestic (and aggregate) welfare levels than a policy of laissez-faire.

There are two types of inefficiencies induced by the existence of a positive $c$. First, there is the direct cost of the resources consumed in monitoring. Second, there is an allocative effect - the fact that the most efficient entrepreneurs need not wind up managing a given asset. These inefficiencies could conceivably be eliminated by government wealth transfers to skillful entrepreneurs; large enough transfers would allow all asset purchases to be made without recourse to external finance.

In the absence of such government intervention, however, the existence of FDI can

[20] This particular feature is sensitive to the assumption that the exchange rate change is temporary. If, alternatively, the dollar depreciation were purely permanent, interest rates in both currencies would remain the same. Thus, the domestic entrepreneur's reservation price would be unchanged. Now, in order for a depreciation to have any effect on foreign reservation prices (and, hence, for our proposition to go through), foreign wealth must not be unlimited.

reduce both domestic and aggregate welfare. To see how exchange rate movements can make this happen, it is useful to consider a specific example.[21]

First, suppose that $X^d = 10$, $X^f = 5.40$, $c = 3$, $w^d = .30$, and $W^f = 3.00$. Suppose also that $e = 1$ initially, so that $r = 0$. Then according to Proposition 1, the low wealth of the domestic entrepreneur places him in Region 1, where he is credit constrained. The maximum loan he can obtain is 2.45. Thus, with his wealth of .30, he can bid at most 2.75 for the asset. Note, however that under his management, the asset is expected to yield a surplus net of agency costs of 2.90.

By contrast, the foreign entrepreneur can finance the entire investment out of his existing wealth. Therefore, he will be willing to bid 2.70 for the asset, which is exactly its expected yield under his control. The favorable value of the exchange rate, however, implies that the domestic entrepreneur will wind up owning the asset: Even though his wealth is low, his higher ability allows him to outbid the competition.

Now suppose that the domestic currency depreciates, so that $e = 2$. The maximum loan obtainable by the domestic entrepreneur doubles to 4.90, while his dollar wealth remains unchanged at .30. Thus he can bid only 5.20, even though the asset now generates a surplus of 5.80 under his management. Since the foreign entrepreneur holds his wealth in the foreign currency, the domestic-currency value of his wealth doubles. His reservation value therefore also doubles, to 5.40. (Note that this is again the net value of the asset under foreign control.) At the higher exchange rate, the foreign entrepreneur wins the bidding, at a price less than 5.40. This lowers both domestic welfare - an asset worth 5.80 in domestic hands is sold "too cheap" - and aggregate social welfare - the net surplus generated by foreign ownership is less than that generated by domestic ownership. Only the foreign country benefits from the currency depreciation and the ensuing FDI.

Clearly, this example of welfare reduction is special. It can easily be reversed in a

[21] As the example illustrates, welfare reduction can occur only when the entrepreneur is credit constrained, as in Region 1. Stochastic monitoring would therefore preclude welfare-reducing FDI. Note, however, that alternative formulations of the information asymmetry (such as adverse selection) give rise to credit-rationing, and hence could lead to welfare results similar to that in the example below.

number of ways. First, if the wealth of the domestic entrepreneur is sufficient to place him in Regions 2 or 3, he will always be able to make a bid that equals the value of the asset (net of agency costs) under his control. This alone prevents welfare-reducing FDI, since to win an auction, a foreign investor will have to top the domestic bid, and hence generate more net value out of the asset.

Another way to generate more optimistic welfare conclusions for the domestic country is to introduce multiple foreign bidders. Competition among these bidders makes it more likely that any increases in reservation values due to exchange rate movements will be passed along to domestic sellers of the asset.

Finally, it should be noted that our model disregards two important features of FDI that may have welfare consequences. First, our model is really only about foreign acquisitions of existing assets, and not about new capital formation initiated by foreigners. A model that allows foreigners to create new assets in the domestic country might yield more positive welfare results, particularly if the beneficial spillovers associated with these new assets were properly accounted for. It is one thing if dollar depreciation allows a Dutch company to win an auction for a plant being sold off by a shrinking U.S. conglomerate. It is another thing if dollar depreciation causes the Dutch company to build a new plant that otherwise would not exist. A second potentially rich area for welfare analysis concerns the implications of FDI for product-market behavior. If reduced capital costs make it cheaper for foreigners to undertake strategic investments, the terms of oligopolistic competition can be altered.[22]

## 4. Other Explanations for the Observed Exchange-Rate/FDI Relationship

Several other explanations have been offered to explain the pattern in Figure 1. We briefly mention several of these competing hypotheses here, and will return to evaluate some of them empirically.

[22] This possibility is raised in Kester and Luehrman (1989), and modeled in Froot and Stein (1989).

i) Tax code changes can affect the relative amounts of domestic versus foreign investment. In 1981, just as the dollar began its upward surge, more favorable depreciation allowances gave domestic investors an edge over foreign investors in purchasing certain depreciable assets. Similarly, the dollar's fall in 1986 closely coincided with the enactment of the 1986 Tax Reform Act. At that time the most rapid depreciation schedules were eliminated, so domestic investors lost any edge they had gained over their foreign counterparts.[23] Although there may well be some truth to the tax hypothesis, we are not aware of any tax effects that can explain why the exchange-rate - FDI relationship was as strong before 1980 as after.

ii) A second alternative hypothesis holds that FDI should be a roughly fixed proportion of the overall capital inflow, which itself may be correlated with exchange rates. Suppose, for example, that Japanese investors wish to invest a fixed number of yen in the U.S., and that, for purposes of diversification, they put half into direct investments, and half into portfolio investments. When the dollar falls, the resulting valuation effects cause the *dollar* amount of *both types* of inflow to rise proportionately. In contrast, our model predicts that FDI behaves fundamentally differently than portfolio investment: only the former should be negatively correlated with the value of the dollar. We test this implication of the model below.

iii) A third argument holds that some assets (e.g. real estate) may have "sticky" prices in the face of exchange rate changes, and that this somehow creates a temporary window of opportunity for foreign buyers. Two points should be made with regard to the sticky-price argument. First, if capital markets are perfect, such price sluggishness would indeed represent an opportunity, but one equally attractive to domestic as well as foreign investors. Second, and perhaps more significantly, the imperfect-capital-markets model presented above *implies* sluggish asset-price responses: in the presence of informational asymmetries, real estate prices should indeed move less than those of bonds in response

[23] For a discussion how U.S. tax changes affect the relative valuation of U.S. real assets by foreigners and domestics, see Scholes and Wolfson (1988). For a discussion of the potential impact on FDI inflows and outflows, see Froot (1989).

to an exchange rate change. Because domestic bidders cannot up their reservation prices one-for-one with the exchange rate, foreign investors can acquire some assets at prices that foreigners view as bargains.

iv) According to the "tariff-jumping" explanation for FDI, trade barriers are a likely outcome of an increased trade deficit. FDI allows foreign firms to avoid these barriers, in a way that investments in export capacity would not. If trade deficits tend to precede currency depreciations, the FDI increase may coincidentally happen at about the same time that the currency falls in value. This view suffers from the fact that protection, while potentially raising the rate of return on investment in recipient sectors, does not benefit foreigners more than Americans. So, while it might explain FDI increasing as a share of foreign-held assets, it does not explain FDI increasing as a share of total assets located in the domestic country. Put differently, the tariff-jumping story does not provide an explanation for foreign *acquisitions* of domestic assets.

v) A final explanation of the relationship between FDI and the dollar has to do with industrial-organization considerations such as brand loyalty. An appreciation of the dollar may cause Americans to become "hooked" on attractively-priced Japanese consumer goods and automobiles. When the dollar recedes, both Japanese and American companies find it more economical to locate production in the U.S. But since foreign producers have built up market share and customer loyalty at the expense of their U.S. counterparts, they may be more willing to invest in new plants or additions to existing capacity. The two attractions of this story are that its economics are sound and that it rings true for the U.S. experience, yet it remains to be seen how important it is in the data.

## 5. Empirical Results

The strong relationship between FDI and the dollar seen in Figure 1 is consistent both with our model and with several of the alternative hypotheses discussed above. In this section we look more closely at a variety of capital flows to see if we can better distinguish our imperfect-capital markets hypothesis from the competing alternatives.

As a first step, we compare the behavior of other forms of capital inflows into the U.S. with that of FDI. In Tables 1 and 2, we break down total foreign capital inflows into the U.S. into their constituent parts: foreign official and foreign private inflows, the latter being also further subdivided into direct investment, foreign investment in U.S. Treasury securities, and foreign (portfolio) investment in corporate stocks and bonds.[24] Each of these (deflated by U.S. GNP) is regressed on the real value of the dollar, a measure of U.S. relative to foreign wealth, and a time trend.[25]

The regressions on quarterly data (1973-88) are presented in Table 1. The first column reports the dependent variable – the type of capital inflow. These range from the most aggregated to the most disaggregated available. Each regression was estimated using OLS, and standard errors were calculated both in the usual way and to allow for conditional heteroskedasticity (White, 1980) in the regression residuals. Although we frequently found evidence of heteroskedasticity in the data, the heteroskedasticity-consistent covariance matrix estimator is downward-biased in finite samples, while the usual OLS covariance matrix (under homoskedasticity) is not. To be careful we should weigh the downward bias more heavily than the loss in power, and therefore in each case draw inferences on the basis of the larger of the two standard errors.

There are several striking features of the estimates reported in Table 1. First, FDI is the only type of capital inflow that is statistically negatively correlated with the value

[24] In the Balance of Payments data, an investment in a U.S. company is considered direct if a foreign entity owns or acquires more than 10 percent of that company. Ownership of less than 10 percent is treated as portfolio investment.

[25] To measure the real exchange rate we used the log of the IMF's merm rate. As a proxy for relative wealth, we used a flow measure – the log of the ratio of U.S. to foreign real income. The time trend was included because of the overwhelming evidence that the U.S. has increasingly become a home to, as well as a host for, foreign investment. We also included constant terms in the regressions, which we do not report to save space.

of the dollar. (Foreign official assets, which for the most part are determined directly by foreign monetary authorities, also have negative, albeit not statistically significant, coefficients.) The point estimate for portfolio inflows into corporate stocks and bonds is positive and not statistically different from zero. Interpreted in terms of Figure 4, these portfolio investments correspond to the flat line with low monitoring costs. Our theory predicts that since the agency costs associated with passive investments are small, these investments should be uncorrelated with exchange rates. This seems to be borne out in the data.

A second feature of the estimates in Table 1 is that they appear robust. The regressions in Table 1 are performed both with and without relative income terms, with similar results for each. In addition, we tried estimating the same regressions on annual (instead of quarterly) data to see whether the correlation between exchange rates and FDI was purely a high-frequency phenomenon. Table 2 reports estimates from these regressions; the results are almost identical to those of Table 1. Indeed, the point estimates are somewhat larger in absolute value (although, as one might expect, the standard errors are higher as well).

The next set of tables further disaggregates U.S. FDI inflows. Table 3 uses detailed data from the Balance-of-Payments Accounts to break total FDI inflows into 13 separate industries.[26] The results show that the aggregate data in Figure 1 are not hiding great diversity across industries. All of the 13 coefficients on the exchange rate in Table 3 are negative, and five of these are statistically so. Interestingly, the strongest exchange rate effects appear in manufacturing industries, particularly chemicals. To the extent that chemical products are not differentiated products on which U.S. consumers might get hooked, more is going on in the data than can be explained by just the addiction hypothesis in Alternative (v) above.

The first three tables above have all used inflow data from the Balance-of-Payments

[26] Because the mnrm exchange rate gives weight only to the industrialized countries' currencies, the FDI inflows in Table 4 are from industrialized countries only. The results remain essentially unchanged if we were to report instead U.S. inflows from all countries.

Accounts. These data include not only the acquisitions and purchases that are most appropriate for testing our model, but also additions to existing physical capital. If, for example, dollar depreciation leads an entire sector of the economy to expand, we might expect FDI in that sector to increase as each firm, foreign and domestic, expands its production capacity. Since our theory is about the share of U.S. capacity owned by foreigners, the best data to test it would distinguish between acquisitions and this kind of expansion. Fortunately, the International Trade Administration (ITA) collects individual FDI transactions and distinguishes them on exactly this basis. Using these data, we can now look not only across industries, but also across different types of investment.

Table 4 presents estimates of the sensitivity to exchange rates of the eight types of FDI transactions recognized by the ITA.[27] The inflow measure is either the recorded value of transactions (divided by U.S. GNP) or the number of transactions.[28] Once again, all the coefficients are negative, suggesting that the correlation with the exchange rate is broadly-based. Of the eight types, Mergers and Acquisitions and Equity Increases are by far the largest in magnitude, accounting for 51 and 20 percent, respectively, of total FDI in 1987. Both of these, as well as the aggregate ITA numbers in the first line of Table 4, show statistically significant relationships with the real exchange rate. Thus the overall FDI/dollar relationship reflects primarily the types of investment that best capture the spirit of our model. The estimates for New Plant and Plant Expansion are also significantly negative. This correlation is predicted by the sectoral growth hypothesis as well as by our model. However, the magnitudes of these inflows are quite small (5 percent of the ITA total in 1987). It therefore appears that our overall results do not merely reflect foreigners' participation in the rise and fall of exchange-rate sensitive sectors.

Finally, we ask whether the U.S. experience is typical of other countries. With only

[27] These data are for investments originating in 15 countries: Austria, Australia, Belgium, Canada, Denmark, France, West Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom.

[28] Most transactions did not report the value of the investment. We followed Caves (1988) by replacing missing values with the average investment value for those investments where value was recorded.

aggregate Balance of Payments data available, we cannot go very far in answering this question – particularly since we do not know whether foreign inflows are driven by acquisition-type activity to same the extent as U.S. inflows. Nevertheless, Table 5 examines FDI inflows into the U.S., U.K., West Germany, Canada and Japan, performing regressions similar to those in previous tables.[29] While most of the regression coefficients continue to be negative, only that for Germany offers evidence strongly supportive of the model above.

## 6. Conclusions

We have presented a simple model in which relative wealth – and therefore the exchange rate – has a systematic effect on FDI. The correlation of FDI with the exchange rate is very different than that observed for other forms of capital inflow, including passive portfolio investments. In looking at particular industries and types of investment, we found the exchange rate effects to be strongest in manufacturing (particularly Chemicals) and in transactions (such as Mergers and Acquisitions) involving a transfer rather than an expansion of existing assets.

Our model and empirical results lend some credence to popular claims that the currently low value of the dollar has given foreigners an edge in buying control of physical assets in the U.S. Indeed, the reasoning behind the model closely parallels that given in less formal accounts: exchange rate changes have important impacts on international wealth, and wealthier buyers find it easier to acquire assets. However, our welfare analysis does caution against the kinds of kneejerk protectionist sentiments that are often aroused by these accounts. While the welfare consequences of FDI can theoretically be adverse, they depend on a number of subtle effects which may be difficult to measure in any given instance.

We should stress that we have not attempted to provide a comprehensive theory of

[29] The data in this table are from the IMF Balance of Payments Yearbooks, and do not correspond precisely to the data in earlier tables. Because none of the other countries had significant time trends, we excluded the time trend from the specifications in Table 5. Also, note that we use no data on *outflows* from any country. This is because such data are effectively measured in the wrong currency, and therefore are contaminated by valuation effects pertaining to the existing asset stocks. For example, suppose a U.S. firm owns pound-denominated assets in its U.K. subsidiary. When the dollar depreciates, it may mark up the dollar value of those assets, and the increase could be counted as a U.S. direct investment outflow.

FDI. Although the exchange rate adds some explanatory power to the experience of the U.S. (and perhaps West Germany), there are obviously many other forces at work. In the U.S. this can be seen in the presence of an upward trend in the share of assets owned by foreigners, which has more than tripled over the last decade. Our model sheds no light on this general trend, which has led the U.S. to become an important host for world FDI.

## 7. References


Abel, Andrew B., and Olivier J. Blanchard, "The Present Value of Profits and Cyclical Movements in Investment," *Econometrica,* LIV (March 1986), 249-73.

Bernanke, Ben S. and Mark Gertler, "Financial Fragility and Economic Performance," NBER Working Paper no. 2318, 1987.

Bernanke, Ben S. and Mark Gertler, "Agency Costs, Collateral, and Business Fluctuations," NBER Working Paper no. 2015, forthcoming *American Economic Review,* 1989.

Caves, Richard E., *Multinational Enterprise and Economic Analysis,* (Cambridge: Cambridge University Press, 1982).

Caves, Richard E., "Exchange-Rate Movements and Foreign Direct Investment in the United States," Harvard Institute of Economic Research, May 1988.

Donaldson, Gordon, *Managing Corporate Wealth,* (Boston: Division of Research Graduate School of Business Administration, Harvard University, 1984).

Fazzari, Steven M., R. Glenn Hubbard, and Bruce C. Petersen, "Financing Constraints and Corporate Investment," NBER, January 1988.

Fisher, Irving, "The Debt-Deflation Theory of Great Depressions," *Econometrica,* 1 (October 1933), 337-57.

Froot, Kenneth A., "Multinational Corporations, Exchange Rates and Direct Investment." Forthcoming in *International Policy Coordination and Exchange Rate Determination,* W. Branson, J. Frenkel and M. Goldstein, eds. (University of Chicago Press: Chicago), 1989.

Froot, Kenneth and Jeremy C. Stein, "Financial Aspects of International Competitiveness," in progress, NBER, 1989.

Gale, Douglas, and Martin Hellwig, "Incentive-Compatible Debt Contracts I: The One-Period Problem," *Review of Economic Studies,* 52 (October 1985), 647-64.

Greenwald, Bruce, Joseph Stiglitz, and Andrew Weiss, "Informational Imperfections

in the Capital Market and Macroeconomic Fluctuations," *American Economic Review*, 74 (May 1984), 194-200.

Greenwald, Bruce, and Joseph Stiglitz, "Information, Finance Constraints, and Business Fluctuations," mimeo, Princeton University, 1986.

Hoshi, Takeo, Anil Kashyap, and David Scharfstein, "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Panel Data," MIT, September 1988.

Hymer, S.H., 1960, "The International Operations of Multinational Firms: A Study of Direct Foreign Investment," Ph.D. Dissertation, M.I.T. (MIT Press, 1976).

Jaffee, Dwight, and Thomas Russell, "Imperfect Information, Uncertainty, and Credit Rationing," *Quarterly Journal of Economics*, 90 (November 1976), 651-66.

Kester, W. Carl, and Timothy Luehrman, "Are We Feeling More Competitive Yet?," forthcoming *Sloan Management Review*, 1989.

Kindleberger, 1969, *American Business Abroad: Six Lectures on Direct Investment*, (Yale University Press: New Haven).

Krugman, Paul R., "The J-Curve, the Fire Sale, and the Hard Landing," MIT, December 1988.

Krugman, Paul R., "Foreign Direct Investment in the United States," Institute of International Economics, October 1988.

Mundell, Robert A., *International Economics*, (MacMillan: New York, 1968).

Myers, Stewart C., and N.S. Majluf, "Corporate Financing and Investment Decisions when Firms Have Information that Investors Do Not Have," *Journal of Financial Economics*, 13 (June 1984), 187-221.

Ray, Edward J., "The Determinants of Foreign Direct Investment in the United States: 1979-85," Ohio State University, 1988.

Scholes, M., and M. Wolfson, 1988, "The Effects of Changes in Tax Laws on Corporate Reorganization Activity," Stanford University.

Stiglitz, Joseph, and Andrew Weiss, "Credit Rationing in Markets with Imperfect

Information," *American Economic Review*, 71 (June 1981), 393-410.

Tolchin, Martin, "Foreigners' Investing: A Warning," *New York Times*, February 22, 1988.

Townsend, Robert M., "Optimal Contracts and Competitive Markets with Costly State Verification," *Journal of Economic Theory*, 21 (October 1979), 265-93.

Vernon, Raymond, "International Investment and International Trade in the Product Cycle," *Quarterly Journal of Economics*, 80 (May 1966), 190-207.

White, Halbert, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica*, 48 (1980), 817-838.

Williamson, Stephen D. "Costly Monitoring, Financial Intermediation, and Equilibrium Credit Rationing," *Journal of Monetary Economics*, 18 (September 1986), 159-79.

Williamson, Stephen D. "Costly Monitoring, Optimal Contracts, and Equilibrium Credit Rationing," *Quarterly Journal of Economics*, 102 (February 1987), 135-45.

Figure 1
US Foreign Direct Investment Inflows
and the Real Exchange Rate

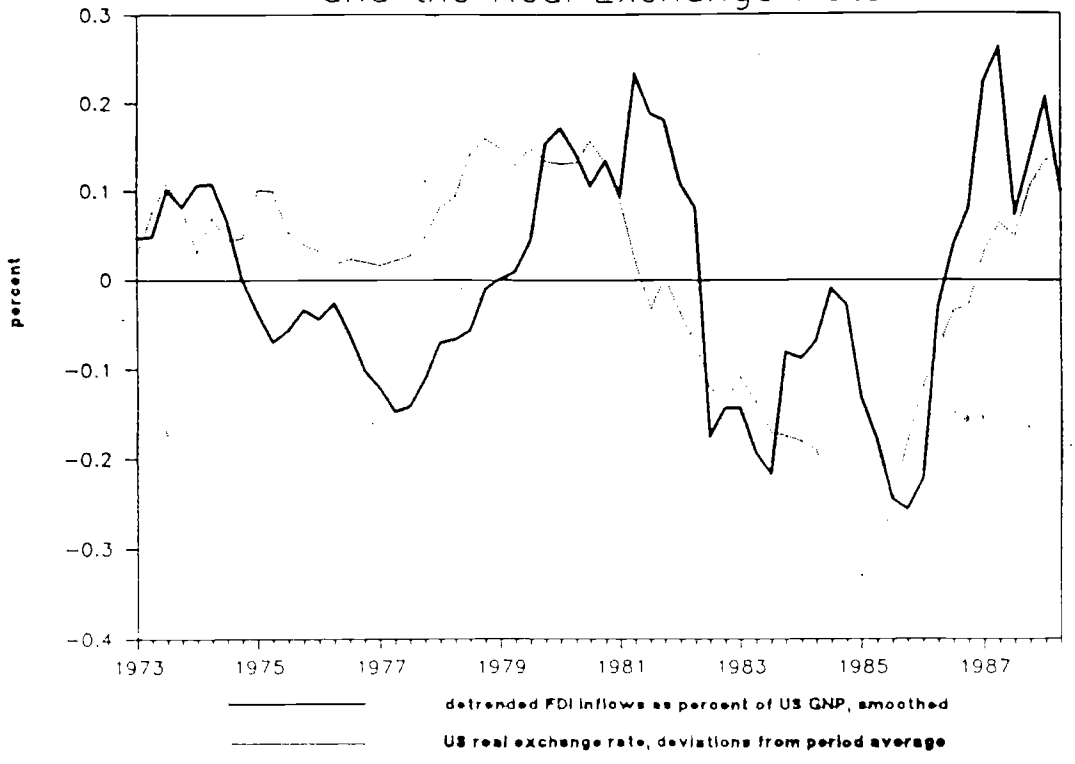

Figure 2
Loan Supply Schedule

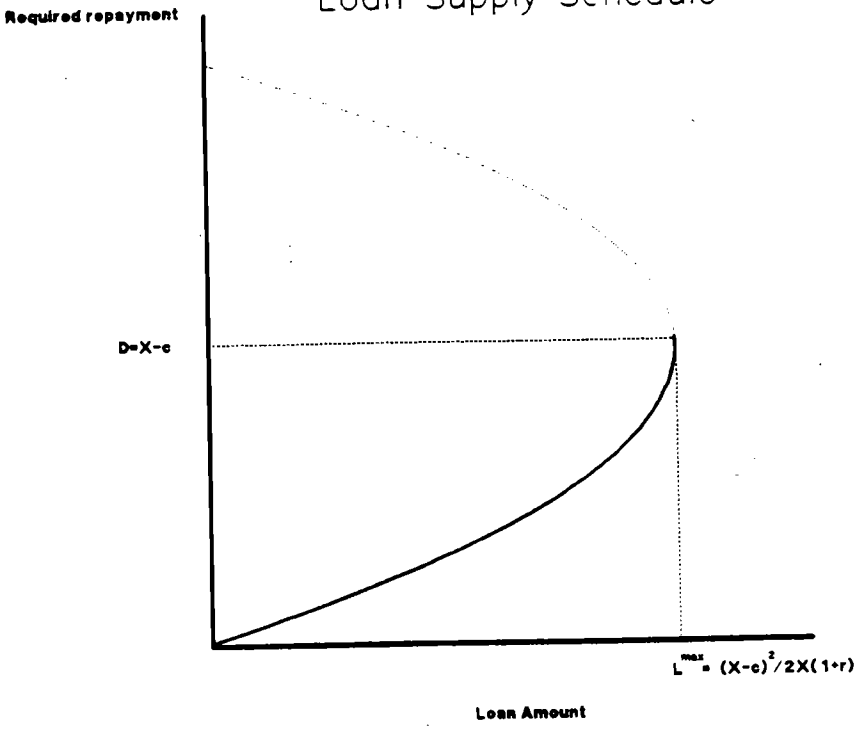

Figure 3
Entrepreneur's Reservation Price
as a Function of Wealth

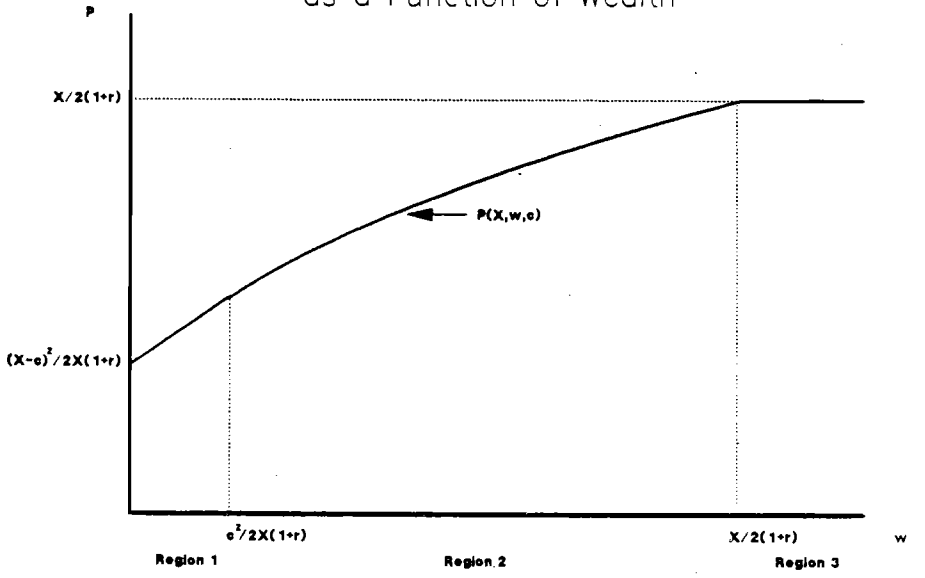

Figure 4

FDI Inflows as a Function of The Exchange Rate

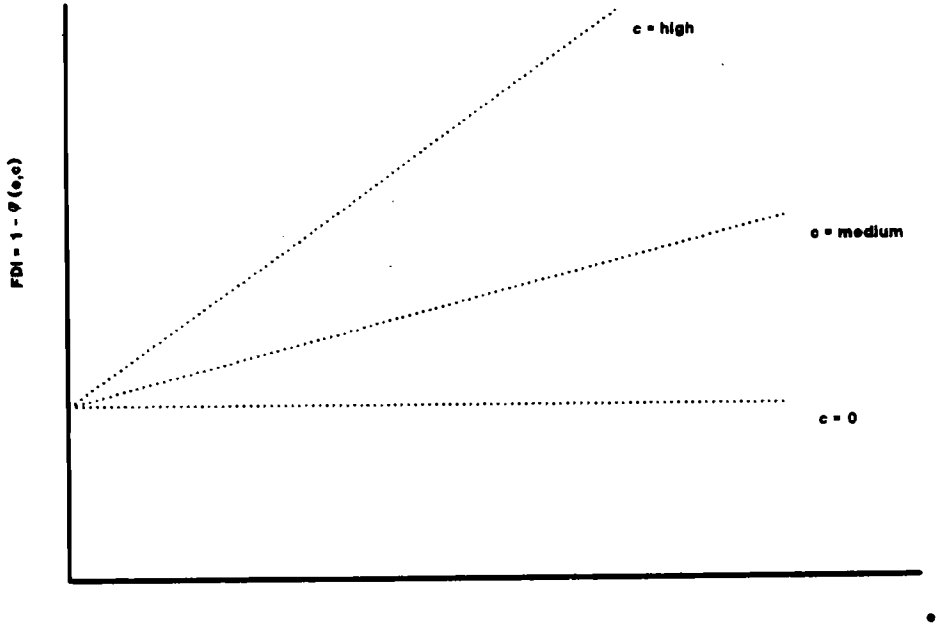

Table 1
Regressions of Changes in Foreign Assets in the U.S. on the Value of the Dollar
(quarterly data, 1973 to 1988)

| Form of gross capital inflow into the U.S. | coefficients on e | t | wgnp | DW | $R^2$ | DF |
|---|---|---|---|---|---|---|
| Total foreign assets | -0.9620 | 0.0414 | | 1.79 | 0.21 | 59 |
| | (1.4387) | (.0102) *** | | | | |
| | (1.5008) | (.0094) *** | | | | |
| | -0.7198 | 0.0411 | 3.4159 | 1.77 | 0.18 | 57 |
| | (1.5393) | (.0114) *** | (10.4148) | | | |
| | (1.6493) | (.0106) *** | (9.3166) | | | |
| Foreign official assets | -1.7831 | 0.0015 | | 1.66 | 0.01 | 59 |
| | (1.1534) | (.0082) | | | | |
| | (1.0466) | (.0076) | | | | |
| | -1.9335 | 0.0024 | -0.7112 | 1.62 | 0.00 | 57 |
| | (1.2351) | (.0091) | (8.3564) | | | |
| | (1.1414) * | (.0077) | (7.4955) | | | |
| Foreign private assets | 0.8211 | 0.0399 | | 1.81 | 0.32 | 59 |
| | (1.2339) | (.0088) *** | | | | |
| | (1.5166) | (.0108) *** | | | | |
| | 1.2134 | 0.0387 | 4.1272 | 1.62 | 0.29 | 57 |
| | (1.3128) | (.0097) *** | (8.8829) | | | |
| | (1.6660) | (.0123) *** | (7.3618) | | | |
| Direct investment | -0.6710 | 0.0134 | | 1.92 | 0.45 | 59 |
| | (.2618) ** | (.0019) *** | | | | |
| | (.2094) *** | (.0019) *** | | | | |
| | -0.6242 | 0.0130 | 0.1640 | 1.87 | 0.41 | 57 |
| | (.2780) ** | (.0021) *** | (1.8944) | | | |
| | (.2378) *** | (.0022) *** | (1.9529) | | | |
| US Treasury securities | 0.9427 | 0.0009 | | 1.63 | 0.19 | 59 |
| | (.2832) *** | (.0020) | | | | |
| | (.3296) *** | (.0025) | | | | |
| | 1.0786 | -0.0001 | 0.1008 | 1.71 | 0.20 | 57 |
| | (.2966) *** | (.0022) | (2.0068) | | | |
| | (.3427) *** | (.0027) | (1.4542) | | | |
| Corporate stocks & bonds & other bonds | 0.5749 | 0.0158 | | 0.59 | 0.31 | 59 |
| | (.5250) | (.0037) *** | | | | |
| | (.5408) | (.0046) *** | | | | |
| | 0.8366 | 0.0190 | 10.8512 | 0.71 | 0.39 | 57 |
| | (.5213) * | (.0039) *** | (3.5273) *** | | | |
| | (.6131) | (.0050) *** | (3.1008) *** | | | |

Notes: Standard errors in parentheses are valid for homoskedasticity and heteroskedasticity, respectively. *, **, *** represent statistical significance at the 10, 5 and 1 percent levels, respectively. Regressions were estimated with constant terms, which were supressed to save space. Legend: e - log of IMF merm real dollar exchange rate; t - time trend; gnpdif - log of domestic less log of world gnp (world gnp measured as an average of 5 major U.S. trading partners. Dependent variable is expressed as a percent of U.S. gnp.

Table 2
Regressions of Changes in Foreign Assets in the U.S. on the Value of the Dollar
(annual data, 1973 to 1987)

| Form of gross capital inflow into the U.S. | coefficients on e | t | gnpdif | DW | $R^2$ | DF |
|---|---|---|---|---|---|---|
| Total foreign assets | -0.6192 | 0.1646 | | 1.57 | 0.45 | 12 |
| | (1.8160) | (.0517) *** | | | | |
| | (1.4967) | (.0468) *** | | | | |
| | -0.1474 | 0.1815 | 16.1842 | 1.81 | 0.46 | 11 |
| | (1.8343) | (.0530) *** | (13.8658) | | | |
| | (1.5711) | (.0442) *** | (10.7084) * | | | |
| Foreign official assets | -0.1170 | 0.0006 | | 1.54 | 0.00 | 12 |
| | (.1139) | (.0032) | | | | |
| | (.0973) | (.0022) | | | | |
| | -1.1364 | 0.0019 | 9.6273 | 1.64 | 0.00 | 11 |
| | (1.6750) | (.0484) | (12.6615) | | | |
| | (1.3088) | (.0308) | (5.7132) ** | | | |
| Foreign private assets | 0.7978 | 0.1727 | | 1.94 | 0.74 | 12 |
| | (1.2360) | (.0352) *** | | | | |
| | (.8916) | (.0335) *** | | | | |
| | 0.9890 | 0.1796 | 6.5568 | 2.07 | 0.73 | 11 |
| | (1.2974) | (.0375) *** | (9.8072) | | | |
| | (.9774) | (.0321) *** | (9.1563) | | | |
| Direct investment | -0.8325 | 0.0569 | | 2.13 | 0.71 | 12 |
| | (.3386) ** | (.0096) *** | | | | |
| | (.2386) *** | (.0056) *** | | | | |
| | -0.7424 | 0.0601 | 3.0894 | 1.83 | 0.72 | 11 |
| | (.3410) * | (.0099) *** | (2.5779) | | | |
| | (.2340) *** | (.0046) *** | (1.3987) * | | | |
| US Treasury securities | 1.3312 | -0.0087 | | 1.22 | 0.55 | 12 |
| | (.3300) *** | (.0094) | | | | |
| | (.3714) *** | (.0100) | | | | |
| | 1.3138 | -0.0093 | -0.6002 | 1.26 | 0.51 | 11 |
| | (.3525) ** | (.0102) | (2.6646) | | | |
| | (.3885) ** | (.0098) | (1.8884) | | | |
| Corporate stocks & bonds & other bonds | 0.2893 | 0.0728 | | 0.97 | 0.41 | 12 |
| | (.9646) | (.0275) | | | | |
| | (.7962) | (.0251) | | | | |
| | 0.6752 | 0.0867 | 13.2358 | 1.59 | 0.53 | 11 |
| | (.8877) | (.0256) *** | (6.7104) ** | | | |
| | (.8527) | (.0224) *** | (5.3899) ** | | | |

Notes: Standard errors in parentheses are valid for homoskedasticity and heteroskedasticity, respectively. *, **, *** represent statistical significance at the 10, 5 and 1 percent levels, respectively. Regressions were estimated with constant terms, which were supressed to save space. Legend: e - log of IMF merm real dollar exchange rate; t - time trend; gnpdif - log of domestic less log of world gnp (world gnp measured as an average of 5 major U.S. trading partners. Dependent variable is expressed as a percent of U.S. gnp.

Table 3
Regressions of FDI Inflows by Industry
(BOP data, annual 1974-87)

| Industry | coefficients on e | t | DW | $R^2$ | DF |
|---|---|---|---|---|---|
| All Industries | -0.8760<br>(0.3200)** | 0.0687<br>(0.0122)*** | 1.88 | 0.70 | 11 |
| Petroleum | -0.0200<br>(0.1120) | 0.0063<br>(0.0043) | 2.46 | 0.05 | 11 |
| Manufacturing | -0.5160<br>(0.1600)*** | 0.0279<br>(0.0060)*** | 1.81 | 0.61 | 11 |
| Food | -0.0640<br>(0.0440) | 0.0055<br>(0.0017)*** | 2.90 | 0.39 | 11 |
| Chemicals | -0.2160<br>(0.0680)*** | 0.0116<br>(0.0026)*** | 2.10 | 0.58 | 11 |
| Fabricated Metals | -0.0160<br>(0.0320) | 0.0008<br>(0.0012) | 2.69 | 0.00 | 11 |
| Machinery | -0.1440<br>(0.0520)** | 0.0050<br>(0.0019)** | 1.54 | 0.37 | 11 |
| Other Manufacturing | -0.0880<br>(0.0400)** | 0.0060<br>(0.0015)*** | 1.78 | 0.53 | 11 |
| Trade | -0.0200<br>(0.0600) | 0.0064<br>(0.0022)** | 2.03 | 0.40 | 11 |
| Finance | -0.0880<br>(0.0880) | 0.0064<br>(0.0034)* | 3.11 | 0.11 | 11 |
| Insurance | -0.0320<br>(0.0640) | 0.0039<br>(0.0024) | 1.72 | 0.07 | 11 |
| Real Estate | -0.0480<br>(0.0600) | 0.0064<br>(0.0023)** | 2.11 | 0.34 | 11 |
| Other Industries | -0.1280<br>(0.0800) | 0.0093<br>(0.0030)*** | 2.17 | 0.37 | 11 |

Notes: Standard errors in parentheses are valid for homoskedasticity and heteroskedasticity, respectively. *, **, *** represent statistical significance at the 10, 5 and 1 percent levels, respectively. Regressions were estimated with constant terms, which were supressed to save space. Legend: e - log of IMF mems real exchange rate; t - time trend. Dependent variable is in percent of GNP.

Table 4
Regressions of Foreign Direct Investments Purchased
(ITA data, annual 1977-87)

| Type of Investment | | coefficients on e | t | DW | $R^2$ | DF |
|---|---|---|---|---|---|---|
| All Types: | value | -0.0547 (.0172) *** | 2.2270 (.3626) *** | 2.70 | 0.78 | 8 |
| | number | -2.4721 (.8107) *** | 76.4754 (17.1283) *** | 1.05 | 0.65 | 8 |
| Mergers and Acquisitions: | value | -0.0285 (.0084) *** | 1.1242 (0.1785) *** | 2.14 | 0.79 | 8 |
| | number | -0.9498 (.2534) *** | 25.2579 (5.3531) *** | 2.35 | 0.83 | 8 |
| Equity Increase: | value | -0.0046 (.0032) | 0.2554 (.0681) | 2.39 | 0.56 | 8 |
| | number | -0.0612 (.0231) ** | 2.8988 (.4873) *** | 2.39 | 0.77 | 8 |
| Real Estate: | value | -0.0045 (.0092) | 0.0805 (.1935) | 1.00 | 0.00 | 8 |
| | number | -0.4256 (.5479) | -0.6168 (11.5767) | 0.64 | 0.00 | 8 |
| New Plant: | value | -0.0049 (.0014) *** | 0.1634 (.0285) *** | 2.58 | 0.76 | 8 |
| | number | -0.4062 (.1090) *** | 10.6475 (2.3027) *** | 1.81 | 0.68 | 8 |
| Joint Venture: | value | -0.0028 (.0012) ** | 0.1302 (.0252) *** | 2.28 | 0.72 | 8 |
| | number | -0.1211 (.0501) ** | 7.7024 (1.0582) *** | 2.27 | 0.82 | 8 |
| Plant Expansion: | value | -0.0020 (.0005) *** | 0.0920 (.0102) *** | 2.07 | 0.89 | 8 |
| | number | -0.1093 (.0833) | 5.3164 (1.7592) *** | 1.80 | 0.42 | 8 |
| Other expansion: | value | -0.0033 (.0028) | 0.4420 (.0608) *** | 2.39 | 0.86 | 8 |
| | number | -0.0260 (.1525) | 18.9768 (3.2226) *** | 2.52 | 0.82 | 8 |
| No Type Listed: | value | -0.0039 (.0044) | -0.0607 (.0936) | 2.24 | 0.06 | 8 |
| | number | -0.3729 (.4315) | -6.0785 (9.1160) | 2.24 | 0.06 | 8 |

Notes: Standard errors in parentheses are valid for homoskedasticity.
*, **, *** represent statistical significance at the 10, 5 and 1 percent levels, respectively. Regressions were estimated with constant terms, which were supressed to save space. Legend: e - 4 times the log of IMF merm real exchange rate; t - time trend. Dependent variable is expressed as percent of U.S. GNP.

Table 5
Country Regressions of Direct Investment Inflows on Exchange Rates
(annual data, 1972-87)

| Country | coefficients on e | t | DW | $R^2$ | DF |
|---|---|---|---|---|---|
| United States | -9.4829<br>(3.5670) **<br>(2.5647) *** | 0.6564<br>(.0969) ***<br>(.0507) *** | 2.14 | 0.75 | 13 |
| United Kingdom | -0.4999<br>(1.6465)<br>(1.1537) | | 1.57 | 0.00 | 14 |
| West Germany | -1.0344<br>(.2499) ***<br>(.2988) *** | | 1.22 | 0.52 | 14 |
| Canada | 0.8387<br>(2.8670)<br>(2.2597) | | 1.52 | 0.00 | 14 |
| Japan | -0.0621<br>(.2692)<br>(.2728) | | 2.40 | 0.00 | 14 |

Notes: Standard errors in parentheses are valid for homoskedasticity and heteroskedasticity, respectively. *, **, *** represent statistical significance at the 10, 5 and 1 percent levels, respectively. Regressions were estimated with constant terms, which were supressed to save space. Legend: e - log of IMF mwrm real exchange rate; t - time trend. Dependent variable is an index of FDI inflows divided by GNP, 1972=1.