Firm-Specific Assets and the Link Between Exchange Rates and Foreign Direct Investment

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Foreign direct investment (FDI) theory and empirical studies have generated mixed support for a link between exchange rates and FDI. This paper argues that exchange rate movements may affect acquisition FDI because acquisitions involve firm-specific assets which can generate returns in currencies other than that used for purchase. Using data on Japanese acquisitions in the United States across 3-digit SIC industries from 1975–1992, maximum-likelihood estimates from discrete dependent variable models support the hypothesis that real dollar depreciations make Japanese acquisitions more likely in U.S. industries, particularly those which more likely have firm-specific assets. (*JEL* F21, F23, F31)

Foreign direct investment flows from other industrialized countries into the United States in the last two decades have been marked by substantial swings, most notably in FDI via acquisitions of U.S. firms. While traditional theories concerning FDI may explain the increasing investment flows into the United States in the long run, they offer little explanation for short-run movements in FDI. Until the late 1970's, trade theorists and others were content to write off FDI as mainly a phenomenon of comparative costs, specifically arising where trade did not equalize factor prices. This theory came out of a world where the majority of multinational firms were from the United States and a significant share of their investment was into less developed countries with significantly lower costs. However, the large share of FDI between only industrialized countries turned attention to another theory: internalization. Based on transactions cost literature, this theory predicts FDI will occur where there are high transactions costs involved in exporting or licensing a product to another country. In these cases, the firm may choose to internalize the transaction and set up operations in the other country.

However, the experience of the United States in the 1980's and 1990's presents a difficult question for theories of comparative costs and internalization. Figure 1, panel A, shows the number of U.S. acquisitions by all foreign countries and the multilateral exchange rate, while panel B presents Japanese acquisitions in the United States and the dollar-yen real exchange rate, which are the focus of this paper's empirical work.[1] Both panels show substantial short-run swings in U.S. inward acquisition FDI and beg the question whether these swings could be the manifestation of corresponding changes in comparative costs and/or transactions costs between the United States and other industrialized countries. For example, how can these traditional theories explain why foreign acquisitions can double in one year? It seems unlikely that comparative costs between the United States and foreign countries fell enough or transactions costs of exporting or licensing to the United States rose enough to account for this.

Given the inefficacy of traditional and general theories to answer these questions, a

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[1] While Figure 1 graphs numbers of foreign acquisitions, aggregate dollar values of acquisition FDI from all foreign countries and from Japan follow a similar pattern.

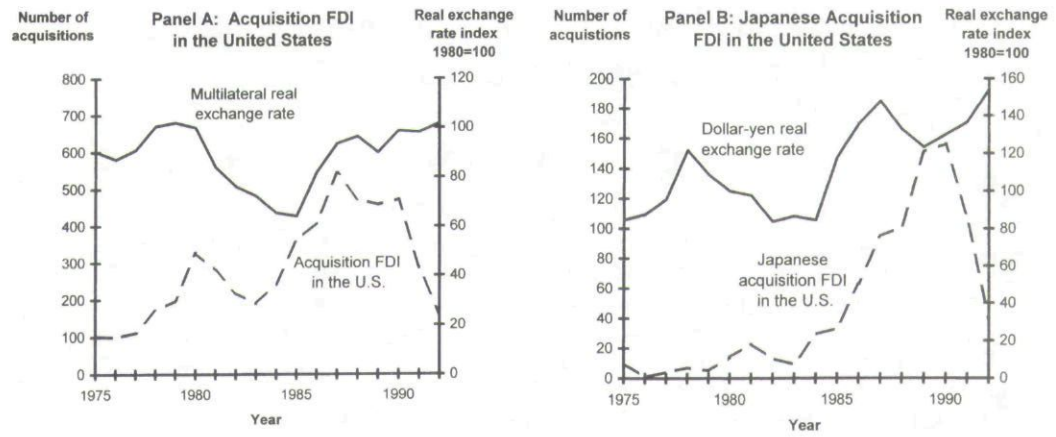

FIGURE 1. NUMBERS OF ACQUISITIONS IN THE UNITED STATES BY ALL FOREIGN COUNTRIES AND BY JAPAN, 1975–1992

Notes: The multilateral real exchange rate is a trade-weighted index of foreign currencies to the dollar. The dollar-yen real exchange rate was constructed using the nominal exchange rate and consumer price indexes.
Sources: Numbers of acquisitions were tabulated from U.S. Department of Commerce, International Trade Administration, *Foreign Direct Investment in the United States: Transactions*. The multilateral real exchange rate, the nominal dollar-yen exchange rate and U.S. consumer price index come from the *Economic Report of the President*, 1995, while the Japanese consumer price index comes from the *Japan Statistical Yearbook*, various issues.

number of recent papers have turned to exchange rate movements for an empirical explanation. While Figure 1 suggests the exchange rate levels may have substantial explanatory power for FDI flows, empirical studies have had only limited success establishing this connection.[2] This may not be surprising since the traditional view is that exchange rate levels should not affect investment incentives. Specifically, if exchange rates are a random walk and an asset's purchase price and return on an asset (such as a bond) are in the same currency, the relative valuation of domestic versus foreign firms for an asset will remain unchanged.

This paper presents a new hypothesis which comes from the observation that firm-specific assets do not fit this standard analysis. If foreign and domestic firms have equal opportunity to purchase firm-specific assets in the domestic market, but different opportunities to generate returns on these assets in foreign markets, then currency movements may affect relative valuations. While both firms pay in the same currency, unlike bond-like assets they may generate returns in different currencies. In the case where the domestic firm does not have equal access to the foreign market, this asymmetry means that the relative level of foreign firm acquisitions of these assets may be affected by exchange rate movements. As a simple example to illustrate this, suppose there are two prospective acquiring firms of a U.S. target firm: a Japanese firm and a U.S. firm. The markets are completely segmented, so that both firms have production and sales solely in their own country. A U.S. target firm has an innovation (a firm-specific asset) which will make an acquiring firm's assembly line 10-percent more productive (i.e., it gets 10-percent more output for the same level of inputs). For the U.S. acquiring firm, a change in the exchange rate makes no difference in its valuation of the target firm, since its gains will be denominated in dollars, as will be the price it must pay for the target firm. However, the Japanese firm's gains will be denominated in yen, since its production and sales are in Japan,

[2] Kenneth A. Froot and Jeremy C. Stein (1991) provide a theoretical connection between exchange rates and FDI, which will be discussed below. Many empirical studies of FDI into the United States have included the exchange rate as a regressor, with mixed results. These studies include Richard E. Caves (1989), Edward J. Ray (1989), Froot and Stein (1991), Steven Martin (1991), Guy V. G. Stevens (1992), and Deborah L. Swenson (1994).

while if it wins the bid it must pay for the target firm in dollars. Therefore, a depreciation of the dollar relative to the yen will raise the Japanese firm's reservation bid, while leaving the U.S. firm's bid unchanged, and presumably make it more likely that the Japanese firm will acquire the asset.

The next section quickly reviews the literature on possible links between exchange rate movements and FDI. The second section details this paper's idea more formally. It presents a stylized model which shows why it is plausible that real dollar depreciations increase acquisitions involving firm-specific assets by foreign firms. Next, an empirical section tests the relationship between exchange rate movements and acquisition FDI predicted by the model using a panel data set of Japanese acquisitions across 3-digit Standard Industrial Classification (SIC) industries in the United States from 1975 through 1992. Because this paper's model is too stylized to generate a complete empirical specification for Japanese acquisition patterns in the United States, other traditional determinants of acquisition FDI are included in the regressions in addition to the exchange rate. Controlling for these other determinants, it is found that real depreciations of the dollar to the yen lead to substantial increases in acquisition FDI in industries that more likely have firm-specific assets, while no such relationship is found in Japanese acquisition activity in other U.S. industries. In addition, there is no similar differential exchange rate effect across industries with respect to Japanese new plant FDI. Some evidence is found for a similar exchange rate effect on West German acquisitions in the United States as well. These results suggest an explanation for why previous empirical studies of the effect of exchange rate movements on *overall* FDI flows have been largely inconclusive.

I. A Link Between Exchange Rate Movements and FDI?

One potential explanation for short-run fluctuations in FDI flows is movements in the exchange rate. Casual empiricism of exchange rate movements of the dollar in the 1980's reveals possible correlation between a depreciating dollar and boom periods of FDI into the United States, especially acquisition FDI. The observation that acquisition FDI may be correlated with exchange rate movements tends to support a "common wisdom" belief that foreign firms are able to purchase U.S. assets and technology "cheaply" when the dollar is weak. In addition, a number of empirical studies, including Caves (1989), Froot and Stein (1991), Swenson (1994), and Michael W. Klein and Eric S. Rosengren (1994), have found correlation between dollar depreciations and increased FDI in the United States. Other studies have found little support for exchange rate movements on FDI, including Ray (1989), Stevens (1992), and Paul M. Healy and Krishna G. Palepu (1993). However, with the exception of Froot and Stein (1991) discussed below, no one has offered an explanation for why a weak dollar would be correlated unambiguously with increases in inward FDI. At the same time, most economists have rejected any link between exchange rates and FDI flows for a seemingly good reason. The main argument is that the *price* of U.S. assets should not matter, only their *rate of return*; when the dollar depreciates relative to another country's currency, not only the price, but the nominal return of the U.S. asset in the foreign currency, will go down. Thus, as Rachel McCulloch (1989 p. 188) states, the traditional theory maintains that:

> If a U.S. asset is seen as a claim to a future stream of dollar-denominated profits, and if profits will be converted back into the domestic currency of the investor at the same exchange rate, the level of the exchange rate does not affect the present discounted value of the investment.

McCulloch goes on to note that this argument must be modified if a U.S. asset engages in export or import activities, but because exporting and importing activities lead to opposing exchange rate exposure, the effect of exchange rates on the value of U.S. assets is ambiguous. Froot and Stein (1991), however, present an unambiguous connection between exchange rate levels and FDI when capital markets are imperfect. Specifically, Froot and Stein analyze a financial environment where lenders do not have perfect information and

thus charge a premium for monitoring costs. In this environment, firms which have more assets in an appreciating currency and experience relative wealth gains can finance more of an investment internally, and avoid the premium-laden external financing.

Froot and Stein (1991) provide an important first step in linking exchange rate movements to FDI flows, but still leave some important issues unresolved. First, while their wealth effect need not distinguish the effect of exchange rate movements on different types of FDI, their empirical findings present evidence that various forms of FDI respond differently to the exchange rate changes. Second, it may be empirically difficult to distinguish relative wealth gains from currency movements compared to other factors affecting firm wealth. For example, with respect to Japanese FDI in the United States, did Japanese firms experience larger wealth gains in the late 1980's from exchange rate movements or from the speculative bubble in the Japanese stock market and real estate markets?

This paper presents perhaps an even more apparent flaw in the argument against any link between exchange rates and FDI: the traditional argument implicitly assumes that the assets connected with FDI are similar to bonds or other assets for which the price and nominal return are in the same currency, regardless of the investor. This need not be the case with respect to acquisition FDI, because the assets of a target firm can often be in the form of firm-specific assets, which can generate returns simultaneously in a variety of markets and currencies, without involving any foreign currency transactions.[3] The next section details how this may lead to an unambiguous relationship between exchange rates and acquisition FDI.

[3] Elhanan Helpman (1984), James R. Markusen (1984), and Ignatius J. Horstmann and Markusen (1989) are examples of papers that have used the unique property of firm-specific assets to be essentially costlessly transferrable across a firm's various operations to derive interesting economic conclusions in the analysis of FDI. The central idea of this paper goes one step further, by noting that transfer of intangible assets across international borders need not involve currency transactions.

II. A Model of Foreign Demand for Firm-Specific Assets via Acquisitions

This section provides a simple stylized example involving a representative foreign firm and U.S. firm bidding for a U.S. target firm with firm-specific assets to show how real exchange rate depreciations of the dollar can plausibly increase foreign acquisitions of these target firms. For the sake of intuitive clarity, the example is not a fully specified model in many ways, but the discussion identifies important conditions which are necessary for the proposed relationship to hold, including deviations from the law of one price (LOP) and some degree of market segmentation.

To begin, I assume that each firm has production and sales solely in its own country, and I focus on the foreign firm. Assume the objective of a representative foreign firm is to maximize profit subject to available technology:

$$(1) \quad \text{Max } \Pi_F = p^* y_F - \mathbf{w}^{*\prime}\mathbf{x}_F \quad \text{subject to}$$

$$(2) \quad y_F = F(\mathbf{x}_F; \mathbf{Z}),$$

where Π_F is the foreign firm's restricted profit (ignoring payment to fixed factors), y_F is firm output, $\mathbf{x}_F$ and $\mathbf{Z}$ are vectors of variable and fixed inputs, respectively, and p^* and $\mathbf{w}^*$ are the exogenous output price and vector of exogenous variable input prices in the foreign currency, respectively. The foreign firm can solve this problem by first choosing variable inputs, $\mathbf{x}_F$, to minimize costs subject to the production constraint in equation (2) and then choosing y_F to maximize

$$(3) \quad \Pi_F = p^* y_F - C(y_F; \mathbf{w}^*, \mathbf{Z}),$$

where $C(y_F; \mathbf{w}^*, \mathbf{Z})$ is the minimum cost for a chosen y_F. The vector, $\mathbf{Z}$, includes such fixed inputs as various forms of capital, including firm-specific assets. Given an initial $\mathbf{Z}$, $\mathbf{Z}^0$, output price, and variable input prices, the foreign firm will solve equation (3) to obtain its restricted profit $\Pi_F^0 = \Pi_F(p^*, \mathbf{w}^*, \mathbf{Z}^0)$, where Π_F^0 is homogeneous of degree one in $(p^*, \mathbf{w}^*)$ and valued in the foreign currency.

Now suppose that the foreign firm has the opportunity to obtain a firm-specific asset via an acquisition of a U.S. target firm. Acquisition of the firm (and hence, the asset) would

increase the firm's stock of fixed capital from $\mathbf{Z}^0$ to $\mathbf{Z}^1$, such that $F(\mathbf{x}_F, \mathbf{Z}^1) > F(\mathbf{x}_F, \mathbf{Z}^0)$ for all values of $\mathbf{x}_F$. Profit-maximizing behavior means $\Pi_F^1 \equiv \Pi_F(p^*, \mathbf{w}^*, \mathbf{Z}^1) > \Pi_F(p^*, \mathbf{w}^*, \mathbf{Z}^0) \equiv \Pi_F^0$. Define the difference $\Delta\Pi_F = \Pi_F^1 - \Pi_F^0 > 0$. Because it is linear in Π_F^1 and Π_F^0, $\Delta\Pi_F$ has similar properties to Π_F, including homogeneity of degree one in $(p^*, \mathbf{w}^*)$ and valuation in the foreign currency. Let e denote the bilateral exchange rate between the United States and the foreign country expressed in dollars per foreign currency, R_F denote the foreign firm's reservation price in dollars, and ρ the rate of return the firm would receive by investing the funds in a relatively "safe" investment over a similar time period. The foreign firm's reservation price in dollars can be expressed as

$$(4) \quad R_F \leq \frac{(ep^*)\Delta\Pi_F\left(1, \frac{\mathbf{w}^*}{p^*}, \mathbf{Z}^0, \mathbf{Z}^1\right)}{1+\rho}.$$

For ease of comparison, assume that the U.S. bidding firm has the same production technology and an identical fixed capital stock as the foreign firm. However, the U.S. firm maximizes in dollars and faces a vector of dollar-denominated prices, $(p, \mathbf{w})$. Similar to the foreign firm's problem, the U.S. firm's reservation bid in dollars is

$$(5) \quad R_{US} \leq \frac{p\Delta\Pi_{US}\left(1, \frac{\mathbf{w}}{p}, \mathbf{Z}^0, \mathbf{Z}^1\right)}{1+\rho}.$$

Equations (4) and (5) show that a permanent dollar depreciation (e increases) raises the foreign firm's reservation price relative to the U.S. firm's reservation price, ceteris paribus. However, LOP implies that prices across countries will adjust to offset nominal exchange rate changes. In the context of this model, this means that the foreign firm must expect to realize a return before LOP-related price movements completely offset the nominal exchange rate change.[4] This may not be a restrictive condition, since the empirical evidence shows that LOP is a long-run phenomenon at best.[5] Thus, a depreciation (appreciation) of the industry-specific real exchange rate will increase (decrease) the foreign firm's dollar-denominated reservation bid for the U.S. firm-specific assets relative to the U.S. firm's reservation bid, provided the real exchange rate does not adjust to its original level before the foreign firm realizes a return.

The direct implication is that real dollar depreciations lead to a greater likelihood of foreign acquisition of the U.S. asset, ceteris paribus. The exchange rate effect on the foreign firm's return from an acquisition occurs because the firm-specific assets accompanying the acquisition yield a nominal return in the foreign currency [$\Delta\Pi_F$ in equation (3) or (4)], yet do not involve a currency transaction, as does the initial purchase of the asset (R/e). Seen in another way, firm-specific assets are not location-specific like other assets such as bonds. With bonds, the price and coupon return are denominated necessarily in the same currency. However, acquisition assets are not location-specific in the sense that the price is in one currency, but the nominal return may occur in a variety of currencies. However, the investors in this model may be location-specific (unlike the bond example), because in order to generate a return in a certain currency, the investor must have access to that market.

This last point is an important one. The above analysis suggests that any investor that sells in the foreign market (i.e., faces foreign prices) may benefit from the acquisition of U.S. firm-specific assets. It is easy to show that a U.S. multinational firm that had production and sales in the foreign country similar to the

[4] For ease of analysis, I do not model expectations formally, but clearly the likelihood of observing changes in relative reservation prices from exchange rate changes depends on firms' expectations and risk preferences. It is not clear what foreign firms' expectations involving LOP corrections would be, but the sooner they expect a correction to occur, the less their reservation price changes relative to the U.S. firm, ceteris paribus. In addition, the more risk adverse the foreign firm, the less its expected profit and, hence, reservation price changes as well. (See David O. Cushman, 1985.)

[5] For empirical evidence on LOP, see Pier G. Ardeni (1989), Barry K. Goodwin et al. (1990), and Michael M. Knetter (1994). For related evidence on purchasing power parity, see Mark P. Taylor (1995).

foreign firm would experience a similar increase in its reservation bid for a dollar depreciation, in which case a real dollar depreciation would not necessarily increase the likelihood of foreign acquisition. However, if there is some degree of market segmentation to the extent that access to the foreign market is limited for the U.S. firm relative to the foreign firm, then exchange rate movements can affect the likelihood of foreign acquisition.[6]

The importance of a goods market imperfection for this paper's hypothesis contrasts with Froot and Stein (1991), who find that capital market imperfections can lead to a link between exchange rate movements and FDI. An additional difference, however, is that while the Froot and Stein effect is applicable to potentially many forms of FDI, this paper's hypothesis concerns only acquisition FDI that involves firm-specific assets. Acquisitions comprise a large portion of FDI activity for the United States and many of these acquisitions may have included firm-specific assets, since a wide variety of assets have firm-specific properties, including process technology, product innovation, and managerial skills.[7]

III. Empirical Test: Japanese Acquisitions in the United States

To test the theory linking exchange rates to foreign acquisitions, I focus primarily on Japanese acquisitions in the United States from 1975 to 1992. This paper's hypothesis relies on a couple of important conditions that are particularly applicable to the Japanese-U.S. international market structure. First, the link between acquisition FDI and exchange rate movements relies on some degree of market segmentation, in the sense that domestic firms have limited access to the foreign market relative to the foreign firm. In this respect, a number of papers (see Bela Balassa [1986]; Robert Z. Lawrence [1991, 1993]; Dennis J. Encarnation [1992]; Marcus Noland [1997]) have demonstrated that the Japanese market has been particularly insulated from foreign import penetration and FDI, which has given Japanese firms a larger presence in their own market relative to foreign firms than perhaps any other industrialized country in the world. While there has been an intense debate over whether the low levels of foreign investment and trade are due to artificial barriers (see Gary R. Saxonhouse, 1986; Saxonhouse and Robert M. Stern, 1989), all agree that the levels are low. Second, a link between acquisition FDI and exchange rates depends on the condition that acquisitions involve firm-specific assets. In this regard, there is evidence that Japanese acquisition FDI into the United States is strongly motivated by the intent to access technology and other firm-specific assets. A number of empirical studies, including Bruce Kogut and Sea Jin Chang (1991) and Hideki Yamawaki (1993), have found evidence that Japanese U.S. acquisitions are motivated by the desire to access technology. In this sense, the literature has indicated that the Japanese are interested in technology-related, firm-specific assets, which suggests high research and development (R&D) manufacturing industries as an area that should be more likely to support my hypothesis in the case of the Japanese investors. Finally, Knetter (1994) gives evidence that LOP does not hold well with respect to Japan, which makes it more likely that Japanese firms will have adequate time to realize a return from a U.S. acquisition after a real exchange rate change.

While the model presented above is too stylized to suggest a full empirical specification, it suggests that given certain conditions, the probability of a foreign firm acquiring a U.S. target firm is a function of the reservation prices in equations (4) and (5), which implies

$$(6)\quad \text{Prob(foreign acquisition)} = f(\underset{+}{\text{RER}_{it}}),$$

where $\text{RER}_{it} = e_t p^*_{it}/p_{it}$, is the real exchange rate for bidding firms in industry i in year t.[8]

[6] One way to show this in the above model is to impose a quantitative restriction on the U.S. firm's sales to the foreign market at the level before the acquisition. In this case it is easy to show that exchange rate movements would have no effect on the U.S. firm's reservation bid, despite presence in the foreign market. Proof is available from author on request.

[7] Klein and Rosengren (1994) found that acquisitions as a percent of all FDI inflows into the United States ranged from 60 to 89 percent from 1979–1991—see their Table 2, p. 377.

[8] Specification of a nominal exchange rate (conditional on industry prices) yielded almost identical results as a

If firm-specific assets are involved with each observed acquisition, then both reservation prices will be nonzero and an assumption of negligible U.S. access to the Japanese market allows an unambiguous expected sign on the real exchange rate variable. To the extent that U.S. firms have significant market presence in Japan or acquisitions do not involve firm-specific assets, it is less likely that coefficient signs will be correct and/or have statistical significance.

Modifications of equation (6) are necessary to make the testing equation appropriate for available data. While equation (6) specifies the probability of foreign acquisition at the firm level, typical sources of FDI data report at very aggregated levels.[9] This paper uses data published by the International Trade Administration (ITA) of the U.S. Department of Commerce in its annual publication, *Foreign Direct Investment in the United States: Transactions*. This ITA publication contains a compiled list of FDI transactions reported in public sources during the year, including the type of investment, the foreign investor and country, and the industry of the U.S. investment. However, since dollar values of FDI, including acquisitions, are not necessarily a matter of public record, dollar values for acquisitions are missing for over one-third of the observations. Therefore, I specify the dependent variable as the number of Japanese acquisitions into the United States in 3-digit SIC industry i in year t (where $t = 1975-1992$). In order to correspond to these data considerations, equation (6) is modified to yield the following testing specification:

$$(7)\quad \text{Prob(number of foreign acquisition)} = f(\text{RER}_{it}, \Omega_{it}, \Psi_{it}),$$

where RER_{it} represents the industry-specific real exchange rate, and Ω_{it} and Ψ_{it} represent characteristics of industry i in year t that control for the U.S. supply of, and foreign demand for, U.S. target firms available for acquisition, respectively. While equation (6) specifies the probability that a foreign firm will purchase a U.S. target firm, equation (7) indicates the probability that the number of total foreign acquisitions in an industry will take some nonnegative integer value. A common way to specify this type of discrete probability function is as a Poisson or negative binomial model. These specifications model the integer property of the dependent variable explicitly and include "0" observations as natural outcomes. Initial estimates are with maximum-likelihood estimates from a standard negative binomial specification. However, a major concern is that a standard negative binomial model does not take into account the panel nature of the data used here. Accounting for heterogeneity can be very important in panel models, since controlling for it can reduce a significant amount of apparent serial correlation. In a linear, least-squares context, fixed effects and random effects models are often employed to address these concerns. Jerry Hausman et al. (1984) derive negative binomial models which account for cross-sectional variation in a manner analogous to the fixed and random effects models in the linear context, and I use the random effects specification (random NEGBIN) in results reported below.[10] The Appendix provides a brief description of the Hausman et al. (1984) random effects negative binomial model used for estimation.

real exchange rate specification in all regressions, and likelihood ratio tests indicated that the restrictions implied by constructing a real exchange rate were appropriate. Stationarity issues, however, argue for using the real exchange rate, since it more likely tends to a long-run equilibrium.

[9] The most widely known source of FDI data, the annual article in the U.S. Department of Commerce's *Survey of Current Business* (SCB), reports dollar values on only very aggregate FDI flows to avoid revealing dollar values that can be traced to specific firms and transactions. In addition, the SCB articles do not separately list acquisition FDI from other forms of FDI by industry.

[10] Hausman et al. (1984) point out that their random effects negative binomial model achieves asymptotically more efficient estimators than their fixed effects model. However, if the industry-specific effects are correlated with the regressors, the random effects' estimates are not necessarily consistent. A Hausman test indicated that the random effects model estimates are consistent for these data, and thus I report only the more efficient random effects model estimates.

TABLE 1—NUMBER OF JAPANESE ACQUISITIONS IN THE UNITED STATES, 1975–1992

Year	Number of Japanese acquisitions in the United States[a]					Real exchange rate[b]
	Total	Nonmanufacturing	Manufacturing			
			Total	High R&D	Low R&D	
1975	10	5	5	3	2	84.7
1976	1	0	1	0	1	87.7
1977	4	1	3	1	2	95.8
1978	7	3	4	4	0	121.8
1979	5	4	1	0	1	108.7
1980	14	8	6	4	2	100.0
1981	23	6	17	9	8	97.6
1982	13	5	8	3	5	83.7
1983	9	2	7	4	3	86.6
1984	29	11	18	7	11	84.6
1985	33	14	19	10	9	118.0
1986	63	27	36	24	12	135.7
1987	95	36	59	38	21	147.9
1988	101	35	66	37	29	132.8
1989	151	77	74	50	24	123.3
1990	156	89	67	45	22	129.9
1991	107	58	49	35	14	136.7
1992	39	19	20	16	4	154.0

Source: Same as Figure 1.

[a] Nonmanufacturing industries are Standard Industrial Classification (SIC) 011–179 and 401–899; manufacturing industries are SIC 200–399; high R&D manufacturing industries are industries that are at or above the mean in terms of R&D expenditures as a percent of sales in 1991 (National Science Foundation) and comprise SIC 281–289, 351–359, 365–367, 371–372, 376, and 381–389; low R&D industries are all other manufacturing industries.

[b] The real exchange rate of the dollar and yen using the nominal exchange rate and consumer price indexes with base year 1980 = 100.

A. *Data*

My dependent variable is taken from the ITA publication mentioned above. Table 1 lists the number of annual Japanese acquisitions in the United States from 1975 to 1992, including separate totals for manufacturing and nonmanufacturing. It also breaks down manufacturing totals into industries with high R&D expenditures and those with low R&D, as well as reports an economywide real exchange rate between the dollar and yen. These data are

much more aggregate than the data used for the dependent variable, but it shows that the late 1980's correspond to a substantial increase in Japanese acquisitions across all these industry groupings, as well as a real dollar depreciation. By itself this may mean very little, since it can be argued that a number of different forces may have affected Japanese acquisitions in the late 1980's, as discussed below. However, Table 1 shows that years in which the real exchange rate is relatively high correspond to years where the ratio of high R&D acquisitions to total manufacturing (column 4 divided by column 3) is large. A greater proportion of high R&D acquisitions during periods of a real dollar depreciation lends support to this paper's hypothesis, in the sense that these manufacturing industries should have more firm-specific assets.

The vector of explanatory variables used for estimation are based on equation (7), and a detailed Data Appendix is available upon request. Annual industry-specific real exchange rates are constructed using the dollar-yen nominal exchange rate and roughly 2-digit SIC price indexes for the United States and Japan. An increase in the industry-specific real exchange rate variable represents a real depreciation of the dollar relative to the yen; thus, a positive correlation between the real exchange rate and Japanese acquisitions is expected. To capture industry supply characteristics, Ω_{it}, I include a regressor indicating the number of acquisitions of U.S. target firms by other U.S. firms in industry i during year t, which was compiled by the author from various issues (1975–1993) of *Mergers and Acquisitions*. Domestic acquisitions are the largest portion of U.S. acquisitions each year, and their distribution across industries should be representative of the overall activity and target firm supply for each industry and year. Thus, the number of foreign acquisitions in an industry should be positively correlated with this supply variable. To control for Japanese demand for U.S. target firms, I include a variable that captures the share of Japanese value added in industry i, constructed from Japan's census of manufactures, and the annual real growth of Japanese GDP, which I expect to have positive correlations.

I also control for alternative explanations that may account for movements in Japanese acquisition FDI, especially the large increase in the late 1980's. First, I include an industry-specific U.S. protection variable constructed from the SMART software developed by the trade division of the World Bank, since one traditional reason for FDI which may be most applicable to Japan during this period is establishing production in the protected market to avoid protectionism. A second theory relevant to Japanese FDI in the United States is that the boom in Japanese acquisitions of U.S. firms in the late 1980's and early 1990's was an outgrowth of the speculative "bubble" economy of Japan during those years. Edward M. Graham and Paul R. Krugman (1995) discuss this possibility and casual observation of my data showed support for such a speculative bubble, which was potentially highly correlated with exchange rate movements in the late 1980's. Thus, I include the annual growth in the Tokyo Stock Price Index (TOPIX) as a regressor and expect it to have a positive sign. I also include a time trend.

B. *Empirical Results*

Columns 1 and 2 of Table 2 report negative binomial and random NEGBIN estimates of the determinants of Japanese acquisitions in the United States across a balanced panel of 361 industries (both manufacturing and nonmanufacturing) and the years 1975–1992.[11] Many of the coefficients are the expected sign and are statistically significant across the two specifications. The level of U.S. domestic acquisitions in an industry are positively correlated with the level of Japanese acquisitions. This corresponds with the assumption that supply shocks should similarly affect the equilibrium number of acquisitions by Japanese and U.S. firms in an industry. Likewise, variables to control for demand-side factors, Japanese GDP growth, and the Japanese industry's share of total value added positively affect the probability of Japanese acquisitions as predicted.

As for other theories of Japanese FDI in the U.S., there is strong evidence that growth periods in the Japanese stock market index are highly correlated with increased Japanese

[11] All samples used for estimation in this paper are balanced panels. Financial sectors, SIC 60–67, were not included because there is no value-added data for these industries.

TABLE 2—DETERMINANTS OF NUMBER OF JAPANESE ACQUISITIONS IN THE UNITED STATES, 1975–1992: SEPARATE ESTIMATES FOR ALL INDUSTRIES, NONMANUFACTURING, AND MANUFACTURING

	Dependent variable: Japanese acquisitions in the United States, 1975–1992					
	All industries		Nonmanufacturing		Manufacturing	
Variables	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN
Constant	−6.948*** (0.328)	−4.559*** (0.346)	−7.252*** (0.562)	−4.718*** (0.642)	−6.431*** (0.425)	−3.272*** (0.758)
Real exchange rate	0.219** (0.570)	0.851* (0.480)	0.382 (1.124)	0.385 (0.802)	2.292*** (0.692)	1.548** (0.657)
Domestic acquisitions	0.068*** (0.008)	0.017*** (0.002)	0.059*** (0.018)	0.009* (0.006)	0.079*** (0.009)	0.042*** (0.008)
Industry value-added share	1.086*** (0.196)	2.334*** (0.397)	0.737 (0.449)	1.235* (0.736)	0.316*** (0.046)	0.526*** (0.117)
Japan real GDP growth	0.174*** (0.046)	0.140*** (0.039)	0.236*** (0.073)	0.200** (0.088)	0.120* (0.067)	0.129*** (0.046)
Japan stock market	0.779*** (0.292)	0.900*** (0.283)	0.719 (0.535)	0.534 (0.542)	0.785* (0.415)	0.761** (0.307)
U.S. protection	0.159 (0.332)	0.688 (0.519)	−0.807 (10.801)	0.124 (13.339)	−0.230 (0.227)	−0.180 (0.281)
Time trend	0.193*** (0.014)	0.188*** (0.012)	0.226*** (0.023)	0.206*** (0.023)	0.158*** (0.016)	0.164*** (0.015)
Alpha	4.592*** (0.311)		11.381*** (1.096)		1.182*** (0.213)	
a		4.333*** (0.671)		3.753*** (0.778)		18.762 (12.180)
b		0.458*** (0.057)		0.390*** (0.067)		1.009*** (0.249)
Log-likelihood (LogL)	−1900.9	−1676.5	−871.5	−754.2	−949.7	−894.4
Restricted LogL[a]	−3020.1	−2441.3	−1501.2	−1237.1	−1464.3	−1204.2
Likelihood ratio test[b]	2238.4	1529.6	1259.4	965.8	1029.2	619.6
Observations	6498	6498	3978	3978	2520	2520

Note: Standard errors are in parentheses and ***, **, and * denote *t*-statistics at the 99-percent, 95-percent, and 90-percent confidence level, respectively.

[a] The coefficients are restricted to slopes equal to zero and intercept equal to the mean of the dependent variable. For the random effects model, I also restrict *a* and *b* to be equal to one.

[b] Likelihood ratio tests have 9 and 11 degrees of freedom for the negative binomial and random NEGBIN model, respectively. All *p*-values for the likelihood ratio tests are less than 0.001.

acquisition activity. Evidence for tariff-jumping is lacking, however. There are a number of potential explanations for why this may be true. First, this sample tests for the effect of protection over time, but FDI flows may be affected by protection only around the time the protection is put into place. Second, U.S. protection may be highest in those industries where other factors make FDI less likely. Sensitivity tests showed a strong negative effect

between FDI and protected sectors in textiles, apparel, and steel. High labor costs may deter textiles and apparel FDI into the United States, despite high levels of protection, while plant-level scale economies may severely limit FDI in steel industries.

Column 1 of Table 2 also reports an estimated alpha parameter for the negative binomial model. Unlike a Poisson specification, this parameter allows the variance of the distribution to differ from the mean. The positive, statistically significant alpha parameter in Table 2 suggests that overdispersion in the data (i.e., a greater variance than mean) and that the negative binomial model, therefore, is a better specification than a Poisson model.[12] In addition, the shape parameters for the random NEGBIN model (see Appendix), a and b, are estimated with precision. While it is difficult to measure goodness of fit in these nonlinear models, the null hypothesis that the slopes are zero is strongly rejected by the likelihood ratio test for both models.

Of particular interest, the real exchange rate variable is statistically significant and has the correct sign across both models. Thus, without controlling for the conditions connected with the paper's hypothesis (market presence and firm-specific assets), there is support for a link between exchange rate movements and Japanese acquisition FDI in the United States. However, because the conditions have not been controlled for, it is impossible to distinguish from these initial estimates whether the predicted coefficient on the exchange rate variable is due to this paper's hypothesis effect or the Froot and Stein (1991) wealth effect discussed earlier. The rest of the empirical section is intended to separately identify this paper's hypothesis in the data from other alternative explanations, particularly that of Froot and Stein (1991).

Froot and Stein's (1991) effect does not necessarily predict a difference in how exchange rate movements affect different forms of FDI across different industries; this paper predicts an exchange rate effect for acquisition FDI, particularly for industries in which firm-specific assets are important. As a first cut on the data, I test the model separately on manufacturing and nonmanufacturing samples, reported in columns 3–6 in Table 2. While most of the coefficients across the two samples are similar, the coefficient on the real exchange rate is statistically insignificant for the nonmanufacturing industries (which include services, wholesale and retail trade, and agricultural production) and only one-fourth to one-sixth as large as the real exchange rate coefficient for manufacturing industries. This difference is not predicted by Froot and Stein (1991), but supports this paper's hypothesis to the extent that firm-specific assets may be more important in manufacturing industries.

I next focus on manufacturing acquisitions and test whether industries with higher R&D expenditures experience a larger real exchange rate effect on foreign acquisitions than low R&D manufacturing industries. As discussed above, a number of papers have found evidence that Japanese firms may be particularly interested in technology-related, firm-specific assets in the United States. Thus, I predict the exchange rate effect on Japanese acquisition behavior should be strongest in high R&D manufacturing industries. Using the National Science Foundation publication, *Selected Data on Research and Development in Industry: 1991*, I classify industries that are at or above the average R&D as a percentage of sales as high R&D and all other manufacturing industries as low R&D. Columns 1–4 of Table 3 detail estimates for these samples from both a negative binomial and the random NEGBIN specification for the years 1975–1992. The difference between these high R&D and low R&D manufacturing industries is even more striking than that between manufacturing and nonmanufacturing. In the negative binomial model, the coefficient on the real exchange rate variable is insignificant for the low R&D sample and only one-eighth as large as for high R&D industries. In addition, a Wald test rejects the hypothesis that the coefficients are equal at the 99-percent confidence level. Despite less precision, the random NEGBIN specification yields qualitatively similar results. The real exchange rate coefficient for both the high and low R&D

[12] In addition, regression-based tests suggested by A. Colin Cameron and Pravin K. Trivedi (1990) confirm significant overdispersion. Poisson estimates yielded very similar results for all regressions, suggesting that the reported results presented are not biased by misspecification errors in the negative binomial models used for analysis.

TABLE 3—DETERMINANTS OF NUMBER OF JAPANESE ACQUISITIONS IN THE UNITED STATES: SEPARATE ESTIMATES FOR HIGH R&D AND LOW R&D MANUFACTURING, FOR SAMPLE YEARS 1975–1992 AND 1975–1984

	Dependent variable: Japanese acquisitions, 1975–1992				Dependent variable: Japanese acquisitions, 1975–1984			
	High R&D manufacturing		Low R&D manufacturing		High R&D manufacturing		Low R&D manufacturing	
Variables	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN
Constant	−6.496***	−4.126***	−6.266***	−3.898***	−4.906***	−5.168**	−4.841**	−3.307
	(0.753)	(1.400)	(0.563)	(0.755)	(1.876)	(2.404)	(1.910)	(3.366)
Real exchange rate	4.036***	2.562**	0.490	0.143	9.787***	11.327**	−0.163	0.963
	(1.177)	(1.252)	(1.117)	(1.261)	(2.017)	(4.901)	(3.244)	(4.308)
Domestic acquisitions	0.057***	0.038***	0.083***	0.080***	0.045**	0.051*	0.112***	0.121*
	(0.011)	(0.013)	(0.015)	(0.016)	(0.022)	(0.031)	(0.039)	(0.073)
Industry value-added share	0.150**	0.147	0.501***	0.543**	0.025	−0.008	0.327	0.307
	(0.057)	(0.233)	(0.108)	(0.199)	(0.145)	(0.254)	(0.201)	(0.380)
Japan real GDP growth	0.114	0.140**	0.117	0.116	−1.100**	−1.107	−0.228	−0.180
	(0.096)	(0.070)	(0.095)	(0.103)	(0.439)	(0.679)	(0.405)	(0.434)
Japan stock market	0.325	0.385	1.414**	1.237*	6.553	6.449	0.223	0.421
	(0.611)	(0.627)	(0.604)	(0.713)	(4.329)	(6.710)	(4.637)	(5.952)
U.S. protection	0.158	0.863	−0.340	−0.423	1.536	2.133	0.361	0.518
	(0.437)	(1.456)	(0.324)	(0.617)	(1.393)	(4.243)	(0.746)	(0.875)
Time trend	0.160***	0.172***	0.187***	0.187***	0.110	0.177	0.211	0.233
	(0.021)	(0.030)	(0.031)	(0.029)	(0.141)	(0.160)	(0.157)	(0.208)
Alpha	0.930***		1.045***		0.013		0.679	
	(0.248)		(0.324)		(0.607)		(0.748)	
a		9.681		13.887*		9.011		9.755
		(9.377)		(8.130)		(19.048)		(9.437)
b		1.727		1.575**		3.406		0.840
		(1.158)		(0.640)		(11.093)		(1.066)
Log-likelihood (LogL)	−392.6	−374.1	−529.7	−506.0	−98.9	−101.1	−131.7	−128.2
Restricted LogL[a]	−622.3	−460.0	−683.4	−744.2	−119.4	−145.8	−158.5	−341.8
Likelihood ratio test[b]	459.4	171.8	307.4	476.4	41.0	89.4	53.6	427.2
Observations	522	522	1998	1998	290	290	1110	1110

Note: Standard errors are in parentheses and ***, **, and * denote *t*-statistics at the 99-percent, 95-percent, and 90-percent confidence level, respectively.

[a] The coefficients are restricted to slopes equal to zero and intercept equal to the mean of the dependent variable. For the random effects model, I also restrict *a* and *b* to be equal to one.

[b] Likelihood ratio tests have 9 and 11 degrees of freedom for the negative binomial and random NEGBIN model, respectively. All *p*-values for the likelihood ratio tests are less than 0.001.

samples is lower, but the difference in the real exchange rate coefficients between the two samples is statistically significant at the 90-percent confidence level.

One critique with the above analysis is that R&D expenditures may be a proxy for other characteristics of an industry that would make a Japanese firm more likely to acquire in that

industry when the dollar depreciates. Perhaps high R&D industries are also the ones that are relatively more capital intensive. The Froot and Stein (1991) capital market story may suggest that exchange rate depreciations will benefit capital-intensive industries proportionally more. I create a capital intensity variable by dividing an industry's current-cost gross stock of fixed private capital by the industry's value added (both reported annually in the *Survey of Current Business*). I then sample the relatively high capital-intensive industries (those above the mean of 1.715) and find the real exchange rate effect for these high capital-intensive industries is negative and insignificant for both model specifications (results omitted for brevity). This suggests that my high R&D/low R&D distinction is not proxying for capital intensity.

Another critique may suggest that because the depreciation of the dollar in the late 1980's occurred at the same time that the Japanese economy was experiencing significantly lower costs of capital (see Jeffrey A. Frankel, 1991; David M. Meerschwam, 1991) and a possible speculative bubble, the correlation of increased acquisition activity with exchange rate movements may be spurious.[13] To a large extent, these criticisms are controlled for in the above regressions. First, neither alternative explanation predicts differential effects across manufacturing and nonmanufacturing and high R&D and low R&D manufacturing. Second, the Japanese stock market growth variable controls for the speculative bubble and is positive as expected, and the real exchange rate effect for capital-intensive industries shows no relationship. However, I also run estimates for high R&D and low R&D industries for sample years from 1975–1984, and report these in column 5–8 of Table 3. While the estimates are less precise, the same qualitative differences emerge in the real exchange rate coefficient estimates between high and low R&D manufacturing for this pre-1985 sample of years.

In addition to these specification tests, I next run a similar equation for *new plant* manufacturing FDI, as opposed to *acquisition* manufacturing FDI. This provides an important comparison because, first of all, this paper's proposition does not predict any exchange rate effect for new plant FDI: a foreign firm cannot gain new firm-specific assets by building its own plant. The Froot and Stein (1991) effect does not necessarily make a distinction between new plant FDI and acquisition FDI in predicting an exchange rate effect. Second, the above specification tests simply may not capture some unobservable factor that causes the Japanese to invest (through all forms of FDI) in high R&D industries. Thus, I test the determinants of Japanese new plant FDI in the United States using the same specification as used to test Japanese acquisition FDI, with the exception of the U.S. domestic acquisition regressor.[14] This testing equation is similar to previous studies of determinants for various types of FDI, including new plant FDI. (See for example, Ray, 1989; Martin, 1991.) Table 4 shows separate estimates for Japanese new plant FDI in the United States for manufacturing, high R&D manufacturing, and low R&D manufacturing from 1975–1992.

Columns 1 and 2 of Table 4 show that there is evidence that Japanese new plant FDI is positively affected by real exchange rate depreciation and display coefficients that are similar in magnitude to the Japanese acquisition FDI estimates. However, columns 3–6 show that there is no differential impact of the real exchange rate on Japanese new plant FDI across high and low R&D manufacturing industries, as was true with Japanese acquisitions. Thus, while there seems to be a positive effect of real dollar depreciations on Japanese FDI in general (which could be due to a number of explanations, including the Froot and Stein [1991] effect), the differential impact on high R&D and low R&D manufacturing industries is large and specific to acquisition FDI, as predicted by this paper's hypothesis.

[13] Another potential explanation for inward FDI into the United States over this period is U.S. tax law changes in 1986, as suggested by Myron S. Scholes and Mark A. Wolfson (1990), which may have increased the Japanese demand for U.S. assets. However, Alan J. Auerbach and Kevin A. Hassett (1993) dispute this conclusion.

[14] There is no a priori belief that domestic acquisition activity should affect new plant FDI. In addition, inclusion of the domestic acquisition variable has no qualitative effect on the results.

TABLE 4—DETERMINANTS OF NUMBER OF JAPANESE NEW PLANT FDI IN THE UNITED STATES, 1975–1992: SEPARATE ESTIMATES FOR MANUFACTURING, HIGH R&D MANUFACTURING, AND LOW R&D MANUFACTURING

	Dependent variable: Japanese new plant FDI, 1975–1992					
	Manufacturing		High R&D manufacturing		Low R&D manufacturing	
Variables	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN
Constant	−5.055*** (0.353)	−2.928*** (0.590)	−3.425*** (1.974)	−2.076 (1.580)	−5.819*** (0.496)	−3.464*** (0.760)
Real exchange rate	2.596*** (0.591)	1.840*** (0.662)	1.974** (1.006)	1.240 (1.567)	1.943** (0.879)	1.968* (1.066)
Industry value-added share	0.565*** (0.045)	0.390*** (0.107)	0.312*** (0.059)	0.257 (0.214)	0.704*** (0.098)	0.543** (0.212)
Japan real GDP growth	−0.020 (0.058)	0.061 (0.055)	−0.082 (0.107)	0.031 (0.102)	0.051 (0.073)	0.077 (0.074)
Japan stock market	2.254*** (0.422)	1.151*** (0.344)	2.439*** (0.770)	1.374** (0.569)	2.086*** (0.527)	1.402** (0.570)
U.S. protection	−0.626** (0.245)	−0.227 (0.419)	0.636 (0.663)	0.377 (1.100)	−0.835*** (0.294)	−0.630 (0.667)
Time trend	0.111*** (0.015)	0.109*** (0.012)	0.093*** (0.022)	0.088*** (0.019)	0.147*** (0.026)	0.145*** (0.026)
Alpha	1.190*** (0.216)		0.595*** (0.190)		1.045*** (0.347)	
a		9.539** (4.752)		9.152 (13.109)		11.610 (7.671)
b		1.133*** (0.265)		1.992* (1.075)		1.002*** (0.314)
Log-likelihood	−1119.7	−1026.8	−444.6	−418.5	−631.1	−587.4
Restricted LogL[a]	−1655.8	−1302.6	−688.2	−487.6	−785.5	−814.9
Likelihood ratio test[b]	1072.2	551.6	487.2	138.2	308.8	455.0
Observations	2520	2520	522	522	1998	1998

Note: Standard errors are in parentheses and ***, **, and * denote *t*-statistics at the 99-percent, 95-percent, and 90-percent confidence level, respectively.

[a] The coefficients are restricted to slopes equal to zero and intercept equal to the mean of the dependent variable. For the random effects model, I also restrict *a* and *b* to be equal to one.

[b] Likelihood ratio tests have 9 and 11 degrees of freedom for the negative binomial and random NEGBIN model, respectively. All *p*-values for the likelihood ratio tests are less than 0.001.

How large is the effect of the real exchange rate on Japanese acquisitions in the United States from 1975–1992? In a highly nonlinear setting such as this, perhaps the best way to estimate these magnitudes is through simulations. Table 5 reports results from a simulation where I increase the real exchange rate by 10 percent across all years and industries and estimate its effect on the yearly prediction of total Japanese acquisitions. In addition to determining the eco-

TABLE 5—SIMULATED EFFECTS OF 10-PERCENT INCREASE IN EXCHANGE RATE ON NUMBER OF JAPANESE ACQUISITIONS IN THE UNITED STATES, 1975–1992

	Manufacturing industries				High R&D manufacturing industries			
Year	Actual FDI	Predicted FDI	Predicted FDI after 10-percent exchange rate increase	Percent change	Actual FDI	Predicted FDI	Predicted FDI after 10-percent exchange rate increase	Percent change
1975	6	1.6	1.8	**12.2**	4	1.1	1.4	**26.8**
1976	0	3.0	3.4	**11.9**	0	1.7	2.1	**25.0**
1977	1	4.4	4.9	**12.3**	1	2.4	3.0	**25.9**
1978	6	7.3	8.4	**15.4**	5	5.1	6.8	**32.3**
1979	2	8.7	10.0	**14.3**	0	5.7	7.4	**29.8**
1980	7	6.7	7.6	**12.6**	5	3.6	4.5	**25.1**
1981	19	9.3	10.4	**12.4**	9	4.9	6.2	**24.4**
1982	10	8.6	9.5	**10.3**	5	3.6	4.3	**19.7**
1983	5	11.9	13.1	**10.4**	2	5.2	6.3	**19.7**
1984	17	20.0	22.1	**10.3**	7	7.7	9.2	**19.4**
1985	22	31.0	34.0	**9.9**	12	11.0	13.0	**18.4**
1986	40	55.1	62.3	**13.1**	21	23.9	29.8	**24.5**
1987	57	60.2	69.1	**14.9**	35	29.7	38.0	**27.9**
1988	66	99.0	115.5	**16.6**	34	49.5	65.1	**31.6**
1989	76	65.6	75.8	**15.5**	46	36.9	47.5	**28.9**
1990	67	66.6	75.7	**13.6**	41	33.0	41.4	**25.1**
1991	50	46.3	53.2	**14.9**	34	29.4	37.4	**27.2**
1992	20	33.0	38.2	**15.9**	14	23.4	30.2	**29.0**

nomic significance of the real exchange rate on Japanese acquisitions, comparing predicted to actual FDI helps indicate the fit of the model in general. I run these simulations using the estimated coefficients for the manufacturing and high R&D samples, where the real exchange rate effect is largest and statistically significant. On a final note, I use the negative binomial model and its estimates for the simulations, because unlike the random NEGBIN, the predicted values have a closed-form solution.

Table 5 shows that for both the manufacturing and high R&D manufacturing samples the predicted FDI totals match the actual totals fairly well, lending further support of the goodness of fit of the model. Second, the simulations capture how much the predicted Japanese acquisitions change each year for a 10-percent increase in the real exchange rate (or similarly, a 10-percent increase in the nominal exchange rate, holding prices constant). For the manufacturing sample, a 10-percent real exchange rate depreciation of the dollar generates a 10–16-percent increase in total Japanese acquisitions across the years in the sample. The effect of a 10-percent increase in the exchange rate on Japanese acquisition activity in high R&D manufacturing is even larger, ranging from 18 percent to over 32 percent.

TABLE 6—DETERMINANTS OF NUMBER OF GERMAN ACQUISITION FDI IN THE UNITED STATES, 1975–1990: SEPARATE ESTIMATES FOR MANUFACTURING, HIGH R&D MANUFACTURING, AND LOW R&D MANUFACTURING

	Dependent variable: German acquisition FDI, 1975–1990					
	Manufacturing		High R&D manufacturing		Low R&D manufacturing	
Variables	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN	Negative binomial	Random NEGBIN
Constant	−5.160***	−3.605***	−4.231***	−3.328**	−5.192***	−2.995***
	(0.576)	(0.610)	(0.867)	(1.254)	(0.751)	(0.874)
Real exchange rate	3.236***	3.640***	3.269***	3.434**	2.520***	2.448**
	(0.847)	(0.882)	(1.217)	(1.727)	(1.137)	(1.223)
Domestic acquisitions	0.090***	0.072***	0.052***	0.053***	0.106***	0.088***
	(0.010)	(0.012)	(0.012)	(0.015)	(0.021)	(0.028)
Industry value-added share	0.156***	0.270***	0.063	0.062	0.032	0.082
	(0.055)	(0.071)	(0.071)	(0.095)	(0.243)	(0.191)
German real GDP growth	0.016	0.021	0.015	0.035	0.029	0.037
	(0.054)	(0.059)	(0.070)	(0.089)	(0.080)	(0.089)
U.S. protection	−0.488	−0.452	−0.494	−0.401	0.110	−0.466
	(0.377)	(0.722)	(0.805)	(2.910)	(0.455)	(0.711)
Time trend	0.011	0.018	0.033	0.039	0.004	0.009
	(0.022)	(0.019)	(0.030)	(0.027)	(0.031)	(0.036)
Alpha	11.701***		1.103***		1.298	
	(0.449)		(0.405)		(0.968)	
a		9.193**		8.378		21.787
		(4.625)		(7.129)		(20.981)
b		1.300***		2.644		2.555
		(0.411)		(1.669)		(2.028)
Log-likelihood (LogL)	−645.1	−629.9	−303.2	−298.6	−318.2	−318.4
Restricted LogL[a]	−780.7	−856.5	−342.2	−333.9	−348.6	−422.6
Likelihood ratio test[b]	271.2	453.2	78.0	70.6	60.8	208.4
Observations	2240	2240	464	464	1776	1776

Note: Standard errors are in parentheses and ***, **, and * denote *t*-statistics at the 99-percent, 95-percent, and 90-percent confidence level, respectively.

[a] The coefficients are restricted to slopes equal to zero and intercept equal to the mean of the dependent variable. For the random effects model, I also restrict *a* and *b* to be equal to one.

[b] Likelihood ratio tests have 8 and 10 degrees of freedom for the negative binomial and random NEGBIN model, respectively. All *p*-values for the likelihood ratio tests are less than 0.001.

C. *Extension: Empirical Test of West German Acquisitions in the United States*

While I have suggested that this paper's theory linking exchange rate movements is particularly appropriate for examining Japanese acquisitions in the United States, it may apply to other countries' acquisition behavior in the United States as well. Table 6 presents results for West German acquisi-

tions in the United States from 1975–1990.[15] All regressors are the West German equivalent to the Japanese acquisition FDI estimates in Tables 2 or 3 (and described in the Data Appendix, available upon request), except the stock market growth index is omitted because there is no a priori belief that West Germany experienced a speculative bubble. Data sources are similar as well, except the West German statistical yearbook was used for German industry-level price indexes and value-added shares. Like Japanese acquisition behavior, the real exchange rate has a positive and significant effect on all West German manufacturing acquisitions. In addition, when the manufacturing sample is split into high R&D and low R&D, the point estimates show approximately a 30-percent higher coefficient for the high R&D sample. The evidence for a differential relationship between the high and low R&D samples is weaker than the case of Japan, however, because there is no statistical difference in the real exchange rate coefficient across the two samples. The weaker West German results may reflect that certain conditions of the theory are not as appropriate for the West Germany–U.S. international relationship; e.g., perhaps the U.S. firms have a greater market presence in West Germany than Japan.

IV. Conclusion

The inadequacy of traditional theories of FDI to explain the U.S. experience in inward FDI over the last 20 years has caused a new search for explanations that can naturally account for substantial short-run fluctuations in FDI flows. While both anecdotal and empirical evidence has supported a link between FDI and exchange rate movements, few formal theories for this link have been presented and previous empirical evidence has been mixed. This paper attempts to shed light on the relationship between exchange rate movements and FDI. Specifically, a theoretical connection between exchange rate movements and acquisition FDI can be found, provided that acquisitions involve firm-specific assets and goods-market imperfections prevent investors from having equal access to all markets. The data on Japanese acquisitions in the United States from 1975–1992 display a strong correlation between periods of a weaker dollar and higher levels of Japanese acquisition FDI in the United States for industries which more likely involve firm-specific assets. Postregression simulations find that a 10-percent lower dollar increases Japanese acquisition FDI activity in high R&D manufacturing sectors from 18 to 32 percent. In addition, this effect does not display itself in Japanese new plant FDI, where acquisition of firm-specific assets is not involved.

[15] The sample leaves out 1991–1992 because the reunification of Germany made data consistency with the rest of the sample problematic for these years.

Appendix: Random Effects Negative Binomial Model

To develop a random effects negative binomial model, Hausman et al. (1984) begin with a standard Poisson distribution and assume that the Poisson parameter, λ_{it}, follows a gamma distribution with shape parameters, (γ, δ). As is standard, we can parameterize γ to be an exponential function of the independent variables, X_{it}, such that $\gamma_{it} = \exp(X_{it}\boldsymbol{\beta})$. Then, to introduce variation across industries, they assume that each industry (i) has its own δ_i, which are randomly distributed across the (i) industries. To accomplish this, Hausman et al. assume that the ratio $\delta_i/(1 + \delta_i)$ is distributed as a beta random variable with shape parameters (a, b). Using this beta density they derive the joint probability of an industry's acquisitions over the panel years to be

$$\begin{aligned}\mathrm{pr}(y_{i1},\ldots, y_{iT} \mid X_{i1},\ldots, X_{iT}) &= \frac{\Gamma(a+b)\Gamma(a+\Sigma\gamma_{it})\Gamma(b+\Sigma y_{it})}{\Gamma(a)\Gamma(b)\Gamma(a+b+\Sigma\gamma_{it}+\Sigma y_{it})} \\ &\times \left(\prod_t \frac{\Gamma(\gamma_{it}+y_{it})}{\Gamma(\gamma_{it})\Gamma(y_{it}+1)}\right),\end{aligned}$$

where y_{it} denotes the dependent variable. The random effects negative binomial (NEGBIN) model thus has two "shape" parameters, a and b, to estimate, in addition to our coefficient vector, $\boldsymbol{\beta}$.

REFERENCES

Ardeni, Pier G. "Does the Law of One Price Really Hold for Commodity Prices?" *American Journal of Agricultural Economics*, August 1989, *71*(3), pp. 661–69.

Auerbach, Alan J. and Hassett, Kevin A. "Taxation and Foreign Direct Investment in the United States: A Reconsideration of the Evidence," in Alberto Giovanini, R. Glenn Hubbard, and Joel Slemrod, eds., *Studies in international taxation*. Chicago: University of Chicago Press, 1993, pp. 119–44.

Balassa, Bela. "Japan's Trade Policies." *Weltwirtschaftliches Archiv*, October 1986, *122*(4), pp. 745–90.

Cameron, A. Colin and Trivedi, Pravin K. "Regression-Based Tests for Overdispersion in the Poisson Model." *Journal of Econometrics*, December 1990, *46*(3), pp. 347–64.

Caves, Richard E. "Exchange-Rate Movements and Foreign Direct Investment in the United States," in David B. Audretsch and Michael P. Claudon, eds., *The internationalization of U.S. markets*. New York: New York University Press, 1989, pp. 199–228.

Cushman, David O. "Real Exchange Rate Risk, Expectations, and the Level of Direct Investment." *Review of Economics and Statistics*, May 1985, *67*(2), pp. 297–38.

Economic Report of the President. Washington, DC: U.S. Government Printing Office, February 1995.

Encarnation, Dennis J. *Rivals beyond trade: America versus Japan in global competition*. Ithaca, NY: Cornell University Press, 1992.

Frankel, Jeffrey A. "Japanese Finance in the 1980's: A Survey," in Paul R. Krugman, ed., *Trade with Japan: Has the door opened wider*? Chicago: University of Chicago Press, 1991, pp. 225–68.

Froot, Kenneth A. and Stein, Jeremy C. "Exchange Rates and Foreign Direct Investment: An Imperfect Capital Markets Approach." *Quarterly Journal of Economics*, November 1991, *106*(4), pp. 1191–1217.

Goodwin, Barry K.; Grennes, Thomas and Wohlgenant, Michael K. "Testing the Law of One Price When Trade Takes Time." *Journal of International Money and Finance*, March 1990, *9*(1), pp. 21–40.

Graham, Edward M. and Krugman, Paul R. *Foreign direct investment in the United States*. Washington, DC: Institute for International Economics, 1995.

Hausman, Jerry; Hall, Bronwyn H. and Griliches, Zvi. "Econometric Models for Count Data with an Application to the Patents-R & D Relationship." *Econometrica*, July 1984, *52*(4), pp. 909–38.

Healy, Paul M. and Palepu, Krishna G. "International Corporate Equity Associations: Who, Where, and Why?" in Kenneth A. Froot, ed., *Foreign direct investment*. Chicago: University of Chicago Press, 1993, pp. 231–50.

Helpman, Elhanan. "A Simple Theory of International Trade with Multinational Corporations." *Journal of Political Economy*, June 1984, *92*(3), pp. 451–71.

Horstmann, Ignatius J. and Markusen, James R. "Firm-Specific Assets and the Gains from Direct Foreign Investment." *Economica*, February 1989, *56*(221), pp. 41–48.

Japan Statistical Yearbook. Tokyo: Japan Statistical Association, various issues.

Klein, Michael W. and Rosengren, Eric S. "The Real Exchange Rate and Foreign Direct Investment in the United States: Relative Wealth vs. Relative Wage Effects." *Journal of International Economics*, May 1994, *36*(3–4), pp. 373–89.

Knetter, Michael M. "Why Are Retail Prices in Japan So High?: Evidence from German Export Prices." National Bureau of Economic Research (Cambridge, MA) Working Paper No. 4894, October 1994.

Kogut, Bruce and Chang, Sea Jin. "Technological Capabilities and Japanese Foreign Direct Investment." *Review of Economics and Statistics*, August 1991, *73*(3), pp. 401–13.

Lawrence, Robert Z. "Efficient or Exclusionist? The Import Behavior of Japanese Corporate Groups." *Brookings Papers on Economic Activity*, 1991, (1), pp. 311–41.

_____. "Japan's Low Levels of Inward Investment: The Role of Inhibitions on Acquisitions," in Kenneth A. Froot, ed., *Foreign direct investment*. Chicago: University of Chicago Press, 1993, pp. 85–107.

Markusen, James R. "Multinationals, Multiplant Economies, and the Gains from Trade." *Journal of International Economics*, May 1984, *16*(3–4), pp. 205–26.

Martin, Stephen. "Direct Foreign Investment in the United States." *Journal of Economic Behavior and Organization*, December 1991, *16*(3), pp. 283–93.

McCulloch, Rachel. "Japanese Investment in the United States," in David B. Audretsch and Michael P. Claudon, eds., *The internationalization of U.S. markets*. New York: New York University Press, 1989, pp. 171–97.

Meerschwam, David M. "The Japanese Financial System and the Cost of Capital," in Paul R. Krugman, ed., *Trade with Japan: Has the door opened wider?* Chicago: University of Chicago Press, 1991, pp. 191–220.

Mergers and Acquisitions. Philadelphia, PA: MLR Publishing Company, various issues, 1975–1993.

National Science Foundation. *Selected data on research and development in industry: 1991*, NSF 93-322. Arlington, VA: National Science Foundation, October 1993.

Noland, Marcus. "Public Policies, Private Preferences, and the Japanese Trade Pattern," *Review of Economics and Statistics*, 1997 (forthcoming).

Ray, Edward J. "The Determinants of Foreign Direct Investment in the United States, 1979–85," in Robert C. Feenstra, ed., *Trade policies for international competitiveness*. Chicago: University of Chicago Press, 1989, pp. 53–77.

Saxonhouse, Gary R. "Japan's Intractable Trade Surpluses in a New Era." *World Economy*, September 1986, *9*(3), pp. 239–58.

Saxonhouse, Gary R. and Stern, Robert M. "Differentiated Products, Economies of Scale, and Access to the Japanese Market," in Robert C. Feenstra, ed., *Trade policies for international competitiveness*. Chicago: University of Chicago Press, 1989, pp. 145–74.

Scholes, Myron S. and Wolfson, Mark A. "The Effects of Changes in Tax Laws on Corporate Reorganization Activity." *Journal of Business*, January 1990, *63*(1/2), pp. S141–64.

Stevens, Guy V. G. "Exchange Rates and Foreign Direct Investment: A Note." International Finance Paper No. 444, Board of Governors of the Federal Reserve System, Washington, DC, 1992.

Swenson, Deborah L. "Impact of U.S. Tax Reform on Foreign Direct Investment in the United States." *Journal of Public Economics*, June 1994, *54*(2), pp. 243–66.

Taylor, Mark P. "The Economics of Exchange Rates." *Journal of Economic Literature*, March 1995, *33*(1), pp. 13–47.

U.S. Department of Commerce, Bureau of Economic Analysis. *Survey of current business*. Washington, DC: Bureau of Economic Analysis, various issues.

U.S. Department of Commerce, International Trade Administration. *Foreign direct investment in the United States: Transactions*. Washington, DC: International Trade Administration, various issues.

Yamawaki, Hideki. "International Competitiveness and Choice of Entry Mode: Japanese Multinationals in the U.S. and European Manufacturing Industries." Working paper, Université Catholique de Louvain, Louvain-la-Nueve, Belgium, 1993.