Board of Governors of the Federal Reserve System

International Finance Discussion Papers

Number 362

September 1989

DETERMINANTS OF JAPANESE DIRECT INVESTMENT IN U.S. MANUFACTURING INDUSTRIES

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Abstract

The rapid rise in Japanese owned assets in the United States and the substantial fall of the dollar against the yen naturally raises the question of whether there is a causal relationship between Japanese direct investment and the yen/dollar exchange rate.

This paper contributes in two ways to the analysis of the direct investment-exchange rate link. First, it presents a hybrid model of direct investment which incorporates insights from both portfolio balance models and industrial-organization-based models of direct investment. Second, it tests and compares these three models of direct investment using data for Japanese direct investment in 12 U.S. manufacturing sectors.

The results suggest that familiar I-O determinants of industry profitability attract Japanese direct investment into U.S. manufacturing. Lower raw material costs, more profitable investment opportunities (as measured particularly by growing markets, presence of valuable patents, and more highly concentrated production structure), as well as trade barriers all significantly increase Japanese direct investment in U.S. manufacturing industries.

Portfolio balance factors also affect the demand for U.S. assets. Greater Japanese internal and external savings and reduced profitability of alternative assets (including ownership stakes in Japanese domestic industries) lead to significant increases in direct investment transactions in U.S. industries.

There is no evidence that the exchange rate alone is a significant determinant of Japanese direct investment in U.S. manufacturing.

Determinants of Japanese Direct Investment in U.S. Manufacturing Industries

Catherine L. Mann[1]

Introduction.

The growing foreign presence in U.S. manufacturing has generated increased policy attention and concern. Many think there is a strong causal relationship between exchange rate movements and foreign direct investment inflows. The argument is that dollar depreciation has made U.S. industries too cheap, and that "excessive" foreign ownership will ultimately harm the U.S. economy. The rapid rise in Japanese owned assets and the substantial fall of the dollar against the yen naturally focuses attention on Japanese direct investment and the yen/dollar exchange rate.

Tolchin and Tolchin, for example, state that "The United States can expect a substantial increase in hostile foreign takeovers in the future -- especially in view of the decline in the dollar... There is little recognition that some of these foreign businesses have hidden agendas, including the destruction of American competitors and the acquisition of American technology." Lee Hamilton (chairman of the Joint Economic Committee and Democratic representative from Indiana) argues that '[f]oreign investors do not want to be holding U.S. assets if the dollar should fall... In fact, when private foreign investors backed away

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1. The author is a staff economist in the Division of International Finance. This paper represents the view of the author and should not be interpreted as reflecting the view of the Board of Governors of the Federal Reserve System or other members of its staff.

An initial draft of this paper was presented at the Western Economics Association Conference, June 1989. I have benefitted greatly from conversations with Jaime Marquez. Thanks also to Neil Ericsson, William Helkie, Michael Klein, Ross Levine, Lois Stekler and P.A.V.B Swamy. Of course, none are responsible for remaining errors.

from lending to the United States in 1987 [it] contributed to the October stock market crash... That we *need* foreign lending, whatever its benefits, is negative... [T]o end that dependence, we will have to pull up our socks and...save more." Salomon Brothers "detect[s] a very cautious attitude toward foreign securities by Japanese [investors]... mainly because of uncertainty about the direction of the U.S. dollar." The Survey of Current Business concludes that "in the face of sharp dollar depreciation, foreign firms may tend to shift operations to the United States to maintain their U.S. market share. In this way, they may be able to avoid price increases to their U.S. consumers...".

While the benefits of foreign direct investment are in general being reassessed, the growth and composition of the Japanese purchases makes it a particular target. Over the last decade, Japanese direct investment as a share of total direct investment in U.S. manufacturing has fluctuated, from a low of about 4 percent in 1982 to a high of nearly 35 percent in 1984. Nonetheless, a trend is clear. In the last three years (1985-1987) the Japanese share averaged 15 percent while in 1977-1979 the share was about 10 percent. Moreover, Japanese direct investment has increasingly taken the form of stock transactions (takeovers, mergers, equity infusions, joint ventures) -- 70 percent of the value of Japanese direct investment in U.S. manufacturing in 1987 up from 10 percent in 1977.[2]

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2. It is increasingly difficult to distinguish "direct investment" from "portfolio investment". The old distinction, that portfolio investment was in short term stocks and bonds while direct investment involved the building a new plant, is no longer valid.

Capital inflows designated direct investment in the external accounts are distinguished from portfolio investments solely on the basis of percent of foreign ownership. If a single foreign beneficial entity

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While the growth of Japanese ownership of U.S. assets has been quite rapid, the Japanese are still relatively small owners of U.S. capital as compared to the British and the Dutch. In addition, the Japanese capital inflows are a natural outcome of the macroeconomic imbalances within Japan and the United States. Moreover, in the early 1980s, some argued the reverse causality -- that relatively higher rates of return in U.S. industries attracted foreign capital buoying the dollar. In any case, there clearly could be many factors besides the exchange rate attracting Japanese and other foreign investors to U.S. goods and asset markets, including production cost differentials, market growth and market structure, and trade barriers.

This paper contributes in two ways to the analysis of the direct investment-exchange rate link. First, it develops a hybrid model of direct investment which incorporates insights from both pure portfolio balance models and pure industrial-organization-based models of direct investment. This model explicitly places the decision to acquire ownership of U.S. industries in an optimizing setting where the investor also holds ownership positions in Japanese industries and in passive portfolio investments. The returns to ownership of U.S. assets are based on microeconomic theories of firm behavior.

In analyzing the hybrid model, the role for the exchange rate is highlighted. The portfolio balance aspect explicitly links investment allocation to the exchange-rate adjusted rates of return, and the effect

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owns directly or indirectly 10 percent or more of the voting securities of an incorporated (of similar interest in an unincorporated) enterprise, then capital inflows are termed direct investment regardless of whether those inflows are used to purchase new plant or equipment or to buy existing equity stocks.

of macroeconomic imbalances (both internal and external) on investment flows occurs through exchange-rate induced changes in wealth. The I-O aspect allows the exchange rate to affect production costs and competition in the domestic market. In addition, the hybrid model suggests ways that the exchange rate could differentially affect direct investment that is a plant or an equity transaction.

Second, the three models (pure portfolio balance, pure I-O, and hybrid) are tested and compared econometrically. Data for Japanese direct investment in 12 U.S. manufacturing sectors are available annually 1977 through 1987. The paper differentiates between direct investment transactions for plant construction and expansion and direct investment transactions that are stock purchases of existing firms. This distinction facilitates testing the hypothesis that the exchange rate has a differential effect on equity transactions.

The results from the hybrid model suggest that familiar I-O determinants of industry profitability attract Japanese direct investment into U.S. manufacturing. Lower raw material costs, more profitable investment opportunities, as measured particularly by growing markets, presence of valuable patents, and more highly concentrated production structure, and trade barriers all significantly increase Japanese direct investment in U.S. manufacturing industries. The portfolio balance aspects of the hybrid model also give insights into the demand for U.S. assets. Greater Japanese internal and external savings and reduced profitability of alternative assets (including ownership stakes in Japanese domestic industries) lead to significant increases in direct investment transactions in U.S. industries. There is no evidence that the exchange rate alone is a significant determinant of direct investment flows.

There is some evidence that equity transactions and plant transactions have different fundamental determinants. Equity-style direct investment seems to be more affected by Japanese gross savings, by trade barriers, by patents, and by market sales. Plant-style direct investment seems to be more affected by profitability of alternative investments, as well as by the other factors noted above.

The results overall do not support the theory that Japanese direct investment strategies in the United States depend directly on exchange rate movements. They do support the argument that Japanese gross savings and intra-sectoral, U.S.-Japanese bilateral trade imbalances (which are indirectly affected by the exchange rate) are important determinants of Japanese investment levels and sectoral distribution. In addition, factors affecting U.S. profitability, including trade barriers, some market structure variables, as well as returns to alternative investments in the domestic Japanese industry are important factors determining Japanese direct investment in the United States.

A Hybrid Portfolio Balance/Industrial Organization Model of Direct Investment

The simple model presented here incorporates the industrial-organization theories of direct investment into an asset portfolio balance model. The role for the exchange rate is highlighted. The Japanese investor allocates wealth across three assets: a passively held "world" asset, and two types of ownership investment -- ownership investment in Japanese industry and ownership investment in U.S. industry. The investor maximizes an objective function in the mean and variance of the return to wealth, taking the exchange-rate-adjusted rates of return on the various assets as given. Solving the portfolio balance problem yields the optimal shares of wealth invested in each asset. Using these shares, the optimal amounts of investment in each asset is a function of wealth, the mean and variance of the exchange rate, and the nominal rates of return on the various assets.

Using standard theories of the imperfectly competitive firm, the rate of return to ownership investment in U.S. industry is determined by factors generally associated with industrial-organization-based theories of direct investment, such as market structure, production technology, and demand characteristics (elaborated below).

Linking the two models through the relationship between the profitability of the firm and the rate of return on the U.S. asset shows that Japanese demand for U.S. direct investment assets is a function of Japanese wealth, the mean and variance of the yen/dollar exchange rate, the rates of return on Japanese firms, and market structure, production technology, and demand characteristics in the U.S. market that affect profitability of U.S. industries.

<u>The portfolio balance model.</u>

According to this model, the Japanese investor maximizes an objective function in the mean and variance of the return to real wealth.[3]

$$(1) \quad V = E[\widehat{W/Q}] - 1/2\ \beta\ \mathrm{VAR}[\widehat{W/Q}]$$

3. See Branson and Henderson (1985). This objective function can be derived from a utility function of the constant relative risk aversion form, such as $U(x) = 1/\gamma\ (x)^{\gamma}$, $\gamma<1$.

where V is the objective function, $\hat{W/Q}$ is the percent change in real wealth (defined below), β is the coefficient of relative risk aversion, E the expectations operator, and VAR the variance.

Real wealth is composed of three assets, all in yen values, deflated by the Japanese domestic price index.

(2) $W/Q = (I_j + eI_u + kI_*)/Q$

where I_j represents an ownership stake in Japan industry earning r_j in nominal yen. I_u is direct investment in U.S. manufacturing industries (dollar value) earning r_u in nominal dollars. The yen/dollar exchange rate, e, follows the stochastic process $\hat{e} = \bar{e}dt + \sigma_e dz_e$, where dz_e is white noise. I_* is investment in a world asset which earns r_* in nominal foreign currency units. The exchange rate in yen/foreign currency, k, follows the stochastic process $\hat{k} = \bar{k}dt + \sigma_k dz_k$, where dz_k is white noise. W is nominal wealth. Q is the domestic price index for the Japanese investor, which follows the stochastic process $\hat{Q} = \bar{q}dt + \sigma_q dz_q$, where dz_q is white noise. I assume that any other assets purchased in the Japanese domestic, other domestic, or international markets yield r^* with exchange adjustment following stochastic processes that are linear combinations of $\hat{k}$.[4]

The shares of nominal wealth allocated to each of these three investments are defined as:

(3a) $\lambda^u = eI_u/W$, the share allocated to U.S. assets;

(3b) $\lambda^* = kI_* /W$, the share allocated to the world asset;

(3c) $(1-\lambda^*-\lambda^u) = I_j/W$, the share allocated to Japanese assets.

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4. This assumes that international capital markets for portfolio investments are perfectly competitive and that other assets are perfect substitutes.

Following the presentation in Branson and Henderson yields the optimal portfolio share rule, in matrix form:

(4) $\lambda = [(\beta-1)/\beta]\ \Omega^{-1}\ \rho + (1/\beta)\ \Omega^{-1}\ \delta$

where λ is the vector of shares $[\lambda^{u},\lambda^{*}]'$, $\Omega^{-1}$is the inverse of the variance/covariance matrix of exchange rates e and k, ρ is the vector of covariances between the two exchange rates and domestic inflation, and δ is the vector of expected return differentials $[r_u-\bar{e}-r_j, r_*-\bar{k}-r_j]'$.

Solving for λ^u alone and simplifying yields:

(5) $\lambda^u = a_0(r_u+\bar{e}) - a_0a_1(r_*+\bar{k}) + a_0(a_1-1)\ r_j + a_0a_2$

where $a_0 = \sigma_k^2 / [\beta(\sigma_e^2\sigma_k^2-\rho_{ke}^2)]$, $a_1 = \rho_{ek}/(\beta\ \sigma_k^2)$, and $a_2 = (\beta-1)(\rho_{qe}-a_1\rho_{qk})$.

Substituting (5) into (3a) and solving for I_u yields the optimal amount of investment in the U.S. asset in dollars:

(6) $I_u^{PB} = \lambda^u W/e = [a_0(r_u+\bar{e}) - a_0a_1(r_*+\bar{k}) + a_0(a_1-1)\ r_J + a_0a_2]\ W/e$

where superscript ^{PB} denotes the pure portfolio balance model.

In this model, expected exchange rate changes affect the initial allocation of the portfolio among the three assets in part because the Japanese investor is assumed to maximize over returns on U.S. assets converted to yen. However, expected exchange rate changes may not affect the portfolio allocation decision for two reasons. First, the Japanese investor may maximize over the rate of return on the U.S. asset in dollars. If the investor can fully hedge the dollar exposure inherent in that return, either "naturally" (through offsetting dollar costs of acquiring the asset) or "financially" (through a swap contract), movements in the yen/dollar rate will not affect the return to holding the asset. Alternatively, if the investor believes that the exchange rate follows a random walk, then the best predictor of the expected exchange rate is today's exchange rate and the return to holding the U.S. asset is simply the dollar rate of return.

Incorporating the I-O-based models of direct investment.

The industrial organization theory often underlying models of direct investment can be incorporated into the portfolio balance result by exploring the determination of the rate of return on the U.S. investment. Most generally, r_u is the rate of change in the value of the U.S. asset over time: $r_u = [dI_u/I_u]/dt$. More specifically, we can think of it as the dividend associated with ownership of the underlying capital investment, which is assumed to be a U.S. firm. Under appropriate assumptions (100 percent equity financing, 100 percent stock purchase by the Japanese investor, and full payout of dividends from current profits), this asset rate of return can be approximated by the profit rate of the U.S. firm. In other words, $r_u = [p(Q)Q - c(Q)Q] / [p(Q)Q]$ where $p(Q)Q$ is total sales of the firm, $c(Q)Q$ is total costs.

The profit maximizing price in terms of its structural determinants, assuming that the U.S. firm has incomplete market power is:

(7) $p = c \{[1+1/\gamma(n,e)]/[1+1/\epsilon(e,n)]\}$,

where ϵ is the price elasticity of demand ($\%\Delta p/\%\Delta Q$) and γ measures the returns to scale ($\%\Delta c/\%\Delta Q$). Assuming a Spence-Dixit-Stiglitz monopolistic competition framework, both γ and ϵ are functions of the number of firms in the industry, n. If moreover, entry and exit occur on account of exchange rate movements then each of these elasticities could also be a function of the exchange rate.[5]

Rearranging, so as to express (7) as a profit rate yields an expression for r_u in terms of market structure and elasticity parameters:

5. See Baldwin's (1988) beachhead model.

(8) $r_u = [\epsilon(n,e) - \gamma(n,e)]/[1 + \gamma(n,e)]$

A pure I-O model of direct investment hypothesizes that direct investment is a function of the profitability of the investment in the destination market.

(9) $I_u^{IO} = g[\epsilon(n,e) - \gamma(n,e)]/[1 + \gamma(n,e)]$

where superscript ^{IO} denotes the pure industrial-organization model.

I-O hypotheses of direct investment consider a variety of proxies for these structural determinants of firm profitability. Some hypotheses include:[6] "locational" determinants of direct investments, or how differences in taxes, resource endowments, and market growth rates, or the presence of barriers to trade, can affect the profitability of investment, either directly by affecting the price or cost of output, or indirectly by affecting the relevant elasticities.[7] Other hypotheses, founded on product life cycle, differentiated products, internalization of production, or licensing, reputation and intangibles, stress how the dynamics of changing technology and marketplace affect firm profitability.[8] Still other hypotheses have a more macroeconomic focus, stressing a role for different savings rates, lending rates, and preferred currency areas in affecting firm profitability and direct investment.[9]

Substituting expression (8) into equation (6) yields the hybrid model:

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6. The most recent, comprehensive, and succinct review of the literature is in Dunning (1988). Other reviews include: Agarwal (1980), Ethier (1986), Rugman (1978).
7. See Caves (1971), Brander and Spencer (1987), Lipsey and Weiss (1981), Baldwin (1979).
8. See Vernon (1966,1979), Ethier (1986), Grumbaugh (1987), Hymer (1976), Ray (1977, 1988), Markusen (1984), Horst (1972).
9. See Kojima (1986), Kojima and Ozawa (1984), Aliber (1970), Stevens and Lipsey (1988).

$$(10) \quad I_u^H = [a_0\{[\epsilon(n,e) - \gamma(n,e)]/[1 + \gamma(n,e)]\} + \bar{e}) - a_0 a_1 (r_* + \bar{k}) + a_0(a_1 - 1)\, r_j + a_0 a_2]\ W/e$$

where superscript ^{H} denotes the Hybrid model.

Here, equilibrium demand for U.S. ownership assets by Japanese investors, I_u^H, is a function of U.S. market structure, rates of return on alternative assets, current and expected exchange rates, wealth, and a variety of other factors, which will be taken as constant, including the covariance of the exchange rate and the Japanese price index, the degree of risk aversion, and the variance of the exchange rate.[10]

This expression embraces both the insights of portfolio theory -- e.g. investors must balance risk against return, and that they often have a variety of assets to choose from, and the various industrial-organization-based theories of firm profitability and foreign direct investment -- e.g. relative costs and market structure determine the destination for direct investment.

The exchange rate and the equity versus plant decision.

The quotes at the beginning of the paper suggested that direct investment in the form of equity purchases might be more sensitive to exchange rate changes than might be direct investment in the form of plant construction. Suppose that equation (10) above yields the equilibrium direct investment flow into the United States. Is there any reason to believe that exchange rate movements might differentially

10. While it is true that the variance of the exchange rate has not been constant over this period, the relevant measure for exchange rate risk is unclear. Moreover, work by Gagnon suggests that the coefficient of relative risk aversion necessary for risk to affect trade flows is too large to be reasonable. Whether this insight carries over to direct investment flows is another matter.

affect the allocation of that direct investment stream into an *equity purchase* of a plant versus one designated for *building* a plant?

Suppose the dollar cost of building a plant in the United States is $B = \kappa_u^c\ (\kappa_j/e)^{(1-c)}$, where κ_u are costs incurred in dollars (say labor) and κ_j are costs incurred in yen (say technology, foreign capital equipment, or blueprints which are proprietary information of the Japanese investor); (the relevant shares are c and (1-c) respectively). The dollar price of buying an existing plant is M (the current market value of equity).

The usual way to address the "build versus buy" decision is to examine Tobin's q, the ratio of market value to replacement cost:

(11) $q(e) = M/[\kappa_u^c(\kappa_j/e)^{1-c}]$

Expectations for the exchange rate may affect the build versus buy decision and thereby affect whether the direct investment flow takes the form of equity transactions or plant construction. Suppose the building process, the factor costs, and the market valuation are independent of the exchange rate. Then today,

(12a) $q_t(e_t) = M/[\kappa_u^c\kappa_j^{1-c}]\ e_t^{1-c}$

and tomorrow,

(12b) $E[q_{t+1}(e_{t+1})] = M/\{\kappa_u^c\kappa_j^{1-c}\}\ E[e_{t+1}^{1-c}]$

Suppose again that the decision to buy versus build is affected by movements in q (as opposed to simply whether q is greater or less than one). Then the choice of whether to invest by acquiring an existing company or building a new one depends on a comparison of the current and expected q's: if $q_t < E[q_{t+1}]$, then the investor is more likely to buy today, since the relative price is expected to rise. But under the assumptions imposed earlier, this relative price depends only on the exchange rate.

(12c) If $e_t < E[e_{t+1}]$ then $q_t < E[q_{t+1}]$

So, if the dollar is currently depreciated relative to expectations for its value next period, the Japanese investor should buy today and build tomorrow. A currently "undervalued" dollar (that is, a dollar that is expected to appreciate in the future) will lead not only to an increase in Japanese direct investment in U.S. assets (according to equation (10), but the flow of this investment will more likely be in the form of acquisitions of existing companies (equation (12c)).

Literature

Equation (10) implies several hypotheses about the effect of the exchange rate on direct investment in the United States. Some of these hypotheses have been tested in the empirical literature although none explicitly use a model that incorporates both portfolio balance and industrial-organization considerations, and most use data aggregated a variety of ways. A depreciation of the dollar (modelled as e falling) should increase the dollar value of foreign currency wealth W, thus increasing direct investment in the United States. Moreover, if the dollar is currently "low", and is expected to appreciate ($\bar{e}$ rises), then the expected return on U.S. assets rises, as does the demand for them. In particular, we should expect a relatively larger amount of investment in the form of equity investment if the dollar is currently undervalued.

Cushman (1985), analyzing aggregate U.S. direct investment abroad to five industrial countries, found that expected real depreciation of the dollar reduced direct investment outflows, as exports increased instead. More recent work focuses on direct investment inflows. Caves (1988), using data aggregated across type of investment, industry, and source, found a significant effect of contemporaneous exchange movements, but no effect of expected exchange rate movements. Ray (1988), using disaggregated investment data but aggregated explanatory variables, found that the exchange rate was a significant determinant of direct investment sourced from Canada and the European Communities but not from Japan. Froot and Stein (1989), using data disaggregated by industry or type of investment but aggregated across country source, and using only the exchange rate and time as explanatory variables, found that several manufacturing industries and several types of investments were significantly affected by the exchange rate.

Overview of the Data

The short time series for much direct investment data has often stymied econometric work. The International Trade Administration of the U.S. Department of Commerce compile the direct investment data used in this paper. All publicly acknowledged direct investment transactions are tabulated, along with their value, if known.[11] Data compiled in a consistent manner are annual beginning in 1976 and available through 1987. The ITA data set also sorts transactions by SIC code. The two digit SIC disaggregation is used in this paper.[12] Since many of the independent variables are matched SIC specific, a cross-section, time-series econometric approach is a feasible way to increase the sample

11. These data are different from those collected by Bureau of Economic Analysis. The BEA obtains wider coverage through required filings of FDI notifications. The BEA data are not public nor do they distinguish the form of investment transaction. For additional discussion of the differences between the BEA and ITA data, see the ITA publications.
12. Although the direct investment data are available at the 4 digit level, many of the independent variables are available only at higher levels of aggregation.

size. This yields a data set of 132 observations -- 12 industries, 11 years each.[13]

ITA characterizes each transaction as new plant, plant expansion, aquisition/merger, joint venture, equity increase, or other (mostly investment in warehouses or distribution networks), thus allowing the separate investigation of equity and plant investments. I define direct investments of the equity type as those designated by the ITA as aquisition/merger, equity increase, or joint venture. I define direct investments for plant as those designated as new plant, plant expansion, other.

The total value of transactions must be estimated since the value of some transactions known to have taken place are unreported. There are several ways to estimate values of reported but unvalued transactions. The approach taken in this paper regressed the time series of value against the matched number of transactions (equation (13a) below). The coefficient was then applied to the transactions that were known to have taken place but whose value went unreported, thus generating the estimated total value of transactions (equation (13b) below).[14]

$$\text{(13a)}\quad V_{ij,t} = \alpha_{ij} \; N^{O}_{ij,t} + \mu_{ijt} \;, \quad \mu_{ijt} \simeq N\,(0,\sigma^2_V)$$

$$\text{(13b)}\quad V^{E}_{id,t} = V_{id,t} + \hat{\alpha}_{id}\,(N^{T}_{id,t} - N^{O}_{id,t})$$

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13. While the investment data are available 1976-1987, some of the independent variables are available only 1977-1987.

14. Other ways of estimating the unobserved values include regressing the value data against time and sector dummies and using these to estimate the unobserved values. Another is Heckman's (1979) method to correct for sample selection bias caused by unobserved data. There is no reason to believe that there are systematic reasons why some transactions are valued and some are not.

where the indexes are t for time, i for industry, d for type of direct investment transaction (d=E,P for equity or plant), superscript ^{O} for the number of transactions with observed values, superscript ^{T} for the total number of transactions, and superscript ^{E} for the estimated value of transactions.[15]

Estimating the models and testing procedures.

Simple linear versions of equation (6) -- the pure portfolio balance model, equation (9) -- the pure I-O-based model, and equation (10) -- the hybrid model, are used for estimation, encompassing tests, and hypothesis testing, shown as equation (14).

(14) $\mathbf{V}^E = \alpha + \mathbf{X}\beta + \mu$

where $\mathbf{V}^E$ is a vector of value of direct investment transactions, (I_u^{PB} in equation (6), I_u^{IO} in equation (9), and I_u^H in equation (10)). The (different) constant in each equation is α, the different exogenous variables in each of equations is represented by the $\mathbf{X}$ matrix, and β the corresponding coefficient.

For estimating all three models, $\mathbf{V}^E$ is a 1 x 132 vector of estimated values composed of 12 1 x 11 time-series subvectors, $V_{it}^E = \{V_{i1} \ldots V_{i11}\}$, for each industry i, i=1 to 12. Elements of $\mathbf{V}^E$ are of three possible aggregations of total estimated value of direct investment transactions: equity-type transactions only, plant-type transactions only, or all transactions (the sum of the two). The assumption that plant and equity transactions can be pooled is tested.

15. The several other papers that use the ITA data do not try to estimate the value of transactions using the information contained in the difference between the observed values and the transactions that are known to have taken place but whose values are not known. My own analysis using the corrected and uncorrected value data indicates that substantial information is lost by not correcting for reported transactions of unknown value.

$$\mathbf{V}^{\mathbf{E}}_{\mathbf{d}} = \{V_{1,\mathrm{d}}, V_{2,\mathrm{d}}, \ldots, V_{12,\mathrm{d}}\}$$

equity
plant
total

The industries 1 to 12 are: food and kindred products (SIC 20); textile mill and apparel products (SIC 22 and 23); paper and allied products, and printing and publishing (SIC 26 and 27); chemicals and allied products (SIC 28); stone, clay, and glass products (SIC 32); iron and steel mill products (SIC 331-332); non-ferrous metals (SIC 333-335); fabricated metal products (SIC 34); machinery, except electrical (SIC 35); electric and electronic equipment (SIC 36); passenger vehicles, motorcycles, and parts (SIC 371)[16]; instruments and related products (SIC 38).

The regressor matrix **X** is N x N*132, where N represents the number of explanatory variables which varies across models. There are three types of independent regressors. All are 1x132 vectors composed of 12, 1x11 sub-vectors. The sub-vectors are of three types, industry-specific time series, industry constants, or aggregate time series yielding the following types:

(1) Industry-specific time series,

$$X_1 = \{X_{i1} \ldots X_{i11}\}, \text{ for } i = 1 \text{ to } 12.$$

(2) Industry-specific constants (observed in 1982),

$$X_2 = \{X_i X_i X_i X_i X_i X_i X_i X_i X_i X_i X_i\}, \text{ for } i = 1 \text{ to } 12..$$

(3) Aggregate time-series,

$$X_3 = \{X_t X_t X_t X_t X_t X_t X_t X_t X_t X_t X_t X_t\}, \text{ for } t = 1 \text{ to } 11$$

16. It is well known that much of Japanese direct investment in the auto industry is often included in the Wholesale Trade category. I have extracted these investments and incorporated them into my data for vehicles, etc.

The β is a 1 x N vector of coefficients, where N matches the number of independent regressors. This constrains each industry to have the same coefficient for each regressor. Based on the portfolio balance theory alone, we would not expect industry-specific effects of the exchange rate, once industry-specific profitability is accounted for. Nevertheless, since the exchange rate is of particular interest, a test of this constraint is reported below.

The α is a constant intercept. As a constant, it constrains all the industries to have the same intercept. As a 1 x 12 vector, it allows each industry to have its own intercept. A discussion of this assumption, and a test of the hypothesis that all industries have the same intercept is reported below.

For example, in estimating the pure portfolio balance model, the **X** matrix is 6 x 6*132. The six independent regressors are[17] profitability of U.S. industry (PRU) and profitability of the Japanese industry (PRJ), constructed as type (1) above. The exchange rate (XR) (same exchange rate used for each industry), Japanese gross savings in yen (JGS) (as a proxy for wealth and which is the same for each industry)[18], and the return to 12 month Euroyen bonds (IR) (as a proxy for the world asset and which is the same for each industry[19], all constructed as type (3) above).

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17. See the Data Appendix for a more complete description of the data and sources.
18. Savings is a flow variables and wealth is a stock variable. But the augmentation to wealth each period is savings (plus capital gains and losses). Therefore, the two pick up the same trends, with a constant adjustment. Net savings yielded the same results.
19. Other proxies for the world asset include the 3 month Euroyen rate, the 3 month and 12 month Eurodollar rate. Results were virtually identical.

In the case of the pure I-O model of direct investment, the **X** matrix is 12 x 12*132. The 12 independent regressors are: two aggregate time series variables (constructed as type (3) above): the exchange rate (XR) and a raw material cost variable (RM). Five industry specific, time series regressors (constructed as type (1) above): labor compensation cost (W), market sales (S), capacity utilization (CU) (as a proxy for supply elasticity), the bilateral trade balance (TB) (as a proxy for tangible and intangible superiority of Japanese product, technology, or management). Five industry specific, constant regressors (constructed as type (2) above): royalty payments to sales ratio (RP), advertising payments to sales ratio (AP), 4-firm concentration ratio (CR), establishments per company (EPC) (as a proxy for economies of scale), trade barriers (NTB) (a zero-1 dummy).

The hybrid model includes all regressors from the I-O based model and all regressors from the pure portfolio balance model, except for profitability of U.S. industries. Encompassing tests are used to compare the three models.

The rationale for and the expected signs for most of these regressors are clear-cut. Higher profitability of U.S. industries (PRU) and higher Japanese gross savings (JGS) should increase Japanese direct investment in the United States (as well as elsewhere). Higher rates of return on the alternative assets (PRJ,IR) should reduce Japanese investment in the United States. Higher costs in the United States (RM, W) should reduce direct investment in the United States.

Large industry-specific trade imbalances (TB) may induce direct investment in the U.S. in that industry in order to reduce transport costs (as in internalization theory), to produce on-site in an increasingly important market (as in the product life-cycle theory), and, possibly, to offset the likelihood of trade restraints in the future (the presumption being that large bilateral trade deficits today could lead to trade barriers tomorrow). In addition, the sign may suggest whether Japanese firms appear to prefer to direct invest within their industry group (negative sign) or diversify into another industry group (positive sign).

Higher industry sales (S), given a constant supply elasticity, should increase potential profits, making the industry more attractive to Japanese investors. Capacity utilization rates (CUR) is an alternative proxy for the supply conditions. If the industry is operating below optimal capacity, it would not be profit maximizing for further investment in new plant (ceteris paribus unchanged technology). High capacity utilization rates suggest higher profit possibilities; so capacity utilization could be positively related to investment, particularly in plant. On the other hand, if Japanese management or technological expertise could "turn-around" a declining industry in the United States, then low capacity utilization could point to industries targeted for Japanese takeover.

A high number of establishments per company (EPC) may indicate an equilibrium market and production structure characterized by many small plants. It might be difficult (less profitable) to build a single plant in such a market, thus discouraging direct investment, particularly in plant. Moreover, if the Japanese firm's expertise is in technological innovation or management style, it may be more difficult to extend these intangible benefits to U.S. industries that are composed of many establishments. These problems may be less important for the equity investor who buys the company and all its establishments outright. On the other hand, a more concentrated industry (CR) may be more profitable, and therefore attract Japanese investment.

Product characteristics which affect the elasticity of demand, are proxied by advertising to sales (AP) ratio. If consumers love variety, but are fickle, then high advertising to sales ratios suggest advantages to being "close-to-the-market"; AP should be positively correlated with direct investment.

Several new theories of direct investment emphasize the importance of licensing in encouraging direct investment. The higher the royalty to payments ratio, the more likely the Japanese are to buy the U.S. firm to eliminate the requirement to pay royalty payments.

A dummy variable for the presence of trade barriers in the industry (NTB) is included to account for trade-barrier-jumping foreign investment. Trade barriers should be positively correlated with direct investment, especially in plant.

Empirical Results

The empirical investigation involves three stages: a first stage of estimation incorporating all constraints (intercept, exchange rate coefficient, and pooling), followed by encompassing tests[20] to determine if either of the "pure" models encompassed the hybrid model. In the second stage, each model is investigated separately, with certain constraints relaxed. Finally, the three models, with statistically

20. See Mizon (1984). The encompassing test used was an F-test. The null hypothesis was that the pure model encompassed the hybrid model. A failure to accept was a non-zero coefficient on the included variables from the hybrid model.

significant constraints relaxed, are once again compared through encompassing tests.[21]

Fully constrained estimation.

Table 1 presents the constrained, pooled estimation for each of the three models. The hypothesis that the pure portfolio balance model encompassed the hybrid model is rejected. This suggests that other empirical work that does not take into account industry specific determinants of of firm profitability in the United States are flawed because the results are based on incomplete models. The hypothesis that the pure I-O model encompassed the hybrid model was rejected at the .95 significant level, although accepted at the .99 significance level. There is thus substantial support for the statistical relevance of the hybrid model.

However, examining the coefficient estimates in Table 1 may be misleading in that the hypothesis that plant and equity transactions could be pooled, conditional on α and β (for the exchange rate only, hereafter β_{xr}) constrained across all industries, is rejected for both the "pure" models, and is rejected at the .95 significance level for the hybrid model (although not rejected at the .99 for the latter). Moreover, the results in Table 1 may be further flawed in that the constraints on α and β_{xr} may not be valid.

The constraints on α and β_{xr} require further discussion. In the pure portfolio balance model, relaxing the constraint on α makes sense since only the regressor for industry profitability accommodates

21. Christensen, Jorgenson, and Lau (1975) address this issue of sequential testing, and suggest using alternative significant levels for tests at various points in the sequence. There does not appear to be much guidance on this point, however.

Table 1

Total Estimated Value of Direct Investment
(Constrained Pooled Estimation)

(coefficient estimates)

Regressors	(mnemonic)	Portfolio Balance	Industrial Organization	Hybrid
		MODEL		
Constant		-640.823**	321.732	392.381
Exchange rate	(XR)	0.018488	0.11542	0.130619
Japanese gross saving	(JGS)	11.9318****	--	18.5174***
J. profitability	(PRJ)	-4.71373	--	-12.7082
Euroyen	(IR)	-36.9182*	--	-33.6764*
U.S. profitability	(PRU)	11.3036	--	--
Raw materials	(RM)		-14.0947****	-9.09147**
Labor compensation	(W)		16.924****	-3.06049
Trade balance	(TB)		-0.000445	0.041955
U.S. sales	(S)		0.006594****	0.006206****
Capacity utilization	(CUR)		-3.08179	-6.01598
Non-tariff barriers	(NTB)		487.224****	484.017***
Royalty payments	(RP)		281.315**	246.312*
Advertising	(AP)		-4.05782	-10.9309
Concentration ratio	(CR)		-0.469166	0.678055
Establishments	(EPC)		-135.116**	-148.778**
Regression Statistics				
$\bar{R}^2$		.162105	.362135	.390098
SSR		20000860	14501030	13518690
DW		1.21517	1.66786	1.69723

* .95
** .975
*** .99
**** .995

industry-specific effects. The failure of the encompassing test in stage 1 indicates that allowing for industry-specific effects (as in the hybrid model) is necessary. On the other hand, since industry-specific profitability is accounted for, relaxing the constraint on β_{xr} does not make sense from a theoretical standpoint, since the exchange rate is common across all industries. Similarly, in the hybrid model, relaxing the constraint on α to allow for industry-specific effects makes little sense since the purpose of the industry-specific constant regressors is to capture those effects. Nevertheless, while there is some question as to the theoretical validity of relaxing some of these constraints, their statistical relevance may be revealing.

Relaxing the constraints.

The Portfolio Balance model.

Table 2 presents coefficient estimates resulting from the second stage of investigation. The pure portfolio model (equation (6)) was examined first. The constraint on α, that all industries have the same intercept and the constraint on β, that all industries have the same coefficient on the exchange rate were both rejected. However, the joint hypothesis that relaxing both constraints yielded statistically significant different estimates is also rejected. [22] Based on the theoretical argument above, the estimation relaxing only the α constraint

22. That is, the hypothesis that the β coefficient for the exchange rate was the same across all industries, conditional on the α's being allowed to vary across industries, was accepted. Similarly, the hypothesis that the α coefficient for the exchange rate was the same across all industries, conditional on the exchange rate β 's being allowed to vary across industries, was also accepted. Based on the theoretical argument that the exchange rate should not differentially affect industry-specific investment, once industry profitability is accounted for, I choose to proceed with a model using unconstrained α, but constrained β.

Table 2

Portfolio Balance Model
(Unconstrained Intercept)

(coefficient estimates)

Regressors	(mnemonic)	Total	Plant Only	Equity Only
Constant[1]				
Exchange rate	(XR)	0.190128	0.459928*	-0.2698
Japanese saving	(JGS)	13.5762****	5.30542***	8.27081***
J. profitability	(PRJ)	-15.8964***	-25.9911****	-33.9054*
Euroyen	(IR)	-34.0924**	-18.6573****	-15.4351
U.S. profitability	(PRU)	30.3722	11.645***	18.7273*

[1]Unconstrained, unreported.

Regression Statistics

$\bar{R}^2$	.518905	.662094	.333995
SSR	12709600	1757515	8659277
DW	1.72037	1.89139	1.56017

*	.95
**	.975
***	.99
****	.995

is analyzed further.[23] The hypothesis that equity and plant transactions could be pooled is tested with this specification (industry specific intercepts). The hypothesis is not rejected, although only barely. What these results suggest is that by allowing industry-specific effects through different intercepts, the portfolio balance model captures a substantial additional portion of the variation in the data, and that a single pooled regression is a valid model for both equity and plant transactions. The results of the pooled and separate regressions are presented in Table 2.

What the coefficient estimates in Table 2 suggest is that the exchange rate is not a significant determinant of Japanese direct investment. Of the other regressors, Japanese gross savings is highly significant. The profitability of investments in Japan, the profitability of investments in the U.S., and the return to the alternative asset are all significant and the correct sign. In all, the portfolio balance model, adjusting for industry-specific effects, is a good model of Japanese direct investment in the United States. It is somewhat uncommon to obtain good empirical results of the portfolio balance model.[24]

At the risk of becoming redundant, and because the pure I-O based model of direct investment very nearly encompassed the hybrid

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23. It is interesting to note that when only β_{xr} was allowed to vary, significant exchange rate coefficients appeared only for two industries: electrical machinery and vehicles,etc. When both the α and the β_{xr} constraints were relaxed, all exchange rate coefficients were insignificant.

24. Although the hypothesis that plant and equity transactions could be pooled was not rejected, the separate coefficient estimates of the unpooled regressions are shown in Table 2. These are shown because it is only in the unpooled regression for plant transactions that the exchange rate is significant -- it is only significant at the .95 percent level, and is of the wrong sign.

model, there will be no further discussion of the pure I-O model. We turn instead to a statistical investigation of the hybrid model.

The Hybrid Model.

The discussion earlier questioned the theoretical validity of testing the hypothesis that the α should be constrained across industries in the hybrid model. Nevertheless, the hypothesis is tested and rejected for all transactions and for plant transactions, but not for equity transactions (not rejected only at the .95 significance level). This suggests that the industry-specific effects incorporated in the equation through the industry-specific regressors (RP,AP,EPC,CR,NTB) are not a sufficient set of industry effects to capture all industry variation. One problem with the analyzing the hybrid specification with unconstrained intercepts is that a full set od intercepts dummies obviously creates a singularity. More importantly, the choice of which intercept dummies to include leads to different coefficients on the industry-specific constant regressors.[25]

Experimenting around this issue, alternative hypotheses are tested. A test of the hypothesis that β_{xr} could be constrained, given unconstrained α, is not rejected. A test of the hypothesis that β_{xr} could be constrained, given constrained α, is rejected at the .95 significance level, but not rejected at the .99 level.[26] Given these observations, the estimates of the hybrid model with constrained α and β_{xr} are presented in Table 3. Since the pooling of plant and equity is

25. The overall equation statistics as well as the coefficients on all the other regressors are, of course, unchanged by the choice of which intercept dummies to include.
23. None of the exchange rate coefficients are signficant.

Table 3

Hybrid Model
(Constrained Unpooled)

(coefficient estimates)

Regressors	(mnemonic)	Total	Plant Only	Equity Only
Constant		392.381	-240.216	632.597
Exchange rate	(XR)	0.130619	0.36125	-0.230632
Japanese saving	(JGS)	18.5174***	6.57855***	11.9388*
J. profitability	(PRJ)	-12.7082	-10.647*	-20.6126
Euroyen	(IR)	-33.6764*	-12.9169**	-20.7595
Raw materials	(RM)	-9.09147**	-1.28706	-7.80441**
Labor compensatoin	(W)	-3.06049	-2.55052	-0.509968
Trade balance	(TB)	0.041955	-0.118284****	0.160239**
U.S. sales	(S)	0.006206****	0.001392**	0.004814***
Capacity utilization	(CUR)	-6.01598	0.084102	-6.10008
Non-tariff barriers	(NTB)	484.017****	95.4883**	388.528****
Royalty payments	(RP)	246.312*	-16.2935	262.605***
Advertising	(AP)	-10.9309	12.0216	-22.9525
Concentration ration	(CR)	0.678055	3.02784**	-2.34978
Establishments	(EPC)	-148.778**	-40.4318*	-108.346**

Regression Statistics

$\bar{R}^2$	.390098	.621894	.262069
SSR	13518690	1575237	8852363
DW	1.69723	1.96995	1.6036

*	.95
**	.975
***	.99
****	.995

rejected at the .95 significance level (although not at the .99), both types of transactions, as well as the total are shown.

Examining these results, one concludes that exchange rates are not statistically significant determinants of Japanese direct investment in the United States, neither plant investments nor equity investments. It is also clear that the model's explanatory power for plant investments is much greater than its explanatory power for equity direct investment.[27] Increased plant and equity direct investments are caused by higher Japanese savings, presence of non-tariff barriers, increased U.S. sales, and a more concentrated production structure. Increased direct investment in plant results from lower profitability in the home industry and in alternative investments and higher concentration ratios in the industry in the United States. Increased direct investment in equity results from higher royalty payments. One interesting result is that direct investment in plant is increased by bilateral trade deficits in the same industry (supporting the lifecycle hypothesis), while direct investment in equities is negatively related to this bilateral trade imbalance suggesting that some externally generated funds may be financing diversification out of the parent's industry group.

The final stage of the investigation involves encompassing tests of the preferred specifications for the portfolio balance model and the hybrid model. The hypothesis that the portfolio balance model with industry-specific intercepts encompasses the hybrid model is rejected for investments in plant, and is rejected for direct investment in equities at the .95 significance level (although not rejected at the .99). Thus,

27. This observation is true as well for the pure portfolio balance model.

even after allowing for industry specific effects, there remains statistically significant information contained in the hybrid model which is not captured by the portfolio model. Thus, the hybrid model is chosen as the superior model for explaining Japanese direct investment in the United States.

<u>Summary</u>

This paper examines the determinants of Japanese direct investment in U.S. manufacturing industries. It uses a cross-section time-series approach with eleven years of annual data across 12 different industries. In contrast to most empirical work, many of the independent regressors are matched industry-specific. It distinguishes between direct investments that take the form of new or expanded plant versus those that take the form of an equity purchase of an ownership position in an existing firm. It considers three models of direct investment -- a pure portfolio balance model, a pure industrial-organization based model, and a hybrid model that incorporates insights from both the portfolio balance model and the industrial-organization model.

Neither of the two pure models encompass the hybrid model, implying that it is the superior model for explaining Japanese direct investment in the United States. Examining the results of the hybrid model more closely reveals that Japanese strategies for direct investment in plant and equity are somewhat different, but neither depend explicitly on the exchange rate. Overall, increased Japanese direct investment is caused by higher Japanese savings, higher U.S. sales, some characteristics of market structure (including trade barriers), and lower returns on alternative investments. Japanese direct investment should be considered in the broader light of both asset portfolio and industrial organization theories. There appears to be little concern that exchange rate movements alone either have led to Japanese direct investment into U.S. industries or will lead to dumping of Japanese direct investment assets on the market.

Data Appendix

Direct investment data: Foreign Direct Investment in the United States, U.S. Department of Commerce, International Trade Administration.

Raw materials cost: Constructed series used by Peter Hooper and Catherine L. Mann in "Exchange Rate Pass-through in the 1980s: The Case of U.S. Imports of Manufactures", in Brookings Papers on Economic Activity, 1:1989, 297-337.

Labor compensation: Unpublished series, U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology.

Japanese gross savings: Table titled "National Disposable Income and its Appropriation", in Japanese Statistical Yearbook, Statistics Bureau, Management and Coordination Agency, . Same series is available from the OECD.

Capacity Utilization rates: FRB database.

Twelve month Euroyen interest rate: FRB database.

Yen/dollar exchange rate: FRB database.

Royalty payments to sales: Table 11, 1982 Enterprise Statistics General Report on Industrial Organization, U.S. Department of Commerce, Bureau of the Census.

Advertising-to-sales: Table 12, ____________________.

Establishments-per-company: Table 1, ________________.

Concentration ratio: 1982 Census of Manufactures, Concentration Ratios in Manufacturing, U.S. Department of Commerce, Bureau of the Census.

Sales: Table 1, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations, U.S. Department of Commerce, Bureau of the Census.

U.S. Profit-to-sales: Table 2, __________________.

Japanese profit-to-sales: Table 5, TANKAN Short-term Economic Survey of Enterprises in Japan, Research and Statistics Department, The Bank of Japan.

Industry-specific bilateral trade balance: FT990, End-use categories, exports minus imports, FRB database.

Non-tariff barriers: author's own analysis of affected sectors.

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