Foreign exchange rates and Japanese foreign direct investment in Asia

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Abstract

We show that an appreciation of the yen against the dollar and against the Asian currencies significantly increases Japanese foreign direct investment (FDI) in Asia. Also, a depreciation of the Asian currencies against the dollar, while not significantly affecting the FDI in aggregate manufacturing, have a significant positive impact in the export-oriented electrical machinery sector. The labor productivity differential has a significant impact on FDI in most sectors but the direction of the effect varies across sectors. Also, there is evidence that a higher import tariff rate or wage rate in the host country significantly decreases Japanese investment in Asia. © 2001 Elsevier Science Inc. All rights reserved.

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\textit{Keywords:} Foreign exchange rates; Japanese investment; FDI in Asia

1. Introduction

As the yen grew strong in the latter half of 1980s,\textsuperscript{1} Japanese foreign direct investment (FDI) increased rapidly. With the weakening of the yen in 1991 and 1992, the growth of FDI slowed down. However, in the ensuing years the rise in the value of the yen again led to an acceleration of offshore manufacturing even as unemployment rate in Japan rose to a postwar high.\textsuperscript{2} A noticeable feature in the regional composition of Japanese FDI has been its increasing concentration in Asian countries. The share of the total Japanese FDI in Asia for...
manufacturing sectors was about 20% in the 1980s; it increased to 33% in 1993 and about 38% in 1997.\(^3\) Considering the importance of the role of exchange rates in Japanese FDI and its concentration in Asian countries, this paper examines two related questions: (a) what is the effect of exchange rates on Japanese FDI in manufacturing? And, (b) what is the relative importance of different exchange rates—the yen against the dollar and against the Asian currencies, and the dollar against the Asian currencies?

Most of the existing studies on the relationship between FDI and exchange rates focus on investment flows in the US and on the bilateral exchange rates between the home (source) country and the host country (i.e., the US). These bilateral exchange rates are important when FDI is for production and sales in the host country. However, a significant proportion of Japanese FDI into Asia is directed for production for a third market. According to a survey by the Ministry of International Trade and Industry (MITI) of Japan, the domestic sales of Japanese subsidiaries in manufacturing industries in Asia were only 40% of their total sales in 1997 and 1998 while those in the US were over 70% for the same period.\(^4\) In general, Japanese FDI in Asian countries is characterized as export-oriented investment to create a production site for exporting. When this characteristic of Japanese FDI into Asia is considered, the investment decision must be based on not only the exchange rates between the yen and the host countries’ currencies (henceforth, the Asian currencies), but also the exchange rates of the yen and the Asian currencies against the currency customarily used in international transactions, e.g., the US dollar. This is an issue of sharply growing interest and importance in relation to the recent Asian currency crisis for the following reasons. As noted earlier, Japanese investment in this region has been propelled largely by the strong yen against the US dollar. Since the value of many Asian currencies was more or less tied to a basket of currencies, primarily to the dollar, Japanese companies could use them as a low-cost substitute for an American manufacturing base. However, Asian currencies sharply devalued against the dollar in 1997, and against the yen to a lesser extent; but the yen also depreciated against the dollar. It would be interesting to examine if Japanese investment in Asia is significantly affected by not only the yen-dollar exchange rates but also the Asian currencies against both the dollar and the yen. Since the Japanese FDI in Asia has become a significant source of economic growth in the region, the result of the study would suggest important exchange rate policy implications to the countries, which want to attract Japanese investment or provide an incentive to investors to use them as an export base.\(^5\) In examining the role of exchange rates in Japanese FDI in Asia, the analysis in this paper thus focuses on exchange rates of the yen against the Asian currencies, of the yen against the US dollar, and of the dollar against the Asian currencies.

It has been well documented in the literature that there is a significant relationship between FDI and the bilateral exchange rates between home (source) countries and host countries. The strength of the yen and the rapid growth of the flow of FDI from Japan into the US during the mid-1980s prompted most studies to focus on Japanese FDI in the US. Mann (1993) shows that between 1977 and 1987 the effect of the bilateral yen-dollar exchange rate on the Japanese FDI in the US varied in significance across different manufacturing sectors. However, the expected exchange rate generally had a significant effect.\(^6\) Wakasugi (1994) analyzes the determinants of production location for Japanese manufacturing companies between Japan and the US for the period of 1970 to 1992. He shows that the exchange rate
and the relative rent in the two countries significantly affected the relative ratio of exports to FDI while wage rates were not a significant factor. Froot and Stein (1991) focus on the link between exchange rate and FDI given imperfect information about capital markets. They show that FDIs into the US during 1973 to 1988 were negatively related to the real value of the dollar. When the study used data on FDI that is disaggregated by types of transactions, the same result also holds for most types of transactions with the exception for real estate transactions.7 Klein and Rosengren (1994) examine whether relative wealth across countries caused by information imperfection of capital markets and relative wages have been of significant importance on FDI to the US from seven industrial countries including Japan over the period of 1979–1991. They found strong evidence to suggest that relative wealth significantly affected FDI while relative wages were not significant. An appreciation of real exchange rates of the dollar significantly decreased all types of FDI except for the acquisition of land.

Studies also focus on specific motives of a firm for foreign investment in explaining the link between foreign investment and exchange rates. For example, in Blonigen (1997), the relevance of exchange rate in FDI is explained in the case of foreign acquisition of firm-specific assets since it can generate returns in various currencies other than that used for purchase. This theory is tested using the data on Japanese acquisitions in the US from 1975–1992. Results show that a real appreciation of the yen is strongly associated with higher levels of Japanese acquisitions in the US for firms in industries which are more likely to acquire firm-specific assets whereas the effect is not significant in cases where acquisition of firm-specific assets is not involved. In Choi (1989), the motivation of corporate international investments is to diversify risks associated with operational cash flows and with real exchange rate. The study theoretically demonstrates that, in a stochastic world, the covariance of exchange rates with output and input prices is a significant factor in foreign investment decision, suggesting that gains from real exchange risk diversification attract foreign investment. Hung (1997) focuses on the effect of exchange rate on multinational companies’ overseas profits. The study empirically shows that a 1% dollar depreciation increases overseas profits by 0.94%. Since a 1% dollar depreciation is translated into a 1% increase in dollar profit for a given foreign currency profit, the results suggest that the net volume effect of exchange rate on overseas profits is negligible.

This paper examines Japanese FDI in manufacturing in Asia, focusing on the role of various exchange rates—the yen against the Asian currencies, the yen against the US dollar, and the dollar against the Asian currencies. Wage rates, labor productivity differential, and the import tariff are also included as determinants of FDI. The results show that an appreciation of the yen, both against the dollar and against the Asian currencies, significantly increases FDI in Asia in the manufacturing sector and most subsectors. Also, the exchange rate between the Asian currency and the dollar, while not significantly affecting the aggregate manufacturing sector, has a significant impact in some sectors, especially the electrical machinery industry which is the most export-oriented in Japanese overseas manufacturing production in Asia.8 The results also show that the wage rates in both Japan and the host countries are significant factors in determining FDI, but the effects of labor productivity vary across the sectors. In addition, there is evidence that a reduction of import tariff rate may help attract Japanese FDI in Asia.
The rest of the paper is as follows. Section 2 examines decisions on FDI and derives estimation equations, followed by data description and the estimation method in Section 3. Estimation results are presented in Section 4 and Section 5 concludes the paper.

2. Decisions on foreign direct investment

Consider a firm producing an internationally traded composite good and using two inputs—labor and imported raw material—in the production. Assuming a fixed coefficient production function, the production cost in Japan in yen, $C_j$, is:

$$C_j = W_j A_j + \frac{R^*}{E_j} B_j$$

where $A_j$ and $B_j$ are the labor and raw material required to produce one unit of the good, respectively, $W_j$ is the nominal wage rate in the source country in domestic prices (yen), $E_j$ is the exchange rate of yen per US dollar, and $R^*$ is the world price of raw material in dollars. Then, the dollar production cost in Japan, $C^*_j$, is:

$$C^*_j = \frac{W_j A_j}{E_j} + R^* B_j$$

Eq. (2) shows that an appreciation of the yen makes the dollar cost of production (equivalently, the dollar price of Japanese product under perfect competition) higher, deteriorating Japanese competitiveness in international trade. To stay competitive, firms have to improve their productivity by decreasing $A_j$ or $B_j$, or decreasing the domestic wage rate, $W_j$. Or, firms would invest abroad to take advantage of a lower cost of production in dollars. Let $C^*_h$ be the dollar production cost in host country $h$ as:

$$C^*_h = \frac{W_h A_h}{E_h} + R^* B_h$$

where $A_h$ and $B_h$ are the labor and raw material used to produce one unit of the good in the host country, respectively, $W_h$ is the nominal wage rate in the host country, and $E_h$ is the exchange rate of the Asian currency per dollar. Eq. (3) indicates that a lower production cost abroad comes not only from a lower wage rate but also from a depreciation of the host country’s currency against the dollar.

It is assumed that due to technology transfer accompanied by FDI there is no differential in the raw material input in the production between the host country and Japan, implying that $B_j = B_h$. Then, the production cost differential depends on the share of labor cost in domestic production, $C^*_{L,j} (-W_j A_j/E_j)$, relative to that in foreign production, $C^*_{L,h} (-W_h A_h/E_h)$.

In addition to relatively lower production costs, other factors attract FDI. For example, a possible motive of FDI could be to avoid trade barriers or by-pass protectionism such as import tariffs. This type of FDI was common among Japanese firms that invested in the US during 1980s. In the presence of import tariff, the decision by Japanese firms on whether to produce domestically and export or to invest and produce abroad depends on the tariff-
adjusted cost differential in dollar terms. Now suppose that FDI in country \( h \), \( F_h \), is a function of the tariff-adjusted cost differential as:

\[
F_h = f \left( \frac{(1 + \tau)C_{Lj}}{C_{Lh}} \right) = \left( 1 + \tau \right) \left( \frac{W_jA_j}{W_hA_h} \right) \left( \frac{E_{h}}{E_j} \right)
\]

where \( \tau \) is the tariff rate imposed on imports by the host country. One should note that \( A_k \) \((k = j, h)\) represents inverse of labor productivity since it represents the amount of labor required in producing one unit of the product in country \( k \). When, other things being equal, the labor productivity of country \( h \) increases, production in country \( h \) becomes more competitive, attracting FDI. However, FDI is often used to transfer technology when a firm has a competitive advantage in technologies or management skills, and uses its advantage to earn profits by investing directly in foreign countries. If FDI is intended for technology transfer, the larger the productivity differential between Japan and country \( h \), the greater FDI flows to country \( h \). Therefore, the productivity differential also measures the need for technology transfer. In order to capture the role of technology transfer in the FDI decision, the labor productivity differential between Japan and host country is considered as a determinant of FDI, instead of the productivity of Japan and that of host country separately. Then, a log-linearization of Eq. (4) is obtained as: (Henceforth, lower-case letters denote the logarithm of a variable; \( x = \ln X \).)

\[
f_{ht} = b_1da_{ht} + b_2w_{jt} - b_3w_{ht} + b_3e_{ht} - b_4e_{jt} + b_5\tau_{ht}
\]

where \( da_{ht} = a_j - a_h \) and all the \( b \)'s are expected to be positive except for \( b_1 \). \( b_1 \) would be negative if FDI is mainly to take advantage of relatively low unit production cost; and positive if FDI is attributed to technology transfer.

When the investment decision is based on the production cost differential in terms of the yen, the exchange rates between the yen and the Asian currency are accounted for as:

\[
f_{ht} = c_1da_{ht} + c_2w_{jt} - c_2w_{ht} + c_3e_{yt} + c_4\tau_{ht}
\]

where \( e_y (=e_h - e_j) \) is the exchange rate of the Asian currency per yen.

It has often been argued in the literature that real exchange rate rather than nominal rate determines FDI. To further examine this, we specify each of the nominal exchange rates as the combination of the purchasing power parity (PPP) and the deviation from the PPP, equivalently, the real exchange rate, \( q \). For example, the exchange rate of the Asian currency per dollar at \( t \), \( e_{h,t} \), is:

\[
e_{h,t} = (p_{h,t} - p_{us,t}) + q_{h,t}
\]

where \( q_{h,t} = e_{h,t} - p_{h,t} + p_{us,t} \), and \( p_h \) and \( p_{us} \) are the price levels of country \( h \) and the US, respectively. The PPP relationship is often generalized in a form of proportional changes in exchange rate and in the price levels, which is called the relative version of PPP. Then, based on the relative PPP, the change in nominal exchange rate is rewritten from Eq. (7) as:

\[
\Delta e_{h,t} = (\Delta p_{h,t} - \Delta p_{us,t}) + \Delta q_{h,t}
\]
where $\Delta x_t = x_t - x_{t-1}$ ($x = e, p, q$). Eq. (8) indicates that the change in nominal exchange rate is the sum of the inflation rate differential and the change in real exchange rate. Since $\Delta e_{h,t} = e_{h,t} - e_{h,t-1}$, $e_{h,t}$ is specified as:

$$e_{h,t} = \pi_{h,t} + \delta_{h,t}$$

(9)

where $\pi_{kt} = e_{h,t-1} + (\Delta p_{h,t} - \Delta p_{us,t})$, the relative PPP rate and $\delta_{kt} = \Delta q_{h,t}$, the change in real exchange rate. For $e_{h}$ and $e_{j}$, we obtain the similar specification.

This specification of the actual exchange rates enables us to conduct the following line of inquiry. Suppose that Japanese firms believe that the PPP rate is an equilibrium exchange rate and the deviation from the PPP is temporary and thus use the PPP rate as a base exchange rate to evaluate the dollar cost of Japanese production. Then, only the PPP rate matters in their investment decision. On the other hand, if investors perceive that overvalued or undervalued exchange rates from the PPP level reflect the exchange rate movements caused by fundamental factors other than price changes, then the deviation from the PPP rate should be also accounted for. To examine the importance of each component of the exchange rate, using Eq. (9) Eqs. (5) and (6) are rewritten as:

$$f_{ht} = g_1 d_{aht} + g_2 w_{jit} - g_3 w_{ht} - g_4 \pi_{jit} - g_5 \delta_{jit} + g_6 \pi_{ht} + g_7 \delta_{ht} + g_8 \tau_{ht}$$

(10)

$$f_{ht} = z_1 d_{aht} + z_2 w_{jit} - z_3 w_{ht} + z_4 \pi_{jit} + z_5 \delta_{jit} + z_6 \tau_{ht}$$

(11)

Based on Eqs. (5), (6), (10) and (11), estimation equations for the aggregate manufacturing and for individual sector are derived.

3. Estimation

3.1. Estimation method

The data used in estimation are cross-sectional and time-series annual data. The data are disaggregated by country as well as by sector; the data are from 6 countries and 8 sectors for each country. The data covers the period from 1983 to 1992, resulting in a total of 480 observations.

Estimation method is based on standard time series-cross sectional regression models. The regressions are for the aggregate manufacturing as well as for each sector. In the regression for the aggregate sector, country- and sector-specific constant terms are included to capture differences across the countries and sectors. Then, based on Eq. (5), the estimation equation for the aggregate manufacturing sector is written as:

$$f_{hit} = \sum_h \sum_i \alpha_{0hi} + \alpha_1 d_{aht} + \alpha_2 w_{ht} + \alpha_3 w_{jit} + \alpha_4 e_{jit} + \alpha_5 e_{ht} + \alpha_6 \tau_{ht} + \varepsilon_{hit}$$

(12)

where $\alpha_{0hi}$ is a dummy variable indicating host country $h$ and sector $i$. Based on pooled ordinary least square (OLS) estimates, the Lagrange multiplier (LM) test rejects the hypothesis of homoscedasticity. The regression is reestimated allowing for groupwise heteroscedasticity, i.e., $E(\varepsilon^2_{kt}) = \sigma_{kk}$ where subscript $k$ denotes for group $k$ with $T$ observations. The
data set used in the estimation contains 48 subgroups (8 sectors for each of 6 countries) with each subgroup having 10 observations. The estimation equations for the aggregate sectors based on Eqs. (6), (10) and (11) are also specified in a similar manner.

The regression equation for each sector is also estimated using the same method. To capture differences across the countries, the estimation equation includes country-specific constant terms. Then, based on Eq. (5), the estimation equation for each sector is written as:

$$f_{ht} = \sum_{h} \beta_{0h} + \beta_1 d_{aht} + \beta_2 w_{ht} + \beta_3 e_{jt} + \beta_4 e_{ht} + \beta_5 t_{ht} + \mu_{ht}$$  \hspace{1cm} (13)

where $\beta_{0h}$ is a dummy variable indicating host country $h$. Using pooled OLS, the LM test of the hypothesis of homoscedasticity is rejected in all cases. Also, groupwise heteroscedasticity, i.e., $E(\mu_{jt}^2) = \sigma_{jj}$ is tested as a restriction on groupwise heteroscedasticity and cross-group correlation, i.e., $Cov(\mu_{kt}, \mu_{jt}) = \sigma_{kj}$. The LM test indicates a significant presence of cross-sectional correlation in most cases. To correct for these problems, the estimation process allows for groupwise heteroscedasticity, and correlation of the disturbances across groups if necessary. For each sector, there are 6 groups (for 6 countries), with each group having 10 observations. The estimation equations for each sector based on Eqs. (6), (10) and (11) are also specified in the same manner.

3.2. Data

Data used in the estimation include 6 countries—Newly Industrialized Countries except Taiwan (South Korea, Hong Kong, and Singapore) and ASEAN-3 (Malaysia, Indonesia and Thailand). For each country, the data are from 8 sectors; chemicals and allied products, electrical machinery, food, primary metals and fabricated metal products, general machinery, textile products, transportation machinery, and ‘others’. Electrical machinery sector is the most primary sector in Japanese manufacturing FDI in Asia in terms of the value of investment, followed by chemical sector in 1996 and 1997. The dependent variable is Japanese FDI in each country for each sector in dollars. The data on FDI used in this study are compiled by the Ministry of Finance (MOF) based on data submitted by Japanese investors, as required by the Foreign Exchange Control Law. The independent variables are:

(a) labor input coefficient of production in Japan and host countries, $a_j$ and $a_h$. Index of $a_j$ is calculated by the number of employment divided by the real output for each sector, using 1987 as the base year. For index of $a_h$, we either use the inverse of a country’s real output per employee in manufacturing as published by the World Bank, or calculated by using employment index and real gross national products. The lower the $d_{a_h} (=a_j - a_h)$, the lower labor productivity of country $h$ relative to Japan, and thus the higher the unit production cost in country $h$. Therefore, other things being constant, it would have a negative impact on FDI. However, if FDI is mainly motivated for technology transfer, a lower $d_{a_h}$ indicates more need for technology transfer and thus increase FDI.

(b) wage rate index of Japan and host countries, $w_j$ and $w_h$. They are obtained from the publications of the Bank of Japan, World Bank and the IMF. It has been long argued that a
low wage rate in a country attracts foreign direct investors. A higher (lower) wage rate at home (abroad), a more FDI. Therefore, an increase in \( w_j \) (\( w_h \)) would increase (decrease) FDI.

(c) exchange rates, \( e_j \), \( e_h \), and \( e_y \). \( e_j \) and \( e_h \) are the log of the nominal exchange rate of the yen and the Asian currency per dollar, respectively. They are obtained from the International Financial Statistics published by the IMF. \( e_y \) is the log of the nominal exchange rate of the Asian currency per yen that is calculated by subtracting \( e_j \) from \( e_h \). A depreciation of the Asian currency against the dollar would make the production of the host country more competitive in international trade market. Thus, we expect that \( e_h \) have a positive impact on FDI. Also, an appreciation of the yen against the dollar or the Asian currencies would increase Japanese production cost at home, resulting in an increase in investment abroad by Japanese firms. Therefore, it is predicted that \( e_j \) (\( e_y \)) has a negative (positive) impact on FDI.

(d) PPP rates, \( \pi_j \), \( \pi_h \), and \( \pi_y \). The PPP rates are calculated based on the relative PPP, using 1980 as the base year.

(e) change in real exchange rates (or, deviation from the PPP rates), \( \delta_j \), \( \delta_h \), and \( \delta_y \). They are calculated subtracting the PPP rates from the nominal exchange rates.

(f) import tariff, \( \tau \). \( \tau \) is measured by import duties as a percentage of imports for each country, as published by the World Bank.\(^{15}\)

Detailed data description and the sources are shown in Table 1.

### Table 1
Data description and sources

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{hi} )</td>
<td>Japanese FDI in industry ( i ) and country ( h )</td>
<td>Ministry of Finance of Japan</td>
</tr>
<tr>
<td>( a_h )</td>
<td>labor input in production of host country ( h )</td>
<td>World Table by the World Bank and International Financial Statistics by IMF</td>
</tr>
<tr>
<td>( a_j )</td>
<td>labor input in Japanese production</td>
<td>Economic Planning Agency of Japan</td>
</tr>
<tr>
<td>( w_h )</td>
<td>wage in host country</td>
<td>World Table by the World Bank and International Financial Statistics by IMF</td>
</tr>
<tr>
<td>( w_j )</td>
<td>wage in Japan</td>
<td>Bank of Japan</td>
</tr>
<tr>
<td>( e_j )</td>
<td>exchange rate of the yen per dollar</td>
<td>International Financial Statistics by IMF</td>
</tr>
<tr>
<td>( e_h )</td>
<td>exchange rate of host country’s currency per dollar</td>
<td>International Financial Statistics by IMF</td>
</tr>
<tr>
<td>( \tau )</td>
<td>import tariff rate</td>
<td>World Development Indicators by the World Bank</td>
</tr>
</tbody>
</table>

4. Estimation results

Results from the estimation for the aggregate manufacturing sector appear in Table 2.\(^{16}\) FDI at the aggregate level is significantly affected not only by the exchange rate between the source country’s currency (yen) and the Asian currency, \( e_y \), but also by the exchange rate between the yen and the dollar, \( e_j \). The nominal exchange rates and the PPP rates for these
currencies are all significant in explaining FDI at the 1% level. Also, the signs of the coefficients on exchange rates are all consistent with the prediction, indicating that an appreciation of the yen against the dollar or against the Asian currencies significantly increases FDI. This implies that an appreciation of the yen worsens Japanese competitiveness of manufacturing sector making their production abroad more attractive or the appreciation of yen makes it cheaper for Japanese firm to invest abroad. On the contrary, neither of the nominal exchange rate of the Asian currencies per dollar, \( e_{i,j} \), nor the PPP rates or the real exchange rate rates of host country currency per the dollar or per the yen, \( e_{h,j} \) and \( e_{j} \), have significant effects on FDI. The results from estimation of FDI for aggregate manufacturing sector are presented in Table 2.

Table 2
Results from estimation of FDI for aggregate manufacturing sector

<table>
<thead>
<tr>
<th></th>
<th>FDI</th>
<th>FDI</th>
<th>FDI</th>
<th>FDI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n.s.</td>
<td>n.s.</td>
<td>sig</td>
<td>sig.</td>
</tr>
<tr>
<td>( c_{hi} )</td>
<td>0.5614</td>
<td>0.4059</td>
<td>0.1760</td>
<td>-0.5825</td>
</tr>
<tr>
<td>( d_{ah} )</td>
<td>(1.557)</td>
<td>(1.121)</td>
<td>(0.488)</td>
<td>(-0.159)</td>
</tr>
<tr>
<td>( w_{h} )</td>
<td>-2.3743</td>
<td>-2.0422</td>
<td>-1.5858</td>
<td>-1.2167</td>
</tr>
<tr>
<td>( w_j )</td>
<td>-5.261**</td>
<td>-4.460**</td>
<td>-3.642**</td>
<td>-2.732**</td>
</tr>
<tr>
<td>( w_{h,j} )</td>
<td>6.6703</td>
<td>3.8828</td>
<td>7.7194</td>
<td>5.0101</td>
</tr>
<tr>
<td>( t_h )</td>
<td>2.3743</td>
<td>2.0422</td>
<td>1.5858</td>
<td>1.2167</td>
</tr>
<tr>
<td>( t_{j} )</td>
<td>2.0422</td>
<td>1.5858</td>
<td>1.2167</td>
<td>0.8467</td>
</tr>
<tr>
<td>( e_j )</td>
<td>-2.5316</td>
<td>(-2.193)*</td>
<td>(-2.316)*</td>
<td>(-2.605)**</td>
</tr>
<tr>
<td>( e_{j} )</td>
<td>(-8.726)**</td>
<td>(-7.008)**</td>
<td>(-4.507)**</td>
<td>(-4.507)**</td>
</tr>
<tr>
<td>( e_{h} )</td>
<td>-0.307</td>
<td>(-0.084)</td>
<td>0.3113</td>
<td>(0.828)</td>
</tr>
<tr>
<td>( e_{h} )</td>
<td>-1.4064</td>
<td>(-1.558)</td>
<td>1.6103</td>
<td>(7.345)**</td>
</tr>
<tr>
<td>( t_{h} )</td>
<td>2.0150</td>
<td>(7.949)**</td>
<td>0.8028</td>
<td>(2.342)*</td>
</tr>
<tr>
<td>( t_{j} )</td>
<td>0.3113</td>
<td>(0.828)</td>
<td>-1.4064</td>
<td>(-1.558)</td>
</tr>
<tr>
<td>( e_{j} )</td>
<td>(-8.726)**</td>
<td>(-7.008)**</td>
<td>(-4.507)**</td>
<td>(-4.507)**</td>
</tr>
</tbody>
</table>

(The value in the parentheses is the t-value. * and ** indicate significance at the 5 percent and 1 percent, respectively.)

FDI = Japanese foreign direct investment;
\( c_{hi} \) = country- and industry-specific dummy variable where n.s. indicates not significant and sig. indicates significant;
\( d_{ah} \) = labor input coefficient differential between Japan and host country h;
\( w_{h,j} \) = wage rate in host country h and in Japan, respectively;
\( t_{h} \) = import tariff rate in country h;
\( e_{j} \) = exchange rate of the yen per the dollar;
\( e_{h} \) = exchange rate of host country’s currency per the dollar;
\( e_{j} \) = exchange rate of host country’s currency per the yen;
\( t_{k} \) = PPP rate of \( e_{k} \) (k=j,h,y);
\( \delta_{k} \) = the change in real exchange rate of \( e_{k} \) (k=j,h,y).

exchange rate change significantly affects FDI. This suggests that a depreciation of those
countries’ currencies against the dollar, which improve international competitiveness of the
production in the host countries, does not induce the Japanese FDI in manufacturing at the
aggregate level, unless it results in a depreciation of the currencies against the yen.

Results also show that in all specifications wage rates both in Japan and host countries
significantly affect FDI in the aggregate manufacturing sector. As expected, an increase
(decrease) in the wage rate in Japan (host countries) significantly increases FDI. These results
indicate that production cost differentials between the Asia countries and Japan, whether it
is a result of a wage rate differential or a weak currency against the yen, significantly induce
the Japanese FDI in the manufacturing sector.

In addition, the results indicate that labor productivity differential does not have a
significant effect on the overall FDI in the manufacturing sector. This insignificant effect
could be because the productivity differential affects FDI in two opposite directions. The
higher the Japanese productivity relative to the host country, the higher the unit production
cost abroad and thus the lower the FDI. On the contrary, a higher productivity differential
indicates more need for technology transfer, resulting in a greater FDI. Therefore, with these
factors simultaneously at work across the sectors, the productivity differential could have an
insignificant impact at the aggregate level.

A noticeable result is that the import tariff rate has a negative impact on FDI. When import
tariff in host country increases, exports of goods produced in Japan become more expensive.
The traditional argument is that to by-pass the tariff Japanese firms would increase the
investment and production in the tariff-imposing country. Thus, a higher tariff would induce
more FDI. However, the results in Table 2 are contrary to this traditional view. One possible
explanation of this result is that Japanese FDI in Asia is not mainly intended to avoid
protectionism. A higher tariff in those countries may be an indicator that the economy is less
open and/or the business environment is less accommodating to foreign investors. Moreover,
since Japanese FDI often induces exports of raw materials and parts from the parent company
in Japan to Japanese subsidiaries or their incorporated companies in host countries, a higher
tariff rate would make Japanese exports of intermediate goods more expensive and thus
discourage FDI. However, this interpretation should be treated with caution because
various important forms of nontariff barriers are not included in the import tariff rates.

Sectoral results from the estimation of FDI are presented in Table 3 when the yen
exchange rates against the dollar and the host country currencies are included. As in the
aggregate manufacturing case, an appreciation of the yen against the dollar significantly
increases FDI in all sectors at the 5% level, with transportation machinery sector being the
only exception. The result also suggests that the movements of the real exchange rate of the
yen against the dollar seem to be as important as the PPP rate in the FDI decision. A notable
finding is that a depreciation of the Asian currencies against the dollar significantly increases
FDI in the leading sectors such as chemical and electrical machinery sectors. In particular,
Japanese FDI in the electrical machinery sector is the most export-oriented among all the
sectors. Over 70% of the total sales in electrical machinery sector by Japanese subsidiaries
in Asia was for exports in 1997 and 1998 whereas only about 45% of the total sales was for
exports in the rest of the manufacturing sectors. Also, the exports in the electrical machinery
sector were about 70% of the total exports by Japanese subsidiaries in Asia. The estimation
Table 3
Results from estimation of FDI for individual industry with exchange rates against the dollar

<table>
<thead>
<tr>
<th>Sector</th>
<th>c</th>
<th>da_h</th>
<th>w_h</th>
<th>w_j</th>
<th>(\tau_h)</th>
<th>e_h</th>
<th>(\pi_h)</th>
<th>(\delta_h)</th>
<th>e_j</th>
<th>(\pi_j)</th>
<th>(\delta_j)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals &amp; allied products</td>
<td>sig.</td>
<td>-4.9624</td>
<td>2.0136</td>
<td>10.9917</td>
<td>-0.4242</td>
<td>4.5280</td>
<td>-1.1002</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(n.s.)</td>
<td>(-3.812)**</td>
<td>(1.768)</td>
<td>(5.195)**</td>
<td>(4.493)**</td>
<td>(4.470)**</td>
<td>(-2.510)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical machinery</td>
<td>n.s.</td>
<td>-4.0243</td>
<td>2.3175</td>
<td>1.8850</td>
<td>-0.4927</td>
<td>5.2789</td>
<td>0.7664</td>
<td>-1.6646</td>
<td>1.4688</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(n.s.)</td>
<td>(-2.433)**</td>
<td>(1.993)*</td>
<td>(0.782)</td>
<td>(-5.920)**</td>
<td>(5.914)**</td>
<td>(0.539)</td>
<td>(-2.839)**</td>
<td>(2.524)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>sig.</td>
<td>-4.5389</td>
<td>0.3178</td>
<td>11.4795</td>
<td>0.1081</td>
<td>1.6405</td>
<td>-0.9302</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(n.s.)</td>
<td>(-5.114)**</td>
<td>(0.273)</td>
<td>(4.048)**</td>
<td>(1.386)</td>
<td>(2.104)*</td>
<td>(1.433)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary metals &amp; metal products</td>
<td>n.s.</td>
<td>1.4233</td>
<td>0.6129</td>
<td>2.8266</td>
<td>0.0852</td>
<td>1.0878</td>
<td>-2.2091</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General machinery</td>
<td>n.s./sig.</td>
<td>1.4485</td>
<td>1.1950</td>
<td>-0.9993</td>
<td>0.1440</td>
<td>-0.6621</td>
<td>1.8028</td>
<td>-3.3850</td>
<td>-1.7989</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textile products</td>
<td>n.s./sig.</td>
<td>3.6107</td>
<td>2.9671</td>
<td>9.7514</td>
<td>-0.0247</td>
<td>3.5048</td>
<td>-5.076</td>
<td>-0.5774</td>
<td>0.6052</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation machinery</td>
<td>n.s.</td>
<td>-3.9834</td>
<td>2.8190</td>
<td>-3.0054</td>
<td>-0.0177</td>
<td>2.0808</td>
<td>-1.7378</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>n.s.</td>
<td>-3.2926</td>
<td>3.5307</td>
<td>-5.1640</td>
<td>-0.2345</td>
<td>-0.0982</td>
<td>0.2731</td>
<td>0.1047</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: See Table 2 for the notation of the independent variables.
result suggests that a depreciation of Asian currencies against the dollar makes the products in the export-oriented electrical machinery sector more competitive in international trade and thus increases FDI in those countries as production site for exports.

The effect of the exchange rates of the Asian currencies against the yen is presented in Table 4. A strong yen against these currencies especially the PPP rates, has a significant effect on an increase in outward FDI from Japan to the Asian countries in all sectors except textile and transportation machinery sectors. It is noteworthy that the significant effect of the nominal yen-Asian currency rate on FDI comes from the PPP component, rather than the real exchange rate changes.

The sectoral results on the wage rate variables are in general consistent with the ones for the aggregate. We find that wage rates both in host countries and in Japan have a significant impact on FDI in most sectors. A higher wage rate in Japan or a lower wage rate in host

<table>
<thead>
<tr>
<th>Sector</th>
<th>c</th>
<th>da_y</th>
<th>w_y</th>
<th>e_y</th>
<th>d_y</th>
<th>π_y</th>
<th>δ_y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals &amp; allied products</td>
<td>-4.1135</td>
<td>1.2019</td>
<td>11.5038</td>
<td>-0.2603</td>
<td>1.9625</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>-1.5865</td>
<td>1.0476</td>
<td>-1.0739</td>
<td>-0.3367</td>
<td>2.8898</td>
<td>-1.1176</td>
<td></td>
</tr>
<tr>
<td>Electrical machinery</td>
<td>-0.3486</td>
<td>-3.5848</td>
<td>8.6417</td>
<td>-0.0800</td>
<td>2.8214</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>-1.4402</td>
<td>-6.2700</td>
<td>8.5750</td>
<td>-0.9590</td>
<td>(16.881)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>-4.1311</td>
<td>-0.0189</td>
<td>10.8797</td>
<td>0.1055</td>
<td>1.2275</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>-4.4720</td>
<td>-0.1587</td>
<td>12.7718</td>
<td>0.1088</td>
<td>0.9550</td>
<td>1.7029</td>
<td></td>
</tr>
<tr>
<td>Primary metals &amp; metal products</td>
<td>1.8265</td>
<td>0.8384</td>
<td>4.3884</td>
<td>0.1299</td>
<td>1.3189</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>1.3107</td>
<td>1.4400</td>
<td>2.1069</td>
<td>0.1222</td>
<td>1.7379</td>
<td>1.0591</td>
<td></td>
</tr>
<tr>
<td>General machinery</td>
<td>4.2223</td>
<td>-5.4020</td>
<td>14.4449</td>
<td>-0.0710</td>
<td>1.7018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textile products</td>
<td>2.1990</td>
<td>-2.8020</td>
<td>4.2657</td>
<td>-0.0824</td>
<td>2.8181</td>
<td>0.2264</td>
<td></td>
</tr>
<tr>
<td>Transportation machinery</td>
<td>1.5250</td>
<td>-3.6100</td>
<td>3.3950</td>
<td>-0.9197</td>
<td>(1.259)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>1.5803</td>
<td>-7.2275</td>
<td>28.4579</td>
<td>-0.0563</td>
<td>-1.5745</td>
<td>0.7456</td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>1.2500</td>
<td>-3.7710</td>
<td>3.8270</td>
<td>-0.5220</td>
<td>(1.700)</td>
<td>(0.579)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>-6.0393</td>
<td>4.7542</td>
<td>-2.2446</td>
<td>-0.0502</td>
<td>-0.1576</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>-5.8236</td>
<td>5.4783</td>
<td>-12.6261</td>
<td>-0.1647</td>
<td>1.2187</td>
<td>-3.2059</td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>0.3774</td>
<td>-2.9348</td>
<td>11.0007</td>
<td>-0.0804</td>
<td>1.4584</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>0.2875</td>
<td>-2.8849</td>
<td>10.9555</td>
<td>-0.0876</td>
<td>1.4434</td>
<td>1.4025</td>
<td></td>
</tr>
<tr>
<td>n.s.</td>
<td>0.4700</td>
<td>-5.3030</td>
<td>6.5700</td>
<td>-1.5800</td>
<td>(4.893)**</td>
<td>(3.369)**</td>
<td></td>
</tr>
</tbody>
</table>

Note: See Table 2 for the notation of the independent variables.
countries significantly attracts Japanese firms to make FDI in Asia. The result supports the traditional argument that labor cost differential is a main determinant of FDI.

The effect of import tariff on FDI is insignificant in most sectors. However, in sectors where the tariff rate variable is significant, the tariff has a negative impact on FDI with exception being the food sector. These results suggest evidence that the Japanese FDI in Asia is not motivated to by-pass trade barriers.

The results in Tables 3 and 4 also show that the productivity differential is significant in FDI in most sectors but the direction of the effect varies across the sectors. A higher productivity of Japan relative to that of host country, i.e., a lower $d_{ah}$, would significantly increase FDI in chemicals, electrical machinery, food and transportation machinery sectors. This may provide evidence that Japanese FDI in those sectors is attributed to transfer of the Japanese high productivity and technology to the host countries. However, the productivity differential has a contrasting effect on FDI in metals and general machinery sectors. That is, a higher productivity of host country relative to Japan significantly induces FDI, indicating that FDI in those sectors is mainly to take advantage of a lower unit production cost.

Results from this study have some policy implications. Since a significant portion of exports of Asian countries is by Japanese subsidiaries, a policy of attracting Japanese FDI may be closely linked to export promotion as well as job creation. Our study suggests that stable wage rates and appropriate management of exchange rates are essential in order to attract Japanese investment. For example, when the yen becomes substantially weak against the dollar, keeping their currencies pegged to the dollar and the resulting appreciation against the yen would hinder Japanese FDI inflows into those countries. Also, an overvalued Asian currency against the dollar has a significant negative impact on Japanese investment especially in the export-oriented electrical machinery sector. In addition, this study provides evidence that a reduction of protectionism by decreasing import tariff rates may help induce Japanese FDI.

Results also suggest that, along with high labor cost in Japan, a strong yen against the dollar and against the Asian currencies would shift production activities to Asian countries away from Japan, which may have a negative impact on trade balance, production and employment in Japan.21

5. Conclusion

This paper examines the determinants of Japanese FDI in manufacturing in Asia, focusing on the role of various exchange rates along with wage rates, labor productivity differential and import tariff. The exchange rates that are considered are the yen per dollar, the Asian currencies per dollar, and the Asian currencies per yen; also for each exchange rate, the nominal rate, the PPP rate, and the change in real exchange rate (equivalently, the deviation from the PPP rate) are considered.

The study shows that exchange rate variables—the yen against the Asian currencies and also against the dollar—are significant factors in FDI in the manufacturing sector. When the nominal exchange rates are decomposed into the PPP rates and the change in real exchange rates, both components generally have a significant effect on FDI. The signs on these
significant coefficients are all consistent with the prediction, i.e., an appreciation of the yen against the dollar and against the Asian currencies significantly increases FDI. These results for the aggregate manufacturing sector are in general consistent with those for each individual sector. The exchange rate between the Asian currency and the dollar, while not significantly affecting the aggregate sector, has a significant impact in some sectors such as the chemical and the electrical machinery sectors. Notably FDI in the electrical machinery sector, that is the most export-oriented, is significantly induced by a depreciation of the Asian currency against the dollar, especially the PPP rate.

The wage rate variables have a consistent impact at the aggregate level and in most sectors. As expected, an increase in the wage rate in Japan or a decrease in the wage rate in the host countries significantly increases FDI, suggesting that the investment is attracted by relatively cheap labor.

Results show that, even though the labor productivity differential is insignificant at the aggregate level, it has a significant effect on FDI in most individual sectors. However, the direction of the effect is contrasted across sectors. This may provide evidence that Japanese FDI in Asia is attributed to capitalize on the competitive advantage in technologies in some sectors (chemicals, electrical machinery and transportation machinery), but also to take advantage of an efficient production and thus a low unit production cost in some other sectors (metals and general machinery). The study also suggests that an increase in import tariff rates significantly decreases Japanese FDI in most sectors as well as at the aggregate level, implying that Japanese investment and production in Asia are not motivated primarily to by-pass protectionism of the host countries.

Notes

1. The yen appreciated against the currencies of Japan’s major trading partners, as shown in the increase in the nominal effective exchange rate of the yen by 57% between 1984 and 1988. During the same period, the yen appreciated against the dollar by 46%. Source: *International Financial Statistics*, IMF.


3. Source: Ministry of Finance of Japan. The figure for 1997 is for the first fiscal year (April through September).


5. Over 9% of the total exports of ASEAN 4 (Indonesia, Malaysia, the Philippines and Thailand) was by Japanese subsidiaries in 1997. The contribution of Japanese FDI to the exports in electrical machinery sector is the most substantial- the share of exports of Japanese subsidiaries was about 25% of the total exports in electrical sector of ASEAN4 in 1997. Source: MITI (1999) and *International Trade Statistics Yearbook*, United Nations (1997). Also, *The Economist* (October 11, 1997) reports that one in
seven manufacturing workers in Thailand is employed by a Japanese firm and a fifth of Malaysia’s manufacturing jobs in the 1990s are at Japanese companies.

6. In her paper, the expected rate was proxied with lagged and leading percentage change in the yen/dollar exchange rate.

7. The study includes different types of transactions such as mergers and acquisitions, equity increases, real estate, new plant, joint ventures and plant expansion.

8. The ratio of export sales to the total sales of Japanese subsidiaries in Asia for electrical machinery industry is over 70% in 1997 and 1998, which is the highest among all manufacturing industries.

9. The notion of the PPP rate being an equilibrium exchange rate is particularly important in long term investment decisions.

10. The Ministry of Finance of Japan began publishing FDI data in 1951. However, the data on FDI by country as well as by sector are available only from 1983.

11. The variables, $w_t$, $e_t$, $c_t$, $\tau_t$, are not sector specific, i.e., $e_{hi} = e_h$ for all $i$.


14. This data are based on notification rather than actual transfer. Since it is notification-based, there might be time lags between the submitted dates and the actual execution of FDI. However, the notification-based data are appropriate for this study because the timing of notification reflects the timing for firm’s decision to invest abroad. Moreover, only the MOF data are disaggregated both by host country and by subsector.

15. Import duties include levies for import protection or revenue purposes, whether on a specific or ad valorem basis, as long as they are restricted to imported products. See World Development Indicators 1999, World Bank.

16. A negative relationship between FDI and the exchange rates in empirical results could be driven by the fact that FDI is measured in dollars and exchange rates of the yen and the host country currencies per dollar are used as regressors. However, when FDI as a fraction of the Japanese output for each sector is used, the effects of exchange rates and other regressors are generally consistent with those when FDI is measured in dollars—the sign and the significance of the coefficients on $e_j$, $c_h$, $e_y$, $\pi_j$, $\pi_h$, $\pi_y$, and $\delta_h$ are analogous.

17. To test the additional explanatory power of exchange rate variables in the presence of the other regressors, a $\chi^2$ test based on the log-likelihood ratio is conducted. Results indicate that the inclusion of the exchange rate variables significantly increases the explanatory power at the 1% significance level.

18. The insignificance is not due to the muticollinearity between $e_j$ and $e_h$. The correlation between the two is $-0.014$.

19. An estimate shows that the total export inducement effect was about $117 billion and $125 billion in 1995 and 1996, respectively. See MITI (1998).


21. See MITI (1998). MITI also reported that imports from foreign affiliated manufacturers accounted for 9.1% of the total Japanese imports in 1997 and most of these imports come from Asia.
Acknowledgments

We thank Arindam Bandopadhyaya for valuable suggestions and comments.

References


World Bank, *World Table*, various issues.