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Which Exchange Rates Matter for FDI? Evidence for Japan

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Which Exchange Rates Matter for FDI? Evidence for Japan

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Using industry level data for Japanese foreign direct investment (FDI) flows to five Asian countries, we investigate how the sensitivity of FDI to the exchange rate changes across different industry types and exchange rate indices. Key results are as follows: (i) aggregated FDI data reported at the national level are insufficient for analysis, and industry-level data are required; (ii) pooling industries by export orientation reveals heterogeneity in the response of different *types* of FDI to the exchange rates; and (iii) alternative exchange rate measures, particularly the competitor-weighted exchange rate, perform better for export-oriented FDI. We use our results to address key conflicts in the literature on exchange rates and FDI.

JEL Classification: F21, F23

1. Introduction

Although the scope of its benefits is the subject of recent debate, foreign direct investment (FDI) has long been recognized as an important means for economic growth. Not only does FDI aid in capital accumulation, it also allows developing countries to raise total factor productivity through the introduction of new ideas, skills, and technology (De Mello 1997). The role of FDI as a source of growth in developing countries is increasing, with FDI to these countries rising by 50% from $156 billion in 2002 to $233 billion in 2004 (UNCTAD 2005); this occurred despite a 9% decline in total global FDI flows.

Since exchange rate movements affect expected profits, they influence the attractiveness of FDI. The connection between FDI and exchange rates has been extensively studied from a theoretical perspective, including the impact on FDI of both the level of the exchange rate—which influences the local cost of production—and its volatility—which determines the riskiness of the investment. Yet the diversity of ways to measure an appropriate real exchange rate has long served as an embarrassment of riches. Chinn (2006), for example, reviews the literature and determines that the selection of effective exchange rate measures depends on the economic issue being analyzed.

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This paper provides evidence that the choice of exchange rate measure is central to understanding FDI. We demonstrate that the most appropriate exchange rate measure depends on the type of FDI being considered, and that use of industry-level data on FDI is essential for this purpose. For example, if FDI is intended to break into domestic markets (which we term "domestic-oriented" FDI), profits will depend in part on the price of imports to the extent that imported inputs are required for production. Thus, an import-weighted exchange rate measure would appear to be the best exchange rate choice for this type of FDI. On the other hand, FDI intended to create export platforms to produce for sale in a third-country market (termed "export-oriented" FDI) may be more closely tied to other measures. Many studies that presume an export role for FDI concentrate on trade-weighted exchange rate measures. However, because countries compete to attract FDI, an exchange rate measure that accounts for the exchange rates of rival nations, even if they are not large trade partners, may be more appropriate. This may be particularly true for developing nations where South-South trade is relatively small.

Studies that focus on aggregate FDI flows, for which data are more readily available, cannot distinguish between these variants of FDI, and this represents a clear shortcoming *if* each type of FDI is most influenced by a different exchange rate measure. In this paper, we focus on industry-level data that allow us to test this theory. By using disaggregated Japanese FDI data on flows between 1989 and 2003, we can differentiate between export- and domestic-oriented FDI. We then empirically investigate the relationship between different exchange rate indices and these two types of FDI. We construct a set of industry-specific trade-weighted real effective exchange rates. In addition, we create a measure of exchange rate competitiveness that uses the global export shares of competitors as weights.

Our results shed new light on key competing theories of FDI, providing some support for those that suggest exchange rate volatility encourages export-oriented FDI, but not for those that suggest exchange rate volatility (as a trade barrier) should increase domestic-oriented FDI. Using disaggregated FDI data, we find that both the level and volatility of the exchange rate significantly affect the share of Japanese FDI received by the host country. Both depreciation of the local currency and lower exchange rate volatility encourage FDI, consistent with most theoretical predictions. However, we also find that this is more the case with industries oriented toward the domestic market as opposed to industries oriented toward exports. The difference is significant, with export-oriented FDI sometimes responding *positively* to certain kinds of exchange rate volatility. In addition, we find that the bilateral exchange rate between host and source matters, but that broader exchange rate measures contain additional information. In particular, volatility in exchange rates with competitors for FDI better explains how FDI is allocated than trade-based measures.

After a brief literature review in section 2, section 3 presents the data and the empirical model. The main results are provided in section 4. Section 5 concludes.

2. Literature Review

In general, the theoretical impact of exchange rate levels and volatility on FDI is ambiguous and depends significantly on the motives behind the investment (Cushman 1985). Lower exchange rate levels—implying that the host country's currency is relatively depreciated—mean lower costs of production and hence a more attractive investment location for export-oriented FDI. However, a lower exchange rate level may also imply lower dollar profits for domestic-oriented FDI once local revenues are converted into the source country's currency.

The effect of exchange rate *volatility* also depends on the orientation of FDI, but with more exceptions. Since domestic-oriented FDI is a substitute for trade, high exchange rate volatility may foster increased FDI flows given that producing goods locally would reduce mismatches between local prices, costs, and revenues caused by exchange rate shocks. Alternatively, if the production from FDI is reexported back to the source country or to a third market, the variability of the exchange rate introduces additional risk in multinational cashflows leading to reduced FDI. However, the uncertainty created by this volatility gives rise to an options value of enhancing production flexibility by investing in several countries simultaneously and rotating production to whichever country provides the cheapest production platform (Aizenmann 1992, 2003; Sung and Lapan 2000). Yet uncertainty also creates an options value to wait and see (how uncertainty might be resolved) before committing to an investment, a prospect that leads to a negative relationship between volatility and FDI (Dixit 1989; Campa 1993).

In light of the ambiguity found in the literature, it is not surprising that empirical studies using *aggregate* data display mixed results. For example, using country level FDI flows, Cushman (1985) and Goldberg and Kolstad (1995) find a positive relationship between exchange rate volatility and FDI. In seeming contradiction, Bénassy-Quéré, Fontagné, and Lahrèche-Révil (2001), using data on FDI flows from OECD countries to developing countries, provide empirical evidence of a negative relationship between exchange rate volatility and FDI. With respect to Asia, where the empirical focus of this paper lies, Bayoumi and Lipworth (1997) and Goldberg and Klein (1998) examine the effect of exchange rate movements on Japan's outward FDI and the linkages between trade flows and FDI. They show that the exchange rate depreciation of the host country encourages FDI from Japan and Japanese FDI increases both the export and import linkages of Southeast Asia. However, the volatility of exchange rate is not considered in their studies.

Baek and Okawa (2001) also use industry-level data (in combination with aggregate data) in their investigation of Japanese manufacturing FDI in Asia. They explore the impact of the behavior of various bilateral exchange rates and find that appreciation of the yen against the Asian currencies or against the dollar increases Japanese FDI to Asian countries significantly. Although a depreciation of the Asian currencies against the dollar had no significant impact on the FDI in aggregate manufacturing, it did increase FDI into the export-oriented electrical machinery sector. Industry-level differences matter.

In our view, however, the common use of the bilateral real exchange rate between the source and host countries is flawed. Countries now engage with more international trade and investment partners than in previous decades. Because bilateral exchange rates may prove misleading, the U.S. Federal Reserve (Leahy 1998) and the IMF construct aggregate "effective" exchange rates from weighted averages of bilateral exchange rates. While these indices focus on economy-wide prices, Goldberg (2004) argues that the use of industry-specific indices is more effective. She shows that use of aggregate indices misses the empirical importance of the exchange rate on producer profits in specific industries.

We therefore construct industry-specific trade-weighted exchange rates for five Asian countries for use in our empirical estimation, including one that focuses on competitors for third-country market share and not, as is traditional, on trade partners. We then test how well these various exchange rate measures explain FDI behavior at the industry level.

3. Data and Empirical Approach

Our investigation uses Japanese FDI data by country disaggregated at the industry level. The panel data include FDI flows to China, Indonesia, Malaysia, the Philippines, and Thailand in 18 industries from 1989 to 2003.[1] Outside of the major industrialized countries, these were the prime recipients of Japanese FDI, with China alone receiving 25% of manufacturing investment over this period and another 42% going to the Southeast Asian countries. The industries examined in this study, data, and definitions are described in the data appendix and include nine manufacturing and nine nonmanufacturing categories.[2]

There are significant advantages in focusing on Japanese FDI to this region. FDI is conceivably motivated by a variety of factors, including global shocks and events in the FDI source countries. By focusing on a single source country—Japan—during a period of significant FDI outflows and restricting our hosts to countries known to be competitors in the same markets, we have designed our study to filter out as many alternative factors as possible, including differences in membership in trade arrangements such as the common market area of the European Union or regional trade agreements such as the North American Free Trade Agreement, large differences in level of development, and regional differences of location.[3] In purely pragmatic terms, industry-level data on FDI flows is very difficult to find and yet exists for Japanese FDI in each of these countries. Even restricting our attention to these five hosts, they account for nearly 70% of FDI flows from Japan to non-OECD countries.

The FDI data exhibit a wide variety of patterns across industries, illustrating how the determinants of FDI may be masked if aggregate FDI data are used in an empirical analysis. Figure 1 displays the industry breakdown of FDI flows in electrical, chemicals, metals, and service. China is the top destination of FDI in the electrical sector. FDI in chemical products is mainly concentrated in Indonesia, while Thailand is on average the prime recipient of FDI in the metal industry. As shown in the figure, China and Indonesia dominate FDI in the business service sector, which is not surprising given that these are the two largest countries by population and aggregate GDP.

We focus on FDI flowing to countries by industry (rather than aggregate country-level data) to address industry-level heterogeneity in understanding the connection between FDI flows and exchange rates. We also focus on the period before the Asian crisis, 1989 to 1996. The greater stability of this period provides a better sample period for isolating the effects of exchange rates on FDI flows.

Although most studies focus on FDI levels, we work with the *share* of FDI that countries receive out of the total amount of global FDI for the following reasons. First, FDI levels may reflect global economic conditions or source country circumstances (beyond control of the host country) that cause global FDI levels to rise or fall.[4] Second, FDI levels at the aggregate country level are typically nonstationary (Choi and Jeon 2007), while FDI shares are not. We verified that this was the case with our data after conducting panel unit root tests on the

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[1] Note that our data, like most FDI data, do not distinguish between new investment and mergers and acquisition. Blonigen (1997) provides evidence on how this distinction can create differences in the relationship between exchange rates and FDI.

[2] The nonmanufacturing sector titled "others" is dropped because it includes only five observations.

[3] There is evidence that distance matters for FDI as it does for trade (Di Giovanni 2005).

[4] It is even possible that the level of FDI a country receives may rise even as the share of global FDI attracted by the country falls, and vice versa.

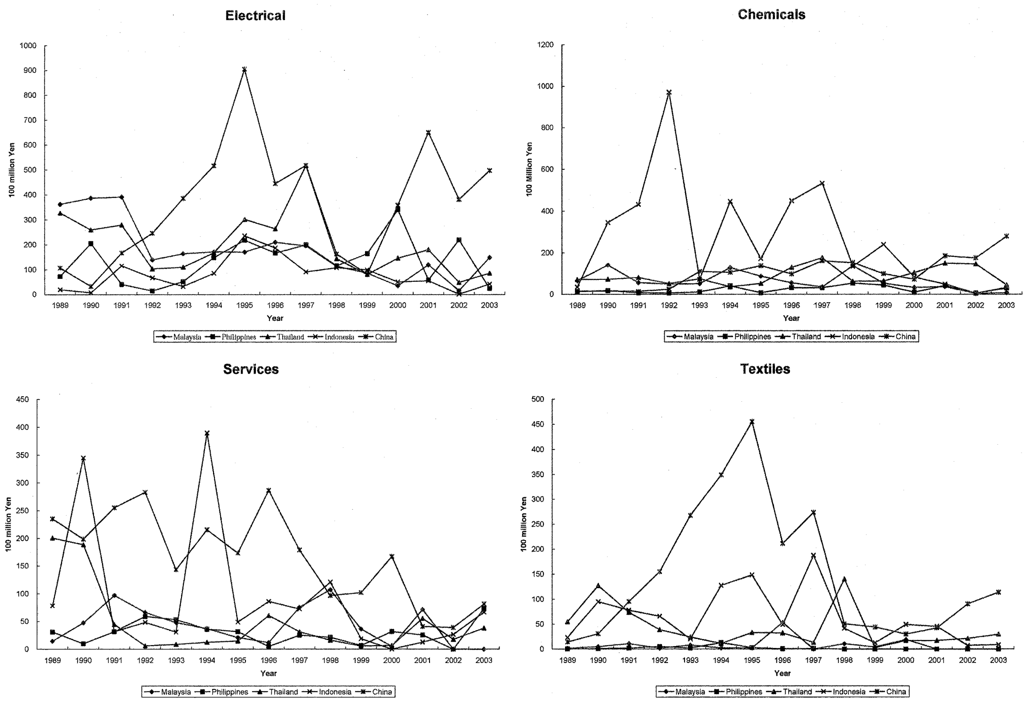

Figure 1. FDI Flows from Japan to Asian Countries by Selected Industries

precrisis data.[5] Third, external common unobserved shocks may still influence the levels of FDI flows and exchange rates simultaneously. Goldberg and Kolstad (1995) stress the general equilibrium link between exchange rate shocks and demand shocks (domestic and foreign), which has implications for FDI flows. Shares of FDI, on the other hand, control for outside macroeconomic shocks that are common across the potential hosts and industries, and this allows us to maintain our focus on how host countries' exchange rate behavior influences FDI.[6]

Given that our dependent variable, the share of FDI, is bounded above and below, we need to account for censored observations, and hence we use a Tobit specification for our estimation. At the industry level, approximately 15% of the observations are left censored (implying zero FDI that year in a given country and industry), but none are right censored. The general form of the Tobit model is

$$FDI_{jt}^{i} = \beta_0 + \beta_1 EX_{jt}^{i} + \beta_2 VOL_{jt}^{i} + \beta_3 X_{jt} + \beta_4 FE + \varepsilon_{ijt},$$

where ε_{ijt} is an idiosyncratic error term uncorrelated with the regressors defined below, assumed to be *iid* and distributed $N(0, \sigma^2)$. The dependent variable, FDI_{jt}^{i}, refers to the FDI share constructed by dividing the FDI flows from Japan to country *j* in industry *i* in a given year *t* by the overall FDI flows from Japan to all non-OECD countries in industry *i*, or $FDI_j^i \Big/ \sum_k FDI_k^i$, where k indexes all non-OECD countries.

[5] The tests are (i) Levin, Lin, and Chu; (ii) Im, Pesaran, and Shin; and (iii) Augmented Dickey-Fuller-Fisher chi-square tests. The same tests conducted over all the years, 1989 to 2003, produced nearly identical results. At the aggregate level, we cannot reject the null hypothesis of a unit root for FDI levels, but we do reject it for the aggregate FDI share in one test (out of three). Upon disaggregating FDI at the industry level or using shares, however, we can reject the null at the 1% level in all tests.

[6] Nevertheless, our results using FDI levels instead of shares, available upon request, tell largely the same story.

EX indicates an indexed exchange rate measure in natural logs. We use the bilateral exchange rate as our benchmark, $rer_{j,\text{Japan}} = ER_{j,J}CPI_j/CPI_{\text{Japan}}$, where $ER_{j,J}$ is the nominal exchange rate between country j and Japan, and CPI is the consumer price index.[7] We also construct three additional industry-specific trade-weighted exchange rates following Goldberg (2004):

$$EX^i_{j,t} = \sum_k w^i_{jk,t} rer_{jk,t},$$

where $rer_{jk,t}$ is the bilateral real exchange rate between country j and its trading partner k at time t. The weights $w^i_{jk,t}$ differ by trade measure and vary over time to reflect changing trading patterns. The weights will be the share of country k in country j's exports in industry i for the export-weighted measure, the share of imports from country k for the import-weighted measure, and a simple average of the export- and import-weighted measures for the trade-weighted measure. Trade partners with less than 0.5% share in exports or imports are excluded.[8] The selection of countries to include is based on trade shares in 1997, the midpoint of our entire sample. We used Standard International Trade Classification (SITC) revision 3 trade data from the United Nations' Comtrade database to map the FDI industry designations to the trade data.[9]

We also construct an index based on the exchange rates of competitors (not trade partners) given that, when multinationals decide to invest abroad, they compare the attractiveness of potential host countries in terms of cost, openness, risk, and other factors. In this case, the weights, $w^i_{jk,t}$, are given by the global export share of competitor k to host country j in each industry i.

At the country level, all exchange rate measures are positively correlated with correlation coefficients ranging between 0.64 and 0.98. At the industry level, however, correlation coefficients fall as low as 0.48, indicating significant variation. Of course, because Japan is a major trade partner with these countries, the trade-based measures (which are all highly correlated with one another) are much more correlated with the bilateral host/yen exchange rate than are the competitor-based measures. The competitor-weighted exchange rate shows the lowest degree of correlation with the other measures, indicating that although these hosts often compete in the same export markets, the overlap is limited.

VOL likewise represents one of several measures of exchange rate volatility. Our benchmark, used in literature, is calculated as the natural log of the standard deviation of the monthly real exchange rate over the previous three years, normalized by the mean level during that period (Baek and Okawa 2001; Bénassy-Quéré, Fontagné, and Lahrèche-Révil 2001). Industry-specific volatility measures, using the same trade-weighting schemes described above, correspond to each different exchange rate measure. In general, the weighted volatility

[7] Exchange rate and price-level data are from the International Financial Statistics. We use the consumer price index (CPI) instead of the producer price index (PPI) to adjust nominal variables because a large number of countries in our dataset do not report PPI figures. Therefore we choose to treat the data consistently by using the CPI, which is generally available.

[8] The simple average for the trade-weighted measure follows both Goldberg (2004) and the Federal Reserve. The 0.5% cutoff is the same criterion used by the Federal Reserve. Some countries were excluded because of a lack of available exchange rate or CPI data even though they met the 0.5% criterion, but they were all relatively small trading partners. The Appendix provides more details.

[9] For the nonmanufacturing industries, we used the weights for the manufacturing "others" designation as a reasonable proxy for the diversity among the nonmanufacturing categories.

measures exhibit a higher degree of correlation than the level indices. The correlation coefficients range from 0.71 to 0.97. However, the bilateral volatility measure exhibits the least correlation with the other measures.

X is a set of control variables other than the exchange rate that theoretically affect FDI, including market size, *per capita* income, labor costs, worker productivity, expected returns, and capital account openness. For example, large market countries (proxied by the natural log of real GDP) are more attractive for domestic-oriented FDI, implying a positive relationship between GDP and the FDI share for domestic-oriented industries. The standard of living is controlled for by including the log of real *per capita* GDP.

The cost of production and the productivity of labor are key influences on FDI but are difficult to disentangle given the data we have. We start with disaggregated industry-level wage data for manufacturing sectors in each country from the International Labor Organization (ILO) Laborsta database. We construct a wage index for each industry by dividing the host country industry-level wage (converted into yen at current exchange rates) by the yen wage in Japan (see Appendix). The effect of higher wages on FDI is ambiguous given that higher wages do not necessarily imply higher unit costs of production if they are matched by higher productivity. To the extent that productivity lags behind wage gains, or that these jobs require few skills by nature, we expect higher wages to have a negative impact on export-oriented FDI. For domestic-oriented FDI, higher wages may reflect greater purchasing power, which would have a positive effect on FDI. Including *per capita* GDP may help to control for this at the cost of some degree of collinearity.

An increase in the real interest rate differential between the host country and Japan may indicate an increase in risk (which would tend to lower FDI) or an increase in demand (which would tend to raise FDI). Given that we already proxy for demand through GDP and GDP *per capita*, we expect the differential to pick up risk not otherwise captured in exchange rate volatility, and thus expect a negative coefficient.[10]

We use the Chinn-Ito (Chinn and Ito 2005) measure of financial openness to control for host country restrictions on FDI. Both Montiel and Reinhart (1999) and Asiedu and Lien (2003) find empirical evidence of negative effects of capital controls on FDI flows. The Chinn-Ito index accounts for multiple exchange rates, restrictions on current and capital account transactions, and any requirement to surrender proceeds from exports. A larger index implies greater financial openness and an expected positive effect on the FDI share.

In addition to the bilateral exchange rate between the source (Japan) and the host country, we include the yen/dollar exchange rate index and volatility given that previous studies find that an appreciation of the yen against the dollar is associated with an increase in FDI flowing to Southeast Asia (Goldberg and Klein 1998).[11] Finally, *FE* denotes country and industry fixed effects, which turn out to be highly significant in the majority of our Tobit regressions. Including these fixed effects, particularly the industry dummies, alters the empirical results, underscoring the importance of using industry-level data.[12]

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[10] The real interest rates of the five Asian countries and Japan are obtained from the World Bank's World Development Indicator database.

[11] We also controlled for the world business cycle and the aggregate level of Japanese FDI in each year, but these variables were never significant and did not affect the results.

[12] We employed time fixed effects, but they were generally not significant, individually or jointly (except in one case), and had no impact on the coefficients of interest and so were dropped.

4. Results

Our key objective is to determine how the sensitivity of FDI to the exchange rate changes across different industry types and exchange rate indices. We consider two factors in particular: (i) whether pooling industries by export orientation reveals heterogeneity in the response of different *types* of FDI to the exchange rates; and (ii) how much additional information alternative exchange rate levels and volatility provide. It is helpful to discuss how we evaluate these issues in advance.

We begin by analyzing the relationship between FDI and exchange rates across all sectors in data to obtain the baseline results. We then exploit our industry-level data by identifying, within the manufacturing sectors, export-oriented versus domestic-oriented industries. The review in section 2 suggests that domestic-oriented FDI will be more sensitive to the level of the exchange rate because it implies changes in the purchasing power of host country consumers (Cushman 1985). We do, indeed, find strong evidence of this effect. As discussed earlier, the predictions for the effect of exchange rate volatility on FDI are ambiguous. On the one hand, higher volatility increases risk and thus raises the value of deferring FDI until uncertainty is resolved, leading to a negative effect on FDI. Alternatively, Aizenmann (1992, 2003) and Sung and Lapan (2000) suggest that higher volatility should increase FDI specifically in export-oriented industries because it encourages firms to maintain greater production flexibility. Our results show that volatility is negatively related to FDI for domestic-oriented industries and statistically different for export-oriented industries. Moreover, we find some evidence that the relationship could be positive, in a manner consistent with Aizenmann and Sung and Lapan's theories, if one focuses on the exchange rate of the host against the export markets.

We then test whether the alternative measures used throughout this paper can answer the question posed in the title. By pairing measures, we can test whether any measure outperforms the others. Not surprisingly, we find that the level of the bilateral exchange rate between source and host is always important. We also find that measures based on trade weights add some, but not much, additional information. By contrast, we find that volatility in the exchange rate against alternative hosts (the competitor-weighted measure) matters more than any other type of volatility.

Baseline Results

Our baseline results are reported in Table 1, which uses data on 18 sectors and five countries from 1989 to 1996 that we pool together into a single panel. We use a Tobit analysis to account for censored observations and report the corrected marginal effects.[13] Results are organized by type of exchange rate measure, and for each measure we report results based on

[13] The Tobit coefficients reported show the marginal impact of a change in the explanatory variables accounting for the censored observations. Actual estimated coefficients, which show the marginal impact on the latent variable, are available upon request. We only report results using data from 1989 to 1996 because of the Asian financial crisis that began in 1997. Estimated coefficients with respect to the control variables (GDP and GDP *per capita* in particular) were highly sensitive to the period used, implying that they were accounting for country-specific outcomes of the Asian crisis. For example, Indonesia experienced a political crisis that compounded the economic distress and strongly discouraged FDI inflows, while Malaysia implemented capital controls that stabilized the economy fairly swiftly, thereby restoring FDI flows more quickly. We performed additional regressions splitting the sample period, using time dummies, and dropping the years immediately surrounding the crisis, with no significant changes. These results, available upon request, led us to conclude that the precrisis years better represent the general case.

Table 1. Impact of Exchange Rates on FDI Shares at Industry Level

	Bilateral			Export-Weighted			Import-Weighted			Trade-Weighted			Competitor-Weighted		
Regressors	No (1)	Industry (2)	Both (3)	No (4)	Industry (5)	Both (6)	No (7)	Industry (8)	Both (9)	No (10)	Industry (11)	Both (12)	No (13)	Industry (14)	Both (15)
RER	−0.2713***	−0.2837***	−0.3586***	−0.2600***	−0.2461***	−0.2267***	−0.2827***	−0.2801***	−0.2499***	−0.2300***	−0.2225***	−0.2457***	−0.2462***	−0.2632***	−0.3557***
	(−5.42)	(−5.93)	(−4.62)	(−5.32)	(−5.31)	(−3.04)	(−5.87)	(−6.14)	(−4.56)	(−5.90)	(−5.95)	(−4.03)	(−5.50)	(−6.11)	(−5.13)
VOL	−0.0585**	−0.0433*	0.0051	−0.0366*	−0.0189	0.0537*	−0.0539**	−0.0444*	−0.0054	−0.0420**	−0.0302*	0.0139	−0.0693***	−0.0645***	−0.0312
	(−2.53)	(−1.95)	(0.17)	(−1.82)	(−0.97)	(1.79)	(−2.20)	(−1.88)	(−0.21)	(−2.32)	(−1.70)	(0.50)	(−3.68)	(−3.51)	(−1.09)
$wage_{t-1}$	0.0035**	−0.0026	0.0009	0.0047**	−0.0023	0.0025	0.0041*	−0.0028	0.0012	0.0034**	−0.0020	0.0018	0.0038**	−0.0017	0.0011
	(2.11)	(−1.29)	(0.39)	(2.24)	(−0.91)	(0.86)	(1.91)	(−1.12)	(0.54)	(2.08)	(−0.97)	(0.75)	(2.30)	(−0.84)	(0.50)
$r_j - r_{Japan}$	0.0025*	0.0014	−0.0019	0.0011	−0.0001	−0.0061**	0.0011	−0.0004	−0.0031	0.0007	−0.0004	−0.0039*	0.0011	0.0000	−0.0018
	(1.69)	(0.95)	(−0.83)	(0.60)	(−0.04)	(−2.20)	(0.62)	(−0.23)	(−1.44)	(0.45)	(−0.29)	(−1.76)	(0.75)	(0.01)	(−0.82)
GDP^j_{t-1}	0.1133***	0.0992***	0.9020	0.1406***	0.1195***	1.2672*	0.1362***	0.1177***	0.4576	0.1103***	0.0962***	0.7124	0.1049***	0.0937***	0.3014
	(9.07)	(8.00)	(1.63)	(9.07)	(7.78)	(1.73)	(9.19)	(8.06)	(0.83)	(9.33)	(8.08)	(1.25)	(9.25)	(8.30)	(0.48)
GDP^{Japan}_{t-1}	−0.3506**	−0.3195*	−1.0260**	−0.4413*	−0.3990*	−1.6346***	−0.4447**	−0.3996*	−0.7487	−0.3675**	−0.3323**	−0.9929**	−0.3223*	−0.3204*	−0.6942
	(−2.04)	(−1.94)	(−2.32)	(−1.96)	(−1.88)	(−2.65)	(−2.00)	(−1.91)	(−1.64)	(−2.12)	(−2.00)	(−2.08)	(−1.79)	(−1.86)	(−1.26)
$GDPpc^j_{t-1}$	0.0128	0.0348***	−0.7168	0.0126	0.0360**	−0.8647	0.0066	0.0298*	−0.3057	0.0078	0.0260**	−0.5126	0.0010	0.0207	−0.2352
	(1.05)	(2.78)	(−1.45)	(0.82)	(2.32)	(−1.35)	(0.42)	(1.90)	(−0.64)	(0.65)	(2.12)	(−1.04)	(0.08)	(1.61)	(−0.43)
Yen/$ EX	0.3402***	0.3519***	0.4389***	0.1800*	0.1735*	0.2930*	0.1872*	0.1846*	0.1307	0.1460*	0.1438*	0.1597	0.0779	0.0739	−0.0541
	(3.70)	(4.01)	(3.29)	(1.71)	(1.75)	(1.69)	(1.78)	(1.87)	(0.97)	(1.79)	(1.85)	(1.17)	(0.95)	(0.94)	(−0.36)
Yen/$ VOL	0.0583	0.0437	−0.0549	0.0332	0.0263	−0.0975	0.0349	0.0236	−0.0349	0.0244	0.0177	−0.0529	0.0276	0.0205	−0.0115
	(1.18)	(0.93)	(−0.88)	(0.53)	(0.44)	(−1.32)	(0.56)	(0.40)	(−0.61)	(0.51)	(0.38)	(−0.90)	(0.57)	(0.44)	(−0.19)
KC_{t-1}	0.0206***	0.0234***	0.0461***	0.0290***	0.0302***	0.0573***	0.0258***	0.0275***	0.0376***	0.0218***	0.0233***	0.0407***	0.0208 ***	0.0228***	0.0343***
	(5.36)	(6.33)	(3.98)	(6.18)	(6.82)	(3.93)	(5.39)	(6.09)	(3.24)	(6.01)	(6.69)	(3.50)	(5.50)	(6.29)	(2.73)
F-tests															
Industry		5.10***	4.52***		4.73***	4.31***		4.89***	4.30***		4.75***	4.18***		5.07***	4.41***
Country			4.49***			4.21***			3.07**			3.50***			2.60**
No. obs.	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616
Left-censored	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Log-likelihood	301.99	342.82	351.66	301.52	339.58	347.89	304.48	343.75	349.83	304.62	342.79	349.72	304.99	345.58	350.75

Dependent variable is the share of non-OECD Japanese FDI flows by industry. All coefficients report the unconditional marginal effects correcting for the nonlinearity in the Tobit model. Column headings (bilateral, export, import, trade, and competitor weighted) indicate the exchange rate measures used in RER and VOL in first column and described in section 3. Subcolumn headings "No," "Industry," and "Both" indicate, respectively, no country or industry dummies included, industry dummies only included, and both country and industry dummies included in the regression. Other regressors include lagged real wage, the interest rate differential, lagged ln GDP and ln GDP per capita in host country, lagged ln GDP of Japan, and the yen/dollar exchange rate levels and volatility, and the Chinn-Ito financial openness measure. *T*-statistics are in parentheses. All tests are Tobit specifications.

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

which dummies are used: none, industry only, or industry and country. The strong statistical significance of industry dummies in our results indicates that industry-level heterogeneity matters. In general, once both industry and country dummies are included, the only variables that are consistently statistically significant are the real exchange rate level and capital control measure.

The coefficients on the level and volatility of the exchange rates show the sensitivity of FDI share changes in percentage point terms. The total level of FDI to non-OECD countries from Japan in 1996 was about $1.6 billion. Thus, a one percentage point change in share is worth approximately $16 million in FDI from Japan alone. For example, in column 6 using the export-weighted measures, a 10% appreciation against export partners implies an annual loss of over 2.3% of the FDI share or $36 million. Similarly, a 10% increase in volatility against export partners, in contrast, would lead to more than half a percentage point share (or $9 million) *increase*—an interesting result that we discuss further below.

To put these results into a broader context, compare the implications of the coefficients on trade and competitor-weighted measures. The trade-weighted coefficient (column 12 of Table 1) implies that a 10% appreciation of a host currency against its major trading partners would lead to a loss of 2.5 percentage points of FDI share. For Indonesia in 1996, this would have implied an annual loss of $40.35 million out of $200 million of Japanese FDI in Indonesia. If the appreciation occurs relative to competitor nations, the loss is nearly 3.6 percentage points in share on average or $58 million in FDI from Japan. Consider, for example, recent arguments that the Chinese currency is seriously overvalued, requiring as much as a 20% revaluation. If the exchange rates of China's competitors hold steady in the wake of such a large change, China could stand to lose over $114 million dollars annually in Japanese FDI.

Export Orientation

We test for differences in the coefficients for domestic- and export-oriented industries as follows. We use data from the Japanese Ministry of Industry and Trade to compute export-to-sales ratios for Japanese firms operating in these countries by manufacturing industry categories (with the exception of "manufacturing other").[14] Among the eight manufacturing industry categories in our data set, industrial machinery, electrical, textiles, and metals have the highest export-to-sales ratios. We therefore classify these four industries as high export-to-sales ratio (HES) industries and the other manufacturing sectors as low export-to-sales ratio (LES) industries. The LES industries include food and tobacco, lumber and pulp, chemicals, and transport (the Appendix contains more details). As an approximation, we consider FDI in HES industries to be export-oriented, and FDI in LES industries as domestic-oriented.

To see whether the level and volatility of the exchange rate affects FDI in these two types of industries differently, we use a dummy-interaction variable to separate the HES from the LES industries. The dummy variable takes on a value of one if the industry is LES and zero otherwise. We perform Chow tests to uncover significant differences in coefficients across

[14] We also used a method similar to the one described to differentiate between manufacturing and nonmanufacturing industries under the premise that nonmanufacturing is domestic-oriented and manufacturing is export-oriented. The results were broadly similar. However, because we could not construct industry-specific exchange rate measures for nonmanufacturing industries as explained in section 3, we put less weight on these estimates and do not report them here.

industry types. A statistically significant coefficient on the interaction term indicates that the coefficient for the LES industries is significantly different from that of the HES industries. We also report the implied total value of the coefficient for LES industries. The joint tests given below each interaction term refer to an *F*-test on the nulls that $RER + RER * LES = 0$ and $VOL + VOL * LES = 0$. A rejection of the null hypothesis indicates that the computed coefficient for the LES industries is significantly different from zero.

All exchange rate levels are highly statistically significant and negative for *both* HES and LES industries. The interaction term $RER * LES$ is never significant and hence we cannot reject that the exchange rate coefficient is identical for both kinds of industries. Volatility, on the other hand, is only significant for HES industries when using the export- and trade-weighted measures (and only slightly so for the latter). However, for LES industries, exchange rate volatility is significant for the import- and competitor-weighted measures (as seen in the joint tests), and in all cases the interaction term makes clear that the volatility coefficient for LES industries is significantly different from that for HES industries.

Does volatility discourage FDI or act instead as a barrier to trade that encourages FDI as a means of evasion? The most striking aspect of this difference between industries is that the coefficient on exchange rate volatility is usually positive or indistinguishable from zero for HES industries but is reliably *negative* for LES industries. This result is consistent with the export-oriented production-flexibility arguments of Aizenmann (1992, 2003) and Sung and Lapan (2000). We find that volatility either has no impact on HES FDI and possibly even a positive impact when one considers the volatility against the export markets. By contrast, volatility clearly lowers FDI for the LES industries where revenues are more directly linked to the host exchange rate. This provides evidence against theories claiming volatility induces greater FDI by acting as a trade barrier.

Also striking is that the volatility effects for HES and LES industries tend to cancel each other out when we do not distinguish by type as in Table 1 (see coefficients on $VOL + VOL * LES$ in Table 2). The positive volatility coefficient on the export-weighted specification in Table 1 (the only measure for which volatility was previously significant) is misleading in that it balances significant coefficients on the HES and LES industries that pull in different directions. As a result of differentiating, the magnitudes of the coefficients on the exchange rate levels (for both LES and HES industries) are from 16% to 74% higher than the estimates in Table 1. As in Table 1, the magnitude of the coefficients on the competitor-weighted and bilateral measures are generally much larger than that of the other measures. In this case, a 10% revaluation by China *vis-a-vis* its competitors would cost it over 6% of total Japanese manufacturing FDI (China has averaged 17% of this FDI since 2002, which would thereby drop to 11%).

Once we control for differences between LES and HES industries, the cost variables (i.e., the wage and interest rate differentials) become significant (the wage variables strongly so, the interest rate differential intermittently). This stands in contrast to the lack of significance of these variables in Table 1 (when both dummies are present). While the negative sign on the interest rate differential matches our expectations, the robust positive coefficient on the wage strongly suggests that it serves as a proxy for productivity, rather than as a reflection of costs. Under this interpretation, FDI inflows in manufacturing are positively related to labor productivity. We interpret the general lack of significance of the industry fixed effects in these regressions as confirmation that a focus on export orientation captures the key heterogeneity across industries that matters for FDI.

Table 2. High Export-Sales versus Low Export-Sales Manufacturing Industries

	Bilateral High	Export-Weighted High	Import-Weighted High	Trade-Weighted High	Competitor-Weighted High
RER	−0.6077*** (−4.81)	−0.2474** (−2.38)	−0.4063*** (−4.21)	−0.3960*** (−3.65)	−0.6175*** (−5.17)
VOL	0.0608 (1.16)	0.1204*** (3.16)	0.0386 (0.94)	0.0786* (1.76)	−0.0045 (−0.09)
RER ∗ *LES*	0.0101 (0.12)	−0.0176 (−0.17)	0.0160 (0.16)	−0.0319 (−0.31)	0.1305 (1.18)
RER + *RER* ∗ *LES* (*Joint test*)	−0.5976*** (22.06)	−0.2650** (5.79)	−0.3903*** (18.54)	−0.4279*** (14.87)	−0.487*** (17.12)
VOL ∗ *LES*	−0.1001** (−2.43)	−0.0941*** (−2.78)	−0.1123*** (−3.15)	−0.1203*** (−3.31)	−0.0762* (−1.87)
VOL + *VOL* ∗ *LES* (*Joint test*)	−0.0393 (0.57)	0.0263 (0.44)	−0.0737* (3.29)	−0.0417 (0.76)	−0.0807* (2.96)
$wage_{t-1}$	0.0083** (2.52)	0.0072** (2.16)	0.0086** (2.61)	0.0081** (2.46)	0.0083** (2.52)
$r_j - r_{Japan}$	−0.0049 (−1.34)	−0.0106*** (−3.16)	−0.0075** (−2.26)	−0.0085** (−2.50)	−0.0052 (−1.47)
GDP^j_{t-1}	0.6579 (0.76)	0.7042 (0.78)	0.1027 (0.12)	0.3721 (0.42)	−0.3213 (−0.33)
GDP^{Japan}_{t-1}	−0.9648 (−1.40)	−1.3944* (−1.88)	−0.5986 (−0.85)	−0.9640 (−1.32)	−0.4073 (−0.48)
$GDPpc^j_{t-1}$	−0.5425 (−0.71)	−0.2633 (−0.34)	0.0259 (0.03)	−0.1578 (−0.21)	0.2850 (0.34)
Yen/$ EX	0.5080** (2.40)	0.2169 (1.01)	0.0647 (0.31)	0.1024 (0.48)	−0.2659 (−1.14)
Yen/$ VOL	−0.0427 (−0.43)	−0.0835 (−0.91)	−0.0062 (−0.07)	−0.0357 (−0.38)	0.0275 (0.29)
KC_{t-1}	0.0449** (2.43)	0.0502*** (2.77)	0.0370** (2.01)	0.0432** (2.36)	0.0273 (1.37)
F-test					
Industry	1.03	1.33	1.57	1.31	1.82*
Country	6.92***	7.26***	6.10***	6.57***	4.85***
No. obs.	276	276	276	276	276
Left-censored	6	6	6	6	6
Log-likelihood	194.26	187.59	191.8	191.08	192.64

Dependent variable is the share of non-OECD Japanese FDI flows by industry. All coefficients report the unconditional marginal effects correcting for the nonlinearity in the Tobit model. Data were divided into high export sales and low export sales according to the designations in the Japan Ministry of Finance data. Column headings (bilateral, export, import, and competitor) indicate the exchange rate measures used and described in section 3. All Tobits employ both country and industry dummies. *T*-statistics are in parentheses. Joint coefficients, such as RER+RER∗LES, refer to the sum of the base variable RER and the interaction term that gives the total effect for low export sales categories. The corresponding statistic is the *F*-test for the null hypothesis that this sum is equal to zero. All tests are Tobit specifications.

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Which Exchange Rates Matter?

We now turn to the question posed in the title of the paper, "Which exchange rates matter for FDI?" We want to know whether any of the various weighting schemes add any explanatory power beyond simply using the bilateral exchange rate. In order to shed light on which exchange rate measures are most appropriate while still conserving statistical power, we adopt a pairwise technique in which we introduce two exchange rate measures at a time and judge their relative performance. We distinguish between LES and HES industries as above. Our results are given in Table 3. In each column, we list two exchange rates, the first of which is designated *RER*(1) and the second *RER*(2). For example, in the first column, *RER*(1) is the bilateral measure and *RER*(2) is the export-weighted measure. We collect all of the exchange rate level terms in the first horizontal "box." The second box contains all of the exchange rate volatility terms, while the third contains statistical tests on whether the exchange rate measures are significantly different. Each regression also employs all of the explanatory variables used previously, but they are not reported to conserve space.

We find that the bilateral exchange rate significantly affects FDI share but does not tell the whole story, particularly with respect to the influence of exchange rate volatility. Trade-weighted measures occasionally contribute information but not consistently. However, the competitor-weighted measures do help explain variation in the data. Our results suggest that volatility against rival host nations (the competitor-based measure) is more important than volatility with trade partners. We find striking, yet unsurprising, confirmation that the bilateral exchange rate is robust to the inclusion of broader exchange rate measures. Moveover, the bilateral exchange rate appears equally influential for both the LES and HES industries (all interaction terms involving the LES dummy variable are insignificant).

The same is largely true for the volatility measures with the important exception of the competitor-weighted measure. The pairing of the competitor-weighted measure with the bilateral exchange rate is particularly intriguing. The bilateral exchange rate volatility is weakly significant and *positive* for HES industries, but the competitor-weighted exchange rate volatility measure is significant and *negative* for these same industries. This suggests that, for HES industries, the volatility that increases FDI according to the "production flexibility" arguments discussed above is between source and host and not across competitors. Increased volatility relative to alternative host locations decreases FDI share.

The final three columns compare the two relevant trade-weighted measures with each other and with the competitor-weighted measure.[15] In the first pairing, the exchange rate level is significant only for the import-weighted measure. The export-weighted volatility coefficient remains positive and robust for the HES industries, and tests reported at the bottom of the table show that the two volatility measures are significantly different for HES industries.

When pairing the export-weighted measure with the competitor-weighted measure, we find that the level of the competitor-weighted measure is negative and significant only for the HES industries. This most likely reflects the need for cost competitiveness in the export-oriented industries. In addition, the signs on the volatility measures are significant and of opposite sign for the HES industries (again). For the combination of the import- and competitor-weighted exchange rate measures, we anticipated that the competitor-weighted measure would be more

[15] We exclude the trade-weighted measure, which is merely a simple average of the import- and export-weighted measures.

Table 3. Direct Comparison of ER Measures

	Bilateral (1) Export-Weighted (2)	Bilateral (1) Import-Weighted (2)	Bilateral (1) Trade-Weighted (2)	Bilateral (1) Competitor-Weighted (2)	Export Weighted (1) Import-Weighted (2)	Export Weighted (1) Competitor-Weighted (2)	Import Weighted (2) Competitor-Weighted (2)
RER(1)	−0.8801*** (−4.16)	−0.4987** (−2.50)	−0.6352*** (−2.69)	−0.6466** (−2.48)	0.0075 (0.04)	0.2784 (1.59)	−0.0307 (−0.18)
RER(2)	0.2915* (1.66)	−0.1324 (−0.86)	0.0304 (0.15)	0.0214 (0.08)	−0.3908** (−2.25)	−0.7853*** (−3.74)	−0.5707*** (−2.60)
RER(1) ∗ *LES*	0.1100 (0.72)	0.0661 (0.48)	0.1255 (0.80)	−0.0688 (−0.59)	−0.0392 (−0.18)	−0.3752* (−1.83)	−0.3749* (−1.94)
RER(1) + *RER(1)LES* (*H_0*: *RER(1)* + *RER(1)LES* = 0)	−0.7701*** (15.71)	−0.4326** (6.22)	−0.5097** (5.95)	−0.7154*** (7.75)	−0.0317 (0.04)	−0.0968 (0.28)	−0.4056*** (8.80)
RER(2) ∗ *LES*	−0.0837 (−0.48)	−0.0579 (−0.39)	−0.1303 (−0.74)	0.1760 (1.26)	0.0211 (0.10)	0.4624** (2.06)	0.4771** (2.18)
RER(2) + *RER(2)LES* (*H_0*: *RER(2)* + *RER(2)LES* = 0)	0.2078 (1.44)	−0.1903 (2.40)	−0.0999 (0.31)	0.1974 (0.60)	−0.3697*** (8.79)	−0.3229 (2.52)	−0.0936 (0.26)
VOL(1)	−0.0526 (−0.67)	0.0644 (0.95)	0.0056 (0.07)	0.1350* (1.76)	0.1465** (2.50)	0.1767*** (2.81)	0.0237 (0.38)
VOL(2)	0.1157* (1.94)	−0.0225 (−0.40)	0.0498 (0.74)	−0.1262* (−1.67)	−0.0727 (−1.16)	−0.1751** (−2.21)	−0.0393 (−0.53)
VOL(1) ∗ *LES*	0.0280 (0.32)	−0.0415 (−0.49)	0.0087 (0.09)	−0.0771 (−0.94)	−0.1053 (−1.63)	−0.1135 (−1.61)	−0.0248 (−0.33)
VOL(1) + *VOL(1)LES* (*H_0*: *VOL(1)* + *VOL(1)LES* = 0)	−0.0246 (0.14)	0.0229 (0.11)	0.0143 (0.04)	0.0579 (0.69)	0.0412 (0.90)	0.0632 (1.87)	−0.0011 (0.00)
VOL(2) ∗ *LES*	−0.0929 (−1.36)	−0.0689 (−0.96)	−0.1082 (−1.30)	−0.0096 (−0.12)	−0.0001 (−0.00)	0.0751 (0.87)	−0.0576 (−0.67)
VOL(2) + *VOL(2)LES* (*H_0*: *VOL(2)* + *VOL(2)LES* = 0)	0.0228 (0.23)	−0.0914 (2.72)	−0.0584 (0.77)	−0.1358** (4.60)	−0.0728 (2.29)	−0.100* (3.00)	−0.0969 (1.78)
H_0:							
RER(1) = *RER(2)*	10.19***	1.22	2.58	1.76	1.38	8.41***	2.14
RER(1)LES = *RER(2)LES*	8.10***	0.81	1.24	3.41*	1.80	0.38	1.09
VOL(1) = *VOL(2)*	1.72	0.60	0.11	3.41*	3.80*	6.96***	0.25
VOL(1)LES = *VOL(2)LES*	0.22	1.00	0.31	2.55	2.18	3.22*	0.56

Table 3. Continued

	Bilateral (1) Export-Weighted (2)	Bilateral (1) Import-Weighted (2)	Bilateral (1) Trade-Weighted (2)	Bilateral (1) Competitor-Weighted (2)	Export Weighted (1) Import-Weighted (2)	Export Weighted (1) Competitor-Weighted (2)	Import Weighted (2) Competitor-Weighted (2)
F-test							
Industry	0.82	1.17	1.02	1.36	0.90	1.40	1.86*
Country	6.92***	7.52***	6.94***	4.80***	7.04***	4.61***	5.01***
No. obs.	276	276	276	276	276	276	276
Left-censored	6	6	6	6	6	6	6
Log-likelihood	197.08	196.75	194.41	197.83	195.1	197.87	197.3

Dependent variable is the share of Japanese FDI flows by industry and country to all non-OECD countries. Data were divided into high export sales and low export sales according to the designations in the Japan Ministry of Finance data. Column headings (bilateral, export, import, and competitor) indicate the pair of exchange rate measures used in RER and VOL in first column and described in section 3. (1) and (2) refer in order to the listings at the top. All Tobits employ both country and industry dummies. Other regressors include lagged wage, the interest rate differential, lagged ln GDP and ln GDP per capita in host country, lagged ln GDP of Japan, the yen/dollar exchange rate levels and volatility, and the financial openness measure though not all are reported in the table. *T*-statistics are in parentheses. Joint coefficients, such as *RER(1) + RER(1)LES*, refer to the sum of the base variable *RER* and the interaction term that gives the total effect for low export sales categories. The corresponding statistic is the *F*-test for the null hypothesis that this sum is equal to zero. The corresponding tests report the test that the coefficients on the level and volatility of the exchange rate measures are equivalent across the types of industries. All tests are Tobit specifications.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

important for the HES industries, and the import-weighted measure would matter most for the LES industries. Indeed, we do find this result, since the competitor-weighted exchange rate is negative and significant for the HES (but not LES) industries, and the opposite occurs for the import-weighted measure. However, we cannot reject the null that the two measures have the same effect. None of the volatility coefficients are statistically significant under this pairing.

5. Conclusion

This paper contributes to the understanding of the effect of exchange rates on FDI in several ways. First and foremost, we find evidence that the impact of exchange rates on FDI reflects heterogeneity across different types of FDI and that this, in turn, must be addressed with industry-level data. We feel that verifying our results using disaggregated data for other FDI source countries would be an important extension given that our results are based only on evidence for Japan and during a period when Japanese FDI was large and rising. Second, we argue that using the share of FDI as the dependent variable, as opposed to the level, produces more reliable results by controlling for common shocks and avoiding potential problems with nonstationarity of the data series that could generate spurious correlation.

Third, our results help shed light on the validity of competing theories of FDI. For our most tightly focused regressions—those delineating manufacturing industries by export orientation—we find that for industries with a high degree of export orientation the FDI share will depend on the level of the exchange rate measure and is most sensitive to movements in the real exchange rate against rival hosts. Our results support theories that argue that the effect of volatility on FDI may in fact be positive when FDI is export-oriented. However, we find no evidence in support of the theory that an increase in volatility functions as a trade barrier, thereby increasing domestic-oriented FDI. Rather, we find that greater volatility reduces domestic-oriented FDI.

Finally, the competitor-weighted exchange rate allows for a better understanding of how other exchange rates influence FDI flows for two reasons. First, it allows us to isolate a key outside influence on FDI, the source country's own currency movements against other major international currencies (the dollar). Trade-related measures, which include the yen and dollar, are not able to separate the effect of the host country's exchange rate and the yen/dollar exchange rate so cleanly. Second, the competitor-weighted measure demonstrates that while both exchange rate levels and volatility matter, the more important comparison (in terms of magnitude) lies with rival hosts rather than trading partners. Higher volatility originating in industrialized trade partners may not be problematic. However, an increase in exchange rate volatility in a specific potential host reduces FDI significantly because less volatile alternative locations exist. Thus, policy makers concerned with attracting FDI appear justified in their concerns about how their exchange rate behaves relative to rivals.

Appendix

Table A1 provides descriptive statistics of the variables used in the Tobit analyses. The first five lines describe the real exchange rate measures, and the next group shows the volatility measures employed. The dependent variable we use is *share*, which represents the share of Japanese FDI flows to non-OECD countries in a given year and industry to a

Table A1. Descriptive Statistics of Variables Employed

Variable	Description	Mean	Standard Deviation	Min	Max
RER					
Bilateral RER	Bilateral real exchange rate	94.88	13.85	63.50	134.10
Export RER	Export-weighted real exchange rate	104.81	14.85	74.97	176.68
Import RER	Import-weighted real exchange rate	102.61	14.17	71.75	169.21
Trade RER	Trade-weighted real exchange rate	103.78	14.24	74.07	172.52
Competitor RER	Competitor-weighted real exchange rate	98.53	11.78	69.68	136.00
VOL					
Bilateral VOL	Bilateral real exchange rate volatility	0.08	0.03	0.05	0.19
Export VOL	Export-weighted real exchange rate volatility	0.07	0.04	0.02	0.21
Import VOL	Import-weighted real exchange rate volatility	0.07	0.04	0.03	0.21
Trade VOL	Trade-weighted real exchange rate volatility	0.07	0.04	0.03	0.21
Competitor VOL	Competitor-weighted real exchange rate volatility	0.08	0.04	0.04	0.21
Share	Share of non-OECD FDI flows from Japan	0.10	0.14	0.00	0.79
Wage	Real wage index	6.40	4.70	0.77	26.46
$r_j - r_{\text{Japan}}$	Real interest rate differential between host country and Japan	2.51	4.47	−11.48	13.27
GDP_j	GDP in host country	1.81E+11	2.05E+11	4.17E+10	7.97E+11
$\text{GDP}_{\text{Japan}}$	GDP in Japan	4.28E+12	1.91E+11	3.90E+12	4.58E+12
GDPpc_j	GDP per capita in host country	1346.88	951.23	355.45	3721.11
Yen/$ EX	Bilateral real exchange rate between yen and $	110.12	12.20	90.96	128.45
Yen/$ VOL	Bilateral real exchange rate volatility between yen and $	0.09	0.02	0.06	0.13
KC	Capital control in host country	0.58	1.55	−1.75	2.62
Country dummy	China, Indonesia, Malaysia, the Philippines, and Thailand	0.20	0.40	0	1
Industry dummy	Food, textiles, lumber and pulp, chemicals, metals, machinery, electrical, transport, other manufacturing, farming and forestry, fishery, mining, construction, trade, finance and insurance, service, transportation, real estate	0.06	0.23	0	1

particular host nation. The remainder of the variables are the regressors we use. Details on the source of the dependent variable and the construction of some of the regressors can be found below.

Japanese FDI

Japanese outward FDI data are from Ministry of Finance, Japan. The FDI data are divided into nine manufacturing industries (food, textiles, lumber and pulp, chemicals, metals, machinery, electrical, transport, and other) and 10 nonmanufacturing industries (farming and forestry, fishery, mining, construction, trade, finance and insurance, service, transportation, real estate, and other). In the empirical work the nonmanufacturing category "other" is dropped from the data set because it includes only five observations. The Japanese data report the prior notified investment rather than the realized investment. *Ex post* reporting adjustment is only required for investments that exceed 100 million yen (which is the vast majority). It includes acquisition of securities or lending of money, disbursement of money related to the establishment, and enlargement of branches, factories, and other offices in foreign countries.

Construction of Wage Index

Industry-specific wage data that matched the categories in the Japanese FDI data were available from the ILO's Laborsta database for most of the years and most of the manufacturing industries. Wages were reported as monthly figures for all countries except Indonesia, which were reported weekly. Indonesia's weekly wages were converted to monthly by multiplying by 4.348 (days in the year divided by seven days per week times 12 months). These wages were then converted into yen equivalents using annual period average exchange rates. The index given is the ratio of the host wages in yen terms divided by Japan's wages times 100. In some cases industry-specific wages were not available from the ILO. In those cases, the Economist Intelligence Unit's (EIU's) wage index for all manufacturing is used to extrapolate the wages either forward or backward as necessary. Using the EIU's wage index allowed us to construct wages for all years and countries of interest, except for Thailand in 1989 where no wage index was available. In other cases, the available wage data did not match the industry categories designated in Japan's FDI data. For Malaysia and the Philippines the categories of textiles, lumber and pulp, chemicals, and metals had wages at a more disaggregated level. We computed the overall sectoral wages by weighting each subsector's wages by its employment share within the category. The employment shares were also computed from employment data from the ILO Laborsta database. For Indonesia, the categories of machinery, electrical, and transport were aggregated together in the ILO data under machinery and thus we were unable to create different series for Indonesia for these three sectors. For the nonmanufacturing sector, we simply use the total manufacturing series as a proxy.

Trade and Exchange Rate Data

Bilateral trade data are obtained from the United Nations Commodity Trade Statistics Database. We use SITC revision 3 data, and the correspondence between manufacturing sectors and trade codes used is available upon request. For China for the years 1989, 1990, and 1991, and for the Philippines for the years 1989 and 1990, SITC revision 3 data were not available. We used the corresponding SITC revision 2 data. Because our categories are at no more than the two-digit level, the discrepancy between the reporting codes is minor. Of the changes in lines at the five-digit level, only 1.2% of those changes affected our classification. The majority of those changes were exchanges between specific categories and the broader catchall category of other manufactured products. Upon examining the data between SITC revisions 2 and 3 that we collected, no noticeable changes in the trade patterns at the industry levels were evident.

In classifying industries as high or low export-to-sales ratio, we used Ministry of International Trade and Industry (MITI) data available online from their Quarterly Survey of Overseas Activity. The MITI data begin in the fourth quarter of 1996 and run through 2003. The data report the aggregate values for our four countries of interest, Indonesia, Malaysia, the Philippines, and Thailand, but do not break these down by country. The categories reported are close but not perfect matches for our FDI data. We classify those sectors with export-to-sales ratios higher than the average at the end of our period, 2003, as export oriented. In 2003, the end of our sample, those included precision instruments, industrial machinery, electrical machinery, ceramics, textiles, and metals. However, our FDI data do not distinguish either precision instruments or ceramics from our category of "other." Thus, we use only industrial machinery, electrical, textiles, and metals. Food and tobacco, lumber and pulp, chemicals, and transport make up the less export-intensive category. We do not include our "other" measure in the estimates based on this classification, since it is a catchall category.

Exchange rates and consumer price indices come from the International Monetary Fund's International Financial Statistics. GDP (constant 2000 U.S. dollar), GDP per capita (constant 2000 U.S. dollar), and real interest rate are collected from World Bank's World Development Indicators.

The exchange rate for Taiwan is from the Central Bank of China (Taiwan) and CPI of Taiwan is from National Statistics of Taiwan. Since Taiwan is not an official member of the United Nations, its name is not shown as a reporting country. We use the partner "Asia Other, not elsewhere specified" to collect the bilateral trade data for Taiwan from the UN Commodity Trade Statistics Database. Comparison between these figures and figures available on Taiwan's official websites reveal a very high level of correlation of the trade volume at the aggregate level with the UN's designation of

"Asia Other, not elsewhere specified." For countries that converted to the Euro in 1999, we use the official conversion rates as exchange rates in 1999 and calculate the exchange rates for the following years based on the annual change in the Euro against the dollar. The exchange rate of Czech Republic 1990–1992 is from Penn World Table 6.1. CPI of Brunei, Luxembourg, and United Arab Emirates are from the United Nations Common Database. The CPI of Germany was obtained from the OECD Main Economic Indicator.

Owing to data availability, some countries or years for partner countries are excluded in the construction of the industry-specific trade-weighted indices. Completely excluded (all years): Congo, Cuba, Democratic People's Republic of Korea, Equatorial Guinea, Iraq, Kiribati, Liberia, Ukraine, Uzbekistan. Some early years with missing data: Benin (1989–1991), Cambodia (1989–1993), Czech Republic (1989–1992), Mongolia (1989–1991), Russia (1989–1992), United Arab Emirates (1989–1993 and 2003), Vietnam (1989–1994). Last years of data not available: Brunei, Cameroon, Gabon (2001–2003), Sudan (2002–2003), Syria, United Arab Emirates, Zimbabwe.

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