EXCHANGE RATE EXPOSURE

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Abstract

Finance theory suggests that exposure to foreign markets should have little influence on asset prices in a world with integrated capital markets. In a pooled sample of eight (non-US) industrialized and emerging markets we find that 12-23% of firms are exposed to exchange rate movements. In robustness checks we find that: (i) the choice of exchange rate matters, and using the trade-weighted exchange rate is likely to understate the extent of exposure, (ii) conditioning on the value-weighted vs. the equally-weighted market index has little effect on estimated exposure, while conditioning on the international index does change the estimate of exposure, (iii) the extent of exposure is not a result of a spurious correlation between random variables with high variances, (iv) exposure increases with the return horizon, (v) within a country and within an industry, exposure coefficients are roughly evenly split between positive and negative values, (vi) averaging across the (absolute value of the) significant exposure coefficients in our sample of countries, we find an exposure coefficient of about 0.5, (vii) the extent of exposure is not sensitive to the sample period, but the set of firms that is exposed does vary over time, and (viii) the sign of the exposure coefficients changes across subperiods for about half of the firms of our sample. We find that exposure is not systematically related to firm size, industry affiliation, multinational status, foreign sales, international assets or industry-level trade.

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Introduction

It is widely believed that changes in exchange rates have important implications for financial decision-making and for the profitability of firms. One of the central motivations for the creation of the euro was to eliminate exchange rate risk to enable European firms to operate free from the uncertainties of changes in relative prices resulting from exchange rate movements. But do changes in exchange rates have measurable effects on firms? The existing literature on the relationship between international stock prices (at the industry or firm level) and exchange rates finds only weak evidence of systematic exchange rate exposure (see Doidge, Griffin and Williamson (2000) and Griffin and Stulz (1997) for two recent studies). This is particularly true in studies of U.S. firm share values and exchange rates (see for example, Amihud (1994), Bodnar and Gentry (1993), and Jorion (1990)).

The first objective of this paper is to see whether the finding of low levels of exposure reported in the literature generalizes to countries other than the United States. To this end, we examine the extent of firm- and industry-level exposure as measured by the relationship between excess returns and foreign exchange returns in a sample of eight industrialized and developing countries over a relatively long time span (1980-99). We find a statistically significant level of exposure in the pooled eight-country sample: between 13 to 15 percent of firms are exposed to at least one of the trade-weighted exchange rate, the U.S. dollar, and the currency of the country's major trading partner. We also find considerable heterogeneity in the extent of exposure across our sample of countries. A large fraction of Japanese firms appear to be exposed to weekly movements in the dollar, for example, while few Chilean firms appear to be exposed.

In section II we examine the robustness of our findings on the extent of exposure to different specifications of our estimating equation. In general, we find that (i) the choice of exchange rate matters, and using the trade-weighted exchange rate is likely to understate the extent of exposure, (ii) conditioning on the value-weighted vs. the equally-weighted market index has little effect on estimated exposure, while conditioning on the international index does change the estimate of exposure, (iii) the extent of exposure is not a result of a spurious correlation between random variables with high variances, (iv) exposure increases with the return horizon, (v) within a country and within an industry, exposure coefficients are roughly evenly split between positive and negative values, (vi) averaging across the (absolute value of the) significant exposure coefficients in our sample of countries, we find an exposure coefficient of about 0.5 some countries, (vii) the extent of exposure is not sensitive to the sample period, but the set of firms that is exposed does vary over time, and (viii) the sign of the exposure coefficients changes across subperiods for about half of the firms of our sample.

The second objective of the paper is to examine potential determinants of exchange rate exposure. Economic theory suggests a number of channels through which changes in the exchange rate might affect the profitability of a firm. Firms that export to foreign markets may benefit from a depreciation of the local currency if its products subsequently become more affordable to foreign consumers. On the other hand, firms that rely on imported intermediate products may see their profits shrink as a consequence of increasing costs of production due to a depreciating currency. One might expect, then, to find a correlation between exposure (positive or negative) and a firm's involvement in international markets. If large firms are more likely to be engaged in trade, exposure may also be correlated with firm size.

Even firms that do no international business, however, are likely to be influenced indirectly by foreign competition. For example, if Ford Motor Company were to sell no cars abroad nor import any foreign auto parts, domestic automobile sales would still be affected if the dollar price of competing Japanese automobile imports falls or rises. Exposure could then depend on the competitiveness of a particular industry -- in less competitive industries, prices are set farther from marginal cost implying higher mark-ups. In such industries firms will have some ability to absorb exchange rate changes by adjusting profit margins and lowering "pass through." In more competitive industries we might expect close to perfect pass-through and therefore larger effects of exchange rate movements on stock returns.[1]

While trade would seem to be an obvious source of exposure, it is not clear that firms in the non-traded sector of the economy are fully insulated from changes in the exchange rate. If non-traded goods producers compete with traded-goods producers for factors of production, whose returns may be affected by changes in the exchange rate, exchange rate movements may still affect firm value. It may also be that the more international is a firm, the more likely the firm will hedge exchange rate risk.[2] As a result, *net* exchange rate exposure may be smaller in those firms engaged in international business, not larger.

Although theory suggests a number of channels through which firms and industries may be exposed to exchange rate risk, in the final analysis theory provides us with little guidance as to

[1] Bodnar, Dumas, and Marston (1999) and Marston (2001) develop a framework for analyzing the joint phenomena of pass-through and exposure. Nucci and Pozzolo (2001) examine the impact of exchange rate fluctuations on investment in a sample of Italian manufacturing firms and find a link between monopoly power and the impact of exchange rate effects. Allayannis and Ihrig (2000), Campa and Goldberg (1995, 1999) and Dekle (2000) also find a relationship between market structure and exposure.

[2] Bodnar and Marston (2000) find that foreign exchange exposure is low for a sample of 103 US firms that answered their survey of derivative usage. On the other hand, survey results reported in Loderer and Pichler (2000) suggest that Swiss firms do not seem to know the extent of their cash-flow exposure to exchange rate risk. And, based on surveys, Bodnar and Marston (1998) find that firms do not seem to use derivatives

which firms are most likely to be exposed. Firm size, industry affiliation and degree of internationalization are all factors that may influence whether a firm or industry is exposed. However, the precise linkage between those factors and the direction of the exposure is unclear. Therefore, rather than test a specific model of exchange rate exposure, we use available data at the firm- and industry-level to see what factors tend to be correlated with exposure. The factors we study include firm size, industry affiliation, multinational status, foreign sales, international assets and industry-level trade. In general, we find that both the magnitude and the direction of exposure varies across firms in each of these categories. That is, exposure appears to be a firm-specific phenomenon that is not readily explained by easily observed variables. What little explanatory evidence we can find suggests that small firms are slightly more likely to be exposed than medium- and large-sized firms, and firms in the non-raded sector are as likely to be exposed as firms in the traded sector. We find that exposure is not concentrated in particular industries, nor do we find a systematic link between exposure and foreign sales, international assets, multinational status or information about industry-level trade flows. Taken together with our estimates of exposure, these findings suggest that a significant fraction of firms are exposed to exchange rate risk in our sample of countries, but we are unable to identify the factors that could account for that exposure.

The paper is organized as follows. The definition of exchange rate exposure is covered in Section I and Section II describes our dataset. The benchmark exposure results and the robustness of these results are discussed in Section III. The second-stage results on the links between exchange rate exposure and other factors are reported in Section IV. Section V concludes.

I. *Defining Exchange Rate Exposure*.

We follow the extensive literature on foreign exchange rate exposure by defining exposure as the relationship between excess returns and the change in the exchange rate (Adler and Dumas (1984)). More formally, we measure exposure as the value of $b_{2,i}$ resulting from the following regression:

$$R_{i,t} = b_{0,i} + b_{1,i} R_{m,t} + b_{2,i} \Delta s_t + e_{i,t} \quad (1)$$

to hedge exchange rate risk and in many instances, appear to use derivatives to take open positions with respect to the exchange rate.

where $R_{i,t}$ is the return on firm i at time t, $R_{m,t}$ is the return on the market portfolio, $b_{1,i}$ is the firm's market beta and Δs_t is the change in the relevant exchange rate. Under this definition, the coefficient $b_{2,i}$ reflects the change in returns that can be explained by movements in the exchange rate after conditioning on the market return.

Note that a literal interpretation of the CAPM suggests that in equilibrium, only market risk should be relevant for a firm's asset price, and therefore only changes in the market return should be systematically related to $R_{i,t}$. If the CAPM were the true model for asset pricing, $b_{2,i}$ should be equal to zero and evidence that $b_{2,i}$ is non-zero could be interpreted as evidence against the joint hypothesis that the CAPM holds (i.e. the market efficiently prices systematic risk) and that exchange rate risk is unimportant for stock returns. In this paper, we are not interested in testing a specific version of the CAPM, nor are we testing whether exchange rate risk is "priced." Our main objective is to use equation (1) as a framework for isolating the relationship between excess returns and exchange rates in a cross-section of firms. In the second stage of our analysis (section IV), we will try to link the estimated exchange rate "betas" with a set of factors that could proxy for plausible channels for exposure.

II. *Data set*

Our dataset includes firm-, industry- and market-level returns and exchange rates for a sample of eight countries including Chile, France, Germany, Italy, Japan, the Netherlands, Thailand and the United Kingdom over the 1980-99 period. The specific countries in our sample were chosen both on the basis of data availability and to include in our sample both OECD and developing countries. Returns are weekly (observations are sampled on Wednesdays) and are taken from Datastream. For countries with a large number of publicly traded firms (in our sample these include Germany, Japan and the United Kingdom) we select a representative sample of firms (25% of the population) based on market capitalization and industry affiliation. For the remaining countries we include the population of firms. Table 1 provides summary information on the degree of data coverage across the eight countries. On average our sample includes 300 firms for each country; Japan includes the largest number of firms at 488 and Chile has the smallest number at 199. Firms with fewer than six months of data over the period 1980 to 1999 were excluded from our sample.

In section IV of the paper, we will attempt to link our estimates of exposure to variables such as industry affiliation, firm size, a firm's multinational status, information on trade and a firm's holdings of international assets and its foreign sales. Parts 2 through 6 of Table 1 provide

information about the coverage of these variables. Datastream provides industry-level returns at a fairly disaggregated level (we focus on the 4-digit level). As shown in the second part of table 1, there are between 23 and 39 industry categories across our sample of countries. (The list of industries is provided in Table A1. of the appendix.)

Information about multinational status comes from three sources. The first source is the Worldwide Branch Locations of Multinationals (1994), which includes a sample of 500 companies that have foreign branches. The second source, The Directory of Multinationals (1998), includes the 500 largest firms with consolidated sales in excess of $US 1 billion and overseas sales in excess of $US 500 million in 1996. Our third source of multinational information comes from the Financial Times Multinational Index, created in 2000. If a firm appeared as a multinational in any of the three sources, we coded that firm as a multinational.

We draw on two sources to gather information about trade, both of which provide data only at the industry level. The first is Feenstra's (2000) database on world bilateral trade flows over the 1980-97 period. This data source allows us to identify the currencies of the each country's major bilateral trading partners by industry. As shown in part 4 of Table 1, the Feenstra database covers all of the countries in our sample, although it does not cover all of the industry categories available from Datastream. The second source of trade information is the export, import and net export shares in manufacturing industries reported by Campa and Goldberg (1997). Their study covers two of the countries in our sample, Japan and the United Kingdom.

While Datastream provides information about industry affiliation and market capitalization for all firms in our dataset, the coverage ratios for international asset and foreign sales data is more limited. In the regression analysis below we use annual values of foreign sales and international assets averaged over the period 1996-1999. As shown in parts 5 and 6 of Table 2, the number of firms that report international assets and/or foreign sales varies considerably from country to country. Over 50% of Japanese and UK firms provide these data, while only three percent of Chilean firms (the country with the lowest coverage) provided non-zero foreign sales data and no firms provided non-zero international asset data. Datastream codes firms that do not provide international asset or foreign sales data in two ways, with either a missing value code or a zero. Unfortunately the decision about whether to code a firm without data as missing or with a zero is apparently arbitrary. Firms that do provide information, however, also may genuinely have no foreign sales or international assets. This means that both a zero and a missing value code provide ambiguous information. If one looks only at those firms that report non-zero, and therefore unambiguous information, about foreign sales and international assets, the percent of the sample reporting drops dramatically, especially for international assets. Less than 10

percent of firms report non-zero international assets in Chile, France, Germany, Italy, Netherlands and Thailand. In Japan and the U.K., the share of firms reporting any data on international assets is about 70 percent, and drops to less than 40 percent if we only use non-zero values.

The usefulness of the data on foreign sales – even if we had full coverage - is also somewhat questionable for our purposes. The figures reported by Datastream reflect only sales by foreign affiliates, not the total sales of the firm to foreign markets. However, since previous studies[3] suggest that sales by foreign affiliates may help us predict which firms are likely to be exposed, we include these data in our second-stage tests.

III. The extent and robustness of foreign exchange exposure

We begin by running a benchmark specification for exposure where the independent variable is weekly firm- (or industry-) level returns and the right-hand-side variables are the equally-weighted local market return for each country[4] and the change in the exchange rate. One of the first problems that arises when thinking about exchange rate exposure is "Which is the relevant exchange rate?" Many, if not most studies use the trade-weighted exchange rate to measure exposure.[5] As Williamson (1998) notes, the main shortcoming of using a trade-weighted basket of currencies in exposure tests is that the results lack power if a firm is mostly exposed to a small number of currencies. For instance, if a firm is exposed to only one or a few of the currencies within the basket, this may lead to an underestimation of the exposure of the firm. One possible research strategy to mitigate this problem is to create firm and industry specific exchange rates. The difficulty with this approach is that it is not clear on what basis these exchange rates should be chosen. As we will show below, firms within the same industry have very different exposure coefficients, suggesting that one needs detailed firm-specific data to isolate which exchange rate is the relevant one for capturing exchange risk.

As a starting point, we measure exposure relative to three different exchange rates – the trade-weighted exchange rate (in large part to compare our results with those in the literature), the dollar exchange rate, and one additional bilateral exchange rate based on the country's direction of trade data.[6] Table 2 shows the results of the benchmark results for industry- and firm-level

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[3] See, for example, Doidge, Griffin and Williamson (2000), Frennberg (1997) and Jorion (1990).

[4] In robustness checks, we compare results using the value-weighted local index and the international index as alternatives to the equally-weighted index. See table 3 below.

[5] Two exceptions are Williamson (1998) and Dominguez (1998). Doidge, Griffin and Williamson (2000) use both bilateral rates and trade-weighted exchange rates but "score" total exposure based on one rate.

[6] The country's "major trading partner" is the country with the most trade with the reference country, where trade is defined as the average of exports plus imports in the 1990s. Trade data are taken from the Direction of Trade statistics reported by the International Monetary Fund.

exposure across the eight countries. The table presents information on the percentages of industries and firms in the sample with significant (at the 5% level using robust standard errors) exposure using each of the three currencies. The row labeled "any exchange rate" is the percentage of industries or firms that have significant exposure at the five percent level using at least one of the three listed exchange rates (the bilateral rate for each country is listed in the row below "major trading partner"[7]). Focusing first on exposure at the industry level, we find that the percent of industries exposed to any of the three exchange rates ranges from a minimum of 17 percent in France to a maximum of 65 percent in Germany. Dollar exposure seems to be the most significant in Chile, while the trade-weighted exchange rate or the currency of the country's major trading partner has the most significance for the other countries in the sample.

The extent of exposure at the firm level is qualitatively similar to the exposure at the industry-level. Chile emerges as the least exposed, while Japan is the most exposed. Approximately 10 to 15 percent of the firms in Germany, the Netherlands, Thailand and the UK are exposed to the dollar. Again Japanese firms exhibit the highest extent of exposure, with 22 percent of the firms exposed to the dollar and 26 percent exposed to any of the three exchange rates.

Part C of Table 2 shows the percentage of times a firm is found to be exposed to the U.S. dollar but was not found to be exposed to the trade-weighted exchange rate. This fraction varies from a low of 15 percent in Thailand to a maximum of 86 percent in Chile. Part D repeats the same calculation for exposure to the currency of the country's major trading partner relative to the trade-weighted exchange rate, with similar results. It appears that using the trade-weighted exchange rate alone would understate the true extent of exposure to exchange rate movements, especially in Chile, France, Italy and the Netherlands.

Specification of market index

One possible problem with the benchmark specification is the use of the equally-weighted local market index as the measure of market returns. Empirical tests of the standard CAPM model typically include the value-weighted market return to proxy for "the market." Bodnar and Wong (2000) argue that the value-weighted market return is dominated by large firms that are "more likely to be multinational and/or export oriented and more likely to experience more negative cash flow reactions to dollar appreciations than other US firms" (pp.4). Therefore, including the value-weighted return in an exposure test not only removes the "macroeconomic" effects, but also the more negative effect of exchange rates on cash flow in larger firms. This

[7] If the U.S. is the country's major trading partner, the currency of the second largest trading country is used.

would likely bias tests toward finding no exposure. The second possible problem with our choice of market return is that in a world of perfectly integrated capital markets the "market return" should be better proxied by a global rather than a national portfolio.

Table 3 examines the robustness of our exposure results to the specification of the market index. For purposes of comparison, rows A1 and B1 of the table repeat the results from table 2 for the percent of industries and firms exposed to the dollar at the 5% level. Rows A2 and B2 show the percent exposed when returns are conditioned on the value-weighted index instead of the equally-weighted index. There is some change in the percent exposed at the industry level, but very little change at the firm level. The industry level differences are a bit misleading because there are a relatively small number of industries, so a switch of just one industry from exposed to not exposed results in a fairly large percentage change. The table also lists the percentage of firms that are exposed using the equally-weighted index that are also exposed when the value-weighted index is used. Excluding the Netherlands, which is clearly an outlier, the average percent of firms exposed under specification 1 (using the equally-weighted index) that are still exposed under specification 2 (the value-weighted index) is 84 percent. Because the results using the equally-weighted and the value-weighted market indices are so similar, we will use the equally-weighted index in the remaining analysis.

Table 3 also provides a comparison between the equally-weighted local market index and the international index. The international index is the World index reported by Datastream converted to the reference country's currency. The percent of firms found to be significantly exposed when conditioning on the international index (row B3) is now substantially higher. The reason for the increase in the significance of the exchange rate in the benchmark regression appears to be due to the fact that the international index does a poor job of explaining market returns. Note that the average adjusted-R^2 (part C of the table) of the regression with the international index falls relative to the adjusted-R^2 under the market index specification, in some cases by fifty percent or more.[8] Thus, more firms appear to be exposed simply because the exchange rate is picking up more of the variability of returns and the market is picking up substantially less. In six of the eight countries, the percent of firms that were exposed using the equally-weighted index that are still exposed using the international index is less than 75 percent,

[8] As in most CAPM regressions, the R^2's are small under any specification. The key point here is that the explanatory power of the regression is much smaller when the international index is used.

another indication that it is the coefficient on the index that is unstable. In the remaining tests, we will use the local rather than the international index.[9]

Exposure or Randomness?

Both the exchange rate and stock returns have large variances. Thus, it is possible that adding the exchange rate to the benchmark specification is simply adding a random variable that is spuriously correlated with returns. To test whether the extent of exchange rate exposure we find is in fact statistically significant, we create a random variable that has the same variance as the bilateral dollar exchange rate for each country, and test whether this random variable is correlated with firm returns.[10] Table 4 shows the percent of firms significantly exposed under our benchmark specification, and the percent "exposed" to the random variable.[11] We find that only in the case of Chile is the random variable as correlated with returns as actual dollar returns. In all other countries, the extent of exposure exceeds the amount one would predict based on a purely random sample.

Sensitivity of Exposure to Horizon

Several studies of exposure have found that the extent of estimated exposure is increasing in the return horizon (see, for example, Bartov and Bodnar (1995), Allayannis (1996), Bodnar and Wong (1999) and Chow, Lee and Solt (1997)). Indeed, most studies of exposure are conducted using monthly returns, suggesting that our results based on weekly returns may understate the true extent of exposure. Table 5 shows the percent of firms with significant U.S. dollar exposure in our eight-country sample at the one-week, four-week and 12-week return horizons. The results are based on rolling regressions estimated by GMM, correcting for serial correlation. Consistent with the literature, we find that exposure is indeed increasing in the return horizon for all firms in our sample. Exposure in Chile stands out as the most extreme case. Using weekly returns, less than four percent of Chilean firms appeared to be exposed to the U.S. dollar. That fraction increased to 13 percent at the monthly horizon and to nearly 30 percent at the quarterly horizon. In the second-stage analysis below, we will continue to use exposure estimates based on weekly returns. In future work, however, we will explore the robustness of our findings to longer-horizon returns.

[9] Connolly, Ozoguz and Ravenscraft (2000) indirectly measure exposure by testing whether the relevant regional or country indices outperform the international index in explaining cross-country firm-level returns.

[10] We thank Ken Froot for this suggestion.

[11] We repeated the random variable regression 200 times for each firm and report the average percent exposed in Table 4.

Magnitude and Direction of Exposure

Table 6 provides summary information on the sign and the magnitude of the exposure coefficients. Part A of Table 6 reports the percent of significant exposure coefficients that are positive and the percent that are negative. Currencies are measured in units of the reference country's currency per foreign currency (TW, $US or major trading partner). In three of the countries (Chile, Germany and Italy) positive and negative exposure is about evenly split. In another four countries (France, Japan, the Netherlands and the UK) 60-70% of firms exhibit positive exposure (meaning that a depreciation of the home currency results in an increase in firm share value). In Thailand, 79% of those firms exposed have negative exposure coefficients, suggesting that an depreciation of the baht generally led to an decrease in the value of Thai firm share values.

We also provide information on the average increase in the adjusted R^2 (a measure of goodness of fit) at the firm level when we include the exchange rate in as an explanator of excess returns (Part B of Table 6). The first set of results (B.1) includes all firms, and the second set of results (B.2) includes only those firms with significant (at the 5% level) exposure. When averaging across all firms, the increase in the adjusted R^2 is small, ranging from -.004 percent to 1.5 percent. Note that the R^2's are very small to begin with (i.e. the explanatory power of the market index for returns is low) and the addition of the exchange adds little additional explanatory power. When we average across the regressions where the exchange is found to be significant, the increase in the adjusted R^2 ranges from about one-half of one percent to nearly 3 percent. It is interesting to note that although the smaller countries like Chile and Thailand show relatively low levels of industry and firm exposure – the average increase in adjusted R^2 when we include an exchange rate in the CAPM specification for these countries is relatively high. This suggests that although fewer firms in these countries are exposed, those that are exposed have a relatively high degree of exposure. This phenomenon also shows up in the average size of the coefficient on the exposure variable provided in Part C of the table.

Thus far, we have focused on the extent of exposure as reflected in the fraction of firms that have significant exposure coefficients, but we are also interested in the magnitude of the exposure to exchange rate risk. In other words, it may be that a significant fraction of firms is exposed to exchange rate risk, but we would also like to know if that exposure is economically significant. Part C of Table 2 shows the average of the significant exposure coefficients, sorted by sign. The figures suggest that the magnitude of the positive exposure beta ranges from 0.2 to a maximum of 9. France and the Netherlands exhibit the largest betas with respect to changes in the exchange rate of their major trading partners. The negative betas are of roughly the same order of

magnitude. Averaging across significant dollar exposure betas across countries, the data suggest that a one percent change in the exchange rate is correlated with a one-half percent change in stock returns.

Robustness across sub-samples

Our time-series exposure tests are estimated over the period January 1980-May 1999. In order to test whether our results are robust over subsamples – and whether specific subsamples are driving our full sample results, we re-estimate both firm and industry level tests over three subperiods. Rather than arbitrarily splitting the full sample into three equally sized subperiods, we selected subperiods on the basis of changes in the underlying currencies used for each country. For example, in Thailand all the exchange rate "action" occurs during and after the currency crisis of 1997. Arbitrarily splitting the Thai sample earlier than that, would not allow us to focus on the period in which we might expect firm and industry level exposures to change. Also, by splitting the sample in this way we are able to test whether exposure levels (or changes in exposure) are highest during periods of home currency appreciation and/or depreciation, and whether changes in the underlying volatility of the home currency are related to exposure.[12]

Table 7 reports the percent of firms exposed in the full sample and each of the three subsamples for each of the three currencies. In general, the extent of exposure is about the same in the full and in the three subsamples. This suggests that our finding of exposure at the aggregate level is not driven by a particular subsample and that even though countries experienced different amounts of exchange rate volatility in different time periods, the extent of exposure is fairly constant.

While the aggregate amount of exposure remains roughly constant, we are also interested in whether the same set of firms is exposed across subsamples and in the stability of the direction of exposure. Part A of Table 8 repeats the subsample exposure results from Table 7 for each country's major trading currency. Part B shows the percent of firms exposed in one sample that is still exposed in another subsample. The table shows that almost no firm is exposed across all three subsamples, and only a small fraction (0.5 to 10 percent) is exposed across two subsamples.[13] This suggests that while there may be a fairly constant level of exposure in the economy as a whole, *which* firms are exposed varies over time. Table 9 reports the results on the

[12] The subperiods used for each of the countries are as follows: Chile (10/4/88-5/12/92, 5/19/92-4/18/95, 4/25/95-5/18/99); France (1/1/80-6/3/86, 6/10/86-5/23/95, 5/30/95-5/18/99); Germany (1/1/80-3/5/85, 3/12/85-2/17/87, 2/24/87-5/18/99); Italy (1/1/80-9/8/92, 9/15/92-4/25/95, 5/2/95-5/18/99); Netherlands (1/1/80-3/5/85, 3/12/85-1/5/88, 1/12/88-5/18/99); Thailand (1/1/80-6/17/97, 6/24/97-1/13/98,1/20/98-5/18/99); UK (1/1/80-3/5/85, 3/12/85-12/1/92, 12/8/92-5/18/99)

[13] Percentages are based on the sample of firms that exist across the relevant sub-periods.

stability of the exposure coefficients themselves over time.[14] In only 10 to 35 percent of the firms, does the sign on the exposure coefficient stay the same across subsamples. In about half of the sample of firms, the coefficient switches sign across subsamples, suggesting that both the incidence of exposure (i.e. who is exposed) and the direction of exposure is time-varying. This means that to account for exposure, the underlying economic factor must also vary over time.

IV. Explaining exposure

In this section we attempt to link the foreign exchange exposure estimates we have documented in the previous section to firm- and industry-specific characteristics. Table 10 presents a broad overview of the unconditional relationships between our exposure estimates and potential explanatory variables. In the table the statistically significant exposure betas are sorted by firm size[15], industry affiliation, a traded vs. non-traded industry indicator and multinational status. The results in the table suggest that foreign exchange exposure is not concentrated in any one category. Large firms exhibit a bit more exposure than medium and small firms, there is less exposure in certain industry categories (for example, mining, oil and gas, food & drug retail and telecom, and information technology) but, exposure is very evenly split in traded and non-traded industries, and non-multinationals are more likely to be exposed than multinationals.[16] The last column in table 10 provides information on the percentage of (significant) positive exposure betas in each category. With the one exception of the Electric, Gas and Water industry where most exposure betas are negative, the percentages suggest that the sign on the exposure betas vary both within and across the categories.

Table 11 presents further information regarding the direction of firm-level exposure within three categories of firm size and across ten industry categories. In this table the percentages of firms with positive exposure are calculated from the full sample of exposure betas (including the point estimates of exposure betas that are not statistically significant). These percentages again suggest that with few exceptions, the direction of firm level exposure is mostly fairly evenly split when we group firms by size or industry. Put another way, it does not appear

[14] Table 9 includes information about the sign of all exposure coefficients, not just the significant coefficients.

[15] Nance, Smith and Smithson (1993) suggest that larger firms are more likely to hedge exchange rate risks.

[16] A number of studies in the literature (for example, Jorian (1990), Bartov, Bodnar and Kaul (1996), Gao (1996), Bodnar and Weintrop (1997) and He and Ng (1998)) test for exchange rate exposure in samples of exclusively multinational firms. This first cut at the data for our eight countries indicates that multinational firms are less likely to be exposed than are non-multinationals suggesting that exposure estimates based on a sample of multinationals may understate aggregate exposure levels.

to be the case that firms within an industry (or size class) are affected in the same way by exchange rate movements.[17]

Second-Stage Regressions

Although the relationships between the exposure betas and the explanatory variables reported in tables 10 and 11 are unconditional, the patterns that emerge give some indication that there is unlikely to be a simple explanation for why some firms are exposed to exchange rate risk and others are not. The tables also suggest that testing for exposure at the industry level will be particularly difficult given the within industry variation in the sign of firm-level exposure. It is possible, however, that there exists a set of conditional relationships between the explanatory variables and the exposure betas. We test this hypothesis by running a second-stage regression that takes the estimated exposure betas from equation (1) and regresses these on a series of potential explanatory variables.

The basic regression specification has the firm-level dollar exposure beta as the dependent variable and firm- and industry-level information as explanatory variables.

$$b_{1i} = l_0 + g_2 D_i^{firmsize} + g_2 D_k^{industry} + g_3 Other_k + e_i \qquad (2)$$

All regressions include dummy variables for firm size. These are based on firm-level market capitalization where separate dummies are used for large-sized (top-third) and medium-sized (middle-third) firms (small-sized firms being the excluded category). We also include a measure of industry affiliation in most of our regression specifications. Datastream provides a set of (2-digit) industry groupings (10 categories, see the appendix for a detailed breakdown), from which we create a set of dummy variables (the excluded category being industry 50 "retailers, restaurants, transport").[18] Alternative specifications of regression (2) include as "other" (i) a dummy variable denoting whether the firm is a multinational corporation, (ii) the firm's percentage of foreign to total sales, (iii) the firm's percentage of international to total assets, (iv) a dummy variable denoting whether the firm is in the traded-sector, (v) the volume of the firm's industry export and import flows, (vi) and the export, import and imputed input shares of the firm's industry.

The results from the basic specification of our second-stage regressions (which includes firm size and industry affiliation as explanatory variables) for each of the eight countries in our

[17] Examples of studies in the literature that test for exposure at the industry level include Allayanis (1995), Allayanis and Ihrig (2000), Bodnar and Gentry (1993), Campa and Goldberg (1995) and Griffin and Stulz (1997).

[18] We also tried using a more disaggregated set of industry groupings (at the 4-digit level) in our basic second stage regression specification. These results, reported in Dominguez and Tesar (2001), are qualitatively the same as those reported here using 2-digit industry categories.

sample are reported in table 12. In the upper portion of the table we report the sign (positive or negative) on any of the coefficients of the included explanatory variables that are statistically significant at the 5% level (based on robust standard errors). The first thing to note from the table is that firm size is not systematically related to exposure betas for any of the eight countries. It is also striking that most of the significant industry coefficients are found for Japan and to a lesser extent Italy.[19] Looking over all eight countries, the results suggest that neither firm size nor industry affiliation explain the variation in firm level exposure.[20]

The specification of equation (2) is somewhat restricted, however, in that it asks not only whether firm size and industry play a role in foreign exchange exposure, but it also implicitly restricts the direction of the exposure to be the same within each of those categories. It is possible, for example, that two firms in the same industry are strongly affected by exchange rate movements, but one firm benefits from an exchange rate appreciation while another firm is made worse off by an appreciation. Indeed, we found in table 11 that the direction of firm level exposure within industry categories is often evenly divided. To test whether our firm-level explanatory variables contain information about the magnitude of exposure, if not the direction of the exposure, we next regress the square-root of the absolute value of the exposure betas on the same set of firm and industry characteristics.[21] The results are reported in the bottom portion of table 12. The number of significant coefficients rises substantially when we ignore the sign on the exposure betas. Now firm size is statistically significant for five of the eight countries and the sign on the coefficients suggests that large and medium firms are likely to have *lower* levels of exposure than are the excluded category, small firms. It is also now the case that the numbers of significant industry coefficients is more evenly distributed across the eight countries. However, it remains true that the signs on the industry dummies are not consistent across countries. For example, in Germany and the Netherlands firms in the Mining, Oil and Gas industry are less exposed than other firms, while the reverse is true in Japan and the UK.

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[19] Chamberlain, Howe and Popper (1997) find that while the returns on US banks are sensitive to exchange rate changes, Japanese bank returns are not exposed. In table 12 we find evidence that firms in the Japanese finance industry (which includes banking, insurance and real estate) are likely to have higher levels of exposure than are firms in our excluded category (Distributors, Retail, Hotel, Rest and Transport).

[20] We also experimented with interaction effects between firm size and industry affiliation – but found little evidence that such interactions are operative in the data.

[21] A number of studies in the literature estimate the second-stage regression using the simple absolute value of the exposure beta as the dependent variable. This imposes a truncated bias. We include the square root of the absolute value of the exposure beta – which allows for both positive and negative values and therefore (largely) leaves the error term normally distributed. It is still the case, however, that this specification restricts the error term from taking on extremely large negative values. An alternative transformation of the betas, used in Dominguez and Tesar (2001), which takes the log odds of the absolute

Table 13 presents three alternative specifications of the second-stage regression. In the first specification, in addition to the firm size and industry affiliation variables, we include a dummy variable that distinguishes whether the firm is multinational. The results suggest that in the signed exposure beta specification, German and UK multinational firms, on average, have higher levels exposure. When we ignore the sign on the exposure betas (in the bottom portion of the table), we find that multinational status corresponds to lower exposure betas in France and Italy, and higher magnitudes of exposure in Japan. The second two specifications in table 13 include the percentage of foreign to total sales, and the percentage of foreign to total assets (in addition to the firm size and industry affiliation variables). As described earlier in the paper, firm level data on foreign sales and foreign assets is limited for most countries, so that the degrees of freedom in these regression specifications are often quite low. Further, we would expect that firms that are designated as multinational are also likely to have high levels of foreign assets and foreign sales, so that the explanatory power of the three variables included in this table should be qualitatively similar.[22] The results in the upper portion of the table generally confirm this – higher levels of foreign sales and assets correspond to higher exposure betas for Germany, Italy, Japan, the Netherlands and the UK. Interestingly, in this set of results we find that ignoring the direction of exposure leads to fewer significant coefficients on our explanatory variables.

Another plausible hypothesis regarding exchange rate exposure, suggests that firms that are heavily involved in international trade will be more exposed than purely domestic firms. Our final set of explanatory variables, therefore, attempt to proxy for firm level trade. Although firm-level export and import data is not available for a large sample of firms – information on industry-level international trade is available in Feenstra's (2000) World Trade Flows database. These data will obviously only provide a good proxy for firm-level trade flows in industries where trade patterns at the firm level are similar across firms. As a first cut at testing how important trade may be in explaining firm level exposure, we start by using the World Trade Flows data to identify what currencies to include in our first-stage exposure regression. In particular, rather than include the same exchange rate for all firms in a country as we did in tables 3 through 9, we can now use an industry-specific exchange rate corresponding to the top trade country's currency. So, for example, the country that imports the largest fraction of Japanese automobiles is the United States, suggesting that the appropriate currency to include in the exposure regression for Japanese firms in the

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value of beta, is undefined for values of beta that exceed (-1,1). Our results are qualitatively similar using the two possible transformations of the exposure betas.

[22] Note that the multinational status variable is a (1,0) dummy variable while the foreign sales and assets variables are in percentages. We also tried specifications of equation (2) that include dummy variables

automotive industry is the US dollar. Table 14 presents the percentages of firms that are significantly exposed to these industry-specific currencies. Interestingly the results using both the industry-specific leading export country currencies and the industry-specific leading import country currencies do not much differ from the exposure levels we find when we use the dollar bilateral rate for all the firms.[23] The fact that we do not find that firm-level exposure increases when we use a trade-based currency in the regression, suggests that we are unlikely to find a strong connection between trade and exposure in our second-stage regressions.[24]

Table 15 presents the results of the final three variants of our second stage regression (2) specifications that include various proxies for firm-level international trade. These specifications also include the firm size variables that were included in tables 13 and 14. The first specification includes a dummy variable that indicates whether the firm is in a traded-goods industry or a non-traded industry (see the appendix for the list of industries included in each category). Regardless of whether we take into account the sign of the exposure beta, the traded/non-traded distinction matters only for UK firms. Our second "trade" specification includes the volume of world trade flows in exports and imports for each country by industry.[25] This specification is a second-stage version of the regressions presented in table 14 that use the same trade flows data to specify the currency to include in the first stage exposure estimates. Consistent with our previous findings, these regressions also suggest that there is little connection between an industry's level of international trade and the degree of exchange rate exposure for the firms in the industry.[26]

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which distinguish large, medium and small percentages of foreign sales or assets. We find that results generally did not change depending on how we specify the variables (as dummies or percentages).

[23] The industry-specific trade data were not available for all the Datastream industries, therefore the exposure estimates in table 14 are based on the subsample of firms for which we have the trade data. The dollar exposure comparisons are also based on this subsample of firms, explaining why they do not match the numbers included in table 3.

[24] Forbes *(forthcoming)* examines the connection between trade linkages and country vulnerability to currency crises for a sample of developing countries. In future work we hope to explore the relationships between the ex ante magnitude of firm level exposures in (currency) crisis and non-crisis countries.

[25] Again, because the trade data are not available for all the Datastream industries, these regressions include the subsample of firms in the industries covered by the World Trade Flows data. In addition, we include both the world trade flows as well as the bilateral flows to the US (to correspond with the dollar exposure betas). Results using the US bilateral flows are qualitatively similar to those using world trade flows.

26 A number of studies in the literature have suggested that excluding information about market structure (and in particular mark-ups) in an industry will result in less precise estimates of exposure. Unfortunately we do not have cross-country industry-specific information about mark-ups. However, in Dominguez and Tesar (2001), we attempt to control for mark-ups by using a cross-country industry-specific regression specification. (which implicitly assumes that industry structure is constant across countries). The results based on the signed exposure beta specification suggest that industry-specific trade flows help predict cross-country firm level exposure in two industries: chemicals and automobiles. And when we ignore the sign on beta, we find that trade flows help predict the magnitude of exposure in five out of twelve industries. These results do indicate that market structure may play an important role. Moreover, our

Campa and Goldberg (1997) provide another measure of industry-specific trade orientation for two of our eight countries, Japan and the UK. They provide measures of export share, import share and imported input shares for a number of manufacturing industries in 1993. These data provide another proxy for relative levels of trade across industries. The Campa and Goldberg data are included as explanatory variables in the basic second stage regressions together with the firm size dummy variables. The results suggest that all three measures of trade shares are statistically significant for Japan. In the case of Japan, higher export and import shares in an industry are positively related to the firm-level dollar exposure betas in that industry, while higher imported input shares in an industry are negatively related to firm level exposure in that industry. For the UK firms increasing imported input shares also lead to a reduction in exposure levels. While these results are more encouraging for the hypothesis that trade is related to exposure, it is difficult to know whether the results for Japan and the UK would also hold in a broader set of countries.

IV. Conclusions

We use firm- and industry-level stock returns to test for the presence of exchange rate exposure in eight countries. We find a surprising amount of exposure, ranging from 13 percent of the sample of firms in Chile to 31 percent in Japan. At the two-digit industry level, Germany and Japan exhibit exposures greater than 60 percent of the sample, and the remaining countries show between 20 and 46 percent exposure. These levels of exposure are much higher than one would predict based on a random sampling of firms or industries.

We also find that the direction of firm-level exposure is very much a firm-specific phenomenon. In other words, firms within the same industry and same size category appear to have very different (and unobserved) characteristics that result in exposure to exchange rates. Because of this firm-specific nature of exposure, it is no surprise that empirical studies that have relied on industry-level indices, or on samples with only large firms concentrated in a few industries, have had trouble finding evidence of exposure. And the fact that exposure is firm-specific, is more prevalent among small-sized firms and is as likely to occur in firms in the non-traded sector as in the traded sector, may help explain why the firms (or the investors in these firms) are not better hedged against exchange rate movements. Off-the-shelf foreign exchange risk management techniques based on industry-level characteristics are not likely to provide the right hedge for firms that have very specific hedging needs.

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subsample results in tables 7-9 suggest that a full explanation of exposure will involve time variation as well as cross-sectional variation by industry in mark-ups.

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Appendix

				World Trade Flows
Industry Label	Datastream 4-digit level	Datastream 2-digit level	Traded non-traded	Bilateral Trade Shares BEA categories
Mining	4	IND00	Traded	
Oil &Gas	7			
Chemicals	11	IND10		12,13,14
Construction & Building Materials	13			32
Forestry & Paper	15			7,8,9,30
Steel & Other metals	18			17,18,19
Aerospace & Defense	21	IND20		29
Diversified Industrials	24			31,33
Electronic & Electrical Equipment	25			22,25,26,27
Engineering & machinery	26			20,21,23
Automobiles	31	IND30		15,28
Household Goods & Textiles	34			5,6,24,34
Beverages	41	IND40		2
Food Producers & Processors	43			1,4
Health	44			
Packaging	46			16
Personal Care& Household Products	47			11
Pharmaceuticals	48			10
Tobacco	49			3
Distributors	51	IND50	non-traded	
Retailers, General	52			
Leisure, Entertainment & Hotel	53			
Media & Photography	54			
Restaurants, Pubs, Breweries	56			
Support Services	58			
Transport	59			
Food & Drug Retailers	63	IND60		
Telecom Services	67			
Electricity	72	IND70		
Gas	73			
Water	78			
Banks	81	IND80		
Insurance	83			
Life Assurance	84			
Investment companies	85			
Real Estate	86			
Specialty & other Finance	87			
Information Technology Hardware	93	IND90		
Software & Computer Services	97			

Table 1: Data Coverage

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
1. Coverage of Population of firms								
# of firms in sample	199	228	204	278	488	213	389	388
# of firms in population	225	228	897	301	1942	248	409	1550
% coverage	88.4	100	22.7	92.4	25.1	85.9	95.1	25
2. Coverage of industries								
# of industry indices	23	36	34	31	36	29	20	39
% coverage	100	100	100	100	100	100	100	100
3. Multinational Status								
# of MNCs in our sample	0	33	27	21	64	16	0	47
% of firms	0	14.5	13.2	7.6	13.1	7.5	0	12.1
4. Trade data								
Industry-level bilateral trade	yes	yes	yes	yes	yes	yes	yes	yes
Trade concentration shares	no	no	no	no	yes	no	no	yes
5. International asset data								
% of firms reporting during 1996-99	12.1	21.9	9.8	25.9	69.5	17.8	53.2	70.1
% of firms reporting non-zero values	0	6	9.8	0.4	26.2	9.4	3.9	36.6
6. Foreign sales data								
% of firms reporting during 1996-99	13.6	53.5	58.8	70.1	75.2	59.6	54.8	76
% of firms reporting non-zero values	3	39.4	39.2	49.3	33.8	53.1	5.9	46.1

Notes: Firm- and industry-level returns are Wednesday returns from Datastream in local currencies. Firms are sampled based on industry affiliation and firm size. Industry returns are at the 4-digit level. Multinational status is based on Worldwide Branch Locations of Multinationals (1994), Directory of Multinationals (1998) and the Financial Times Multinationals Index.
in the text. Industry-level bilateral trade data are based on Feenstra (2000). Trade concentration shares are taken from Campa and Goldberg (1997). International asset and foreign sales data are annual figures from Datastream.

Table 2: Benchmark results: The extent of foreign exchange rate exposure

Foreign exchange rate exposure is defined as the coefficient on the exchange rate in the regression:

$$R_{i,t} = b_{0,i} + b_{1,i} R_{m,t} + b_{2,i} \Delta s_t + e_{i,t}$$

The market return is the equally-weighted local market return and the exchange rate is either the trade-weighted, US$ bilateral rate or the bilateral rate of the country's major trading partner. Each cell shows the percent of firms for which the exchange rate coefficient was significant at the 5% level based on the robust standard errors. "Any" exchange rate indicates the percent of firms for which any of the three exchange rates was significant at the 5% level.

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK	All 8
A. Industry exposure: (% of industries with FX exposure at 5% level)									
any exchange rate	10.8	17.1	64.7	32.3	59.5	40.0	25.0	46.2	
tw exchange rate	4.4	5.6	26.5	19.4	58.3	20.7	20.0	35.9	
US$	13.0	8.3	23.5	6.5	52.8	20.7	10.0	38.5	
Major trading partner	4.3 (Yen)	8.6 (DM)	14.7 (BP)	25.8 (DM)	40.5 (HK)	16.7 (DM)	15.0 (YEN)	35.9 (DM)	
B. Firm-level exposure (% of firms with FX exposure at 5% level)									
any exchange rate	13.6	18.9	20.6	26.3	31.1	26.3	21.3	18.8	23.0
tw exchange rate	5.0	7.9	13.7	13.7	26.2	15.0	14.7	11.1	14.8
US$	3.5	7.5	11.3	6.5	21.5	14.6	15.4	13.1	13.1
Major trading partner	8.0 (Yen)	8.3 (DM)	7.8 (BP)	18.7 (DM)	19.7 (HK)	8.0 (DM)	14.4 (YEN)	9.0 (DM)	12.9
C. Percent of times $US is significant but TW coeffic was not:	85.71	64.71	26.09	61.11	18.10	35.48	15.00	39.34	
D. Percent of times the major trading partner's currency is significant but TW coeffic was not:	87.50	84.21	56.25	46.15	9.38	88.24	40.91	17.14	

Table 3: Robustness of Dollar Exposure to the Specification of Market Index

The regression includes the market index (equally-weighted, value-weighted, or the international index) and the bilateral $US exchange rate.

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
A. Industry exposure: (% of industries exposed to $US at 5% level)								
1Country index, Equally-weighted	13.04	8.33	23.53	6.45	52.78	20.69	10.00	38.46
2Country index, Value-weighted	8.70	5.71	20.59	3.23	40.54	20.00	10.00	41.03
3International index	8.70	2.86	14.71	9.68	37.84	23.33	10.00	41.03
% of industries exposed under 1 that are also exposed under 2	66.67	66.67	87.50	0.00	73.68	100.00	100.00	100.00
% of industries exposed under 1 that are also exposed under 3	66.67	33.33	50.00	50.00	63.16	83.33	100.00	66.67
% of industries exposed under 2 that are also exposed under 3	100.00	50.00	23.53	0.00	46.67	83.33	100.00	68.75
B. Firm exposure: (% of firms exposed to $US at 5% level)								
1Country index, Equally-weighted	3.52	7.46	11.28	6.47	21.52	14.55	15.42	13.14
2Country index, Value-weighted	3.52	8.77	13.24	6.14	20.08	14.55	15.17	13.66
3International index	29.15	20.61	27.94	34.53	75.41	25.35	27.25	73.37
% of firms exposed under 1 that are also exposed under 2	85.71	82.35	91.30	100.00	86.67	22.58	98.33	92.16
% of firms exposed under 1 that are also exposed under 3	57.14	47.06	73.91	50.00	76.19	22.58	68.33	76.47
% of firms exposed under 2 that are also exposed under 3	71.43	35.00	74.07	50.00	75.51	70.97	67.80	77.19
							.	
C. Firm regression R2								
Average R2 With Equally Weighted Country Index	0.114	0.121	0.129	0.268	0.220	0.141	0.153	0.121
Average R2 With Value Weighted Country Index	0.114	0.107	0.122	0.239	0.187	0.140	0.153	0.102
Average R2 With international Index	0.008	0.048	0.048	0.057	0.060	0.092	0.005	0.049
Average R2 With Equally Weighted Country Index and Dollor rate	0.115	0.121	0.129	0.268	0.222	0.142	0.160	0.122
Average R2 With Value Weighted Country Index and Dollar rate	0.114	0.106	0.122	0.239	0.103	0.142	0.160	0.103
Average R2 With international Index and Dollar rate	0.009	0.050	0.052	0.062	0.083	0.094	0.023	0.055

Table 4: Spurious correlation between the exchange rate and returns?

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
Firm exposure: (% of firms exposed to $US at 5% level)								
Benchmark 1: Country index, Equally-weighted, US dollar exposure	3.52	7.46	11.28	6.47	21.52	14.55	15.42	13.14
Avg percentage of exposed firms based on 200 draws of a random variable with the same variance as the dollar bilateral rate	5.06	5.50	5.16	5.19	5.38	5.10	5.36	5.31

Note: Both sets of regressions are based on a CAPM specification which includes the equally-weighted local market index.

Table 5: Dollar exposure at 1-week, 4-week and 12-week horizons

The table reports the percent of firms with significant exposure to the dollar at the 5% level (based on a regression where firm returns are conditioned on the equally-weighted local market index). Results are based on rolling regressions using 1-week, 4-week or 12-week lengths estimated with GMM, correcting for serial correlation.

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
Firm-level exposure (% of firms with FX exposure at 5% level)								
1-week exposure	3.52	7.46	11.27	6.50	21.52	14.55	15.42	13.14
4-week exposure	13.07	15.35	20.59	9.75	30.74	21.13	36.25	15.72
12-week exposure	29.15	18.42	27.45	15.16	34.02	22.54	40.87	16.75

Table 6: Direction and Magnitude of FX exposure

Results are based on the benchmark specification using the equally-weighted market index and one of the three exchange rates (trade-weighted, $US, or currency of major trading partner). All significance levels are set at 5% based on robust standard errors.

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
A. Direction of Exposure								
1. TW exchange rate								
% positive	50	61	54	53	62	63	21	70
2. $US								
% positive	43	53	43	54	47	42	25	45
B. Average increase in R2 (in percent)								
1. Across all firms								
tw exchange rate	-0.017	0.015	-0.028	0.150	0.250	0.141	0.632	0.077
US$	0.015	-0.001	-0.004	0.031	0.233	0.178	0.707	0.083
Major trading partner	1.469	0.023	-0.004	0.218	0.507	0.143	0.380	0.041
2. At 5% level of significance								
tw exchange rate	0.851	1.060	0.418	1.099	0.924	1.187	2.641	1.119
US$	2.512	1.171	0.480	0.975	1.111	1.271	2.837	1.147
Major trading partner	1.469	1.234	0.471	1.017	1.207	1.363	2.243	1.159
C. Magnitude of Exposure Coefficient								
1. Significant positive exposure								
tw exchange rate	0.421	2.027	0.637	0.728	0.334	1.452	0.812	0.385
US$	0.568	0.364	0.168	0.426	0.421	0.650	0.739	0.457
Major trading partner	0.253	9.061	0.717	0.563	0.187	3.327	0.602	0.435
2. Significant negative exposure								
tw exchange rate	-0.117	-1.123	-0.502	-0.548	-0.417	-1.801	-1.009	-0.465
US$	-0.777	-0.555	-0.180	-0.268	-0.361	-0.270	-1.024	-0.356
Major trading partner	-0.467	-1.509	-0.244	-1.103	-0.248	-21.364	-0.668	-0.399

Table 7: Foreign Exchange Exposure across Subsamples

The table reports the percent of firms in each country that has a significant exposure coefficient in each of the three sub-samples. Results are based on the benchmark specification using the equally-weighted market index and one of the three exchange rates (trade-weighted, $US, or currency of major trading partner). All significance levels are set at 5% based on robust standard error. The subsamples are described in the text.

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
PERCENT OF FIRMS WITH FOREIGN EXCHANGE EXPOSURE AT 5% LEVEL:								
FULL SAMPLE								
any exchange rate	19.09	21.05	21.97	28.42	31.15	24.41	20.31	19.33
tw exchange rate	5.03	7.89	13.45	13.67	26.23	15.02	14.65	11.08
US$	3.52	7.46	10.31	6.47	21.52	14.55	15.42	13.14
other major currency	8.04	10.53	8.97	18.71	21.31	13.15	14.40	9.54
	(Yen)	(BG)	(Yen)	(DM)	(SG)	(BP)	(SG)	(NL)
FIRST THIRD OF SAMPLE								
any exchange rate	21.49	30.77	28.13	30.19	28.74	42.00	30.91	22.35
tw exchange rate	8.26	7.69	12.50	7.08	11.02	17.00	11.69	9.50
US$	7.44	2.56	10.94	6.60	9.84	13.00	11.43	7.26
other major currency	6.61	7.69	10.94	8.49	8.56	26.00	11.43	9.50
	(Yen)	(BG)	(Yen)	(DM)	(SG)	(BP)	(SG)	(NL)
SECOND THIRD OF SAMPLE								
any exchange rate	23.46	35.95	29.41	21.59	29.95	27.07	27.78	32.20
tw exchange rate	6.17	13.73	13.24	9.25	22.52	9.77	18.89	17.42
US$	7.41	11.11	14.71	6.17	17.79	9.77	16.67	17.42
other major currency	6.17	4.58	5.88	6.17	15.77	6.77	18.15	16.29
	(Yen)	(BG)	(Yen)	(DM)	(SG)	(BP)	(SG)	(NL)
LAST THIRD OF SAMPLE								
any exchange rate	24.47	27.19	18.31	42.45	35.66	35.68	25.73	15.25
tw exchange rate	9.04	5.26	7.98	16.19	23.77	13.15	13.74	7.49
US$	4.79	5.26	6.10	9.71	24.18	14.55	15.50	9.56
other major currency	7.45	10.09	7.04	22.66	21.11	9.39	13.16	5.17
	(Yen)	(BG)	(Yen)	(DM)	(SG)	(BP)	(SG)	(NL)

Table 8: Persistence of firm exchange rate exposure across subsamples

	Chile (YEN)	France (BG)	Germany (USD)	Italy (DM)	Japan (USD)	Neth (USD)	Thailand (USD)	UK (USD)
A. Percent of firms exposed:								
in full sample	8.0	10.5	10.3	18.7	21.5	14.6	15.4	13.1
in first sub-sample	6.6	7.7	10.9	8.5	9.8	13.0	11.4	7.3
in second sub-sample	6.2	5.9	14.7	6.2	17.8	9.8	16.7	17.4
in third sub-sample	7.5	10.1	6.1	22.7	24.2	14.6	15.5	15.5
B. Percent of firms exposed								
across two or more subsamples	0.6	0.7	5.9	4.0	10.4	7.5	3.7	3.4
in all 3 subsamples	0.0	0.0	0.0	0.0	1.2	1.0	0.0	1.7
in 2-3 subperiods but not in full sample	0.0	0.0	0.0	1.3	1.8	1.5	2.3	0.4
in the full sample-- but not in any subsample	2.0	2.6	1.3	5.0	3.3	2.3	6.2	1.8

Table 9: Robustness of the sign on the exposure beta over time

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
A. Exposure measured using the trade-weighted Exchange Rate								
Percent of firms whose signs on beta changes from subperiod 1 to 2	54.8	48.7	48.4	49.5	53.9	44.0	53.4	45.8
Percent of firms whose signs on beta changes from subperiod 2 to 3	49.0	47.1	39.7	45.8	36.3	42.9	52.1	45.6
Percent of firms whose signs on beta changes from subperiod 1 to 3	50.9	48.7	32.8	47.2	59.8	45.0	48.8	48.6
Percent of firms whose sign on beta does not change over all three subperiods	22.5	25.6	40.6	28.3	28.4	33.0	24.3	29.6
B. Exposure measured using the Dollar Exchange Rate								
Percent of firms whose signs on beta changes from subperiod 1 to 2	53.0	56.4	46.9	43.9	49.2	45.0	54.9	54.8
Percent of firms whose signs on beta changes from subperiod 2 to 3	52.3	45.1	35.3	50.7	35.4	45.9	53.7	44.9
Percent of firms whose signs on beta changes from subperiod 1 to 3	50.9	41.0	46.9	48.1	51.2	39.0	49.1	46.9
Percent of firms whose sign on beta does not change over all three subperiods	22.5	28.2	34.4	28.3	35.4	33.0	21.2	26.3
C. Exposure measured using the Major Trading Partner Exchange Rate								
Percent of firms whose signs on beta changes from subperiod 1 to 2	50.4	41.0	42.2	48.1	52.0	35.0	50.4	44.7
Percent of firms whose signs on beta changes from subperiod 2 to 3	50.3	50.3	47.1	41.0	37.6	48.9	50.6	46.0
Percent of firms whose signs on beta changes from subperiod 1 to 3	47.3	51.3	43.8	54.3	59.8	52.0	47.3	45.3
Percent of firms whose sign on beta does not change over all three subperiods	28.8	28.2	34.4	27.8	26.8	35.0	26.3	31.3

Table 10: Number of Significant US Dollar Exposure Betas within Categories

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK	All	% positive coefficient in each category
A. Firm size										
Large firms	2	5	18	9	54	15	21	34	158	51.3
Medium Firms	2	6	3	4	31	11	20	8	85	36.5
Small Firms	3	5	2	5	20	5	19	9	68	33.8
B. Industries										
Mining, Oil & Gas	1	0	0	0	2	0	0	4	7	71.4
Chem, Const, Forestry, Steel	2	0	3	3	19	0	9	4	40	75.0
Aerosp, Indust, Elect, Eng	0	3	4	0	20	7	0	6	40	75.0
Auto, Hhold goods, Textiles	0	3	3	5	11	2	5	1	30	63.3
Bev, Food, Health, Pkg, Pharm, Tob	1	3	3	0	2	5	11	7	32	59.4
Distrib, Retail, Hotel, Rest, Transport	2	3	1	0	14	5	5	17	47	34.0
Food & drug retail, Telecom	0	0	0	2	3	0	1	3	9	22.2
Elect, Gas & Water	0	0	3	1	9	0	1	2	16	6.3
Finance, Ins & Real estate	1	2	6	6	17	8	20	7	67	32.8
Info technol., Software & comp	0	1	0	0	8	4	0	0	13	84.6
C. Traded vs. Nontraded										
Traded	4	9	10	8	54	14	25	22	146	49.3
Nontraded	3	6	13	9	51	17	27	29	155	40.0
D. Multinational										
Multinational	na	4	10	1	29	3	na	16	63	74.6
Non-multinational	na	13	13	17	76	28	na	35	182	39.0

Table 11: Signs on Exposure Betas within Categories

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
I. Percent positive exposure betas within categories of market size								
Large firms	38%	58%	38%	56%	43%	42%	40%	42%
Medium Firms	55%	46%	38%	54%	50%	46%	38%	43%
Small Firms	59%	42%	47%	45%	45%	37%	47%	47%
II. Percent positive exposure betas within Industry Categories								
Mining, Oil & Gas	62%	75%	50%	100%	0%	11%	29%	67%
Chem, const, Forestry, Steel	57%	58%	40%	47%	32%	52%	39%	59%
Aerosp, Indust, Elect, Eng	53%	47%	36%	45%	68%	45%	59%	44%
Auto, Hhold goods, Textiles	83%	57%	52%	43%	69%	31%	47%	39%
Bev, Food, Health, Pkg, Pharm, Tob	51%	42%	20%	50%	46%	38%	49%	48%
Distrib, Retail, Hotel, Rest, Transport	30%	56%	52%	36%	49%	38%	52%	38%
Food & Drug retail, Telecom	22%	20%	67%	29%	18%	17%	29%	46%
Elect, Gas & Water	23%	100%	27%	0%	0%	n.a.	60%	36%
Finance, Ins & Real estate	60%	38%	43%	71%	21%	47%	28%	42%
Info Technol., Softward & comp	56%	50%	100%	0%	89%	60%	33%	52%

Table 12: Firm size, Industry affiliation and $US dollar exposure

"pos" denotes a positive and "neg" denotes a negative coefficient at the 5% level (based on robust standard errors).

		Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
Part A. Regressions using beta coefficients from the first-stage regressions									
Firm size (1)	Large	0	0	0	0	0	0	0	0
	Medium	0	0	0	0	0	0	0	0
Industry (2)	Mining, Oil & Gas	0	0	0	pos	neg	0	neg	0
	Chem, Const, Forestry, Steel	0	0	0	0	neg	0	0	pos
	Aerosp, Indust, Elect, Eng	0	0	0	0	pos	0	0	0
	Auto, Hhold goods, Textiles	0	0	0	0	0	0	0	0
	Bev, Food, health, Pkg, Pharm, Tob	0	0	0	pos	0	0	0	0
	Food & drug retail, Telecom	0	0	0	0	neg	0	0	0
	Elect, Gas & Water	0	0	0	0	neg	0	0	0
	Finance, Ins & Real estate	0	0	0	pos	neg	0	neg	0
	Info technol., Software & comp	pos	0	0	neg	pos	pos	0	0
Part B. Regressions using transformed beta coefficients from the first-stage regressions (3)									
Firm size (1)	Large	neg	neg	0	neg	0	0	neg	neg
	Medium	neg	neg	0	0	0	0	0	neg
Industry (2)	Mining, Oil & Gas	0	0	neg	0	pos	neg	0	pos
	Chem, Const, Forestry, Steel	0	0	0	0	0	0	pos	0
	Aerosp, Indust, Elect, Eng	0	0	0	0	0	0	pos	0
	Auto, Hhold goods, Textiles	neg	0	0	0	0	0	0	0
	Bev, Food, health, Pkg, Pharm, Tob	0	0	neg	0	neg	0	0	0
	Food & drug retail, Telecom	0	0	0	0	0	0	0	pos
	Elect, Gas & Water	neg	neg	0	0	pos	0	0	0
	Finance, Ins & Real estate	0	pos	0	0	0	0	pos	0
	Info technol., Software & comp	pos	0	neg	0	0	pos	0	pos
Degree of Freedom		182	204	192	253	473	201	337	372

(1) Reference industry for creating firm-size dummies is small, defined as the bottom one-third of distribution of market capitalizations.

(2) Reference industry for creating industry dummies is Distrib, Retail, Hotel, Rest, Transport.

(3) Dependent variable is the square root of the absolute value of the betas.

Table 13: Multinational status, foreign sales, international assets and $US dollar exposure

All regressions include firm size and industry dummies.

Only the coefficients on the MNC status, foreign sales and international assets are reported.

"pos" denotes a positive coefficient and "neg" denotes a negative coefficient at the 5% level (based on robust standard errors)

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
Part A. Regressions using beta coefficients from the first-stage regressions								
Multinational(1)	na		pos				na	pos
Foreign sales(2)			pos		pos			pos
International assets(3)	na		pos	pos	pos	pos		pos
Part B. Regressions using transformed beta coefficients from the first-stage regressions (4)								
Multinational(1)	na	neg		neg	pos		na	
Foreign sales(2)	neg				pos			
International assets(3)	na			pos	pos	pos		

(1) The degrees of freedom are 203, 191, 252, 472, 200 and 371 respectively for the 6 countries (excluding Chile and Thailand).

(2) The degrees of freedom are 16, 107, 95,181,351,115, 180, and 281 respectively for the eight countries.

(3) The degrees of freedom are 38, 49, 60, 324, 26, 175 and 261, respectively for the seven countries (excluding Chile).

(4) Dependent variable is the square root of the absolute value of the betas.

Table 14: Exposure using currencies of top trading partners by industry

	Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
1. Data coverage								
# of firms covered by trade data	88	115	114	131	280	99	178	122
# of firms in full sample	199	228	204	277	488	213	389	388
% coverage	44	50	56	47	57	46	46	31
2. Percent of firms in sample exposed to								
currency of leading export country	5.68	6.96	11.40	16.03	18.57	12.12	11.80	13.11
currency of top 3 exporting countries	11.36	14.78	23.68	14.50	19.64	23.23	18.54	18.03
US Dollar(1)	3.41	6.95	11.40	6.06	17.85	10.10	11.24	13.60
3. Percent of firms exposed to								
currency of leading import country	4.55	6.96	7.89	15.27	13.93	12.12	6.18	13.11
currency of top 3 importing countries	25.00	20.87	19.30	12.21	22.86	23.23	25.28	18.03
US Dollar(1)	3.41	6.95	11.40	6.06	17.85	10.10	11.24	13.60

(1) Percent US dollar exposure in the sample of firms that are covered by trade data.

Table 15: International trade and $US dollar exposure

All regressions include firm size dummies.

Only the coefficients on the trade variables are reported.

"pos" denotes positive exposure and "neg" denotes negative exposure coefficient at the 5% level (based on robust standard errors)

		Chile	France	Germany	Italy	Japan	Neth	Thailand	UK
Part A. Regressions using beta coefficients from the first-stage regressions									
Traded sector (1)									pos
World trade flows (2)	Export					pos			
	Import								
Trade shares (3)	Export share	na	na	na	na	pos	na	na	
	Import share	na	na	na	na	pos	na	na	
	Net input share	na	na	na	na	neg	na	na	neg
Part B. Regressions using transformed beta coefficients from the first-stage regressions (4)									
Traded sector (1)									
World trade flows (2)	Export				pos			neg	
	Import							pos	
Trade shares (3)	Export share	na	na	na	na	pos	na	na	
	Import share	na	na	na	na	pos	na	na	
	Net input share	na	na	na	na	pos	na	na	

(1) Industry dummy set to 1 if firm is in a traded-good industry. Degrees of freedom are 190, 212, 200, 261, 481, 208, 345 and 380, respectively for the 8 countries.

(2) Feenstra world trade industry-level volume data. Degrees of freedom are 83, 107, 108, 127, 276, 94, 173 and 120, respectively for the 8 countries.

(3) Campa Goldberg trade share data. Degrees of freedom are 249 for Japan and 105 for the UK.

(4) Dependent variable is the square root of the absolute value of the betas.