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A Reexamination of Exchange-Rate Exposure

By KATHRYN M. E. DOMINGUEZ AND LINDA L. TESAR*

It is widely believed that exchange-rate changes have important implications for financial decision-making and for firm profitability. But do exchange-rate changes have measurable effects on firm returns? The existing literature on the relationship between international stock prices and exchange rates finds only weak evidence of systematic exchange-rate exposure. We argue in this paper that the absence of evidence may be due to restrictions imposed on empirical specifications used in previous studies.

We adopt a data-driven approach to measuring exposure and study a relatively broad sample of countries over a 19-year period. The results indicate that there is considerable exchange-rate exposure at both the industry and firm level.

I. Defining Exchange-Rate Exposure

A firm is said to exhibit exchange-rate exposure if its share value is influenced by changes in currency values (Michael Adler and Bernard Dumas, 1984). There are a number of channels through which 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 their products 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. Even firms that do no international business may be influenced indirectly by foreign competition. Furthermore, firms in the non-traded as well as the traded sectors of the economy compete for factors of production, whose returns may be affected by changes in the exchange rate.

Although there are many explanations for the link between the exchange rate and profitability, the link between the exchange rate and a firm's stock price is less clear. Under the capital-asset-pricing model (CAPM), the expected risk premium on a company's share price is proportional to its covariance with the market portfolio. In theory, investors will only require a return on the nondiversifiable portion of firm risk, and no variable other than the market return should play a systematic role in determining asset returns. Therefore, a test for exchange-rate exposure involves including the change in the exchange rate on the right-hand side of a standard CAPM regression and testing whether its coefficient is significantly different than zero:

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

where $R_{i,t}$ is the return on firm i at time t, $R_{m,t}$ is the return on the market portfolio, $\beta_{1,i}$ is the firm's beta, Δs_t is the change in the relevant exchange rate and $\beta_{2,i}$ measures a firm's exposure to exchange-rate movements after taking into account the overall market's exposure to currency fluctuations. If $\beta_{2,i}$ is zero, this implies that firm i has the same exchange-rate exposure as the market portfolio (not necessarily that the firm has no exposure). Alternatively, if we reject the hypothesis that $\beta_{2,i}$ is 0, on average, we find both evidence of exchange-rate exposure and a rejection of this specification of the CAPM.[1]

If we do indeed find evidence of exchange-rate exposure, this indicates the existence of some form of market inefficiency. A rejection

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[1] It is possible, even likely, that in some countries the exchange rate and the market return are jointly determined. Our definition of exposure will therefore understate the overall impact of a change in the exchange rate on firm returns.

of no exposure suggests either that investors are not fully diversifying their portfolios (so that exchange-rate risk remains) or that firms themselves are not fully hedging their exchange-rate risks. Unfortunately, without more detailed data either on investor portfolio holdings or firms' hedging practices, it is not possible to say which of these situations is operative.

II. Testing for Exposure

Testing for exchange-rate exposure at the firm and industry level entails taking a stand on a number of empirical questions.

A. *Exchange Rates*

One of the first questions that arises when one thinks about exchange-rate exposure is: "Which is the relevant exchange rate to include in equation (1)?" Most of the studies in the literature use a trade-weighted exchange rate to measure exposure. The problem with using a trade-weighted basket of currencies in exposure tests is that the results lack power if the nature of firm exposure does not correspond to the exchange rates (and the relative weights) included in the basket. More generally, we should expect variation in individual firm and industry exposure to various exchange rates. Any test that restricts the measurement of exposure to one exchange rate (whether it be a trade-weighted rate or a bilateral rate) is likely to be biased downward.[2]

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. Firms may hedge exposure to the more obvious currencies (e.g., currencies of the countries where they export or import goods) but remain exposed to currencies of countries with whom their goods compete on world markets (but with whom they do no direct business). Since theory does not provide us with clear exchange-rate candidates for our exposure tests we include multiple exchange rates in our specifications.

B. *Industry Aggregation*

The majority of exposure studies use industry-level data. They do so for two reasons. First, some hypotheses about exposure are most relevant at the industry level. For example, one prediction is that exposure will be greatest in highly competitive industries where markups are low (see e.g., Gordon Bodnar and William Gentry, 1993; José Campa and Linda Goldberg, 1995). The second reason is that cross-country industry-return data are relatively easy to obtain. The problem with industry-level aggregation is that firms within an industry need not be homogeneous. It may be that industry-wide exposure is actually high but that individual firms within the industry are exposed in opposite ways. An aggregation of their returns will therefore average out the individual exposure effects. Moreover, most industry return indices (including the widely used Datastream indices) are value-weighted so that the largest firms in the industry are given the greatest weight in the index. We therefore test for exposure at both the industry and the firm level.

C. *Multinationals and Exporting Firms*

Another common empirical strategy is to test for exposure in a limited set of firms. For example, a number of studies test for exposure in multinational firms, or in firms that actively engage in international trade (see e.g., Philippe Jorion, 1990; Jia He and Lilian Ng, 1998).[3] However, theory does not suggest that exposure will be limited to these firms. Indeed, one might expect that these firms would be the least likely to be exposed, since they are the most likely to have access to both operational and financial hedging strategies.[4] In order to allow the data to inform us about which firms are more or less

[2] Craig Doidge et al. (2000) use both bilateral rates and trade-weighted exchange rates but "score" exposure based on one rate.

[3] Dominguez and Tesar (2000) test whether firms in industries that are involved in international trade are more likely to be exposed.

[4] Examples of operational hedges include locating production abroad and matching the currency of invoice for both receipts and outlays.

likely to be exposed, we include all firms in our empirical work.

D. *Equally Weighted versus Value-Weighted Market Returns*

Empirical tests of the standard CAPM model generally include a country-specific value-weighted market return to proxy for "the market." In a world of perfectly integrated capital markets the "market return" is best proxied by a global portfolio. However, previous empirical work strongly suggests that country-specific market returns better explain firm- and industry-level returns.[5] Further, Bodnar and Franco Wong (2000) explain that value-weighted market returns are dominated by large firms that are more likely to be multinational or export-oriented and are more likely to experience negative cash-flow reactions to home-currency appreciations than other firms. Therefore, including the value-weighted market return in an exposure test not only removes the standard macroeconomic effects, but also the more negative cash-flow effects of larger firms. This would likely bias tests toward finding no exposure. In the tests results reported below we use an equally weighted market return.

E. *Exposure Stability*

The exposure tests are estimated using data covering the period January 1980–May 1999. In order to test whether the results are robust over subsamples (and whether specific subsamples drive the full-sample results), we re-estimate both firm and industry level tests over three subperiods. Subperiods are selected on the basis of changes in the underlying currencies used for each country.

III. The Empirical Specification, the Data, and Results

Augmented CAPM specifications are estimated at the firm and four-digit industry level for eight countries (Chile, France, Germany, Italy, Japan, the Netherlands, Thailand, and the United Kingdom) using a broad sample of firms. We use weekly (Wednesday) returns, country-specific market portfolio returns, and three country-specific exchange rates. All data are from Datastream. For large countries (Germany, Japan, and the United Kingdom) we selected a representative sample of firms (25 percent of the population) based on market capitalization and industry affiliation. For the remaining countries we include the population of firms. The samples include an average of 300 firms for each country; Japan includes the largest number of firms at 488; Chile has the smallest number at 199. Firms with fewer than six months of data over the period 1980–1999 were excluded from the sample. The number of industries varied across countries from 20 in Thailand to 39 in the United Kingdom.

Table 1 shows the percentages of industries and firms within a country with statistically significant exposure at the 5-percent level (based on robust standard errors). The extent of exchange-rate exposure is remarkably high and clearly above the ratios one would expect to see in a random sample. The "any" exchange-rate column shows that firm-level exposure ranges from a low of 14 percent for Chile to a high of 31 percent for Japan. At the industry level, Germany and Japan show greater than 60 per-

TABLE 1—FIRM- AND INDUSTRY-LEVEL EXPOSURE

	Percentage of significant exposure				
	Industry		Firm		
Country	Any	TW	Any	TW	Non-TW
Chile	11	4	14	5	85
France	17	6	19	8	64
Germany	65	26	21	14	26
Italy	32	19	26	14	61
Japan	60	58	31	26	18
Netherlands	40	21	26	15	35
Thailand	25	20	21	15	15
United Kingdom	46	36	19	11	39

Notes: The columns labeled "TW" show the percentages of industries or firms exposed to a trade-weighted exchange rate; "any" columns show the percentage exposed to at least one of the following: the trade-weighted exchange rate, the U.S. dollar, and an additional bilateral rate (based on direction-of-trade data). The final column shows the percentage of exposed firms that are exposed to the dollar bilateral rate but are not exposed to the trade-weighted exchange rate.

[5] In future work we will systematically explore the impact of different CAPM specifications on our estimates of exposure.

cent exposure, and the rest of the countries show 11–46 percent exposure.

The results indicate that tests based on the trade-weighted exchange rate are likely to yield downward-biased estimates of exposure. For example, 18 percent of the Japanese sample consists of firms that are not exposed to the trade-weighted exchange rate but are significantly exposed to one of the included bilateral rates.

The augmented CAPM regressions also provide information on the percentage of significant positive and negative exposure (see Dominguez and Tesar, 2000). 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 United Kingdom), 60–70 percent of firms exhibit positive exposure (meaning that an increase in the value of the home currency relative to other currencies results in an increase in firm share value). In contrast, 80 percent of Thai firms exhibit negative exposure, suggesting that an increase in the value of the baht generally led to a decrease in the value of Thai firm share values.

We also calculate the average increase in the adjusted R^2 at the firm level when we include the exchange rate in a traditional CAPM specification. Although the smaller countries like Chile and Thailand show relatively lower levels of industry and firm exposure, the average increase in adjusted R^2 from including 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 exposure coefficient.

Finally, we test whether the exposure estimates obtained for the full sample of 19 years are robust over subsamples. While there is time-variation in exposure at the firm level, the overall extent of exposure is not sample-dependent. A complete discussion of the subsample results is presented in Dominguez and Tesar (2000).

IV. Conclusions

This study uses a broad sample of firm and industry returns, equally weighted market returns, and multiple exchange rates to test for exchange-rate exposure. The results are consistent with high degrees of exchange-rate exposure at both the firm and industry level across eight countries. In future research we will examine what kinds of country, firm, and industry characteristics best predict exposure.

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