NBER WORKING PAPER SERIES

A RE-EXAMINATION OF EXCHANGE RATE EXPOSURE

Kathryn M.E. Dominguez
Linda L. Tesar

Working Paper 8128
http://www.nber.org/papers/w8128

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 2001

This paper is *forthcoming* in the American Economic Review: Papers and Proceedings, May 2001. We thank Ken Froot, Gordon Hanson and seminar participants at the University of Michigan and the ASSA meetings for helpful comments. We gratefully acknowledge financial support from the Center for International Business Education at the University of Michigan. We are also grateful to Chayawadee Chai-anant and Qiaoqiao Zhu for their outstanding research assistance. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research.

A Re-Examination of Exchange Rate Exposure
Kathryn M.E. Dominguez and Linda L. Tesar
NBER Working Paper No. 8128
February 2001
JEL No.: F23, F31, G15

ABSTRACT

Finance theory suggests that changes in exchange rates should have little influence on asset prices in a world that has become increasingly with integrated capital markets. Indeed, the existing literature examining the relationship between international stock prices and exchange rates finds little evidence of systematic exchange rate exposure. We argue in this paper that the absence of evidence may be due to restrictions imposed on the sample of data and the empirical specifications used in previous studies. We study a broad sample of firms in eight countries over an eighteen-year period. We find that firm-level and industry-level share values are significantly influenced by exchange rates. Further, we do not find evidence that exchange rate exposure is falling (or becoming less statistically significant) over time. Our results suggest that significant firm, industry and country-specific differences remain even as financial markets become more and more "integrated".

Kathryn M.E. Dominguez
Ford School of Public Policy,
Department of Economics and NBER
University of Michigan
Ann Arbor, MI 48109
kathrynd@umich.edu

Linda L. Tesar
Department of Economics and NBER
University of Michigan
Ann Arbor, MI 48109
ltesar@umich.edu

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 an eighteen-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 its 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 nontraded 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 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 non-diversifiable 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:

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

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 beta, Δs_t is the change in the relevant exchange rate and $b_{2,i}$ measures a firm's exposure to exchange rate movements after taking into account the overall market's exposure to currency fluctuations. If $b_{2,i}$ 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 $b_{2,i}$ is, on average, zero – we both find 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 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.

[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.

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 thinking 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 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 (for example, 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.

[2] Craig Doidge, John Griffin and Rohan Williamson (2000) use both bilateral rates and trade-weighted exchange rates but "score" exposure based on one rate.

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 mark-ups are low.[3] 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.[4] 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.[5] In order to allow the data to inform us about which firms are more or less likely to be exposed we include all firms in our empirical work.

---

[3] For example, Gordon Bodnar and William Gentry (1993) and Jose Campa and Linda Goldberg (1995).

[4] For example, Philippe Jorion (1990) and Jia He and Lilian Ng (1998). Dominguez and Tesar (2000) test whether firms in industries that are involved in international trade are more likely to be exposed.

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

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. But, previous empirical work strongly suggests that country specific market returns better explain firm and industry level returns.[6] Further, Gordon Bodnar and Franco Wong (2000) explain that value-weighted market returns are dominated by large firms that are more likely to be multinational and/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 equal-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.

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

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 UK) 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 UK) we selected 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. 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 to 1999 were excluded from the sample. The number of industries varied across countries from 20 in Thailand to 39 in the UK.

Table 1 shows the percentages of industries and firms within a country with significant exposure at the 5% 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 19% for Chile to a high of 31% for Japan. At the industry level, Germany and Japan show greater than 60% exposure and the rest of the countries show between 22-46% exposure.

The results indicate that tests based on the trade-weighted exchange rate are likely to yield downward biased estimates of exposure. For example, 24% 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.

Table 1—Firm and Industry Level Exposure

	Percentage of significant exposure				Percent non-TW firm exposure
Countries:	Industry		Firm		
	Any	TW	Any	TW	
Chile	22	4	19	5	11
France	22	6	21	8	14
Germany	65	26	22	13	14
Italy	32	19	28	14	18
Japan	61	58	31	26	24
Netherlands	31	21	24	15	17
Thailand	25	20	20	15	21
UK	46	36	19	11	16

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

The augmented CAPM regressions also provide information on the percentage of significant positive and negative exposure (see Kathryn M. Dominguez and Linda L. 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 UK) 60-70% 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% 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 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 eighteen 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, equal-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.

References

Adler, Michael and Dumas, Bernard. "Exposure to Currency Risk: Definition and Measurement." Financial Management, 1984,13,pp. 41-50.

Bodnar, Gordon and Gentry, William. "Exchange-rate exposure and industry characteristics: evidence from Canada, Japan and U.S." Journal of International Money and Finance, 1993,12(1), pp. 29-45.

Bodnar, Gordon and Wong, M.H. Franco. "Estimating Exchange Rate Exposures: Some "Weighty" Issues." NBER Working Paper 7497, January 2000.

Campa, Jose and Goldberg, Linda. "Investment in Manufacturing, Exchange-Rates and External Exposure." Journal of International Economics, 1995, 38, pp. 297-320.

Doidge, Craig, Griffin, John and Williamson, Rohan. "An International Comparison of Exchange Rate Exposure." Mimeo,2000.

Dominguez, Kathryn and Tesar, Linda. "Exchange Rate Exposure." Mimeo, University of Michigan, 2000.

He, Jia and Ng, Lilian. "The Foreign Exchange Exposure of Japanese Multinational Corporations." The Journal of Finance, April 1998, LIII(2), pp. 733-753.

Jorion, Philippe. "The exchange rate exposure of U.S. multinationals." Journal of Business, 1990, 63, pp. 33-45.