The Foreign Exchange Exposure of Japanese Multinational Corporations

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ABSTRACT

We find that about 25 percent of our sample of 171 Japanese multinationals' stock returns experienced economically significant positive exposure effects for the period January 1979 to December 1993. The extent to which a firm is exposed to exchange-rate fluctuations can be explained by the level of its export ratio and by variables that are proxies for its hedging needs. Highly leveraged firms, or firms with low liquidity, tend to have smaller exposures. Foreign exposure is found to increase with firm size. We also find that keiretsu multinationals are more exposed to exchange-rate risk than nonkeiretsu firms.

IT IS CONVENTIONAL WISDOM that exchange-rate movements affect both the cash flows of a firm's operations and the discount rate employed to value these cash flows.[1] Measuring foreign exchange exposure is now a central issue of international financial management, and this issue has spawned a considerable amount of research. Existing empirical evidence on foreign exchange exposure, however, seems perplexing; studies have so far documented a weak link between contemporaneous exchange-rate fluctuations and stock returns of U.S. multinational firms.[2] Gendreau (1994) finds it difficult and unconvincing that the weak results imply that exchange-rate changes have no effect on exporters' stock returns. Bartov and Bodnar (1994) attribute the observed insignificant relationship between exchange-rate changes and stock returns to probable problems associated with the previous studies' sample selection procedure, or to mispricing caused by investors' errors in estimat-

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[1] A recent study by Bartov, Bodnar, and Kaul (1996) shows that there is an increase in the variability of equity returns following the period of increased exchange-rate variability. The authors suggest that the increase in exchange-rate fluctuations is an indication of an increase in the riskiness of the multinationals' cash flows.

[2] For example, Jorion (1990), Bodnar and Gentry (1993), Amihud (1994), and Bartov and Bodnar (1994).

ing this linkage. Levi (1994), however, argues that the lack of evidence is due to the difficulty in obtaining stable measures of exchange-rate exposures.

The weak U.S. evidence warrants further investigation that is based on international data. We are therefore motivated to look for evidence in the Japanese market. The Japanese case is of interest for several reasons. First, existing studies rely primarily on the U.S. evidence. The robustness of their findings needs to be examined against evidence from other major industrialized countries such as Japan, whose stock market ranks second in terms of market capitalization after the U.S. Second, the growing significance of the Japanese share of world trade over the past decades has positioned Japan among the leading global economic powers. Also, many Japanese manufacturing sectors are heavily globally oriented and are more susceptible to unanticipated fluctuations in foreign exchange rates. Third, Japan has an interestingly unique corporate system with control mechanisms different from those of many industrialized countries. The key feature of the corporate system to be explained below will add some insights into the issues we are examining here. Finally, to the best of our knowledge, no study has yet conducted a comprehensive analysis of the exposure effect on Japanese multinational corporations.[3] Thus, Japan makes an interesting and attractive candidate for our study.

We investigate whether the value of a Japanese multinational corporation is affected by exchange-rate changes and whether lagged exchange-rate changes have any explanatory power for current stock returns. The analysis of the latter is motivated by Amihud's (1994) and Bartov and Bodnar's (1994) findings that lagged, and *not* contemporaneous, changes in the dollar can explain firms' current stock returns. We test this relationship by regressing stock returns against both contemporaneous and lagged exchange-rate changes. Significance of the coefficient on the latter would imply that current stock returns can be predicted by lagged foreign-exchange fluctuations.

Using a sample of 171 Japanese multinationals, we find that about 25 percent of the firms experienced economically significant positive exposure effects for the whole period of January 1979 to December 1993. Our evidence of significant contemporaneous exposure effects is robust across two subsample periods, suggesting that a depreciation (appreciation) of the yen against other foreign currencies has a positive (adverse) impact on stock returns of Japanese multinationals. We also find that multinationals with significant exposure are concentrated mainly in three sectors: electric machinery, precision equipment, and transport equipment. The implication of this result calls for a finer classification of industries that will help reveal the effect of exchange-rate fluctuations on industries' stock returns, or suggests a firm-level analysis that avoids the averaging effect due to grouping of firms that

[3] Bodnar and Gentry (1993) compare foreign exchange exposures across the United States, Japanese, and Canadian industries. However, they look at aggregate industry level, without distinguishing constituent firms in each industry, and their sample covers only a short span of time between September 1983 and December 1988.

is based on a coarser information set. Further, there exists weak evidence of a lagged exposure effect in our sample.

In this study, we also conduct an exploratory investigation of whether exchange-rate exposure is determined by the level of a firm's international operations, by variables that existing studies find to be significant in explaining a firm's hedging motive, or by both. The more extensive a firm's foreign activities, the greater the exchange-rate exposure. However, the greater the extent to which the company hedges, the lower its exposure to exchange-rate risk. Interestingly, a recent survey finds that about 41 percent of 493 Japanese corporations use derivatives such as currency options, futures, and currency swaps to hedge their risk position.[4]

Our results indicate that exposure is positively related to a firm's export ratio. Consistent with optimal hedging theories, our results also show that the extent to which a firm is exposed to currency fluctuations can be explained by variables that are proxies for a firm's hedging incentives. Evidence indicates that Japanese multinational firms with low short-term liquidity or with high financial leverage are less exposed to fluctuations in exchange rates, and that foreign exchange-rate exposure increases with firm size.

Finally, we examine whether the uniqueness of the Japanese corporate environment plays a role in determining a firm's exposure to exchange-rate fluctuations. One distinctive feature of the Japanese corporate environment is the industrial grouping, or *keiretsu*. Keiretsu refers to a network of firms, affiliated with a main bank or a major firm, in which firms have crossholdings and strong product-market ties. Studies have shown that the bankruptcy risk for firms with close banking ties, and even with high financial leverage, tends to be lower than for unaffiliated, independent firms. Other studies have found that keiretsu firms are less likely to be liquidity constrained than nonkeiretsu firms. In the context of optimal hedging theories, this suggests that an affiliated firm, which generally has a stronger liquidity position and a lower bankruptcy risk than an independent firm, would be likely to hedge less against exchange-rate variability. Our results provide strong evidence that nonkeiretsu multinationals tend to be less exposed to exchange-rate risk than keiretsus, and this may be due to their different hedging motives.

The paper is organized as follows. The first section discusses the relationship between exchange-rate fluctuations and stock returns. The data description and empirical results are contained in the same section. In Section II we explore the determinants of exposure. In Section III we examine effects of Japanese industrial groupings on multinationals' exchange-rate exposure. Section IV concludes the paper.

[4] This information is obtained from a 1996 report by Nippon Life Insurance Company's survey on the usage of derivatives by Japanese corporations. The results of the survey are compared with the results of the U.S. surveys conducted by the Wharton School (see Bodnar, Hayt, and Marston (1996) and Bodnar et al. (1995)), which also find that 41 percent of 530 (350) U.S. firms in 1994 (1995) use derivatives.

I. Exchange-Rate Fluctuations and Stock Returns

A. Measuring Exchange-Rate Exposure

Dumas (1978), Hodder (1982), and Adler and Dumas (1984) define exchange-rate exposure as the effect of exchange-rate changes on the value of a firm. This definition has no implication for a causal relationship between exchange-rate fluctuations and changes in firm value. In other words, stock prices and exchange rates are endogenously determined. However, we assume partial equilibrium in the sense that exchange rates are exogenous to the value of a firm. Thus, exposure can be measured by the following regression model,

$$r_{it} = \beta_{io} + \beta_{ix} r_{xt} + \beta_{im} r_{mt} + \epsilon_{it}, \tag{1}$$

where r_{it} is the rate of return on the ith corporation's stock, r_{xt} is the rate of return on a trade-weighted exchange rate index, measured as the Japanese yen price of the foreign currency, r_{mt} is the rate of return on a market portfolio, and ϵ_{it} is the random error. Hence β_{ix}, the slope coefficient of the regression, is the exchange-rate exposure measure because it describes the sensitivity of stock returns to unanticipated changes in exchange rates.

An appreciation in the yen makes exporting goods more expensive in terms of the foreign currency, and this may lead to a fall in foreign demand, foreign sales revenue, or both. Consequently, the exporting firm's value would be hurt by an appreciation of the home currency. On the other hand, an importing firm would benefit from the appreciation of the home currency, as their imports become cheaper in terms of the home currency. As a result, the β_{ix} coefficient should be negative for importing firms and positive for exporting firms. However, the sign of β_{ix} becomes less distinct for a firm that imports as well as exports. In this case, the sensitivity of the firm value to exchange-rate fluctuations depends on the elasticity of the firm's demand for foreign goods (its imports) relative to the elasticity of the foreign market's demand for the firm's goods (its exports). Unless pertinent information about the type of corporations—exporting, importing, or net exporting/importing firms—is available, the resulting sign of β_{ix} is empirically determined by estimating model (1).

B. Sample Selection of Japanese Multinationals and Economic Factors

We begin by describing the selection of Japanese multinational firms with foreign involvement. Including these firms allows us to examine the sources of cross-sectional differences in Japanese multinational firms' exposure to currency fluctuations. We then discuss the proxy variables for the two economic factors in model (1) that most existing studies use to investigate firms' exposure to exchange-rate variability.

B.1. Japanese Multinational Firms

We select multinational firms based on information about their foreign activities, as measured by the export ratio, overseas ratio, or trade ratio. The export ratio represents a company's exports as a percentage of total sales; the overseas ratio expresses a construction firm's ratio of construction carried out overseas; and the trade ratio measures a trading firm's ratio of export, import, and offshore trading relative to total sales. For convenience, we shall refer to all these different measurements of foreign activities as export ratios. Such export-ratio data are from the *Japan Company Handbook*, published by Toyo Keizai Inc., and are drawn from unconsolidated financial statements from 1978 to 1993.[5]

Following Jorion (1990), we include only individual firms that have export ratios of at least 10 percent in the sample period. As a result, 171 multinational corporations are included in the sample; monthly rates of return on their stocks from January 1979 to December 1993 are obtained from the Pacific Basin Capital Markets (PACAP) database, which is maintained at the University of Rhode Island. Note that the stock data reflect all the information pertaining to both parent companies and their affiliations, whereas the financial data are only available for the parent companies' operations.[6] Thus, the results should be interpreted with this information in mind.

The sample is also divided into two approximately equal subperiods: January 1979 to December 1986 and January 1987 to December 1993. Analyzing subsample periods helps to unveil any structural change in the corporations' exposure to foreign exchange fluctuations.

B.2. Economic Factors

We use two economic factors in this study: (1) the factor associated with market risk (MKT), and (2) the currency risk factor (FX). The Japanese value-weighted market portfolio, as provided by PACAP, is used as a proxy for MKT. FX is measured as the continuous rate of change in a trade-weighted exchange rate index. Like Jorion (1990, 1991), Bodnar and Gentry (1993), and Bartov and Bodnar (1994), we construct the index by taking the weighted average of nine bilateral exchange rates, defined as yen per unit of foreign currencies for Australia, Canada, France, Germany, Italy, Netherlands, Switzerland, the United Kingdom (U.K.), and the United States (U.S.). The weights, updated annually, represent each country's proportion of the nine countries'

[5] Export ratio data of firms that are traded on the Second Section of the Exchange are only available from 1989 onward. Due to limited available information, we exclude such firms from our sample.

[6] Starting in the early 1990s, Japanese corporations are required to provide consolidated financial statements, but apparently keiretsu firms still maintain their own method of financial reporting.

Table I

Cross-Sectional Distribution of Exchange-Rate Exposure Coefficients $\hat{\beta}_{ix}$ of Japanese Multinational Firms

The table reports the quartiles for $\hat{\beta}_{ix}$, with z-scores in parentheses, from the following model,

$$r_{it} = \beta_{io} + \beta_{ix} r_{xt} + \beta_{im} r_{mt} + \epsilon_{it},$$

where r_{it} is the rate of return on the ith asset, r_{mt} is the rate of return on the market portfolio, and r_{xt} is the change in a trade-weighted exchange rate, measured as the Japanese yen price of foreign currencies. N^- reports the number of firms with negative $\hat{\beta}_{ix}$ significant at the 5 percent level, and N^+ reports the number of firms with positive $\hat{\beta}_{ix}$ significant at the 5 percent level. The sample comprises 171 multinational firms whose exports formed at least 10 percent of their annual total sales throughout the sample period 1978 to 1993.

Sample Period (year:month)	Quartiles						
	min	q_1	median	q_3	max	N^-	N^+
1978:01–1993:12	−0.109	0.070	0.242	0.451*	1.075*	2	43
	(0.460)	(0.274)	(1.863)	(2.159)	(4.598)		
1979:01–1986:12	−0.205*	−0.014	0.116	0.303*	0.954*	26	41
	(−1.953)	(−0.111)	(0.749)	(2.742)	(6.025)		
1987:01–1993:12	−0.107	0.144	0.411*	0.859*	1.459*	11	81
	(−0.610)	(1.503)	(3.088)	(4.091)	(8.948)		

*Significant at the 5 percent level.

total trade with Japan.[7] The latter information is obtained from the *International Financial Statistics Supplement of the International Monetary Fund on Direction of Trade Statistics Year Book*, whereas monthly data on the various exchange rates are from PACAP.

C. *The Exposure of Japanese Multinationals*

Table I shows cross-sectional distribution of the 171 Japanese multinationals' estimated β_{ix}, as defined in equation (1), for the full sample period and two subsample periods. It reports the quartiles and minimum and maximum values of $\hat{\beta}_{ix}$ together with the number of significant coefficients obtained. The t-statistics are indicated in parentheses.[8]

We find that for the full sample period, about 25 percent of the 171 firms yield significant positive exposure coefficients and about 2 percent yield negative coefficients.[9] The number of significant positive $\hat{\beta}_{ix}$ increases from 41

[7] We also use fixed weights in our analysis. The results are unaffected and hence not reported.

[8] The Durbin–Watson statistics, not reported, show that the resulting residuals are typically well-behaved. These statistics are available upon request.

[9] Note that the β_{ix} of the 171 Japanese multinationals may be cross-correlated, and therefore the results should be interpreted with caution. But having 43 of the 171 significant exposures cannot be an outcome of chance.

in the first subsample period to 81 in the second subperiod. Correspondingly, the number of significant negative coefficients decreases from 26 to 11. The positive $\hat{\beta}_{ix}$ coefficient suggests that a depreciation of the yen against other foreign currencies has a positive impact on the stock returns of Japanese multinationals. But the few negative $\hat{\beta}_{ix}$ obtained suggest that there are exceptions; that is, these multinationals experience an adverse valuation effect when the yen depreciates and benefit when the yen appreciates. Because we cannot obtain information that helps us distinguish net-exporters from net-importers, we are unable to explore the reasons for the observed phenomenon. In general, however, Japanese multinationals' exposure to exchange-rate changes is predominately positive, indicating that firms benefit (are hurt) when the yen depreciates (appreciates).

Our evidence that Japanese multinationals are exposed to fluctuations in foreign exchange rates differs substantially from the U.S. experience. For the period from January 1971 to December 1987, Jorion (1990) finds that only 15 of 287 U.S. multinationals exhibit significant exchange-rate exposure. His sample is gathered from the Value Line database and consists of non-oil companies whose foreign involvement accounted for more than 10 percent of total operations. Using data from the 32 largest U.S. exporters for the period 1979 to 1988, Amihud (1994) finds virtually no relationship between contemporaneous exchange-rate changes and stock returns. Similarly, Bartov and Bodnar (1994) show no correlation between abnormal returns on the stocks of 208 firms with foreign operations and changes in the U.S. dollar for the period 1978 to 1990.

Other studies, however, look at exposure of industries. Bodnar and Gentry (1993) find that only a few industries in Canada, Japan, and the U.S. display significant exposure during the period 1979 to 1988.[10] In particular, they report that only 9 of 39 U.S. industries and 5 of 20 Japanese industries bear statistically significant exchange-rate exposure. Recently, Allayannis's (1995) study points out that significant exposure is often masked at a coarser classification (i.e., a two-digit Standard Industrial Classification (SIC) level) of industries, hence rendering the underlying exposure undetected. In contrast to Bodnar and Gentry, he finds strong evidence of significant industry exposure at the four-digit level.

It would be interesting to examine industry exposure using Japanese data. Unfortunately, due to the unavailability of the four-digit SIC code, a finer classification of Japanese industries is not possible. And because foreign activities with respect to the level of imports and exports are generally heterogeneous, a two-digit industry grouping may result in averaging out the exposure effect. To avoid this effect, we instead look at industry characteristics of the 171 Japanese multinational firms' exposures to exchange-rate fluctuations. This approach allows us to determine the extent to which firms

[10] We also estimate exchange-rate exposure coefficients using 14 industry portfolios, but find only three have significant exposure. Note that these industry portfolios are formed from the sample of firms having at least 10 percent of export ratios.

with significant exposure are concentrated in a few industries and also to ascertain the type of industry that is more exposed to foreign influences. To conserve space, Table II reports the distribution of significant exposure coefficients from Table I by six selected industries[11]: chemicals, iron and steel, machinery, electric machinery, transport equipment, and precision equipment. However, multinationals with significant exposure are concentrated only in three industries, namely electric machinery, precision equipment, and transport equipment sectors. The magnitude of their exposure is relatively large, indicating that these firms are more exposed to exchange-rate movements than the others. Interestingly, although there is a large number of multinationals in the machinery industry (i.e., 33), none of their exposures is significant at the 5 percent level. One plausible reason why some corporations such as these are not significantly exposed to exchange-rate fluctuations is that they might use foreign currency derivatives and other financial hedging instruments extensively to shield themselves from exchange-rate movements.[12]

D. The Lagged Effect of Exchange-Rate Exposure

The strong evidence that contemporaneous changes in foreign currencies have a significantly positive impact on Japanese stock returns, however, contradicts some existing findings (see Amihud (1994) and Bartov and Bodnar (1994)), suggesting that *lagged*, but not current, changes in the dollar demonstrate a significant effect on abnormal stock performance. These studies suggest that because financial information is generally released to the public with a time lag, it takes longer for exchange-rate changes to have an effect on companies' cash flows. Bartov and Bodnar examine returns conditional on subsequent earnings announcements and attribute the lagged exchange-rate effect to systematic investors' errors in characterizing the relationship between exchange-rate changes and firm value. Such errors are commonly interpreted as evidence of either market inefficiencies or time variation in expected stock returns. We therefore examine whether such an effect can be generalized to Japanese multinationals. Following Amihud (1994), we investigate the lagged effect on the 171 multinational firms by running the following regression,

$$r_{it} = \beta_{io} + \beta_{ix} r_{xt} + \beta_{ix}^{L} r_{xt-1} + \beta_{im} r_{mt} + \epsilon_{it}, \tag{2}$$

where the parameter β_{ix}^{L} measures the effect of lagged exchange-rate changes on stock returns. The results, not reported, contradict those obtained by the

[11] Recall that the results obtained from Table I were generated using individual firms' information.

[12] See, for example, Stulz (1984), Smith and Stulz (1985), and Froot, Scharfstein, and Stein (1993) for theories that suggest why it may be optimal for firms to hedge. See Allayannis and Ofek (1997) and Géczy, Minton, and Schrand (1996) for the use of foreign currency derivatives and their impact on exchange rate risk.

U.S. studies. We find that only 6 of 171 multinationals have significant β_{ix}^{L} estimates, and that adding r_{xt-1} to model (1) has essentially no effect on the stocks' exposure to current exchange-rate fluctuations.[13]

II. Determinants of Exchange-Rate Exposure

Optimal hedging theories postulate that a firm's hedging activities affect the extent to which the firm is exposed to currency fluctuations. In a world of market imperfections, firms have incentives to employ derivative instruments to hedge against currency risk. Extensive use of derivatives as hedging instruments should diminish a firm's exposure. In this section we examine whether exchange-rate exposure is determined by the level of a firm's foreign operations, by variables that existing studies find to be important in explaining a firm's hedging policy, or by both. The choice of the variables is, however, constrained by the availability of the limited number of Japanese firm-specific financial variables.

Existing studies of the U.S. market demonstrate that a firm's exchange-rate exposure is significantly related to the level of its foreign operations. Using a sample of major U.S. multinationals, Jorion (1990) finds that dollar depreciation exposure is positively related to the ratio of a firm's foreign sales to total sales. Allayannis (1995) shows that the exchange-rate exposure of U.S. manufacturing industries is related to the level of exports and imports. We therefore offer similar analyses of Japanese multinational firms.

Smith and Stulz (1985) argue that hedging can reduce the probability that a firm will go bankrupt and thereby reduce the expected costs of financial distress. We employ a firm's long-term debt ratio (DE) to measure its probability of financial distress.[14] Ceteris paribus, firms with higher DE tend to face larger expected costs of financial distress and hence have a greater desire to engage in hedging activities. Thus, we hypothesize that multinational firms with greater financial leverage are more likely to hedge and hence are less exposed to exchange-rate risk.

Nance, Smith, and Smithson (1993), however, posit that corporations can mitigate expected costs of financial distress and agency costs by maintaining a larger short-term liquidity position in terms of having a lower dividend payout ratio (DIV) or a higher quick ratio (QR). Froot et al. (1993) provide a similar argument that liquidity is negatively related to hedging activities. To test this hypothesis, we use both DIV and QR as proxies for liquidity.

Nance et al. (1993) also look at hedging costs that affect a firm's decision to engage in currency derivatives. Because designing hedging strategies and managing risks can be costly, firms have a motive to hedge if hedging benefits are greater than costs. The authors argue that firm size, a proxy for

[13] Results remain unchanged, even up to the sixth lag.

[14] DE measures the ratio of a firm's year-end book value of long-term debt to firm size, as given by the firm's market value of equity (SIZE). The results are not materially affected even when we replace SIZE with the book value of total assets.

Table II

Cross-Sectional Distribution of Exchange-Rate Exposure Coefficients $\hat{\beta}_{ix}$ of Japanese Multinational Firms by Industries

The table reports the distribution for $\hat{\beta}_{ix}$, with z-scores in parentheses, by six selected industries, from the following model,

$$r_{it} = \beta_{io} + \beta_{ix} r_{xt} + \beta_{im} r_{mt} + \epsilon_{it},$$

where r_{it} is the rate of return on the ith asset, r_{mt} is the rate of return on the market portfolio, and r_{xt} is the change in a trade-weighted exchange rate, measured as the Japanese yen price of foreign currencies. N reports the number of firms in the industry, N^- reports the number of firms with negative $\hat{\beta}_{ix}$ significant at the 5 percent level, and N^+ reports the number of firms with positive $\hat{\beta}_{ix}$ significant at the 5 percent level. The sample comprises 171 multinational firms whose exports formed at least 10 percent of their annual total sales throughout the sample period 1978 to 1993.

Industry	N	Min	Median	Max	N^-	N^+
			Panel A: 1979:01–1993:12			
Chemicals	16	−0.317	0.061	0.581*	0	2
		(−1.458)	(0.354)	(3.257)		
Iron and steel	10	−0.396	−0.144	0.055	0	0
		(−1.673)	(−0.629)	(0.357)		
Machinery	33	−0.394	0.085	0.453	0	0
		(−1.512)	(0.575)	(1.774)		
Electric machinery	49	−0.126	0.448*	1.075*	0	29
		(−0.409)	(2.016)	(4.598)		
Transport equipment	27	−0.580*	0.080	0.756*	1	4
		(−2.945)	(0.323)	(3.850)		
Precision equipment	11	−0.045	0.451*	0.819*	0	8
		(−0.171)	(2.159)	(4.660)		
			Panel B: 1979:01–1986:12			
Chemicals	16	−0.658*	0.006*	0.511*	3	3
		(−3.417)	(2.694)	(4.250)		
Iron and steel	10	−0.431*	−0.189	0.021	3	0
		(−3.210)	(−1.300)	(−0.207)		
Machinery	33	−0.940*	0.003	0.415*	6	6
		(−4.944)	(0.017)	(3.395)		
Electric machinery	49	−0.270	0.274	0.954*	0	24
		(−1.679)	(0.401)	(6.025)		
Transport equipment	27	−0.689*	0.033	0.825*	5	7
		(−4.093)	(0.248)	(7.358)		
Precision equipment	11	−0.435*	0.247*	0.628*	1	6
		(−2.946)	(2.312)	(4.499)		

Table II—*Continued*

Industry	N	Min	Median	Max	N^-	N^+
			Panel C: 1987:01–1993:12			
Chemicals	16	−0.295*	−0.080	0.831*	1	3
		(−2.056)	(−0.512)	(6.505)		
Iron and steel	10	−0.476*	−0.178	0.209	2	0
		(−2.379)	(−1.056)	(1.777)		
Machinery	33	−0.886*	0.153	0.861*	3	12
		(−3.211)	(0.858)	(5.861)		
Electric machinery	49	−0.135	0.868*	1.459*	0	42
		(−1.008)	(4.384)	(8.948)		
Transport equipment	27	−0.964*	0.164	1.014*	1	8
		(−5.579)	(1.446)	(7.426)		
Precision equipment	11	0.214	0.861*	1.247*	0	10
		(1.474)	(6.107)	(10.567)		

*Significance at the 5 percent level.

economies of scale in hedging costs, is related to hedging incentives. Larger firms that have access to risk management expertise, or that have economies of scale in hedging costs, are more likely to hedge than smaller firms. As a result, bigger corporations should be less exposed to exchange-rate risk. However, there are circumstances where smaller firms have more incentive to hedge than larger firms; for instance, smaller firms will hedge more, because they face greater bankruptcy costs (Warner (1977)). Thus, the effect of firm size on exchange-rate exposure is ambiguous and shall be empirically determined.

Further Froot et al. (1993) contend that hedging reduces the underinvestment problem, which is due to a firm's dependence on external financing and access to costly external financing. Hedging benefits thus increase with a rise in potential underinvestment costs. The underinvestment cost hypothesis suggests interaction between growth opportunities and costly external financing, and their predicted relationship should be negative. Following Gèczy et al. (1996), we use the ratio of a firm's book-to-market value of equity (BM) as a proxy for a firm's growth opportunities. BM is calculated as the ratio of a firm's year-end book value of equity to SIZE. The lower the BM, the greater a firm's incentive to employ more currency derivatives to hedge in order to reduce underinvestment costs. Thus, the firm's exchange-rate exposure becomes smaller.

We test the above hypotheses by running the following cross-sectional regression,

$$\hat{\beta}_{ix} = a_0 + a_1 \log \text{SIZE}_i + a_2 \text{EXPR}_i + a_3 \text{DIV}_i + a_4 \text{QR}_i + a_5 \text{BM}_i + a_6 \text{DE}_i + \nu_i, \quad (3)$$

where $\hat{\beta}_{ix}$ is estimated from equation (1), EXPR_i denotes the sample average of a firm's export ratio, and the remaining financial variables, defined earlier, represent sample averages as well. All the variables are obtained from the PACAP database. As shown in the preceding section, $\hat{\beta}_{ix}$ are found to be positive and negative, even though only a few exhibit a negative sign. It is therefore interesting to examine whether the right-hand-side variables in model (3) display similar effects on both the negative and positive $\hat{\beta}_{ix}$. We test this implication by introducing dummy variables in equation (3),

$$\begin{aligned}\hat{\beta}_{ix} = {} & a_0 D + a_1 D \log \text{SIZE}_i + a_2 D\text{EXPR}_i + a_3 D\text{DIV}_i + a_4 D\text{QR}_i + a_5 D\text{BM}_i \\ & + a_6 D\text{DE}_i + a_{d0}(1 - D) + a_{d1}(1 - D)\log \text{SIZE}_i + a_{d2}(1 - D)\text{EXPR}_i \\ & + a_{d3}(1 - D)\text{DIV}_i + a_{d4}(1 - D)\text{QR}_i + a_{d5}(1 - D)\text{BM}_i \\ & + a_{d6}(1 - D)\text{DE}_i + \eta_i, \end{aligned} \quad (4)$$

where D is a dummy variable that takes the value of one if $\hat{\beta}_{ix}$ is positive and zero otherwise.

Panel A of Table III contains estimates of model (3) for the entire sample period and the two subperiods, and the signs of the coefficients are as predicted. The data indicate that the proxy variables, EXPR, DIV, QR, SIZE, BM, and DE, have a strong combined explanatory power for exposure. The adjusted R^2 value is 57.3 percent for the entire period, 36.2 percent for the first subperiod, and 48.0 percent for the second. Consistent with the U.S. evidence, EXPR has a significant positive correlation with exposure. Thus, the higher a Japanese multinational's level of export ratios, the larger its exchange-rate exposure.

As seen from Panel A, the signs of DIV, QR, BM, and DE are broadly consistent with optimal hedging theories. Except for a weak effect in the first subperiod, the coefficients of both DIV and QR, although they have opposing effects, are statistically significant in the full sample period and in the second subperiod. The negative DIV coefficient and positive QR coefficient suggest that a firm having a low dividend payout ratio, or a high quick ratio, has less of an incentive to hedge. Further, the coefficient of DE not only is significant, but also remains negatively significant during the entire sample period. In contrast, the BM effect on exposure seems weak; it is positively significant only in the second subperiod. The result is, however, consistent with earlier U.S. findings, suggesting that the role of BM is perhaps subsumed by EXPR.

It is evident that SIZE is also an important determinant of exposure. The results show that the bigger the multinational firm, the larger the exchange-rate exposure. If there were no hedging, exposure to exchange-rate risk might

increase with firm size, by virtue of the fact that bigger corporations tend to be more involved in foreign activities. However, in practice, companies do hedge. For example, a 1996 survey conducted by Nippon Life Insurance Company finds that bigger Japanese companies make more extensive use of derivative instruments and use more varied types of such instruments than smaller ones. The survey also finds that companies use derivatives not only for hedging, but also for speculation purposes. Although smaller multinationals are found to be less exposed to exchange-rate risk, the results of the survey do not suggest that smaller firms on average are more likely to make extensive use of derivative instruments to hedge against exchange-rate risk than larger firms. The plausible reason that exposure increases in SIZE is that larger multinationals having lower relative costs of financial distress may have less desire to hedge and thus are more exposed to currency fluctuations than smaller firms. Alternatively, the positive SIZE effect may possibly be attributed to the use of financial variables from unconsolidated statements. In equation (3), SIZE implicitly reflects the market value of parent firms as well as nonconsolidated subsidiaries, whereas EXPR measures only the level of parent firms' foreign activities. Because larger multinationals tend to have a greater number of subsidiaries, including foreign subsidiaries, the measure of foreign activity based on parent firms is underestimated. Thus, EXPR may not capture the total effect of foreign activity on exposure, thereby inducing a bias that is positively related to SIZE.

Panel B of Table III presents estimates of model (4), where the determinants of positive and negative exchange-rate exposures are examined separately. We find that effects of EXPR, DIV, SIZE, BM, and DE on positive exposure are generally consistent with those reported in Panel A, and the evidence is robust across the subperiods. We interpret that this result is driven mainly by exporting firms with positive exposure. However, except for a significant SIZE effect in the first subperiod, none of the proxy variables exhibits a significant explanatory power for negative exchange-rate exposure. Thus, this evidence implies that the few significant negative exposure coefficients might be spurious in nature, or that they might be a result of the presence of net importers in the sample.

Conceivably, however, the variables, EXPR, DIV, QR, SIZE, BM, and DE, may perhaps capture some industry effects in exposure, as somewhat suggested in Table II. Table IV provides evidence of this issue. Because 98 percent of the sample multinationals that bear significant exposure are concentrated mainly in six sectors, we add six dummy variables to incorporate the industry effects.[15] Except for a significant coefficient on BM in the full sample period, the results in Table IV are substantially similar to those in Table III. Controlling for industry effects therefore does not affect the magnitude, sign, or significant level of the coefficient for each variable. How-

[15] Our use of only six dummy variables is also constrained by the number of observations available in our sample.

Table III

Determinants of the Exchange-Rate Exposure

The table reports estimates of the relationship between $\hat{\beta}_{ix}$ and the variables that are proxies for a firm's hedging incentives, such as the firm's market value of equity (SIZE), dividend payout ratio (DIV), quick ratio (QR), book-to-market equity value (BM), and long-term debt to its market value of equity (DE), and the level of export ratio (EXPR). Their empirical relationship is described below.

$$\hat{\beta}_{ix} = a_0 + a_1 \log \mathrm{SIZE}_i + a_2 \mathrm{EXPR}_i + a_3 \mathrm{DIV}_i + a_4 \mathrm{QR}_i + a_5 \mathrm{BM}_i + a_6 \mathrm{DE}_i + u_i, \tag{3}$$

or

$$\begin{aligned}\hat{\beta}_{ix} = {} & a_0 D + a_1 D \log \mathrm{SIZE}_i + a_2 D\mathrm{EXPR}_i + a_3 D\mathrm{DIV}_i + a_4 D\mathrm{QR}_i + a_5 D\mathrm{BM}_i + a_6 D\mathrm{DE}_i \\ & + a_{do}(1 - D) + a_{d1}(1 - D)\log \mathrm{SIZE}_i + a_{d2}(1 - D)\mathrm{EXPR}_i + a_{d3}(1 - D)\mathrm{DIV}_i \\ & + a_{d4}(1 - D)\mathrm{QR}_i + a_{d5}(1 - D)\mathrm{BM}_i + a_{d6}(1 - D)\mathrm{DE}_i + u_{di},\end{aligned} \tag{4}$$

where D is a dummy variable that takes the value of one if $\hat{\beta}_{ix}$ is positive and zero if otherwise. t-statistics are shown in parentheses; $\bar{R}^2$ represents the adjusted R^2.

Parameter	1979:01–1993:12	1979:01–1986:12	1987:01–1993:12
	Panel A: Estimates from equation (3)		
a_0	−1.226	−1.368*	−1.068*
	(−6.223)	(−5.459)	(−3.117)
a_1	0.108*	0.110*	0.087*
	(7.078)	(5.891)	(3.493)
a_2	0.006*	0.004*	0.010*
	(5.371)	(3.330)	(5.825)
a_3	−29.546*	−7.306	−56.363*
	(−5.960)	(−1.769)	(−4.801)
a_4	0.075*	0.006	0.158*
	(2.540)	(0.141)	(3.953)
a_5	1.678	−0.750	5.620*
	(1.009)	(−0.443)	(2.318)
a_6	−5.024*	−2.956*	−15.834*
	(−5.962)	(−4.787)	(−4.813)
$\bar{R}^2$	0.573	0.362	0.480
	Panel B: Estimates from equation (4)		
a_0	−0.724*	−0.460*	−0.950*
	(−3.849)	(−1.950)	(−3.114)
a_1	0.085*	0.057*	0.106*
	(6.368)	(3.402)	(4.816)
a_2	0.004*	0.004*	0.008*
	(4.854)	(3.555)	(5.775)
a_3	−30.847*	−7.840	−50.257*
	(−5.859)	(−1.805)	(−5.013)
a_4	0.038	−0.037	0.115*
	(1.611)	(−0.758)	(3.751)
a_5	0.650	−0.859	0.852
	(0.447)	(−0.561)	(0.423)

Table III.—*Continued*

Parameter	1979:01–1993:12	1979:01–1986:12	1987:01–1993:12
		Panel B (*continued*)	
a_6	−4.611*	−1.583	−14.081*
	(−5.027)	(−1.868)	(−4.995)
a_{d0}	−0.453	−1.334*	−0.440
	(−0.966)	(−3.829)	(−0.649)
a_{d1}	0.010	0.084*	0.004
	(0.274)	(3.084)	(0.076)
a_{d2}	0.003	0.001	−0.005
	(0.766)	(0.477)	(−1.005)
a_{d3}	−4.460	−3.608	−15.168
	(−0.616)	(−0.800)	(−0.694)
a_{d4}	0.038	0.075	0.101
	(0.224)	(0.834)	(0.551)
a_{d5}	3.108	−0.598	9.887
	(0.888)	(−0.279)	(1.692)
a_{d6}	−1.502	−0.735	−4.376
	(−1.240)	(−1.167)	(−0.677)
$\bar{R}^2$	0.748	0.665	0.710

*Significant at the 5 percent level.

ever, the results show significant coefficients on two or three sectors across the subperiods, thereby suggesting some degree of interaction between the five corporate variables and industry effects.

III. Effects of Industrial Groupings

In this section, we investigate whether differences in the organization of Japanese corporations—firms in industrial groups that are constrained in their actions by major banks or by institutional shareholders, and those that are not—have any impact on the results obtained in the preceding section. Table V offers evidence of these differences.

In Japan, the concept of industrial groups, or keiretsu, is ubiquitous. An industrial group refers to a network of firms, with common ties to a main bank or a major firm, that forms a complex web of interests affecting the firm as a whole. A horizontal keiretsu comprises a large group of corporations that have strong affiliation with a powerful bank. The Mitsubishi Group of companies, the largest of the horizontal keiretsu, is an example. Unlike those in the United States, the main bank in a horizontal keiretsu provides not only loans, but also market information, advice, protection, and even management assistance, in times of crisis, to member firms. Hoshi, Kashyap, and Scharfstein (1990a, 1990b, 1991) examine the role of main banks both in

Table IV

Industry Effects on Exchange-Rate Exposures

The table reports industry effects on the relationship between $\hat{\beta}_{ix}$ and the variables that are proxies for a firm's hedging incentives, such as the firm's market value of equity (SIZE), dividend payout ratio (DIV), quick ratio (QR), book-to-market equity value (BM), and long-term debt to its market value of equity (DE), and the level of export ratio (EXPR). Their empirical relationship is described below.

$$\hat{\beta}_{ix} = b_{d1}D_1 + b_{d2}D_2 + b_{d3}D_3 + b_{d4}D_4 + b_{d5}D_5 + b_{d6}D_6 + b_0 + b_1 \log \mathrm{SIZE}_i + b_2 \mathrm{EXPR}_i + b_3 \mathrm{DIV}_i + b_4 \mathrm{QR}_i + b_5 \mathrm{BM}_i + b_6 \mathrm{DE}_i + \nu_{di}, \quad (3')$$

where D_i, $i = 1,\ldots,6$, is a dummy variable that takes the value of one if the firm belongs to the respective six sectors, namely chemicals, iron and steel, machinery, electric machinery, transport equipment, and precision equipment, and zero otherwise. t-statistics are shown in parentheses; $\bar{R}^2$ represents the adjusted R^2.

	Estimates from equation (3')		
Parameter	1979:01–1993:12	1979:01–1986:12	1987:01–1993:12
b_{d1}	0.144*	0.153	0.039
	(2.240)	(1.717)	(0.373)
b_{d2}	−0.024	0.009	−0.163
	(−0.288)	(0.082)	(−1.284)
b_{d3}	0.048	0.073	−0.021
	(0.902)	(0.997)	(−0.247)
b_{d4}	0.322*	0.258*	0.411*
	(5.873)	(3.445)	(4.652)
b_{d5}	0.053	0.115	−0.046
	(0.939)	(1.488)	(−0.493)
b_{d6}	0.243*	0.236*	0.329*
	(3.202)	(2.278)	(2.646)
b_0	−1.159*	−1.367*	−0.846*
	(−6.148)	(−5.442)	(−2.635)
b_1	0.081*	0.095*	0.061*
	(5.611)	(5.033)	(2.529)
b_2	0.005*	0.003*	0.007*
	(4.462)	(2.458)	(4.417)
b_3	−21.155*	−4.759	−33.291*
	(−4.500)	(−1.135)	(−3.015)
b_4	0.033	−0.025	0.100*
	(1.216)	(−0.560)	(2.711)
b_5	3.848*	0.896	5.141*
	(2.518)	(0.513)	(2.372)
b_6	−3.361*	−2.411*	−9.537*
	(−3.803)	(−3.398)	(−3.021)
$\bar{R}^2$	0.669	0.413	0.599

*Significant at the 5 percent level.

facilitating member firms' investment and in reducing member firms' cost of financial distress. They find that investments by independent firms, unaffiliated with any major bank, are more sensitive to liquidity than those by firms in industrial groups. They also show the importance of industrial groups and close bank ties in mitigating the cost of financial distress. Their results are in accord with the Japanese corporate governance: a major bank will come to the rescue if any of its member firms is in a financial crisis and will prevent bankruptcy of the distressed firm.[16]

In the context of optimal hedging theories, the peculiarities of Japanese organizational structure suggest that keiretsu firms, which have a stronger liquidity position and a lower probability of financial distress, would tend to hedge less against exchange-rate risk than nonkeiretsu firms. To test this implication, we split our sample of multinationals into two groups: firms that are affiliated with a major bank and those that are not. Given that the members in industrial groupings have been very stable over the last three decades, we use the 1994/1995 edition of Dodwell's *Industrial Groupings in Japan* to identify firms that belong to industrial groups and those that do not. We find that 84 out of 171 Japanese multinationals are members of the industrial groups, namely Mitsubishi, Mitsui, Sumitomo, Fuyo, Dai-ichi Kangyo, Sanwa, Tokai, and Industrial Bank of Japan, while the remaining are independent. We examine the keiretsu effect by incorporating in relation (3) a dummy variable for whether a firm belongs to a keiretsu; the regression is given by

$$\begin{aligned}\hat{\beta}_{ix} = {} & c_{d0}D + c_{d1}D\log \mathrm{SIZE}_i + c_{d2}D\mathrm{EXPR}_i + c_{d3}D\mathrm{DIV}_i + c_{d4}D\mathrm{QR}_i \\ & + c_{d5}D\mathrm{BM}_i + c_{d6}D\mathrm{DE}_i + c_0 + c_1\log \mathrm{SIZE}_i + c_2\mathrm{EXPR}_i + c_3\mathrm{DIV}_i \\ & + c_4\mathrm{QR}_i + c_5\mathrm{BM}_i + c_6\mathrm{DE}_i + \nu_i, \end{aligned} \tag{5}$$

where D takes the value of one if the firm belongs to a keiretsu, and zero if otherwise. Because keiretsu firms are less financially constrained, they have less incentive to hedge and thus be more exposed to exchange-rate fluctuations. This can be tested by examining the effects of DIV, QR, and DE; the three variables are good measures of the extent to which a firm is financially constrained. The results are contained in Table V.

The table reveals two interesting observations. One, the effects of DE and DIV on exchange-rate exposure are not only significant, but also are significantly different for keiretsu and nonkeiretsu firms. In contrast, there is no

[16] This is typical of Japan's "convoy system," in which companies move together for safety by offering each other support in times of financial trouble. However, this system is changing now. A good example is a recent case where Japan's Ministry of Finance let Nissan Mutual Life Insurance go bust. Nissan is the first insurer to go into bankruptcy since the war. See the April 30, 1997 *Asian Wall Street Journal*.

Table V
Effects of Japanese Industrial Groupings on Exchange-Rate Exposures

The table reports effects of Japanese industrial groupings on the relationship between $\hat{\beta}_{ix}$ and the variables that are proxies for a firm's hedging incentives, such as the firm's market value of equity (SIZE), dividend payout ratio (DIV), quick ratio (QR), book-to-market equity value (BM), and long-term debt to its market value of equity (DE), and the level of export ratio (EXPR). Their empirical relationship is described below. The sample period is 1979:01 to 1993:12.

$$\hat{\beta}_{ix} = c_{d0}D + c_{d1}D\log\text{SIZE}_i + c_{d2}D\text{EXPR}_i + c_{d3}D\text{DIV}_i + c_{d4}D\text{QR}_i + c_{d5}D\text{BM}_i + c_{d6}D\text{DE}_i + c_0 + c_1\log\text{SIZE}_i + c_2\text{EXPR}_i + c_3\text{DIV}_i + c_4\text{QR}_i + c_5\text{BM}_i + c_6\text{DE}_i + \nu_i, \quad (5)$$

where D is a dummy variable that takes the value of one if the firm belongs to an industrial grouping and zero if the firm is independent. t-statistics are shown in parentheses; $\bar{R}^2$ is the adjusted R^2.

	Estimates from equation (5)							
Parameter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
c_{d0}	−0.163	−0.144	−0.073	−0.054	−0.288	−0.148	−0.144	−0.160
	(−0.405)	(−1.695)	(−0.558)	(−1.209)	(−1.687)	(−0.373)	(−0.356)	(−0.393)
c_{d1}	0.013					−0.006	−0.013	−0.010
	(0.451)					(−0.196)	(−0.447)	(−0.329)
c_{d2}								−0.001
								(−0.470)
c_{d3}		15.990*			16.358	17.114*	18.702*	17.271
		(2.112)			(1.835)	(2.159)	(1.998)	(1.756)
c_{d4}							0.087	0.087
							(1.371)	(1.371)
c_{d5}			2.054		0.134		−0.651	−0.261
			(0.725)		(0.400)		(−0.192)	(−0.075)
c_{d6}				5.636*	5.774*	5.738*	6.697*	6.647*
				(2.760)	(2.809)	(2.847)	(3.103)	(3.079)
c_0	−1.195*	−1.153*	−1.217*	−1.155*	−1.031*	−1.063*	−1.048*	−1.046*
	(−4.592)	(−5.542)	(−5.658)	(−5.686)	(−4.796)	(−4.153)	(−4.034)	(−4.027)
c_1	0.102*	0.105*	0.106*	0.105*	0.103*	0.105*	0.106*	0.105*
	(5.389)	(6.883)	(6.863)	(6.950)	(6.911)	(5.685)	(5.779)	(5.646)
c_2	0.006*	0.006*	0.006*	0.006*	0.006*	0.006*	0.006*	0.006*
	(5.380)	(5.361)	(5.299)	(5.288)	(5.241)	(5.268)	(5.293)	(4.459)
c_3	−29.669*	−37.445*	−29.984*	−30.948*	−39.131*	−39.395*	−39.545*	−39.041*
	(−5.977)	(−6.072)	(−6.009)	(−6.347)	(−6.250)	(−6.415)	(−6.272)	(−6.109)
c_4	0.076*	0.078*	0.076*	0.061*	0.063*	0.063*	0.038	0.038
	(2.554)	(2.664)	(2.587)	(2.085)	(2.175)	(2.183)	(1.019)	(1.102)
c_5	1.779	1.742	1.123	1.764	1.616	1.685	1.812	1.741
	(1.047)	(1.040)	(0.573)	(1.063)	(0.809)	(1.027)	(0.910)	(0.872)
c_6	−5.163*	−5.415*	−5.094*	−9.803*	−10.233*	−10.193*	−10.704*	−10.647*
	(−5.947)	(−6.288)	(−5.933)	(−5.164)	(−5.402)	(−5.403)	(−5.562)	(−5.525)
$\bar{R}^2$	0.574	0.584	0.575	0.592	0.603	0.603	0.608	0.608

*Significant at the 5 percent level.

differential effect of QR on keiretsu and nonkeiretsu firms. Both the coefficients on DE and DIV are negative but those associated with their dummy variables are significantly positive across all of the different models we estimate. In the regression with DE as the only explanatory variable, the results suggest that a one unit increase in DE causes the level of foreign exchange-rate exposure for a nonkeiretsu firm to fall by 9.80, and for that of a keiretsu firm to decrease by only 4.17. Similarly, a one unit rise in DIV leads to a drop of 37.45 in the exposure of a nonkeiretsu firm and to a drop of merely 21.46 in that of a keiretsu firm. The results indicate that keiretsu and nonkeiretsu firms have different hedging incentives. Two, there is no evidence of a keiretsu effect on the relationship between exchange-rate exposure and SIZE, EXPR, and BM. It is worthwhile to point out that the positive sign of their coefficients, although insignificant, is consistent with the notion that keiretsu firms are less concerned about hedging than independent firms.

Evidence of varying degrees of hedging incentives between a keiretsu firm and a nonkeiretsu firm reflects the difference in their corporate structure. That is, firms with close banking ties have lower probability of financial distress and a lesser need to maintain greater short-term liquidity than unaffiliated firms.

IV. Concluding Remarks

This paper examines whether there exists any relationship between Japanese stock returns and fluctuations in foreign exchange rates. We find that for the period from January 1979 to December 1993, 25 percent of the 171 Japanese multinationals have significant positive exposure. The result is also robust across the two subperiods, indicating that a depreciating (appreciating) yen has a favorable (adverse) impact on Japanese multinationals whose exports form at least 10 percent of their total sales. Contrary to the U.S. finding, we find little evidence that lagged exchange-rate changes have explanatory power.

An exploratory investigation suggests that the extent to which a firm is exposed to changes in exchange rates is determined by its level of export ratio as well as by the variables that are proxies for the firm's hedging policies. The evidence is generally consistent with optimal hedging theories and with existing U.S. results. We find that Japanese multinational firms with weak short-term liquidity positions, or firms with high financial leverage, have more incentive to hedge and hence have smaller exchange-rate exposures. Smaller Japanese multinational firms tend to have lower exposure to exchange-rate risk.

Finally, we test whether there are significant differences in the hedging behavior between keiretsu and nonkeiretsu firms. The results provide evidence of significant differences in the hedging needs between the two types of multinational corporations. We find that independent multinational firms

in our sample which have tighter financial constraints are more likely to hedge and, hence, are less exposed to exchange-rate risk than are keiretsu firms.

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