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The Dollar Exposure of Japanese Companies

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The bulk of Japanese exports and imports are denominated in U.S. dollars rather than Japan's local currency, the yen. The consequences of dollar invoicing depend importantly on the extent to which Japanese companies hedge their dollar exposures. If they fully hedge their dollar exposures, then the choice of invoicing currency will not influence the yen profits of Japanese companies. This paper examines the degree to which Japanese companies hedge by estimating their exposure to movements in the dollar. Using Japanese stock market data and an international version of the CAPM model I estimate the extent to which Japanese company returns are correlated with changes in the yen–dollar exchange rate. The results suggest many Japanese companies are indeed exposed to yen–dollar movements and that dollar appreciations generally are positively correlated with firm returns. Since over the period 1984 to 1995, the dollar depreciated by 36% relative to the yen, it follows that the values of Japanese companies fell as a consequence of their dollar exposure. *J. Japan. Int. Econ.* Dec. 1998, **12**(4), pp. 388–405. University of Michigan, Ann Arbor, Michigan 48109-1220. © 1998 Academic Press

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INTRODUCTION

Companies select the currencies in which they invoice their international transactions. Currency invoicing practices of Japanese companies differ markedly from those in other OECD countries. The bulk of Japanese exports and imports are denominated in U.S. dollars rather than Japan's local currency, the yen. The literature offers numerous explanations for

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this behavior. However, regardless of the underlying reasons for Japanese invoicing practices, the consequences of dollar invoicing depend importantly on the extent to which Japanese companies hedge their dollar exposures. If Japanese companies fully hedge their dollar exposures by using derivative products, locating production in the United States, or matching dollar revenues with dollar costs, then the choice of invoicing currency will not influence the yen profits of Japanese companies.

This paper examines the degree to which Japanese companies hedge by estimating their exposure to movements in the dollar. Japanese companies are not obliged to disclose their derivative activity, and there is no systematic information on the degree of nonfinancial hedging by Japanese companies. Therefore, this paper uses Japanese stock market data and an international version of the CAPM model to estimate the extent to which Japanese company returns are correlated with changes in the yen–dollar exchange rate. If Japanese companies fully hedge their dollar exposures, then their stock price changes should not be correlated with movements in the dollar. Alternatively, if Japanese companies cannot or choose not to hedge fully their dollar exposures, then yen–dollar exchange rates will be correlated with stock prices.

The first section of this paper describes the invoicing practices of Japanese companies and the reasons these practices are likely to increase exposure to yen–dollar movements. Section II describes the theory and practice of hedging exchange rate risk. Section III presents estimates of the extent to which Japanese companies are exposed to dollar movements and analyzes the results. Section IV is the conclusion.

I. THE INVOICING PRACTICES OF JAPANESE EXPORTERS

Most firms in developed countries choose to invoice their exports in domestic currencies. The advantage of this strategy is that the exporter's exchange rate exposure is thereby mitigated. However, since invoice prices are not easily changed when exchange rates fluctuate, export prices rise when domestic currencies strengthen relative to currencies of export destinations. To the extent that higher export prices reduce market shares, long-run profits may suffer. This line of reasoning suggests that, under certain demand conditions in foreign countries, invoicing in the currencies of destination countries may be preferable to invoicing in domestic currencies. This strategy of focusing on shares of foreign markets is termed ''pricing to market,'' and many analysts believe that Japanese firms commonly price to market. This section examines the impact of exchange rates and market structure in the invoicing decisions of Japanese firms.[1]

[1] This section draws heavily from Dominguez (1997).

The Choice of Invoicing Currency in International Trade

A study of Swedish companies in the 1960s reports that the exporter's currency, rather than a common vehicle currency (such as dollars or pounds sterling), was most frequently used to denominate international trade contracts.[2] This observation, which is commonly known as Grassman's Law, continues to describe most developed countries other than Japan. Recent empirical studies of international invoicing practices find the following additional patterns: (1) invoicing in the exporter's currency is more likely for differentiated manufactured products; (2) trade between a developed country and a developing country tends to be denominated in the currency of the developed country; (3) trade in primary products and transactions in financial investments is usually denominated in U.S. dollars; (4) exports to the United States tend to be invoiced in U.S. dollars; and (5) currency hedging by importers is not common.[3]

When an exporting firm invoices in a foreign currency, its profits are affected directly by exchange rate changes. Likewise, from an importer's point of view, the cost of foreign products depends on exchange rates if prices are set in foreign currencies. Both exporters and importers, therefore, prefer to invoice trade contracts in their own currencies in order to minimize foreign exchange risk. However, it is typically exporters (and not importers) that invoice in their own currencies. A number of explanations for this are offered in the literature. In the case of differentiated manufacturing products, exporters are likely to have some degree of monopoly power, as a consequence of which they will have more negotiating power than importers. Another explanation focuses on the ability of both sides to offset exchange rate risks. In the absence of competing domestic industries importers may be in a better position to guard against currency fluctuations by shifting burdens of higher costs due to exchange rate changes to their domestic customers. This, in turn, may be the explanation for why trade contracts between developing countries (that are less likely to have competing domestic industries) and developed countries tend to be invoiced in the developed country's currency. McKinnon (1979) offered yet another explanation for observed invoicing patterns. He reports that importers often receive open-account credits from exporters that allow importers some discretion in the timing of their payments in return for bearing currency risk.

Market structure is typically invoked to explain why primary products and capital assets are commonly denominated in dollars. Whereas exporters selling differentiated products are usually assumed to have some degree of market power, international capital markets and markets for primary

[2] Grassman (1973, 1976).

[3] Marston (1990), Fukuda and Ji (1994), and see Bilson (1983) and Tavlas (1991) for overviews.

products are more often highly competitive. Because prices in competitive markets tend to be relatively volatile, it is useful to denominate prices in numeraire currencies in order to make price changes as informative as possible.[4] Further, the numeraire currency is likely to be an established vehicle currency, such as the dollar.

It is difficult to explain why it is so uncommon for importers to hedge exchange rate risk. In the case of primary goods prices, McKinnon (1979) noted that these are determined by global demand and supply conditions, thereby providing importers an automatic hedge. If the value of an importer's currency falls, the homogeneous nature of the product ensures that the domestic-currency price of the importer's inventories will rise by the same amount as does the exchange rate.

Recent Currency Invoicing Practices among the G-6

A comparison of invoicing practices among the G-6 countries puts Japanese practices in context. Table I presents domestic currency invoice ratios for exports and imports by G-6 countries in the years 1980 and 1988. Japan and Italy are outliers in the export panel of the table, showing the lowest domestic currency invoice ratios. In the import panel of Table I, Japan's domestic currency invoice ratio is well below those of the other G-6 countries.

Beyond reporting aggregate statistics on currency invoice ratios, it is difficult to characterize fully the differences between Japanese behavior and the behavior of firms elsewhere. However, a number of recent empirical studies of Japanese manufacturing firms find evidence of ''pricing-to-market'' behavior.[5] Although this evidence helps to explain why dollar prices of Japanese goods often do not change one-for-one with changes in the value of the yen relative to the dollar, it does not explain the proclivity of Japanese firms to invoice in dollars. As long as Japanese firms hedge the exchange rate risk that arises when trade is invoiced in a foreign currency, pricing-to-market behavior does not depend on the use of a particular currency of invoice. In other words, Japanese firms could invoice in yen (or any other currency) and simply vary the yen price so that relevant exchange rate changes do not impact final destination prices. If firms are able to hedge against adverse movements in the exchange rate, then they can effectively decouple profits and the exchange rate, and, in turn, weaken the relationship between profits and the invoicing currency. Therefore, there remains a puzzle as to why Japan is an outlier among the G-6 in its trade invoicing practices.

[4] Swoboda (1968), Magee and Rao (1980).

[5] Marston (1990), Fukuda and Ji (1994), Gagnon and Knetter (1995).

TABLE I
The Domestic Currency Invoice Ratios among the G-6, 1980 and 1988

	1980			1988[a]		
	National currency	Japanese yen	Other	National currency	Japanese yen	Other
			Exports			
France	62.5	—	37.5	58.5	0.5	41.0
Germany	82.3	—	17.7	81.5	0.5	18.0
Italy	36.0	—	74.0	38.0	—	62.0
Japan	29.4	29.4	70.6	34.3	34.3	65.7
United Kingdom	76.0	—	24.0	57.0	—	43.0
United States	97.0	—	3.0	96.0	1.0	3.0
			Imports			
France	33.1	1.0	65.9	48.9	1.3	49.8
Germany	43.0	—	57.0	52.6	2.5	44.9
Italy	18.0	—	82.0	27.0	—	73.0
Japan	2.4	2.4	97.6	13.3	13.3	86.7
United Kingdom	38.0	—	62.0	40.0	2.0	58.0
United States	85.0	1.0	14.0	85.0	3.0	12.0

Sources. Page (1981); Alterman (1989); Black (1990); Tavlas and Ozeki (1992); original data: the ministries of finance of France, Germany, Italy, Japan, and United States, Commerce Department, Bureau of Labor Statistics.

Note. Entries are percentages of G-6 trade invoices denominated in national currencies, the yen, or other currencies.

[a] 1988 data are provided except for German exports and Italian exports and imports, for each of which 1987 data are provided.

II. HEDGING YEN EXCHANGE RATE RISK

The data presented in the previous section show that the majority of Japan's trade contracts are denominated in U.S. dollars rather than yen.[6] Typical Japanese exporters therefore are likely to receive dollar revenues but incur most of their costs in yen. Likewise, Japanese importers make dollar payments though sales are likely to be denominated in yen. In both of these situations Japanese firms face exchange rate risk. Over the past twenty five years, markets in numerous hedging instruments have been created in order to provide firms opportunities to hedge against losses due to adverse exchange rate movements. This section examines the theory and practice of yen exchange rate risk management.

[6] See Dominguez (1997) for a broader discussion of the role of the yen relative to the dollar in international capital markets.

Overview of Yen-Dollar Exchange Rate Behavior

The yen appreciated by 250% against the dollar from 1970 to 1994. Among other major currencies, only the Swiss franc and the deutsche mark appreciated strongly against the dollar (by 225 and 125%, respectively) over the same period. The rise in the value of the yen relative to the dollar occurred in two stages. The first stage occurred in the 1970s after the breakdown of the Bretton Woods system and in the wake of the 1973 oil shock, during which the yen strengthened from 360 yen to the dollar to just under 200 yen per dollar. The dollar then strengthened considerably in the early 1980s (largely as a consequence of Volcker's tight money regime and Reagan's fiscal expansion), with the exchange rate above 200 yen per dollar until late 1985. In the fall of 1985, and in concert with G-5 intervention efforts to weaken the dollar, the yen began its second dramatic appreciation against the dollar, peaking in April 1995 at 80 yen to the dollar. After a two year period of relative stability during which the yen/dollar rate remained in the 115–125 range, in 1998 the yen depreciated dramatically to over 140 yen per dollar in the wake of political and economic turmoil in Japan.

Dramatic movements in the yen–dollar exchange rate over the last 25 years leave no doubt that Japanese firms invoicing in dollars face substantial exchange rate risks. However, reports in the financial press in 1993 and 1994, before the yen had actually peaked against the dollar, suggest that Japanese firms anticipated yen weakening. The possibly widespread belief that the yen was due to depreciate against the dollar may explain accompanying reports that many Japanese firms were not adequately hedged against exchange rate risk in the early 1990s.

Exchange Rate Hedging Instruments

An exchange rate hedge provides insurance against adverse currency movements. A Japanese exporter invoicing in dollars is ''completely hedged'' if changes in the value of the yen relative to the dollar do not influence its yen profits. Such a hedge provides an offsetting cash receipt if the value of the dollar falls relative to the yen and requires an offsetting cash payment if the dollar rises relative to the yen.

The market for hedging instruments has grown dramatically in the past 20 years. There are many ways to manage exchange rate risk (and other forms of risk). The most basic exchange rate hedge involves a forward or futures contract that simply fixes the future price of foreign currency. A slightly more sophisticated hedge involves an option contract that is left unexercised if currency movements are favorable. Further, there are many swap instruments that allow firms to take advantage of differences in financing opportunities over time, geographic regions, and currency markets.

Exchange rate risk management can involve simple transaction-by-trans-

action hedging, overall balance sheet hedging, and more sophisticated hedging techniques that take into account exchange rate risks that competitors face. Likewise, the instruments used to hedge exchange rate risks range from "plain vanilla" contracts to exotic derivative structures. The notional principal outstanding of exchange-traded derivatives grew by 40% annually over the past decade.

The Practice of Yen Exchange Rate Risk Management

Japanese firms are not obliged to disclose the details of their hedging practices and most hedges appear as off-balance sheet items in company accounts.[7] Further, as Garber (1997) discussed, the use of derivative products does not necessarily imply that firms are attempting to reduce risks. Derivative products can be used to speculate as well as to hedge (or to enhance) risk. The existing anecdotal evidence on the hedging practices of Japanese firms suggests that, along with using financial instruments to hedge exchange rate risks, firms have shifted production from Japan during periods of yen appreciation. Numerous articles in the financial press in the last few years report that Japanese manufacturers have shifted production to lower cost countries including the United States.[8] On the other hand, many observers explain the fact that a majority of Japanese trade is handled by a small number of large trading companies by the greater ability of the trading companies effectively to manage exchange rate risks. Trading companies have the advantage of economies of scale, and they may be able to offset risk exposure from their export business with that from imports.

The first currency options contract was concluded in Japan between the Bank of Tokyo and one of the major trading companies in 1984. From around 1987, the market grew rapidly as Japanese exporters were faced with the sudden appreciation of the yen against the dollar (initiated by the Plaza Accord of September 1985). Reports in the financial press suggest that exporters initially hedged using zero-cost leverage type options. This transaction involves the customer purchasing a dollar put and offsetting it by selling a dollar call with several times the notional amount. The advantage of

[7] In April 1994 the Ministry of Finance banned the use of a device known as historic rate rollovers. These allowed Japanese companies to delay taking a hit on loss-making forward currency contracts—agreements to buy or sell a currency at a fixed rate in the future—by selling them to friendly banks before they expire. The banks avoided making a loss themselves by immediately selling the companies new forward contracts at the same rate. This accounting trick allowed some companies to disguise heavy losses. In 1993, for example, Showa Shell Sekiyu, a Japanese affiliate of royal Dutch-Shell, said it had discovered that its treasury department had covered up losses of Y166 billion using this technique. The affiliate's chairman and president subsequently resigned. (*The Economist*, March 26, 1994, pp. 96–97)

[8] See, for example, the article in the *New York Times* on August 29, 1993 with the headline "Japanese Moving Production Abroad."

this sort of strategy is that it allowed exporters to lock in at relatively high strike prices. From around 1992, reports suggest that the most popular hedging technique for major export companies and institutional investors was the range forward transaction. In these transactions, the customer purchases a dollar put at a relatively lower strike price, and sells a dollar call at a relatively higher strike price. As long as the ratio of selling to buying is about one-to-one, this transaction is regarded as a relatively conservative hedging technique (*Asia Money*, Asian Currency Supplement, November 94, pp. 24–27). Starting in 1995 yen–dollar implied volatility rose from 6 to 7% to near 20%, dramatically pushing up the price of options. By way of illustration, a company wishing to hedge a $100 million exposure would have to pay $4.5 million in up front costs, as compared to approximately $2 million in 1994 (Charts, 1995).

In 1994, Swiss Bank Corporation calculated that every one yen rise against the dollar cut exporters' profits by $100 million. In 1994, Toyota claimed to hedge about half its foreign-currency exposure. Honda and Sony claim that they try to hedge all of their foreign-exchange risk. However, in 1994 Honda used only short-dated forwards and only hedged the sales it clinched, not the sales it expected (*The Economist*, March 26, 1994). In the first quarter to June 1993, Sony reported net gains of 20 billion yen on currency hedging (*AFP-Extel News Limited*, November 16, 1994).

Unfortunately there are no aggregate data on the proportion of Japanese firms engaging in exchange rate risk management. But, a 1996 survey of the use of derivatives by Japanese corporations by Nippon Life Insurance found that about 41% of the 493 corporations polled used derivative products. Also, there exist BIS survey data on the currency composition of derivative products typically used to manage risk. There is not necessarily a strong correlation between hedging practices and the use of a currency in derivative markets, but information on the size of the yen derivative market indicates something about the hedging opportunities available to Japanese firms.

The BIS survey indicates that, in OTC derivative contracts involving foreign exchange, the yen has the second highest volume, well below that of the U.S. dollar, but greater than deutsche mark volume. The U.S. dollar is involved on one side of 92% of all foreign currency derivative contracts. The comparable figures for the yen and deutsche mark are 26 and 23%, respectively.[9] In the exchange rate futures markets, dollar–yen contracts make up 31% of the market.

The geographical distribution of OTC derivative trading is similar to the distribution of overall foreign exchange trading. The United Kingdom is the most active center with about 30% of total market activity, with the

[9] BIS, *Central Bank Survey of Foreign Exchange and Derivatives Market Activity*, 1995, p. 30.

United States and Japan the second and third most active. Further, the United Kingdom, the United States, and Japan account together for 56% of total trading. While Japan's share of the derivative market vastly exceeds that of Germany, yen-denominated instruments account for roughly the same share of the market as do deutsche mark denominated instruments. As in the foreign exchange market, the two centers outside of Japan in which the yen is relatively heavily used to denominate derivative contracts are Singapore and Hong Kong.

The BIS data indicate that the market in yen-denominated derivative products is substantial and that foreign exchange swaps are the most heavily traded of the four categories of OTC foreign exchange derivative products (these include: outright forwards, foreign exchange swaps, currency swaps, and options). This, in turn, suggests that Japanese firms interested in hedging dollar–yen exchange rate risk have ample opportunities to do so.

One issue related to hedging opportunities is the available maturity structure of instruments. If trade contracts are set long in advance, then effective hedges may require hedging instruments with long maturities. For the OTC derivative products, 89% of forwards, foreign exchange swaps, and options are for products with maturities of up to one year. The most liquid futures markets tend to be those for products with maturities of less than six months. On the other hand, over 50% of currency swaps have maturities of 1 year to 5 years, and roughly 24% of these contracts exceed 5 years.

III. THE DOLLAR EXPOSURE OF JAPANESE COMPANIES

The evidence presented so far suggests that, although Japanese companies tend to invoice in dollars, there exist ample opportunities for firms to hedge yen–dollar movements using financial instruments—and there is some evidence that Japanese companies engage in nonfinancial hedging of dollar exposures. This section analyzes the degree to which Japanese firms have been successful at reducing their dollar exposures.

Previous research examining the effects of exchange-rate exposure on firms' returns, using methodology similar to that used in this paper, report mixed results depending on the country examined. Jorion (1990) found that U.S. multinationals have small exchange rate exposures, although he found a positive relationship between firms' exposure to dollar depreciation and the ratio of their foreign sales to total sales. Booth and Rotenberg (1990) find that Canadian firms generally benefit from appreciations of the Canadian dollar. Bodnar and Gentry (1993) studied exchange rate exposure in U.S., Canadian, and Japanese firms and found that, for all three countries, between 20 and 35% of industries have statistically significant exchange

rate exposures and that exchange rate fluctuations affect industry returns. Williamson (1998) examined exchange rate exposure in the U.S., Japanese, and German automotive industries and finds evidence that the level of exposure changes over time, across country portfolios, and depends on demand characteristics in the auto industry. He also found that exposure is reduced as firms increase foreign production. He and Ng (1998) examined firm specific exchange rate exposure using a sample of 171 Japanese multinational corporations and found that 25% of these firms exhibit exposure effects. Moreover, they found that higher exposure levels are related to higher export ratios, low levels of financial leverage, high levels of liquidity, larger firm size, and membership in a keiretsu. Hamao (1988) and Dominguez (1992) included the exchange rate as an observable factor in APT models of Japanese and U.S. industry returns, respectively, with mixed results.[10]

This study differs from those in the literature in a number of important respects. First, motivated by the evidence presented earlier in the paper regarding Japanese company practice of invoicing in dollars, the regressions test specifically for dollar exposure. Many of the previous studies use trade weighted exchange rates rather than specific bilateral rates to test for exposure. Second, firms are grouped into broad industry portfolios and both domestic and multinational firms are included (although separately) in order to test for systematic patterns of exposure across a broad range of companies. Also, companies with little or no export/import activity are included in the sample. And third, weekly returns data are used in the empirical tests to take into account the sometimes dramatic short-term volatility in the yen–dollar rate. Previous studies have generally used monthly or quarterly returns data.

Exchange rate exposure is typically defined as the correlation between exchange rate movements and asset values (Adler and Dumas, 1984). Of course, exchange rates and asset values are likely to be jointly determined, so that it is not possible to test whether exchange rate movements cause changes in aggregate asset values. On the other hand, exchange rate movements are likely to be relatively exogenous to the values of individual industries. And, even if simultaneity is important for some industries, differences in exposures across industries should persist, since exposures reflect the contemporaneous impact of fundamentals on both exchange rate movements and industry value (Bodnar and Gentry, 1993).

The efficient markets hypothesis states that stock prices should reflect the influence of news, including unanticipated changes in exchange rates,

[10] Hamao (1988) and Dominguez (1992) tested for a relationship between innovations in exchange rates and expected returns. The test in this paper measures the effect of changes in exchange rates on realized returns.

on firm value. A way to measure exchange rate exposure, therefore, involves adding changes in the exchange rate to the market model of industry portfolio returns.

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

where $R_{i,t}$ is the return on portfolio i in Japan; $R_{m,t}$ is the return on the Japanese market portfolio; Δs_t is the weekly yen–dollar return (defined so that a positive (negative) $\beta_{2,i}$ coefficient indicates that dollar appreciation increases (decreases) the return to portfolio i) and the market beta, $\beta_{1,i}$, measures the industry's exposure to changes in Japan's market index. Since the market index is included as an explanatory variable, $\beta_{2,i}$ measures an industry's exposure to exchange rate movements after taking into account the overall market's exposure to yen–dollar fluctuations.

Equation 1 is estimated using SUR (seemingly unrelated regression) using weekly data over the period January 1984 through October 1995. SUR estimation allows for contemporaneous correlation of the error terms across industry portfolios. Table II presents summary statistics for the 18 industry portfolios included in the regressions.[11] The portfolios comprise four main industry groupings: (1) consumer goods and services, (2) energy and utilities, (3) finance and real estate, and (4) industrials. The portfolios are further disaggregated by size, where the firm size classification within each industry is based on a size-sorting algorithm which depends on the annual observations of each firm's market capitalization denominated in yen.[12] The portfolios are also distinguished by content of domestic and multinational firms. This designation is based on the listing of multinational corporations in Worldwide Branch Locations of Multinational Companies (1994). The primary criterion for a firm's inclusion in the multinational category is the existence of one or more branches, subsidiaries, manufacturing plants, or other holdings located outside of Japan.

The Japanese firm returns are allocated into portfolios that are distinguished by industry type, firm size, and degree of internationalization because these factors are likely to influence the impact of exchange rate exposure on the firms' returns. Industries that are export intensive or compete with foreign importers may be more likely to be influenced by exchange rate movements than are industries that produce predominately nontraded

[11] I am grateful to Linda Tesar for providing the Japanese stock market data.

[12] Approximately one third of the total industry market capitalization falls into each of the small, medium, and large categories. See Rowland and Tesar (1997) for further details.

TABLE II
Summary Statistics for Japanese Portfolio Classifications, 1984–1995

Portfolio classification[a]	Firm size in portfolio[b]	Number of firms in population[c]	Number of firms in sample[d]	Sample mean returns	Standard error
		Domestic firms[e]			
CGS	small	503	30	.3065	2.918
	medium	44	30	.2927	2.708
	large	14	14	.3471	2.841
EU	small	22	22	.3217	3.542
	medium	4	4	.2931	3.692
	large	3	3	.3644	4.403
FIR	small	186	30	.3367	3.297
	medium	9	9	.4091	4.232
	large	6	6	.3768	4.392
IND	small	1047	30	.2995	3.543
	medium	43	30	.2264	2.822
	large	5	5	.1624	2.848
		Multinational firms[f]			
CGS	small	3	3	.3412	4.019
	medium	4	4	.2505	3.157
	large	6	6	.2514	3.220
IND	small	12	12	.2672	2.983
	medium	25	25	.2596	2.917
	large	12	12	.1919	3.365
Japan market index				.1629	2.678
Yen–dollar returns				−.1240	1.493

[a] CGS denotes consumer goods and services; EU denotes energy and utilities, FIR denotes finance and real estate; and IND denotes industrials.

[b] The firm size classification within each industry is based on a size-sorting algorithm which depends on the annual observations of each firm's market capitalization denominated in yen. Approximately one third of the total industry market capitalization falls into each of the small, medium and large categories.

[c] The number of firms in the population refers to the number of Japanese firms included in Datastream's database.

[d] The maximum number of firms in the sample for each portfolio is 30 firms. If the number of firms in a category is less than 30, all firms are included in the sample portfolio. If the number of firms in a category exceeds 30, a random sample of 30 firms was drawn for that category. Sample is January 1984 through October 1995.

[e] Firms are designated as domestic or multinational firms based on the listing of multinational corporations in Worldwide Branch Locations of Multinational Companies (1994).

[f] The primary criteria for a firm's inclusion in the multinational category is the existence of one or more branches, subsidiaries, manufacturing plants or other holdings located outside of Japan.

goods.[13] The profits of firms in industries that import dollar-priced inputs (such as oil) are likely to be adversely effected by an appreciation of the dollar. The yen value of firms with foreign investments will depend directly on exchange rate changes. And, finally, previous surveys of U.S. company financial hedging behavior suggests that smaller firms are less likely to engage in hedging activities than are larger companies (Nance, Smith, and Smithson, 1993).

Table III presents the coefficient estimates of the dollar exposure of Japanese firms over the full period 1984 through 1995. The first thing to note is that 9 of the 18 portfolios (or 50%) exhibit significant exposure to contemporaneous dollar movements.[14] Of the firms designated as domestic, the returns of small firms in the consumer goods and services industry and all firms in the energy and utility industries are adversely affected by dollar appreciations. In the case of the energy and utility industry this is unsurprising, in that these firms are likely to be large importers of oil, which is priced in dollars. The returns of medium and large industrial firms that are categorized as domestic (on the basis of a low degree of foreign asset ownership—not their amount of export/import activity) are found to be favorably influenced by dollar appreciations relative to the yen. This suggests that the firms in this portfolio are predominately exporters to the United States who benefit from dollar appreciation. Of the multinational firms, again small firms in the consumer goods and services industry and medium and large-sized firms in the industrials portfolio are positively influenced by increases in the yen value of the dollar. The eight industries that show no significant dollar exposure presumably contain firms which, on average, are not exposed to dollar risk or successfully hedge their dollar exposures using financial or nonfinancial methods.

[13] Annual data on the percentage of export sales are available for Japanese parent company operations in the Japan Company Handbook. (Japanese corporations only began to report consolidated financial data in the early 1990s). Average export ratios (the company's exports as a percentage of total sales including direct exports by the company and all exports through trading firms) for the firms in each portfolio indicate wide variation both across firms and over time. In general, firms classified as "multinational" have higher export ratios than the firms included in the "domestic" portfolios. However, even firms classified as multinationals may have low export ratios. For example, Matsushita Electric Works is in the multinationals medium-sized industrials category, but typically has export ratios well below 10%. On the other hand, companies like Sharp, Honda Motor, and Sony all have average export ratios above 50% and are included in the large-size industrials category.

[14] Amihud (1994) and Bartov and Bodnar (1994) included lagged values of the exchange rate term in their exposure tests. Their specification takes into account the possibility that financial information is released with a lag, so that it may take time for foreign exchange rate changes to influence company cash flows. The results of tests including lagged values of the yen–dollar rate in Eq. (1), not reported, indicate no significant lagged effect. In other words, for the portfolios used in this paper, the contemporaneous exposure effect is not influenced by the inclusion of lagged values of the exchange rate.

TABLE III
Japanese Portfolio Dollar Exposures, 1984–1995: $R_{i,t} = \beta_{0,i} + \beta_{1,i}R_{m,t} + \beta_{2,i}\Delta s_t + \varepsilon_{i,t}$[a]

Portfolio classification	Firm size in portfolio	$\beta_{0,i}$	Std. error	$\beta_{1,i}$	Std. error	$\beta_{2,i}$	Std. error	R^2	DW
				Domestic firms					
CGS	small	0.0016	0.0007**	0.8517	0.0272***	−0.0822	0.0488*	0.61	1.98
	medium	0.0015	0.0006***	0.8713	0.0207***	−0.0217	0.0371	0.74	2.14
	large	0.0020	0.0006***	0.8871	0.0234***	0.0009	0.0420	0.70	2.18
EU	small	0.0013	0.0010	0.8709	0.0387***	−0.4051	0.0696***	0.47	1.75
	medium	0.0008	0.0010	0.9588	0.0386***	−0.3993	0.0692***	0.52	1.95
	large	0.0013	0.0012	1.1172	0.0474***	−0.4167	0.0849***	0.49	1.74
FIR	small	0.0019	0.0009**	0.9210	0.0329***	0.0553	0.0590	0.56	2.17
	medium	0.0018	0.0008**	1.3462	0.0332***	−0.0746	0.0596	0.73	2.02
	large	0.0017	0.0011	1.2774	0.0415***	0.0150	0.0743	0.61	2.06
IND	small	0.0014	0.0009	0.9872	0.0354***	0.0048	0.0636	0.56	1.74
	medium	0.0008	0.0005	0.9122	0.0212***	0.0795	0.0381**	0.74	2.08
	large	0.0005	0.0007	0.7681	0.0295***	0.1274	0.0530**	0.52	1.97
				Multinational firms					
CGS	small	0.0022	0.0013*	0.8705	0.0492***	0.1485	0.0882*	0.34	2.08
	medium	0.0009	0.0008	0.9147	0.0298***	−0.0859	0.0534	0.61	2.06
	large	0.0008	0.0007	0.9824	0.0279***	−0.0399	0.0499	0.67	2.09
IND	small	0.0012	0.0006*	0.9438	0.0239***	0.0514	0.0427	0.72	1.94
	medium	0.0013	0.0006**	0.9203	0.0232***	0.1971	0.0417***	0.72	2.12
	large	0.0011	0.0010	0.7971	0.0383***	0.4052	0.0687***	0.43	1.98

Note. CGS denotes consumer goods and services; EU denotes energy and utilities, FIR denotes finance and real estate; and IND denotes industrials. Regressions were estimated using SUR (seemingly unrelated regressions) in order to take account of potential contemporaneous correlation of the error terms across the portfolios. The sample period covers the period January 1984 through October 1995; 617 weekly observations are used in each regression.

[a] $R_{i,t}$ is the return on portfolio i; $R_{m,t}$ is the return on the Japanese market portfolio; Δs_t is the weekly yen–dollar return such that a positive (negative) $\beta_{2,i}$ coefficient indicates that dollar appreciation, on average increases (decreases) the return on portfolio i.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Tables IV and V provide dollar exposure coefficient estimates for two split samples, returns over the period 1984 through November 1989 and returns over the period December 1989 through October 1995, respectively. The yen–dollar rate fell by over 36% over the full period, but the rate of dollar depreciation was significantly more dramatic in the first half of the full sample period.[15] The exposure regression is estimated over the two samples separately in order to investigate whether the volatility of yen–dollar returns influenced the hedging behavior of firms. In periods of higher than usual exchange rate volatility we might expect firms to increase their hedging activities. The results suggest that the energy and utility portfolio is negatively affected by dollar exposure in both subperiods. Likewise, firms

[15] In the first half of the sample, from 1984 to 1989, the yen-dollar rate fell by 21%; and in the second half of the sample (1989–1995) the yen-dollar rate fell by 15%.

TABLE IV
Japanese Portfolio Dollar Exposures, 1984–1989: $R_{i,t} = \beta_{0,i} + \beta_{1,i}R_{m,t} + \beta_{2,i}\Delta s_t + \varepsilon_{i,t}$[a]

Portfolio classification	Firm size in portfolio	$\beta_{0,i}$	Std. error	$\beta_{1,i}$	Std. error	$\beta_{2,i}$	Std. error	R^2	DW
				Domestic firms					
CGS	small	0.0037	0.0012***	0.7607	0.0531***	−0.0764	0.0829	0.40	2.04
	medium	0.0025	0.0009***	0.8348	0.0389***	0.0243	0.0609	0.60	2.17
	large	0.0027	0.0011**	0.8414	0.0459***	−0.0134	0.0718	0.52	2.11
EU	small	0.0018	0.0018	0.9311	0.0781***	−0.5064	0.1219***	0.34	1.66
	medium	0.0012	0.0017	1.0818	0.0752***	−0.4751	0.1174***	0.43	1.92
	large	0.0010	0.0022	1.2417	0.0916***	−0.6265	0.1431***	0.41	1.65
FIR	small	0.0031	0.0016**	0.9801	0.0666***	0.0300	0.1041	0.42	2.21
	medium	0.0011	0.0014	1.5001	0.0596***	−0.1345	0.0931	0.68	2.02
	large	0.0010	0.0017	1.3833	0.0710***	−0.0856	0.1109	0.56	1.99
IND	small	0.0037	0.0014***	0.5900	0.0593***	0.0212	0.0926	0.28	1.97
	medium	0.0012	0.0010	0.8116	0.0430***	0.1525	0.0672**	0.54	2.12
	large	0.0011	0.0013	0.6728	0.0556***	0.2432	0.0869***	0.34	1.95
				Multinational firms					
CGS	small	0.0038	0.0022*	0.7018	0.0933***	0.2683	0.1458*	0.18	2.07
	medium	0.0014	0.0012	0.9174	0.0523***	−0.0377	0.0818	0.51	2.09
	large	0.0005	0.0012	1.1128	0.0530***	−0.0247	0.0829	0.60	2.16
IND	small	0.0028	0.0009***	0.6877	0.0412***	0.0827	0.0644	0.48	1.94
	medium	0.0019	0.0011*	0.8382	0.0443***	0.3142	0.0692***	0.55	2.24
	large	0.0008	0.0017	0.7681	0.0727***	0.5942	0.1135***	0.31	1.96

Note. CGS denotes consumer goods and services; EU denotes energy and utilities, FIR denotes finance and real estate; and IND denotes industrials. Regressions were estimated using SUR (seemingly unrelated regressions) in order to take account of potential contemporaneous correlation of the error terms across the portfolios. The sample period covers the period January 1984 through November 1989; 308 weekly observations are used in each regression.

[a] $R_{i,t}$ is the return on portfolio i; $R_{m,t}$ is the return on the Japanese market portfolio; Δs_t is the weekly yen–dollar return such that a positive (negative) $\beta_{2,i}$ coefficient indicates that dollar appreciation, on average increases (decreases) the return on portfolio i.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

in the multinational industrials portfolio are positively affected by dollar exposure in both periods. But, with the exception of positive dollar exposure for small multinational consumer goods and services firms, all the remaining significant exposures arise in the second subperiod. Hence, the regression results suggest that firms engaged in more hedging activities when yen–dollar volatility was highest.

The evidence presented in the tables suggests that about half of Japanese companies were exposed to fluctuations in the yen–dollar rate over the period 1984 to 1995. These findings differ substantially from other foreign exchange rate exposure estimates in the literature. In particular, studies of U.S. multinationals find little evidence of foreign exchange exposure, even when firms are sampled based on export ratios (Amihud, 1994, and Bartov and Bodnar, 1994). He and Ng (1998) also included only Japanese firms that have export ratios of at least 10% in their sample, and find that just

TABLE V
Japanese Portfolio Dollar Exposures, 1990–1995: $R_{i,t} = \beta_{0,i} + \beta_{1,i}R_{m,t} + \beta_{2,i}\Delta s_t + \varepsilon_{i,t}$[a]

Portfolio classification	Firm size in portfolio	$\beta_{0,i}$	Std. error	$\beta_{1,i}$	Std. error	$\beta_{2,i}$	Std. error	R^2	DW
				Domestic firms					
CGS	small	−0.0001	0.0007	0.8965	0.0253***	−0.0892	0.0501*	0.80	1.98
	medium	0.0006	0.0006	0.8889	0.0211***	−0.0681	0.0417*	0.85	2.09
	large	0.0015	0.0006**	0.9119	0.0219***	0.0142	0.0434	0.84	2.40
EU	small	0.0004	0.0009	0.8259	0.0333***	−0.2992	0.0659***	0.67	2.03
	medium	−0.0002	0.0010	0.8738	0.0361***	−0.3162	0.0713***	0.66	1.98
	large	0.0008	0.0013	1.0333	0.0449***	−0.2000	0.0888**	0.63	1.97
FIR	small	0.0004	0.0008	0.8732	0.0277***	0.0858	0.0546	0.76	2.12
	medium	0.0015	0.0011	1.2484	0.0365***	−0.0073	0.0721	0.79	2.06
	large	0.0017	0.0014	1.2107	0.0495***	0.1204	0.0978	0.66	2.20
IND	small	0.0012	0.0011	1.2321	0.0378***	−0.0289	0.0746	0.77	1.72
	medium	0.0011	0.0005**	0.9769	0.0169***	0.0015	0.0335	0.91	1.98
	large	0.0005	0.0008	0.8286	0.0299***	0.0071	0.0590	0.71	2.15
				Multinational firms					
CGS	small	0.0014	0.0014	0.9717	0.0491***	0.0222	0.0970	0.56	2.18
	medium	0.0004	0.0010	0.9103	0.0348***	−0.1333	0.0687*	0.69	2.03
	large	0.0004	0.0008	0.8991	0.0273***	−0.0485	0.0538	0.78	1.95
IND	small	0.0009	0.0007	1.1013	0.0244***	0.0091	0.0481	0.87	1.95
	medium	0.0013	0.0006*	0.9727	0.0225***	0.0762	0.0446*	0.86	1.78
	large	0.0016	0.0011	0.8214	0.0383***	0.2136	0.0757***	0.60	1.96

Note. CGS denotes consumer goods and services; EU denotes energy and utilities, FIR denotes finance and real estate; and IND denotes industrials. Regressions were estimated using SUR (seemingly unrelated regressions) in order to take account of potential contemporaneous correlation of the error terms across the portfolios. The sample period covers the period December 1989 through October 1995; 309 weekly observations are used in each regression.

[a] $R_{i,t}$ is the return on portfolio i; $R_{m,t}$ is the return on the Japanese market portfolio; Δs_t is the weekly yen–dollar return such that a positive (negative) $\beta_{2,i}$ coefficient indicates that dollar appreciation, on average increases (decreases) the return on portfolio i.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

25% exhibit significant foreign exchange exposure (using a trade weighted exchange rate). Bartov and Bodnar (1994) suggested that one of the reasons previous studies were unable to find strong exposure effects for U.S. multinationals is that grouping firms into portfolios may average out the exposure effects. However, even given the wide heterogeneity of export ratios within the portfolios included here, as well as the inclusion of firms with export ratios less than 10%, the evidence of dollar exposure remains strong. In particular, the energy and utilities portfolio is highly exposed to dollar risk, yet the companies included in the portfolio are not exporters. This suggests that, at least for Japan, exchange rate exposure is not limited to companies involved in exporting. Indeed, the results here suggest that by excluding companies with low export ratios previous studies may have underestimated the foreign exchange exposure of Japanese companies.

IV. CONCLUSION

The Japanese practice of invoicing exports and imports in dollars remains a puzzle in the literature. Invoicing in dollars leaves Japanese companies exposed to exchange rate risk. However, if Japanese companies successfully hedge this exchange rate exposure, then the currency of invoice will have no influence on yen profits.

This paper measures the dollar exposures of Japanese companies by estimating the correlation between yen–dollar returns and company value. The results suggest many Japanese companies are indeed exposed to yen–dollar movements. This, in turn, implies that they do not fully hedge against exchange rate risk. With the exception of the electric and utility industry, the evidence suggests that dollar appreciations are positively correlated with firm returns. Since over the period 1984 to 1995, the dollar depreciated by 36% relative to the yen, it follows that the values of Japanese companies fell as a consequence of their dollar exposure.

These findings raise the question of why so many Japanese companies choose to remain exposed to dollar risk. The data analyzed in this paper cannot distinguish between several competing explanations. While hedging opportunities exist, they are costly and very likely perceived by company managers as being too costly to justify the benefits. Managers may find it difficult to justify the purchase of derivatives that were ex post unnecessary. Consequently, it may be that, only in periods of exchange rate volatility do managers find that the benefits of hedging outweigh the costs.

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