Exchange Rate Exposure and Currency Derivatives Usage by Japanese firms

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1. Introduction

This paper aims to estimate the exchange rate exposure using stock market data and then investigate its effects on the firms' demand for currency derivatives for hedging purposes focusing on Japanese listed companies. **Figure 1** shows recent trends in the Nominal USD/JPY daily exchange rate from the end of March 2021 to the end of fiscal year 2024 (i.e., March 2025). In recent years, the yen has weakened sharply, temporarily reaching around 160 yen per U.S. dollar from approximately 110 yen.

Figure 1. Recent Trends in the Nominal USD/JPY Exchange Rate

（Source）Nikkei Astra Manager.

Under these circumstances, the exchange rate risks faced by Japanese firms differ depending on their business characteristics. Empirical evidence for Japanese firms suggests substantial heterogeneity in exchange rate exposure across firms, reflecting differences in pricing behavior and international production structures (Ito, Koibuchi, Sato, and Shimizu, 2016). For example, while export-oriented firms benefit from yen depreciation, it poses a headwind for import-oriented firms. As Japanese firms have expanded internationally over the past several decades, their approaches to risk management have

diversified. These approaches include not only financial hedging against foreign exchange risk using derivatives, but also operational hedging, such as the strategic selection of locations for overseas operations (e.g., Allayannis et al.,2001, Goto, 2025).

In this context, it is important and effective to examine whether the stock market appropriately assesses individual firms' exposure to exchange rate fluctuations. Accordingly, this paper estimates firm-level exchange rate exposure for Japanese companies listed in the Prime and Standard Markets (1st/2nd Sections until April 3, 2022. The same applies below.) on the Tokyo Stock Exchange using data from fiscal years 2021–2025. We then focus on financial hedging as one risk management strategy and empirically investigate the association between firms' exchange rate exposure and their demand for currency derivatives.

2. Prior Research

This paper is related to studies examining exchange rate exposure. Adler and Dumas (1984) define the concept of economic exchange rate exposure as the sensitivity of firm value to exchange rate movements beyond accounting effects. Jorion (1990) estimates exchange rate exposure using a market model augmented with exchange rate factors, and finds that, although exchange rate exposure is economically meaningful, it is difficult to detect statistically. Bodnar and Gentry (1993) investigate industry-level exchange rate exposure and show that not only manufacturing, but also non-manufacturing industries exhibit substantial exposure. Dominguez and Tesar (2006) investigate the firm level exchange rate exposure and show substantial heterogeneity across firms such as firm size and multinational status.

This paper is also closely related to prior research examining currency derivative usage from a risk management perspective. Geczy et al. (1997) found that firms with greater growth opportunities and extensive foreign currency exposure are more likely to use currency derivatives. Allayannis and Ofek (2001) show that firms with higher foreign sales and exchange rate exposure are more likely to use foreign currency derivatives and that such usage reduces exposure. Han and Laing (2025) find that firms

with more advanced ERM implementation are more likely to adopt currency derivatives to hedge exchange rate exposure.

There are some previous studies on Japanese firms' demand for derivative usage. Yanase (2011) finds that hedge accounting disclosure promotes firms' use of interest rate derivatives. Limpaphayom et al. (2019) show that bank equity ownership is positively associated with both derivative usage and firm value, suggesting that bank ownership enhances corporate hedging and firm valuation. These studies also rely on quantitative data on derivative transactions based on hedge accounting, which has been available since March 2010, and use the contracted amounts of derivative holdings as a proxy for firms' hedging behavior.

3. Empirical Analysis

3.1. Data and Methodology

We gather data on Japanese listed companies in the Prime and Standard Markets of the Tokyo Stock Exchange from fiscal years 2021 to 2024. We focus on firms with a March fiscal year-end and exclude financial firms. We collect data on stock returns, derivatives and financial items from Astra Manager and Nikkei-Cges. We exclude firms with fiscal years shorter than 12 months and those that adopt IFRS accounting standards.

Following the two-index model such as Jorion (1990), we estimate the following specification:

$$R_{i,t} = \alpha_1 + \alpha_2 R_{m,t} + \alpha_3 R_{S,t} + \varepsilon_{i,t} \quad (1)$$

where $R_{i,t}$ denotes the daily stock return of firm i in period t: from July 1 to the end of March. $R_{m,t}$ is the daily index return of TOPIX in the period t, and $R_{S,t}$ is the percentage change in currency S over the period t. We use the daily nominal USD/JPY exchange rate. $\varepsilon_{i,t}$ is the residual of the two-index model.

Among the 9,787 firms in the full sample used in the analysis, 7,567 firms (approximately 77%) show a negative coefficient of α_3. Conversely, the proportion of firms with a positive coefficient is relatively small. A positive coefficient indicates that a depreciation of the yen increases the sensitivity of stock returns to exchange rate movements.

However, when the sample is restricted to manufacturing firms, the sample size decreases to 3,279 firms, of which 1,596 firms (49%) have a negative coefficient. In this subsample, the proportions of positive and negative coefficients are roughly evenly split. This indicates that there exists a non-negligible number of firms whose exchange rate exposure increases regardless of whether the yen depreciates or appreciates particularly in the manufacturing sector. Following the prior literature, we use the absolute value of the estimated coefficient and further take its natural logarithm to account for the skewness of its distribution. This transformed value is used as our primary measure of exchange rate exposure (Exchange rate exposure). Since this measure is based on the estimation results of Equation (1), it may be subject to estimation bias. However, because it directly captures stock market evaluation of firms' exposure to exchange rate risk, we use it as our main variable. As an alternative measure, we use the ratio of foreign sales to total sales as a second proxy for exchange rate exposure.

Based on the panel data set, we estimate the linear probability model for the demand of derivatives usage and the OLS model for the determinant of derivative amounts as follows:

$$Hedge\_dum_{i,t} = \beta_1 + \beta_2 Exchange\ rate\ exposure_{i,t-1} + \beta \cdot X_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$CR\_ivative\_at_{i,t} = \gamma_1 + \gamma_2 Exchange\ rate\ exposure_{i,t-1} + \gamma \cdot X_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

Regarding the dependent variable of Equation (1), we use a dummy variable that takes the value of one if a firm uses currency derivatives subject to hedge accounting and zero otherwise (CR_Hedge_dum). The left-hand side of equation (2) is CR_Derivative_at, which represents the contract amount of currency derivatives subject to hedge accounting, scaled by total assets. Standard errors are clustered at the firm level.

Our primary interest is the coefficient of foreign exchange rate exposure. If a firm demands currency derivatives as a financial hedging instrument to manage foreign exchange risk, the expected sign of the coefficient is positive in both Equations (1) and (2). We include several control variables denoted by X. Specifically, we include the natural logarithm of sales (ln_sales). We use the ratio of book value to market value (Tobin_Q) as a proxy for Tobin's simple Q, and the ratio of operating income to total assets (roa) as a proxy for firm performance. We also include the ratio of foreign sales to total

assets (foreign_sales). All explanatory variables are measured at the end of the previous fiscal year. In addition, we include industry and year dummy variables (Sector_dum, Year_dum) in all specifications.

Table 1. Descriptive Statistics

VARIABLES	Obs	Mean	Std. dev.	Min	Max
Total Sample					
CH_Hedge_dum	9,787	0.154	0.361	0	1
CR_Derivative_at	9,787	0.006	0.029	0	0.581
ln_abs_ex	9,787	0.186	0.176	0	1.431
foreign_sales	9,787	0.1161	0.2173	0	1
ln_sales	6,686	10.7981	1.6428	5.0626	16.3560
roa	9,664	0.0619	0.0919	-1.825	2.188
simple_q	9,735	1.3672	1.4994	0.3534	34.0288
Manufacturing					
CH_Hedge_dum	3,279	0.282	0.450	0	1
CR_Derivative_at	3,279	0.009	0.034	0	0.539
ln_abs_ex	3,279	0.174	0.156	0	1.097
foreign_sales	3,279	0.292	0.271	0	1
ln_sales	3,279	10.846	1.515	5.273	16.356
roa	3,270	0.056	0.065	-0.221	2.188
simple_q	3,279	1.032	0.685	0.353	11.418

Panel A of Table 1 summarizes the descriptive statistics for our total sample firms used in the following analysis. We note that 15% of firms use currency derivatives subject to hedge accounting, indicating that approximately one-tenth of firms engage in derivative transactions. With respect to the ratio of derivative contracts to total assets, interest rate derivatives account for less than 1%. These results suggest that both the number of firms using derivatives and the notional amounts of interest rate derivative contracts are relatively limited. **Panel B of Table 1** reports the descriptive statistics for the subsample of manufacturing firms. In this subsample, the share of firms using currency derivatives subject to hedge accounting increases to 28%. In contrast, the notional amounts of derivative contracts remain largely unchanged relative to the full sample and appear to be small on average.

3.2. Empirical Results

Table 2 summarizes the results on the relationship between estimated foreign exchange rate exposure and derivative usage. Rows 1 and 2 report the results for the effect of exchange rate exposure—the primary focus of this paper—on the demand for currency derivatives. Columns 1 and 2 present preliminary results without control variables. In this sense, Column 3 constitutes our main results. Column 4 reports the results for the subsample of manufacturing firms. Column 3 shows that the coefficient on foreign exchange rate exposure is positive and statistically significant, indicating that firms with higher exchange rate exposure exhibit greater demand for currency derivatives. This finding underscores the importance of financial hedging and implies that firms use derivatives as a risk management tool to mitigate increased exchange rate risk.

Table 2 Exchange Rate Exposure and Demand for Currency Derivatives

	(1)	(2)	(3)	(4)
VARIABLES	CR_Hedge_dum			
	all sample			Manufacturing
ln_abs_ex		0.020	0.062**	0.151***
		(0.98)	(2.00)	(3.02)
foreign_sales	0.440***	0.439***	0.133***	-0.031
	(16.74)	(16.72)	(4.46)	(-0.90)
ln_sales			0.083***	0.111***
			(21.78)	(20.16)
roa			-0.301***	-0.408***
			(-5.98)	(-2.95)
simple_q			0.008*	-0.019
			(1.74)	(-1.60)
Constant	0.100***	0.096***	-0.705***	-0.904***
	(24.48)	(17.66)	(-17.80)	(-16.32)
Sector_dum	YES	YES	YES	YES
Year_dum	YES	YES	YES	YES
Observations	9,787	9,787	6,626	3,268
R-squared	0.155	0.156	0.211	0.171

The t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 3 summarizes the extent of derivative usage. Row 1 shows that the use of interest rate derivatives, measured by contract value, is generally positively associated with estimated exchange rate exposure. Row 2 reports positive and statistically significant coefficients for the foreign sales variable, except in Column 5, where the coefficient has the opposite sign and is statistically insignificant. This suggests that the main results are driven by firms across all sectors, whereas within the manufacturing sector there is no clear association between foreign sales and the demand for currency derivatives. One possible interpretation is that, as discussed in the introduction, manufacturing firms may also rely more on operational hedging strategies, whereas such options are more limited for non-manufacturing firms, leading to differences in the results.

Regarding the control variables, the size proxy, ln_sales, is positive and statistically significant. In contrast, the firm's performance measured by roa is negative and statistically significant. These results imply that larger and less profitable firms exhibit greater demand for currency derivatives.

Table 3 Exchange Rate Exposure and the Amount of Currency Derivatives

	(1)	(2)	(3)	(4)
VARIABLES	CR_Derivative_at			
	all sample			manufacturing
ln_abs_ex		0.003	0.006*	0.008*
		(1.61)	(1.82)	(1.86)
foreign_sales	0.017***	0.016***	0.007*	-0.009**
	(5.93)	(5.87)	(1.85)	(-2.25)
ln_sales			0.002***	0.004***
			(7.26)	(8.03)
roa			0.000	0.002
			(0.06)	(0.16)
simple_q			0.000	-0.001
			(0.18)	(-0.73)
Constant	0.004***	0.003***	-0.016***	-0.032***
	(9.87)	(7.22)	(-5.65)	(-6.87)
Sector_dum	YES	YES	YES	YES
Year_dum	YES	YES	YES	YES
Observations	9,787	9,787	6,626	3,268
R-squared	0.119	0.119	0.151	0.065

The t-statistics are reported in parentheses. Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4. Conclusions

We estimated exchange rate exposure using stock market data and then investigated its effects on the firms' demand for currency derivatives for hedging purposes focusing on Japanese listed companies. Specifically, this paper estimates firm-level exchange rate exposure for Japanese firms listed in the Prime and Standard Markets Tokyo Stock Exchange using data from fiscal years 2021–2024

5. We then focus on financial hedging as one risk management strategy and empirically investigate the association between firms' exchange rate exposure and their demand for foreign exchange derivatives. We found that the coefficient on foreign exchange rate exposure is positive and statistically significant, indicating that firms with higher exchange rate exposure exhibit greater demand for currency derivatives. This finding underscores the importance of financial hedging and implies that firms use derivatives as a risk management tool to mitigate increased exchange rate risk.

Overall, our results provide empirical evidence that exchange rate exposure is an important determinant of firms' financial hedging behavior. This result suggests that market-based measures of exchange rate exposure are still informative for understanding firms' hedging decisions. In recent years, uncertainty surrounding factors affecting exchange rates, including trade policy uncertainty and geopolitical risks, has intensified. Understanding how these factors influence exchange rate exposure and risk hedging remains an important avenue for future research.

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