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Exchange rate fluctuations and firm performance: Evidence from the historic depreciation period of the Japanese yen

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Abstract

The extensive and persistent depreciation of the Japanese yen since 2022 has prompted Japanese exporting manufacturers to revise their sales and earnings forecasts. This effect is generally more significant for larger-sized firms than smaller-sized ones while some globally operating firms with the largest size are less likely to revise their forecasts in the same period. To explore these observations, this paper formulates the interaction among invoice currency choice, operational hedging, and foreign exchange exposures. For empirical analysis, this paper uses the earnings forecasts data released by manufacturers listed in the Japanese stock exchange since the data can detect the direct foreign exchange exposure. The results indicate that firms with more intra-firm exports tend to improve their financial performance more swiftly as the Japanese yen depreciates. In contrast, the performance of firms having production subsidiaries and local headquarters in foreign countries is less likely to fluctuate due to the operational hedging. The results show the choice of invoice currency and operational hedging at the firm level play an essential role in a firm's performance, and are consistent with the view that the direct foreign exchange exposure is the inverse U-shape in firm size.

Keywords: depreciation of Japanese yen; earnings forecast revision; invoice currency; operational hedging; foreign exchange exposure;
JEL classification: F23, F31, F33, G32

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1. Introduction

Japanese yen started to continuously depreciate vis-à-vis the US dollar and other major currencies by almost 36 percent from March 2022 until March 2025. This period was called the "historic depreciation period of Japanese yen" in Japan. This period covers almost three consecutive fiscal years of Japanese firms, including FY2022, FY2023, and FY2024.

Under the extensive and persistent depreciation of the home currency, the corporate sector of the Japanese economy is characterized by the following two distinct observations: first, the assumed nominal exchange rate (NER) of Japanese yen by Japanese large manufacturers was always below the actual NER (spot rate), which means the large manufacturers systematically overestimated the value of Japanese yen. (Figure 1-1); Second, regarding the performance of the corporate sector during this period, larger firms improved their performance more swiftly and significantly than smaller firms. According to the Japanese central bank's survey data, sales, exports, and profits of larger firms soared more compared to those of smaller firms, especially in FY2022 and FY2023. (Figure 1-2)

Figure 1-1. Actual versus assumed nominal exchange rate of Japanese yen vis-à-vis the US dollar

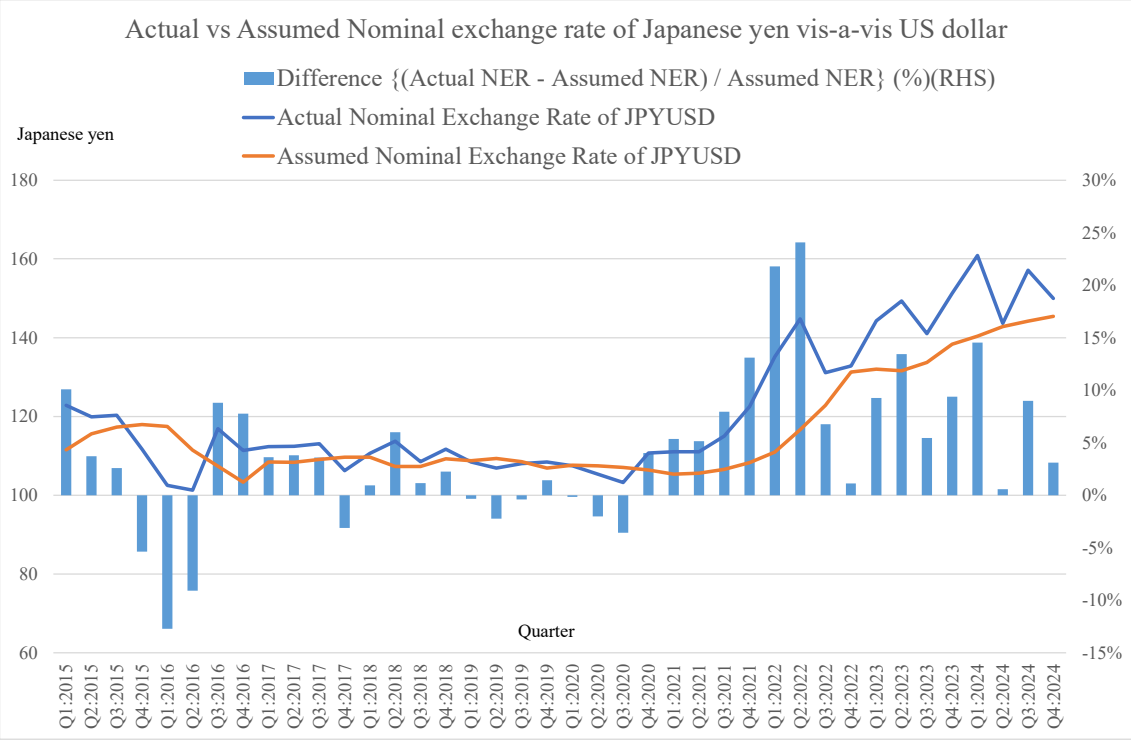
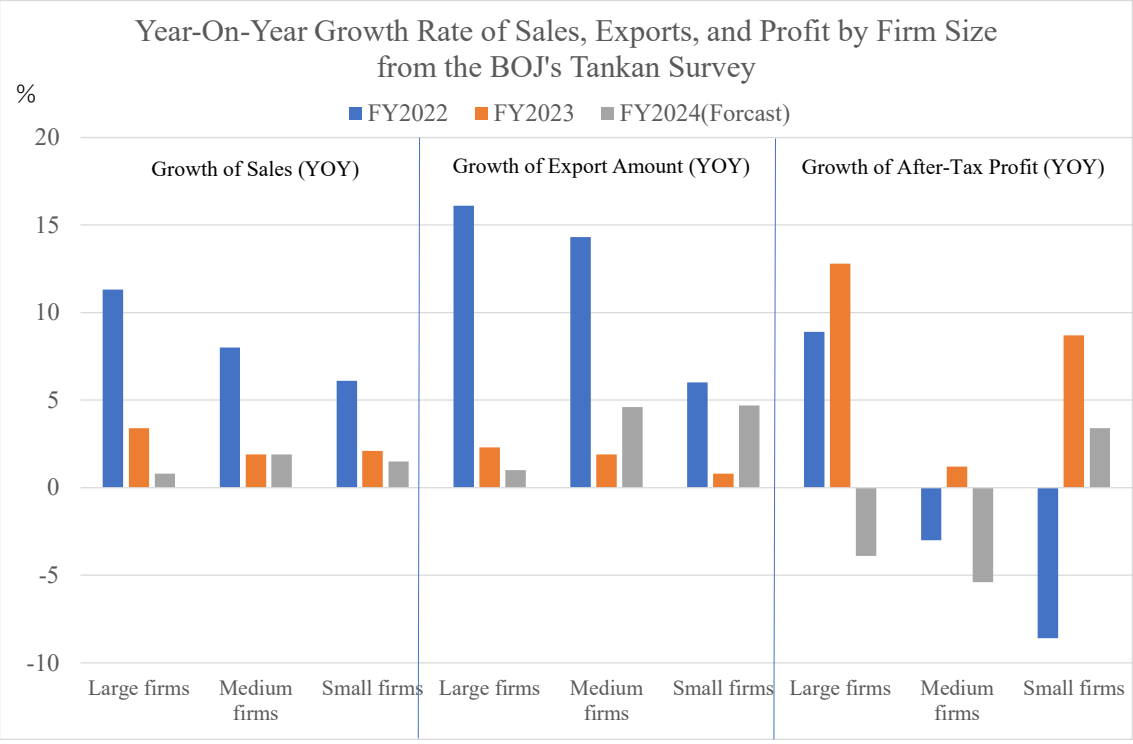


Figure 1-2. Performance of the corporate sector by firm size in FY2022-2024: the BOJ's Tankan Survey



Based on these observations, we have the following basic questions: first, why do larger firms improve their financial performance more swiftly and significantly, facing the extensive and persistent depreciation of their home currency; second, what kind of features of firms affect their performance as the exchange rate fluctuates. To consider these questions, we argue about the foreign exchange exposure of Japanese firms.

Hutson and Laing (2014) state, "investigating the extent and sources of foreign exchange exposure has become one of the most challenging issues in empirical international financial management. Contrary to theory, most studies have found little significant and firm-level foreign exchange exposure." They mention the phenomenon the co-called "foreign exchange exposure puzzle". However, under the circumstances such as recent significant depreciation of home currency vis-à-vis foreign currencies in Japan, the above casual observations suggest the possibility that the Japanese corporate sector experienced significant foreign exchange exposure at a firm level depending on their characteristics.

The purpose of this paper is to explore the interaction among invoice currency choice, operational hedging, and corporate performance, and estimate foreign exchange exposure at a firm level by using the earnings forecasts data released by manufacturers listed in the Japanese stock

exchange since the forecast revision data can purely detect the direct exposure.

The remainder of this paper is structured as follows. The next section discusses the existing literature and develops our research questions. Section 3 provides the data descriptions, and Section 4 describes the empirical methodology. Section 5 reports the main results, and the Final section concludes the paper.

2. Literature review and research questions

To explore the impacts of extensive and persistent depreciation of home currency on the financial performance of the corporate sector, this section discusses the prior literature and formulates the theoretical and empirical relationship among invoice currencies, expected exchange rates by firms (assumed exchange rates), operational and financial hedges, and foreign exchange exposures

2.1. Invoice currency

After controlling for the impacts of foreign market dependency and the assumed exchange rate of exporting firms, the choice of invoice currency plays an essential role in the firm's accounting performance. The choice of invoice currency in exports has a significant scale effect, according to the questionnaire survey on Japanese listed manufacturers conducted by the previous research. Ito, et al (2018) report that there is a significant scale effect in the choice of invoice currency in Japanese manufacturing exporters. Larger-sized listed firms tend to have a smaller share of home currency (Japanese yen) invoicing and thus a larger share of foreign currency invoicing, including the importer's currency and the US dollar (Table 2-1).

Table 2-1. Status of Invoice currency choice by firm size: Japanese listed manufacturers

Status of Invoice Currency Choice by Firm Size: Listed Manufactures

Sample firms	Size of Consolitated Sales	Share of Japanese Yen in Total Exports	
		Average	Median
Listed Manufacturers	Large-size	29.8%	11%
	Medium-size	41.3%	34%
	Small-size	51.5%	47%

Source: Ito, et al (2018, 2021)

Ito et al. argue that this distinct pattern of invoicing currency choice stems from a larger share of intra-firm trades by larger-sized listed firms. As large-sized firms tend to have their own foreign subsidiaries in major countries/regions, the majority of exports from Japan are occupied by

the intra-firm exports from headquarters in Japan to their own foreign subsidiaries. Since its own foreign subsidiary is viewed as a group company in terms of consolidated financial statements, the parent firms have an incentive to incur the burden of exchange rate risk by choosing the invoice currency of the importer rather than the home currency. In the case of exports to developing countries with minor currencies, they tend to choose a vehicle currency, or a dominant currency, such as the US dollar. These arrangements of invoice currency choice insulate foreign subsidiaries from exchange rate risk; in exchange, the treasury department of the parent firm in Japan gathers the exchange risk and manages it in an efficient manner. This motivation of the parent firm of Japanese firms tends to be intensified as the parent firms have higher equity participation in their foreign subsidiaries. In summary, the firms having a higher share of intra-firm trade and higher equity participation in their foreign subsidiaries have a stronger tendency to choose foreign currency invoicing in exports from Japan to the world.

2.2. Foreign exposure and operational hedging

Another clue from the existing literature is about the relationship between exchange rate exposure and the degree of globalization of firms. Hutson and Laing (2014) describe that a firm's overall foreign exchange exposure comprises *direct exposure*, which arises from known and expected future foreign currency transactions, and *indirect exposure*, which arises from the competitive environment in which the firm operates.

They argue that the relation between operational hedging and foreign exchange exposure at a firm level can be non-linear. This is because if operational hedging reduces direct foreign exchange rate exposure, direct exposure generally would fall with a greater degree of operational hedging. However, as a definition, purely domestic firms (thus having no operational hedging) have no direct exposure. Therefore, the theoretical relation between operational hedging and direct exposure becomes an inverse U-shape, in which firms with an intermediate level of operational hedging have the highest exposure. On the other hand, regarding indirect exposure, all firms are potentially indirectly exposed to exchange rate fluctuations, especially domestic firms, which should be the most exposed, and multinational firms that highly engage in operational hedging are the least. Therefore, the relation between indirect exposure and operational hedging can be ambiguous or in some case, can be rather linear, having a negative relation. Consequently, because overall exposure is derived from the combination of direct and indirect exposure, the resulting relation between operational hedging and overall exposure appears as an inverse U-shape.

The Hutson and Laing (2014) argument points out that the major source of the inverse U-shape in the relation between overall exposure and operational hedging comes from the feature of

the direct exposure, which has the inverse U-shaped relation with the degree of operational hedging.[1] Therefore, this paper focuses on the direct exposure at a firm-level rather than indirect exposure, and its relation with the degree of operational hedging that firms operate.

2.3. Direct foreign exchange exposure and firm performance

From the above discussions in these existing literatures, we derive the following hypotheses regarding the size difference of performance of the corporate sector during the historical depreciation period of the Japanese yen:

(1) The significant and continuous depreciation of the Japanese yen directly affects the export firms having foreign currency invoicing through direct foreign exchange exposure. Amounts of their sales and exports in terms of home currency increase immediately after the Japanese yen starts to depreciate vis-à-vis foreign currencies. In the case of Japanese firms, larger-sized firm has a strong tendency to choose foreign currency invoicing over smaller-sized firms because of their larger share of intra-firm trades using the network of their own foreign subsidiaries.

(2) However, more globalized firms with a network of their own foreign subsidiaries are able to reduce exchange rate exposure at the group firm as a whole by utilizing operational hedging. This implies that the largest group of firms with the most globalized and multi-nationalized operations tends to stabilize their performance against exchange rate fluctuations. Thus, we may observe that the largest group of Japanese listed firms, which are also the most globalized in general, have their own network of foreign subsidiaries, indicating more stable performance even in the period of historic depreciation of the Japanese yen due to their ability to implement operational hedging strategies.

3. Data

To estimate the direct exposure of Japanese firms and test the above hypotheses, we use a dataset of the earnings forecasts released by 1,480 Japanese listed manufacturers from Q1 in FY2022 through Q4 in FY2024. The statutory timely disclosure system under the Japanese stock exchange requires top managers of listed firms to disclose the information on the revision of earnings forecast

[1] Allayanis, et al (2001) also argue the role of operational hedging strategies on exchange rate exposures. Amiti, et al (2014) emphasize the operational hedging through a trade itself because large exporters are simultaneously large importers.

on financial results (consolidated sales, operating profit, ordinary profit, and after-tax profit) as of the end of coming fiscal year as swiftly as they recognize the necessity of revision of forecasted financial results caused by various factors including the exchange rate fluctuations.[2]

By purifying the earnings forecast data to remove the revisions due to causes other than exchange rate fluctuations, we obtain purified data that has a direct connection between exchange rate fluctuations and the financial results of firms in a timely manner.

Various factors other than EXR fluctuations affect the revision of earnings forecasts by the CEO/CFO of firms. Noise reduction is necessary through the cleansing of raw revision data. We go through the “reason of revision” in earning forecast data and pick up only the cases that the article mentions a factor relating to exchange rate fluctuation (“EXR factor") by distinguishing from other factors ("Non-EXR factors")

Figure 3-1 through Figure 3-3 report the comparison between the number of upward revisions, downward revisions, and difference (upward minus downward), respectively, and the quarterly nominal exchange rate vis-à-vis the US dollar from Q1 of FY2022 through Q4 of FY2024. By comparing the revisions caused by the exchange rate (EXR) factor with those caused by the non-EXR factor, we observe a more significant correlation between the number of revisions in each quarter and the movement of the nominal exchange rate in the graphs of the EXR factor.

[2] Kato, Skinner, and Kunimura (2009) is a rare study using earnings forecasts in Japan.

Figure 3-1. Earnings forecast's upward revision due to the EXR factor

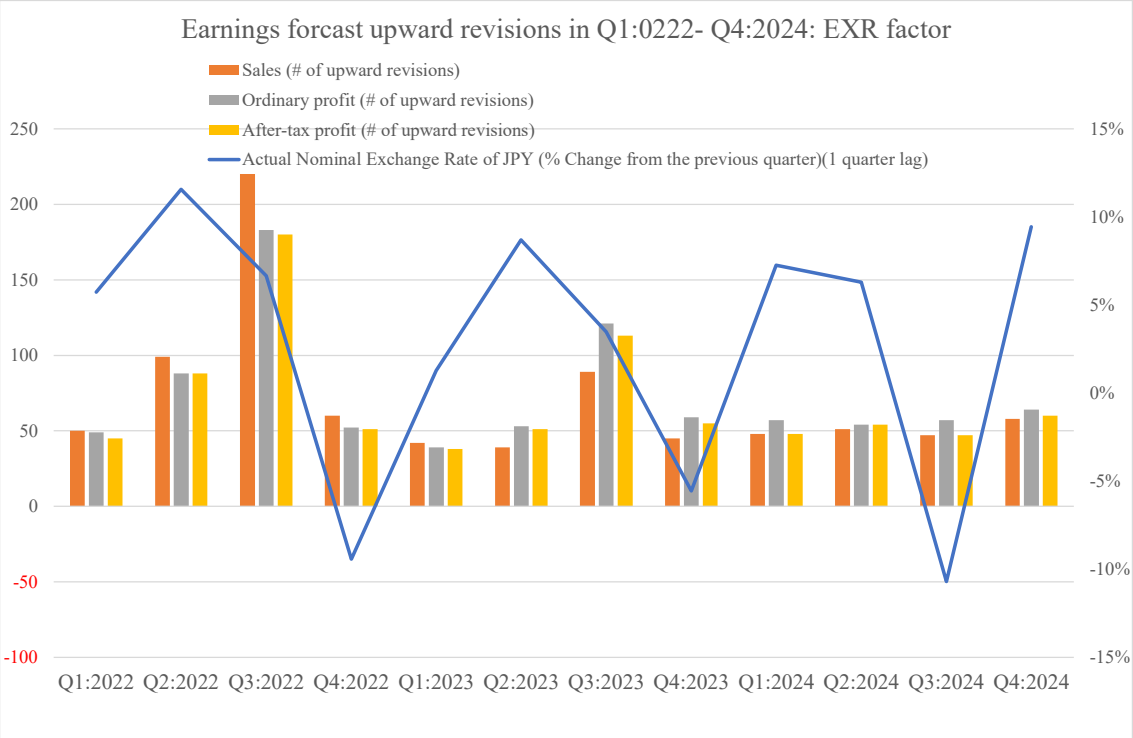


Figure 3-2. Earnings forecast's downward revision due to the EXR factor

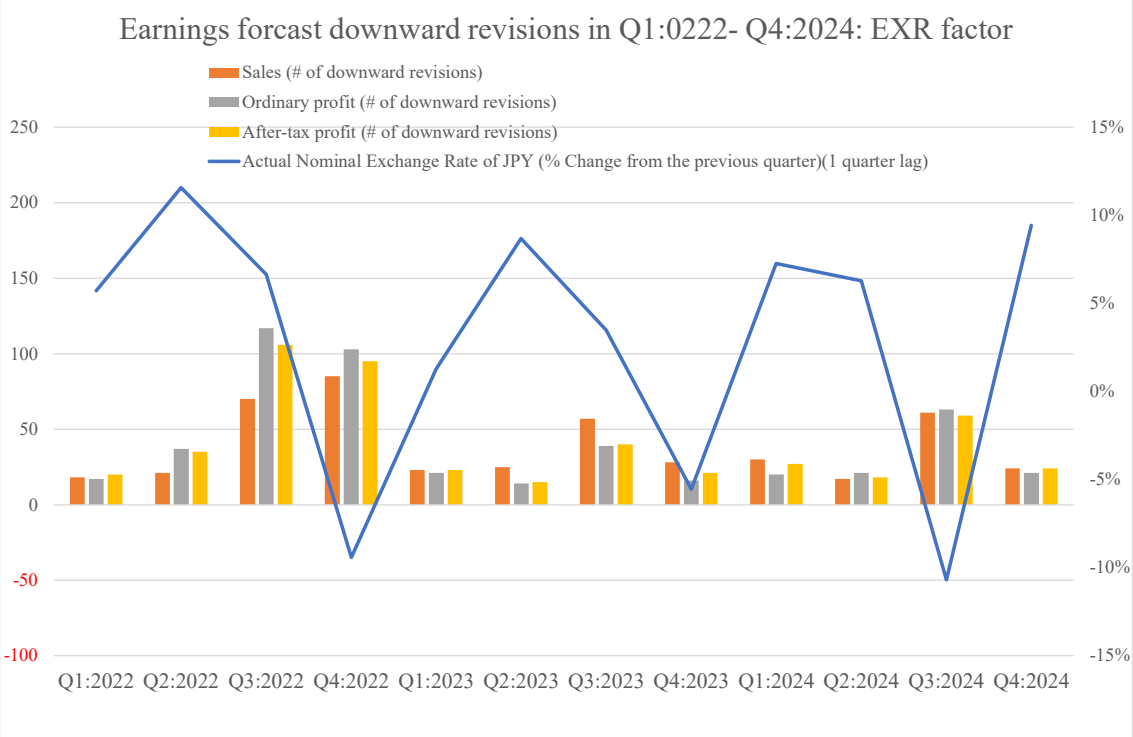
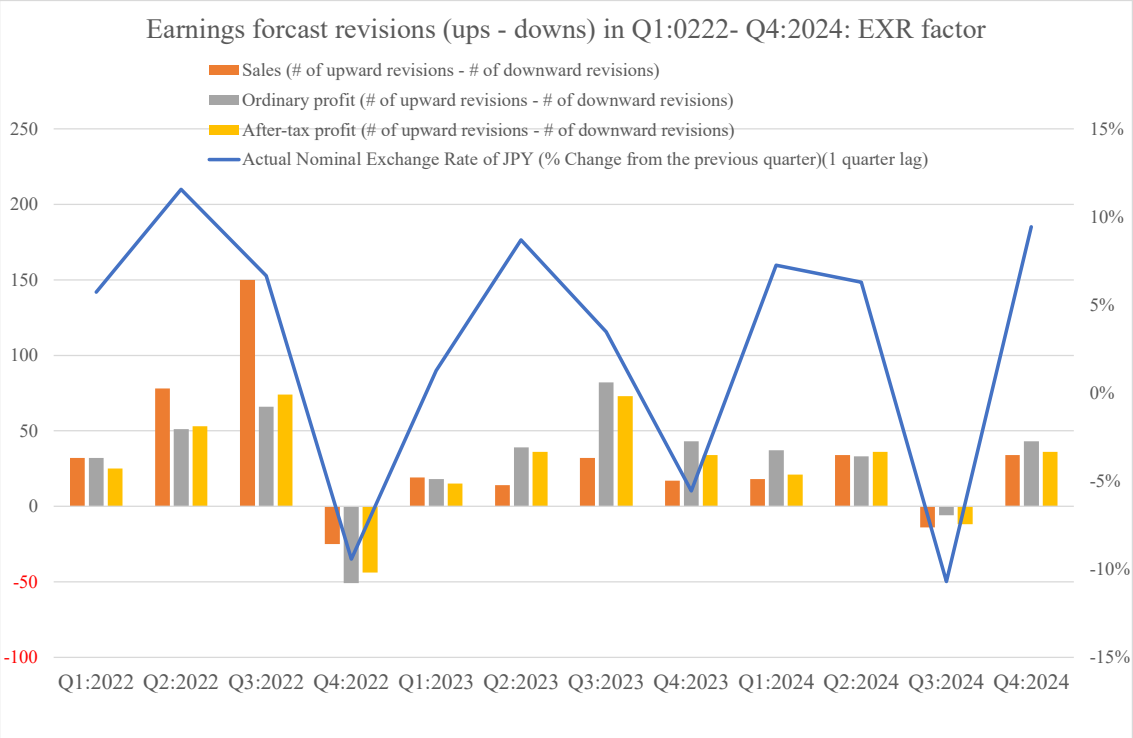


Figure 3-3. Earnings forecast's net revisions (upward – downward) due to the EXR factor



4. Methodology

To test the hypotheses that we discuss in Section 2, we conduct the following regressions by using the earnings forecast data of Japanese listed manufacturers.

$$ForecastRevision_{t_i} = \alpha + \beta_1\, ForeignRatio_i + \beta_2\, Sales_i + \beta_3\, AssumedEXR_{t-1_j} + \gamma_1\, Intrafirm_i + \gamma_2\, Operational_i + \delta_1\, Quarter\ dummies + \delta_2\, Industry\ dummies + \varepsilon_{t_i}$$

In the first regression model, the dependent variable, *ForecastRevision, is the percent change of the* forecast from the previous forecast.

Explanatory instruments include four categories of variables. In the first category, *ForeignRatio* is the ratio of total foreign sales (sales outside Japan) divided by total consolidated sales of firm *i*, which represents the exposure of the firm's foreign market. *Sales* is the log of consolidated sales of firm i, which is a proxy of firm size. *AssumedEXR* is the industry-averaged assumed exchange rate as of quarter *t* for industry *j* that firm *i* belongs to.

In the second category, *Intrafirm* includes two variables: the log of the number of foreign

subsidiaries of firm i and the share of 100% owned subsidiaries of firm *i*. These variables represent the degree of intra-firm exports and thus proxy for the share of foreign currency invoicing of firm *i*.

In the third category, *Operational* includes two variables: log of (one plus) the number of foreign plants and log of (one plus) the number of (foreign) local headquarters of firm *i*. Many Japanese listed firms have foreign production subsidiaries (plants). Log of the number of foreign plants is a proxy for the production cost in terms of foreign currency arising from the production outside Japan. Some Japanese globalized firms have local headquarters in major countries/regions of the world, which engage in activities including operational hedging and financial hedging at the regional level. Thus, these variables represent the degree of hedging activities to stabilize the firm's performance against exchange rate fluctuations. In the last category, quarter dummies and industry dummies are included.

Second, we also conduct the probit estimation by identifying upward and downward revisions from the percent change of forecast revision data. Explanatory instruments are same as those of the first regression model.

$$Prob(Upward_{ti} = 1) = \alpha + \beta_1\, ForeignRatio_i + \beta_2\, Sales_i + \beta_3\, AssumedEXR_{t-1_j} + \gamma_1\, Intrafirm_i + \gamma_2\, Operational_i + \delta_1\, Quarter\ dummies + \delta_2\, Industry\ dummies + \varepsilon_{t_i}$$

$$Prob(Downward_{ti} = 1) = \alpha + \beta_1\, ForeignRatio_i + \beta_2\, Sales_i + \beta_3\, AssumedEXR_{t-1_j} + \gamma_1\, Intrafirm_i + \gamma_2\, Operational_i + \delta_1\, Quarter\ dummies + \delta_2\, Industry\ dummies + \varepsilon_{t_i}$$

5. Results

Tables 5-1 and 5-2 report the regression results. Table 5-1 shows the results of OLS regressions using the percent change of forecasted sales, ordinary profit, and after-tax profit as dependent variables.

Table 5-1. OLS regressions on the percent change of the forecast from the previous forecast

	Revised forecast data based on exchange rate fluctuation								
DATA	Percent change of forecast from the previous forecast								
METHOD	Ordinary least square								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Sales	Ordinary profit	After-tax profit	Sales	Ordinary profit	After-tax profit	Sales	Ordinary profit	After-tax profit
Foreign sales ratio	0.00500***	0.0194***	0.0120***	0.00539***	0.0206***	0.0130***	0.00597***	0.0213***	0.0148***
	(0.000683)	(0.00444)	(0.00455)	(0.000697)	(0.00453)	(0.00464)	(0.000719)	(0.00468)	(0.00479)
Ln(sales)	0.000236**	-0.000876	-0.00124*	0.000182*	-0.00104	-0.00139*	4.08e-05	-0.00166**	-0.00225***
	(0.000106)	(0.000688)	(0.000705)	(0.000108)	(0.000700)	(0.000717)	(0.000114)	(0.000740)	(0.000757)
Actual - Asumed NER (t-1)	0.0257***	0.0541***	0.0691***	-0.00803	-0.0443	-0.0185			
	(0.00212)	(0.0138)	(0.0141)	(0.0125)	(0.0814)	(0.0834)			
Ln(# of foreign subsidiaries)	-9.35e-05	0.00462*	0.00769***	1.25e-05	0.00492*	0.00795***	0.000469	0.00710**	0.0102***
	(0.000429)	(0.00279)	(0.00285)	(0.000430)	(0.00279)	(0.00286)	(0.000446)	(0.00290)	(0.00297)
Share of 100% owned subsidiaries	-0.000239	0.00175	0.00211	-0.000197	0.00187	0.00222	-0.000109	0.00223	0.00256*
	(0.000207)	(0.00135)	(0.00138)	(0.000207)	(0.00135)	(0.00138)	(0.000210)	(0.00136)	(0.00139)
Ln(# of foreign plants)	0.000139	-0.00400	-0.00779**	8.45e-05	-0.00413	-0.00792**	-0.000346	-0.00661**	-0.0104***
	(0.000490)	(0.00318)	(0.00326)	(0.000489)	(0.00318)	(0.00326)	(0.000509)	(0.00331)	(0.00339)
Ln(# of local headquarters)	-0.000422	-0.00633**	1.84e-05	-0.000380	-0.00620*	0.000134	-0.000461	-0.00587*	0.000623
	(0.000495)	(0.00321)	(0.00329)	(0.000494)	(0.00321)	(0.00329)	(0.000499)	(0.00325)	(0.00332)
Constant	-0.00544***	0.000379	0.00357	-0.00187	0.0164	0.0163	-0.00228*	0.0177**	0.0197**
	(0.00104)	(0.00673)	(0.00689)	(0.00201)	(0.0131)	(0.0134)	(0.00124)	(0.00807)	(0.00826)
Quarter dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	No	No	No	No	Yes	Yes	Yes
Observations	17,760	17,719	17,689	17,760	17,719	17,689	17,760	17,719	17,689
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1								

First, the *Foreign sales ratio* has statistically significant positive coefficients in all specifications from (1) to (9). This means that the firms with higher foreign market dependency revise their earnings forecasts more frequently during the period of depreciation of the Japanese yen.

Second, *AssumedEXR* has statistically significant positive coefficients in specifications (1) through (3), in specifications without quarterly and industry dummies. This means that firms having a higher positive difference between actual and assumed exchange rate, which is consistent with overvalued Japanese yen during the FY2022- 2024, revise the earnings forecast more frequently.

Third, among explanatory variables for intra-firm trade, the number of foreign subsidiaries has statistically significant positive coefficients in almost all specifications except specifications (1), (4), and (7), while the share of 100% foreign subsidiaries has statistically significant positive coefficients only in specification (9). This means that intra-firm exports promote foreign currency invoicing, including the importer's currency or the US dollar; thus, the firms with active intra-firm exports revise the earnings forecast positively more frequently.

Fourth, explanatory variables for hedging activity, including the number of foreign production subsidiaries and local headquarters, show generally statistically significant negative coefficients. This means operational hedging activities through worldwide production and financial

hedging at local headquarters reduce the exchange rate exposure and stabilize the corporate performance even in the period of massive and prolonged depreciation of the home currency.

Table 5-2(a) and Table 5-2(b) show the results of Probit estimation using the upward and downward revisions as dependent variables, respectively. Although results are basically similar to those of Table 5-1, the following features are worth noting.

First, in the probit estimation on upward revision in Table 3(a), the coefficients of intra-firm trade are statistically significant and positive, while the coefficients of the log of sales no longer show a statistically significant value. In our interpretation, this is because Japanese firms showing the upward revision on sales and profit as the Japanese yen depreciates are mainly active exporters, thus they established many foreign subsidiaries and export their products through intra-firm trades, and improve their financial performance immediately after home currency depreciation.

Second, in the probit estimation on downward revision in Table 3(b), contrary to Table 3(a), the coefficients of the log of sales no longer show a statistically significant value, while the coefficients of intra-firm trade no longer show a statistically significant value. This is because Japanese firms showing the downward revision as the Japanese yen depreciates are not active exporters but importers that do not have foreign subsidiaries all over the world.

Third, the coefficients of the number of foreign plants are completely different across Table 5-2(a) and Table 5-2(b). In the upward revision estimation in Table 5-2(a), the coefficients are negative and statistically significant in the specifications (3) and (6) – (9). On the other hand, the coefficients are generally positive and statistically significant in the downward estimation in Table 3(b). In our interpretation, firms having many foreign plants have costs in terms of foreign currencies, thus benefit from home currency depreciation decreases, which causes more downward revisions rather than upward revisions.

Finally, firms having local headquarters are less frequently revising earnings forecasts during the period of prolonged home currency depreciation, both in upward and downward revision estimations, which is consistent with the view that firms having local headquarters actively engage in operational and financial hedging activity to stabilize performance against exchange rate fluctuation.

Table 5-2(a). Probit estimation on the upward revision of the forecast

DATA	Revised forecast data based on exchange rate fluctuation only upward revision due to exchange rate fluctuations								
METHOD	Probit estimation								
VARIABLES	(1) Sales	(2) Ordinary profit	(3) After-tax profit	(4) Sales	(5) Ordinary profit	(6) After-tax profit	(7) Sales	(8) Ordinary profit	(9) After-tax profit
Foreign sales ratio	0.0557***	0.0588***	0.0544***	0.0566***	0.0589***	0.0556***	0.0593***	0.0597***	0.0566***
	(0.00543)	(0.00567)	(0.00548)	(0.00548)	(0.00571)	(0.00553)	(0.00556)	(0.00577)	(0.00559)
Ln(sales)	0.000450	0.000669	0.000867	0.000298	0.000391	0.000524	-0.00120	-0.00117	-0.000943
	(0.000999)	(0.00105)	(0.00101)	(0.000992)	(0.00103)	(0.00100)	(0.00102)	(0.00107)	(0.00104)
Actual - Asumed NER (t-1)	0.256***	0.205***	0.204***	0.174	0.120	0.0342			
	(0.0173)	(0.0184)	(0.0177)	(0.117)	(0.121)	(0.117)			
Ln(# of foreign subsidiaries)	0.0130***	0.0158***	0.0165***	0.0129***	0.0157***	0.0167***	0.0171***	0.0188***	0.0193***
	(0.00315)	(0.00332)	(0.00318)	(0.00310)	(0.00326)	(0.00314)	(0.00319)	(0.00333)	(0.00320)
Share of 100% owned subsidiaries	0.00426***	0.00560***	0.00521***	0.00428***	0.00564***	0.00534***	0.00472***	0.00578***	0.00545***
	(0.00147)	(0.00147)	(0.00142)	(0.00144)	(0.00144)	(0.00139)	(0.00142)	(0.00142)	(0.00137)
Ln(# of foreign plants)	-0.00133	-0.00458	-0.00712**	-0.00137	-0.00442	-0.00706**	-0.00610*	-0.00826**	-0.0104***
	(0.00347)	(0.00367)	(0.00353)	(0.00340)	(0.00359)	(0.00347)	(0.00349)	(0.00367)	(0.00354)
Ln(# of local headquarters)	-0.0166***	-0.0223***	-0.0188***	-0.0162***	-0.0219***	-0.0184***	-0.0160***	-0.0204***	-0.0172***
	(0.00370)	(0.00400)	(0.00385)	(0.00363)	(0.00392)	(0.00378)	(0.00358)	(0.00387)	(0.00373)
Quarter dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	No	No	No	No	Yes	Yes	Yes
Observations	17,760	17,719	17,689	17,760	17,719	17,689	17,760	17,719	17,689
Report the maeginal effect	Standard errors in parentheses			*** p<0.01, ** p<0.05, * p<0.1					

Table 5-2(b). Probit estimation on the downward revision of the forecast

DATA	Revised forecast data based on exchange rate fluctuation only downward revision due to exchange rate fluctuations								
METHOD	Probit estimation								
VARIABLES	(1) Sales	(2) Ordinary profit	(3) After-tax profit	(4) Sales	(5) Ordinary profit	(6) After-tax profit	(7) Sales	(8) Ordinary profit	(9) After-tax profit
Foreign sales ratio	0.0156***	0.0124**	0.0153***	0.0132***	0.0107**	0.0134***	0.0117**	0.0107**	0.0141***
	(0.00504)	(0.00487)	(0.00464)	(0.00472)	(0.00427)	(0.00417)	(0.00473)	(0.00436)	(0.00423)
Ln(sales)	0.00184**	0.00272***	0.00264***	0.00165**	0.00226***	0.00229***	0.00110	0.00180**	0.00181**
	(0.000854)	(0.000836)	(0.000803)	(0.000794)	(0.000728)	(0.000716)	(0.000809)	(0.000747)	(0.000729)
Actual - Asumed NER (t-1)	0.00318	0.0712***	0.0578***	0.0748	0.0666	0.0866			
	(0.0161)	(0.0148)	(0.0143)	(0.0885)	(0.0803)	(0.0799)			
Ln(# of foreign subsidiaries)	0.00267	0.000538	-0.00159	0.00207	0.000335	-0.00177	0.00145	-0.000144	-0.00184
	(0.00308)	(0.00296)	(0.00288)	(0.00284)	(0.00255)	(0.00254)	(0.00287)	(0.00263)	(0.00261)
Share of 100% owned subsidiaries	0.00162	0.000494	0.000789	0.00143	0.000421	0.000685	0.000951	7.61e-05	0.000476
	(0.00136)	(0.00149)	(0.00133)	(0.00125)	(0.00128)	(0.00117)	(0.00125)	(0.00130)	(0.00117)
Ln(# of foreign plants)	-7.77e-05	0.00552*	0.00736**	0.000349	0.00494*	0.00679**	0.00122	0.00572**	0.00702**
	(0.00347)	(0.00327)	(0.00318)	(0.00319)	(0.00281)	(0.00280)	(0.00322)	(0.00291)	(0.00288)
Ln(# of local headquarters)	-0.00955***	-0.0102***	-0.0120***	-0.00878***	-0.00860***	-0.0104***	-0.00638**	-0.00793***	-0.00934***
	(0.00360)	(0.00322)	(0.00314)	(0.00330)	(0.00276)	(0.00276)	(0.00322)	(0.00272)	(0.00272)
Quarter dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	No	No	No	No	Yes	Yes	Yes
Observations	17,760	17,719	17,689	17,760	17,719	17,689	17,760	17,719	17,689
Report the maeginal effect	Standard errors in parentheses			*** p<0.01, ** p<0.05, * p<0.1					

6. Conclusion

This paper formulates the interaction among invoice currency choice, operational hedging, and foreign exchange exposures. For empirical analysis, this paper uses the earnings forecasts data released by manufacturers listed on the Japanese stock exchange since the data can detect the direct foreign exchange exposure. In summary, the results indicate that firms with more intra-firm exports tend to improve their financial performance more swiftly as the Japanese yen depreciates. In contrast, the performance of firms having production subsidiaries and local headquarters in foreign countries is less likely to fluctuate due to the operational hedging. These results show the choice of invoice currency and operational hedging at the firm level play an important role in a firm's performance. The results are also consistent with the Hutson and Laing's theoretical prediction so that the direct foreign exchange exposure has the inverse U-shape in the degree of operational hedging activity.

We suppose potential originality and contributions of the paper to the literature in the field of international finance and corporate finance are as follows:

First, the paper provides valuable evidence using the corporate financial data regarding the impacts of the historic depreciation of Japanese yen on the Japanese economy, which was controversial and actively debated among researchers and policymakers, as the Japanese yen had experienced the significant and continuous depreciation vis-à-vis major foreign currencies since the first half of FY2022.

Second, the paper relates to a research topic of the impacts of extensive and persistent depreciation of home currency on the economy and its corporate sector, which was previously studied in the context of developing countries that suffered from economic and financial crises. The historic depreciation of the Japanese yen occurs without any crisis; thus, evidence observed during the period provides a valuable opportunity to isolate the pure impacts of significant depreciation of the home currency on the corporate sector.

Third, the paper is the first empirical study using the earnings forecast revision data for Japanese listed firms to estimate direct foreign exchange exposure at the firm level. Superiority of the earnings forecast data over other data, such as a firm's stock price and consolidated financial data, because the performance of firms is directly connected to the factor caused by exchange rate fluctuations.

Finally, the results of the paper show that there exists an inverse U-shape relationship between foreign direct exchange exposure and the degree of operational hedging or firm size, which provides the novel evidence to solve the so-called "foreign exchange exposure puzzle".

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