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Foreign Exchange Liberalization and Exchange Rate Exposure:
Firm-Level Evidence of the Japanese Automobile Industry

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Abstract

This paper empirically examines the effect of the drastic amendment of the Foreign Exchange and Foreign Trade Act (FEFTA) in 1998 on the exchange rate exposure of ten Japanese automobile firms. By conducting panel estimation using the firm-level explanatory variables constructed originally, we find that (1) the degree of automobile firms' exchange rate exposure increased significantly during the post-1998 FEFTA amendment period; (2) however, more profitable automobile firms with higher ROE and facing larger exchange rate volatility could reduce their exposures after the 1998 FEFTA amendment because they could conduct efficient operational hedging through expanding supply chains and more readily utilize efficient hedging instruments to reduce group-wide foreign exchange risk; (3) more sales in and exports to Southeast Asian countries significantly reduced automobile firms' exposures, because they tended to invoice their exports to Southeast Asian countries not in USD but in the yen. Our findings would be insightful for Asian economies that move gradually toward foreign exchange liberalization. Efficient operational and financial hedging, as well as invoice currency choice, significantly affects the degree of exposure after foreign exchange liberalization.

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1. Introduction

This paper empirically investigates the impact of foreign exchange liberalization on the foreign exchange exposure of Japanese automobile firms. In April 1998, the Japanese government drastically amended the Foreign Exchange and Foreign Trade Act (FEFTA), and foreign exchange transactions were liberalized entirely. After the complete liberalization, people expected that Japanese firms would increase yen-invoiced trade transactions and use more efficient hedging instruments to reduce foreign exchange exposure. [1] However, Japanese firms continued to use or even increase U.S. dollar (USD) invoiced transactions after the 1998 FEFTA amendment (Ito *et al.*, 2018). A natural question is whether Japanese firms' exposures increased or decreased in the post-1998 FEFTA amendment period. If their foreign exchange exposure increased after the amendment, what caused such a rise?

Despite its significance, to our knowledge, no previous studies have examined how the 1998 FEFTA amendment affected the degree of foreign exchange exposure of Japanese firms. Our primary objective is to empirically investigate how the firms' exposure changed before and after the 1998 FEFTA amendment and what determines the possible differences in exposure between pre- and post-amendment periods, focusing on ten Japanese automobile firms.

The novelty of our empirical analysis is three-fold. First, we estimate the exchange rate exposure of ten Japanese automobile firms employing a two-factor model with an end-week series of firm stock prices and exchange rates. We use two types of exchange rates: one is the bilateral nominal exchange rate of the Japanese yen vis-à-vis the USD, and the other is the firm-specific nominal effective exchange rates (NEERs) based on the firm-specific trade weights obtained from annual securities reports and various statistics on the automobile industry.

Second, a fixed-effect panel estimation is conducted to demonstrate the impact of the FEFTA amendment on the foreign exchange exposure of the ten automobile firms that were highly export-oriented and built production and sales networks globally, even during the sample period from 1993 to 2004. Our empirical results can potentially have important implications for Asian firms that operate globally but face strict capital controls.

Third, we exploit several firm-specific variables from reports and statistics published by automobile firms, industry associations, and research companies. We carefully checked and scrutinized available statistics and reports published not in English but in Japanese only and not available online. We then constructed firm-level explanatory variables, including firm-specific NEERs that have not been used before.

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[1] For the discussion on whether Japanese firms' trade invoicing behavior was affected by the liberalization of foreign exchange transactions, see, for instance, Fukuda and Ji (1994), Kawai (1996), and Sato (1999).

Our main findings are as follows. (1) The panel estimation demonstrates that the degree of foreign exchange exposure increased in the post-1998 FEFTA amendment period. Even though foreign exchange transactions were completely liberalized, Japanese automobile firms became more subject to exchange rate risk, likely because Japanese firms continued to use or even increased USD invoiced trade. (2) After the 1998 amendment, automobile firms could reduce their foreign exchange exposure if they had higher ROE and faced more firm-specific exchange rate volatility. A more profitable automobile firm with a higher ROE tends to have larger overseas production and sales, which enables the firm to conduct efficient operational hedging in active intra-firm trade between the Japanese head office and overseas subsidiaries. A profitable head office may also readily utilize efficient hedging instruments to reduce group-wide foreign exchange risk. When facing more considerable exchange rate volatility, the firm would make more effort to efficiently manage exchange rate exposure than other firms through various financial and operational hedging techniques. (3) The invoice currency choice significantly affected the automobile firms' exposures. Since Japanese automobile firms tended to invoice their exports to Southeast Asian countries not in USD but in the yen, more sales in and exports to Southeast Asian countries significantly reduced their foreign exchange exposures.

Examining these research questions provides an insightful lesson for Asian economies. Growing currency risk has been a concern for Asian economies that generally choose USD invoicing in their trade. After the Asian financial crisis, capital flow management became one of the vital policy issues for Asian economies (Kawai and Lamberte, 2010). While the effect of capital control differs across countries, several studies illustrate that some emerging countries and most developing countries in Asia keep strict foreign exchange restrictions.[2]

It must also be noted that, whereas strict restrictions are still imposed, Asian countries have moved gradually toward foreign exchange liberalization.[3] It is debatable whether the degree of foreign exchange exposure will increase or decrease if Asian economies finally remove capital controls and completely liberalize their foreign exchange transactions. Our empirical findings on Japanese firms' foreign exchange exposure after the 1998 FEFTA amendment would be insightful for Asian firms that are trade-oriented and need efficient exchange risk management.

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[2] Following Schindler (2009) and Klein (2012), Fernandez et al. (2016) constructed capital control indicators and categorized some Asian countries as "Wall economy," which kept long-standing controls on a broad range of capital transactions. The Chinn-Ito Index (KAOPEN) and the Trilemma Indexes showed that many Asian countries maintained capital controls to the extent that they could keep exchange rate stability (Chinn and Ito, 2006; Aizenman et al., 2008; Aizenman, 2019; Chinn and Ito, 2020).

[3] Intriguingly, the Chinese government actively promoted renminbi (RMB) internationalization to manage currency risk in its foreign trade while maintaining strict capital controls (Eichengreen and Kawai, 2015). While RMB internationalization has gained considerable attention, Ito et al. (2018) and Sato and Shimizu (2018) demonstrated that the RMB has not yet been widely used in intra-Asian trade. Ito (2017) also pointed out that the Chinese government must remove residual foreign exchange restrictions for further RMB internationalization.

The rest of the paper is structured as follows. Section 2 reviews previous studies on exchange exposure and its determinants of Japanese firms and details the background and contents of the FEFTA amendment. Section 3 illustrates our empirical framework and describes the data for empirics. Section 4 presents our empirical results and interpretation. Finally, Section 5 concludes the paper.

2. Foreign Exchange Exposure of Japanese Firms and Industries

2-1. Previous studies on Japanese experience

After the collapse of the Bretton Woods system in the early 1970s, Japan abandoned the fixed exchange rate policy and moved to the floating exchange rate. Since then, Japanese firms operating in global markets have been exposed to large exchange rate movements. Many studies have analyzed Japanese firms' foreign exchange exposure and exchange risk management.

Early research mainly focused on the period when the yen appreciated sharply against the USD, from 360 yen in July 1971 to 79 yen in April 1995. Japanese firms with higher export dependence suffered from the sharp yen appreciation. Most studies demonstrated that Japanese firms with higher export ratios were more negatively affected by yen appreciation (Bodnar and Gentry, 1993; Prasad and Rajan, 1995; Chow and Chen, 1998; Dominguez, 1998; He and Ng, 1998; Doukas *et al*., 2003). He and Ng (1998) also indicated that a firm's hedging needs were important determinants of the exchange rate exposure. They showed that firms with high leverage or low liquidity and smaller sizes tended to have smaller exposures because they had high hedging needs and relied on financial hedges. Although most research examines many industries and firms, Williamson (2001) focused on the exchange rate exposure and its determinants of automotive firms in the United States and Japan. Using the firms' market share and considering the market competition in each destination market, the paper showed that domestic competition from foreign firms was an important determinant of exposure. It also indicated that foreign sales ratio and market competition were major determinants of exposure, and overseas production decreased the foreign exchange exposure.

The choice of invoice currency is regarded as a hedging tool and likely affects firms' foreign exchange exposures. For example, producer's currency invoicing (i.e., yen invoicing for Japanese firms) can mitigate foreign exchange risk arising from exports and imports. However, the effect of invoice currency choice has rarely been considered in the literature because the information on the firm-level invoice currency choice is hard to obtain. One of the exceptions is Ito *et al*. (2016), who empirically investigated the extent to which invoice currency choice affects firms' exposures: (1) The higher the USD invoicing share, the greater the foreign exchange

exposure was, which could be reduced by both financial and operational hedging. (2) Yen invoicing reduces foreign exchange exposure.

2-2. Foreign exchange liberalization in April 1998

While there have been many studies on foreign exchange exposure, as surveyed above, the literature thoroughly overlooks whether and how foreign exchange liberalization affected the firms' exchange rate risk management.

The FEFTA, enacted in December 1949, strictly regulated foreign exchange transactions among private sectors in Japan. Since the 1950s, the government gradually removed foreign exchange restrictions. However, all foreign exchange operations continued to be concentrated on authorized foreign exchange banks. In April 1998, the FEFTA was drastically amended, accomplishing Japanese foreign exchange liberalization. [4] This amendment enabled direct transactions of foreign currencies between firms without transacting with banks. The following changes need to be noted, as they could facilitate the exchange risk management of Japanese firms.

(1) Japanese firms could perform multilateral netting among their group companies.
(2) Japanese firms could make a foreign currency payment for imports by using foreign currency earned by exports (exchange "marry," i.e., offsetting claims and debts relating to foreign exchange transactions).
(3) Japanese firms could settle through overseas bank deposits in foreign currency. The treasury center managed their group companies' funds centrally and efficiently (pooling transactions).

Our primary objective is to investigate whether the amendment of the FEFTA enabled Japanese firms to reduce foreign exchange exposures arising from exchange rate fluctuations (Figure 1). To our knowledge, this issue has not been sufficiently examined. In the following sections, we investigate how the firms' exposure changed before and after the 1998 amendment and what factors affected the degree of exposure, focusing on Japanese automobile firms.

<Insert Figure 1 around here>

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[4] The amendment of the FEFTA was a vital financial reform project called the "Financial Big Bang." In November 1996, Prime Minister Ryutaro Hashimoto advocated the drastic deregulatory plan to restore the status of the Tokyo financial market and the yen. The project, which started in April 1998, sought to make the Japanese financial system free, fair, and global.

3. Empirical Method and Data

3-1. Two-Factor Model

It is widely believed that unexpected changes in exchange rates influence firms' current and future expected cash flows. Dumas (1978), Hodder (1982), and Adler and Dumas (1984) define exchange rate exposure as the sensitivity of the market value of the firm to unanticipated exchange rate movements. Following this definition, the exchange rate exposure is measured by the degree of response of stock returns to exchange rate returns. A two-factor model is generally chosen to estimate foreign exchange exposures (see, among others, Jorion, 1990; Bodnar and Gentry, 1993; Prasad and Rajan, 1995; Dominguez and Tesar, 2006; Ito *et al*., 2016; Thorbecke, 2021; and Thorbecke *et al*. 2022).

$$\Delta r_t = \beta_0 + \beta_1 \Delta s_t + \beta_2 \Delta r_t^m + \varepsilon_t \tag{1}$$

where r_t denotes the natural log of individual firms' stock prices, s_t the natural log of the home currency's exchange rate against the foreign currency, r_t^m the market portfolio, ε_t an error term, and Δ the first-difference operator. The market portfolio, r_t^m, is included in equation (1) to control the market-wide effect of macroeconomic factors.[5] Our primary interest is β_1 that measures the degree of foreign exchange exposures.

While previous studies tend to analyze many firms for estimation to avoid sample selection bias, we focus on ten Japanese firms that manufacture and export finished automobiles.[6] Previous research unanimously demonstrated that the extent of firms' foreign activities, such as exports and foreign sales, was one of the critical determinants of exchange rate exposure. The automobile firms we chose operated globally and were heavily influenced by exchange rate fluctuations during our sample period that spans from January 1993 to December 2004, i.e., before and after the amendment of the FEFTA in 1998.

The end-week stock prices of ten automobile firms and the Tokyo Stock Price Index (TOPIX) are collected from the TOYO KEIZAI Stock Price Database. We construct weekly stock returns by taking log differences of weekly series from January 8, 1993, to December 31, 2004. We use the TOPIX for the market portfolio variable.[7]

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[5] The most straightforward approach to measure exchange rate exposure is a single-factor model that includes only exchange rate returns as an explanatory variable. See Dumas (1978), Hodder (1982), and Adler and Dumas (1984).

[6] Our sample firms are Nissan, Isuzu, Toyota, Hino, Mitsubishi, Mazda, Daihatsu, Honda, Suzuki, and Fuji.

[7] Ito *et al*. (2016) indicated that a strong correlation between the TOPIX and the Yen/Doller rate caused the multicollinearity problem. Bodnar and Wong (2003) also pointed out that the market portfolio variable strongly influenced the results, sometimes putting a downward bias on the coefficient and lowering the

Bilateral nominal exchange rates and NEERs are generally used in the literature on foreign exchange exposures. We also use the weekly bilateral nominal exchange rate of the yen vis-à-vis the USD (henceforth, Yen/USD NER) and the weekly yen's NEER. Instead of using the conventional NEER published by the Bank for International Settlements (BIS) and other international institutions, we uniquely construct the weekly *firm-specific* NEER of the yen.

Specifically, we use a firm-specific weight for the geometric weighted average of the bilateral nominal exchange rates against the partner country's currencies.[8] As the firm-specific weight, we calculate the firm's sales ratio in a partner country to its total world sales for each sample year. The annual sales data for each automobile firm is obtained from *World Motor Vehicle Statistics* published by the Japan Automotive Manufacturers Association. We take the three-year moving average value for the firm-specific NEER to smooth out unusual fluctuations arising from large annual changes in the firm's sales ratio. Our firm-specific NEER enables us to consider the exchange rate effects that are unique to each firm. Unlike conventional NEERs, an increase (decrease) in our firm-specific NEER is defined as yen depreciation (appreciation). For both the Yen/USD NER and firm-specific NEER, the expected sign of β is positive in equation (1) if the firms' stock return responds positively to the exchange rate return, implying significantly positive exposure.

3-2. The determinants of the exchange rate exposure

After estimating the exchange rate exposure of individual firms, we conduct panel estimation to investigate the determinants of the firms' exchange rate exposure. Following previous studies such as He and Ng (1998) and Ito *et al*. (2016), we employ a fixed effect model to explore what determines the foreign exchange exposures of Japanese automobile firms.

$$\hat{\beta}_{it} = \delta X_{it} + \alpha_i + \alpha_t + u_{it} \qquad (2)$$

where $\hat{\beta}_{it}$ denotes estimated exposures for firm *i* at time *t* obtained from equation (1). X_{it} is a vector of firm-specific explanatory variables. α_i and α_t denote, respectively, cross-section and time-fixed effects. u_{it} denotes an error term. Using the two-factor model, equation (1), we obtain two types of estimated exposures, $\hat{\beta}_{it}$: one is obtained from the Yen/USD NER, and the

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significance level. We also tried to estimate a single-factor model to consider possible multicollinearity, and the estimated results showed that most estimated coefficients were largely positive, often larger than unity, and strongly statistically significant (the results are available upon request). Even though the number of statistically significant coefficients for foreign exchange exposure is smaller in the two-factor model, we emphasize the need to control the market-wide effect of macroeconomic factors to estimate individual firms' exposures.

[8] The yen's weekly bilateral nominal exchange rate vis-à-vis the partner country's currency is obtained from the Pacific Exchange Rate Service (https://fx.sauder.ubc.ca/fxdata.php).

other is from the firm-specific yen's NEER. We perform panel estimation for each of these two estimated exposures.

3-2-A. Firm-specific Explanatory Variables

The firm-specific explanatory variables that are annual series are collected from the published databases: annual securities reports (YUHO) of ten automobile firms, statistics published by automobile industry associations (the Japan Automotive Manufacturers Association and the Automobile Business Association of Japan), and the statistics published by the Fourin Inc., a Japanese research company regarding the automobile industry. These data sources are primarily published in Japanese and are not easily accessible to non-Japanese researchers. Thus, some of our firm-specific variables listed below have rarely been used in previous studies.

Export, Foreign Production, and Foreign Sales Ratios: Previous research unanimously supports that the degree of foreign sales positively affects the exchange rate exposure. We separately include each sample firm's export, foreign production, or foreign sales ratio for panel estimation. (i) "Export Ratio" is defined as the number of finished automobile exports divided by the number of domestic productions of finished automobiles. The data is collected from *Automotive Yearbook* published by the Automobile Business Association of Japan. (ii) "Foreign Production Ratio" is defined as the number of foreign productions of finished automobiles divided by the number of corresponding total (domestic and foreign) productions. The data is obtained from *Global Automotive Statistics* and *Global Automotive Manufacturers Yearbook* published by Fourin Inc. (iii) "Foreign Sales Ratio" is defined as the foreign sales amounts of finished automobiles divided by the corresponding total (domestic and foreign) sales amounts. The data is collected from ten sample firms' annual securities reports (YUHO).

Sales Ratio in the U.S. and Asia: We also use two more sales ratios: one is the "U.S. Sales Ratio," which is defined as the sales amounts of finished automobiles in the U.S. divided by the total (domestic and foreign) sales amounts of finished automobiles; and the other is the "Asia Sales Ratio," which is defined as the sales amounts of finished automobiles in Asia divided by the total (domestic and foreign) sales amounts of finished automobiles. Asia includes Singapore, Malaysia, Indonesia, the Philippines, and Thailand. [9] As shown below, the choice of invoice currency differs markedly between Japanese exports of finished automobiles to the U.S. and Asia. Thus, the two sales ratios likely capture different effects of the invoice currency choice. The data is collected from *World Motor Vehicle Statistics* published by the Japan Automotive

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[9] We considered just five Southeast Asian countries to construct the "Asia Sales Ratio," which is due to the data limitation: we could collect the country-specific sales amounts only for the five countries from the Asian region. However, the small number of Southeast Asian countries conforms to the destination-specific invoice currency data as discussed in Section 3-2-C and Table 1 below.

Manufacturers Association.

ROE: We include return on equity (ROE) for estimation, which represents each firm's profitability and competitiveness. ROE is defined as the ratio of current net income to equity capital. The data is collected from ten sample firms' annual securities reports (YUHO).

Firm-specific NEER volatility: The volatility of firm-specific NEER is also included to examine how each automobile firm responds to exchange rate fluctuations. To measure the volatility of firm-specific NEER, we use the standard deviation of the change of firm-specific NEER.

FEFTA amendment dummy: To examine the effect of the FEFTA amendment, we set up an FEFTA amendment dummy that takes one from 1999 to 2004; otherwise, zero. We also include interaction terms of the FEFTA amendment dummy with other explanatory variables.

3-2-B. Firm's Foreign Exchange Hedging

Multinational firms can mitigate the currency risk by combining some hedging instruments such as financial hedges (financial derivatives and foreign currency debt) and operational hedges (overseas production, exchange marry, and netting). Almost all previous studies presume that hedges are the essential instruments to reduce exchange rate exposure (see Pantzalis *et al*., 2001; Allayannis *et al*., 2001; Bartram, 2008; Bartram *et al*., 2010; Kuzmina and Kuznetsova, 2018).

Since Japanese firms are not obliged to disclose the details of their hedging activities, previous research has hardly quantified their use of derivatives.[10] Ito *et al*. (2016) constructed dummy variables on financial and operational hedges using the questionnaire survey data of 227 Japanese listed firms conducted in 2009. They found that Japanese firms' hedging strategies reduced their exchange rate exposure. We scrutinized ten automobile firms' annual securities reports (YUHO). We found that all firms conducted financial hedging during the sample period, which indicates that a financial hedging dummy does not work for a panel estimation. Instead, the FEFTA amendment dummy captures the likely effects of the foreign exchange liberalization on financial hedging explained in Section 2-2. The FEFTA amendment enabled operational hedging, such as exchange marry and netting, which indicates that the FEFTA amendment dummy likely captures the impact of operational hedging as well.

In the panel analysis below, we assume that the firms' hedging activities are measured

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[10] Previous studies used a proxy variable for firms' derivative incentives. Chow and Chen (1998) used firm size, leverage, and growth opportunity as a proxy for hedging incentives. He and Ng (1998) found evidence that Japanese firms with high financial leverage, weak short-term liquidity position, and tighter financial constraints, like small non-keiretsu firms, had more incentive to hedge and, hence, had smaller exchange rate exposure.

as the coefficients of two interaction terms. First, since the FEFTA amendment enabled Japanese firms to manage exchange rate risk more efficiently than ever, firms facing higher exchange rate volatility were more likely to hedge foreign exchange risk efficiently to reduce their exposures. Second, firms with higher ROE are likely to have various hedging tools after the FEFTA amendment, which results in lower exchange rate exposures.

3-2-C. Effect of Invoice Currency Choice

Invoice currency choice affects the degree of firms' foreign exchange exposures. Since Japanese firms do not disclose the choice of invoice currency in their exports and imports, collecting data on firm-level invoice currency choice is usually very difficult, which prevents us from analyzing the possible effect of currency invoicing on firms' foreign exchange exposures. [11] We cannot obtain information on the choice of invoice currency by the ten Japanese automobile firms. However, we can indirectly consider the effect of currency invoicing on the firms' foreign exchange exposures.

<Insert Table 1 around here>

Table 1 presents the share of both yen and USD invoicing for Japanese exports and imports by destination, source country/region, and industry as of March 1998. Intriguingly, focusing on exports of passenger motor cars, a marked difference is observed in invoice currency choice between the United States and Southeast Asia (Table 1-A). Specifically, the USD invoicing share was 86.4% in exports to the United States, while the yen invoicing share was 87.7% in exports to Southeast Asia. [12] Thus, the larger the U.S. Sales Ratio, the higher the USD invoicing share is. In this case, Japanese firms' foreign exchange exposure will be growing. In contrast, the larger the Asia Sales Ratio, the higher the yen invoicing share is, indicating that Japanese firms' exposure will decline.

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[11] One exception is Ito *et al*. (2016) who showed that USD invoicing (yen invoicing) significantly increased (decreased) firms' foreign exchange exposures by using the data obtained from the questionnaire survey with Japanese listed firms conducted in 2009.

[12] See Sato (1999), Table 8 that showed that the yen invoicing share of Japanese passenger motor car exports to Southeast Asia was 66.1%–87.7% from March 1994 to March 1998. Ito *et al*. (2012) also revealed that the share of Japanese firms' automobile exports to Asia was 65.6% in their interview research period from 2007 to 2008. According to Table 1-B, the similar invoicing pattern can be observed in Japanese imports as of March 1998. Specifically, the USD invoicing share was 73.9% in Japanese imports of motor vehicles from the United States, while the yen invoicing share was 90.5% in Japanese motor vehicle imports from Southeast Asia.

4. Empirical Results

4-1. Estimated foreign exchange exposures of Japanese automobile firms

We estimated a two-factor model for each sample year, i.e., Equation (1). The estimated foreign exchange exposures obtained from the Yen/USD NER (henceforth, USD exposures) and those obtained from the firm-specific NEER (henceforth, firm-NEER exposures) are presented in Panels 1 and 2 of Table 2, respectively. [13]

<Insert Table 2 around here>

First, the estimated USD exposures tend to vary over the sample period (Panel 1 of Table 2). Dividing the whole sample period into two sub-samples, the estimated USD exposures increased from the pre-amendment period (1993–1998) to the post-amendment period (1999–2004). [14] If we calculate the percentage of statistically significant exposures, it rises from 16.7% in the pre-amendment to 45.0% in the post-amendment period. This result suggests that Japanese automobile firms increased their exposure after the FEFTA amendment.

Second, turning to the estimates of firm-NEER exposures, we observe a moderate increase in statistically significant exposures, which are somewhat smaller than that of USD exposures (Panel 2 of Table 2). This difference between USD and firm-NEER exposures may be ascribed to Japanese automobile firms' choice of invoice currency. Specifically, Japanese firms tended to invoice their exports not in the yen but in USD (Fukuda and Ji, 1994; Kawai, 1996; Sato, 1999), which suggests that the Yen/USD NER will better estimate Japanese firms' exposure.

4-2. Determinants of Foreign Exchange Exposures

4-2-A. Determinants of USD Exposure: Overseas Operation and Exports

We conducted a fixed-effect panel estimation to investigate what determines the USD exposures (Tables 3 and 4).

<Insert Table 3 around here>

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[13] Descriptive statistics of all variables for estimation are presented in Appendix Table A1.
[14] Table 2 shows several negative estimates of exposures, which are often observed in previous studies such as He and Ng (1998) and Bartram *et al*. (2010).

First, neither Export Ratio, Foreign Production Ratio, nor Foreign Sales Ratio indicates statistically significant coefficients for all columns from (1) to (15) in Table 3. This result does not change even if year-fixed effects or the FEFTA amendment dummy is included. Since these three variables measure the degree of firms' overseas activities, including overseas sales, production, and exports, we may say that Japanese automobile firms' USD exposures were not significantly affected by their active overseas operations and exports.

Second, the estimated coefficient of ROE is always positive and statistically significant for all columns (1) – (15) in Table 3, irrespective of whether including either year-fixed effects or the FEFTA amendment dummy. ROE typically reflects the profitability of sample firms. Although the Export Ratio, Foreign Production Ratio, or Foreign Sales Ratio does not affect the firms' USD exposures, Japanese automobile firms with higher ROE were more profitable and likely to be export-oriented, which raises their foreign exchange exposures, especially when they invoice their exports in USD or importer's currency.

Third, to allow for the possible effect of the 1998 FEFTA amendment on exposures, we include a dummy for the post-amendment that takes one from 1999 to 2004 and otherwise zero. The dummy variable exhibits a positive and statistically significant effect on firms' exposure in columns (7) – (15) of Table 3 while keeping the estimated coefficients of ROE significantly positive. The results suggest that firms' foreign exchange exposure increased after the 1998 FEFTA amendment, which conforms to the increase in firms' USD exposure during the post-amendment period from 1999 to 2003 (Table 2)

Fourth, when including an interaction term between ROE and the FEFTA amendment dummy, the interaction term indicates negative and statistically significant while keeping coefficients of both ROE and the FEFTA amendment dummy significantly positive in columns (10) – (12) of Table 3. This result suggests that while ROE increased their USD exposure, Japanese automobile firms with higher ROE were likely to lower the degree of exposure during the post-amendment period. After the 1998 FEFTA amendment, there was no restriction for Japanese firms on financial and operational hedging. Thus, we may interpret that more profitable firms could easily access financial hedging instruments and conduct operational hedging by expanding global supply chains, which likely reduced their exposures.

Fifth, when an interaction term of the firm-NEER volatility is included with the FEFTA amendment dummy, the interaction term becomes negative and statistically significant. In contrast, the firm-NEER volatility variable remains insignificant, keeping the 1998 FEFTA amendment dummy significantly positive in columns (13) – (15) of Table 3. This result suggests that Japanese automobile firms facing considerable exchange rate volatility could utilize financial and operational hedging during the post-amendment period to decrease the USD exposures.

4-2-B. Determinants of USD Exposure: Sales Ratio in the U.S. or Asia

Table 4 presents the results when we include either the U.S. Sales Ratio or Asia Sales Ratio as an alternative to the Export Ratio, Foreign Production Ratio, or Foreign Sales Ratio. The U.S. Sales Ratio coefficient is positive and statistically significant for almost all cases, implying that the more extensive their sales dependence on the United States, the greater the Japanese firms' USD exposures are. In contrast, the Asia Sales Ratio coefficient is always statistically insignificant, keeping the sign and significance level of other variables' coefficients the same as in Table 3.

<Insert Table 4 around here>

In column (11) of Table 4, we include an interaction term between the U.S. Sales Ratio and the FEFTA amendment dummy. Whereas the U.S. Sales Ratio becomes insignificant, the interaction term becomes positive and statistically significant. As discussed in Section 3-2-C, since Japanese automobile exports tend to be invoiced in USD, the USD exposures increased when the automobile firms depended more on the U.S. market for their sales and exports. [15]

More intriguingly, in column (12) of Table 4, an interaction term of Asia Sales Ratio with the FEFTA amendment dummy becomes negative and statistically significant, keeping the FEFTA amendment dummy positive and statistically significant. Although the FEFTA amendment enlarged the USD exposures, a more extensive sales and export dependence on Asian markets reduced the USD exposures because Japanese exports to Asian countries were generally invoiced in the yen, as shown in Section 3-2-C.

4-2-C. Determinants of Firm-NEER Exposures

Tables 5 and 6 present the results of determinants of firm-NEER exposures. As shown in Table 2, an increase in exposures after the FEFTA amendment becomes less evident if firm-NEER exposures are evaluated.

In columns (1) – (6) of Table 5, where both cross-section and year-fixed effects are included for estimation, the coefficients of all explanatory variables are not statistically significant. When including not the year-fixed effects but the FEFTA amendment dummy, the Export Ratio, Foreign Production Ratio, and Foreign Sales Ratio become positive and statistically significant in columns (7) – (15) of Table 5. However, ROE is not always statistically significant, and the FEFTA dummy becomes insignificant when the Foreign Sales Ratio is included to allow for firms'

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[15] The data on sales amounts in the United States include both local sales in the U.S. market and Japanese exports to the United States.

sales and export dependence on foreign markets.

<Insert Table 5 around here>

Table 6 presents the estimated results when including either the U.S. Sales Ratio or the Asia Sales Ratio to consider the likely effect of invoice currency choice. Contrary to our discussion in Section 3-2-C, when including both cross-section and time-fixed effects, the Asia Sales Ratio becomes positive and statistically significant in columns (2) and (4) of Table 6, while there are no significant results in columns (1) and (3).

<Insert Table 6 around here>

When including not the time-fixed effects but the FEFTA amendment dummy, the U.S. Sales Ratio becomes negative and statistically significant in columns (5), (9), and (11) of Table 6, while no significant coefficients are found for the Asia Sales Ratio. In column (11), while the U.S. Sales Ratio is significantly negative, an interaction term of the U.S. Sales Ratio with the FEFTA amendment dummy becomes positive and statistically significant. This implies that the Japanese firms' exposures increased when their sales and exports depended more on the U.S. markets.

The estimated results using the firm-NEER exposures are contrary to what we found from the estimated results using the USD NEER. We attempted to construct the NEER unique to each sample firm to allow for different dependence of the firms' sales and exports on respective countries. However, it may be more important to consider the choice of invoice currency in evaluating the degree of exposure by the two-factor model. Since the USD is primarily used in Japanese automobile exports, the USD exposures are more appropriate for the determinant analysis.

5. Concluding Remarks

Japanese firms have been exposed to substantial exchange rate fluctuations for over 50 years, and efficient foreign exchange risk management has been their central concern. In April 1998, the Japanese government drastically amended the FEFTA, and foreign exchange transactions were liberalized entirely. While the amendment enabled Japanese firms to conduct efficient foreign exchange risk management, we have revealed that their foreign exchange exposure increased after 1998, i.e., in the post-FEFTA amendment period. Even though foreign exchange transactions were completely liberalized, Japanese automobile firms became more

subject to exchange rate risk. This is contrary to what the government aimed for by implementing the FEFTA amendment.

The panel estimation results have demonstrated that the automobile firms' exposures increased during the post-1998 FEFTA amendment, especially when firms' exposures are evaluated by the USD. Automobile firms' exports, overseas production, and foreign sales ratios do not influence their USD exposures. More profitable automobile firms with higher ROE tend to have larger overseas production and sales, which enables the firm to conduct efficient operational hedging after the amendment through active intra-firm trade between the Japanese head office and overseas subsidiaries. A profitable head office may also be able to more readily utilize efficient hedging instruments after the amendment to reduce group-wide foreign exchange risk. When facing larger exchange rate volatility, the firm would make more effort to efficiently manage exchange rate exposure than other firms through various financial hedging techniques and operational hedging that could be used after the amendment. Moreover, the invoice currency choice significantly affected the automobile firms' USD exposures. Since Japanese automobile firms tended to invoice their exports to Southeast Asian countries not in USD but in the yen, more sales in and exports to Southeast Asian countries significantly reduced their USD exposures.

Local currency invoiced trade has been recently promoted by policy coordination among ASEAN economies (Sato, 2019), and the share of local currency invoiced trade has been growing in intra-firm trade between Japan and Asian economies (Ito *et al*., 2019; 2021). Whereas foreign exchange restrictions are still imposed, Asian economies are gradually deregulating foreign exchange transactions. Our empirical findings suggest that foreign exchange liberalization would not necessarily reduce firms' foreign exchange exposure, which likely depends on firms' invoicing behavior and financial/operational hedging strategies. To reduce their exposures to exchange rate volatility, it is necessary for firms to have efficient exchange risk management by utilizing financial hedging instruments and operational hedging along increasing regional supply chains.

Data Appendix

This study's notable contribution is constructing the firm-specific variables of ten Japanese automobile firms as elaborated in Section 3. This appendix shows the details of the data source. We obtained firm-level information from the following data sources:

- Annual securities report (YUHO) of the 10 firms from FY1992 to FY2004: Nissan (7201), Isuzu (7202), Toyota (7203), Hino (7205), Mitsubishi (7211), Mazda (7261), Daihatsu

(7262), Honda (7267), Suzuki (7269), and Fuji (7270), where four-digit ticker symbols are in parenthesis.

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- World Motor Vehicle Statistics, 1994-2006, Japan Automotive Manufacturers Association.

Appendix Table A1. Descriptive Statistics of Variables for Panel Estimation

Variables:	NOBS	Mean	Std. Dev.	Min	Max
USD Exposure	120	0.531	0.681	-0.966	2.901
Firm-NEER Exposure	120	0.229	0.377	-0.560	1.225
Export Ratio	120	0.422	0.160	0.103	0.786
Foreign Production Ratio	110	0.367	0.134	0.094	0.609
Foreign Sales Ratio	114	0.399	0.178	0.100	0.771
ROE	120	-0.042	0.368	-2.481	0.256
Firm-NEER Volatility	120	0.045	0.027	0.014	0.173
U.S. Sales Ratio	120	0.264	0.159	0.000	0.595
Asia Sales Ratio	120	0.284	0.264	0.000	0.907

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Figure 1. Nominal Exchange Rate of the Yen vis-à-vis the U.S. Dollar
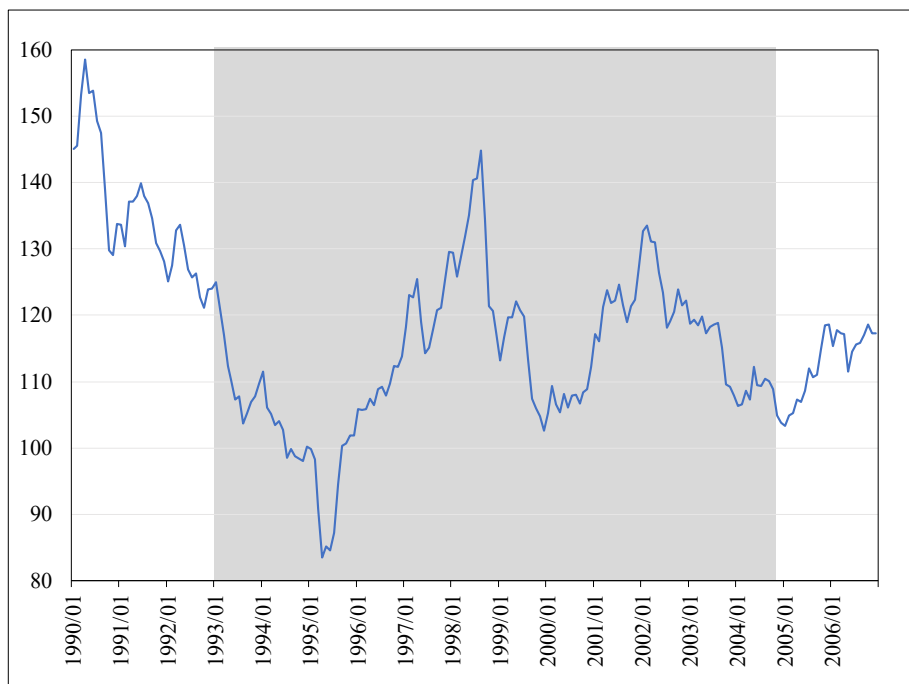
Note: The data is the monthly average of the yen's nominal exchange rate vis-à-vis the U.S. dollar in the
　　Tokyo market from January 1990 to December 2006. Our sample period from January 1993 to
　　December 2004 is shaded in grey.

Source: Bank of Japan, BOJ Time-Series Data Search (https://www.stat-search.boj.or.jp/index_en.html).

Table 1. Invoice Currency Share in Japanese Exports and Imports: March 1998 (%)

A. Invoice Currency Share in Japanese Exports

	To World		To the United States		To EU		To Southeast Asia	
	Yen	USD	Yen	USD	Yen	USD	Yen	USD
All Commodities	36.0	51.2	15.7	84.1	34.9	13.2	48.4	48.7
Food Stuff	52.7	42.9	17.6	82.4	37.9	21.1	59.2	35.6
Textiles	35.7	59.0	16.3	83.3	59.8	8.8	28.2	70.8
Chemicals	29.7	61.5	29.0	70.5	38.3	20.4	29.8	68.5
Non-Metallic Mineral Manuf.	41.8	50.9	18.4	81.3	40.7	11.6	53.1	43.1
Metal Products	21.3	74.3	11.2	88.8	34.2	31.2	23.2	76.2
General Machinery	38.1	50.2	17.7	82.1	32.6	22.9	59.7	37.7
Electric Machinery	32.4	55.6	13.6	86.4	37.4	9.7	42.7	53.4
IC (Integrated Circuits)	21.4	68.9	9.3	90.5	16.2	15.9	26.7	70.8
Telecom Equipment	24.8	59.2	10.8	89.2	38.0	6.1	34.0	48.6
Transport Equipment	43.4	40.4	12.6	87.4	36.9	3.6	81.3	15.4
Passenger Motor Cars	37.6	40.7	13.6	86.4	37.8	0.1	87.7	2.6
Parts of Motor Vehicles	39.3	53.8	12.4	87.6	51.2	0.1	81.1	17.8
Precision Instruments	37.1	45.6	20.9	78.9	34.5	6.2	61.5	37.1
Others	27.2	55.6	16.6	83.2	23.8	13.0	40.3	54.9

B. Invoice Currency Share in Japanese Imports

	From World		From the United States		From EU		From Southeast Asia	
	Yen	USD	Yen	USD	Yen	USD	Yen	USD
All Commodities	21.8	71.5	16.9	83.0	44.3	14.3	26.7	71.6
Food Stuff	27.4	66.7	21.4	78.6	31.7	19.0	30.7	68.8
Raw Materials	6.8	91.3	1.2	98.7	27.6	53.0	14.8	84.6
Mineral Fuels	1.3	98.6	4.5	95.5	38.0	42.8	1.0	98.7
Crude Oil	0.5	99.3	0.0	100.0	-	-	4.6	93.3
Petroleum Products	0.9	98.9	1.7	98.3	29.8	52.7	1.0	99.0
Manufacturing Goods	28.2	62.2	16.9	83.0	46.5	12.3	33.7	63.9
Chemicals	32.1	61.2	14.8	85.1	76.8	7.6	22.8	71.5
Textiles	18.5	72.5	11.1	88.6	41.8	6.0	16.6	82.0
Metals	27.2	69.7	14.4	85.6	35.1	43.1	51.6	46.9
Machinery & Equipment	31.2	57.3	19.8	80.3	35.2	10.1	37.7	60.1
Office Machinery	31.9	65.4	32.6	67.3	16.5	62.1	34.9	63.1
Semiconductors, etc.	51.6	47.4	23.2	76.8	44.4	32.1	54.3	45.6
Motor Vehicles	43.0	14.2	26.0	73.9	45.7	0.2	90.5	7.6
Others	20.8	67.4	14.7	85.2	31.0	15.3	24.5	72.7

Note: Southeast Asia includes the following 22 economies: Korea, Taiwan, Hong Kong, Singapore, Indonesia, Malaysia, the Philippines, Thailand, Brunei, Cambodia, Laos, Myanmar, India, Pakistan, Sri Lanka, Maldives, Bangladesh, East Timor, Macao, Afghanistan, Nepal, and Bhutan.

Source: Ministry of International Trade and Industry (MITI), *Yushitsu (Yunyu) Kessai Tsukadate Doko Chosa* (Export and Import Settlement Currency Invoicing).

Table 2. Estimated Foreign Exchange Exposures

	1. Estimated Foreign Exchange Exposure (Bilateral Nominal Exchange Rate of the Yen vis-à-vis the U.S. Dollar)												**Mean of Estimated Exposure**		
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1993–2014	1993–98	1999–2004
Nissan (7201)	0.65	-0.37	0.41	0.36	0.45	-0.31	0.44	0.13	2.38 **	1.50 ***	0.63	0.75 **	0.58	0.20	0.97
Isuzu (7202)	0.62	0.15	0.38	-0.22	0.05	-0.28	0.31	0.37	1.39	-0.22	-0.19	0.49	0.24	0.12	0.36
Toyota (7203)	0.14	-0.24	0.09	0.25	1.20 ***	0.39 *	0.37	-0.30	1.31 **	0.64 **	0.85 *	1.05 ***	0.48	0.31	0.65
Hino (7205)	0.37	-0.04	-0.07	-0.26	0.42	-0.68	0.45	-0.70	0.52	0.19	-0.12	0.40	0.04	-0.04	0.12
Mitsubishi (7211)	0.42	0.30	0.16	0.39	-0.43	-0.16	0.94	-0.77	0.86	1.85 ***	-0.03	-0.56	0.25	0.11	0.38
Mazda (7261)	0.37	0.06	0.46	0.50	0.76	0.48	1.30 **	0.46	2.90 ***	1.57 **	0.15	0.89 ***	0.82	0.44	1.21
Daihatsu (7262)	0.13	-0.97 ***	-0.09	0.69	0.37	0.41	1.16 **	0.32	0.44	1.02 ***	0.35	0.46	0.36	0.09	0.63
Honda (7267)	0.54	0.76 ***	0.27	1.41 **	1.50 ***	0.91 **	0.31	1.72 **	1.95 **	1.02 **	0.99 **	1.16 ***	1.05	0.90	1.19
Suzuki (7269)	0.48	0.35	0.07	0.82	0.34	0.34	0.81 *	2.40 **	1.84 **	0.64 **	0.06	0.76 **	0.74	0.40	1.08
Fuji (7270)	0.19	-0.75 **	0.45 *	0.42	0.40	1.11 ***	0.78	0.71	2.26 ***	1.61 ***	0.67	1.19 ***	0.75	0.30	1.20
	2. Estimated Foreign Exchange Exposure (Firm-Specific Nominal Effective Exchange Rate)												**Mean of Estimated Exposure**		
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1993–2014	1993-98	1999-2004
Nissan (7201)	0.31	0.18	-0.13	0.23	0.66	-0.08	1.04 *	0.67	1.22 *	0.50	0.81 *	0.90 **	0.53	0.20	0.86
Isuzu (7202)	0.36	-0.26 ***	-0.12	-0.01	0.08	-0.12	0.05	0.23	0.05	0.04	-0.30	1.01	0.08	-0.01	0.18
Toyota (7203)	0.68 ***	-0.12	-0.05	0.00	0.07	0.43 **	-0.02	0.01	0.03	-0.01	0.30	0.83 ***	0.18	0.17	0.19
Hino (7205)	0.96 **	-0.45 **	-0.03	-0.16	-0.09	-0.54 ***	0.08	-0.05	0.01	0.10	0.02	0.23	0.01	-0.05	0.07
Mitsubishi (7211)	0.37	0.27 **	0.03	0.04	0.03	-0.17	0.19	0.27	0.12	0.39	0.01	0.28	0.15	0.09	0.21
Mazda (7261)	-0.17	0.59	0.73 *	0.09	0.47	0.39	1.07 **	0.11	0.98	0.71	0.01	0.79 **	0.48	0.35	0.61
Daihatsu (7262)	0.26	-0.30 ***	0.01	0.00	0.03	0.23	-0.04	-0.01	0.01	0.07	0.03	0.44	0.06	0.04	0.08
Honda (7267)	0.95 ***	0.08	0.03	-0.07	0.40	1.23 ***	0.28	0.28	1.51 **	0.49 *	0.08	1.13 ***	0.53	0.44	0.63
Suzuki (7269)	0.11	-0.11	0.00	-0.04	-0.05	0.05	0.07	0.56 **	0.23	-0.06	0.31	0.42	0.12	-0.01	0.26
Fuji (7270)	-0.13	-0.31	0.00	0.29	0.28	0.86 ***	0.74 *	-0.02	0.97 *	0.73 *	0.15	0.86 **	0.37	0.16	0.57

Note: The estimated coefficients of Equation (1), i.e., estimated foreign exchange exposures, are presented. Triple (***), double (**), and single (*) asterisk(s) denote one percent, five percent, and ten percent significance levels, respectively. The first column shows the sample firms with their four-digit ticker symbols in parenthesis.

Source: Authors' estimation.

Table 3. Determinants of Foreign Exchange Exposures (USD Exposures)

VARIABLES	(1) USD Exposure	(2) USD Exposure	(3) USD Exposure	(4) USD Exposure	(5) USD Exposure	(6) USD Exposure	(7) USD Exposure	(8) USD Exposure	(9) USD Exposure	(10) USD Exposure	(11) USD Exposure	(12) USD Exposure	(13) USD Exposure	(14) USD Exposure	(15) USD Exposure
Export Ratio	0.985			0.994			0.884			1.014			0.588		
	(0.682)			(0.693)			(0.708)			(0.750)			(0.719)		
Foreign Production Ratio		0.961			0.958			0.340			0.214			-0.290	
		(1.310)			(1.339)			(1.146)			(0.946)			(1.306)	
Foreign Sales Ratio			-0.465			-0.469			0.259			-0.135			-0.206
			(0.689)			(0.690)			(0.677)			(0.762)			(0.715)
ROE	0.466***	0.416***	0.422***	0.468***	0.416***	0.421***	0.532***	0.469***	0.512***	2.874**	2.509**	4.423***	0.513***	0.455***	0.487***
	-0.0466	(0.0335)	(0.0384)	(0.0494)	(0.0358)	(0.0403)	(0.106)	(0.125)	(0.127)	(0.917)	(0.997)	(1.096)	(0.119)	(0.126)	(0.136)
Firm-NEER Volatility				0.857	0.0471	-0.401	0.151	-1.027	-0.779	0.201	-1.022	-0.841	2.579	1.461	2.056
				(2.345)	(2.811)	(2.445)	(1.784)	(1.826)	(1.970)	(1.715)	(1.730)	(1.854)	(1.679)	(1.784)	(2.060)
D(FEFTA Amendment)							0.538***	0.481***	0.570***	0.593***	0.539***	0.744***	0.886***	0.843***	0.967***
							(0.0797)	(0.118)	(0.146)	(0.0858)	(0.101)	(0.128)	(0.119)	(0.199)	(0.197)
ROE ×D(FEFTA Amendment)										-2.392**	-2.085*	-3.967***			
										(0.907)	(0.980)	(1.070)			
Firm-NEER Volatility ×D(FEFTA Amendment)													-8.386**	-8.356**	-8.450***
													(2.635)	(3.546)	(2.433)
Constant	-0.0242	0.170	0.490**	-0.0800	0.168	0.516**	-0.0959	0.262	0.214	-0.216	0.246	0.216	-0.110	0.342	0.219
	(0.341)	(0.358)	(0.157)	(0.410)	(0.385)	(0.178)	(0.349)	(0.428)	(0.250)	(0.351)	(0.345)	(0.280)	(0.336)	(0.436)	(0.261)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Observations	120	110	114	120	110	114	120	110	114	120	110	114	120	110	114
R-squared	0.507	0.492	0.519	0.507	0.492	0.519	0.245	0.212	0.252	0.280	0.240	0.301	0.269	0.238	0.274
Number of Firms	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Note: Estimated exposure obtained from the yen/USD exchange rate (i.e., USD exposure) is used as a dependent variable. Clustered standard errors are presented in parentheses. Triple (***), double (**), and single (*) asterisk(s) denote one percent, five percent, and ten percent significance levels, respectively.

Source: Authors' estimation.

Table 4. Determinants of Foreign Exchange Exposures (USD Exposures): U.S. and Asia Sales Ratio

VARIABLES	(1) USD Exposure	(2) USD Exposure	(3) USD Exposure	(4) USD Exposure	(5) USD Exposure	(6) USD Exposure	(7) USD Exposure	(8) USD Exposure	(9) USD Exposure	(10) USD Exposure	(11) USD Exposure	(12) USD Exposure
U.S. Sales Ratio	1.466**		1.463**		1.650**		2.457***		1.550**		1.063	
	(0.609)		(0.612)		(0.541)		(0.692)		(0.495)		(0.647)	
Asia Sales Ratio		-0.0868		-0.109		-0.0909		-0.432		-0.382		0.0293
		(0.999)		(0.988)		(0.535)		(0.389)		(0.546)		(0.458)
ROE	0.432***	0.430***	0.434***	0.432***	0.501***	0.496***	3.699***	2.980**	0.493***	0.484***	0.475***	0.452***
	(0.0327)	(0.0320)	(0.0348)	(0.0345)	(0.122)	(0.119)	(1.111)	(0.957)	(0.136)	(0.135)	(0.118)	(0.132)
Firm-NEER Volatility			0.661	0.802	0.437	0.0738	0.652	-0.0845	2.846	2.700	0.176	-0.655
			(2.188)	(2.115)	(1.576)	(1.829)	(1.443)	(1.758)	(1.685)	(1.746)	(1.563)	(1.775)
D(FEFTA Amendment)					0.547***	0.565***	0.617***	0.609***	0.885***	0.937***	0.259	0.734***
					(0.0788)	(0.0978)	(0.0953)	(0.0965)	(0.121)	(0.136)	(0.177)	(0.112)
ROE ×D(FEFTA Amendment)							-3.272**	-2.547**				
							(1.058)	(0.953)				
Firm-NEER Volatility ×D(FEFTA Amendment)									-8.361***	-9.657***		
									(2.471)	(2.513)		
U.S. Sales Ratio ×D(FEFTA Amendment)											1.061*	
											(0.495)	
Asia Sales Ratio ×D(FEFTA Amendment)												-0.705***
												(0.203)
Constant	-0.0280	0.415	-0.0672	0.372	-0.176	0.292	-0.483*	0.336**	-0.283	0.237	-0.0117	0.297
	(0.262)	(0.296)	(0.247)	(0.337)	(0.174)	(0.210)	(0.226)	(0.140)	(0.166)	(0.203)	(0.192)	(0.183)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Observations	120	120	120	120	120	120	120	120	120	120	120	120
R-squared	0.517	0.501	0.517	0.501	0.265	0.239	0.325	0.276	0.290	0.270	0.283	0.259
Number of ID	10	10	10	10	10	10	10	10	10	10	10	10

Note: Estimated exposure obtained from the yen/USD exchange rate (i.e., USD exposure) is used as a dependent variable. Clustered standard errors are presented in parentheses. Triple (***), double (**), and single (*) asterisk(s) denote one percent, five percent, and ten percent significance levels, respectively.

Source: Authors' estimation.

Table 5. Determinants of Foreign Exchange Exposures (Firm-NEER Exposures)

VARIABLES	(1) Firm-NEER Exposure	(2) Firm-NEER Exposure	(3) Firm-NEER Exposure	(4) Firm-NEER Exposure	(5) Firm-NEER Exposure	(6) Firm-NEER Exposure	(7) Firm-NEER Exposure	(8) Firm-NEER Exposure	(9) Firm-NEER Exposure	(10) Firm-NEER Exposure	(11) Firm-NEER Exposure	(12) Firm-NEER Exposure	(13) Firm-NEER Exposure	(14) Firm-NEER Exposure	(15) Firm-NEER Exposure
Export Ratio	0.543			0.549			1.072**			1.143**			0.958*		
	(0.599)			(0.599)			(0.428)			(0.446)			(0.445)		
Foreign Production Ratio		0.605			0.521			0.916**			0.855**			0.684*	
		(0.364)			(0.343)			(0.350)			(0.269)			(0.359)	
Foreign Sales Ratio			-0.0390			-0.0284			0.656**			0.568**			0.483*
			(0.389)			(0.392)			(0.232)			(0.248)			(0.216)
ROE	0.0733	0.0578	0.0360	0.0746	0.0604	0.0381	0.114***	0.0811	0.0837*	1.394***	1.062***	0.949	0.107**	0.0761	0.0744
	(0.0423)	(0.0407)	(0.0316)	(0.0422)	(0.0399)	(0.0315)	(0.0343)	(0.0491)	(0.0396)	(0.356)	(0.326)	(0.599)	(0.0412)	(0.0515)	(0.0462)
Firm-NEER Volatility				0.538	1.329	1.103	-0.357	-0.295	-0.346	-0.330	-0.292	-0.360	0.578	0.622	0.709
				(1.266)	(1.251)	(1.289)	(0.518)	(0.712)	(0.566)	(0.532)	(0.696)	(0.559)	(0.891)	(0.875)	(1.047)
D(FEFTA Amendment)							0.111*	0.135*	0.0869	0.142**	0.163**	0.125	0.246*	0.268**	0.235*
							(0.0561)	(0.0624)	(0.0671)	(0.0566)	(0.0567)	(0.0783)	(0.132)	(0.105)	(0.114)
ROE ×D(FEFTA Amendment)										-1.307***	-1.002**	-0.878			
										(0.360)	(0.320)	(0.608)			
Firm-NEER Volatility ×D(FEFTA Amendment)													-3.232	-3.077	-3.144
													(2.830)	(2.495)	(2.710)
Constant	0.142	0.0869	0.300	0.107	0.0256	0.229	-0.259	-0.159	-0.0492	-0.324	-0.167	-0.0488	-0.264	-0.129	-0.0472
	(0.341)	(0.176)	(0.193)	(0.327)	(0.171)	(0.175)	(0.170)	(0.132)	(0.0833)	(0.181)	(0.108)	(0.0852)	(0.152)	(0.120)	(0.0890)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Observations	120	110	114	120	110	114	120	110	114	120	110	114	120	110	114
R-squared	0.336	0.353	0.354	0.337	0.357	0.356	0.087	0.086	0.084	0.122	0.107	0.092	0.099	0.097	0.094
Number of Firms	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Note: Estimated exposure obtained from the firm-specific NEER (i.e., Firm-NEER exposure) is used as a dependent variable. Clustered standard errors are presented in parentheses. Triple (***), double (**), and single (*) asterisk(s) denote one percent, five percent, and ten percent significance levels, respectively.

Source: Authors' estimation.

Table 6. Determinants of Foreign Exchange Exposures (Firm-NEER Exposures): U.S. and Asia Sales Ratio

VARIABLES	(1) Firm-NEER Exposure	(2) Firm-NEER Exposure	(3) Firm-NEER Exposure	(4) Firm-NEER Exposure	(5) Firm-NEER Exposure	(6) Firm-NEER Exposure	(7) Firm-NEER Exposure	(8) Firm-NEER Exposure	(9) Firm-NEER Exposure	(10) Firm-NEER Exposure	(11) Firm-NEER Exposure	(12) Firm-NEER Exposure
U.S. Sales Ratio	-0.623		-0.626		-0.779**		-0.527		-0.830***		-1.065**	
	(0.378)		(0.377)		(0.324)		(0.325)		(0.254)		(0.402)	
Asia Sales Ratio		1.052**		1.054**		0.362		0.212		0.256		0.381
		(0.400)		(0.420)		(0.284)		(0.215)		(0.337)		(0.283)
ROE	0.0536	0.0643*	0.0546	0.0641*	0.0694**	0.0752**	1.067**	1.161**	0.0656	0.0711	0.0568*	0.0683*
	(0.0315)	(0.0293)	(0.0319)	(0.0290)	(0.0297)	(0.0325)	(0.364)	(0.388)	(0.0387)	(0.0402)	(0.0284)	(0.0361)
Firm-NEER Volatility			0.512	-0.0771	-0.530	-0.164	-0.463	-0.233	0.705	0.783	-0.657	-0.280
			(1.357)	(1.509)	(0.530)	(0.584)	(0.515)	(0.570)	(0.836)	(0.825)	(0.500)	(0.576)
D(FEFTA Amendment)					0.161**	0.171**	0.183***	0.190***	0.334***	0.305**	0.0206	0.198**
					(0.0527)	(0.0556)	(0.0530)	(0.0531)	(0.0924)	(0.0964)	(0.0451)	(0.0809)
ROE ×D(FEFTA Amendment)							-1.021**	-1.113**				
							(0.366)	(0.398)				
Firm-NEER Volatility ×D(FEFTA Amendment)									-4.284	-3.483		
									(2.479)	(2.815)		
U.S. Sales Ratio ×D(FEFTA Amendment)											0.518***	
											(0.158)	
Asia Sales Ratio ×D(FEFTA Amendment)												-0.112
												(0.143)
Constant	0.547**	0.0649	0.517*	0.0689	0.381***	0.0515	0.285**	0.0706	0.326**	0.0316	0.461***	0.0522
	(0.226)	(0.164)	(0.259)	(0.155)	(0.0888)	(0.113)	(0.0956)	(0.0855)	(0.102)	(0.0986)	(0.0981)	(0.111)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Observations	120	120	120	120	120	120	120	120	120	120	120	120
R-squared	0.340	0.373	0.341	0.373	0.075	0.066	0.095	0.090	0.097	0.080	0.090	0.068
Number of Firms	10	10	10	10	10	10	10	10	10	10	10	10

Note: Estimated exposure obtained from the firm-specific NEER (i.e., Firm-NEER exposure) is used as a dependent variable. Clustered standard errors are presented in parentheses. Triple (***), double (**), and single (*) asterisk(s) denote one percent, five percent, and ten percent significance levels, respectively.

Source: Authors' estimation.