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INVOICING CURRENCY CHOICE: STRATEGIC COMPLEMENTARITIES AND CURRENCY MATCHING

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ABSTRACT

Japanese exporters' choice of invoice currencies is investigated using newly available official Customs declaration data, which records detailed information, including the trading partners' names, invoicing currency, and product descriptions. The strategic complementarity mechanism, that is, choosing the same invoice currency as others in the same industry or the same destination market, is found among Japanese exporters. We propose the "broad two-way exporters" whose export destinations and import origins do not necessarily match and the "narrow two-way exporters" whose export destination and import origins match in the same year. It is found that currency matching for exports and imports is as essential as strategic complementarity for two-way exporters, regardless of dominant currency, producer currency, or local currency invoicing. However, as one of this paper's novelty, we found evidence that newly entering two-way exporters are less concerned about currency matching. Therefore, the currency matching mechanism for two-way exporters is gradually formed as they continue to survive in international markets.

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1 Introduction

In addition to making decisions for producing and distributing their products to foreign customers, exporters must choose the invoicing currency for their exports. Faced with fluctuating exchange rates, the choice of invoicing currency affects the exporter's revenue in terms of home currency, as discussed in Gopinath and Rigobon (2008) and Gopinath, Itskhoki, and Rigobon (2010).[1] This study investigates determinants of invoicing currency choice by utilizing the export/import transaction level data at Japan Customs that have become available recently. Each transaction entry includes the identification of the exporter/importer, the departing/landing port, the content of products, invoicing currency, volume, value, the identification of the trading partner, the port in the partner's country, mode of transport, and other detailed information regarding exporting and importing.

Instead of working on individual raw transaction records, we aggregated transaction records by pairs of exporters and trading partner countries. The choice of the aggregation strategy makes us depart from the existing studies in the literature. The aggregation of granular data is not usually pursued in research simply because of fear of losing information and the number of observations. However, the benefits of some aggregation outweigh the cost. Invoicing currency decisions at the granular level are not independent of each other.

The choice of invoice currency will depend on the destination countries. For example, the exporter is more likely to choose US dollar invoicing for exports to the United States while choosing the British Pound for exports to the United Kingdom. These considerations lead us to work on the pairs of exporters and trading partner countries. Moreover, the loss of observations is less problematic, as the aggregation still leaves the data set with three million observations of exporter-country pairs for seven years between 2014 and 2020, as shown in Table 2.

Using the Belgian firm transaction level data, Amiti, Itskhoki, and Konings (2022) showed the phenomenon called strategic complementarity, i.e., the competitors' choice of invoicing currency in the same industry and market induces an exporter to choose the same currency.[2] Following Gopinath, Itskhoki, and Rigobon (2010) and Amiti, Itskhoki, and Konings (2022), we examine whether Japanese exporters choose invoicing currency with consideration of strategic comple-

[1] The choice of invoicing currency also has a macroeconomic consequence for the importing country. If a large portion of the import is invoiced in the importing country's currency, i.e., local currency pricing, the import price index shows a small change with respect to a change in the exchange rate. In contrast, invoiced in the exporter's currency, i.e., producer currency pricing, the import price index demonstrates a relatively large proportionate change.

[2] Amiti, Itskhoki, and Konings (2019) define strategic complementarity in terms of the elasticity of own price to a change in the competitors' price.

mentarities, that is, to select the same invoicing currency as their competitors. For exporters facing competition from other firms, setting their prices to move in tandem with competitors' prices is essential. For example, Japanese exporters use the US dollar as invoicing currency because their competitors also use US dollar invoicing in the same destination country and/or in the same industry. Amiti, Itskhoki, and Konings (2022) constructed strategic complementarity variables at the industry-destination level. However, we are interested in differentiating strategic complementarity into destination and industry components separately. We construct two strategic complementarity variables in the following way. The country-specific strategic complementarity variable is the ratio of all other firms' exports invoiced in the US dollar to the overall export value of all other firms in the destination country. The industry-level strategic complementarity variable is constructed in two steps. First, we construct the US dollar ratio in each HS 4-digit industry by all other firms to all destination countries. Second, the weighted average of US dollar ratios at HS 4-digit industries, with weight being the share of firms' exports in the industry over the firm's total exports.

In addition, we also find that exporters tend to choose the invoicing currency for exports to match the invoicing currency for their imports. Previous studies in the literature found such a link. Chung (2016) finds that using producer currency for inputs increases the likelihood of UK exporters choosing local currency for exports. As in other authors, the observation unit in Chung (2016) is firm-product-destination. We generalize the concept and broaden it to the firm-destination level. The Japanese exporters favor using US dollar invoicing in exports to a destination if their imports from the same country are invoiced in US dollars. This is not only so for the case of dominant currency but also applies to the cases of producer currency pricing and local currency invoicing. With this data set, we define narrow two-way exporters as exporters that export to and import from the same country.[3] Among determinants of invoicing currency choice, we found that currency matching is as essential as strategic complementarity for exporters who do imports and exports. By matching the invoice currency for exports with that for imports, the exporter can minimize the exchange risk generated by currency mismatch.

Our contribution is sixfold. First, this study is one of the first to use the Japan Customs transaction data, which have only recently become available for approved researchers. The availability of transaction-level data with information on currency invoicing made it possible for us to push forward the research on invoicing currency choice for Japanese exporters. Some countries have inherent problems in investigating the issue of invoicing currency choice. The US dollar is simultaneously the dominant and local currency for US imports, as argued in (Gopinath and

[3]In the empirical section, we propose narrowly defined and broadly defined two-way exporters.

Rigobon 2008); therefore, it is impossible to distinguish between the effects of local and dominant currency. A particular problem arises for EU member countries: No information on invoicing currency is recorded at the Customs office because intra-EU trade is exempt from customs. The Belgian exporters use the euro extensively with neighboring countries[4]; thus, excluding these exports from the analysis may distort the results(Amiti, Itskhoki, and Konings 2022), reducing the sample size significantly. Since the U.K. is not in the Eurozone, the UK data seem to have fewer similar problems, as shown in Chung (2016),Crowley, Han, and Son (2021),Corsetti, Crowley, and Han (2022).[5] Therefore, investigating the exporters with their home currency being neither the dollar nor the euro is expected to make an important contribution to the literature.[6] Using the new data set for Japanese firms, we examine how dollar invoicing is used for non-dollar destination countries without discarding a large portion of trade data, unlike some previous studies in the literature.

Second, the primary variable of analysis is the firm-destination pair. Instead of using raw transaction data, we aggregated the data at the level of exporting firms and destination countries. In this way, we can capture the exporters' motive for the common invoicing currency, i.e., the cost of managing multiple currencies can be avoided. More formally, the decisions on invoicing currency are not independent among transactions, at least for those under the same macroeconomic environment, i.e., exports to the same destination country. We are aware of the trade-off between the benefit of aggregation and the loss of detailed information. The optimal level of aggregation for investigating the choice of invoicing currency depends on the objective of the research. We believe that using a firm-destination pair in this study brings forth several advantages without significant loss of information in the original dataset. We assume that firms make an invoicing currency decision at the partner country level, not at each transaction level. Theoretical models in the literature, for example, Amiti, Itskhoki, and Konings (2022) assume that a firm sells only one product to one market. In this case, the solution to the firm's optimization problem leads to a uniquely chosen single currency. However, in reality, a firm tends to sell many products to the same market. The firm's optimal decision would not be a single currency for exports for all products. Different products may have different invoicing currencies. The choice of a product is affected by each product's idiosyncratic sensitivity of marginal cost and

[4]In 2018, non-EU destination exports (imports) by Belgian firms made up only 27 (34) percent of total exports (imports), (Amiti, Itskhoki, and Konings 2022). However, Boz, Casas, Georgiadis, Gopinath, Le Mezo, Mehl, and Nguyen (2022) demonstrate that assuming the use of the euro being 100 percent within the Euro area is not plausible.

[5]In 2011, non-EU destination exports by UK firms accounted for 46.5% of the total UK exports, (Chung 2016).

[6]The strong presence of the Japanese yen in foreign exchange markets also makes it interesting. The Japanese yen as an invoicing currency is relatively more acceptable by trading partners than minor currencies.

markup to foreign currencies. Our empirical analysis shows that the firm's invoicing currency decisions are well explained at the firm-country pair level.

Third, we provide two decomposed dimensions of strategic complementarity: destination country and industry. The existing studies, such as Amiti, Itskhoki, and Konings (2022), measure strategic complementarity at the firm- industry-country level. The index at this level correctly captures the interaction among the Belgian exporters, but distinguishing the difference among destinations is not measured. We constructed a strategic complementary index based on the destination country, i.e., how much other Japanese exporters use US dollars as an invoicing currency given the destination country. The other index based on industry is more complicated because we use firm-level instead of single transaction as a unit of observations. As a preliminary step, we construct the US dollar ratio as an invoicing currency for each HS 4-digit industry. Then, we calculate a weighted US dollar ratio by other exporters with weights as industry proportions of an exporter's exports. We find that the positive effects of both dimensions of strategic complementarity are statistically significant and robust to any specifications. The magnitude of strategic complementarity at the industry dimension is significantly larger. Therefore, the invoicing currency choice is driven more by which industry an exporter competes in than where it competes.

Fourth, two definitions of two-way exporters are proposed considering the matching of invoicing currencies between exports and imports. broad two-way exporters are defined as those who export and import, with destination and origin may not be the same. Narrow two-way exporters are defined as those who export to and import from the same country. We find that narrow two-way exporters are more inclined to match invoicing currencies of exports and imports than broad two-way exporters.

Fifth, we adopt a fractional probit regression with instrumental variables. In the previous studies examining the invoicing currency choice at the transaction level, probit or logit models were applied to the binary dependent variable of taking the value of one if the target currency is chosen and zero otherwise. We apply the fractional probit estimation method because the invoicing currency ratio ranges between zero and one.

Sixth, we also examine the invoicing currency choice of firms newly entering export markets. The panel estimates may suffer from biased estimates because currency invoicing decisions are persistent. Long-surviving firms may only repeatedly use the same currency as the previous years. In order to capture the first decision of choosing invoicing currency, new entrants that did not engage in any international trade in the last year are free from such a bias. The currency matching motive is less pursued, whereas the strategic complementarity motive is essential from

the first year.

The rest of this paper is organized as follows. The next section describes how the data set is prepared in this study. Section 3 provides empirical models, and section 4 shows empirical evidence. Section 5 revisits the invoicing currency choice of new exporters. Section 6 compares our results with the existing literature and the last section concludes.

2 Invoicing Currency Choice at the Firm-Country level

2.1 The Export and Import Declarations submitted to the Japan Customs Office

The data set became available in 2022 under a program of government-owned data utilization at the Ministry of Finance, Japan.[7] The data consists of a complete set of general export and import declarations between 2014 and 2020.[8] Each transaction is recorded as a separate record, even for the same firm, and the number of records for exports is in the order of millions for one year. Table 1 summarizes this dataset between 2014 and 2020 by invoicing currency.

The left part of Table 1 provides the statistical summary of this export data set. On the top row, with the total export values at the leftmost, the ratios of invoicing currencies are shown. Four currencies of interest are (i) the Japanese yen, the producer currency for Japanese exporters; (ii) the US dollar, the dominant currency of the world; (iii) the euro, the largest regional currency in Europe; and (iv) local currencies, i.e., the official national currency used in the destination country. US dollars have the largest share, 51 percent, in the invoicing currency of Japanese exports. The Japanese yen is also extensively used for 36 percent of the invoiced currency in Japanese exports, but the euro plays a small part as it is only 6 percent of Japan's exports. The seemingly high ratio of local currency invoicing can be explained using the US dollar in the US and the Euro in the Euro area.

Panel A of Table 1 shows the use of invoicing currencies by country and region. The US dollar is overwhelmingly used in exports to the US market, and it is also the largest invoicing currency in China and the rest of Asia. Although a small share in overall trade, Euro invoicing is significant at 56 percent in the Euro area.[9] For the rest of the world, excluding the US and Euro area, the local currency invoicing is below six percent, not shown in the table.

[7] Researchers affiliated with universities need to be cross-appointed by the Ministry of Finance and work under the binding regulations of public officers. Any private information revealed to the researchers during the research must be kept secret.

[8] Low-value cargoes under the simplified customs clearance are excluded from the database.

[9] The countries included in the Asia and Euro area are listed in the appendix.

Panel B of Table 1 shows invoicing currency for selected industries. The overall picture does not change much; however, the Japanese yen is the most-used invoicing currency in the textile industry, and the US dollar use is even amplified to 68 percent in the base metal industry. The right part represents the invoicing currency for imports. Like exports, the US dollar is also the dominant invoicing currency in Japanese imports. The use of the US dollar is even more pronounced in imports, 61 percent. The noteworthy facts are that 71 percent of imports from China are invoiced in the US dollar, and textile imports are invoiced in the currency of the exporting country for only five percent.

Table 1: Invoice currency by region and industry (2014-2020)

	Exports					Imports				
	values	JPY (PCP)	USD	EUR	LC	values	JPY (LCP)	USD	EUR	PC
ALL	552	0.36	0.51	0.06	0.27	563	0.32	0.61	0.04	0.14
Panel A: by trading regions	values	JPY (PCP)	USD	EUR	LC	values	JPY (LCP)	USD	EUR	PC
US	105	0.13	0.87	0.00	0.87	61	0.25	0.74	0.01	0.74
Euro Area	46	0.32	0.12	0.56	0.56	55	0.53	0.11	0.33	0.33
China	136	0.42	0.52	0.00	0.06	138	0.24	0.71	0.01	0.04
ASIA	167	0.47	0.47	0.00	0.05	133	0.38	0.58	0.00	0.03
Panel B: by HS sections	values	JPY (PCP)	USD	EUR	LC	values	JPY (LCP)	USD	EUR	PC
Chemical (Sec.6)	44	0.33	0.57	0.05	0.20	47	0.54	0.38	0.04	0.16
Textiles (Sec.11)	7	0.48	0.45	0.05	0.12	29	0.16	0.79	0.03	0.05
Base Metal (Sec.15)	46	0.26	0.68	0.03	0.13	28	0.37	0.57	0.03	0.13
Machinery & Electronics (Sec.16)	204	0.41	0.47	0.07	0.24	134	0.25	0.67	0.05	0.16
Transport (Sec.17)	127	0.31	0.50	0.08	0.48	23	0.50	0.31	0.14	0.25
Precision Instruments (Sec. 18)	35	0.35	0.49	0.09	0.29	25	0.43	0.41	0.07	0.28

Note: The figures in the first column (values) represent the total export values in trillion Japanese yen between 2014 and 2020. The figures in other columns represent the ratio of invoice currency used in the corresponding region/sectors. LC and PC are trade partners' currencies. LC in exports represents local currency invoicing, and PC in imports represents producer currency invoicing. Asia region includes 21 countries, excluding China. The number of countries in the Euro Area varies as new members adopt the Euro. The countries in the Asia and Euro Area are listed in the appendix. '0.00' in some cells is not exactly zero, only representing rounded values. Sections 6, 11, 15, 16, 17, and 18, respectively, consist of a group of two-digit industries (chapters): HS28 through HS38, HS50 through HS63, HS72 through HS83, HS84 and HS85, HS86 through HS89, and HS90 through HS92.

2.2 Firm-country Invoicing Currency Ratio

The previous studies extensively used the Custom data at the transaction level to investigate the exporters' choice of invoicing currency (Amiti, Itskhoki, and Konings 2022, Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller 2020, Chung 2016, Crowley, Han, and Son 2021, Devereux, Dong, and Tomlin 2017) among others. The optimal currency choice problem in Amiti, Itskhoki, and Konings (2022) can be shown as follows:

$$l = argmax_l(max_{p_i^l} E\Pi_i(p_i^l - e_l \mid \Omega)) \tag{1}$$

where firm i determines the level of optimal price, p_i^l, for a given currency l and its associated exchange rate e_l to maximize the expected profit, Π_i. The expected profit is also conditional with the information set Ω. Export i chooses currency l, which brings the highest expected profit among other currencies.

However,Amiti, Itskhoki, and Konings (2022) discusses the possibility of firms adopting common invoicing when considering additional fixed costs associated with using each currency.

$$l = argmax_l(max_{p_i^l} E\Pi_i(p_i^l - e_l \mid \Omega) - F_{l,i}) \tag{2}$$

where they introduce an additional fixed cost $F_{l,i}$ for using currency l for exporter i. Reducing the number of currencies saves an exporter fixed costs associated with managing additional foreign currencies. Therefore, treating individual transactions of the same firm separately misses the firm's possible strategy of common invoicing. Exporters need to make the choice of invoicing currency for each transaction, and they have to make these decisions several times over the period if they make multiple transactions. However, these decisions are not mutually independent. A straightforward way to capture the tendency to use the common currency is to calculate the likelihood of each firm using dollars, i.e., the ratio of the sum of dollar-invoiced transactions to all transactions.

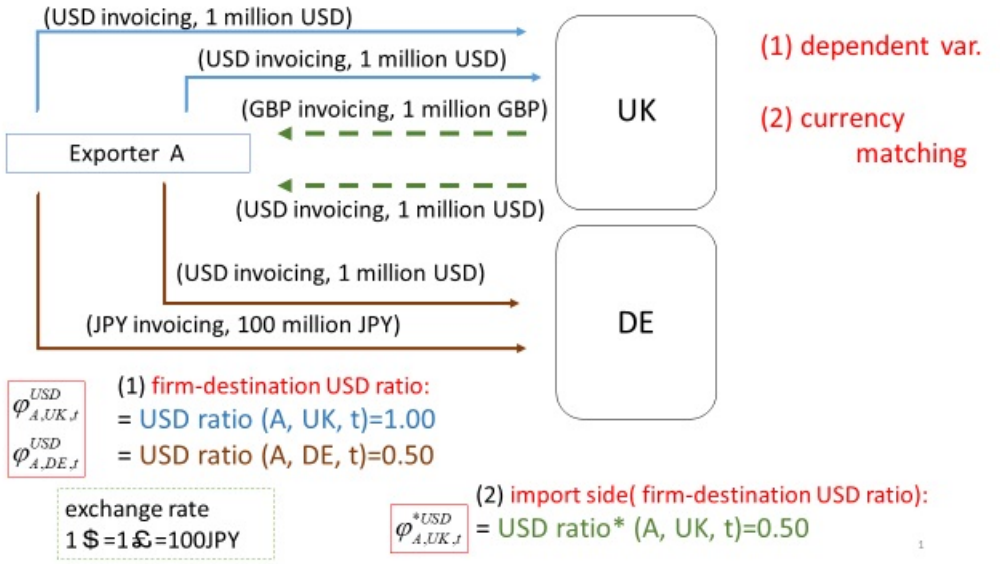
Furthermore, we assume fixed cost also varies with destination country k,

$$l = argmax_l(max_{p_i^l} E\Pi_i(p_i^l - e_l \mid \Omega) - F_{l,i,k}) \tag{3}$$

We assume a currency-firm-destination idiosyncratic fixed effect because the cost associated with currency management should differ between the use of US dollars in the US and in UK, i.e., $F_{USD,i,US} \neq F_{USD,i,UK}$. Whether this specification is appropriate is an empirical question, and we pursue this dimension of data granularity in this study.

We now describe how we calculate each firm-country pair's US dollar invoicing ratio. The export and import declarations, which exporters and importers must submit to Japan Customs,

Figure 1: The invoicing currency ratio and currency matching



Note: This figure represents the subset of transaction-level data in the data and shows how the calculation of the invoicing currency ratio is structured.

include the identity of the reporting company and the foreign trading partner, product characterization, corresponding HS 9-digit code, the value and quantity of transactions, and the invoicing currency. The value of each transaction record has five arguments: invoicing currency c, firm i, product j, partner country k, and year t: $val(c, i, j, k, t)$. We construct the dollar invoicing ratio by exporter-destination pairs in year t as follows.

$$\phi_{i,k,t}^{\text{USD}} = IC_{c=\text{USD},i,k,t} = \frac{\sum_{c=\text{USD},j} val(c, i, j, k, t)}{\sum_{c,j} val(c, i, j, k, t)}, \tag{4}$$

where c =USD represents the US dollar invoicing currency. The numerator in equation (4) represents the value of transactions invoiced in US dollars, and the denominator is the value of all transactions. For the rest of the paper, we use IC with corresponding subscripts, USD, to denote the dollar invoice ratio.

Figure 1 demonstrates how an invoicing currency ratio, $\phi_{i,k,t}^{\text{USD}}$, is calculated with the example of four export transactions by exporter A. In the example, export transactions are invoiced in different currencies; however, we set exchange rates so that the values of all transactions are

equivalent in the common currency. Exporter A exported to the UK in two transactions, both invoiced in US dollars, and to Germany in two transactions, one in US dollars and the other in Japanese yen. In this case, $\phi^{\text{USD}}_{A,\text{UK},t} = 1.00$ and $\phi^{\text{USD}}_{A,\text{DE},t} = 0.50$.

2.3 Determinants of Currency Choice

Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller (2020) propose the dominant currency paradigm in which exporters set prices in a dominant currency, face strategic complementarities in pricing, and use foreign inputs. Following their dominant currency paradigm model, they empirically confirm the model's implications by using the worldwide coverage of bilateral trades. The theoretical model in Amiti, Itskhoki, and Konings (2022) showed that the desired exchange rate pass-through depends on the exposure of the firm's marginal cost to exchange rates, ϕ, and the exposure of the firm's desired markup to exchange rates, γ. In turn, the invoicing currency is chosen based on the lowest variance of the desired price expressed in that currency. Amiti, Itskhoki, and Konings (2022) proxy for ϕ with the firm's share of imported inputs in total variable costs, sourced in foreign (non-euro) currencies for the Belgian exporters. The proxy variables for γ use the export-weighted average currency use of the firm's Belgian competitors in a given destination industry. Using the UK transaction level of exports and imports between 2010 and 2016, Crowley, Han, and Son (2021) find that the US dollar is an invoicing currency choice for UK exports to extra-EU destinations, i.e., transactions with all countries outside of the EU, are driven by strategic complementarities, operational hedging, and prior experience.

2.3.1 Strategic Complementarity Indices

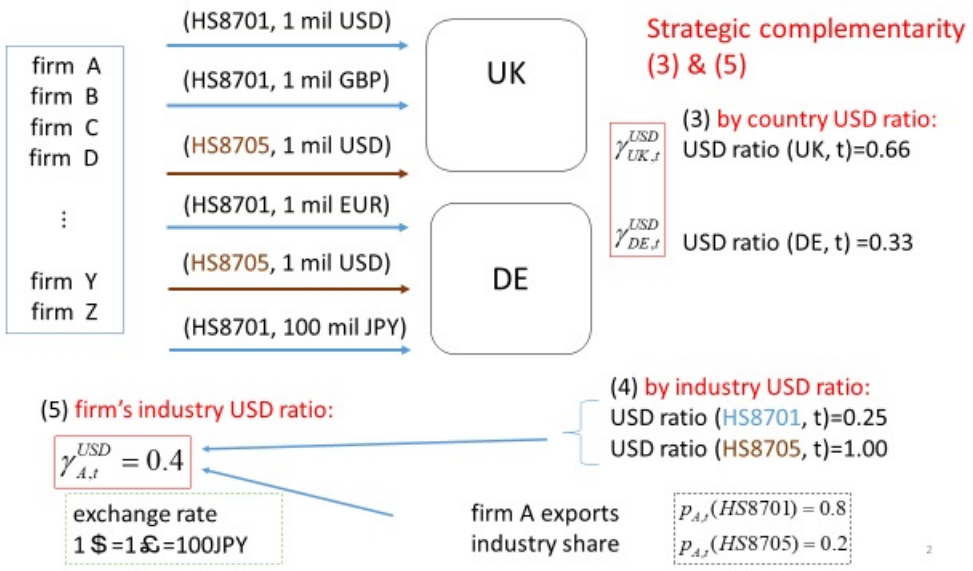
The first strategic complementary index we introduce is the likelihood of dollar use by the competitors in the destination market, k.[10]

$$\gamma^{\text{USD}}_{k,t} = IC_{c=\text{USD},-i,k,t} = \frac{\sum_{c=\text{USD},-i,j} val(c,i,j,k,t)}{\sum_{c,-i,j} val(c,i,j,k,t)} \tag{5}$$

where $-i$ indicates that the sum is taken over for all firms except firm i.

[10] Firms may obtain information about the competitors' invoicing currency through their business partners in destination countries, financial institutes, and government agencies. In fact, the Bank of Thailand has made public the invoicing currency by partner countries since 2015, and the Ministry of Finance of Japan has started to show the invoicing currency ratios for the top ten countries in exports and imports since 2023.

Figure 2: Strategic complementarity variables



Note: This figure represents the subset of transaction-level data in the data and shows how the calculation of strategic complementarity variables is structured.

The second strategic complementary index is the likelihood of dollar use by the competitors in the industries associated with the firm. This takes two steps. First, we construct the dollar invoicing ratio in each HS 4-digit industry.

$$IC_{c=\text{USD},-i,j,t} = \frac{\sum_{c=\text{USD},-i,k} val(c,i,j,k,t)}{\sum_{c,-i,k} val(c,i,j,k,t)} \tag{6}$$

$IC_{c=USD,-i,j,t}$ is the dollar ratio in industry j and is adjusted for each Japanese exporter. Then, we calculate each firm's weighted average of these industry indices.

$$\gamma_{i,t}^{\text{USD}} = \sum_{j} \{p_{i,t}(j) \cdot IC_{c=\text{USD},-i,j,t}\} \tag{7}$$

where $p_{i,t}(j)$ is the share of firm i's export in HS 4-digit industry j in year t. This index reflects how much dollar invoice is used by the competitors in the industries with which firm i is associated.

Figure 2 shows how the strategic complementarity indices are calculated. In this figure,

all transactions by all exporters are shown. There are three export transactions to the UK and Germany each. The product categories of these transactions are either HS8701 or HS8705 at the HS 4-digit industry. Exchange rates are set so that the values of all transactions are equivalent in the common currency. The strategic complementarity index at the country level is straightforward as in equation (5). Two out of three transactions to the UK are invoiced in US dollars, so $\gamma_{UK,t}^{\text{USD}} = 0.66$. Similarly, we can calculate the US dollar invoicing ratio in Germany; $\gamma_{DE,t}^{\text{USD}} = 0.33$. The calculation of the strategic complementarity index reflecting industry dimension involves two steps. First, the US dollar invoicing ratios are calculated for each industry as in equation (6). Only one out of four transactions in HS8701 industry is invoiced in US dollars; therefore, $IC_{\text{USD},HS8701,t} = 0.25$. Similarly, the US dollar invoicing ratio for HS8705 is calculated as $IC_{\text{USD},HS8705,t} = 1.00$. Second, these indices are used to calculate the industry-weighted average for each exporter, as in Equation (7). If firm A exports 80 percent to the HS8701 industry and 20 percent to the HS8705 industry, the industry-wise strategic complementarity index for firm A is $\gamma_{A,t}^{\text{USD}} = 0.40$.[11]

2.3.2 Currency Matching Index

Amiti, Itskhoki, and Konings (2022) construct the Belgian firm's import intensity as the ratio of total imports from outside the eurozone to total variable costs. They use this variable as a proxy for the firm's marginal cost sensitivity to the exchange rate. The underlying implicit assumption is that these imports are not invoiced in euros.[12] If, as an extreme example, all imports from non-Euro countries are invoiced in euros, the Belgian firms are unaffected by a change in the exchange rate, at least from the importing side.

Theoretical models of exchange rate pass-through and currency invoicing explicitly considered the imported inputs in the international finance literature.[13] Chung (2016) is one of the first empirical studies that highlighted the link between imported inputs and exporters' decisions on invoicing currency. Chung (2016) introduced the ratio of imported inputs invoiced in the exporter's currency to its total imported inputs at the UK firm level to consider the role of exporter's operational hedging behavior.[14]

[11] $\gamma_{A,t}^{\text{USD}} = 0.8 * IC_{\text{USD},HS8701,t} + 0.2 * IC_{\text{USD},HS8705,t} = 0.40$

[12] Therefore, Amiti, Itskhoki, and Konings (2022) further breaks the import intensity index into euro-invoiced import intensity and non-euro-invoiced import intensity for alternative specifications.

[13] The role of imported inputs in exporting firms has also been well examined in the international trade literature. Imported inputs can be used to measure the degree of participation in global value chains as surveyed in Johnson (2018). Imported inputs can be a source of growth engine for multinational firms (Halpern, Koren, and Szeidl 2015).

[14] Operational hedge is also found essential even in domestic transactions in the dollarization economy of Uruguay

Our approach to constructing an import intensity variable is to consider the invoicing currency choice in imports, similar to (Crowley, Han, and Son 2021). The new contribution of this study is to introduce three indices that are complementary to each other. The first is a straightforward extension of the currency choice variable to the import side. The dollar used on the import side is matched with the export side at the firm-country level. Note that this variable has two dimensions, in firms and destinations, whereas the import intensity index in Amiti, Itskhoki, and Konings (2022) varies only over firms.[15] The currency matching variable is formulated as the following with an asterisk indicating the importing side:

$$\phi^{*\text{USD}}_{i,k,t} = IC^{*}_{c=\text{USD},i,k,t} = \frac{\sum_{c=\text{USD},j} val^{*}(c,i,j,k,t)}{\sum_{c,j} val^{*}(c,i,j,k,t)} \tag{8}$$

Figure 1 shows that exporter A imports from the UK but not from Germany. In this case, we can calculate $\phi^{*\text{USD}}_{A,\text{UK},t} = 0.50$, but not for Germany.

In regression models in the following section, We implicitly assume that exporters make an invoicing currency choice, given the invoicing currency of their imports. However, a priori, there is no consensus on the causality direction, and we face a simultaneity problem. To address this endogeneity issue, we introduce the second and the third ratios that are the import side version of equations (5) and (7).

$$\gamma^{*\text{USD}}_{k,t} = IC^{*}_{c=\text{USD},-i,k,t} = \frac{\sum_{c=\text{USD},-i,j} val^{*}(c,i,j,k,t)}{\sum_{c,-i,j} val^{*}(c,i,j,k,t)} \tag{9}$$

$$\gamma^{*\text{USD}}_{i,t} = \sum_{j} \{p^{*}_{i,t}(j) \cdot IC^{*}_{c=\text{USD},j,t}\} \tag{10}$$

These two indices are the US dollar invoicing ratios of the competitors' imports, therefore not directly linked to firm i's decision on invoicing currency choice of its exports. We use them as instrumental variables when we include the import intensity index, i.e., equation (8).

(Licandro and Mello 2019). On the other hand, Lyonnet, Martin, and Mejean (2022) found that large EU firms are more willing to use non-euro invoicing if financial hedging tools are available.

[15] In fact, the import intensity index in Amiti, Itskhoki, and Konings (2022) is also time-invariant, whereas our indices change by year.

2.3.3 Control variables

The variables of interest in this study are two strategic complementarity variables and the currency-matching variable we discussed in the previous subsections. In this subsection, we describe other control variables that capture the other effects on currency choice. We introduce firm size and market share variables to control individual firm characteristics. Devereux, Dong, and Tomlin (2017) found that market shares of both exporters and importers matter for exchange rate pass-through.

The firm size variable is the natural log of the firm i's total export to destination k: $lnSize_{i,k,t} = ln\{\sum_{c,j} val(c,i,j,k,t)\}$. As the robustness check in section 4.3, we use alternative definitions for firm size: total export to all destinations, the sum of export to and import from country k, and the sum of export to and import from all countries. The first of these alternatives corresponds to the firm size used in Crowley, Han, and Son (2021).

Market share variable is the value-weighted average of market shares at HS 4-digit industries: $MShare_{i,t} = \sum_j w^j(\sum_{c,k} val(c,i,j,k,t)/\sum_{c,i,k} val(c,i,j,k,t))$. For each 4-digit industry (across all destination countries) in which firm i exports, the market share is calculated. Then, these market shares are taken average with firm i's export share at HS 4-digit industries,w^j, as weights.[16] In robustness section 4.3, we also use three alternative definitions for market share. Two alternatives use HS 2-digit and HS 6-digit levels instead of HS 4-digit level. The last definition uses the market share in the destination country.

Fixed effects can potentially be constructed at the level of firms, destination countries, industries, and years. We avoided using firm-fixed effects because the firm-year-varying market share variable, $MShare_{i,t}$, already controls this dimension. Similarly, we do not use destination-fixed effects because the strategic complementarity variable, $\gamma_{k,t}$, captures destination characteristics. Industry-fixed effects are not appropriate because the observation unit in this study aggregates over industries. Therefore, we only include year-fixed effects to control for time-varying effects on a firm's currency choice.

[16] Due to these definitions in the base model, two firm characteristics variables measure different aspects of exporters. $lnSize_{i,k,t}$ measures the total exports to destination market k whereas $MShare_{i,t}$ is a weighted measure of total exports to all destination countries. A priori, these variables should be free of multicollinearity problems.

3 Empirical Model of Invoicing Currency Choice

The data records all export and import declarations individually.[17] Therefore, even within a year, the same product is exported multiple times to the same destination market by the same exporter.[18] Instead of analyzing exports at each declaration, we pooled exports by the exporter and destination market each year. The advantage of pooling products at this level is that we can measure the likelihood of choosing a specific invoicing currency for an exporter in a particular destination market. Therefore, the choice of invoicing currency is aggregated at the pair of exporter and destination market as the dollar ratio, $\phi_{i,k,t}^{\text{USD}}$ with subscripts denoting exporter i, destination country k, and year t, see equation (4). The choice of invoicing currency is also constructed for imports as $\phi_{i,k,t}^{*\text{USD}}$, see equation (8).

3.1 Invoicing Currency Choice and Strategic Complementarities

The first base model only includes firm size and strategic complementarity variables. The dependent variable is the ratio of the values invoiced in the US dollar in total export values by firm-destination pair, $\phi_{i,k,t}^{\text{USD}}$.

$$\phi_{i,k,t}^{\text{USD}} = \alpha + \beta_0 lnSize_{i,k,t} + \beta_1 MShare_{i,t} + \beta_2 \gamma_{k,t}^{\text{USD}} + \beta_3 \gamma_{i,t}^{\text{USD}} + \epsilon_{i,k,t} \tag{11}$$

The firm's size, $lnSize_{i,k,t}$, is the natural log of the firm i's total export to destination k, the market share of the firm, $MShare_{i,t}$, is the value-weighted average of market shares at HS 4-digit industries, and the two complementarity indices are the likelihood of dollar invoice in the destination market, $\gamma_{k,t}^{\text{USD}}$, and the likelihood of dollar invoice in associated industries, $\gamma_{i,t}^{\text{USD}}$. The definitions of complementarity indices are shown in equations (5) and (7).

The dependent variable is fractional, $0 \leq \phi_{i,k,t}^{\text{USD}} \leq 1$, with non-zero mass at the two extreme values. The predicted values from an OLS regression cannot be guaranteed to lie between 0 and 1. Therefore, similar to binary dependent variable models, we assume that

$$E(\phi_{i,k,t}^{\text{USD}} \mid X_{i,k,t}) = G(X_{i,k,t}B) \tag{12}$$

where $X_{i,k,t}$ denotes the vector of explanatory variables, B is the vector of parameters, and $G(\cdot)$ is the standard normal cumulative density function, satisfying $0 < G(z) < 1$ for all $z \in \Re$. In particular, we apply the fractional response regression proposed by Papke and Wooldridge (1996).

[17] Low-value cargoes under the simplified customs clearance are excluded from the database.

[18] For example, in the first six months of 2014, for about four percent of the sample, different invoice currencies are chosen for the same HS 9-digit export to the same destination country by the same exporter within a month.

The expected signs of two strategic complementary indices, $\gamma_{k,t}^{\text{USD}}$ and $\gamma_{i,t}^{\text{USD}}$, are positive. The expected sign of firm size is less evident in the previous studies. Firm size positively correlates with non-euro invoicing for the Belgian exporters in Table 2 of Amiti, Itskhoki, and Konings (2022). This non-euro currency includes US dollars, destination currency, and other currencies. Table 4 of Amiti, Itskhoki, and Konings (2022) further shows that firm size negatively correlates with US dollar invoicing. On the other hand, the dollar invoicing by UK exporters is positively correlated with firm size in Crowley, Han, and Son (2021). These analyses are based on the extra-EU exports for Belgian and UK firms. A significant number of observations are excluded from the original sample. On the market share, the expected sign is ever less clear in previous empirical evidence. The market share is estimated to positively affect non-euro invoicing for the Belgian firms in Amiti, Itskhoki, and Konings (2022); however, the statistical significance of market share disappears when the firm size variable is introduced in the regression model.

3.2 Currency Matching

Our approach slightly differs from Amiti, Itskhoki, and Konings (2022) and Crowley, Han, and Son (2021) in implementing the import side variables. Amiti, Itskhoki, and Konings (2022) use firm-specific import intensity, i.e., the ratio of total extra-EU import to total variable costs. This import intensity is also constructed for non-euro invoicing and dollar invoicing. Constructing this variable requires matching trade data and accounting data by identifying each firm in both data sets and is much more data-demanding. However, their index is the average of the entire sample period and is time-invariant and destination-invariant. Crowley, Han, and Son (2021), on the other hand, rely solely on the trade data set; therefore, their construction of import-side indices is similar to ours. Their index is the share of the firm's dollar invoiced imports in its total imports. This variable is time-varying but not destination-varying. Our index, $\phi_{i,k,t}^{*\text{USD}}$, in equation (8) is both destination-varying and time-varying. This new index has an important implication when we focus on two-way exporters. More precisely, we define a firm-destination pair as two-way if we observe export and import data in the same year. Note that the definition of two-way exporter applies to the pair of firm-destination so that a firm can be two-way for one market and not for another. Our regression model for evaluating a firm's incentive to match the invoice currencies of exports and imports is the following.

$$\phi_{i,k,t}^{\text{USD}} = \alpha + \beta_0 lnSize_{i,k,t} + \beta_1 MShare_{i,t} + \beta_2 \gamma_{k,t}^{\text{USD}} + \beta_3 \gamma_{i,t}^{\text{USD}} + \beta_4 \phi_{i,k,t}^{*\text{USD}} + \epsilon_{i,k,t} \qquad (13)$$

The analysis with the import-side variables has one drawback: The invoicing currency choice on exports and imports are simultaneous decisions. Also, from the perspective of the importing

side, a similar relationship between the firm's import invoicing and competitors' import invoicing should hold.[19] Alternatively, using $\gamma_{k,t}^{*\text{USD}}$ and $\gamma_{i,t}^{*\text{USD}}$ as instruments, we also estimate equation (13) by instrumental variable (IV) fractional probit.

3.2.1 Two-way Exporters

Table 2: Invoice currency by exporter type (2014-2020)

		all exporters	broad two-way	narrow two-way
	(no. of pairs)	3,043,901	1,949,043	921,088
	(no. of firms)	747,353	187,354	131,923
	(trillion yen)	551.9	538.0	495.1
USD		0.51	0.52	0.53
-	excl. US	(0.35)	(0.35)	(0.35)
JPY		0.36	0.35	0.34
EUR		0.06	0.07	0.07
LC		0.27	0.28	0.30
-	excl. US	(0.11)	(0.11)	(0.11)

Note: Broad two-way exporters are those exporters that also import in the same year. Narrow two-way exporters are defined over the exporter and destination country pairs that also import from the same destination country in the same year. These definitions are applied to the observations of each year. The first row represents the number of exporter-country pairs whereas the second row indicates the number of distinct exporters. The ratio in parenthesis excludes the US from the calculation. LC is local currency invoicing.

For broad two-way exporters, imports from other countries should affect the invoicing currency choice of exports. For example, a Japanese exporter exporting to China and importing from Germany and the US would not be a narrow two-way because it does not import from the country of export destination, China. The observation of this exporter's export to China would be dropped from the above regression when we restrict the sample to narrow two-way exporters. However, up to the degree of US dollar invoicing for its imports from Germany and the US, the exporter considers the use of US dollar invoicing for its exports to China. This concept is adopted by Amiti, Itskhoki, and Konings (2022), and we define it as broad two-way.

[19] We estimated an import-side regression analogous to equation (11) and obtained similar results.

We also estimate equation (13) with the sample of broad two-way exporters, and import side index, $\phi^{*\text{USD}}_{i,k,t}$, is replaced by $\phi^{*\text{USD}}_{i,t}$, the US dollar ratio for import invoicing at the firm level.

Table 2 summarizes the use of invoicing currencies by exporter types. The first column represents all exporters, corresponding to the first row of Table 1. In the second and third columns, the summary statistics for invoicing currencies for broadly defined and narrowly defined two-way exporters are shown, respectively. There are some salient features. Based on our definitions of firm-destination, the number of observations for seven years decreases to about two-thirds in the broad two-way sample and one-third in the narrow two-way sample. The corresponding firms are 747, 187, and 131 thousand firms for all, broad two-way, and narrow two-way exporters, respectively. This implies that about 75 percent of Japanese exporters do not import at all and that about 70 percent of firms engaging in both exports and imports, in fact, use (at least) one particular country for both exports and imports. More importantly, these two-way exporters conduct a large share of exports (in terms of values): 97 percent by broad two-way and 90 percent by narrow two-way exporters. On the other hand, only a little difference exists in the use of invoicing currencies among exporter types.

4 The Empirical Results

For the empirical investigation on the choice of invoicing currency in Japanese exports, we use the data set consisting of the general export and import declarations submitted to Japan Customs, the Ministry of Finance, between 2014 and 2020. As described in section 3, we use the US dollar invoicing ratio at the firm-country level as the dependent variable in the base model and estimate the regression models (11) and (13). The appendix table A.1 provides the statistical summary of variables used in the regression models.

4.1 US dollar Invoicing, Dominant Currency

Table 3 shows regression (11) estimation results by all exporters, broadly defined two-way exporters, and narrowly defined two-way exporters for the panel between 2014 and 2020. The models are estimated by fractional probit, and the table shows the marginal effects of covariates. The sign of $\gamma^{\text{USD}}_{k,t}$, the US dollar invoicing ratio in the destination k, is positive and it captures strategic complementarity among exporting firms. By comparing the magnitude, it is interesting to find that two-way exporters in columns (2) and (3) are more inclined to follow the currency choice of competitors than the entire sample of exporters in column (1). More specifically, the effect of strategic complementarity in the destination country dimension is more

substantial for narrowly defined two-way exporters. Exporters that export to and import from the same country pay more attention to the competitors' choice of invoicing currency in that market. Similarly, the competitors' currency choice in the corresponding industries, $\gamma_{i,t}^{\text{USD}}$, the weighted average of the dollar ratio with the firm's exporting value by industries as weights, are positive and statistically significant. An exporter is likely to increase the use of US dollars as invoicing currency if the dollar is predominantly used in a destination country and/or in the firm's associated industries. On the other hand, big exporters, measured as large total exports to the corresponding destination countries or higher market share, lower the use of the US dollar. At this moment, it should not be confused with the notion implicitly indicating that they prefer the Japanese yen as invoicing currency. Besides the Japanese yen, local currency or other vehicle currency is also possible as an alternative invoicing currency. We will come back to this issue in subsection 4.2.

Table 3: US dollar invoicing and strategical complementarity, 2014-2020

	(1) USD Fractional Probit	(2) USD Fractional Probit	(3) USD Fractional Probit
$lnSize_{i,k,t}$	-0.0061***	-0.0084***	-0.0096***
	(0.0012)	(0.0006)	(0.0009)
$MShare_{i,t}$ (HS4)	-0.9715***	-1.0216***	-0.7431***
	(0.1349)	(0.1380)	(0.1876)
$\gamma_{k,t}^{USD}$ (SC_Country_USD)	0.2573***	0.3442***	0.4528***
	(0.0213)	(0.0132)	(0.0113)
$\gamma_{i,t}^{USD}$ (SC_HS4_USD)	1.1298***	1.1140***	1.0982***
	(0.0187)	(0.0116)	(0.0147)
year fixed effects	yes	yes	yes
N. of observations	3,043,872	1,949,018	921,088
Psuedo R^2	0.35	0.27	0.29
firm-type	all	broad two-way	narrow two-way

Note: The dependent variable is the US dollar invoicing currency ratio. The coefficients and standard errors estimated by a fractional probit model are shown for the marginal effect. The standard errors in parenthesis are clustered by the import size of destination countries and years. broad two-way exporters are those exporters that also import in the same year. Narrow two-way exporters are defined over the exporter and destination country pairs that also import from the same destination country in the same year. ***, **, * represent one, five, and ten percent significance level.

Table 4: US dollar invoicing with import side invoicing currency, 2014-2020

	(1) USD Fractional Probit	(2) USD IV Frac. Probit	(3) USD Fractional Probit	(4) USD Frational Probit	(5) USD w/o US IV Frac. Probit
$lnSize_{i,k,t}$	-0.0074***	-0.0073***	-0.0082***	-0.0077***	-0.0082***
	(0.0008)	(0.0007)	(0.0008)	(0.0006)	(0.0004)
$MShare_{i,t}$ (HS4)	-0.7316***	-0.7317***	-0.6870***	-0.9607***	-0.6207***
	(0.1709)	(0.1708)	(0.1724)	(0.1302)	(0.1448)
$\gamma_{k,t}^{USD}$ (SC_Country_USD)	0.2676***	0.2651***	0.4248***	0.3359***	0.1857***
	(0.0127)	(0.0168)	(0.0115)	(0.0131)	(0.0119)
$\gamma_{i,t}^{USD}$ (SC_HS4_USD)	0.9664***	0.9647***	1.0002***	1.0517***	0.8893***
	(0.0164)	(0.0211)	(0.0187)	(0.0129)	(0.0207)
$\phi_{i,k,t}^{*USD}$ (USDRatio_im)	0.1925***	0.1954***			0.2136***
	(0.0056)	(0.0135)			(0.0132)
$\phi_{i,t}^{*USD}$ (byfirm_USDRatio_im)			0.1203***	0.0827***	
			(0.0079)	(0.0038)	
year fixed effects	yes	yes	yes	yes	yes
N. of observations	921,088	921,088	921,088	1,949,018	809,308
Pseudo R^2	0.33		0.30	0.27	
firm-type	narrow two	narrow two	narrow two	broad two	narrow two

Note: The dependent variable is the US dollar invoicing currency ratio. The coefficients and standard errors are shown for marginal effect. The standard errors in parenthesis are clustered by the import size of destination countries and years. broad two-way exporters are those exporters that also import in the same year. Narrow two-way exporters are defined over the exporter and destination country pairs that also import from the same destination country in the same year. ***, **, * represent one, five, and ten percent significance level.

Table 3 shows that the results of two-way exporters are qualitatively the same as those of all exporters, including one-way exporters. Table 4 presents the estimated results with the dollar invoicing ratio on the import side. This variable is not introduced here to relate the exporter's choice of invoicing currency with the competitors' currency strategies as in Table 3. This analysis examines a possible incentive for firms to match currencies on the asset, i.e., receipt from exports, and debit side, i.e., payment for imports, of the balance sheet, and we call it a currency-matching incentive. If the cash inflow from exports and cash outflow for imports are in the same currency, the exchange rate risk hinges only on the net balance.

The first column in Table 4 includes the US dollar ratio of imports, $\phi_{i,k,t}^{*\text{USD}}$, as an additional explanatory variable for narrow two-way exporters. The US dollar ratio for imports is similarly constructed as the US dollar ratio, the dependent variable, for the same firm and the same country. The US dollar ratio for imports is statistically significant. The estimated coefficient indicates that a ten-percentage point increase in the US dollar ratio for imports in the same industry and country induces a 1.93 percentage point increase in the dollar use in exports. The endogeneity issue may exist for the import-side variable.[20] In the second column, we re-estimated the model as in column (1) but used $\gamma_{k,t}^{*\text{USD}}$ and $\gamma_{i,t}^{*\text{USD}}$ as instruments in the instrumental variable fractional probit model. The estimated results are similar to those in column (1).

In columns (3) and (4), we replace the US dollar ratio for firm-destination import,$\phi_{i,k,t}^{*\text{USD}}$, with the US dollar ratio for firm import, $\phi_{i,t}^{*\text{USD}}$, which is not destination-specific. Firm size, market share, and strategic complementarity variables are only marginally affected, and their estimates remain statistically significant at the one percent level. In column (3), the magnitude of the currency-matching coefficient at the firm level is smaller than the currency-matching variable at the firm-destination level in column (1). This result implies that a typical firm pays more attention to balancing the currency flows on a country basis than managing every currency flow over the firm's entire accounting. Column (4) shows that the US dollar invoicing ratio for broad two-way exporters is less sensitive to the firms' US dollar invoicing for imports. To summarize, narrow two-way exporters are more inclined than broad two-way exporters to match the invoicing currency of exports to the overall invoicing currency of imports, and they pay more attention to a country basis for currency matching.

[20] We estimated the corresponding estimation model as of equation (11) for imports and found that similar results hold for the import side.

4.2 Vehicle Currency, Producer Currency, and Local Currency Invoicing

We found supporting evidence for strategic complementarities and currency matching for the US dollar invoicing in the preceding section. In this section, we investigate other currency invoicing practices and show that the central message holds.

Table 5: Producer currency pricing and local currency pricing

	(1) JPY Frac. Probit	(2) JPY IV Frac. Probit	(3) LC Frac. Probit	(4) LC IV Frac. Probit
$lnSize_{i,k,t}$	0.0046***	0.0017***	0.0024***	0.0033***
	(0.0006)	(0.0005)	(0.0004)	(0.0005)
$MShare_{i,t}$ (HS4)	0.1242	0.2521***	-0.9528***	-0.7118***
	(0.0996)	(0.0904)	(0.1116)	(0.1042)
$\gamma^{JPY}_{k,t}(\gamma^{LC}_{k,t})$ (SC_Country_JPY(LC))	0.3811***	0.2806***	0.3797***	0.2560***
	(0.0258)	(0.0193)	(0.0069)	(0.0267)
$\gamma^{JPY}_{i,t}(\gamma^{LC}_{i,t})$ (SC_HS4_JPY(LC))	1.0501***	0.9623***	0.7737***	0.7137***
	(0.0063)	(0.0076)	(0.0311)	(0.0379)
$\phi^{*JPY}_{i,k,t}(\phi^{*LC}_{i,k,t})$ (JPY(LC)Ratio_im)		0.2168***		0.1239***
		(0.0067)		(0.0299)
year fixed effects	yes	yes	yes	yes
N. of observations	921,088	921,088	921,088	921,088
Psuedo R^2	0.30		0.41	
firm-type	narrow two	narrow two	narrow two	narrow two

Note: The dependent variable is the Japanese yen invoicing ratio in columns (1) and (2) and the local currency invoicing ratio in columns (3) and (4). The coefficients and standard errors are shown for the marginal effect. Standard errors in parenthesis are clustered by the import size of destination countries and years. Narrow two-way exporters are defined over the pairs of exporter and destination country that also import from the same destination country in the same year. ***, **, * represent one, five, and ten percent significance level.

4.2.1 Vehicle Currency: The US dollar Invoicing to non-US markets

Including the US as a destination country in the estimation for the US dollar invoicing may bias the estimates. The US dollar invoicing to non-US destination countries is a form of vehicle currency invoicing. This pervasive use of the US dollar in trade with countries other than the U.S. supports the fundamental idea of the dominant currency paradigm in the literature, for

example, in Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller (2020). Therefore, we re-estimate the regressions, excluding the US as the destination country.

Column (5) in Table 4 presents the estimated equation (13) results by excluding the US from destination countries. This robustness check confirms that the qualitative results remain intact even when the US is excluded from the sample, reducing approximately 12 percent of firm-destination observations. The impact of strategic complementarity in the destination market is lower, consistent with our expectations. In the competing industries, it is also lower but less substantially. The effect of currency matching is slightly more significant. To summarize, the preceding results of US dollar invoicing do not hinge on the presence of the US in the sample, but vehicle currency use or the dominant currency role of the US dollar is supported in samples other than the United States.

4.2.2 Producer Currency Invoicing: Japanese yen Invoicing

Examining whether the strategic complementarity and currency matching mechanisms also work on other invoicing currencies is important. In our data set, we turn to the producer currency invoicing, i.e., the Japanese yen invoicing. The dependent variable is the Japanese yen invoicing ratio at the firm-destination pairs. The explanatory variables are similarly constructed for the Japanese yen invoicing. The first two columns of Table 5 present the estimation results for the Japanese yen invoicing.

There is one noteworthy difference between the US dollar and Japanese yen invoicing. The estimated signs of size and market share variables are opposite of the US dollar invoicing model. Therefore, it implies that a larger-sized Japanese exporter is more likely to choose the Japanese yen over the US dollar. The market share, representing the competitiveness of exporters, allows the Japanese exporters to use their own currency. This is consistent with the results found in Ito, Koibuchi, Sato, and Shimizu (2012) that firms that responded positively to the questionnaire about their international competitiveness are more likely to choose Japanese yen invoicing. Besides these differences, the qualitative results are the same for the US dollar and Japanese yen invoicing.

4.2.3 Local Currency Invoicing

Columns (3) and (4) in Table 5 show the results for local currency pricing. The estimated sign of the size variable is positive and opposite of the US dollar invoicing model. In contrast, the market share variable shows the same sign as in the US dollar invoicing model. The size variable is consistent with the result in Amiti, Itskhoki, and Konings (2022) with the subsample

analysis of dollar-invoicing against local-currency invoicing for non-US and non-USD-pegging countries. The estimated coefficients of the firm's employees are negative and statistically significant, implying a larger firm is more likely to invoice in local currencies.[21]

Regarding strategic complementarity and currency matching variables, the estimates are a little smaller than the US dollar invoicing, but they are all statistically significant at the one percent level. Therefore, regardless of the dominant vehicle, producer, or local currency, strategic complementarity and currency-matching mechanisms for choosing the invoicing currency work for Japanese exporters.

4.3 Robustness: Alternative size, market share, and strategic complementarity

Some of the control variables used so far can be defined differently. In this section, we re-estimate the models by replacing the original variables with alternatives. The estimated results of the base model, column (2) in Table 4, are reproduced in column (1) of Table 6. First, we evaluate the robustness of firm size. The size of firms is measured initially as export values by a firm to a destination country. Alternatively, export values by a firm to all destination countries in column (2), the sum of export and import values by a firm to a destination country in column (3), and the sum of all exports and imports by a firm in column (4) are used in the model. The estimated coefficients of alternative size variables are consistent with the estimate in column (1); they are negative and statistically significant at the one percent level, and the estimates are smaller.

Second, we check the robustness of market share. Alternative variables are defined as the firm's export value to total export values by all Japanese exporters in a destination country in column (5), and HS 2-digit and 6-digit instead of HS 4-digit level are used in columns (6) and (7), respectively. All the estimates are consistent with the result of the base model. The magnitude varies among alternatives due to decreased measure of market share as industry classification becomes broader. Third, the strategic complementarity variable is replaced with those with different levels of industry classification in columns (8) and (9). The estimated results are almost identical to the result of the original variable. In summary, the results in previous sections are robust to alternative definitions of explanatory variables.

[21] See, Table IV in Amiti, Itskhoki, and Konings (2022).

Table 6: Alternative definitions of size, market share, and strategic complementarity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
alternative variable		size (e, all)	size (e&i)	size (e&i, all)	ms (dest.)	ms (HS2)	ms (HS6)	sc (HS2)	sc (HS6)
$lnSize_{i,k,t}$	-0.0073***	-0.0064***	-0.0044***	-0.0035***	-0.0075***	-0.0072***	-0.0074***	-0.0075***	-0.0074***
	(0.0007)	(0.0007)	(0.0008)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
$MShare_{i,t}$	-0.7317***	-0.5842***	-0.9623***	-0.8997***	-0.0847*	-2.6846***	-0.2910***	-0.3568***	-0.7524***
	(0.1708)	(0.1678)	(0.1736)	(0.1784)	(0.0515)	(0.2497)	(0.0820)	(0.1188)	(0.1733)
$\gamma_{k,t}^{USD}$ (SC country)	0.2651***	0.2469***	0.2529***	0.2462***	0.2661***	0.2645***	0.2654***	0.2482***	0.2585***
	(0.0168)	(0.0189)	(0.0180)	(0.0194)	(0.0168)	(0.0168)	(0.0168)	(0.0172)	(0.0169)
$\gamma_{i,t}^{USD}$ (SC industry)	0.9647***	0.9835***	0.9552***	0.9647***	0.9624***	0.9661***	0.9637***	1.0000***	0.9404***
	(0.0211)	(0.0202)	(0.0208)	(0.0198)	(0.0213)	(0.0213)	(0.0211)	(0.0197)	(0.0214)
$\phi_{i,k,t}^{*USD}$ (USDRatio_im)	0.1954***	0.1890***	0.2096***	0.2044***	0.1952***	0.1953***	0.1955***	0.2053***	0.2067***
	(0.0135)	(0.0143)	(0.0135)	(0.0136)	(0.0135)	(0.0136)	(0.0135)	(0.0142)	(0.0135)
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
NOB	921,088	921,088	921,088	921,088	921,088	921,088	921,088	921,088	921,088
N. of firms	131,923	131,923	131,923	131,923	131,923	131,923	131,923	131,923	131,923

Note: The dependent variable is the US dollar invoicing currency ratio. These models are estimated by instrumental variable fractional probit, and the coefficients are marginal effects. Standard errors in parenthesis are clustered by the import size of the destination country and years. Firm types are narrow two-way exporters. ***, **, * represent one, five, and ten percent significance level. The first column is the base model and corresponds to column (2) in Table 4. From columns (2) to (4), alternative definitions for firm size are used; (e, all) export values to all destination countries, (e&i) the sum of export and import values to the same destination country, and (e&i, all) the sum of export and import values to and from all countries. From column (5) to (7), alternative definitions for market share are used: (dest.) market share of firms' export values in the destination country, (HS2) market share of firms' export in the corresponding HS 2-digit categories, and (HS6) market share of firms' export in the corresponding HS 2-digit categories. In the last two columns, alternative strategies complementarity variables are constructed at the level of HS 2-digit and 6-digit industries.

5 New Exporters

As discussed in section 3.2, one way to address the simultaneous problem of choosing invoicing currency in exports and imports is to use instrumental variable estimation or two-stage least squares. These are statistical methods to obtain consistent estimators. We applied the instrumental variable fractional probit estimation method in the previous section.

In addition to the simultaneous problem, we also face the difficulty of capturing firms' real-time decisions because of the strong inertia of invoicing currency.[22] What we observe as the current choice of invoicing currency of firms, conditional on the current explanatory and control variables, may be a legacy of past decisions. The estimates are biased if the current choice of invoicing currency does not reflect the current state of strategic complementarity and currency matching but the past state of those when the first decision is made.

In this section, we propose an alternative quasi-natural-experiment approach to tackle the issue. We focus on the subsample of firms that have yet to record international trade transactions in the last year. Therefore, the invoicing currency decision we analyze here is the first decision on new exporters' invoicing currency. In this way, we can at least exclude the pre-determined decision of the previous year on exports and imports from affecting the current year's decisions on exports. For these subgroups of firms, we re-estimate the regression model in equation (13). In the following years, firms may reevaluate the first decision and may alter the invoicing currency.

This analysis allows us to examine whether a currency-matching mechanism gradually forms as a firm accumulates years of trade experience.[23]

The first column in Table 7 shows the estimation results of equation (13) for 2015, including all narrow two-way exporters. Even for this particular single year, we confirm that strategic complementarity variables and currency matching variables, at the firm-destination level, significantly impact the invoice decision of the Japanese exporters. Size effect and market share effects are also consistent with the panel results.

[22] The strong inertia of invoicing currency at the macroeconomic level is discussed in Boz, Casas, Georgiadis, Gopinath, Le Mezo, Mehl, and Nguyen (2022). Theoretical models examining the emergence of vehicle currency or predominant international currency also generate the persistent role of vehicle currency in the international monetary system, see Devereux and Shi (2013) and Mukhin (2022).

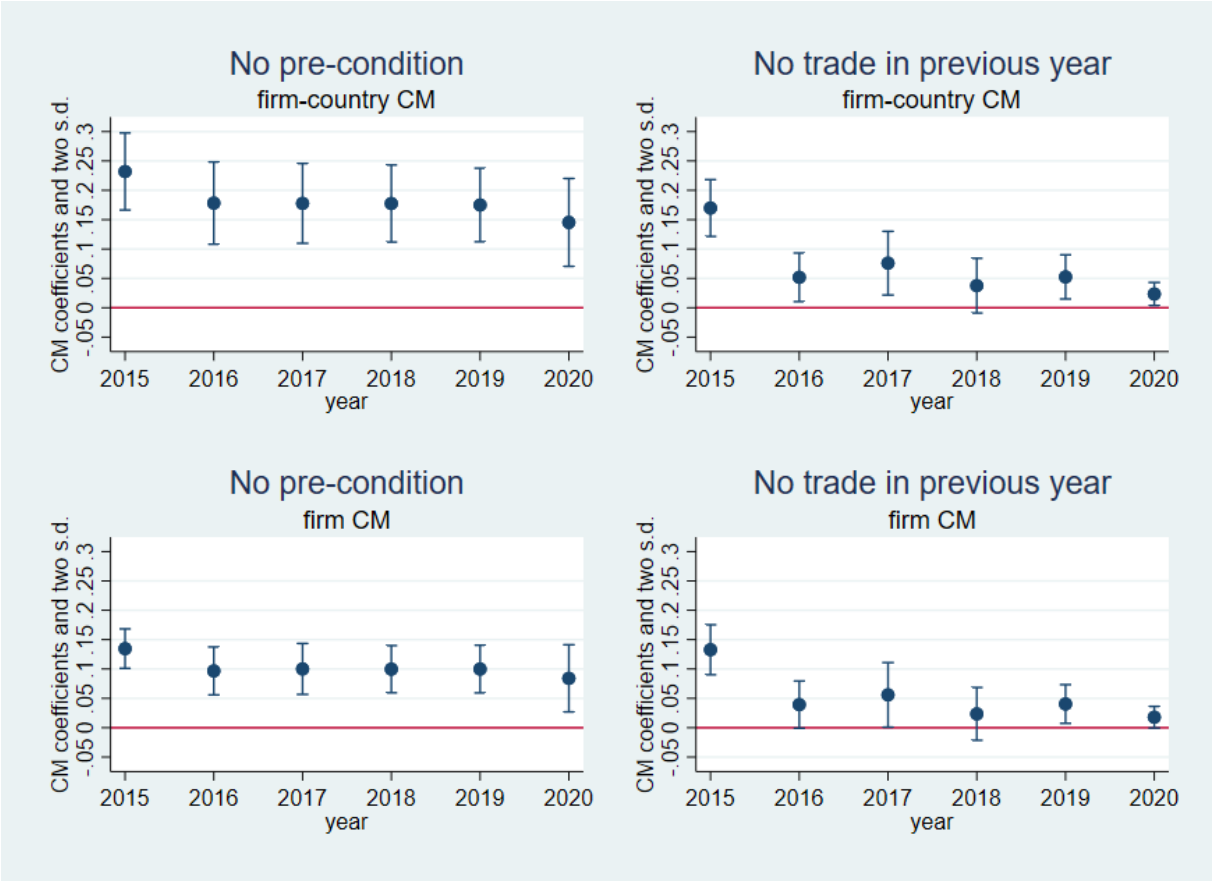
[23] Crowley, Han, and Son (2021) also examines the dynamic effects of dollar invoicing for UK firms. However, their focus is on the impact of the experience of using the dollar in *any markets* on choosing the dollar invoice in a new market.

Table 7: New Exporters in 2015

previous year		no trade		no trade
$lnSize_{i,k}$	-0.0099***	-0.0199***	-0.0112***	-0.0207***
	(0.0012)	(0.0015)	(0.0014)	(0.0016)
$MShare_i$ (HS4)	-1.0604***	0.0615	-0.9712***	0.0473
	(0.2738)	(0.5655)	(0.2896)	(0.6070)
γ_k^{USD} (SC_Country_USD)	0.2579***	0.2009***	0.4521***	0.2737***
	(0.0497)	(0.0305)	(0.0305)	(0.0270)
γ_i^{USD} (SC_HS4_USD)	0.8995***	1.4673***	0.9420***	1.4688***
	(0.0512)	(0.1226)	(0.0419)	(0.1278)
$\phi_{i,k}^{*USD}$ USDRatio_im	0.2320***	0.1698***		
	(0.0328)	(0.0242)		
ϕ_i^{*USD} byfirm_USDRatio_im			0.1347***	0.1328***
			(0.0168)	(0.0213)
NOB	131,417	5,343	131,417	5,343
N. of firms	49,935	4,494	49,935	4,494

Note: The dependent variable is the US dollar invoicing currency ratio. These models are estimated by instrumental variable fractional probit, and the coefficients are marginal effects. Standard errors in parenthesis are clustered by the import size of the destination country and years. Firm types are narrow two-way exporters. ***, **, * represent one, five, and ten percent significance level.

Figure 3: The effects of currency matching on new exporters



Note: The marginal effects are estimated by instrumental variable fractional probit. The vertical lines represent the confidence interval of two standard deviations for the impact of currency matching on the choice of invoicing currency in firm-destination pairs. All four panels are based on the estimated results for narrowly defined two-way exporters. For the definitions of currency matching, the upper panels use the firm-destination invoicing currency ratio, whereas the lower panels use the firm-level invoicing currency ratio. The left panels show the results without restrictions on the previous year's experience. The right panels show the sample with no trade in the last year.

The second column limited the sample to only new exporters in 2015. More precisely, the sample included only narrow two-way exporters in 2015, but these exporters did not export to or import from any countries in 2014. Regarding the number of firm-destination observations, compared with column (1), new exporters were about four percent of all exporters in 2015. Regarding the number of firms, new exporters in 2015 were about ten percent of all exporters. By replacing the currency matching variable with the firm-level measure, the third and fourth columns show the estimation results of equation (13) for all exporters and new exporters, respectively. In columns (2) and (4), the estimated coefficients remain statistically significant for firm size and two strategic complementarity indices. On the other hand, the market share is not statistically significant. The variable of interest in this section is currency matching variables, $\phi_{i,k}^{*\text{USD}}$ in column (2) and $\phi_{i}^{*\text{USD}}$ in column (4). The noteworthy point is that the magnitude of the estimate for the US dollar invoicing ratio substantially declined for new exporters, although still statistically significant.

The effects of currency matching for new exporters for other years are summarized in Figure 3.[24] The figure shows the point estimate and two standard deviation bands for the currency-matching variable. The estimates of currency matching variables at the firm-destination level are shown in the upper panel, and those of firm-level currency matching are shown in the lower panel. The currency matching variables are statistically significant at the one percent level when the sample includes all two-way exporters. However, the effects of currency matching became no longer statistically significant for 2016, 2018, and 2020 at the two standard deviations level when the sample only included new exporters. There are some differences in the estimation results among sample years; however, the qualitative results remain the same, namely, that currency matching evidence is weak at best for new exporters.

We have shown in the previous section that exporters choose their invoicing currency based on strategic complementarity and currency matching. This mechanism holds for the US dollar invoicing as well as producer currency invoicing, i.e., the Japanese yen invoicing in this study and local currency pricing. New exporters also choose their invoicing currency based on imitating their competitors' decisions in the destination country and the competing industries. However, currency matching is not the primary force for new exporters. How can this result of new exporters reconcile with the result of experienced exporters who consider currency matching as an essential factor for invoicing currency decisions?

One interpretation of these results is the following. A new exporter enters a destination market and observes what other competitors are doing, including invoicing currency choices.[25]

[24] The estimates of all variables are shown in the appendix tables.

[25] Exporters do not directly observe their competitors' invoicing currency, but they face business practices and

An exporter may import intermediate inputs from the same country but accept the import contract with the specified invoicing currency. As an exporter continues these transactions for several years, currency matching becomes an important issue. It may renegotiate with the incumbent trade partner about altering the invoicing currency or switch to a new partner that accepts the invoicing currency of the exporter's choice.

6 Discussions

So far, we have shown that our approach of aggregating Customs transaction records to the firm-destination level adequately captures the invoicing currency choice of Japanese exporters, especially for two-way exporters. The emphasis on this level of aggregation is based on favoring the approach of using the firm-level data, instead of using disaggregated individual transaction events, for firm-level decisions. However, we should not entirely ignore the empirical evidence found in the previous studies using transaction-level variables for invoicing currency choice.[26] As in this paper, one disadvantage of using observations at the firm-destination level is blurring the possible heterogeneous industry effects. It is not a problem for single-product firms; however, we had to take a weighted average of industry invoicing currency ratio for multi-product firms. In this section, we revisit the industry-level effects by constructing more robust variables for strategic complementarity.

Similar to the idea of strategic complementarity, Goldberg and Tille (2008) suggested coalescing effects in the choice of invoicing currency and found supporting evidence in transaction data of the Canadian imports. Both ideas are similar in the sense that they capture the interactions between competitors, resulting in the behaviors of following the invoicing choice of competitors.[27] In particular, Goldberg and Tille (2016) found evidence that a larger exporting country's market share of HS 4-digit industry induces more exporters to use their own currency than destination currency or vehicle currency, see also Bacchetta and Van Wincoop (2005). Countries with smaller market shares of HS 4-digit industry follow the decisions of these large market share countries.

standards for pricing when they enter the market. Their trade counterparts will likely request new exporters to follow the current business practices.

[26] Examining the invoice currency choice at the transaction level is necessary if we examine invoicing currency decisions as the result of bargaining between exporters and importers; see Friberg and Wilander (2008), Goldberg and Tille (2013), and Devereux, Dong, and Tomlin (2017). In fact, we are working with transaction-level data to investigate the bargaining model between exporters and importers in another ongoing project.

[27] In addition, Goldberg and Tille (2008) also emphasizes that this effect is more likely to appear in the industry for homogeneous products in which products of competitors are close substitutes.

This section introduces two additional indices to the previous framework and examines the coalescing effect discussed in Goldberg and Tille (2008) and Goldberg and Tille (2016). As the first new variable, We introduce a modified strategic complementarity index, accommodating Japan's industry-level market share in destination markets. First, the shares of Japan's exports in the destination country k's import at HS 4-digit industry j are calculated at the annual frequency by using the UN Comtrade database, $JPNShare_{j,k}$. Next, the weighted average over all destination countries is taken; $JPNShare_j = \sum \omega_k JPNShare_{j,k}$. Then, each term in equation (7) is multiplied by Japan's HS-4 industry share.

$$\tilde{\gamma}^{\text{USD}}_{i,t} = \sum_j JPNshare_j \{p_{i,t}(j) \cdot IC_{c=\text{USD},-i,j,t}\} \tag{14}$$

where $p_{i,t}(j)$ is the share of firm i's export in HS 4-digit industry j in year t, and $IC_{c=\text{USD},-i,j,t}$ is the dollar ratio in industry j, adjusted for each Japanese exporter.

With this new strategic complementarity variable, we estimate the modified version of equation (13).

$$\phi^c_{i,k,t} = \alpha + \beta_0 lnSize_{i,k,t} + \beta_1 MShare_{i,t} + \beta_2 \gamma^c_{k,t} + \beta_3 \gamma^c_{i,t} + \tilde{\beta}_3 \tilde{\gamma}^c_{i,t} + \beta_4 \phi^{*c}_{i,k,t} + \epsilon_{i,k,t}, \tag{15}$$

where c is either USD, JPY, or LC. The expected hypothesis of the coalescing effect is that a higher exporting country market share induces exporters to invoice in their currency, i.t., producer currency invoicing. Therefore, the modified strategic complementarity index, $\tilde{\gamma}^c_{k,t}$, is expected to positively affect the Japanese invoicing currency ratio and negatively affect the US dollar or local currency invoicing ratio. The estimated results are shown in the appendix table B.1. Dependent variables are the US dollar, Japanese yen, and local currency invoicing ratio at firm-destination pairs, in columns 1 through 3. The corresponding results without $\tilde{\gamma}^c_{k,t}$ are Column (2) in Table 4 and Column (2) and (4) in Table 5. The estimated coefficients of other variables are only mildly affected except for the size variable in the Japanese yen invoicing model. For the parameters of interest, we obtained negative and statistically significant effects on both US dollar and local currency invoicing although the effect on Japanese yen invoicing is not statistically significant. Therefore, the coalescing effect emphasized in Goldberg and Tille (2008) and Goldberg and Tille (2016) are also found in our analysis while we can still capture the strategic complementarity effect.

Next, we constructed the importing country's market share, following the emphasis on the bargaining between exporters and importers in Goldberg and Tille (2016).[28] First, we use the

[28] Goldberg and Tille (2016) considered importer concentration by using the share accounted by the top 10 Canadian importers by HS 4-digit industry.

UNComtrade database again for importing country k, and the shares of country k's exports in the world exports at HS 4-digit industries are calculated, $ImpShare_{j,k,t}$. Then, we construct the importing country's share,$ImpShare_{i,k,t}$, corresponding to the firm i's HS 4-digit weights. For a higher market share by importing country, the PCP, the Japanese yen invoicing in this study, will be chosen less. On the other hand, the LCP or VCP, i.e., USD invoicing, will chosen more often if an importing country's market share is large. The estimated results are shown in appendix table B.2. As similar as in the table B.1, the estimated coefficients are qualitatively the same as in the previous sections. More importantly, the variable of interest, $ImpShare_{i,k,t}$, shows a positive effect on the USD invoicing and local currency invoicing with statistical significance and a negative effect on the Japanese yen invoicing. The results in the appendix tables confirm that our empirical evidence is simultaneously consistent with strategic complementarity and coalescing effects.

7 Conclusions

We contribute to the literature by providing evidence of the Japanese exporters, not only as another example but as a country not using the US dollar or euro as its own currency nor being involved in dominant currency regimes, such as the UK or Canada. No study using this new database has appeared because the data set became available only in 2022. This is not to claim that no previous studies examined the invoicing currency choice of Japanese exporters. Ito, Koibuchi, Sato, and Shimizu (2012) and Ito, Koibuchi, Sato, and Shimizu (2018) conducted multi-year questionnaire surveys to the listed multinational corporations in Japan and concluded that foreign exchange risk management is the driving force for the dominating share of US dollar invoicing for Japanese exporters, especially to the US and China as destination markets. They also found that intra-firm trade occupies a lion's share of international trade for multinational firms, and the parent firms headquartered in Japan tend to use the currency of subsidiaries' locations. This study complements the earlier findings that the competitors' currency choice and matching with the invoicing currency of imports are also important factors for invoicing currency choice for Japanese exporters.

In addition, we focus our attention on two-way exporters and provide narrow and broad definitions. A broader definition of two-way exporters includes a firm that imports from country A and exports to country B. As long as a firm experiences exports and imports in the same year regardless of which countries, by a broader definition, it is labeled as a broad two-way exporter. Our definition of narrow two-way exporter excludes those firms.[29] This narrow definition has

[29]More precisely, our definition does not mechanically exclude a firm that imports from A and exports to B. It

important implications. Firms surviving this screening may be more active in intra-firm trade, especially if located in the middle of a vertical production network. Another plausible scenario is that the sample merely captures the fact that narrow two-way exporters are trading with big countries with a prominent share in both producing and consuming in the world, such as the United States. We confirmed that the latter is not a decisive factor, as shown by the analysis of excluding the US from the sample in section 4.2.1. More importantly, we find evidence of matching with invoicing currency of imports, $\phi^*_{i,k}$, even when we restrict to this narrow definition of two-way exporters, which should make detecting the effect more difficult.

Finally, it should be noted that the strategic complementarity and currency matching mechanisms are not only found for the so-called dominant currency, but we also found the same mechanisms work robustly for producer currency invoicing and, even surprisingly, for local currency invoicing. The latter is a new finding in the currency invoicing literature, often emphasizing the US dollar's dominant role. Therefore, we conclude that the observed invoicing currency may differ for destination countries and industries, but the underlying driving force is essentially the same.

is labeled a two-way exporter as long as it also imports from B.

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A Appendix:

The list of 21 Asian countries included in Table 1

Bangladesh, Bhutan, Brunei, Cambodia, India, Indonesia, Republic of Korea, Laos, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Timor-Leste, Viet Nam, and Taiwan.

The list of Euro area countries included in Table 1

Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania (from 2015), Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain.

Table A.1: Statistical Summary for regression variables

	all exporters			broad two-way exporters			narrow two-way exporters		
Variable	observations	mean	std. dev	observations	mean	std. dev	observations	mean	std. dev
USDRatio	3,043,901	0.2571	0.4239	1,949,043	0.3082	0.4437	921,088	0.3325	0.4448
JPYRatio	3,043,901	0.6807	0.4526	1,949,043	0.6079	0.4693	921,088	0.5645	0.4676
LCRatio	3,043,901	0.0879	0.2758	1,949,043	0.1001	0.2898	921,088	0.1508	0.3429
size (base)	3,043,901	13.4956	3.6387	1,949,043	14.2880	3.6974	921,088	14.9796	3.9483
size (e, all)	3,043,901	16.3558	4.6324	1,949,043	18.2988	3.9995	921,088	18.2667	4.2292
size (e&i)	921,088	16.9312	3.0968	921,088	16.9312	3.0968	921,088	16.9312	3.0968
size (e&i, all)	921,088	19.9535	3.3963	921,088	19.9535	3.3963	921,088	19.9535	3.3963
ms (dest.)	3,043,901	0.0005	0.0107	1,949,043	0.0008	0.0129	921,088	0.0006	0.0097
ms (HS2)	3,043,901	0.0002	0.0025	1,949,043	0.0003	0.0031	921,088	0.0004	0.0033
ms (HS4)	3,043,901	0.0006	0.0069	1,949,043	0.0009	0.0075	921,088	0.0010	0.0077
ms (HS6)	3,043,901	0.0013	0.0131	1,949,043	0.0016	0.0133	921,088	0.0018	0.0147
SC (country)	3,043,872	0.4540	0.2211	1,949,018	0.4292	0.2266	921,088	0.4587	0.2261
SC (HS4)	3,043,901	0.1076	0.1724	1,949,043	0.1369	0.1826	921,088	0.1518	0.1914
USDRatio*	18,941,417	0.4159	0.4878	1,970,981	0.4970	0.4798	921,088	0.5189	0.4712
byfirm_USDRatio*	19,969,372	0.4241	0.4642	2,998,936	0.5293	0.3977	921,088	0.5371	0.3867
SC (country)*	18,941,386	0.5447	0.2599	1,970,967	0.4825	0.2793	921,088	0.5196	0.2603
SC (HS4)*	18,941,417	0.2644	0.3148	1,970,981	0.3223	0.2706	921,088	0.3225	0.2650

Note: Broad two-way exporters are those exporters that also import in the same year. Narrow two-way exporters are defined over the exporter and destination country pairs that also import from the same destination country in the same year. These definitions are applied to the observations of each year. The first row represents the number of exporter-country pairs whereas the second row indicates the number of distinct exporters. The ratio in parenthesis excludes the US from the calculation. LC is local currency invoicing.

Table A.2: New Exporters in 2016

previous year		no trade		no trade
$lnSize_{i,k}$	-0.0064***	-0.0025**	-0.0073***	-0.0026**
	(0.0015)	(0.0010)	(0.0018)	(0.0011)
$MShare_i(HS4)$	-1.4520***	0.2470	-1.3882***	0.3317
	(0.2864)	(1.1597)	(0.3144)	(1.2514)
γ_k(SC_Country_USD)	0.2816***	0.1270***	0.4366***	0.1563***
	(0.0415)	(0.0157)	(0.0217)	(0.0148)
γ_i(SC_HS4_USD)	0.9841***	1.0130***	1.0268***	1.0223***
	(0.0505)	(0.0383)	(0.0438)	(0.0306)
$\phi^*_{i,k}$USDRatio_im	0.1782***	0.0518**		
	(0.0350)	(0.0207)		
ϕ^*_ibyfirm_USDRatio_im			0.0967***	0.0393*
			(0.0204)	(0.0201)
NOB	130,863	4,905	130,863	4,905
N. of firms	49,404	4,247	49,404	4,247

Note: The dependent variable is the US dollar invoicing currency ratio. These models are estimated by instrumental variable fractional probit, and the coefficients are marginal effects. Standard errors in parenthesis are clustered by the import size of the destination country and years. Firm types are narrow two-way exporters. ***, **, * represent one, five, and ten percent significance level.

Table A.3: New Exporters in 2017

previous year		no trade		no trade
$lnSize_{i,k}$	-0.0069***	-0.0054***	-0.0077***	-0.0055***
	(0.0015)	(0.0019)	(0.0018)	(0.0020)
$MShare_i$ (HS4)	-0.3815	-0.0310	-0.3433	-0.0401
	(0.3789)	(0.1670)	(0.3804)	(0.1934)
γ_k (SC_Country_USD)	0.2678***	0.1587***	0.4107***	0.2057***
	(0.0425)	(0.0298)	(0.0253)	(0.0223)
γ_i (SC_HS4_USD)	0.9744***	1.0986***	1.0144***	1.1128***
	(0.0517)	(0.0229)	(0.0473)	(0.0313)
$\phi^*_{i,k}$ USDRatio_im	0.1777***	0.0759***		
	(0.0340)	(0.0271)		
ϕ^*_i byfirm_USDRatio_im			0.1001***	0.0559**
			(0.0217)	(0.0275)
NOB	132,648	8,315	132,648	8,315
N. of firms	50,825	6,494	50,825	6,494

Note: The dependent variable is the US dollar invoicing currency ratio. These models are estimated by instrumental variable fractional probit, and the coefficients are marginal effects. Standard errors in parenthesis are clustered by the import size of the destination country and years. Firm types are narrow two-way exporters. ***, **, * represent one, five, and ten percent significance level.

Table A.4: New Exporters in 2018

previous year		no trade		no trade
$lnSize_{i,k}$	-0.0065***	-0.0031	-0.0074***	-0.0034*
	(0.0015)	(0.0019)	(0.0018)	(0.0020)
$MShare_i$ (HS4)	-0.7688	0.4015	-0.7540	0.3133
	(0.4897)	(1.1139)	(0.4981)	(1.1955)
γ_k(SC_Country_USD)	0.2719***	0.1538***	0.4185***	0.1791***
	(0.0455)	(0.0216)	(0.0266)	(0.0155)
γ_i(SC_HS4_USD)	0.9810***	1.0325***	1.0231***	1.0578***
	(0.0490)	(0.0230)	(0.0447)	(0.0228)
$\phi^*_{i,k}$USDRatio_im	0.1775***	0.0376		
	(0.0328)	(0.0233)		
ϕ^*_ibyfirm_USDRatio_im			0.0997***	0.0235
			(0.0201)	(0.0225)
NOB	130,776	6,460	130,776	6,460
N. of firms	49,134	5,560	49,134	5,560

Note: The dependent variable is the US dollar invoicing currency ratio. These models are estimated by instrumental variable fractional probit, and the coefficients are marginal effects. Standard errors in parenthesis are clustered by the import size of the destination country and years. Firm types are narrow two-way exporters. ***, **, * represent one, five, and ten percent significance level.

Table A.5: New Exporters in 2019

previous year		no trade		no trade
$lnSize_{i,k}$	-0.0063***	-0.0009	-0.0070***	-0.0011
	(0.0017)	(0.0011)	(0.0019)	(0.0011)
$MShare_i$ (HS4)	-0.7293	6.0224**	-0.7085	6.6410**
	(0.4849)	(2.7632)	(0.5036)	(2.9414)
γ_k(SC_Country_USD)	0.2789***	0.0748***	0.4295***	0.0986***
	(0.0376)	(0.0178)	(0.0172)	(0.0197)
γ_i(SC_HS4_USD)	1.0106***	0.9665***	1.0500***	0.9826***
	(0.0523)	(0.0418)	(0.0480)	(0.0394)
$\phi^*_{i,k}$USDRatio_im	0.1750***	0.0525***		
	(0.0313)	(0.0188)		
$\phi^*_{i,}$byfirm_USDRatio_im			0.0999***	0.0404**
			(0.0203)	(0.0165)
NOB	129,953	4,106	129,953	4,106
N. of firms	49,137	3,674	49,137	3,674

Note: The dependent variable is the US dollar invoicing currency ratio. These models are estimated by instrumental variable fractional probit, and the coefficients are marginal effects. Standard errors in parenthesis are clustered by the import size of the destination country and years. Firm types are narrow two-way exporters. ***, **, * represent one, five, and ten percent significance level.

Table A.6: New Exporters in 2020

previous year		no trade		no trade
$lnSize_{i,k}$	-0.0029	0.0010	-0.0033	0.0010
	(0.0022)	(0.0008)	(0.0025)	(0.0009)
$MShare_i$ (HS4)	-1.3609***	0.7241	-1.3424***	0.8296
	(0.2818)	(2.0715)	(0.2884)	(2.0540)
γ_k(SC_Country_USD)	0.2575***	0.0310***	0.3724***	0.0396***
	(0.0403)	(0.0107)	(0.0146)	(0.0091)
γi(SC_HS4_USD)	1.0703***	0.8981***	1.1022***	0.9065***
	(0.0584)	(0.0636)	(0.0566)	(0.0632)
$\phi i, k^*$USDRatio_im	0.1453***	0.0234**		
	(0.0374)	(0.0098)		
ϕ_i^*byfirm_USDRatio_im			0.0841***	0.0179*
			(0.0286)	(0.0092)
NOB	133,242	8,589	133,242	8,589
N. of firms	55,831	7,627	55,831	7,627

Note: The dependent variable is the US dollar invoicing currency ratio. These models are estimated by instrumental variable fractional probit, and the coefficients are marginal effects. Standard errors in parenthesis are clustered by the import size of the destination country and years. Firm types are narrow two-way exporters. ***, **, * represent one, five, and ten percent significance level.

B Appendix: Coalescing effect

Table B.1: Coalescing effect, exporting country's market share at HS 4-digit industry

	(1) USD IV Frac. Probit	(2) JPY IV Frac. Probit	(3) LC IV Frac. Probit
$lnSize_{i,k,t}$	-0.0056***	-0.0005	0.0046***
	(0.0006)	(0.0005)	(0.0004)
$Mshare_{i,t}$ (HS4)	-0.6310***	0.1752*	-0.5006***
	(0.1682)	(0.0917)	(0.0853)
$\gamma_{k,t}^{USD}$ (SC_Country_USD)	0.2661***		
	(0.0185)		
$\gamma_{k,t}^{JPY}$ (SC_Country_JPY)		0.2885***	
		(0.0227)	
$\gamma_{k,t}^{LC}$ (SC_Country_LC)			0.2474***
			(0.0318)
$\gamma_{i,t}^{USD}$ (SC_HS4_USD)	0.9319***		
	(0.0220)		
$\gamma_{i,t}^{JPY}$ (SC_HS4_JPY)		0.9593***	
		(0.0096)	
$\gamma_{i,t}^{LC}$ (SC_HS4_LC)			0.6953***
			(0.0317)
$\tilde{\gamma}_{i,t}^{USD}$ (JPN share adj., SC_HS4_USD)	-0.3610***		
	(0.0579)		
$\tilde{\gamma}_{i,t}^{JPY}$ (JPN share adj., SC_HS4_JPY)		0.0109	
		(0.0624)	
$\tilde{\gamma}_{i,t}^{LC}$ (JPn share adj., SC_HS4_LC)			-0.5068***
			(0.0838)
$\phi_{i,k,t}^{*USD}$ (USDRatio_im)	0.2020***		
	(0.0152)		
$\phi_{i,k,t}^{*JPY}$ (JPYRatio_im)		0.2392***	
		(0.0068)	
$\phi_{i,k,t}^{*LC}$ (LCRatio_im)			0.1454***
			(0.0339)
NOB	753,205	753,205	753,205

Note: The dependent variable is the corresponding invoicing currency ratio. $\tilde{\gamma}_{k,t}^{c}$ is the strategic complementarity index, adjusted for Japan's export market shares. The corresponding results without $\tilde{\gamma}_{k,t}^{c}$ are shown in Column (2) in Table 4 and Column (2) and (4) in Table 5. The coefficients and standard errors estimated by an instrumental variable fractional probit model are shown for the marginal effect. The standard errors in parenthesis are clustered by the import size of destination countries and years. Narrow two-way exporters are defined over the exporter and destination country pairs that also import from the same destination country in the same year. ***, **, * represent one, five, and ten percent significance level.

Table B.2: Coalescing effect, importing country market share

	(1) USD IV Frac. Probit	(2) JPY IV Frac. Probit	(3) LC IV Frac. Probit
$lnSize_{i,k,t}$	-0.0053***	0.0004	0.0034***
	(0.0007)	(0.0005)	(0.0005)
$Mshare_{i,t}$ (HS4)	-0.6600***	0.1210	-0.5827***
	(0.1715)	(0.0805)	(0.0919)
$\gamma_{k,t}^{USD}$ (SC_Country_USD)	0.3093***		
	(0.0169)		
$\gamma_{k,t}^{JPY}$ (SC_Country_JPY)		0.3205***	
		(0.0239)	
$\gamma_{k,t}^{LC}$ (SC_Country_LC)			0.2752***
			(0.0312)
$\gamma_{i,t}^{USD}$ (SC_HS4_USD)	0.9724***		
	(0.0186)		
$\gamma_{i,t}^{JPY}$ (SC_HS4_JPY)		1.0389***	
		(0.0079)	
$\gamma_{i,t}^{LC}$ (SC_HS4_LC)			0.7441***
			(0.0336)
$ImpShare_{i,k,t}$	0.1634*	-0.5435***	0.5319***
	(0.0872)	(0.1493)	(0.1080)
$\phi_{i,k,t}^{*USD}$ (USDRatio_im)	0.1663***		
	(0.0139)		
$\phi_{i,k,t}^{*JPY}$ (JPYRatio_im)		0.1932***	
		(0.0063)	
$\phi_{i,k,t}^{*LC}$ (LCRatio_im)			0.0963***
			(0.0349)
NOB	637,404	637,404	637,404

Note: The dependent variable is the corresponding invoicing currency ratio. $ImpShare_{i,k,t}$ represents the importing country's market shares at HS 4-digit industries, adjusted for each Japanese exporter. The corresponding results without $dest\_HS4\_share$ are shown in Column (2) in Table 4 and Column (2) and (4) in Table 5.The coefficients and standard errors estimated by an instrumental variable fractional probit model are shown for the marginal effect. The standard errors in parenthesis are clustered by the import size of destination countries and years. Narrow two-way exporters are defined over the exporter and destination country pairs that also import from the same destination country in the same year. ***, **, * represent one, five, and ten percent significance level.