Invoice Currency Choice: Strategic Complementarities and Currency Matching

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Abstract

In this study, we investigate the determinants of invoice currency choice by utilizing the transaction level information contained in export and import declarations at Japan Customs. With this new data set, we identified two-way exporters that export to and import from the same country in the same year. As determinants for invoice currency choice, we found currency matching is as essential as strategic complementarity for two-way exporters. In particular, two-way exporters choose the same invoice currency for exports and imports to minimize the exchange risk generated by currency mismatch. In addition, the strategic complementarity mechanism found in the literature also works for Japanese exporters. They choose the same invoicing currency as the competitors in the same industry or in the same destination market. We also found evidence that newly-entering two-way exporters consider less 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 make one international financial decision. Faced with fluctuating exchange rates, the choice of invoice currency affects the exporter's consequent revenue in terms of home currency. In this study, we investigate the determinants of invoice currency choice by utilizing the transaction level information contained in export and import declarations at Japan Customs. With this new data set, we identified two-way exporters by the definition of exporting firms also involved in importing in the same country. As determinants for invoice currency choice, we found currency matching is as essential as strategic complementarity for two-way exporters. In particular, two-way exporters have incentives to choose invoice currency for their exports to match those for their imports to minimize the exchange risk generated by currency mismatch. Using the Belgian firm transaction level data, Amiti, Itskhoki, and Konings (2022) called the phenomenon strategic complementarity in which the competitors' choice of invoice currency in the same industry induces an exporter to choose the same currency[1]. We also examine whether the exact mechanism works for Japanese exporters.

The choice of invoice currency is an important component for the degree of exchange rate pass-through. From the point of view of importing country, an import price invoiced in the importing country's currency shows a small change with respect to a change in the exchange rate, whereas an import price invoiced in the exporter's currency demonstrates a relatively large proportionate change, see Gopinath and Rigobon (2008) and Gopinath, Itskhoki, and Rigobon (2010).

The availability of transaction-level data with information on currency invoicing pushed forward research on invoice currency choice. However, some countries have inherent problems in investigating this issue. The US dollar is simultaneously the dominant currency and local currency for US imports(Gopinath and Rigobon 2008), therefore, the observed effects cannot be distinguished between the local currency effect and the dominant currency effect. The euro is used extensively with neighboring countries for the Belgian exporters, thus, excluding these exports from the analysis distorts the results(Amiti, Itskhoki, and Konings 2022). Having been a member of the EU, the UK data cannot avoid similar problems (Chung 2016, Crowley, Han, and Son 2021, Corsetti, Crowley, and Han 2022) Therefore, investigating the exporters with their home currency being neither the dollar nor the euro is expected to make a good contribution to the literature. Using a new data set for Japanese firms, we examine how dollar invoicing is

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

formed for non-dollar destination countries, without discarding the large portion of trade data.

The data set became available in 2022 for the purpose of government-owned data utilization in the Ministry of Finance, Japan[2]. The data consists of a complete set of general export and import declarations between 2014 and 2020[3]. Each transaction record includes the identification of the exporter/importer, the departing/landing port, the content of products, invoice 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. 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. Instead of raw records, we aggregated records by exporters (importers) and trading partner countries. This aggregation still leaves the data set with hundreds of thousands of records for single-year exports. In addition, we also utilize industries at the Harmonized System (HS) 4-digit classification codes.

We construct the ratio of the US dollar invoiced trade value to the overall trade value in the firm-country pair. Following the studies by Gopinath, Itskhoki, and Rigobon (2010) and Amiti, Itskhoki, and Konings (2022), we examine whether currency invoicing decision is determined by strategic complementarities. The Japanese exporters use the US dollar as invoice currency because their competitors also use US dollar invoicing in the same destination country and/or in the same industry. In addition, we also find currency matching incentives in the balance sheet of exporters are important drivers for US dollar invoicing. The Japanese exporters favor the use of US dollar invoicing in exports if their imports are invoiced in US dollars.

The remaining structure 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. Section 4 shows empirical evidence, and the last section concludes.

2 Invoice Currency Choice at the Firm-Country level

2.1 Literature review on invoice currency and dominant currency

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

[2]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 from the public.

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

bilateral trades. Information on invoicing currency is not always available for each country. Boz, Casas, Georgiadis, Gopinath, Le Mezo, Mehl, and Nguyen (2022) construct the worldwide database for invoicing currency use by combining currently publicly available data sets with new data sets collected by directly requesting to the national authorities. Their study confirmed the dominant role of the US dollar in the world and the pervasive use of the euro in Europe and Africa. Gopinath, Itskhoki, and Rigobon (2010) investigates how currency choice is endogenously chosen and affects the observed exchange rate pass-through. For their study, the US import price survey data collected by the BLS are examined for the invoice currency. The ERPT regressions are estimated for US imports, distinguishing those invoiced in the US dollar and those invoiced in non-US dollar currencies. They find that ERPT for goods invoiced in US dollars is about 25 percent and ERPT for non-US dollars is about 95 percent.

Amiti, Itskhoki, and Konings (2022) examine the currency choice of Belgian exporters and exchange rate pass-through. With regard to the invoice currency choice, they regress the binary variable, which takes the value of one if the invoice currency is either destination currency or the US dollar, on firm-level determinants and competitors' currency choice.

From the theoretical model in Amiti, Itskhoki, and Konings (2022), they 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 invoice 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. For the proxy variables for γ, they use two measures of firm size, the firm's employment and the destination-industry-specific market share. Another theoretical model in Mukhin (2022) provides an explanation for how the US dollar arises as the dominant currency. The large economic size of the US relative to the world consists of one factor.

Using the UK transaction level of exports and imports between 2010 and 2016, Crowley, Han, and Son (2021) find that the US dollars as invoicing currency choice for UK exports to extra-EU destinations are driven by strategic complementarities, operational hedging, and prior experience. The study by Devereux, Dong, and Tomlin (2017) utilizes transaction-level data on Canadian import. Most Canadian imports are invoiced in US dollars because it shares its border with and has a strong economic tie to the US. Using the transaction level customs data for Canadian imports in monthly frequency between 2002 and 2008, Devereux, Dong, and Tomlin (2017) found the invoice currency matters for the observed exchange rate pass-through.

2.2 The Export and import clarification documents submitted to the Japan Customs Office

All exporters and importers in Japan are required to submit export and import declarations to Japan Customs. This information includes the identity of both reporting company and the foreign partner, product characterization including the corresponding HS 9-digit code, the value and quantity of transactions, and the invoice currency. The value of each transaction record has five arguments; invoicing currency c, firm i, product j, partner country k, and year t.

Amiti, Itskhoki, and Konings (2022) discuss the possibility of firms adopting common invoicing when considering additional fixed costs associated with using each currency.[4] However, treating separately individual transactions of the same firm misses the firm's possible strategy of common invoicing. We cannot apriori distinguish whether two transactions by the same firm to the same destination use different invoice currencies or common invoicing. One simple way to capture the tendency of using the common currency is to calculate the likelihood of using dollars by each firm, i.e., the ratio of the sum of dollar invoiced transactions to all transactions. With these firm-level dollar use in the horizontal axis, we expect to observe a U-shaped distribution curve if common invoicing is strongly in effect.

We further break down the firm-level dollar invoice ratio by the destination country. In this way, we can observe the common currency mechanism and at the same time exploit the benefit of transaction-level data. We construct the dollar invoice ratio by exporter-destination pairs in year t.

$$\phi_{i,k,t} = IC_{c=D,i,k,t} = \frac{\sum_{j,c=D} val(c,i,j,k,t)}{\sum_{j} val(c,i,j,k,t)} \ , \tag{1}$$

where $val(c,i,j,k,t)$ is currency c invoiced export value of firm i for HS 9-digit product j to destination country k in year t. For the rest of the paper, we use IC with corresponding subscripts, D, to denote the dollar invoice ratio.

2.3 Determinants of Currency Choice

The first strategic complementary index is the likelihood of dollar use by the competitors in the destination market, k.

$$\gamma_{k,t} = IC_{c=D,k,t} = \frac{\sum_{c=D,i,j} val(c,i,j,k,t)}{\sum_{i,j} val(c,i,j,k,t)} \tag{2}$$

[4] In equation (12) of Amiti, Itskhoki, and Konings (2022), they introduce an additional fixed cost $F_{l,i}$ for using currency l for exporter i.

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.

$$IC_{c=D,j,t} = \frac{\sum_{c=D,i,k} val(c,i,j,k,t)}{\sum_{i,k} val(c,i,j,k,t)} \tag{3}$$

$IC_{c=D,j,t}$ is dollar ratio in industry j and is common for all Japanese exporters. Then, we calculate each firm's weighted average of these industry indices.

$$\gamma_{i,t} = \sum_{j} p_{i,t}(j) IC_{c=D,j,t} \tag{4}$$

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.

Amiti, Itskhoki, and Konings (2022) construct the Belgian firm's import intensity as the ratio of total imports outside of 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. 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.

We improve this import intensity variable by considering the invoice currency choice in imports. We construct three indices 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 of the firm and the country.

$$\phi^*_{i,k,t} = IC^*_{c=D,i,k,t} = \frac{\sum_{j,c=D} val^*(c,i,j,k,t)}{\sum_{j} val^*(c,i,j,k,t)} \tag{5}$$

The second and the third ones are the import side version of equations 2 and 4.

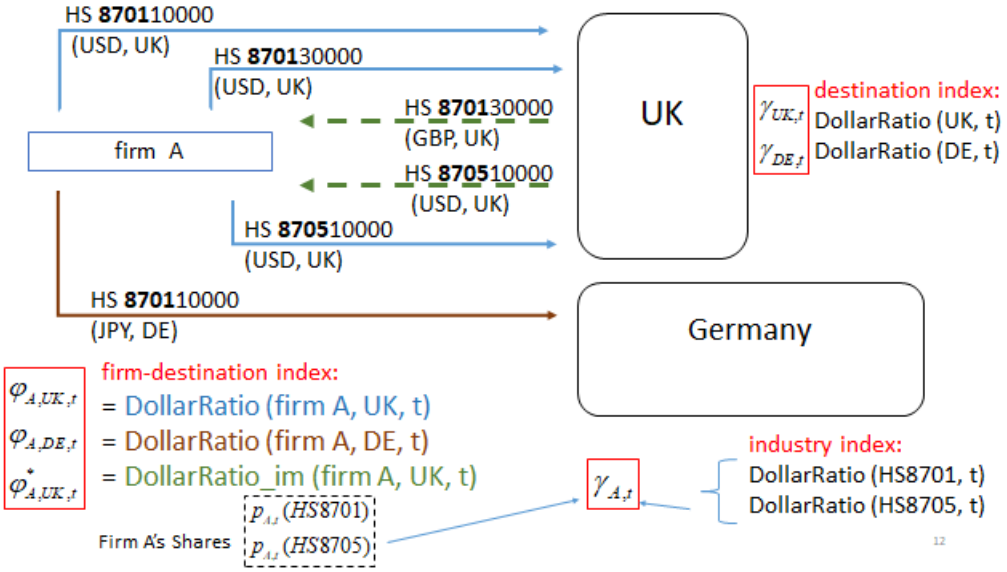
$$\gamma^*_{k,t} = IC^*_{c=D,k,t} = \frac{\sum_{c=D,i,j} val^*(c,i,j,k,t)}{\sum_{i,j} val^*(c,i,j,k,t)} \tag{6}$$

$$\gamma^*_{i,t} = \sum_{j} p^*_{i,t}(j) IC^*_{c=D,j,t} \tag{7}$$

3 Empirical Model of Invoice Currency Choice

The data records all export and import declarations individually[5]. Therefore, even within a year, the same product is exported multiple times to the same destination market by the same exporter.[6] 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 particular invoice currency for an exporter in a particular destination market. Therefore, the choice of invoice currency is aggregated at the pair of exporter and destination market as the dollar ratio, $\phi_{i,k,t}$ with subscripts denoting for exporter i, destination country k, and year t, see equation 1. The choice of invoicing currency is also constructed for imports as $\phi^*_{i,k,t}$, see equation 5.

Figure 1: Constructing the invoice currency ratio



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

Figure 1 shows how the dollar ratio indices are constructed. In the figure, the trade records of one firm are shown with exports of three (HS 9-digit) products to two countries and imports of two (HS 9-digit) products from one country. With these records, we calculate two $\phi_{i,k,t}$ for

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

[6]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.

exports and one $\phi^*_{i,k,t}$ for imports. These indices are calculated as the transaction-value weighted average. With all other firms' export records, invoice currency indices are constructed for each destination country, $\gamma_{k,t}$ in equation 2, and each HS 4-digit industry as intermediate indices. The industry index reflecting strategic complementarity is then calculated as $\gamma_{i,t}$ in equation 4. These industry and country invoice currency indices are also constructed for imports.

3.1 Invoice currency choice and strategic complementarities

The first base model only includes firm size and strategic complementarity indices. The dependent variable is the ratio of dollars as invoiced transactions by firm-destination pair, $\phi_{i,k,t}$.

$$\phi_{i,k,t} = \alpha + \beta_0 lnSize_{i,t} + \beta_1 \gamma_{k,t} + \beta_2 \gamma_{i,t} + \epsilon_{i,k,t} \tag{8}$$

The firm's size, $lnSize_{i,t}$, is the natural log of the firm's total export, and the two complementarity indices are the likelihood of dollar invoice in the destination market, $\gamma_{k,t}$, and the likelihood of dollar invoice in associated industries, $\gamma_{i,t}$. The definitions of complementarity indices are shown in equations 2 and 4.

The expected signs of two strategic complementary indices, $\gamma_{k,t}$ and $\gamma_{i,t}$, are positive. The expected sign of firm size is less clear in the previous studies. Firm size is shown to be positively correlated with non-euro invoicing for the Belgian exporters in Table 2 ofAmiti, Itskhoki, and Konings (2022). This non-euro currency includes US dollars as well as destination currency and other currencies. In Table 4 of Amiti, Itskhoki, and Konings (2022), they further show that firm size is negatively correlated 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). Notably, these analyses are based on the extra-EU exports for Belgian and UK firms. A great number of observations are excluded from the original sample.

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) uses firm-specific import intensity, i.e., the ratio of total extra-EU import to total variable costs. This import intensity is also construed 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 therefore time-invariant and destination-invariant. Crowley, Han, and Son (2021), on the other hand, relies solely on the trade data set, and therefore, their construction

of import-side indices has similarity with our index. 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, $\phi^*_{i,k,t}$, in equation 5 is both destination-varying and time-varying. This new index has an important implication When we focus on two-way exporters. We define two-way exporters as those exporting to and importing to the same country. More precisely, we define a firm-destination pair as two-way if we observe both export and import data in the same year. Our regression model for evaluating a firm's incentive to match the invoice currencies of exports and imports is the following.

$$\phi_{i,k,t} = \alpha + \beta_0 lnSize_{i,t} + \beta_1 \gamma_{k,t} + \beta_2 \gamma_{i,t} + \beta_3 \phi^*_{i,k,t} + \epsilon_{i,k,t} \tag{9}$$

The analysis with the import-side variables has one drawback: The invoice 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[7]. We also estimate currency matching mechanism by replacing $\phi^*_{i,k,t}$ with $\gamma^*_{k,t}$ and $\gamma^*_{i,t}$. Alternatively, using $\gamma^*_{k,t}$ and $\gamma^*_{i,t}$ as instruments, we also estimate equation 9 by two-stage least squares (2SLS).

4 The empirical results

For the empirical investigation on the choice of invoice currency in Japanese exports, we use the general export and import declarations submitted to Japan Customs, the Ministry of Finance, between 2014 and 2020. Table 1 provides the statistical summary of this data set for exports. On the rightmost column, with the total in the top rows, the aggregation is conducted by the currencies of the invoice. Three currencies of interest are the US dollar, the dominant currency of the world, the euro, and the Japanese yen, one of the second-tier currencies in the foreign exchange market and producer currency for Japanese exporters. In the second panel, the number of observations represents those exporter-destination pairs that use the Japanese yen as invoice currency. It should be noted that the same exporter-destination may use more than one invoice currency. Therefore, the sum of the second to fourth panel exceeds that of the top panel.

The share of the US dollars in export values as invoice currency is the greatest for the entire sample, consistent with the dominant currency role emphasized in the literature. However, in terms of observations or the number of firms, the share of the US dollar is below that of the

[7] We estimated an import-side regression analogous to equation 8 and obtained similar results.

Japanese yen. On the other hand, the share of the Japanese yen as invoice currency exceeds 70 percent in terms of observations or firms. However, the share in terms of values is less than 40 percent. These facts indicate that average individual transactions invoiced in US dollars are larger. The Euro as invoice currency in Japanese exports plays a minor role; the shares are less than ten percent. In addition, we calculate local currency invoices in the bottom panel. This is counted by checking whether the invoice currency matches the local currency in the destination country. The shares of local currency invoicing exceed 20 percent, but it should be noted that this includes the US dollar invoicing in the US.

4.1 Panel results

Table 2 shows the estimation results for the base model by all exporters, one-way exporters, and two-way exporters for the panel between 2014 and 2020. The data set is limited to firm-destination pairs with full seven-year observations. The sign of γ_k, 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 are more prone to follow the currency choice of competitors. Similarly, the competitors' currency choice in the corresponding industries, γ_i, the weighted average of dollar ratio with the firm's exporting value by industries as weights, positive and statistically significant. An exporter is likely to increase the use of US dollars as invoice currency if the dollar used in a destination country and/or in the firm's associated industries is higher. On the other hand, big exporters lower the use of the US dollar. Notably, the sample only consists of exporter-destination pairs that use US dollars. It should not be confused with the notion implicitly indicating that they prefer the Japanese yen as invoice currency.

Table 1: Statistical Summary

		2014	2015	2016	2017	2018	2019	2020
Total	Number of observations	378,595	383,621	384,252	398,062	465,462	460,211	573,697
	Number of firms	136,015	139,860	141,505	146,631	224,191	222,106	284,009
	values(trillion yen)	59.84	59.95	55.5	61.52	65.31	61.9	54.72
JPY invoice	Number of observations	269,062 (0.71)	275,396 (0.72)	276,144 (0.72)	286,223 (0.72)	360,730 (0.77)	356,877 (0.78)	455,703 (0.79)
	Number of firms	103,870 (0.76)	107,656 (0.77)	108,752 (0.77)	112,494 (0.77)	193,539 (0.86)	191,624 (0.86)	247,794 (0.87)
	values(trillion yen)	23.35 (0.39)	22.19 (0.37)	21.01 (0.38)	23.02 (0.37)	24.98 (0.38)	23.83 (0.38)	21.28 (0.39)
USD invoice	Number of observations	143,308 (0.38)	141,003 (0.37)	139,598 (0.36)	141,439 (0.36)	134,415 (0.29)	131,608 (0.29)	147,104 (0.26)
	Number of firms	53,018 (0.39)	52,483 (0.38)	52,435 (0.37)	53,505 (0.36)	49,677 (0.22)	48,634 (0.22)	55,120 (0.19)
	values(trillion yen)	31.18 (0.52)	32.32 (0.54)	28.97 (0.52)	32.03 (0.52)	32.99 (0.51)	30.97 (0.50)	26.82 (0.49)
EUR invoice	Number of observations	24,382 (0.06)	25,097 (0.07)	25,779 (0.07)	26,779 (0.07)	26,330 (0.06)	26,382 (0.06)	25,605 (0.04)
	Number of firms	9,314 (0.07)	9,540 (0.07)	9,805 (0.07)	10,351 (0.07)	9,961 (0.04)	9,986 (0.04)	9,707 (0.03)
	values(trillion yen)	3.22 (0.05)	3.07 (0.05)	3.18 (0.06)	3.49 (0.06)	3.96 (0.06)	3.90 (0.06)	3.24 (0.06)
LC invoice	Number of observations	45,568 (0.12)	45,830 (0.12)	47,138 (0.12)	49,282 (0.12)	46,585 (0.10)	47,284 (0.10)	52,825 (0.09)
	Number of firms	29,642 (0.22)	29,519 (0.21)	30,391 (0.21)	31,948 (0.22)	29,155 (0.13)	29,689 (0.13)	35,558 (0.13)
	values(trillion yen)	12.09 (0.20)	13.39 (0.22)	12.57 (0.23)	13.73 (0.22)	15.1 (0.23)	14.92 (0.24)	12.7 (0.23)

Note: Multiple transactions are aggregated as an observation for a pair of firm and destination. Therefore, multiple invoice currencies could be associated with an observation in this table. The sum of JPY, USD, an EUR exceeds that of the Total. The figures in parentheses indicate the percentage.

Table 2: Panel data analysis, US dollar invoicing

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0406***	-0.0361***	-0.0405***
	(0.000184)	(0.000406)	(0.000206)
γ_k USD_BY_Country	0.378***	0.300***	0.467***
	(0.00286)	(0.00467)	(0.00363)
γ_i FirmInd_USD_tendency	0.510***	0.451***	0.520***
	(0.00338)	(0.00585)	(0.00412)
Constant	0.923***	0.973***	0.842***
	(0.00325)	(0.00650)	(0.00386)
Observations	427,589	139,556	288,033
R-squared	0.139	0.088	0.166
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

From table 2, we confirmed that the results of two-way exporters are qualitatively the same as those of all exporters or one-way exporters. Table 3 presents the estimated results with the dollar invoicing variables on the import side. These variables are not introduced here to relate the exporter's choice of invoice currency with the competitors' currency strategies. They represent a possible incentive to match currencies on the asset and debit side of the balance sheet, and we call it a currency-matching incentive. If the incoming cash flow from exports and outgoing cash flow for imports are in the same currency, the exchange rate risk hinges only on the net balance. If the same invoice currency is chosen for both exports and imports, a temporary loss on the one side due to an exchange rate fluctuation will be automatically canceled out by the temporary gain on the other side.

The first column in Table 3 includes the US dollar ratio of imports, $\phi^*_{i,k}$, as an additional explanatory variable. 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 percent increase in the US dollar ratio for imports (in the same industry and country) induces a 2.79 percent increase in the dollar use in exports.

In the second column, the model also includes the import-side counterparts of the dollar ratio in the country and industry variables, respectively γ_k^* and γ_i^*. Contrary to the expected results of positive effects, the US dollar ratio at the importing country is not statistically significant. This may be due to the endogeneity issue between these three import-side variables [8].

In the third column, we removed $\phi_{i,k}^*$ to avoid the endogeneity issue and the estimated results for γ_k^* and γ_i^* are positive and statistically significant. In the fourth column, we re-estimated the model as in column (1), but used γ_k^* and γ_i^* as instruments in the two-stage least squares. The estimated results are similar to those in column (1), but the impact of $\phi_{i,k}^*$ became slightly larger.

[8] We estimated the corresponding estimation model as of equation 8 for imports and found that similar results hold for the import side.

Table 3: Panel data analysis with importing side, US dollar invoicing

	(1)	(2)	(3)	(4)
VARIABLES	OLS	OLS	OLS	2SLS
lnSize	-0.0333***	-0.0332***	-0.0395***	-0.0329***
	(0.000212)	(0.000213)	(0.000208)	(0.000269)
γ_k USD_BY_Country	0.280***	0.277***	0.363***	0.271***
	(0.00403)	(0.00499)	(0.00489)	(0.00552)
γ_i FirmInd_USD_tendency	0.455***	0.454***	0.491***	0.452***
	(0.00419)	(0.00430)	(0.00421)	(0.00447)
$\phi^*_{i,k}$USDRatio_im	0.279***	0.278***		0.299***
	(0.00215)	(0.00221)		(0.00891)
γ^*_k USD_BY_Country_im		0.00762	0.154***	
		(0.00554)	(0.00496)	
γ^*_i FirmInd_USD_tendency_im		0.00769*	0.130***	
		(0.00434)	(0.00411)	
Constant	0.651***	0.644***	0.725***	0.635***
	(0.00436)	(0.00519)	(0.00466)	(0.00802)
Observations	255,215	255,215	288,032	255,215
R-squared	0.200	0.200	0.172	0.200
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

4.2 Robustness

We found supporting evidence for strategic complementarities and currency matching in the preceding section. In this section, we provide several robustness checks and show that the main message of this study holds.

4.2.1 Multiple transactions

First, the current sample consists of a single transaction at the firm-destination level. This is troublesome because the US dollar invoicing ratio takes the maximum value of one for these observations. This may bias the estimated coefficients. Table 4 and 5 provide the estimation results with restricted observations of multiple transactions. All coefficients in Table 4 increased compared to the results in Table 2. In Table 5, on the other hand, the coefficients on the importing side decreased. Overall, the qualitative results remain the same.

Table 4: Panel data analysis with only multiple transactions

	(1)	(2)	(3)
VARIABLES	OLS	OLS	OLS
lnSize	-0.0355***	-0.0317***	-0.0338***
	(0.000217)	(0.000459)	(0.000246)
γ_k USD_BY_Country	0.408***	0.320***	0.511***
	(0.00306)	(0.00492)	(0.00390)
γ_i FirmInd_USD_tendency	0.546***	0.466***	0.563***
	(0.00366)	(0.00618)	(0.00449)
Constant	0.791***	0.875***	0.665***
	(0.00383)	(0.00741)	(0.00459)
Observations	392,512	131,622	260,890
R-squared	0.116	0.078	0.136
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table 5: Panel data analysis with only multiple transactions, with importing side

	(1)	(2)	(3)	(4)
VARIABLES	OLS	OLS	OLS	2SLS
lnSize	-0.0265***	-0.0265***	-0.0329***	-0.0269***
	(0.000254)	(0.000255)	(0.000247)	(0.000315)
γ_k USD_BY_Country	0.317***	0.321***	0.413***	0.325***
	(0.00436)	(0.00540)	(0.00527)	(0.00602)
γ_i FirmInd_USD_tendency	0.495***	0.496***	0.532***	0.498***
	(0.00459)	(0.00473)	(0.00461)	(0.00494)
$\phi^*_{i,k}$ USDRatio_im	0.288***	0.289***		0.270***
	(0.00229)	(0.00236)		(0.00940)
γ^*_k USD_BY_Country_im		-0.00804	0.144***	
		(0.00597)	(0.00533)	
γ^*_i FirmInd_USD_tendency_im		-0.00674	0.126***	
		(0.00473)	(0.00446)	
Constant	0.471***	0.477***	0.555***	0.485***
	(0.00511)	(0.00595)	(0.00538)	(0.00878)
Observations	230,186	230,186	260,889	230,186
R-squared	0.175	0.175	0.142	0.175
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

4.2.2 Vehicle currency: The US dollar invoicing to non-US markets

Second, US dollar invoicing to non-US destination countries is the vehicle currency invoicing. This pervasive use of the US dollar in non-US countries is the key idea of the dominant currency paradigm in the literature. Including the US as a destination country in the estimation for the US dollar invoicing biases the estimates. Therefore, we re-estimate the regressions with the data excluding the US as the destination country.

Table 6: Panel data analysis without US destination

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0449***	-0.0374***	-0.0457***
	(0.000204)	(0.000424)	(0.000232)
γ_k USD_BY_Country	0.366***	0.302***	0.444***
	(0.00366)	(0.00510)	(0.00514)
γ_i FirmInd_USD_tendency	0.552***	0.467***	0.573***
	(0.00366)	(0.00604)	(0.00456)
Constant	0.981***	0.986***	0.915***
	(0.00359)	(0.00674)	(0.00441)
Observations	371,868	132,421	239,447
R-squared	0.144	0.088	0.168
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table 7: Panel data analysis without US destination, with import side

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0377***	-0.0377***	-0.0445***	-0.0372***
	(0.000242)	(0.000243)	(0.000233)	(0.000305)
γ_k USD_BY_Country	0.237***	0.222***	0.270***	0.227***
	(0.00594)	(0.00724)	(0.00687)	(0.00692)
γ_i FirmInd_USD_tendency	0.501***	0.501***	0.544***	0.496***
	(0.00468)	(0.00479)	(0.00465)	(0.00503)
$\phi^*_{i,k}$ USDRatio_im	0.279***	0.277***		0.302***
	(0.00229)	(0.00237)		(0.00857)
γ^*_k USD_BY_Country_im		0.0214***	0.183***	
		(0.00579)	(0.00526)	
γ^*_i FirmInd_USD_tendency_im		0.00461	0.146***	
		(0.00488)	(0.00454)	
Constant	0.724***	0.717***	0.798***	0.705***
	(0.00510)	(0.00578)	(0.00514)	(0.00847)
Observations	207,380	207,380	239,446	207,380
R-squared	0.211	0.211	0.177	0.211
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Tables 6 and 7 present the estimated results for equations 8 and 9 by excluding the US as a destination country. This robustness check confirms that the qualitative results remain intact even when the US is excluded from the sample. Approximately, 20 percent of the number of firm-destination observations is dropped. The impact of strategic complementarity in the destination market is a little lowered and that in the competing industries is raised by about five percentage points. The fitness of regression is slightly improved.

4.2.3 Japanese yen as invoice currency

Third, it is imperative to pursue whether the strategic complementarity and currency matching mechanisms also work on other invoicing currencies. We turn to the producer currency invoicing, i.e., the Japanese yen invoicing in our data set. The dependent variable is the Japanese yen invoicing ratio at the firm and destination pairs. The explanatory variables are similarly constructed for the Japanese yen invoicing. Tables 8 and 9 present the estimation results for the Japanese yen invoicing.

Table 8: Panel data analysis, Japanese yen invoice

	(1)	(2)	(3)
VARIABLES	OLS	OLS	OLS
lnSize	-0.0267***	-0.0194***	-0.0260***
	(0.000136)	(0.000231)	(0.000170)
γ_k JPY_BY_Country	0.379***	0.189***	0.522***
	(0.00267)	(0.00332)	(0.00397)
γ_i FirmInd_JPY_tendency	0.292***	0.206***	0.367***
	(0.00229)	(0.00302)	(0.00323)
Constant	0.920***	0.992***	0.765***
	(0.00304)	(0.00455)	(0.00409)
Observations	729,595	308,009	421,586
R-squared	0.117	0.055	0.148
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

There are two noteworthy differences between the US dollar and Japanese yen invoicing. First, in Table 8, the difference in the estimated coefficients between one-way exporters and two-way exporters is large, especially for γ_k. For the US dollar invoicing in Table 2, the difference was negligible. Second, the relative magnitude of γ_k and γ_i is the opposite. Greater strategic complementarity for the Japanese yen invoicing arises from the destination country. In Table

9, the bias adjustment for $\phi^*_{k,i}$ due to addressing the endogeneity of importing side variables is large: the estimated coefficients by OLS is 0.240 and the estimate by 2SLS is 0.154. Besides these differences, the qualitative results are the same for the US dollar and Japanese yen invoicing.

Table 9: Panel data analysis for JPY invoice, with importing side

	(1)	(2)	(3)	(4)
VARIABLES	OLS	OLS	OLS	2SLS
lnSize	-0.0238***	-0.0238***	-0.0263***	-0.0252***
	(0.000215)	(0.000215)	(0.000170)	(0.000246)
γ_k JPY_BY_Country	0.407***	0.423***	0.527***	0.451***
	(0.00512)	(0.00521)	(0.00400)	(0.00617)
γ_i FirmInd_JPY_tendency	0.368***	0.365***	0.363***	0.375***
	(0.00399)	(0.00400)	(0.00323)	(0.00406)
$\phi^*_{i,k}$ JPYRatio_im	0.240***	0.245***		0.154***
	(0.00163)	(0.00167)		(0.00692)
γ^*_k JPY_BY_Country_im		-0.101***	-0.0502***	
		(0.00563)	(0.00439)	
γ^*_i FirmInd_JPY_tendency_im		-0.0180***	0.0943***	
		(0.00462)	(0.00367)	
Constant	0.666***	0.700***	0.757***	0.720***
	(0.00537)	(0.00570)	(0.00442)	(0.00683)
Observations	229,795	229,795	421,551	229,795
R-squared	0.244	0.245	0.149	0.235
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

4.3 New exporters

As discussed in section 3.2, one way to address the simultaneous problem of choosing invoice currency in exports and imports is to use instrumental variable estimation or two-stage least squares. These are statistical methods to obtain consistent estimators. Alternatively, we propose

a robust strategy to analyze whether a currency-matching mechanism is gradually formed as a firm accumulates years of trade experience[9]. For each year, we focus on the subgroup of firms that did not have a record of international trade in the previous year. For these subgroups of firms, we re-estimate the regression model in equation 9.

In this subsection, we focus on the subsample of firms that do not have any record of international trade transactions in the previous year. Therefore, the invoice currency decision we analyze here is the very first decision on new exporters' choice of invoice currency. In the following years, it is not to deny the plausibility that firms may reevaluate the first decision and may alter the invoice currency.

The first column in Table 10 shows the estimation results for strategic complementarity variables as in equation 8 for the subsample of only new exporters in 2015. Even for this particular single year, strategic complementarity effects, at the destination market as well as the associated industries, significantly impact the invoice decision of the Japanese exporters. Regarding the number of firm-destination observations, compared with appendix table B.3, new exporters are about 28 percent of all exporters in 2015. In the second column, the number of observations is reduced to about one-tenth of the first column and six percent of all two-way exporters in 2015 (see column (3) of Table B.3). This subsample represents those new exporters that also import from the same market this year: They did not export to country A, but they import from and export to country A this year [10]. The estimated coefficients remain statistically significant and are slightly greater in absolute value for firm size and two strategic complementarity indices. The third and fourth columns show the estimation results for equation 9. For new exporters, the choice of invoice currency seems not to be based on currency-matching motives. Appendix tables A.1 through A.5 show the results for other years. It should be noted that for other years new exports are defined as no exports in the previous *years*. There are some differences in the estimation results of other years; however, the qualitative results remain the same, that currency matching evidence is weak at best for new exporters.

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

[10] Precisely, the restriction on the previous year hinges only on the export side. So technically, the sample does not exclude the possibility that these firms have experience of importing from the country in the previous year.

Table 10: Newly entering exporters, USD invoicing in 2015

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	2SLS
VARIABLES	All	Two-way	Two-way	Two-way
lnSize	-0.0150***	-0.0291***	-0.0290***	-0.0270***
	(0.000361)	(0.00152)	(0.00154)	(0.00247)
γ_k USD_BY_Country	0.0374***	0.0939***	0.0701***	0.0722***
	(0.00372)	(0.0168)	(0.0216)	(0.0269)
γ_i FirmInd_USD_tendency	0.0943***	0.167***	0.164***	0.147***
	(0.00525)	(0.0226)	(0.0230)	(0.0252)
γ_k^* USD_BY_Country_im			0.0449*	
			(0.0264)	
γ_i^* FirmInd_USD_tendency_im			0.0144	
			(0.0230)	
$\phi_{i,k}^*$ USDRatio_im				-0.177
				(0.246)
Constant	1.084***	1.154***	1.130***	1.325***
	(0.00415)	(0.0196)	(0.0263)	(0.241)
Observations	39,072	4,018	4,018	3,389
R-squared	0.048	0.102	0.102	0.013
entering year	2015	2015	2015	2015

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

5 Discussions and Conclusions

We have shown that exporters choose their invoice 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. These new exporters choose their invoice currency based on imitating their competitors' decisions in the destination country and the competing industries. However, currency matching is not the major force for

new exporters. How can this result of new exporters reconcile with the result of experienced exporters that consider currency matching as an important factor for invoice 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 invoice currency choices [11]. An exporter imports intermediate inputs from the same country but accepts the import contract with specified invoice currency. As an exporter continues these transactions for a number of years, currency matching becomes an important issue and it renegotiates with the incumbent trade partner about altering the invoice currency or switches to a new partner that accepts the invoice currency of the exporter's choice.

The contributions of this study, in addition to the analysis of new exporters, are two folds. First, the evidence of the Japanese exporters contributes to the existing literature, not only as another example but as a country not using the US dollar or euro as its own currency nor being involved in vehicle currency regimes, such as UK or Canada. No study using this new database has appeared because the new data set became available only in 2022.

Second, our definition of two-way traders is unique and narrowly defined. A broader definition of two-way traders may include 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 two-way exporter (or trader). Our definition of two-way exporter excludes those firms [12]. This narrow definition has important implications. Firms surviving this screening may be more active in intra-firm trade if located in the middle of a vertical production network. Another plausible scenario is that the sample only captures firms that trade heavily with a country with a prominent share in both producing and consuming. The latter is not a problem as shown by the analysis of excluding the US from the sample in section 4.2.2. More importantly, we find evidence of the effect of $\phi^*_{i,k}$ despite that this narrow definition of two-way exporters should make detecting the effect more difficult.

[11] Exporters do not literally observe their competitors' behaviors, but they face business practices and standards when they enter the market. Their trade counterparts will likely request new exporters to follow the active business practices.

[12] More precisely, our definition does not mechanically exclude a firm that imports from A and exports to B. It is labeled a two-way exporter as long as it also imports from B.

References

Amiti, M., O. Itskhoki, and J. Konings (2019): "International Shocks, Variable Markups, and Domestic Prices," *The Review of Economic Studies*, 86(6), 2356–2402.

——— (2022): "Dominant Currencies: How Firms Choose Currency Invoicing and Why it Matters," *The Quarterly Journal of Economics*, 137(3), 1435–1493.

Auer, R., A. Burstein, and S. M. Lein (2021): "Exchange Rates and Prices: Evidence from the 2015 Swiss Franc Appreciation," *American Economic Review*, 111(2), 652–686.

Boz, E., C. Casas, G. Georgiadis, G. Gopinath, H. Le Mezo, A. Mehl, and T. Nguyen (2022): "Patterns of invoicing currency in global trade: New evidence," *Journal of International Economics*, 136, 103604.

Chung, W. (2016): "Imported inputs and invoicing currency choice: Theory and evidence from UK transaction data," *Journal of International Economics*, 99, 237–250.

Corsetti, G., M. Crowley, and L. Han (2022): "Invoicing and the dynamics of pricing-to-market: Evidence from UK export prices around the Brexit referendum," *Journal of International Economics*, 135, 103570.

Crowley, M., L. Han, and M. Son (2021): "Dominant currency dynamics: Evidence on dollar-invoicing from UK exporters," .

Devereux, M. B., W. Dong, and B. Tomlin (2017): "Importers and exporters in exchange rate pass-through and currency invoicing," *Journal of International Economics*, 105, 187–204.

Freitag, A., and S. M. Lein (2023): "Endogenous product adjustment and exchange rate pass-through," *Journal of International Economics*, 140, 103706.

Gopinath, G., E. Boz, C. Casas, F. J. Díez, P.-O. Gourinchas, and M. Plagborg-Møller (2020): "Dominant Currency Paradigm," *American Economic Review*, 110(3), 677–719.

Gopinath, G., and O. Itskhoki (2010): "Frequency of price adjustment and pass-through," *Quarterly Journal of Economics*, 125, 675–727.

Gopinath, G., O. Itskhoki, and R. Rigobon (2010): "Currency Choice and Exchange Rate Pass-Through," *American Economic Review*, 100(1), 304–336.

Gopinath, G., and R. Rigobon (2008): "Sticky Borders," *The Quarterly Journal of Economics*, 123(2), 531–575.

Ilzetzki, E., C. M. Reinhart, and K. S. Rogoff (2019): "Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?," *The Quarterly Journal of Economics*, 134(2), 599–646.

Itskhoki, O., and D. Mukhin (2021): "Exchange Rate Disconnect in General Equilibrium," *journal of political economy*, 129(8), 2183–2232.

Klenow, P. J., and J. L. Willis (2016): "Real Rigidities and Nominal Price Changes," *Economica*, 83(331), 443–472.

Mukhin, D. (2022): "An Equilibrium Model of the International Price System," *American Economic Review*, 112(2), 650–688.

A Appendix: New exporters results with other single years

Table A.1: Newly entering exporters, USD invoicing in 2016

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	2SLS
VARIABLES	All	Two-way	Two-way	Two-way
lnSize	-0.0115***	-0.0219***	-0.0220***	-0.0206***
	(0.000295)	(0.00133)	(0.00135)	(0.00354)
γ_k USD_BY_Country	0.0253***	0.0566**	0.0214	0.0384
	(0.00400)	(0.0224)	(0.0302)	(0.0470)
γ_i FirmInd_USD_tendency	0.0940***	0.136***	0.140***	0.172***
	(0.00679)	(0.0294)	(0.0304)	(0.0347)
γ_k^* USD_BY_Country_im			0.0564*	
			(0.0318)	
γ_i^* FirmInd_USD_tendency_im			-0.0114	
			(0.0245)	
$\phi_{i,k}^*$ USDRatio_im				-0.220
				(0.384)
Constant	1.042***	1.086***	1.080***	1.289***
	(0.00433)	(0.0233)	(0.0279)	(0.375)
Observations	32,684	3,041	3,041	2,543
R-squared	0.046	0.088	0.089	
entering year	2016	2016	2016	2016

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table A.2: Newly entering exporters, USD invoicing in 2017

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	2SLS
VARIABLES	All	Two-way	Two-way	Two-way
lnSize	-0.0124***	-0.0233***	-0.0232***	-0.0248***
	(0.000298)	(0.00120)	(0.00121)	(0.00346)
γ_k USD_BY_Country	0.0240***	0.0981***	0.0943***	0.0827**
	(0.00382)	(0.0193)	(0.0270)	(0.0415)
γ_i FirmInd_USD_tendency	0.106***	0.206***	0.204***	0.211***
	(0.00670)	(0.0258)	(0.0266)	(0.0399)
γ_k^* USD_BY_Country_im			0.00591	
			(0.0301)	
γ_i^* FirmInd_USD_tendency_im			0.00795	
			(0.0218)	
$\phi_{i,k}^*$ USDRatio_im				-0.389
				(0.332)
Constant	1.047***	1.052***	1.046***	1.449***
	(0.00428)	(0.0204)	(0.0248)	(0.317)
Observations	33,971	3,958	3,958	3,413
R-squared	0.050	0.096	0.096	
entering year	2017	2017	2017	2017

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table A.3: Newly entering exporters, USD invoicing in 2018

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	2SLS
VARIABLES	All	Two-way	Two-way	Two-way
lnSize	-0.0135***	-0.0215***	-0.0213***	-0.0169***
	(0.000351)	(0.00126)	(0.00128)	(0.00164)
γ_k USD_BY_Country	0.0312***	0.126***	0.0571**	0.00525
	(0.00468)	(0.0190)	(0.0280)	(0.0491)
γ_i FirmInd_USD_tendency	0.166***	0.191***	0.175***	0.136***
	(0.00795)	(0.0274)	(0.0281)	(0.0315)
γ_k^* USD_BY_Country_im			0.104***	
			(0.0327)	
γ_i^* FirmInd_USD_tendency_im			0.0450**	
			(0.0217)	
$\phi_{i,k}^*$ USDRatio_im				0.341
				(0.283)
Constant	1.023***	1.017***	0.969***	0.747***
	(0.00520)	(0.0214)	(0.0254)	(0.246)
Observations	30,429	3,939	3,939	3,363
R-squared	0.052	0.085	0.089	0.089
entering year	2018	2018	2018	2018

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table A.4: Newly entering exporters, USD invoicing in 2019

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	2SLS
VARIABLES	All	Two-way	Two-way	Two-way
lnSize	-0.0101***	-0.0192***	-0.0195***	-0.0176***
	(0.000342)	(0.00151)	(0.00152)	(0.00273)
γ_k USD_BY_Country	0.0269***	0.100***	0.0689**	0.0657
	(0.00428)	(0.0212)	(0.0283)	(0.0403)
γ_i FirmInd_USD_tendency	0.0834***	0.137***	0.140***	0.114**
	(0.00786)	(0.0349)	(0.0353)	(0.0464)
γ_k^* USD_BY_Country_im			0.0621*	
			(0.0351)	
γ_i^* FirmInd_USD_tendency_im			-0.0141	
			(0.0242)	
$\phi_{i,k}^*$ USDRatio_im				-0.336
				(0.429)
Constant	1.035***	1.044***	1.034***	1.388***
	(0.00469)	(0.0239)	(0.0292)	(0.407)
Observations	24,501	2,553	2,553	2,176
R-squared	0.037	0.076	0.077	
entering year	2019	2019	2019	2019

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table A.5: Newly entering exporters, USD invoicing in 2020

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	2SLS
VARIABLES	All	Two-way	Two-way	Two-way
lnSize	-0.0167***	-0.0280***	-0.0278***	-0.0113
	(0.000388)	(0.00143)	(0.00143)	(0.00800)
γ_k USD_BY_Country	0.0140***	0.0314	0.0583**	-0.133
	(0.00385)	(0.0193)	(0.0260)	(0.104)
γ_i FirmInd_USD_tendency	0.208***	0.185***	0.169***	0.0393
	(0.0101)	(0.0370)	(0.0374)	(0.0923)
γ_k^* USD_BY_Country_im			-0.0681*	
			(0.0393)	
γ_i^* FirmInd_USD_tendency_im			0.0691***	
			(0.0245)	
$\phi_{i,k}^*$ USDRatio_im				1.371*
				(0.782)
Constant	1.041***	1.158***	1.148***	-0.170
	(0.00480)	(0.0232)	(0.0297)	(0.743)
Observations	41,274	3,354	3,354	2,919
R-squared	0.044	0.103	0.106	
entering year	2020	2020	2020	2020

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

B Appendix: Base model Results with single years

Table B.1: Estimation results of base model, year(2014)

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0456***	-0.0329***	-0.0470***
	(0.000279)	(0.000343)	(0.000472)
γ_k USD_BY_Country	0.196***	0.130***	0.414***
	(0.0039)	(0.00407)	(0.00765)
γ_i FirmInd_USD_tendency	0.354***	0.242***	0.427***
	(0.00458)	(0.00514)	(0.00803)
Constant	1.227***	1.175***	1.036***
	(0.00388)	(0.00436)	(0.00766)
Observations	143,308	83,461	59,847
R-squared	0.176	0.116	0.18
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.2: Estimation results with importing side, year(2014)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0381***	-0.0381***	-0.0458***	-0.0384***
	(0.000489)	(0.000495)	(0.00048)	(0.000696)
γ_k USD_BY_Country	0.223***	0.238***	0.337***	0.229***
	(0.0086)	(0.0115)	(0.0114)	(0.0126)
γ_i FirmInd_USD_tendency	0.369***	0.368***	0.404***	0.371***
	(0.00816)	(0.00831)	(0.00817)	(0.00894)
$\phi^*_{i,k}$ USDRatio_im	0.292***	0.293***		0.277***
	(0.00476)	(0.00486)		(0.0229)
γ^*_k USD_BY_Country_im		-0.0254**	0.101***	
		(0.0124)	(0.0113)	
γ^*_i FirmInd_USD_tendency_im		0.00417	0.120***	
		(0.00906)	(0.00864)	
Constant	0.808***	0.812***	0.935***	0.821***
	(0.00912)	(0.0111)	(0.00977)	(0.0213)
Observations	52,515	52,515	59,847	52,515
R-squared	0.216	0.216	0.185	0.216
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.3: Estimation results of base model, year(2015)

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0448***	-0.0331***	-0.0458***
	(0.000278)	(0.000343)	(0.000472)
γ_k USD_BY_Country	0.177***	0.118***	0.331***
	(0.00363)	(0.004)	(0.00656)
γ_i FirmInd_USD_tendency	0.355***	0.243***	0.434***
	(0.00477)	(0.00539)	(0.00836)
Constant	1.224***	1.179***	1.064***
	(0.00381)	(0.00434)	(0.00736)
Observations	141,004	82,182	58,822
R-squared	0.172	0.116	0.172
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.4: Estimation results with importing side, year(2015)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0369***	-0.0369***	-0.0448***	-0.0359***
	(0.000486)	(0.00049)	(0.000477)	(0.000665)
γ_k USD_BY_Country	0.184***	0.170***	0.228***	0.172***
	(0.007)	(0.00826)	(0.00828)	(0.00905)
γ_i FirmInd_USD_tendency	0.370***	0.371***	0.411***	0.363***
	(0.00844)	(0.00861)	(0.0085)	(0.00911)
$\phi^*_{i,k}$ USDRatio_im	0.299***	0.297***		0.345***
	(0.00481)	(0.00494)		(0.0214)
γ^*_k USD_BY_Country_im		0.0349***	0.192***	
		(0.011)	(0.00966)	
γ^*_i FirmInd_USD_tendency_im		0.000876	0.111***	
		(0.00928)	(0.00889)	
Constant	0.805***	0.791***	0.925***	0.762***
	(0.00886)	(0.0112)	(0.00983)	(0.0215)
Observations	51,628	51,628	58,821	51,628
R-squared	0.213	0.213	0.181	0.212
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.5: Estimation results of base model, year(2016)

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0384***	-0.0284***	-0.0391***
	(0.00023)	(0.000282)	(0.000401)
γ_k USD_BY_Country	0.174***	0.121***	0.412***
	(0.00409)	(0.0043)	(0.0082)
γ_i FirmInd_USD_tendency	0.387***	0.274***	0.496***
	(0.00563)	(0.00652)	(0.00941)
Constant	1.092***	1.078***	0.861***
	(0.00411)	(0.00454)	(0.00828)
Observations	139,598	81,351	58,247
R-squared	0.176	0.122	0.183
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.6: Estimation results with importing side, year(2016)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0314***	-0.0314***	-0.0386***	-0.0317***
	(0.000416)	(0.000418)	(0.000404)	(0.000602)
γ_k USD_BY_Country	0.232***	0.225***	0.315***	0.239***
	(0.00914)	(0.0113)	(0.0111)	(0.0125)
γ_i FirmInd_USD_tendency	0.435***	0.439***	0.474***	0.438***
	(0.00954)	(0.00981)	(0.00965)	(0.0103)
$\phi^*_{i,k}$ USDRatio_im	0.294***	0.295***		0.276***
	(0.00486)	(0.00496)		(0.0237)
γ^*_k USD_BY_Country_im		0.0101	0.134***	
		(0.0116)	(0.0105)	
γ^*_i FirmInd_USD_tendency_im		-0.0124	0.0923***	
		(0.00913)	(0.00869)	
Constant	0.645***	0.649***	0.783***	0.660***
	(0.0097)	(0.0112)	(0.00974)	(0.0214)
Observations	51,024	51,024	58,247	51,024
R-squared	0.219	0.219	0.187	0.218
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.7: Estimation results of base model, year(2017)

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0379***	-0.0270***	-0.0396***
	(0.000226)	(0.000274)	(0.000394)
γ_k USD_BY_Country	0.167***	0.109***	0.394***
	(0.0038)	(0.00394)	(0.0076)
γ_i FirmInd_USD_tendency	0.377***	0.252***	0.495***
	(0.00544)	(0.00622)	(0.00915)
Constant	1.100***	1.081***	0.884***
	(0.00397)	(0.00434)	(0.00793)
Observations	141,439	82,869	58,570
R-squared	0.177	0.115	0.191
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.8: Estimation results with importing side, year(2017)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0317***	-0.0318***	-0.0391***	-0.0326***
	(0.000409)	(0.000411)	(0.000397)	(0.0006)
γ_k USD_BY_Country	0.232***	0.237***	0.309***	0.250***
	(0.0085)	(0.0108)	(0.0106)	(0.0121)
γ_i FirmInd_USD_tendency	0.432***	0.436***	0.472***	0.441***
	(0.00925)	(0.00954)	(0.00942)	(0.0101)
$\phi^*_{i,k}$ USDRatio_im	0.295***	0.297***		0.247***
	(0.00483)	(0.00494)		(0.0239)
γ^*_k USD_BY_Country_im		-0.0103	0.119***	
		(0.0116)	(0.0105)	
γ^*_i FirmInd_USD_tendency_im		-0.0163*	0.0951***	
		(0.00893)	(0.00852)	
Constant	0.654***	0.665***	0.805***	0.694***
	(0.00933)	(0.0108)	(0.00942)	(0.0214)
Observations	51,326	51,326	58,570	51,326
R-squared	0.228	0.228	0.195	0.226
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.9: Estimation results of base model, year(2018)

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0376***	-0.0269***	-0.0393***
	(0.000235)	(0.000294)	(0.000393)
γ_k USD_BY_Country	0.186***	0.120***	0.382***
	(0.00406)	(0.00439)	(0.00758)
γ_i FirmInd_USD_tendency	0.389***	0.278***	0.487***
	(0.00565)	(0.00668)	(0.0092)
Constant	1.081***	1.062***	0.901***
	(0.00419)	(0.00472)	(0.00793)
Observations	134,415	76,168	58,247
R-squared	0.173	0.11	0.189
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.10: Estimation results with importing side, year(2018)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0322***	-0.0321***	-0.0388***	-0.0320***
	(0.000408)	(0.00041)	(0.000396)	(0.000584)
γ_k USD_BY_Country	0.220***	0.229***	0.289***	0.217***
	(0.00835)	(0.0109)	(0.0107)	(0.0118)
γ_i FirmInd_USD_tendency	0.428***	0.425***	0.460***	0.427***
	(0.00936)	(0.00963)	(0.00945)	(0.0101)
$\phi^*_{i,k}$ USDRatio_im	0.278***	0.277***		0.284***
	(0.00485)	(0.00495)		(0.0234)
γ^*_k USD_BY_Country_im		-0.0168	0.134***	
		(0.0127)	(0.0113)	
γ^*_i FirmInd_USD_tendency_im		0.0103	0.106***	
		(0.00889)	(0.00845)	
Constant	0.693***	0.693***	0.810***	0.687***
	(0.00928)	(0.0109)	(0.00946)	(0.0211)
Observations	51,128	51,128	58,247	51,128
R-squared	0.222	0.222	0.194	0.222
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.11: Estimation results of base model, year(2019)

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0389***	-0.0280***	-0.0406***
	(0.000244)	(0.000305)	(0.000405)
γ_k USD_BY_Country	0.192***	0.129***	0.375***
	(0.00416)	(0.0045)	(0.00771)
γ_i FirmInd_USD_tendency	0.393***	0.266***	0.499***
	(0.00581)	(0.00682)	(0.00951)
Constant	1.101***	1.082***	0.928***
	(0.0042)	(0.00472)	(0.0079)
Observations	131,608	73,883	57,725
R-squared	0.174	0.113	0.187
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.12: Estimation results with importing side, year(2019)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0333***	-0.0333***	-0.0400***	-0.0331***
	(0.00042)	(0.000423)	(0.000407)	(0.000587)
γ_k USD_BY_Country	0.208***	0.205***	0.282***	0.204***
	(0.00845)	(0.0104)	(0.0102)	(0.012)
γ_i FirmInd_USD_tendency	0.435***	0.434***	0.471***	0.433***
	(0.00963)	(0.00992)	(0.00977)	(0.0104)
$\phi^*_{i,k}$ USDRatio_im	0.282***	0.282***		0.293***
	(0.00486)	(0.00498)		(0.0231)
γ^*_k USD_BY_Country_im		0.0071	0.148***	
		(0.0125)	(0.011)	
γ^*_i FirmInd_USD_tendency_im		0.00182	0.102***	
		(0.00901)	(0.00855)	
Constant	0.717***	0.714***	0.832***	0.709***
	(0.00923)	(0.011)	(0.00954)	(0.0207)
Observations	50,701	50,701	57,724	50,701
R-squared	0.221	0.221	0.192	0.22
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.13: Estimation results of base model, year(2020)

VARIABLES	(1) OLS	(2) OLS	(3) OLS
lnSize	-0.0374***	-0.0275***	-0.0390***
	(0.000223)	(0.000277)	(0.000399)
γ_k USD_BY_Country	0.146***	0.0848***	0.377***
	(0.00358)	(0.00378)	(0.00748)
γ_i FirmInd_USD_tendency	0.379***	0.281***	0.487***
	(0.00563)	(0.00661)	(0.00958)
Constant	1.112***	1.085***	0.915***
	(0.00354)	(0.00389)	(0.00782)
Observations	147,104	90,931	56,173
R-squared	0.166	0.102	0.188
Firm type	All	One-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.

Table B.14: Estimation results with importing side, year(2020)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
lnSize	-0.0321***	-0.0320***	-0.0383***	-0.0318***
	(0.000414)	(0.000416)	(0.000402)	(0.000624)
γ_k USD_BY_Country	0.231***	0.251***	0.333***	0.223***
	(0.00826)	(0.00996)	(0.00979)	(0.013)
γ_i FirmInd_USD_tendency	0.427***	0.421***	0.456***	0.424***
	(0.00974)	(0.01)	(0.00986)	(0.0107)
$\phi^*_{i,k}$ USDRatio_im	0.269***	0.268***		0.289***
	(0.00498)	(0.00506)		(0.027)
γ^*_k USD_BY_Country_im		-0.0435***	0.0745***	
		(0.0124)	(0.0112)	
γ^*_i FirmInd_USD_tendency_im		0.0219**	0.111***	
		(0.00925)	(0.00881)	
Constant	0.707***	0.712***	0.831***	0.690***
	(0.00921)	(0.0112)	(0.00961)	(0.0235)
Observations	49,563	49,563	56,173	49,563
R-squared	0.218	0.218	0.192	0.218
Firm type	Two-way	Two-way	Two-way	Two-way

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 An observation is classified as One-way if the corresponding exporter does not import from the same destination and as Two-way if the exporter both exports and imports from the same destination.