Invoice Currency Choice under Financial Constraints and Bargaining: Evidence from Japanese SMEs

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Abstract

Recent empirical studies explore factors behind the currency invoicing pattern in exports of listed firms by using questionnaire surveys; however, there is insufficient evidence regarding small and medium-sized enterprises (SMEs). We conducted a questionnaire survey for 2,100 unlisted manufacturers engaged in exports during the 2010s and received responses from 300 firms. By constructing a database with invoice currency choice and trade partner by export destination, we empirically examine the determinants of invoice currency choice in export using the probit model estimation. We confirm that the major determinants of currency invoicing in existing research effectively work as determinants of currency invoicing by SMEs. After controlling for various determinants, we found that financial constraints play an important role in their invoice currency choice. The firms with deteriorated capital ratios and rapid sales growth depend more on the producer's currency invoicing. The results are confirmed through a robustness test using detailed financial data, showing that the firms with lower capital ratios, lower liquidity positions, and greater investment opportunities tend to use the producer's currency invoicing. These novel findings are consistent with the predictions from the theoretical research on the bargaining model of currency invoicing and corporate risk management for hedging.

Keywords: Invoice currency; Japanese exports; SMEs; Financial constraint; R&D;
JEL classification: F23, F31, F33, G32

1. Introduction

While the recent empirical studies explore factors behind the currency invoicing pattern in exports of listed firms by using the questionnaire survey, there is insufficient evidence regarding small and medium-sized enterprises (SMEs). However, the currency risk exposure at the firm level is considered more important for unlisted firms and SMEs than listed firms because the SMEs generally have weak financial conditions and have poor skills for managing currency risk.

The theoretical model, such as Goldberg and Tille (2013), discusses that the choice of invoice currency reflects the result of negotiation between exporter and importer. In this sense, exploring the driving forces behind the invoice currency choice by the SMEs is also crucial because many SMEs are supposed in a weak position in the negotiation of pricing and invoice currency with importers. If the SMEs only have weak bargaining power, we expect the SMEs are forced to choose the importer's currency and shoulder the burden of currency risk exposure.

However, Ito et al. (2013, 2018), which are the recent empirical studies based on the questionnaire surveys on Japanese listed manufactures, found that smaller listed firms more tend to choose exporter's currency as an invoice currency while larger listed firms choose importer's currency or US dollar as an invoice currency. They conclude that this invoice currency pattern is attributed to the pricing-to-the market (PTM) behavior to stabilize the price in terms of local currency in the destination market. Based on the observation of size effect in currency invoicing pattern for Japanese listed manufacturers, we predict that the Japanese unlisted firms tend to choose the Japanese yen as an invoice currency because they are generally much smaller than listed firms.

More importantly, SMEs typically face severer financial constraints than large firms because of the existence of information asymmetry and bankruptcy costs. Froot et al. (1993) explain that if external sources of finance are more costly to corporations than internally generated funds, there will typically be a benefit of hedging by inducing more concave profit function of firms. However, hedging tools available to unlisted SMEs are relatively limited comparing to listed firms. Under these circumstances, we predict that the SMEs facing financial constraints have an incentive to choose producer's currency invoicing to insulate their cash flows from exchange rate fluctuations.

To confirm these theoretical and empirical predictions, we conducted the questionnaire survey in 2019 for 2,100 Japanese firms that are unlisted manufacturers experiencing exports, continuing exports, or started export during the 2010s, and received a response from 300 firms. Using the results of the questionnaire survey, we construct the database and conduct an empirical study to

test the impacts of various determinants on the invoice currency choice by the Japanese manufacturing SMEs.

This paper proceeds as follows. Section 2 reviews the related literature. Section 3 describes the questionnaire survey. Section 4 describes the empirical methodology. Section 5 provides the main results of the empirical examination. Section 6 reports the results of the robustness test. Section 7 concludes the paper.

2. Related literature

2-1. Theoretical models of invoice currency choice

Goldberg and Tille (2008) explore the driving forces of currency invoicing in international trade with a simple model and a country-level dataset. They develop the theoretical model in which a profit-maximizing exporter having the decreasing return to scale production function faces the downward sloping demand curve in the destination country. The model shows the following three forces: first, an exporter has an incentive to follow the invoicing strategy of its competitors, which is called a "coalescing" motive. This is because fluctuations of its price relative to its competitors due to exchange rate fluctuations translate into sizable movement in output, leading to fluctuations in marginal cost and a higher marginal cost on average due to the convexity of a total cost function. Second, the exporter wants to invoice in a currency that delivers a hedging benefit by limiting the deviations between marginal cost and marginal revenue. Third, the exporter prefers a currency with low transaction costs.

We derive several implications on a firm-level invoice currency choice from Goldberg and Tille (2008). First, exporters facing competition from local firms in the destination country who set prices fully in their currency tend to choose the local currency according to the "coalescing" motive. This tendency is more significant if firms export to a large country where many local firms compete and goods are more homogenous. By contrast, the firms with highly differentiated goods are likely to choose producer's currency. Second, the motivation to pursue hedging benefits is intensified in the presence of imported inputs. The firms that import some inputs from the destination country and pay for them in the currency of the destination country tend to choose the same currency in export to that destination for hedging revenue and cost. Third, a currency such as the US dollar is more likely to be used as a vehicle currency because of its low transaction cost, which is mainly driven by the liquidity in the foreign exchange rate market.

While Goldberg and Tille (2008) construct the model in which the exporter unilaterally chooses the invoice currency, Goldberg and Tille (2013) build the bargaining model so that an exporter negotiates with importers on the pricing and the choice of invoice currency, in which the bargaining power plays the role. Their model shows the counterintuitive results. While one may expect that the higher bargaining power of risk-averse importers would lead them to reduce their exchange rate exposure through higher local currency invoicing, their analysis shows that the opposite is the case. This is because the higher bargaining power of importers results in more favorable pricing to them, which in turn reduces the marginal impact of exchange rate risk on the importer's payoff and leads them to accept more exchange rate exposure. They also show the different patterns so that higher bargaining power of importers would raise the extent of local currency invoicing in the case that the price is unilaterally preset by the exporter, and the importer exercises her bargaining power only over the choice of invoice currency. If we focus on the bargaining power of the exporter-side, the higher bargaining power of the exporter will result in ambiguous consequences. However, if we suppose the situation so that the price is preset by the exporters who are risk-averse, we predict that the higher bargaining power of exporters leads to the producer's currency invoicing.

This paper focuses on the invoice currency choice of exporting SMEs. We predict that small exporters are forced to choose the importer's currency and shoulder the burden of currency risk exposure when the bargaining power of these small exporters is expected to be weak. We also predict that even if the exporter is small in terms of sales or assets but holds the product differentiability and product competitiveness, this exporter has some extent of bargaining power in the negotiation on the pricing and the choice of invoice currency and thus tends to choose the producer's currency invoicing.

In contrast to our prediction, Ito et al. (2013, 2018) point out that smaller listed firms more tend to choose exporter's currency (Japanese yen) as an invoice currency while larger listed firms choose importer's currency or US dollar as an invoice currency. They state that this contradictory observation in invoice currency choice is attributed to the PTM behavior by large Japanese exporters who want to stabilize the price in terms of local currency in the destination market. They also found that the tendency to choose the local currency or US dollar as an invoice currency is more prevalent in intra-firm trade than inter-firm trade.

Based on the existence of size effect in currency invoicing patterns for Japanese manufacturers, we predict that the Japanese unlisted firms tend to choose the Japanese yen as an invoice currency in their export because they are generally much smaller than listed firms. We also predict the intra-

firm trades are less prevalent for SMEs than listed firms because many SMEs do not establish their foreign subsidiaries in foreign countries, which diminishes the motivation for SMEs to choose the local currency invoicing.

2-2. Corporate risk management under financial constraints

In the field of corporate finance, the theory of corporate risk management is another theoretical foundation for considering exchange rate risk management at a firm level. SMEs typically face tighter financial constraints than large listed firms because of the existence of information asymmetry and bankruptcy costs. Froot et al. (1993) state that if external sources of finance are more costly to corporations than internally generated funds, there will typically be a benefit of hedging by inducing more concave profit function of firms. The empirical research by Géczy et al. (1997) reports that S&P firms with greater growth opportunities and tighter financial constraints are more likely to use currency derivatives. This evidence suggests that firms might use derivatives to reduce cash flow variation that might otherwise preclude firms from investing in valuable growth opportunities. Firms with extensive foreign exchange-rate exposure and economies of scale in hedging activities are also more likely to use currency derivatives.

SMEs examined in this paper are supposed not only they face tighter financial constraints but also limited availability to various hedging instruments mainly due to the lack of economies of scale, information asymmetry, and creditworthiness. In this sense, the theoretical predictions on invoice currency choice of Japanese SMEs can differ from invoice currency choice of large Japanese listed firms.

3. Questionnaire Survey

To confirm the theoretical and empirical predictions discussed in the previous section, we sent the questionnaire items to 2,100 firms in December 2019 requesting their responses by the end of January 2020. All firms are unlisted manufactures whose head office is located in Japan and are categorized into three groups of sample firms. The first sample group consists of "Continuously exporting" firms (1,050 firms) that are randomly chosen from all firms having the continuous experience of exports, either direct or indirect exports, throughout the 2010s.[1] The second group is "Starting export in the early 2010s" firms (509 firms) that are all firms that started exports from 2010 to 2014. The third group is "Starting export in the late 2010s" firms (541 firms) that are all

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[1] The direct export means a case that an exporter directly exports their goods to a customer located in foreign country. The indirect export means a case that an exporter export goods via a trade firm.

firms that started exports for the first time from 2015-2019. The number of responded firms (response rate) is "Continuously exporting" 164 firms (15.6%), "Starting export in the early 2010s" 63 firms (11.6%), and "Starting export in the late 2010s" 73 firms (14.3%), respectively.[2] The firm size in terms of sales is reported in Table 3-1.

Table 3-1. Descriptive statistics of responded firms

Sales (unit millon yen)	N	Mean	Median	Std. dev.	Max	Min
Stating Export in Early 2010s Firms	73	4,919	1,800	8,674	56,788	113
Stating Export in Late 2010s Firms	63	5,687	1,838	14,300	108,452	140
Continuously Exporting Firms	164	7,304	2,759	11,766	81,000	280
Total	300	6,384	2,422	11,708	108,452	113
Number of destinations	274	3.4	3.0	2.4	12.0	1.0

In the questionnaire survey, we first ask the status of the main currency and trade partner in exports by destination as of the fiscal year 2018, which is called "current export" data. The main currency is defined as an invoice currency most frequently used in export to the trade partner in the destination. Second, we also ask the same question to the import side for the same destination if the respondent firm imports from the destination country in exports, which is called "current import" data. Finally, we ask the retrospective information as of the year when the firm started its export to that destination, which is called "start year export" data.

Trade partners include the following six types: (1) own subsidiaries (sales subsidiaries or plant), (2) related companies (with capital relationship), (3) local agency (with no capital relationship), (4) via Japanese trading companies (Shosha), (5) direct export to local customer, and (6) others. Trade partners (1) and (2) correspond to the intra-firm trades, while the extent of capital tie differs in the two trade partners. Trade partners (3) through (6) correspond to the inter-firm trades, which trade with third parties without any capital relationship.

The last line of Table 3-1 reports the number of export destinations that the respondent firms answered. 274 out of 300 respondent firms answer the information for at least one destination, in which an average number of destinations is 3.4 countries and median 3.0 countries.[3]

4. Status of Invoice Currency Choice and Basic Statistics of Determinants

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[2] In the appendix, Table A-1 reports the number of responded firms by prefecture.
[3] In the appendix, Table A-2 reports the number of destination countries that the respondent firms answered.

Invoice currency choice by trade partner, by destination

Table 4-1 summarizes the status of choice of main currency by trade partner in export to three categories of destinations: first, exports to the US; second, exports to advanced economies including Canada, UK, Eurozone, Australia, and New Zealand; third, export to Asian countries including China, Hong Kong, Korea, Taiwan, ASEAN countries, and India.

Table 4-1. Main currency by trade partner in exports

A. Export to the US by trade partner

	Japanese Yen	US dollar	Euro	Local currency	Total	Percent to NOB
1. Own subsidiary	6	16	0	--	22	17.6
Percent to total	27.3	72.7	0.0	--	100.0	
2. Related firm (with capital tie)	5	7	0	--	12	9.6
Percent to total	41.7	58.3	0.0	--	100.0	
3. Local agency (wihout capital tie)	9	9	0	--	18	14.4
Percent to total	50.0	50.0	0.0	--	100.0	
4. via Japanese trading companies	29	5	0	--	34	27.2
Percent to total	85.3	14.7	0.0	--	100.0	
5. direct export to local customer	13	24	0	--	37	29.6
Percent to total	35.1	64.9	0.0	--	100.0	
6. others	2	0	0	--	2	1.6
Percent to total	100.0	0.0	0.0	--	100.0	
Number of observations (NOB)	64	61	0	--	125	100.0
Percent to total	51.2	48.8	0.0	--	100.0	

B. Export to advanced economies except the US by trade partner

Export to advanced economies exce[	Japanese Yen	US dollar	Euro	Local currency	Total	Percent to NOB
1. Own subsidiary	3	0	0	3	6	3.7
Percent to total	50.0	0.0	0.0	50.0	100.0	
2. Related firm (with capital tie)	2	3	0	2	7	4.3
Percent to total	28.6	42.9	0.0	28.6	100.0	
3. Local agency (wihout capital tie)	23	5	4	10	42	25.8
Percent to total	54.8	11.9	9.5	23.8	100.0	
4. via Japanese trading companies	36	7	0	1	44	27.0
Percent to total	81.8	15.9	0.0	2.3	100.0	
5. direct export to local customer	37	13	4	6	60	36.8
Percent to total	61.7	21.7	6.7	10.0	100.0	
6. others	4	0	0	0	4	2.5
Percent to total	100.0	0.0	0.0	0.0	100.0	
Number of observations (NOB)	105	28	8	22	163	100.0
Percent to total	64.4	17.2	4.9	13.5	100.0	

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Table 4-1. Main currency by trade partner in exports (continued)

C. Export to Asian Countries by trade partner

	Japanese Yen	US dollar	Euro	Local currency	Total	Percent to NOB
1. Own subsidiary	58	17	0	16	91	16.4
Percent to total	63.7	18.7	0.0	17.6	100.0	
2. Related firm (with capital tie)	24	8	0	1	33	5.9
Percent to total	72.7	24.2	0.0	3.0	100.0	
3. Local agency (wihout capital tie)	98	19	0	1	118	21.3
Percent to total	83.1	16.1	0.0	0.8	100.0	
4. via Japanese trading companies	128	10	0	0	138	24.9
Percent to total	92.8	7.2	0.0	0.0	100.0	
5. direct export to local customer	112	41	0	4	157	28.3
Percent to total	71.3	26.1	0.0	2.5	100.0	
6. others	18	0	0	0	18	3.2
Percent to total	100.0	0.0	0.0	0.0	100.0	
Number of observations (NOB)	438	95	0	22	555	100.0
Percent to total	78.9	17.1	0.0	4.0	100.0	

Table 4-1 shows the following characteristics: first, the shares of Japanese yen invoicing are 51 percent in exports to the US, 64 percent in exports to the advanced economies, and 79 percent in exports to Asian countries, respectively. In this sense, the Japanese SMEs tend to choose the producer's currency as a currency most frequently used in exports to all destinations.

Second, Japanese SMEs export their products mainly through inter-firm trades including exports to the local agency, exports via Japanese trading companies, or direct exports to local customers, while the percentage of intra-firm exports, such as exports to own subsidiaries and related firms, to the total number of observations is relatively small. In terms of invoice currency choice, the percentage of Japanese yen as the main currency in inter-firm exports is higher than intra-firm exports. Especially, Japanese yen invoicing occupies most of the exports via Japanese trading companies.

Third, the percentage of choosing the local currency as the main currency in export is higher in intra-firm trades, while US dollar invoicing is most prevalent in exports to the related firms in the advanced economies and Asian countries.

Last, the share of Japanese yen invoicing in exports to Asian countries is generally larger than exports to the US and advanced economies. The percentage of the US dollar invoicing in exports to Asian countries is 17 percent, which is almost comparable to that in exports to the advanced economies excluding the US.

Basic statistics of firm-level determinants

Table 4-2 reports the summary statistics of firm-level proxy variables regarding the determinants for invoice currency choice in exports.

Table 4-2. Summary statistics of country-level and firm-level variables

Variables	Obs	Mean	Std. dev.	Min	Max
Currency volatility (weekly, 1 year)	26	0.01	0.00	0.02	0.01
Firm age (log)	300	3.89	0.43	2.40	4.69
Sales (log) (FY2018)	300	7.86	1.32	4.73	11.59
Profit per employee (FY2017 & 2018)	288	1.39	3.10	-13.29	24.66
World top (global market)	300	0.03	0.17	0.00	1.00
Top 3 largest within domestic industry	300	0.06	0.24	0.00	1.00
Number of patent (log)	300	1.31	1.50	0.00	7.08
Sales growth (FY2009-2018)	294	0.55	1.08	-0.66	7.98
Capital ratio (FY2018)	300	0.32	0.29	0.00	0.95
Usage of forward contract	300	0.15	0.36	0.00	1.00

The currency volatility is calculated as the standard deviation of the weekly bilateral nominal exchange rate between the currency of the destination country and the Japanese yen during the fiscal year 2018 that is the fiscal year immediately before the questionnaire survey. The firm age is the logarithm of one plus the number of years from the establishment year of the firm that are included in the Teikoku Data Bank (TDB) database. The sales (log) are the log of unconsolidated sales of the firm. Profit per employee is the two-year average of after-tax profit as of fiscal years 2017 and 2018 divided by the number of employees as of the fiscal year 2018. World top (global market) is the dummy variable that takes one if the Nikkei news articles reported the firm's products were in the top share in the global market and zero otherwise. The top 3 largest within the domestic industry is a dummy variable that takes one if the firm is within the top 3 largest firms by sales among Japanese firms in the industry extracted from the TDB database that reports the firm's ranking within the Japanese firms in each industry. The number of patents is the logarithm of one plus the number of patents from 2000 through 2019 compiled in the J-Plat Pat database, which provides the database of all patents that Japanese firms take. Sales growth is calculated as the growth rate between the sales of the firms as of the fiscal year 2009 and the sales as of the fiscal year 2018. Capital ratio as of the fiscal year 2018 is provided by the TDB database. The usage of a forward contract is a dummy variable that takes one if the firms answer they use forward contract and zero otherwise. Finally, the longevity of export experience is defined as the logarithm of one plus the number of years from the export start year of the destination that the firm answers.

Panels A to C of Table 4-3 report the results of the univariate analysis that assesses the influence of each variable on the choice of invoice currency. The table presents summary statistics for proxy variables and the results of tests of differences between the mean of these variables for users and non-users of each currency.

Table 4-3. The results of the t-test between different sample groups

A. Japanese yen invoicing

	Main currency (Japanese yen)=1			Main currency (Japanese yen)=0			t-statistic	p-value	
Variables	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.			
Currency volatility (weekly, 1 year)	617	0.01	0.00	255	0.01	0.00	0.95	0.341	
Firm age (log)	658	3.94	0.41	272	3.89	0.48	1.66	0.097	*
Sales (log) (FY2018)	658	7.89	1.40	272	8.18	1.21	-2.91	0.004	***
Profit per employee (FY2017 & 2018)	626	1.55	3.38	257	1.59	2.83	-0.17	0.868	
World top (global market)	658	0.05	0.22	272	0.05	0.21	0.05	0.957	
Top 3 largest within domestic industry	658	0.07	0.25	272	0.04	0.19	1.71	0.087	*
Number of patent (log)	658	1.54	1.61	272	1.69	1.42	-1.36	0.175	
Sales growth (FY2009-2018)	653	0.62	1.05	268	0.45	0.79	2.36	0.018	**
Capital ratio (FY2018)	658	0.32	0.29	272	0.35	0.28	-1.55	0.122	
Import currency (Japanese yen)	658	0.15	0.35	270	0.04	0.20	4.60	0.000	***
Import currency (US dollar)	658	0.05	0.23	270	0.21	0.41	-7.26	0.000	***
Import currency (Local currency)	658	0.03	0.18	270	0.10	0.30	-4.09	0.000	***
Usage of forward contract	658	0.12	0.33	272	0.29	0.45	-6.43	0.000	***
Longevity of export experince (log)	495	2.52	0.79	200	2.54	0.79	-0.40	0.691	

B. Local currency invoicing

	Main currency (local currency)=1			Main currency (local currency)=0			t-statistic	p-value	
Variables	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.			
Currency volatility (weekly, 1 year)	111	0.01	0.00	761	0.01	0.00	-6.33	0.000	***
Firm age (log)	112	3.87	0.50	818	3.93	0.42	-1.29	0.197	
Sales (log) (FY2018)	112	8.31	1.26	818	7.93	1.36	2.75	0.006	***
Profit per employee (FY2017 & 2018)	108	2.06	3.27	775	1.49	3.22	1.72	0.086	*
World top (global market)	112	0.06	0.24	818	0.05	0.21	0.74	0.459	
Top 3 largest within domestic industry	112	0.04	0.19	818	0.06	0.24	-1.04	0.301	
Number of patents (log)	112	1.85	1.58	818	1.55	1.55	1.97	0.049	**
Sales growth (FY2009-2018)	111	0.62	0.90	810	0.56	1.00	0.53	0.595	
Capital ratio (FY2018)	112	0.37	0.28	818	0.33	0.29	1.63	0.104	
Import currency (Japanese yen)	110	0.05	0.21	818	0.12	0.33	-2.45	0.015	**
Import currency (US dollar)	110	0.17	0.38	818	0.09	0.29	2.76	0.006	***
Import currency (Local currency)	110	0.23	0.42	818	0.03	0.16	9.41	0.000	***
Usage of forward contract	112	0.32	0.47	818	0.15	0.36	4.60	0.000	***
Longevity of export experince (log)	87	2.72	0.66	608	2.50	0.80	2.44	0.015	**

Table 4-3. The results of the t-test between different sample groups (continued)

C. US dollar (Vehicle currency) invoicing

Variables	Obs	Main currency (US dollar)=1 Mean	Std. dev.	Obs	Main currency (US dollar)=0 Mean	Std. dev.	t-statistic	p-value	
Currency volatility (weekly, 1 year)	143	0.01	0.00	601	0.01	0.00	-2.08	0.038	**
Firm age (log)	157	3.91	0.46	645	3.93	0.42	-0.54	0.590	
Sales (log) (FY2018)	157	8.12	1.26	645	7.94	1.37	1.52	0.130	
Profit per employee (FY2017 & 2018)	146	1.25	2.46	616	1.59	3.22	-1.19	0.236	
World top (global market)	157	0.04	0.19	645	0.05	0.21	-0.53	0.599	
Top 3 largest within domestic industry	157	0.04	0.19	645	0.07	0.25	-1.33	0.182	
Number of patents (log)	157	1.53	1.30	645	1.59	1.60	-0.40	0.687	
Sales growth (FY2009-2018)	154	0.32	0.66	641	0.62	1.04	-3.40	0.001	***
Capital ratio (FY2018)	157	0.34	0.28	645	0.33	0.29	0.45	0.655	
Import currency (Japanese yen)	157	0.06	0.23	644	0.14	0.35	-2.82	0.005	***
Import currency (US dollar)	157	0.23	0.42	644	0.06	0.23	6.90	0.000	***
Import currency (Local currency)	157	0.01	0.08	644	0.04	0.20	-2.18	0.030	**
Usage of forward contract	157	0.26	0.44	645	0.14	0.35	3.55	0.000	***
Longevity of export experince (log)	108	2.45	0.86	481	2.49	0.78	-0.51	0.610	

Note: The asterisks, ***, **, and *, attached to p-values show that the difference of the mean of the variables within two subsample groups is statistically significant at 1 percent, 5 percent, and 10 percent level, respectively.

In terms of the influence of the proxy variables of a firm's financial characteristics such as sales and profitability, user firms of Japanese yen invoicing are statistically different from non-users with respect to the firm size measured by the log of sales. User firms of local currency invoicing also have a significantly larger amount of sales than do non-users of local currency invoicing. These results are consistent with the observation in the existing empirical research such as Ito et al. (2018), in which larger size Japanese listed firms have a tendency to choose the local currency invoicing not Japanese yen invoicing. On the other hand, profit per employee for users of local currency is statistically larger than that of non-users, while no such statistically significant difference is observed for users and non-users of Japanese yen and US dollar invoicing.

The variables including the firm age, the world top, top 3 largest within the industry, and the number of patents represent the extent of firm's competitiveness in the global market and industry and firm's product differentiability, by which we suppose the firms have higher bargaining power in the negotiation with importers. The univariate tests suggest that users of Japanese yen invoicing are statistically different from non-users only with respect to the firm age and the top 3 largest within the industry, but its statistical significance level is only 10 percent, while no statistically significant differences with respect to the world top and the number of patents. In terms of local currency invoicing, the number of patents held by users of local currency invoicing is larger than

that of non-users, which contradicts our prediction that the firms with higher product differentiability decrease the local currency invoicing due to higher bargaining power for exporters. There is no statistically significant difference between users and non-users of US dollar invoicing in terms of these variables. In summary, although we observe some influence of proxy variables regarding the extent of exporter's bargaining power on the invoice currency choice, pieces of evidence are ambiguous by the univariate test.

The sales growth and the capital ratio constitute the proxy variables related to the financial constraints of the firm. The sales growth has a statistically significant positive difference between users and non-users of Japanese yen invoicing at a 5 percent significance level, while the capital ratio has no statistically significant difference. The sales growth also has a statistically significant negative difference between users and non-users of US dollar invoicing, while the capital ratio has no statistically significant difference. These results show that the impacts of variables related to firm's financial constraints on the invoice currency choice are ambiguous by the univariate test due to the insignificant influence of the capital ratio.

Import currency is a dummy variable related to the choice of invoice currency on the import side of the destination. These dummy variables represent the operational hedging strategy employed by the firm. The choice of invoice currency on the import-side has statistically significant impacts on the choice of invoice currency on the export-side in the same destination.

Dummy variable for the use of forward contract by the firm has a statistically significant negative difference on the Japanese yen invoicing at 1 percent significance level while the statistically significant positive impact on the local currency invoicing at 5 percent level and no impact on the US dollar invoicing. This is consistent with the view that the firm that can utilize the financial hedge would not necessarily depend on the choice of producer's currency (Japanese yen) invoicing for managing the exchange rate risk exposure.

Lastly, the longevity of export experience is calculated as the logarithm of one plus the number of years after the firm started the exports to the destination. This variable represents the degree of experience for handling the currency risk management of destination currency. This variable is statistically significant positive only on the choice of the local currency invoicing while no statistically significant impacts on the Japanese yen and US dollar invoicing.

5. Empirical methodology

We employ the following probit model to examine the determinants of invoice currency decisions. The sample is firm-destination-trade partner data, which is about the firm i's export to the destination country j through the trade channel (trade partner) k.

$$Prob(Curr_{ijk} = 1)$$
$$= \alpha_0 + \beta_1 Currency\ volatiliy_j$$
$$+ \gamma_1 Own\ subsidiary_{ijk} + \gamma_2 Related\ firm_{ijk}$$
$$+ \gamma_3 Local\ agency_{ijk} + \gamma_4 Trade\ company_{ijk}$$
$$+ \theta_1 Firm\ age_i + \theta_2 Sales_i + \theta_3 Profitability_i$$
$$+ \lambda_1 World\ top_i + \lambda_2 Domestic\ top3_i + \lambda_3 Patent_i$$
$$+ \mu_1 Sales\ growth_i + \mu_2 Capital\ ratio_i$$
$$+ \rho_1 Forward_i$$
$$+ \sigma_1 Import\ currency_{ij} + \sigma_2 Experience_{ij}$$
$$+ \delta_1 Industry\ dummies_i + \varepsilon_{ijk}$$

The left-hand side variable, *Curr* is a binary variable that takes one if a concerned currency is the main currency in export to the trade partner in the destination country and zero otherwise. This *Curr* variable can be Japanese yen, the local currency, and the US dollar, interchangeably, depending on the purpose of analysis.

On the right-hand side, the *Own subsidiary* through *Trade company* are dummy variables for each trade partner in the destination country. For instance, if it is the case of firm *i*'s export to a local agency without any capital tie in China, the dummy variable *Local agency* takes one while other trade partner dummies such as *Own subsidiary*, *Related firm*, and *Trade partner*, take zero. Among the six types of trade partners described in the previous section, we take the direct export to local customers and others as a benchmark, thus drop the dummies for these two types of trade partners from the regression model. Other explanatory variables included on the right-hand side are the same variables defined in the previous section except for *Industry dummies*, which are dummy variables for the type of manufacturing industry that the firm belongs. Table 5-1 presents the correlation coefficients between the selected explanatory variables.

Table 5-1. Correlation coefficients for explanatory variables

	firm_age	sales	profit	sales_g	cap_ratio	patent	dometop3	worldtop	im_jpy	im_usd	im_lc
sales	0.291										
	(0.000)										
profit	-0.138	0.235									
	(0.000)	(0.000)									
sales_g	-0.165	0.094	0.235								
	(0.000)	(0.004)	(0.000)								
cap_ratio	0.118	0.353	0.276	-0.018							
	(0.000)	(0.000)	(0.000)	(0.591)							
patent	0.106	0.577	0.211	0.094	0.320						
	(0.001)	(0.000)	(0.000)	(0.004)	(0.000)						
dometop3	0.170	0.350	0.031	0.081	0.100	0.193					
	(0.000)	(0.000)	(0.353)	(0.014)	(0.002)	(0.000)					
worldtop	-0.201	0.229	0.235	0.193	0.124	0.328	0.074				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.023)				
im_jpy	-0.027	0.121	0.052	0.120	0.096	0.116	0.071	0.076			
	(0.405)	(0.000)	(0.121)	(0.000)	(0.003)	(0.000)	(0.030)	(0.021)			
im_usd	-0.022	0.084	-0.017	-0.032	-0.074	0.057	-0.004	-0.025	-0.120		
	(0.495)	(0.010)	(0.613)	(0.330)	(0.024)	(0.083)	(0.904)	(0.455)	(0.000)		
im_lc	-0.021	0.099	0.078	0.016	0.020	0.119	-0.057	0.017	-0.083	0.236	
	(0.530)	(0.002)	(0.020)	(0.629)	(0.551)	(0.000)	(0.083)	(0.615)	(0.011)	(0.000)	
forward	-0.030	0.252	0.070	0.087	0.017	0.315	0.049	0.152	-0.002	0.109	0.052
	(0.363)	(0.000)	(0.036)	(0.008)	(0.597)	(0.000)	(0.132)	(0.000)	(0.952)	(0.000)	(0.111)

Note: Variables are as follows: "sales" is Sales (log); "profit" is Profit per employee (FY2017 and 2018); "sales_g" is Sales growth (FY2009-2018); "cap_ratio" is capital ratio (FY2018); "patent" is Number of patents (log). "dometop3" is Top 3 largest within the domestic industry; "worldtop" is Worldtop (global market); "im_jpy" is Import currency (Japanese yen); "im_usd" is Import currency (US dollar); "im_lc" is Import currency (local currency); "forward" is Usage of forward contract.

Using the above variables, we employ the probit model estimation to test the determinants of the main invoice currency of Japanese SMEs. Table 5-2 reports basic results for impact determinants of Japanese yen invoicing.

First, the export to own subsidiaries has statistically significant negative coefficients in the specification (1) through (4). After controlling for other factors, the probability that the Japanese yen becomes the main invoice currency is 14 percent lower in this type of export than in the direct export to local customers and others, the benchmark export channel in all specifications. On the other hand, the export to related firms, another channel of the intra-firm trades, takes a negative coefficient but is not statistically significant at a conventional significance level. The absolute value of the estimated coefficients is almost halved comparing to those of own subsidiaries. These results show that the intra-firm trades tend to hinder the use of producer's currency (Japanese yen) invoicing, though the extent of intra-firm relationship plays an important role. In own subsidiaries, its capital is owned by the parent firms in Japan more than 50 percent while the capital of the related firm is owned only 20 percent through 49 percent by parent firms and local firms in destination country sometimes participate in Japanese related firms as major shareholders.

Second, the inter-firm trades via Japanese trading companies tend to be invoiced in Japanese yen. The estimated coefficients of export via Japanese trading companies take statistically significant

positive coefficients at a 5 percent level in all specifications (1) through (5). The coefficients show that in export though Japanese trade companies, the Japanese SMEs use Japanese yen as the main invoice currency more by about 21 percent compared to the benchmark trade channel. These results are quite reasonable because the export via Japanese trading companies is viewed as the trade between Japanese firms.

Third, among the basic firm's characteristics, on the one hand, the log of sales takes a negative coefficient whose significance level is 10 percent, indicating that firms with larger sales tend to invoice in foreign currencies. On the other hand, the profit per employee takes insignificant coefficients in any specifications.

Forth, the firm age, which is the number of years since its establishment, takes a statistically significant positive coefficient at a 1 percent significance level, which means that elder firms use Japanese yen as the main invoice currency in exports. Moreover, firms with a top share in the global niche market or the top 3 largest with domestic industry use Japanese yen invoicing more while the number of patents has no statistically significant impacts on Japanese yen invoicing. These results suggest that the variables regarding product competitiveness and differentiability linked to the bargaining power are crucial for Japanese yen invoicing.

Fifth, firms with higher sales growth, which is a proxy for a firm's growth opportunity, tend to invoiced in Japanese yen. Its statistical significance level is 1 percent. The capital ratio, the variables related to the soundness of financial conditions, have negative coefficients that are statistically significant at 10 percent level in (1) through (4) and 5 percent in (5). As stated above, the sales growth and the capital ratio combinedly constitute the measure of financial constraints faced by the firm. These results suggest that firms having higher growth opportunities and more deteriorated financial conditions tend to choose the Japanese yen as an invoice currency in exports.

Sixth, the firms using forward contracts are less likely to use the Japanese yen as an invoice currency in exports. The use of financial hedging such as forward contracts and the use of producer's currency as invoice currency are substitutable in terms of exchange rate risk hedging. We interpret these results that the firms using the forward contract less depend on the hedging by invoice currency.

Seventh, the coefficients of import currency (Japanese yen) are positive with a 1 percent significance level. This means that firms importing goods from the same destination for export have a strong tendency to use a single type of currency between import and export sides. We

interpret this result as indicating that Japanese SMEs implement the operational hedging, in which the firms net out the currency risk on both sides of trade flows.

Last, the specification (5) in Table 5-2 includes the dummy variables representing the longevity of export experience. If firms accumulate the knowledge of the destination country, the number of years since they started exporting to a specific destination can be used as a proxy for the degree of experience. We observe no statistically significant impacts. This result means that the impacts of the longevity of export experience, after controlling for the impact of firm age, is very limited in our examination.

Table 5-2. Impact of determinants on exporter's currency (Japanese yen) invoicing: all destinations

VARIABLES	(1) Japanese yen	(2) Japanese yen	(3) Japanese yen	(4) Japanese yen	(5) Japanese yen
Currency volatility (weekly, 1 year)	5.355	5.291	5.109	5.437	0.401
	(6.415)	(6.407)	(6.404)	(6.400)	(7.195)
Ex. to own subsidiaries	-0.139**	-0.142**	-0.141**	-0.149**	-0.0942
	(0.0580)	(0.0580)	(0.0581)	(0.0586)	(0.0627)
Ex. to related firms	-0.0831	-0.0812	-0.0825	-0.0814	-0.0554
	(0.0738)	(0.0734)	(0.0739)	(0.0732)	(0.0804)
Ex. to local Agency	0.0568	0.0543	0.0569	0.0532	0.0834*
	(0.0398)	(0.0398)	(0.0398)	(0.0399)	(0.0459)
Ex. via Japanese trading companies	0.217***	0.210***	0.219***	0.208***	0.206***
	(0.0328)	(0.0330)	(0.0324)	(0.0333)	(0.0393)
Firm age (log)	0.131***	0.105**	0.115***	0.124***	0.0562
	(0.0443)	(0.0430)	(0.0434)	(0.0442)	(0.0516)
Sales (log) (FY2018)	-0.0274	-0.0273*	-0.0311*	-0.0338**	-0.0366*
	(0.0167)	(0.0165)	(0.0176)	(0.0170)	(0.0195)
Profit per employee (FY2017 & 2018)	0.00146	0.00216	0.000301	0.00217	0.00310
	(0.00712)	(0.00700)	(0.00701)	(0.00705)	(0.00754)
World top (global market)	0.120**			0.116**	0.119*
	(0.0548)			(0.0564)	(0.0657)
Top 3 largest (domestic industry)		0.165***		0.164***	0.167***
		(0.0472)		(0.0485)	(0.0549)
Number of patent (log)			0.0212		
			(0.0138)		
Sales growth (FY2009-2018)	0.100***	0.0950***	0.107***	0.0905***	0.0816***
	(0.0237)	(0.0235)	(0.0239)	(0.0235)	(0.0283)
Capital ratio (FY2018)	-0.127*	-0.117*	-0.135**	-0.121*	-0.190**
	(0.0685)	(0.0681)	(0.0683)	(0.0684)	(0.0810)
Usage of forward contract	-0.234***	-0.222***	-0.246***	-0.235***	-0.303***
	(0.0542)	(0.0532)	(0.0563)	(0.0545)	(0.0673)
Import currency (Japanese yen)	0.223***	0.223***	0.223***	0.220***	0.244***
	(0.0251)	(0.0248)	(0.0251)	(0.0251)	(0.0273)
Longevity of export experince (log)					0.0146
					(0.0257)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Observations	806	806	806	806	617
Pseudo R squared	0.223	0.225	0.222	0.228	0.252

Standard errors in parentheses   *** p<0.01, ** p<0.05, * p<0.1

Table 5-3 and Table 5-4 report the results on the impacts of determinants on local currency invoicing and the US dollar invoicing, respectively. The main results are summarized as follows.

First, the currency volatility has statistically significant negative coefficients in local currency invoicing while statistically significant positive coefficients in the US dollar invoicing. Combined with the result in the Japanese yen invoicing in which there are no impacts of the currency volatility on Japanese yen invoicing, we interpret that large bilateral currency volatility of local currency vis-à-vis Japanese yen hinders the local currency invoicing and promotes the vehicle currency invoicing such as the US dollar.

Second, among the intra-firm trades, the exports to own subsidiaries have a statistically significant positive coefficient at 10 percent level only in the local currency invoicing while no statistically significant impacts on the US dollar invoicing.

Third, firms with the world's top share in a global niche market and firms with a large number of patents are less likely to use the local currency invoicing, while firms with the top 3 largest within the domestic industry are less likely to use the US dollar.

Forth, among the variables related to financial constraints, the firm growth has statistically significant negative impacts on the local currency invoicing and the US dollar invoicing. The capital ratio has positive coefficients in both local currencies invoicing and the US dollar invoicing, but statistically significant coefficients are observed only in the US dollar invoicing.

Fifth, the variables relating to the use of forward contracts and operational hedging are statistically positive impacts on the local currency invoicing and the US dollar invoicing.

Table 5-3. Impact of determinants on local currency invoicing: all destinations

VARIABLES	(1) local currency	(2) local currency	(3) local currency	(4) local currency	(5) local currency
Currency volatility (weekly, 1 year)	-24.88***	-25.01***	-24.18***	-24.89***	-27.29***
	(4.315)	(4.329)	(4.298)	(4.316)	(4.980)
Ex. to own subsidiaries	0.0602*	0.0571*	0.0652*	0.0604*	0.0175
	(0.0338)	(0.0332)	(0.0347)	(0.0339)	(0.0287)
Ex. to related firms	0.00766	0.00691	0.00861	0.00740	-0.00732
	(0.0340)	(0.0341)	(0.0340)	(0.0339)	(0.0312)
Ex. to local Agency	-0.0103	-0.0103	-0.00863	-0.0103	0.00327
	(0.0204)	(0.0205)	(0.0204)	(0.0204)	(0.0264)
Ex. via Japanese trading companies	-0.0652***	-0.0677***	-0.0670***	-0.0650***	-0.0577***
	(0.0175)	(0.0173)	(0.0170)	(0.0175)	(0.0207)
Firm age (log)	-0.0306	-0.0202	-0.0251	-0.0303	-0.00789
	(0.0217)	(0.0206)	(0.0203)	(0.0218)	(0.0248)
Sales (log) (FY2018)	-0.000172	-0.00295	0.00498	8.47e-05	0.00581
	(0.00859)	(0.00840)	(0.00893)	(0.00872)	(0.00997)
Profit per employee (FY2017 & 2018)	0.00411	0.00354	0.00422	0.00406	0.00342
	(0.00308)	(0.00313)	(0.00299)	(0.00309)	(0.00348)
World top (global market)	-0.0391*			-0.0390*	-0.0433**
	(0.0210)			(0.0211)	(0.0217)
Top 3 largest (domestic industry)		-0.00966		-0.00774	-0.0102
		(0.0403)		(0.0420)	(0.0436)
Number of patent (log)			-0.0147**		
			(0.00678)		
Sales growth (FY2009-2018)	-0.0214**	-0.0225**	-0.0237**	-0.0211**	-0.0183
	(0.0102)	(0.0106)	(0.0105)	(0.0104)	(0.0119)
Capital ratio (FY2018)	0.0190	0.0157	0.0217	0.0188	-0.00979
	(0.0325)	(0.0325)	(0.0318)	(0.0325)	(0.0385)
Usage of forward contract	0.0848**	0.0790**	0.101***	0.0851**	0.103**
	(0.0344)	(0.0332)	(0.0379)	(0.0345)	(0.0451)
Import currency (local currency)	0.263***	0.268***	0.281***	0.262***	0.227***
	(0.0807)	(0.0812)	(0.0827)	(0.0809)	(0.0853)
Longevity of export experince (log)					0.00467
					(0.0134)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Observations	797	797	797	797	611
Pseudo R squared	0.278	0.275	0.283	0.278	0.284

Standard errors in parentheses   *** p<0.01, ** p<0.05, * p<0.1

Table 5-4. Impact of determinants on vehicle currency (US dollar) invoicing: all destinations except the US

VARIABLES	(1) US dollar	(2) US dollar	(3) US dollar	(4) US dollar	(5) US dollar
Currency volatility (weekly, 1 year)	10.53*	10.11*	10.64**	10.02*	14.61**
	(5.418)	(5.318)	(5.404)	(5.298)	(5.916)
Ex. to own subsidiaries	-0.0307	-0.0258	-0.0285	-0.0213	-0.00959
	(0.0368)	(0.0366)	(0.0370)	(0.0376)	(0.0443)
Ex. to related firms	0.0327	0.0330	0.0349	0.0326	0.0423
	(0.0607)	(0.0592)	(0.0610)	(0.0590)	(0.0682)
Ex. to local Agency	-0.0662**	-0.0646**	-0.0661**	-0.0631**	-0.102***
	(0.0304)	(0.0295)	(0.0303)	(0.0296)	(0.0302)
Ex. via Japanese trading companies	-0.119***	-0.111***	-0.121***	-0.110***	-0.107***
	(0.0278)	(0.0276)	(0.0276)	(0.0277)	(0.0313)
Firm age (log)	-0.0387	-0.0268	-0.0293	-0.0360	0.00283
	(0.0380)	(0.0358)	(0.0369)	(0.0370)	(0.0426)
Sales (log) (FY2018)	0.00225	0.00535	0.00588	0.00813	0.00936
	(0.0139)	(0.0135)	(0.0146)	(0.0138)	(0.0154)
Profit per employee (FY2017 & 2018)	-0.00564	-0.00549	-0.00416	-0.00592	-0.00504
	(0.00690)	(0.00660)	(0.00680)	(0.00668)	(0.00703)
World top (global market)	-0.0564			-0.0583	-0.0561
	(0.0537)			(0.0512)	(0.0608)
Top 3 largest (domestic industry)		-0.130***		-0.130***	-0.129***
		(0.0216)		(0.0212)	(0.0235)
Number of patent (log)			-0.0136		
			(0.0117)		
Sales growth (FY2009-2018)	-0.0781***	-0.0706***	-0.0813***	-0.0677***	-0.0634***
	(0.0214)	(0.0211)	(0.0213)	(0.0212)	(0.0240)
Capital ratio (FY2018)	0.0929	0.0881	0.0981*	0.0909	0.162**
	(0.0575)	(0.0563)	(0.0574)	(0.0563)	(0.0639)
Usage of forward contract	0.141***	0.139***	0.151***	0.147***	0.193***
	(0.0514)	(0.0506)	(0.0534)	(0.0521)	(0.0679)
Import currency (US dollar)	0.247***	0.253***	0.255***	0.248***	0.243***
	(0.0692)	(0.0696)	(0.0694)	(0.0696)	(0.0799)
Longevity of export experince (log)					-0.0251
					(0.0203)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Observations	678	678	678	678	514
Pseudo R squared	0.181	0.192	0.182	0.193	0.231

Standard errors in parentheses   *** p<0.01, ** p<0.05, * p<0.1

6. Robustness tests

In the previous section, we found some evidence that the soundness of the financial condition of firms plays an important role. For testing the robustness of results, more detailed financial data are available to many sample firms provided by the TDB, which covers almost 60 percent of sample firms. Using the detailed financial data, we construct the new explanatory variables related to the soundness of financial conditions for sample firms.

Table 6-1. Sample statistics of detailed financial variables

	Obs	Mean	Std. dev.	Min	Max
Sales (log) (FY2018)	195	14.85	1.33	11.64	18.50
ROA (FY2018)	195	0.03	0.06	-0.38	0.43
Tangible fixed assets growth (FY2013-2018)	169	0.12	0.45	-1.39	2.11
Capital ratio (FY2018)	195	0.38	0.31	-1.52	0.95
Cash-assets ratio (FY2018)	195	0.16	0.14	0.00	0.82
Temporal liquidity (FY2018)	195	0.22	0.41	0.00	3.80

The first variable is the log of sales as of the fiscal year 2018, which is calculated by using detailed sample data. The second variable is the Return on Assets (ROA), which is calculated as after-tax profit divided by total assets as of the fiscal year. The third variable is the growth rate of intangible fixed assets from the fiscal year 2013 through 2018, a proxy variable to capture the investment opportunity of the sample firm during the second half of the 2010s. The last three variables are related to the soundness of firms. The capital ratio is calculated as capital divided by total assets. This ratio can take a negative value when the capital is reported as a negative value. The cash-assets ratio (the temporal liquidity) is calculated as the sum of cash and deposit divided by total assets (sales).

Table 6-2 provides the results of the t-test between different sample groups for financial variables. Similar to the results in Table 4-3, the size of sales has a negative difference between users and non-users of Japanese yen invoicing and a positive difference for the local currency invoicing and the US dollar invoicing. The growth rate of tangible fixed assets, a proxy for the firm's investment opportunity and demand for external finance, is higher for users of Japanese yen than non-users while lower for users of US dollar. The growth rate does not have a statistically significant influence on the local currency invoicing. The cash-assets ratio and temporal liquidity, proxies for the availability of internal funds, promote the US dollar invoicing and hinder the Japanese yen invoicing while both of these variables have no statistically significant influence on the local

currency invoicing. Last, we observe no statistical influence of the capital ratio on the invoice currency choice by the univariate test.

Table 6-2. The results of the t-test between different sample groups

A. Japanese yen invoicing

Variables	Main currency (Japanese yen)=1			Main currency (Japanese yen)=0			t-statistic	p-value	
	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.			
Sales (log) (FY2018)	403	14.86	1.41	192	15.13	1.22	-2.31	0.021	**
ROA (FY2018)	403	0.03	0.06	192	0.03	0.05	-0.23	0.820	
Tangible fixed assets growth (FY2013-20	359	0.13	0.41	172	0.01	0.43	3.17	0.002	***
Capital ratio (FY2018)	403	0.39	0.31	192	0.43	0.27	-1.60	0.110	
Cash-assets ratio (FY2018)	403	0.15	0.13	192	0.18	0.15	-2.17	0.031	**
Temporal liquidity (FY2018)	403	0.19	0.22	192	0.29	0.58	-2.90	0.004	***

B. Local currency invoicing

Variables	Main currency (local currency)=1			Main currency (local currency)=0			t-statistic	p-value	
	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.			
Sales (log) (FY2018)	76	15.24	1.26	519	14.90	1.37	2.01	0.045	**
ROA (FY2018)	76	0.04	0.05	519	0.03	0.06	1.12	0.265	
Tangible fixed assets growth (FY2013-20	65	0.05	0.49	466	0.09	0.41	-0.73	0.463	
Capital ratio (FY2018)	76	0.43	0.30	519	0.40	0.30	0.78	0.435	
Cash-assets ratio (FY2018)	76	0.16	0.14	519	0.16	0.14	-0.34	0.732	
Temporal liquidity (FY2018)	76	0.23	0.45	519	0.22	0.37	0.24	0.814	

C. US dollar (Vehicle currency) invoicing

Variables	Main currency (US dollar)=1			Main currency (US dollar)=0			t-statistic	p-value	
	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.			
Sales (log) (FY2018)	110	15.15	1.25	409	14.88	1.37	1.82	0.070	*
ROA (FY2018)	110	0.03	0.06	409	0.03	0.06	-0.84	0.402	
Tangible fixed assets growth (FY2013-20	102	-0.02	0.39	364	0.12	0.42	-3.06	0.002	***
Capital ratio (FY2018)	110	0.42	0.25	409	0.40	0.30	0.74	0.458	
Cash-assets ratio (FY2018)	110	0.19	0.15	409	0.16	0.13	2.17	0.031	**
Temporal liquidity (FY2018)	110	0.32	0.66	409	0.20	0.22	3.25	0.001	***

For further analysis, we conduct the probit model estimation by the same regression model employed in section 5 using the new financial variables constructed from the financial data. Table 6-3 presents the correlation coefficients between the selected explanatory variables.

Table 6-3. Correlation coefficients for explanatory variables: detailed financial data

	sales_2018	roa_2018	tangible_g_2013	cap_ratio_2018	cash_asset_2018
roa_2018	0.195				
	(0.000)				
tangible_g_2013	0.103	-0.031			
	(0.017)	(0.469)			
cap_ratio_2018	0.255	0.435	-0.024		
	(0.000)	(0.000)	(0.583)		
cash_asset_2018	-0.260	0.001	-0.152	0.316	
	(0.000)	(0.976)	(0.000)	(0.000)	
temp_liq_2018	-0.211	-0.169	-0.073	0.275	0.744
	(0.000)	(0.000)	(0.091)	(0.000)	(0.000)

Note: Variables are as follows: "roa_2018" is ROA (FY2018); "sales_g_2018" is Sales (log) (FY2018); "cap_ratio_2018" is Capital ratio (FY2018); "cash_2018" is Cash-asset ratio (FY2018); "tangible_g_2013" is Tabgible fixed asset growth (FY2013-2018); "cash_asset_2018" is Cash-asset raio (FY2018); "temp_liq_2018" is Temporal liquidity (FY2018).

Table 6-4, 6-5, and 6-6 report the impacts of determinants on Japanese yen, US dollar, local currency invoicing, respectively, using these financial data. For the limited coverage by the detailed financial data provided by the TDB, the number of observations declines by almost 30 percent. For instance, the number of observations decreases from 806 in Table 5-2 (1) to 548 in Table 6-4 (1). The main results are summarized as follows.

First, the ROA, the after-tax profit divided by total assets, has statistically significant negative impacts on US dollar invoicing. This means that less profitable firms are likely to choose the vehicle currency, i.e., the US dollar, invoicing.

Second, the growth rate of tangible fixed assets, which captures investment and growth opportunities at the firm-level, has positive impacts on Japanese yen invoicing and negative impacts on US dollar invoicing, respectively. Our interpretation is that firms with greater investment opportunities try to minimize the risk from cash flow fluctuations by choosing the Japanese yen invoicing because these firms tend to take additional costs from tapping into external funding.

Third, after controlling for the impacts of the ROA and investment and growth opportunity, both the capital ratio and cash position have statistically significant negative impacts on Japanese yen

invoicing (Table 6-4), and statistically significant positive impacts on US dollar invoicing (Table 6-6). We interpret these results as indicating that deteriorated financial condition and resulting higher cost of the capital provide an incentive for Japanese exporting SMEs to stabilize their cash flows by choosing the exporter's currency (Japanese yen) invoicing.

Last, similar to the results through Table 5-2 to 5-4, the use of the forward contract hinders the Japanese yen invoicing and promotes the US dollar invoicing. These results are consistent with the view that financial hedging is substitutable with Japanese yen invoicing as far as sample SMEs can utilize financial hedging.

Table 6-4. Impact of determinants on Exporter's currency (Japanese yen) invoicing: all destinations using the detailed financial data

VARIABLES	(1) Japanese yen	(2) Japanese yen	(3) Japanese yen	(4) Japanese yen	(5) Japanese yen	(6) Japanese yen
Currency volatility (weekly, 1 year)	3.836	4.488	4.299	5.499	6.352	6.286
	(8.464)	(8.503)	(8.529)	(9.317)	(9.345)	(9.334)
Ex. to own subsidiaries	-0.198***	-0.206***	-0.204***	-0.177**	-0.188**	-0.180**
	(0.0761)	(0.0764)	(0.0771)	(0.0816)	(0.0820)	(0.0822)
Ex. to related firms	-0.0845	-0.0800	-0.0899	-0.0448	-0.0574	-0.0649
	(0.0890)	(0.0890)	(0.0895)	(0.0966)	(0.0990)	(0.0990)
Ex. to local Agency	0.0628	0.0590	0.0473	0.0679	0.0654	0.0576
	(0.0530)	(0.0536)	(0.0547)	(0.0600)	(0.0603)	(0.0606)
Ex. via Japanese trading companies	0.236***	0.241***	0.229***	0.228***	0.237***	0.227***
	(0.0447)	(0.0445)	(0.0459)	(0.0512)	(0.0507)	(0.0517)
Top 3 largest (domestic industry)	0.230***	0.232***	0.233***	0.233***	0.226***	0.231***
	(0.0531)	(0.0519)	(0.0530)	(0.0636)	(0.0659)	(0.0642)
Number of patent (log)	0.0103	0.0114	0.0172	0.0370*	0.0359*	0.0384*
	(0.0187)	(0.0188)	(0.0191)	(0.0214)	(0.0214)	(0.0214)
Sales (log) (FY2018)	-0.00204	-0.0267	-0.0275	-0.0179	-0.0384	-0.0378
	(0.0217)	(0.0217)	(0.0218)	(0.0251)	(0.0249)	(0.0249)
ROA (FY2018)	0.474	0.155	-0.0308	0.590	0.507	0.317
	(0.416)	(0.391)	(0.415)	(0.614)	(0.579)	(0.574)
Tangible fixed assets growth (FY2013-2018)				0.148**	0.125*	0.144**
				(0.0654)	(0.0661)	(0.0657)
Capital ratio (FY2018)	-0.183**			-0.183*		
	(0.0862)			(0.107)		
Cash-assets ratio (FY2018)		-0.540***			-0.585***	
		(0.161)			(0.188)	
Temporal liquidity (FY2018)			-0.237***			-0.250**
			(0.0904)			(0.106)
Usage of forward contract	-0.269***	-0.238***	-0.252***	-0.235***	-0.198**	-0.211***
	(0.0750)	(0.0736)	(0.0734)	(0.0827)	(0.0800)	(0.0798)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	548	548	548	469	469	469
Pseudo R squared	0.163	0.173	0.172	0.150	0.161	0.156

Standard errors in parentheses   *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6-5. Impact of determinants on local currency invoicing: all destinations using the detailed financial data

VARIABLES	(1) Local currency	(2) Local currency	(3) Local currency	(4) Local currency	(5) Local currency	(6) Local currency
Currency volatility (weekly, 1 year)	-31.05***	-31.07***	-31.06***	-33.87***	-33.72***	-33.69***
	(5.725)	(5.739)	(5.738)	(6.681)	(6.689)	(6.691)
Ex. to own subsidiaries	0.0744	0.0751	0.0750	0.0558	0.0551	0.0564
	(0.0475)	(0.0477)	(0.0477)	(0.0498)	(0.0498)	(0.0501)
Ex. to related firms	0.0256	0.0257	0.0254	0.0198	0.0169	0.0167
	(0.0494)	(0.0498)	(0.0497)	(0.0565)	(0.0559)	(0.0557)
Ex. to local Agency	-0.0298	-0.0312	-0.0310	-0.0453	-0.0484*	-0.0483*
	(0.0252)	(0.0249)	(0.0249)	(0.0287)	(0.0283)	(0.0282)
Ex. via Japanese trading companies	-0.0936***	-0.0948***	-0.0946***	-0.105***	-0.106***	-0.106***
	(0.0237)	(0.0236)	(0.0236)	(0.0256)	(0.0257)	(0.0256)
Top 3 largest (domestic industry)	-0.0351	-0.0346	-0.0349	-0.0115	-0.00866	-0.00935
	(0.0381)	(0.0390)	(0.0389)	(0.0620)	(0.0651)	(0.0646)
Number of patent (log)	-0.0133	-0.0137	-0.0144	-0.0255**	-0.0267**	-0.0262**
	(0.00963)	(0.00967)	(0.00990)	(0.0123)	(0.0124)	(0.0124)
Sales (log) (FY2018)	0.00551	0.00410	0.00493	0.00677	0.00410	0.00348
	(0.0114)	(0.0114)	(0.0115)	(0.0145)	(0.0144)	(0.0144)
ROA (FY2018)	0.287	0.243	0.259	0.450	0.352	0.352
	(0.234)	(0.219)	(0.226)	(0.353)	(0.330)	(0.325)
Tangible fixed assets growth (FY2013-2018)				0.00680	0.00839	0.00803
				(0.0344)	(0.0351)	(0.0347)
Capital ratio (FY2018)	-0.0231			-0.0456		
	(0.0424)			(0.0577)		
Cash-assets ratio (FY2018)		-0.00430			-0.0128	
		(0.0809)			(0.105)	
Temporal liquidity (FY2018)			0.00774			-0.0172
			(0.0260)			(0.0440)
Usage of forward contract	0.0562	0.0613	0.0632	0.0433	0.0547	0.0524
	(0.0452)	(0.0455)	(0.0462)	(0.0505)	(0.0512)	(0.0510)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	539	539	539	428	428	428
Pseudo R squared	0.213	0.212	0.213	0.203	0.202	0.202

Standard errors in parentheses   *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6-6. Impact of determinants on vehicle currency (US dollar) invoicing: all destinations except the US using the detailed financial data

VARIABLES	(1) US dollar	(2) US dollar	(3) US dollar	(4) US dollar	(5) US dollar	(6) US dollar
Currency volatility (weekly, 1 year)	13.49**	12.87*	13.08*	10.45	9.810	10.06
	(6.842)	(6.939)	(6.992)	(7.869)	(7.963)	(7.970)
Ex. to own subsidiaries	0.0750	0.0794	0.0700	0.0854	0.0977	0.0834
	(0.0648)	(0.0656)	(0.0656)	(0.0753)	(0.0771)	(0.0761)
Ex. to related firms	0.0770	0.0730	0.0831	0.0567	0.0732	0.0766
	(0.0838)	(0.0832)	(0.0854)	(0.0906)	(0.0961)	(0.0966)
Ex. to local Agency	-0.0645	-0.0598	-0.0501	-0.0566	-0.0487	-0.0415
	(0.0399)	(0.0415)	(0.0433)	(0.0494)	(0.0512)	(0.0522)
Ex. via Japanese trading companies	-0.133***	-0.137***	-0.127***	-0.125***	-0.129***	-0.122***
	(0.0365)	(0.0370)	(0.0383)	(0.0435)	(0.0440)	(0.0448)
Top 3 largest (domestic industry)	-0.168***	-0.166***	-0.170***	-0.182***	-0.181***	-0.184***
	(0.0232)	(0.0242)	(0.0244)	(0.0244)	(0.0256)	(0.0250)
Number of patent (log)	0.0108	0.0107	0.00624	-0.00520	-0.00264	-0.00534
	(0.0156)	(0.0158)	(0.0162)	(0.0186)	(0.0185)	(0.0187)
Sales (log) (FY2018)	-0.00443	0.0169	0.0191	0.0155	0.0332	0.0354
	(0.0182)	(0.0183)	(0.0186)	(0.0218)	(0.0219)	(0.0221)
ROA (FY2018)	-0.828**	-0.469	-0.365	-1.053**	-0.832*	-0.707
	(0.339)	(0.311)	(0.330)	(0.527)	(0.500)	(0.496)
Tangible fixed assets growth (FY2013-2018)				-0.158***	-0.139**	-0.157***
				(0.0591)	(0.0606)	(0.0596)
Capital ratio (FY2018)	0.208***			0.219**		
	(0.0787)			(0.0972)		
Cash-assets ratio (FY2018)		0.428***			0.424***	
		(0.134)			(0.162)	
Temporal liquidity (FY2018)			0.184**			0.187**
			(0.0739)			(0.0864)
Usage of forward contract	0.269***	0.203***	0.225***	0.251***	0.179**	0.200**
	(0.0813)	(0.0744)	(0.0756)	(0.0909)	(0.0824)	(0.0837)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	468	468	468	402	402	402
Pseudo R squared	0.169	0.175	0.175	0.166	0.170	0.169

Standard errors in parentheses   *** $p<0.01$, ** $p<0.05$, * $p<0.1$

7. Conclusion

We conducted the questionnaire survey for 2,100 firms that are unlisted manufacturers experiencing exports, firms continuing exports throughout the 2010s, and firms that started exports in the first half or the second half of 2010s with responses from 300 firms. By constructing the database with the current status of invoice currency pattern and trade partner by export destination as well as the same information on current imports and retrospective information as of year when the firms started exports, we empirically examined the determinants of invoice currency in export by the probit model estimation.

We confirm that many determinants on currency invoicing discussed in existing research on listed manufacturers also function for exporting Japanese SMEs. As the country-level determinants, the currency volatility of the bilateral nominal exchange rate of local currency vis-à-vis Japanese yen hinders the local currency invoicing and promotes the vehicle currency (US dollar) invoicing. As the trade channel (trade partner) determinants, the intra-firm trade, especially exports to own subsidiaries, promotes the local currency invoicing and hinders the producer's currency (Japanese yen) invoicing. The trades through the Japanese trade companies, which is a view as the transaction between Japanese firms, are mostly occupied by the Japanese yen invoicing. As the determinants of firm size characteristics, the firms with large amounts of sales less tend to use producer's currency invoicing. As the determinants of a firm's product competitiveness and product differentiability relating to bargaining power in the negotiation with importers, firms with a top share in the global niche market and with the top 3 largest shares in the domestic industry tend to use producer's currency (Japanese yen) while the firms with a large number of patents are less likely to use the vehicle currency (US dollar) invoicing. We also found that the firm longevity promotes the producer's currency (Japanese yen) invoicing probably because the bargaining power of an exporter in the negotiation with importers is improved by the credibility of the firm which stems from its long history.

In addition to those determinants that have been discussed in the previous studies, we newly found that the variables closely relating to the financial constraints play an important role in the determination of invoice currency by Japanese SMEs. The firms with deteriorated capital ratio combined with rapid sales growth depend more on producer's currency (Japanese yen) invoicing, presumably to avoid the burden of exchange rate risk from foreign currency invoicing. These results are confirmed even after controlling for the impacts of usage of other firm-level hedging instruments such as forward contract and operational hedging through import-side invoice currency choice. We also conducted the robustness test for partial samples by using more detailed

financial data. In the robustness test, we confirm a higher likelihood of producer's currency (Japanese yen) invoicing for firms with lower capital ratio, lower liquidity position and greater investment opportunity.

These results for the firm-level financial constraints are consistent with the predictions from the theoretical researches on the bargaining model of currency invoicing and corporate risk management for hedging, and the recent empirical research on firm-level currency invoicing patterns using the questionnaire survey.

References

Friberg, Richard, and Frederik Wilander (2008) "The currency determination of exports: A questionnaire study", Journal of International Economics, 75(1), pp.54-69.

Froot, Kenneth A., David S. Sharfstein, and Jeremy C. Stein (1993) "Risk management: coordinating corporate investment and financing policies" Journal of Finance, Volume48(5), pp.1629-1658.

Geczy, C., B. A. Minton. And C. Schrand (1997) "Why firms use currency derivatives" The Journal of Finance, Vol.52, Issue4, September 1997, pp.1323-1354

Goldberg, Linda S. and Cedric Tille (2008) "Vehicle currency use in international trade" Journal of International Economics, Vol. 76, pp. 177-192.

Goldberg, Linda S. and Cedric Tille (2013) "A bargaining theory of trade invoicing and pricing" NBER Working Paper 18985, April 2013.

Goldberg, Linda S. and Cederic Tille (2016) "Micro, macro, and strategic forces in international trade invoicing: Synthesis and novel patterns," Journal of International Economics, Vol. 102, pp. 173-178.

Ito, Takatoshi., Satoshi Koibuchi, Kiyotaka Sato and Junko Shimizu (2012) "The choice of an invoicing currency by globally operating firms: A firm-level analysis of Japanese exporters," International Journal of Finance and Economics, Vol.17, Issue4, October 2012, pp.305-320.

Ito, Takatoshi., Satoshi Koibuchi, Kiyotaka Sato and Junko Shimizu (2018), Managing Currency Risk, Edward Elgar.

Stulz, R. (1984) "Optimal hedging policies", Journal of Financial and Quantitative Analysis 19, 127–140.

Appendix: Data description

Table A-1. Number of responded firms by prefecture

Prefecture	Number of responded firms	Percent to total	Prefecture	Number of responded firms	Percent to total
Total	300	100.0	24.Mie	5	1.7
1.Hokkaido	5	1.7	25.Shiga	1	0.3
2.Aomori	3	1.0	26.Kyoto	18	6.0
3.Iwate	2	0.7	27.Osaka	37	12.3
4.Miyagi	7	2.3	28.Hyogo	15	5.0
5.Akita	1	0.3	29.Nara	6	2.0
6.Yamagata	2	0.7	30.Wakayama	1	0.3
7.Fukushima	1	0.3	31.Tottori	0	0.0
8.Ibaraki	5	1.7	32.Shimane	0	0.0
9.Tochigi	3	1.0	33.Oakayama	7	2.3
10.Gunma	2	0.7	34.Hiroshima	12	4.0
11.Saitama	16	5.3	35.Yamaguchi	2	0.7
12.Chiba	5	1.7	36.Tokushima	3	1.0
13.Tokyo	39	13.0	37.Kagawa	3	1.0
14.Kanagawa	13	4.3	38.Ehime	2	0.7
15.Niigata	8	2.7	39.Kochi	1	0.3
16.Yamanashi	7	2.3	40.Fukuoka	4	1.3
17.Nagano	4	1.3	41.Saga	2	0.7
18.Toyama	0	0.0	42.Nagasaki	1	0.3
19.Ishikawa	2	0.7	43.Kumamoto	0	0.0
20.Fukui	13	4.3	44.Oita	4	1.3
21.Gifu	4	1.3	45.Miyazaki	1	0.3
22.Shizuoka	11	3.7	46.Kagoshima	4	1.3
23.Aichi	17	5.7	47.Okinawa	1	0.3

Table A-2. Number of destinations in sample

Destination country (region)	Observations	Percent to total
US	126	13.9
Mexico	33	3.6
Canada	18	2.0
Other countries in Americas	16	1.8
Eurozone	77	8.5
UK	35	3.9
other countries in Europe	23	2.5
Mid-East Asian and Aflican countries	12	1.3
Australia	10	1.1
New Zealand	2	0.2
China	184	20.2
HongKong	10	1.1
Thailand	121	13.3
Korea	61	6.7
Taiwan	55	6.1
Vietnam	31	3.4
Singapore	13	1.4
Indonesia	21	2.3
Malaysia	14	1.5
Other Country in South East Asia	16	1.8
India	18	2.0
Other countries in South Asia	13	1.4
Total	909	100.0