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Export Dynamics and the Invoicing Currency

Kazunobu HAYAKAWA[§]
Inter-disciplinary Studies Center, Institute of Developing Economies, Japan

Toshiyuki MATSUURA[#]
Keio Economic Observatory, Keio University, Japan

Nuttawut LAKSANAPANYAKUL
Science and Technology Development Program, Thailand Development Research Institute, Thailand

Taiyo YOSHIMI
Faculty of Economics, Chuo University, Japan

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Abstract: *In this paper, using finely disaggregated firm-level export data for Thailand, we examine how firms' export experience is related to the dynamic choice of the invoicing currency. We present evidence that the majority of exporters seldom change the invoicing currency for the same product/destination during the sample period. This evidence implies that changing the invoicing currency is costly for exporters. We also find that even after controlling for export size, the probability of choosing the export country's currency, or the producers' currency (PC) for the first export is significantly higher than for the export of the second and subsequent products/destinations. Assuming importers are risk averse, this finding implies that the accumulation of firm export experience provides better know-how for exchange rate risk management and enhances the use of currencies other than the PC in order to gain better profit. We also propose a theoretical model that provides the rationale for these empirical findings.*

***Keywords*:** Export dynamics; invoicing currency; exchange rate risk management; learning

***JEL Classification*:** F1; F3

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[#] Corresponding author: Toshiyuki Matsuura; Address: 2-15-45, Mita, Minato-ku, Tokyo, 108-8345, Japan; E-mail: matsuura@sanken.keio.ac.jp.

Introduction

The exchange rate exposure of trade prices depends on the currencies used for the invoicing of international transactions. The invoicing currency can usually be classified into three types: the producers' currency in the export country (PC), the local currency in the importing country (LC), or a third-vehicle currency (VC).[1] As Gopinath, et al. (2010) and Fabling and Sanderson (2015) discussed, exchange rate changes are mostly passed through into the price denominated in the LC (PC) if products are invoiced in the PC (LC). In the case of VC invoicing (VCI), exporters and importers jointly take the price risk from exchange rate fluctuations. Therefore, the effect of an exchange rate movement on an exporter's profits depends crucially on the type of invoicing currency. In addition, in the case of non-LC invoicing (non-LCI), importers suffer from exchange rate risk and are supposed to decrease their demand if they are risk averse.[2] Thus, there is a trade-off for PC invoicing (PCI) for exporters in that it frees exporters from exchange rate risk but decreases demand and profit by imposing that risk on importers. This trade-off affects exporters' motive in the choice of the invoicing currency.

In this paper, we investigate how exporters' decisions on the invoicing currency change over time. In particular, we examine what currency tends to be chosen when firms start exporting and whether or not these firms change the currency once their export experiences accumulate. In other words, we study the relation between firms' export experience and their choice of invoicing currency. It is known that export starters tend to begin with small sales in order to see whether they are profitable in the destination market and often suspend exporting if they find from the experience of the first export that their overseas business did not go well (Albournoz et al., 2016). The novel insight behind this argument is that firms learn from their initial experiences and reflect the know-how gained from their following behaviour. In this context, our focus is on how firms' experiences affect their choice of invoicing currency. Recently, how firms expand their foreign sales has attracted the attention of researchers because the increase in the number of exporters (i.e. extensive margin) is one of the key policy agendas both in developed and developing countries. Exploring the over-time change in

[1] For the VC, the United States (US) dollar is used most because it is an international key currency.
[2] See Wolak and Kolstad (1991) and Coppejans et al. (2007), who theoretically demonstrated that risk-averse agents decrease demand for products whose prices are uncertain in advance.

the choice of invoicing currency will provide us with a better understanding of the monetary aspects of export dynamics, which have not been argued sufficiently.

For our empirical analysis, we employ transaction-level export data for Thailand from 2007 to 2011. The data are obtained from the Customs Office of the Kingdom of Thailand and cover all commodity exports during the period. Our dataset contains the customs clearing date, HS eight-digit code, export destination country, firm identification code, export values in Thai baht (THB), and the invoicing currency.[3] In Thailand, the share of exports under the PC (i.e. the THB) is around 25% in terms of the number of country-product pairs and around 10% in terms of value (see Appendix A). Although the THB is not an international currency and Thailand is a developing country, the PC plays a certain role in exporting, implying that Thai firms face the choice of the invoicing currency amongst the PC and others. On the other hand, since the THB is not an international currency, exchange rate risk management costs in the case of the non-PCI that we focus on are significant for exporters from Thailand. Thus, the case of Thailand is a good one for examining the above-mentioned trade-off.

By using this finely disaggregated data, we first present two pieces of evidence on the exporters' choice of the invoicing currency that have rarely been discussed in the literature: (i) exporters seldom change their invoicing currency within a firm-country-product pair during the sample period; and (ii) exporters are more likely to choose the PCI when they start exporting than when they export the second and subsequent products or export to the second and subsequent destinations. The evidence (i) indicates that changing the invoicing currency is not easy for exporters, implying that changing the invoicing currency requires firms to incur a variety of costs. These costs may include a typical type of menu cost, efforts to re-examine exchange rate exposures, and accounting costs. The evidence (ii) may indicate that the accumulation of firms' experience of overseas business enables firms to find better means to manage exchange rate risks with lower costs and enhances the use of currencies other than the PC in order to gain better profit from transactions with risk-averse importers.

[3] Although the firm identification code is available, we cannot match firm or plant-level data in Thailand. Thus, we cannot control or firm characteristics such as the foreign capital share or productivity.

To more formally understand the micro-foundations behind these findings, we develop a theoretical model of dynamic choice of the invoicing currency. In our model, two kinds of fixed cost play a key role. One is the cost to switch invoicing currency, and the other is the cost to manage exchange rate risk. The former cost, the currency switching cost, represents the menu cost in a broad sense. Typically, when exporters change invoicing currency, they may revise and reprint brochures. Also, they have to reconsider the profit structures of the product and have to pay implicit/explicit accounting costs. The former cost captures all of these costs. The latter cost, the cost for exchange rate risk management, appears when exporters use foreign currencies in invoicing and represents the effort to deal with the risk of exchange rate fluctuations between contract and settlement. This cost includes the search cost to find an appropriate financial institution to make a forward exchange rate contract and a variety of documentation costs. Importantly, we assume that this latter cost is bigger in the first export than subsequent exports with the consideration of the learning benefit from overseas business experiences.

Considerations of former and latter costs provide rationale for evidence (i) and (ii), respectively. For evidence (i), the inertia of the invoicing currency is more likely to be present when the currency switching cost is larger because firms hesitate to change invoicing currencies if switching the currency requires them to undertake significant burdens. For evidence (ii), the assumption of the learning benefit from overseas business experiences in the cost for exchange rate risk management becomes important. Once firms start exporting and experience foreign sales, they look for the instruments to deal with exchange rate risks and try to find the best way to do so. They may ask closely located banks whether the banks can provide good financial instruments, such as forward exchange rates and currency options. This search cost is expected to be bigger in the first export than subsequent exports. As a result, invoicing in foreign currencies becomes costlier for exporters and is less likely to be chosen for first exports than for exports in the following periods and to the second and subsequent markets, as is consistent with evidence (ii).

Lastly, to obtain robust results on evidence (i) and (ii), we estimate the linear probability model with a large number of fixed effects. The dependent variable is a dummy variable that takes the value 1 if the invoicing currency is the PC. To examine

evidence (i), on the one hand, we introduce a one-year lagged dependent variable at the firm-country-product level. As is consistent with our expectation, the coefficient for this variable is estimated to be close to the value 1. In other words, we find the existence of strong inertia in the invoicing currency choice, even when controlling for transaction size in addition to various types of fixed effects. On the other hand, our main independent variable for examining evidence (ii) takes the value 1 if a concerned transaction is the first one for firms. We find the robust result that the probability of choosing the PC in the first export for firms is significantly higher than in the case of the second and subsequent export product/destination, even when controlling for transaction size.

Our study is related to at least two strands of literature. One is the literature on the choice of invoicing currency. Engel (2006) investigated the link between the choice of invoicing currency and the decision on export prices. Gopinath et al. (2010) extended the framework of Engel (2006) by introducing the dynamic perspective and examine detailed empirical analysis of the choice of invoicing currency. Our focus is also the dynamic choice of the invoicing currency. However, in contrast to Gopinath et al. (2010), we consider how firms' experiences affect the choice of currency used to invoice export prices. Importantly, firms often use a third currency, which is neither the exporter currency nor the importer currency. There are several papers which examine the firm-level choice of invoicing currency. Chung (2016) considered how exporters' dependence on imported inputs affects their choice of invoicing currency using data for the United Kingdom, and Devereux et al. (2017) investigated how firms' market share affects the choice of invoicing currency employing data for Canada.[4] Amongst them, we study the firm-level dynamic choice with consideration of the learning effects.

The other is the literature on export dynamics because we examine the over-time change in firm-level exports. Recent studies in this area have empirically examined how firms' exporting behaviour changes over time in terms of volume, duration, export

[4] Goldberg and Tille (2013) considered how bargaining between exporters and importers affects the choice of invoicing currency and export prices. Although our dataset does not enable us to identify importers' information at the firm level and investigate the bargaining aspect precisely, we try to control for the importers' characteristics using a variety of fixed effects. Also, we will briefly discuss how the bargaining aspect can matter for our results in Section 3.5.

destination country, and export product.[5] For example, as mentioned above, it is found that *new exporters tend to start small and focus on a single, usually neighbouring, country. Once they outlive their entry year, they tend to expand their sales abroad and reach a larger number of destinations* (Albournoz et al., 2016). On the other hand, our study examines firms' invoice currency choice over time. In particular, we show that new exporters tend to start using the PC. However, when they export to the other new countries, the PC is less likely to be chosen perhaps due to the accumulation of know-how for exchange rate risk management through their overseas business experience.

The rest of this paper is organised as follows. The next section takes an overview of firms' choice of invoicing currency in exporting. In Section 3, we present a theoretical model to demonstrate the relationship between export experience and the invoicing currency. Section 4 empirically investigates the relationship between firms' export experience and the dynamic choice of the invoicing currency. Last, Section 5 concludes the paper.

1. First Look

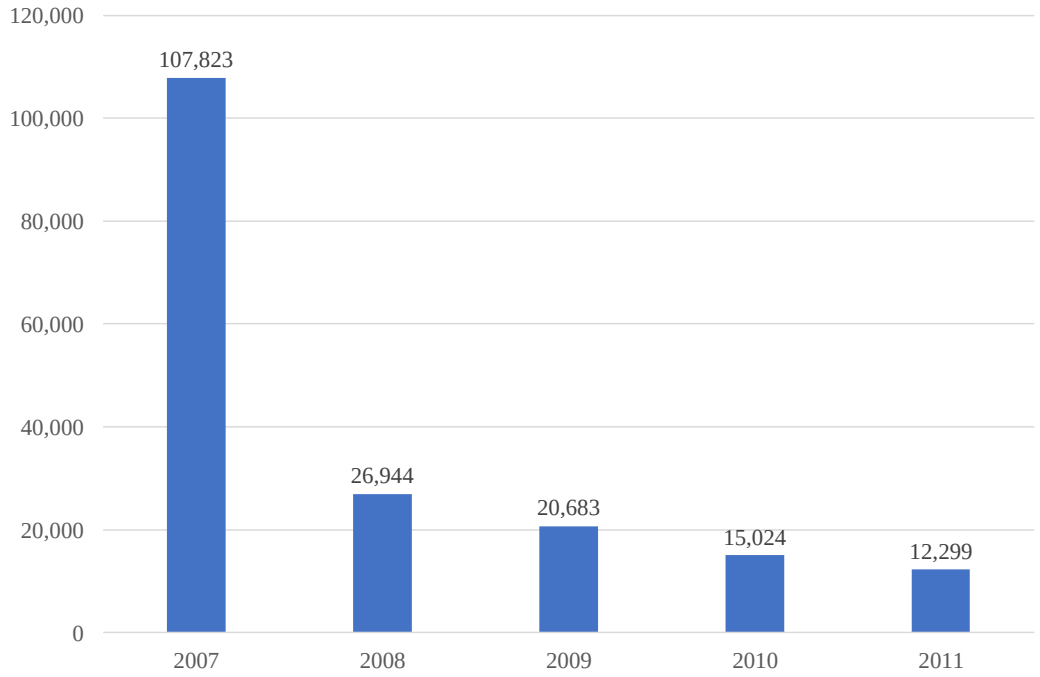
In this section, we take an overview of the over-time change of invoicing currency for new exporters. To do so, we employ transaction-level export data for Thailand for the 2007–2011 period. There are two kinds of shortcomings in our dataset. One is that information on trading partner firms is not available. In other words, within a firm-country-product pair, we cannot identify the change of trading partner firms over time. The other is that our dataset covers a short period. In this paper, we define as a new exporter a firm who did not export in 2007 but did after 2007.[6] However, we have

[5] The early work on export dynamics includes Baldwin (1988) and Baldwin and Krugman (1989). The long list of firm-level studies includes Aeberhardt et al. (2014), Albornoz et al. (2012), Albornoz et al. (2016), Araujo et al. (2016), Bekes and Murakozy (2012), Berman et al. (2015), Berthou and Vincent (2015), Blum et al. (2013), Buono and Fadinger (2012), Defever et al. (2015), Fernandes and Tang (2014), Lawless (2009), and Vannoorenberghe et al. (2016).

[6] One may use a more conservative definition, e.g. a firm who did not export during 2007–2009 but did after 2009 (i.e. a 3-year window). However, in this case, we can investigate the change in invoicing currency only for two years (i.e. 2010 and 2011). In short, there is a trade-off between the accuracy of the first export and the length of sample years for analysis. Since our main interest in this paper is to investigate the over-time change of the invoicing currency, we choose a one-year window in the definition of the first export. Nevertheless, in our estimations, we also try two- and

to keep in mind the possibility that such a new exporter may have experience of exporting before 2007. As shown in Figure 1, most of the export firms appear from the beginning of our sample period, i.e. 2007. Nevertheless, we can see a non-negligible number of new exporters afterwards.

Figure 1. First Appearance Year of Export Firms in Our Sample
(number of firms)



Source: Authors' compilation.

In this study, we focus on the exporters' decisions of the invoicing currency. From the exporters' perspective, the PC is different from other currencies in the sense that only the PC entirely frees them from exchange rate risks. In other words, there exists a critical difference between the PCI and invoicing in foreign currencies for exporting firms. Therefore, we first classify the invoicing currency into two types, the PC or non-PC as a baseline. Obviously, non-PC includes the LC and the VC. We will classify these two types of currencies in the later sections.

We start by investigating the time-series change of invoicing currency within a firm-country-product pair. To do that, for each firm-product-country pair, we identify the first and last years with positive exports during our sample period and then examine

3-year window cases.

whether the invoice currency was different between two years. The results are reported in Table 1. It shows the percentage of firm-product-country pairs that used a different invoicing currency between the two years. From the table, only less than 10% of firm-country-product pairs changed invoicing currency. It is worth noting that in those observations, the invoicing currency change may have occurred due to a change of trading partners within the firm-product-country pair. As mentioned above, our dataset does not enable us to identify such partner changes. However, the figures become smaller if we exclude the case of such partner changes. In short, the invoice currency is less likely to change when trading the same product with the same country.

Table 1. Time-series Change of the Invoicing Currency within a Firm-country-product Pair (%)

	First year		
Last year	2008	2009	2010
2009	8		
2010	10	6	
2011	9	6	4

Note: The figures show the percentage of firm-product-country pairs use a different invoicing currency between the first and last years with positive exports during our sample period.
Source: Authors' calculation.

Next, we examine how new exporters change the invoicing currency between the first country-product pair and subsequent pairs. For each firm, we first identify the first year when positive exports are observed in our dataset (*First export year for firm*). Since our dataset covers 2007–2011, we drop exporters in 2007. This is because these firms may start to export before 2007. Export starters in 2011 are also dropped since we cannot trace the over-time change of invoice currency after 2011. Next, we identify the first year with positive exports for each firm-country-product pair (*First export year for firm-product-country*). Then, we compute the share of exports under the PC out of the total exports for each firm-product-country pair and take its average according to the two kinds of the first years. We use the export information for each firm-product-country pair only in the first year with positive exports. For example, the

share in the firm-product-country pair in which positive exports are for the first time observed in 2008 is used only in 2008, not in subsequent years.

The results are shown in Table 2. For example, the figure in the combination of 2008 for 'First export year for firm' and 2008 for 'First export year for firm-product-country' *roughly* indicates that 46% of firms who for the first time started exporting in 2008 chose the PC.[7] On the other hand, the figure in the combination of 2008 for 'First export year for firm' and 2010 for 'First export year for firm-product-country' shows that the PC was chosen in 36% of the firm-product-country pairs in which the export started in 2010 by firms who started their first export in 2008. Namely, firm-product-country pairs are different in these two cells. The former captures figures in the first product-country pair for firms, while the latter indicates those in the subsequent pairs for those firms. The decrease from 46% to 36% means that the probability of choosing the PC is higher in the first export case than when firms export the subsequent product or export to the subsequent country. Indeed, in firms with 2008 for 'First export year for firm', the share declines as the 'First export year for firm-product-country' increases. A similar trend is observed also in firms with 2009 and 2010 for 'First export year for firm'.

Table 2. Invoicing Currency between the First Country-product Pair and Subsequent Pairs by New Exporters (%)

	First export year for firm		
First export year for firm-product-country	2008	2009	2010
2008	46		
2009	41	48	
2010	36	48	47
2011	34	42	45

Notes: 'First export year for firm' indicates the first year for firms when positive exports are observed in our dataset. 'First export year for firm-product-country' is the first year with positive exports, for each firm-country-product pair. The figures show the average share of exports under the PC out of total exports at the firm-product-country level according to the two kinds of years. Source: Authors' calculation.

[7] More strictly, the figure indicates that the firm-product-country-level average share of exports under the PC is 46% amongst firms who start exporting in 2008. Our use of the share is because some firms start exporting multiple products and/or export to multiple countries. If we exclude such firms, the figures in Table 1 show the frequency of firm-product-country pairs using the PC.

2. Theoretical Model

This section theoretically examines the relation between firms' export experience and the choice of invoicing currency. In particular, we investigate how exporters choose the invoicing currency in the first period of exporting, then their choice in the following period given their experience in the first period.

2.1. Setup

In the literature, it has been discussed that less capable exporters tend to use their home currencies in their exports in order to avoid suffering from exchange rate risks. For instance, Strasser (2013) revealed that the degree of exchange rate pass-through to export prices for financially constrained exporters is almost twice as high as that for unconstrained exporters. Although he does not investigate the determination of the invoicing currencies directly, it is implied that financially constrained exporters may prefer invoicing in their home currency to stabilise the sales value denominated in their home currency since they are not capable to manage exchange rate risks through utilising financial instruments.

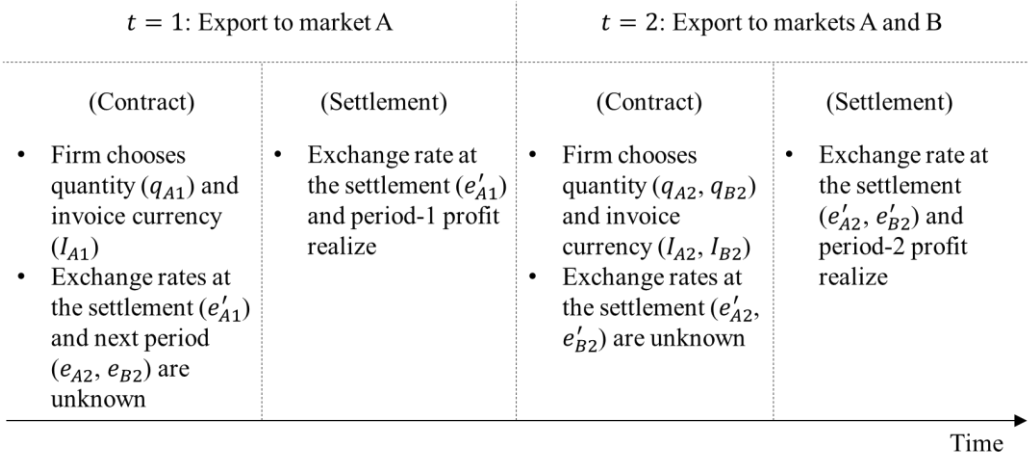
Based on these arguments, a straightforward prediction for the dynamic choice of the invoicing currency is that firms may choose their home currency in invoicing in the first period since they are not capable, then consider what currency to use in the following period given their experience in the first period. To see the theoretical accuracy of this prediction and provide guidance for the empirical analysis, we build a parsimonious model of dynamic choice of the invoicing currency.[8] Our theoretical model consists of two periods of time ($t = 1, 2$). At $t = 1$, a firm starts exporting to market A, which we call the *first export*. At $t = 2$, the firm expands its business to another market B and exports to both markets A and B. Albornoz et al. (2012) investigated the dynamic entry decision of a firm and call the analogous case to ours the *sequential entry*. This case appears when a firm faces uncertainty of its potential in foreign markets and assesses whether it can gain a positive profit abroad before

[8] We only show a limited case where (a) new products are ignored, (b) the exchange rate follows a binary distribution, and (c) the forward exchange rate corresponds to the future spot exchange rate. Our future agenda obviously includes loosening these assumptions to see the robustness of our theoretical consequences.

expanding its business globally. We take the entry structure as given and make a premise of sequential entry since our focus is not the dynamic entry decision but how firms dynamically choose their invoicing currencies when they start exporting and then expand their business to new destinations and products.

At each time period, there are two points of time: contract and settlement points. Straightforwardly, settlement comes after contract. In addition, we assume two types of uncertainty in the exchange rate. The first type of uncertainty is that at the contract point, firms do not know the level of the exchange rate at the settlement point. Therefore, at the contract point, firms determine the output quantity to maximise the expected profit at the settlement point in terms of their home currency. We also assume that exporters utilise forward exchange rates to hedge this exchange rate risk between contract and settlement with the payment of a positive fixed cost, which is required to find an appropriate financial institution. The second type of uncertainty is that firms do not know the level of the exchange rate at the contract point at $t = 2$ when they determine the invoicing currency in the first export at $t = 1$. Thus, firms choose the invoicing currency in the first export taking into account the expected profits at $t = 2$ calculated with expected exchange rates. This flow of time is presented in Figure 2.

Figure 2. Theoretical Time Flow



Source: Authors' calculation.

2.2. Importers' Risk Aversion and Local-Currency Prices[9]

We assume that each exporting firm is small in the destination markets so that the price denominated in the currency of the destination country is exogenous to firms regardless of the currency the firm chooses in invoicing. In addition, importers are assumed to be risk averse. Existing studies, such as Wolak and Kolstad (1991) and Coppejans et al. (2007), discussed that risk-averse agents decrease the demand for products with uncertain prices. If exporters choose their home currency in invoicing, the price in terms of the importer's currency that importers pay at the settlement point becomes uncertain. As a result, demand for the export product becomes smaller when the transaction is invoiced in the exporter's currency taking the local-currency price as given. To incorporate this aspect in the simplest way, we employ the following form for the demand function:

$$q(p) = \mu - 1_{\{PCI\}}\sigma - p, \tag{1}$$

where μ is the exogenous demand component, p the local-currency price. $1_{\{PCI\}}$ represents the indicator function, which becomes 1 when the producer currency is used in invoicing. The positive parameter σ is closely related to the degree of the importer's risk aversion, implying that the demand becomes smaller under the PCI if the importer is more risk averse.

Using the above demand function, we can obtain the following relation between local-currency prices in the cases of the PCI (p^P) and LCI (p^L):

$$q^P = q^L \rightarrow p^P = \left(1 - \frac{\sigma}{p^L}\right) p^L = p^L - \sigma.$$

The intuition of this equation is as follows. Destination markets are competitive, and importers are risk averse. Thus, no importers purchase products invoiced in the exporter's currency if the local-currency price is the same regardless of the invoicing currency. In other words, the local-currency price must be discounted for products invoiced in the exporter's currency in order to gain positive demand. The above

[9] We only show the case of a binary choice (PCI or LCI) due to the space limitation. In Appendix B1, we discuss the case of a ternary choice (PCI, LCI, or VCI) and demonstrate that the major consequences of the binary case hold also in the ternary case.

equation indicates that the extent to which the local-currency price must be discounted for the PCI to compare to the LCI in order to gain the same demand level is positively associated with the degree of the importer's risk aversion.[10]

2.3. Cost Structure

Letting j represent the destination market ($j = A, B$), we assume that an exporter incurs four types of costs. First, we assume that all exporters have to pay a unit production cost $\hat{c}$. Note that hatted cost variables are denominated in the exporter's currency. Second, when a firm exports to market j, it has to incur unit transportation cost $\hat{\tau}_j$. Third, we assume the presence of a cost to manage exchange rate risk if firms employ the LCI when exporting. This cost consists of efforts to find an appropriate institution and prepare documentations to submit the order of forward exchange rates to financial institutions, such as banks. These efforts may become the fixed costs per export.[11] Therefore, we let $\hat{F}_1$ represent the fixed cost for the exchange rate risk management incurred by exporters that choose the LCI at $t = 1$ for market *A*. Further, we let $\hat{F}_{j|I_{A1}}$ represent the type of fixed cost that exporters have to pay when they choose thee LCI at $t = 2$ for market j given they have chosen invoicing currency I_{A1} at $t = 1$ for market *A* ($I_{A1} = PC, LC$). Regarding this cost, we introduce the benefit of learning, that is, the fixed cost for exchange rate risk management becomes smaller at $t = 2$ through export experience at $t = 1$ ($\hat{F}_{j|I_{A1}} < \hat{F}_1$). Fourth, for exports to market *A* at $t = 2$, we assume that exporters have to incur fixed cost $\hat{G}_{I_{A2}|I_{A1}}$ if they switch the currency from I_{A1} at $t = 2$ to I_{A2} at $t = 1$ ($I_{A2} = PC, LC$). Thus, $\hat{G}_{I_{A2}|I_{A1}} = 0$ ($\hat{G}_{I_{A2}|I_{A1}} > 0$) when $I_{A2} = I_{A1}$ ($I_{A2} \neq I_{A1}$). This type of fixed cost consists of the menu cost and the effort for renegotiating the currency.

2.4. Testable Implications

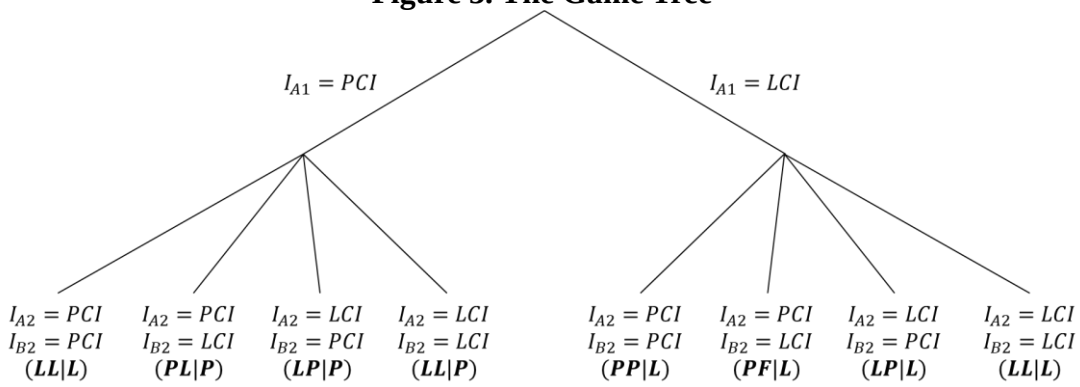
We solve for the firm's decisions using backward induction to provide testable implications related to evidence (i) and (ii). At $t = 2$, exporters determine the export

[10] In Appendix Table A2, we show that unit prices are lower for the PCI than the non-PCI using the same dataset.

[11] We implicitly assume that other types of variable cost are reflected in the forward exchange rates that financial institutions offer to exporters.

quantities and invoicing currencies in markets A and B given the experience in market A at $t = 1$. At $t = 1$, exporters determine the export quantity and invoice currency in market A considering the expected profits at $t = 2$. Figure 3 presents the game tree of our theoretical model.

Figure 3. The Game Tree



2.4.1. Evidence (i): Inertia of Invoicing Currency

Currency Choice for Market A at $t = 2$

The profit structure differs depending on which currency the exporter has chosen at $t = 1$. Given that the exporter chooses the PCI at $t = 1$,[12] the profit in market j at $t = 2$ is given by

$$\hat{\pi}^{P}_{j2|P} = \left(e_{j2}p^{P}_{j} - \hat{c} - \hat{\tau}_{j}\right)q^{P}_{j2} = e_{j2}\left(\mu_{j} - \sigma_{j} - \frac{\hat{c} + \hat{\tau}_{j}}{e_{j2}} - q^{P}_{j2}\right)q^{P}_{j2},$$

$$\begin{aligned}\hat{\pi}^{L}_{j2|P} &= \left(f_{j2}p^{L}_{j} - \hat{c} - \hat{\tau}_{j}\right)q^{L}_{j2} - \hat{F}_{j|P} - 1_{\{j=A\}}\hat{G}_{L|P} \\ &= f_{j2}\left(\mu_{j} - \frac{\hat{c} + \hat{\tau}_{j}}{f_{j2}} - q^{L}_{j2}\right)q^{L}_{j2} - \hat{F}_{j|P} - 1_{\{j=A\}}\hat{G}_{L|P},\end{aligned}$$

for cases of PCI and LCI, respectively. $1_{\{j=A\}}$ is an indicator function that takes a value of 1 for $j = A$. It should be noted that in the PCI case, the exporter gains unit sales, $e_{j2}p^{P}_{j}$, without suffering from exchange rate risk. Also, in the LCI case, the

[12] In Appendix B2, we provide the detailed derivation of propositions 2 and 4 for the case in which the exporter chooses the LCI at $t = 1$.

exporter utilises the forward exchange rate f_{j2} in order to hedge the exchange rate risk by paying the fixed cost $\hat{F}_{j|P}$. The profit maximising quantities are derived as

$$q^{P}_{j2|P} = \frac{1}{2}\left(\mu_j - \sigma_j - \frac{\hat{c} + \hat{\tau}_j}{e_{j2}}\right),$$

$$q^{L}_{j2|P} = \frac{1}{2}\left(\mu_j - \frac{\hat{c} + \hat{\tau}_j}{f_{j2}}\right).$$

Thus, the realised profits become

$$\hat{\pi}^{P}_{j2|P} = e_{j2}\left(\frac{1}{2}\left[\mu_j - \sigma_j - \frac{\hat{c} + \hat{\tau}_j}{e_{j2}}\right]\right)^2,$$

$$\hat{\pi}^{L}_{j2|P} = f_{j2}\left(\frac{1}{2}\left[\mu_j - \frac{\hat{c} + \hat{\tau}_j}{f_{j2}}\right]\right)^2 - \hat{F}_{j|P} - 1_{\{j=A\}}\hat{G}_{L|P}.$$

The exporter chooses the PCI if $\hat{\pi}^{L}_{j2|P} < \hat{\pi}^{P}_{j2|P}$. Here, we focus on the limited case where the expectation for the exchange rate follows a static manner and the forward exchange rate is equal to the expected exchange rate. In this limited case, the forward exchange rate is equal to the current exchange rate (i.e. $f_{j2} = e_{j2}$). As a result, the condition that the exporter chooses the PCI for market A given that it has chosen the PCI in the first export ($\hat{\pi}^{L}_{A2|P} < \hat{\pi}^{P}_{A2|P}$) can be written as

$$\hat{G}_{L|P} + \hat{F}_{A|P} > \frac{\sigma_A}{4}\left(e_{A2}[2\mu_A - \sigma_A] - 2[\hat{c} + \hat{\tau}_A]\right). \tag{2}$$

In other words, the inertia in the invoicing currency appears for market A if condition (2) holds. The condition presents the potential sources of the inertia of the invoicing currency. In particular, two types of fixed costs that we newly introduce in this study play important roles. First, exporters hesitate to change their invoicing currency from the PC to the LC when the currency switching cost ($\hat{G}_{L|P}$) is large. Second, they hesitate to do so if managing the exchange rate risk between the local and producer's currencies is costly ($\hat{F}_{A|P}$ is large). In sum, we can state the following proposition:

Proposition 1. *Given that exporters have chosen their home currency for invoicing exports in the first period, they do not switch the invoicing currency for the same market for exports in the following period when the currency switching cost ($\hat{G}_{L|P}$) or the cost for exchange rate risk management ($\hat{F}_{A|P}$) is large.*

An analogous proposition can be obtained for the case in which the LCI is chosen at $t = 1$.

Proposition 2. *Given that exporters have chosen the local currency for invoicing exports in the first period, they do not switch the invoicing currency for the same market for exports in the following period when the currency switching cost ($\hat{G}_{P|L}$) is large or the cost for exchange rate risk management ($\hat{F}_{A|L}$) is small.*

Propositions 1 and 2 provide potential rationale for evidence (i) that the majority of exporters do not change the invoicing currency for the same destination and product. First, switching the invoicing currency can be costly. This may occur when recalculating the appropriate price in terms of the currency that has not been used in previous periods requires firms to pay significant effort. Also, it may happen when preparing documentation in terms of the *new* currency becomes a burden, or changing the currency leads to non-negligible accounting costs. These types of costs can be interpreted as a part of the menu cost. The role of the cost for exchange rate risk management depends on the currency that has been chosen at $t = 1$. Given that a firm starts exporting with the producer currency, currency switching rarely happens when managing the risk of the exchange rate between the local and producer currencies is costly. In contrast, if the local currency has been chosen at $t = 1$, the cost for exchange rate risk management encourages exporters to change the currency. As a result, propositions 1 and 2 jointly indicate the following testable implications for evidence (i):

Testable Implication 1 *Inertia of the invoicing currency is more likely to be present when the currency switching cost is larger, or the management cost for the exchange rate risk is larger (smaller) for exporters that have used the producer (local) currency in the previous period.*

2.4.2. Evidence (ii): Currency Choice for the Newly-Entered Market

Currency Choice for the Newly-Entered Market B at $t = 2$

For market *B*, to which exporters newly enter at $t = 2$, the condition that the PCI is chosen ($\hat{\pi}^{L}_{B2|P} < \hat{\pi}^{P}_{B2|P}$) can be rearranged in the following manner:

$$\hat{F}_{B|P} > \frac{\sigma_B}{4}(e_{B2}[2\mu_B - \sigma_B] - 2[\hat{c} + \hat{\tau}_B]). \tag{3}$$

Equation (3) indicates that the cost for exchange rate risk management plays an important role: exporters do not employ the local currency in invoicing when the cost to manage the exchange rate risks between local and home currencies ($\hat{F}_{B|P}$) is significantly large. Again, a similar consequence can be derived for the case in which the LCI has been chosen for exports to a newly entered market. In sum, the following proposition can be stated:

Proposition 3. *Regardless of the currency that has been chosen for the first exports, exporters are likely to employ the LCI for a newly entered market when the cost for exchange rate risk management ($\hat{F}_{B|I_{A1}}$, $I_{A1} = PC, LC$) is small.*

Currency Choice for Market A at $t = 1$

We assume that firms at the contract point at $t = 1$ do not know the exact level of the exchange rate at the contract point at $t = 2$ but know the distribution of it. For simplicity, we also assume that the exchange rate moves over periods by following a binary distribution. Specifically, we suppose two scenarios: strong (e^{s}_{j2}) and weak (e^{w}_{j2}) home currency scenarios ($e^{s}_{j2} < e^{w}_{j2}$). Each scenario is assumed to realise with the probability 0.5. In addition, we assume the home currency is *sufficiently* strong (weak) in the strong (weak) scenario so that, regardless of the currency chosen for the first exports, exporters employ the PCI and LCI with probability 0.5 for both markets A and *B*. That is

$$\text{Prob}\left[\hat{\pi}^{P}_{j2|I_{A1}} > \hat{\pi}^{L}_{j2|I_{A1}}\right] = \text{Prob}\left[\hat{\pi}^{P}_{j2|I_{A1}} < \hat{\pi}^{L}_{j2|I_{A1}}\right] = 0.5,$$

for $I_{A1} = PC, LC$ and $j = A, B$. The following assumptions sufficiently guarantee the above probability consequence:

$$e^{s}_{A2} < \frac{1}{2\mu_A - \sigma_A}\left\{\frac{4\left(\hat{F}_{A|L} - \hat{G}_{P|L}\right)}{\sigma_A} + 2(\hat{c} + \hat{\tau}_A)\right\},$$

$$e^{w}_{A2} > \frac{1}{2\mu_A - \sigma_A}\left\{\frac{4\left(\hat{F}_{A|P} + \hat{G}_{L|P}\right)}{\sigma_A} + 2(\hat{c} + \hat{\tau}_A)\right\},$$

$$e^{s}_{B2} < \frac{1}{2\mu_B - \sigma_B}\left\{\frac{4\hat{F}_{B|L}}{\sigma_B} + 2(\hat{c} + \hat{\tau}_B)\right\},$$

$$e^{w}_{B2} > \frac{1}{2\mu_B - \sigma_B}\left\{\frac{4\hat{F}_{B|P}}{\sigma_B} + 2(\hat{c} + \hat{\tau}_B)\right\}.$$

The expected profits at the contract point at $t = 1$ when an exporter chooses its home currency (the local currency) for market A are given as sum of the first-period profit and the expected second-period profit given that the exporter chooses the home (local) currency at $t = 1$. Specifically, using profit maximising output quantities at $t = 1$, the first-period expected profits with the respective invoicing currencies are given by

$$\hat{\pi}^{P}_{A1} = e_{A1}\left(\frac{1}{2}\left[\mu_A - \sigma_A - \frac{\hat{c} + \hat{\tau}_A}{e_{A1}}\right]\right)^2 + \hat{V}_{2|P},$$

$$\hat{\pi}^{L}_{A1} = e_{A1}\left(\frac{1}{2}\left[\mu_A - \frac{\hat{c} + \hat{\tau}_A}{e_{A1}}\right]\right)^2 + \hat{V}_{2|L} - \hat{F}_1,$$

where $\hat{V}_{2|P}$ and $\hat{V}_{2|L}$ are the expected second-period profits when the exporter chooses the home and local currencies, respectively, and given by

$$\hat{V}_{2|P} = \frac{1}{2}\left[e_{A2}^{s}\left(\frac{1}{2}\left[\mu_A - \sigma_A - \frac{\hat{c}+\hat{\tau}_A}{e_{A2}^{s}}\right]\right)^2 + e_{B2}^{s}\left(\frac{1}{2}\left[\mu_B - \sigma_B - \frac{\hat{c}+\hat{\tau}_B}{e_{B2}^{s}}\right]\right)^2 + e_{A2}^{w}\left(\frac{1}{2}\left[\mu_A - \frac{\hat{c}+\hat{\tau}_A}{e_{A2}^{w}}\right]\right)^2 - \hat{F}_{A|P} - \hat{G}_{L|P} + e_{B2}^{w}\left(\frac{1}{2}\left[\mu_B - \frac{\hat{c}+\hat{\tau}_B}{e_{B2}^{w}}\right]\right)^2 - \hat{F}_{B|P}\right],$$

$$\hat{V}_{2|L} = \frac{1}{2}\left[e_{A2}^{s}\left(\frac{1}{2}\left[\mu_A - \sigma_A - \frac{\hat{c}+\hat{\tau}_A}{e_{A2}^{s}}\right]\right)^2 - \hat{G}_{P|L} + e_{B2}^{s}\left(\frac{1}{2}\left[\mu_B - \sigma_B - \frac{\hat{c}+\hat{\tau}_B}{e_{B2}^{s}}\right]\right)^2 + e_{A2}^{w}\left(\frac{1}{2}\left[\mu_A - \frac{\hat{c}+\hat{\tau}_A}{e_{A2}^{w}}\right]\right)^2 - \hat{F}_{A|L} + e_{B2}^{w}\left(\frac{1}{2}\left[\mu_B - \frac{\hat{c}+\hat{\tau}_B}{e_{B2}^{w}}\right]\right)^2 - \hat{F}_{B|L}\right].$$

Therefore, the exporter chooses the home currency in the first export if $\hat{\pi}_{A1}^{L} < \hat{\pi}_{A1}^{P}$. This condition can be rearranged as

$$\hat{F}_1 > \frac{\sigma_A}{4}(e_{A1}[2\mu_A - \sigma_A] - 2[\hat{c}+\hat{\tau}_A]) + \frac{1}{2}\{\hat{F}_{A|P} - \hat{F}_{A|L} + \hat{F}_{B|P} - \hat{F}_{B|L} + \hat{G}_{L|P} - \hat{G}_{P|L}\}. \quad (4)$$

Equation (4) provides two important implications for the exporter's choice of invoicing currency for the first exports. First, the PCI is more likely to be chosen if the cost for managing the exchange rate risk ($\hat{F}_1$) is larger. Second, the fixed costs at $t = 2$ have impacts on the choice of invoicing currency at $t = 1$. In particular, if the second-period fixed costs when the PCI (LCI) has been chosen in the first period, i.e. $\hat{F}_{A|P}$ ($\hat{F}_{A|L}$), $\hat{F}_{B|P}$ ($\hat{F}_{B|L}$) and $\hat{G}_{L|P}$ ($\hat{G}_{P|L}$), are smaller, the PCI (LCI) is more likely to be chosen for the first exports. In other words, if the current use of a particular invoicing currency mitigates future costs, that invoicing currency is more likely to be chosen at present. Therefore, the first-period export experience can matter for the choice of the invoicing currency in both the current and future periods. As a result, the following statement can be proposed:

Proposition 4. *Exporters are likely to employ the PCI for the first exports when the cost for exchange rate risk management ($\hat{F}_1$) is large or the first-period experience of the*

PCI has significant mitigating impacts on the costs of adopting the PCI in future periods.

Proposition 3 on the newly entered market and proposition 4 on the first exports, or equations (3) and (4) more explicitly, jointly provide empirical guidance for examining the potential causes behind evidence (ii). First, differences in the fundamental characteristics of importing countries lead to different choices of the invoicing currency by an exporter. For instance, if importers in one destination country are more risk averse than other destination countries (σ is higher in one country than in other countries), an exporter is less likely to use the PC for this destination country than for others. Also, if the transportation cost is higher ($\hat{\tau}$ is larger), an exporter is more willing to use the PC for that market than for other markets. Second, after fully controlling for these differences in market characteristics, we can examine how the *relative* presence of fixed costs for exchange rate risk management and currency switching affect the relative likelihood of choosing the PCI in alternative markets. For example, if the fixed cost for exchange rate risk management is significantly smaller in the newly entered market B in the second period than that in the first market A in the first period ($\hat{F}_{B|P}$ is significantly smaller than $\hat{F}_1$), the PCI is more likely to be chosen for first exports than for the newly entered market. As discussed above, learning through the first-period experience of overseas business is expected to mitigate the fixed cost ($\hat{F}_{B|P} < \hat{F}_1$). As a result of this learning effect, condition (4) becomes more likely to hold than condition (3). Therefore, the following testable implication can be derived:

Testable Implication 2 *The PCI is more likely to be chosen for first exports than for exports to new markets in the following periods if the mitigating effect of the first-period experience on the cost for exchange rate risk management is significant.*

2.5. Other Possibilities

In order to focus on the effect of firm export experience on the dynamic choice of the invoicing currency, we abstract from several issues that recent researchers have examined vigorously. For instance, we do not consider the bargaining aspect between

exporters and importers, which Goldberg and Tille (2013) emphasised. Goldberg and Tille (2013) demonstrated that if the importers' bargaining power relative to exporters over prices and invoicing currencies is strong, export prices become low and the PC is likely to be chosen. This is because importers with higher bargaining power are willing to purchase at lower prices to gain larger benefits and keep prices in terms of the PC more stable to exchange rate fluctuations in order to stabilise their market shares. In our model, we assume that exporters simultaneously determine prices and invoicing currencies while ignorant of the importers' bargaining power. If importers have positive bargaining power, it is naturally expected that the likelihood that the PC is chosen becomes higher regardless of whether the transaction is the first export or not. Also, the ease of switching currency may depend on the relative bargaining power between exporters and importers since the invoicing currency is one of the important contract terms. If the importers' bargaining power is positive, it may not be easy for exporters to switch the invoicing currency from the currency that the importers prefer. Nevertheless, the implications derived from our model hold basically as far as the relative bargaining power does not change over time.

The market share should be considered as another possibility. For example, Devereux et al. (2017) noted that the PC is more likely to be chosen if the exporter is very small or very large in its market share, or the importer has a small share in the exporter's sales. Market share seems more time variant than bargaining power. Thus, the potential effect of market share on our consequences might be more significant. Also, market shares must be related to *effective* bargaining power, as discussed in Goldberg and Tille (2013). Unfortunately, our dataset does not enable us to calculate the above two variables because it does not identify the import firms.

3. Empirical Analysis

This section empirically investigates two testable implications derived in the previous section. We first investigate the inertia in the invoicing currency; the invoicing currency used in the current year is likely to be again chosen in the next year. Second, we examine the relation between export experience and the choice of invoicing currency.

3.1. Inertia in the Invoicing Currency

In this subsection, we empirically investigate the inertia in the invoicing currency within a firm-product-country pair. In particular, to keep our analysis simple, we examine only whether the users of the PCI in the current year are likely to choose the PCI in the next year.

3.1.1. Baseline Results

To empirically investigate the choice of invoicing currency, we estimate the following lagged dependent variable model.

$$PC_{fipt} = \alpha PC_{fipt-1} + \beta \ln Value_{fipt} + u_{ft} + u_{it} + u_{st} + \epsilon_{fipt}$$

The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC when firm *f* starts to export product *p* to country *i* in year *t*, and is 0 otherwise. The positive coefficient for the lagged variable (lagged THB dummy) will indicate the inertia of choosing the PCI and is related to the currency-switching costs. We basically utilise all firm-export destination-HS eight-digit level observations during 2007–2011. We drop only the observations where multiple invoicing currencies can be detected in any year within a firm-product-country pair.

We control for various other elements. Equations (2), (3), and (4) in the theoretical section indicate that the PCI is less likely to be chosen when the demand size (μ) is larger. This is because the negative effect of a price discount under the PCI on profit becomes larger when the exogenous demand factor is larger. As a result, exporters prefer employing the LCI to the PCI when the demand size is larger. A similar argument is stated by Devereux et al. (2017), which showed the high probability of choosing the PC when the market share of a given product in the import country market is significantly low or significantly high. In order to control for this size effect on the invoicing currency choice, we introduce 'value', which indicates the export values. The data sources for these variables are the same as in Section 2.

Furthermore, we introduce export firm-year fixed effects, which control for time-variant firm-specific characteristics, such as productivity. We also control for import country-year and HS six-digit code (denoted by *s*)-year fixed effects. For example, the former fixed effect controls for time-variant country pair-specific elements,

such as exchange rates. Similarly, the effects of time-variant sector-specific elements in the export country, e.g. production costs, are captured by the latter fixed effect. Due to our introduction of a large number of fixed effects, we estimate this model using the ordinary least squares (OLS) method (i.e. as a linear-probability model), rather than by a Probit estimation technique (i.e. incidental parameter problems). As in Table 2, we cannot exclude the case of the invoicing currency change due to a change in the trading partners within a firm-product-country pair. This may lead to underestimation bias in our estimation of the currency inertia because a currency switch is more likely to happen if we explicitly take into account the change of importers.

The estimation result is shown in column (I) in Table 3. The coefficient for the lagged dependent variable is estimated to be significantly positive. Its magnitude is rather high, that is, 0.80. Namely, we can see the strong inertia for choosing the PCI. As shown in column (III) of the table, the coefficient is slightly smaller if the forward exchange rate is available between the THB and the currency of the destination country. This result is consistent with the statement in Testable Implication 1 that the degree of inertia becomes smaller if the cost for exchange rate risk management is smaller. As is consistent with the expectation from our theoretical model, the coefficient for the log of *Value* is negatively significant, indicating that the PC is likely to be chosen by small-sized firms in terms of export values. Also, as noted above, Devereux et al. (2017) pointed out that small-sized exporters are more likely to invoice in the PC than middle-sized exporters. Our dataset is for Thailand, where most companies are not extremely large and do not have a dominant market share in their destination markets. From this perspective, our empirical finding for a log of *Value* is consistent with Devereux et al. (2017).

Table 3. Lagged Dependent Variable Models: OLS

	(I)	(II)	(III)
Lagged PC Dummy	0.801***	0.812***	0.735***
	[0.002]	[0.003]	[0.004]
ln Value	-0.001***	-0.001***	-0.001***
	[0.000]	[0.000]	[0.000]
Forward rate	ALL	NO	YES
Number of observations	766,931	351,045	401,412
R-squared	0.9353	0.9568	0.9146

OLS = ordinary least squares.

Notes: The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. 'Lagged PC Dummy' is the one-year lagged dependent variable. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate using the OLS method. All specifications include export firm-year, import country-year, and HS six-digit code-year fixed effects. In columns (II) and (III), we restrict the sample export destination countries according to the availability of forward exchange rates for their official currencies in Thailand.

Source: Authors' calculation.

3.1.2. Robustness Checks

Below, we conduct various kinds of robustness checks. In columns (II) and (III) in Table 3, we restrict the sample export destination countries according to the availability of forward exchange rates for their official currencies in Thailand.[13] In developing countries, such as Thailand, unless forward exchange rates are accessible, firms tend to choose the PC or the VC, not the LC. In other words, the available non-PC currency will be different between those two types of destination countries. Thus, we estimate our model according to the availability of forward exchange rates for the importing countries' official currencies in Thailand. In both cases, the coefficient for the lagged dependent variable is estimated to be significantly positive and close to the value 1.

In Table 4, we use instrumental variable (IV) methods. Since the transaction value and the invoicing currency are simultaneously determined in practice, unobservable shocks to the transaction value will also have an influence on the choice of invoicing currency. To address this endogeneity issue, we use as an instrument the importing country's total imports of a concerned product from the world except for Thailand. This

[13] Specifically, forward exchange rates for the following currencies are available in Thailand: EUR, GBP, JPY, AUD, CHF, HKD, SGD, CAD, DKK, NOK, SEK, NZD, CNY, and USD.

instrument captures the demand size in importing countries and thus will be related to the transaction size in exporting from Thailand. Although the demand size has an influence on the average country-level share of an invoicing currency through the importer's share in the exporter's sales (Devereux et al., 2017), this path is controlled by our country-year and product-year fixed effects. Thus, under the control of these fixed effects, our instrument is not directly related to an individual firm's choice of invoicing currency. Indeed, the results show that our instrument is not weak. As shown in Table 4, though the coefficients for the transaction values turn out to be insignificant, the results in the lagged dependent variable are unchanged both qualitatively and quantitatively.

Table 4. Lagged Dependent Variable Models: IV Method

	(I)	(II)	(III)
Lagged PC Dummy	0.801***	0.812***	0.735***
	[0.002]	[0.003]	[0.004]
ln Value	0.000	-0.001	0.000
	[0.001]	[0.002]	[0.001]
Forward rate	ALL	NO	YES
Number of observations	766,931	351,045	401,412
Kleibergen-Paap rk LM statistic	2,072	614	1,067
Cragg-Donald Wald F statistic	1,792	523	1,000
Centered R-squared	0.9353	0.9568	0.9146

Notes: The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. 'Lagged PC Dummy' is the one-year lagged dependent variable. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate using the IV method. Our instrument is the importing country's total imports of a concerned product from the world except for Thailand. All specifications include export firm-year, import country-year, and HS six-digit code-year fixed effects. In columns (II) and (III), we restrict the sample export destination countries according to the availability of forward exchange rates for their official currencies in Thailand.
Source: Authors' calculation.

Some other robustness checks, of which the results are shown in Appendix A, are as follows. First, in order to see the differences across industries, we estimate our equation by the one-digit code of the Standard International Trade Classification (SITC), which is presented in Table A3. All industries show positively significant coefficients for the lagged dependent variable. Manufactured goods classified chiefly by material (category 6) have a relatively small coefficient, while a relatively large coefficient is found for food and live animals (categories 0 and 1). Second, we estimate for trade in parts and

finished products separately in Table A4. Both products have significantly positive coefficients for the lagged dependent variable, although the coefficient is smaller in finished products. Last, we also estimate for the high and low income import countries, separately. Both cases show significantly positive coefficients for the lagged dependent variable, though its coefficient is a bit larger in low-income import countries.

3.2. Export Experience

In this subsection, we examine the relation between export experience and the choice of invoicing currency. After introducing our empirical specification, we show our baseline estimation results in addition to the results using a variety of robustness checks.

3.2.1. Baseline Results

To empirically investigate the choice of the invoicing currency, we estimate the following reduced-form equation.

$$PC_{fipt} = \alpha First_{fipt} + \beta \ln Value_{fipt} + u_{it} + u_{st} + \epsilon_{fipt}$$

In this analysis, our main independent variable is the dummy variable of *First*, which takes a value of 1 if an observation is the first export to a firm and the value 0 otherwise. As demonstrated in Section 3.4.2, we expect a positive coefficient for this variable. The firm-export destination-HS eight-digit level observations are restricted to only those that appear after 2007 in our dataset. Furthermore, we include only those in the first year of appearance in the dataset.[14] Thus, each firm-export destination-HS eight-digit observation appears in our dataset for the estimation only once.[15] As a result, due to smaller variation in observations, we do not include firm-year fixed effects. We estimate this model using the OLS method.

The estimation results are reported in column (I) in Table 5. The coefficient for *First* is estimated to be significantly positive. Namely, as is consistent with our theoretical consequences in Section 3.4.2, the PC is more likely to be chosen when firms start to export for the first time than when they export subsequent products or export to subsequent destinations. This may indicate that the cost of exchange rate risk

[14] Therefore, our sample also includes observations that appear in only one year.
[15] Thus, unlike the case in Section 2, our sample includes the firm-export destination-HS eight-digit pairs that appear after 2007 in the dataset, even if the firm has an export record in other export destination-HS eight-digit pairs in 2007.

management is mitigated through the experience of overseas business for the first export as we assume in the model, as using the LC becomes less costly for exporters through their experience of overseas business and the relative benefit of the LCI becomes bigger for subsequent products or destinations.[16] The coefficient for the log of *Value* is again negatively significant.

Table 5. Estimation Results for the Linear-probability Model

	(I)	(II)	(III)	(IV)
First	0.119***	0.034***	0.107***	0.127***
	[0.001]	[0.006]	[0.002]	[0.002]
ln Value	-0.011***	-0.027***	-0.008***	-0.013***
	[0.000]	[0.001]	[0.000]	[0.000]
Sample	All	Single		
Forward rate			NO	YES
Number of observations	1,099,080	42,880	530,525	565,968
R-squared	0.2535	0.4310	0.3374	0.1974

Notes: The firm-export destination-HS eight-digit level observations are restricted only to those that appear after 2007 in our dataset. Furthermore, we include those in only the first year of appearance in the dataset. The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate using the OLS method. All specifications include import country-year and HS six-digit code-year fixed effects. 'Single' in the sample excludes exporters who start exporting multiple products or export to multiple countries in their first export. In columns (III) and (IV), we restrict the sample export destination countries according to the availability of forward exchange rates for their official currencies in Thailand.
Source: Authors' calculation.

3.2.2. Robustness Checks

We conduct various kinds of robustness checks. In column (II), we exclude exporters who start exporting multiple products or export to multiple countries in their first export. The number of observations significantly decreases since there are a large number of export starters with multiple products/destinations. In columns (III) and (IV), we restrict the sample export destination countries according to the availability of the forward exchange rates for their official currencies in Thailand. All these estimations show that the coefficients for *First* and the log of *Value* are again estimated to be

[16] Another possibility is that due to starting exporting, firms may improve their productivity or cost efficiency and then be able to choose a non-PCI. As mentioned in footnote 3, we cannot control for firm productivity. Also, in our framework, we cannot introduce firm-year fixed effects to control for this possibility.

significantly positive and negative, respectively. In Table 6, we use the IV methods. The instruments are the same as in the previous subsection. The significance and signs of our variables are unchanged compared with those in Table 3. The absolute magnitudes of the coefficients for *Value* slightly increase.

Table 6. Estimation Results of the Linear-probability Model: IV Method

	(I)	(II)	(III)	(IV)
First	0.110***	0.080***	0.099***	0.117***
	[0.002]	[0.014]	[0.002]	[0.003]
ln Value	-0.041***	-0.123***	-0.043***	-0.041***
	[0.004]	[0.027]	[0.005]	[0.007]
Sample	All	Single		
Forward rate			NO	YES
Number of observations	1,099,080	42,880	530,525	565,968
Kleibergen-Paap rk LM statistic	2,047	71	1,047	457
Cragg-Donald Wald F statistic	1,998	68	1,000	490
Centered R-squared	0.2266	0.3001	0.3027	0.1734

Notes: The firm-export destination-HS eight-digit level observations are restricted only to those that appear after 2007 in our dataset. Furthermore, we include those in only the first year of appearance in the dataset. The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate using the IV method. Our instrument is the importing country's total imports of a concerned product from the world except for Thailand. All specifications include import country-year and HS six-digit code-year fixed effects. 'Single' in the sample excludes exporters who start exporting multiple products or export to multiple countries in their first export. In columns (III) and (IV), we restrict the sample export destination countries according to the availability of forward exchange rates for their official currencies in Thailand.
Source: Authors' calculation.

Next, we change the definition of new transactions. In the above estimation, we restricted firm-export destination-HS eight-digit level observations only to new transactions, which are defined as those that for the first time appeared after 2007 in our dataset. However, one may be concerned that firms that only happened to not trade in 2007 are also regarded as 'new transactions' in this definition. In this robustness check, we adopt a more conservative definition by changing '2007' to '2008' or '2009'. Namely, we define '>2008' ('> 2009') as new transactions: observations that do not appear in 2007 or 2008 (2007, 2008, and 2009) but do appear after 2008 (2009). The results for OLS and IV are shown in Table 7. The significance and signs of our variables do not change from those in previous tables. Thus, our results are robust to the

definition of new transactions to some extent, although the absolute magnitudes of the coefficients for *First* slightly increases.

Table 7. Different Definition of New Transactions

	(I)	(II)	(III)	(IV)
First	0.119***	0.116***	0.111***	0.111***
	[0.001]	[0.002]	[0.002]	[0.002]
ln Value	-0.010***	-0.009***	-0.039***	-0.040***
	[0.000]	[0.000]	[0.004]	[0.005]
First year	> 2008	> 2009	> 2008	> 2009
Method	OLS	OLS	IV	IV
Number of observations	782,760	511,091	782,760	511,091
Kleibergen-Paap rk LM statistic			1,366	909
Cragg-Donald Wald F statistic			1,343	903
(Centered) R-squared	0.2540	0.2505	0.2284	0.2221

Notes: The firm-export destination-HS eight-digit level observations in '>2008' and '2009' in the row for 'First year' are restricted only to those that appear after 2008 and 2009 in our dataset, respectively. The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. In the IV estimation, we use as an instrument, the importing country's total imports of a concerned product from the world except for Thailand. All specifications include the import country-year and HS six-digit code-year fixed effects.
Source: Authors' calculation.

We further conduct more estimations, for which the results are shown in Appendix A. For example, we take into account in our analysis that the non-PC includes the VC and LC. To do so, we first restrict the export destination country to the United States because in this case the VC and the LC are the same, i.e. the US dollar. Even in this estimation, we find that the coefficients for *First* and the log of *Value* are again estimated to be significantly positive and negative, respectively. We second estimate the multinomial logit model on the choice of the invoicing currency. The categorical dependent variables include all three types of pricing strategies: PC (the default option), LC, and VC.[17] As independent variables, we again include *First* and the log of *Value* in addition to some control variables. The estimation results show that the coefficients for *First* are significantly negative in both cases for the LC and VC, indicating that for the first export, the PC is again more likely to be chosen than the LC or VC.

[17] The observations under the PC, LC, and VC account for 28%, 15%, and 57%, respectively.

The other estimations are as follows. First, the global financial crisis may have affected our estimates. In particular, it may have induced firms to choose non-US dollar currencies because the risk of the US dollar can be expected to have increased during the global finance crisis (Ogawa and Muto, 2017). To see its effects, we introduce the interaction terms of the *First* dummy with year dummy variables. Although we find some quantitative differences across the coefficients for the interaction terms, all coefficients are positively estimated. Second, in order to see the differences across industries, we estimate our equation by the one-digit SITC codes. All industries show positively significant coefficients for the *First* dummy. Chemical products (category 5) have a relatively small coefficient, while a relatively large coefficient is found for food and live animals (categories 0 and 1). Third, we estimate for trade in parts and finished products, separately. Both products have significantly positive coefficients for the *First* dummy, although its coefficient is slightly larger for finished products. One may say that firms tend to start exporting to less developed countries and the PC is more likely to be used for those countries because exporters can force importers to accept the exporters' currency (PC). To get rid of this possibility, lastly, we estimate for the high- and low-income import countries, separately. Both cases show significantly positive coefficients for the *First* dummy, although its coefficient is slightly larger in low-income import countries.

4. Policy Discussion

Involvement in international business activities can affect firms' behaviour in many aspects. Amongst these aspects, we focused on the effect of firms' export experience on the choice of the invoicing currency. Employing transaction-level export data for Thailand during the 2007–2011 period, we revealed that the majority of exporters did not change the invoicing currency much for the same products/destinations during the sample period. This fact indicates that changing the invoicing currency incurs significant costs for exporters. These costs may include typical menu costs, the effort to reconsider profit structures, accounting costs, and a variety of costs for documentation preparation. Also, it may be affected by the effort to renegotiate with the importer, although this aspect has not been explicitly investigated. Further, we found that the probability of choosing the PC for the first export is

significantly higher than for the export of the second and subsequent products/destinations even after controlling for export size. PC invoicing frees exporters from exchange rate risk but can decrease demand and profit by imposing that risk on importers. Thus, this latter finding implies that an accumulation of firms' export experience provides better know-how on exchange rate risk management and enables firms to diversify their invoicing currencies so that they can pursue better export profits.

It has been emphasised that firms gain benefits from the use of their home currency because they can be free from exchange rate risk and do not need to pay to manage the risk of exchange rate fluctuations (e.g. Ito et al., 2016). If those efforts become a significant burden for firms, the internationalisation of the home currency leads to gains in home welfare and can become an obvious policy objective to pursue. In this study, we examined firms' dynamic choice of invoicing currency for exports discussing the possibility that the PCI can lead to a loss of exporter benefit if importers are risk averse and exporters are required to set low prices in order to capture enough demand to gain profit. If the importers' degree of risk aversion is significantly high, demand can decrease under the PCI. Therefore, exporters are supposed to determine which currency to use in invoicing with the consideration of the trade-off between the benefit of avoiding exchange rate risk and the cost of lower export prices. Our theoretical model shed light on this trade-off mechanism in the dynamic decision of the invoicing currency and provided parsimonious guidance to introduce this trade-off mechanism into the discussion. The model demonstrated that a home currency may not be used for invoicing even if the exporters can utilise forward exchange rates and the cost for managing the exchange rate risk has been well reduced. This consequence provides partial support to the fact that several currencies, such as the Japanese yen, are not largely used for invoicing even though those currencies are well internationalised in a de jure sense.

The strong inertia in the invoicing currency found in this study reconfirms the presence of a currency switching cost, which has been discussed in the literature (e.g. Cohen, 2011). In addition, we revealed a noteworthy fact that the inertia is strong for same destination-product exports, but exporters choose invoicing currencies flexibly for new markets or new products compared to the first export. Interestingly, the inertia within a destination-product pair prevails also in these new markets and new products,

indicating that the currency switching cost is significantly present even after firms accumulate international business experience. In other words, the currency switching cost is huge for firms, and export experience does not have much of a mitigating impact on it. Therefore, if policymakers pursue internationalisation of their home currency, it should be recognised that encouraging firms to switch invoicing currencies in existing transactions is more difficult than enhancing the use of their own currency in new markets and new products.

Our findings also suggest that the home currency tends *not* to be used in international transactions once home firms gain experience. This consequence is basically consistent with conventional findings in the literature that more capable exporters tend to use foreign currencies for invoicing purposes. Since the choice of the invoicing currency is made by firms, it is implied that exporters feel some benefits from using foreign currencies in their exports to attract their foreign customers, and they are inclined to use these currencies if they have enough capacity to manage the exchange rate risks. Again, the export price tends to be lower under the PCI than a non-PCI. Therefore, mitigating the cost of exchange rate risk management is important not only to directly lower firms' cost payments but also to enhance home firms' international competitiveness. If the cost for exchange rate risk management is significantly low, home firms can choose the invoicing currency that is best to attract their customers without being burdened with dealing with exchange rate risk. This issue would be important especially in emerging countries, which have relatively minor currencies and financial environments that are still under development.

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Appendix A. Other Tables

Table A1. Number of Total Export Transactions and Total Exports According to Invoicing Currency in Thailand (Number, %)

		2007		2008		2009		2010		2011	
		Number	Share	Number	Share	Number	Share	Number	Share	Number	Share
Number (Country-product pairs)											
PC		130,489	23	132,982	24	135,550	25	139,548	26	150,058	26
Non-PC		440,698	77	415,421	76	399,020	75	406,021	74	422,905	74
	LC	87,767	15	85,604	16	79,958	15	78,662	14	82,193	14
	VC	352,931	62	329,817	60	319,062	60	327,359	60	340,712	59
Total		571,187		548,403		534,570		545,569		572,963	
Value (Bil. THB)											
PC		333	7	389	7	358	7	469	8	549	8
Non-PC		4,689	93	5,477	93	4,764	93	5,602	92	6,142	92
	LC	1,180	23	1,292	22	1,097	21	1,245	21	1,237	18
	VC	3,510	70	4,185	71	3,667	72	4,357	72	4,905	73
Total		5,022		5,866		5,122		6,072		6,691	

Source: Customs Department, Thailand.

Table A2. Export Prices: PCI versus Non-PCI

	(I)	(II)
1 for PCI (THB)	-0.230***	-0.473***
	[0.005]	[0.009]
Country-year FE	YES	YES
HS6-year FE	YES	YES
Firm-year FE	YES	NO
Number of observations	2,660,718	261,794
R-squared	0.6313	0.5419

Notes: The dependent variable is the log of the unit export price (export value divided by export quantity). The main independent variable is a dummy variable that takes the value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate by OLS. In column (I), we include all observations for the estimation, while the sample in column (II) is restricted only to observations on the first export to each firm (i.e. observations with a one-value First dummy in the analysis in Section 4).
Source: Authors' calculations.

Table A3. Estimation by SITC Sectors: Inertia

SITC	0 & 1	2 & 3	4	5	6	7
Lagged THB Dummy	0.880***	0.824***	0.838***	0.879***	0.798***	0.835***
	[0.013]	[0.014]	[0.021]	[0.006]	[0.005]	[0.005]
ln Value	-0.001*	-0.000*	0.000	-0.000*	-0.001***	-0.000***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of observations	19,798	36,888	18,007	101,422	179,598	154,812
R-squared	0.9813	0.9660	0.9795	0.9679	0.9439	0.9397

Notes: The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is zero otherwise. 'Lagged THB Dummy' is a one-year lagged dependent variable. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate using the OLS method. All specifications include export firm-year, import country-year, and HS six-digit code-year fixed effects.
Source: Authors' calculations.

Table A4. Production Stages and Income Levels of Importers: Inertia

	Stage		Income	
	Parts	Finished	Low	High
Lagged THB Dummy	0.837***	0.771***	0.819***	0.751***
	[0.003]	[0.003]	[0.003]	[0.004]
ln Value	-0.001***	-0.001***	-0.001***	-0.001***
	[0.000]	[0.000]	[0.000]	[0.000]
Number of observations	344,974	410,530	294,830	458,250
R-squared	0.9428	0.9343	0.9603	0.9123

Notes: The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. 'Lagged THB Dummy' is the one-year lagged dependent variable. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate using the OLS method. All specifications include export firm-year, import country-year, and HS six-digit code-year fixed effects. Finished products are defined as items categorised into 112, 122, 41, 51, 52, 61, 62, or 63 in the BEC classification, while the rest are parts. In differentiating between high- and low-income countries, we follow the World Bank classification. Specifically, high income countries include ABW, AND, ARE, ATG, AUS, AUT, BEL, BHR, BHS, BMU, BRB, BRN, CAN, CHE, CYM, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, FRO, GBR, GNQ, GRC, GRL, HKG, HUN, IRL, ISL, ISR, ITA, JPN, KOR, KWT, LUX, MAC, MLT, MNP, NCL, NLD, NOR, NZL, OMN, PRI, PRT, PYF, QAT, SAU, SGP, SMR, SVK, SVN, SWE, TTO, TWN, and USA.

Source: Authors' calculations.

Table A5. Estimation Results for the United States

	(I)	(II)
First	0.090***	0.090***
	[0.006]	[0.006]
ln Value	-0.013***	-0.013***
	[0.001]	[0.001]
Include Other VC?	YES	NO
Number of observations	51,010	49,386
R-squared	0.2466	0.2489

Notes: The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. We estimate using OLS. We restrict the export destination country to the United States. In column (II), we exclude observations invoiced under non-US dollar currencies (e.g. the euro or Japanese yen), which account for only 3% of observations for exports to the United States.

Source: Authors' calculations.

Table A6. Multinomial Logit Results

	(I)		(II)	
Base = PC	LC	VC	LC	VC
First	-0.401***	-1.103***	-0.445***	-1.430***
	[0.008]	[0.006]	[0.008]	[0.008]
ln Value	0.063***	0.083***	0.080***	0.109***
	[0.001]	[0.001]	[0.001]	[0.001]
ln GDP per capita	1.657***	0.012***	0.945***	-0.404***
	[0.007]	[0.002]	[0.010]	[0.006]
Forward	All		YES	
Number of observations	1,057,340		569,972	
Pseudo R-squared	0.1257		0.0897	
Log pseudolikelihood	-885864.28		-555280.92	

Notes: This table reports the estimation results of the multinomial logit model on the choice of the invoicing currency. The categorical dependent variables take into account all pricing strategies, including the PC (the default option), LC, and VC. In all specifications, we introduce year fixed effects and dummy variables on Section of HS tariff classification. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. In column (II), we focus on export destination countries for which the official currency forward exchange rates are available in Thailand.

Source: Authors' calculations.

Table A7. Interactions with Year Dummy Variables

	(I)	(IV)
First	0.121***	0.109***
	[0.002]	[0.003]
* 1 for 2009	0.002	0.001
	[0.003]	[0.003]
* 1 for 2010	-0.025***	-0.020***
	[0.003]	[0.003]
* 1 for 2011	0.014***	0.021***
	[0.003]	[0.003]
ln Value	-0.011***	-0.041***
	[0.000]	[0.004]
Method	OLS	IV
Number of observations	1,099,080	1,099,080
Kleibergen-Paap rk LM statistic		2,046
Cragg-Donald Wald F statistic		1,997
Centered R-squared	0.2536	0.2265

Notes: The firm-export destination-HS eight-digit level observations are restricted only to those that appear after 2007 in our dataset. Furthermore, we include those in only the first year of appearance in the dataset. The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. All specifications include import country-year and HS six-digit code-year fixed effects.

Source: Authors' calculations.

Table A8. Estimation by SITC Sector: Export Experience

SITC	0 & 1	2 & 3	4	5	6	7
First	0.136***	0.123***	0.131***	0.102***	0.109***	0.120***
	[0.009]	[0.006]	[0.010]	[0.004]	[0.003]	[0.002]
ln Value	-0.008***	-0.021***	-0.010***	-0.007***	-0.009***	-0.009***
	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Number of observations	19,373	45,321	12,885	103,308	272,897	241,986
R-squared	0.4737	0.3447	0.5295	0.3268	0.2571	0.3096

Notes: The firm-export destination-HS eight-digit level observations are restricted only to those that appear after 2007 in our dataset. Furthermore, we include those in only the first year of appearance in the dataset. The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. All specifications include import country-year and HS six-digit code-year fixed effects. We estimate using the OLS method.

Source: Authors' calculations.

Table A9. Production Stages and Income Levels of Importers: Export Experience

	Stage		Income	
	Parts	Finished	Low	High
First	0.105***	0.125***	0.124***	0.111***
	[0.002]	[0.002]	[0.002]	[0.002]
ln Value	-0.008***	-0.014***	-0.008***	-0.013***
	[0.000]	[0.000]	[0.000]	[0.000]
Number of observations	454,422	644,617	447,037	649,432
R-squared	0.2932	0.2259	0.3581	0.1885

Notes: The firm-export destination-HS eight-digit level observations are restricted only to those that appear after 2007 in our dataset. Furthermore, we include those in only the first year of appearance in the dataset. The dependent variable is a dummy variable that takes a value of 1 if the invoicing currency is the PC and is 0 otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard errors. All specifications include import country-year and HS six-digit code-year fixed effects. We estimate using the OLS method. Finished products are defined as items categorised into 112, 122, 41, 51, 52, 61, 62, or 63 in the BEC classification, while the rest are parts. In differentiating between high- and low-income countries, we follow the World Bank classification. Specifically, high-income countries include ABW, AND, ARE, ATG, AUS, AUT, BEL, BHR, BHS, BMU, BRB, BRN, CAN, CHE, CYM, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, FRO, GBR, GNQ, GRC, GRL, HKG, HUN, IRL, ISL, ISR, ITA, JPN, KOR, KWT, LUX, MAC, MLT, MNP, NCL, NLD, NOR, NZL, OMN, PRI, PRT, PYF, QAT, SAU, SGP, SMR, SVK, SVN, SWE, TTO, TWN, and USA.

Source: Authors' calculations.

Appendix B. Theoretical Appendix

B1. Ternary Choice Model

In order to introduce VCI in a straightforward way, we assume that the loss of risk-averse importers' demand from exchange rate risk becomes smaller under VCI than PCI because it is usually easier for importers to deal with the exchange rate risk between the LC and the VC, which is usually a major currency such as USD, than with the risk between the LC and the PC, which is THB in this study. In particular, we replace equation (1) with the following:

$$q(p) = \mu - 1_{\{PCI\}}\sigma - 1_{\{VCI\}}\sigma^V - p,$$

where $1_{\{VCI\}}$ represents the indicator function that becomes 1 when the vehicle currency is used in invoicing. We assume $\sigma > \sigma^V > 0$. Given that the exporter choses the PCI for the first export, the second-period profit under VCI in market j can be written as

$$\hat{\pi}^V_{j2|P} = f^V_{j2}\left(\mu_j - \sigma^V_j - \frac{\hat{c} + \hat{\tau}_j}{f^V_{j2}} - q^V_{j2}\right)q^V_{j2} - \hat{F}^V_{j|P} - 1_{\{j=A\}}\hat{G}_{V|P}.$$

$\hat{F}^V_{j|P}$ is the fixed cost for exchange rate risk management under VCI and assumed to be smaller than that under LCI ($\hat{F}^V_{j|P} < \hat{F}_{j|P}$) as VCI is tractable not only for importers but also for exporters. $\hat{G}_{V|P}$ is the fixed cost to switch currency from the PC to the VC. f^V_{j2} is the forward exchange rate of the vehicle currency. Following the same steps in the binary choice model, the profit maximising quantities are derived as

$$q^V_{j2|P} = \frac{1}{2}\left(\mu_j - \sigma^V_j - \frac{\hat{c} + \hat{\tau}_j}{f^V_{j2}}\right).$$

Thus, realised profits become

$$\hat{\pi}^V_{j2|P} = f^V_{j2}\left(\frac{1}{2}\left[\mu_j - \sigma^V_j - \frac{\hat{c} + \hat{\tau}_j}{f^V_{j2}}\right]\right)^2 - \hat{F}^V_{j|P} - 1_{\{j=A\}}\hat{G}_{V|P}.$$

In this ternary version, the exporter chooses the invoicing currency at $t = 2$ so that it maximises $\{\hat{\pi}^P_{j2|P}, \hat{\pi}^L_{j2|P}, \hat{\pi}^V_{j2|P}\}$.

The first-period expected profits with respective invoicing currencies are given by

$$\hat{\pi}^P_{A1} = e_{A1}\left(\frac{1}{2}\left[\mu_A - \sigma_A - \frac{\hat{c} + \hat{\tau}_A}{e_{A1}}\right]\right)^2 + \widehat{W}_{2|P},$$

$$\hat{\pi}^L_{A1} = e_{A1}\left(\frac{1}{2}\left[\mu_A - \frac{\hat{c} + \hat{\tau}_A}{e_{A1}}\right]\right)^2 + \widehat{W}_{2|L} - \hat{F}_1,$$

$$\hat{\pi}^V_{A1} = e^V_{A1}\left(\frac{1}{2}\left[\mu_A - \sigma^V_A - \frac{\hat{c} + \hat{\tau}_A}{e^V_{A1}}\right]\right)^2 + \widehat{W}_{2|V} - \hat{F}^V_1.$$

We assume $\hat{F}^V_1 < \hat{F}_1$. $\widehat{W}_{2|I_{A1}}$ is the expected profit at $t = 2$ in the ternary case.

B2. The Case in Which LCI Has Been Chosen at $t = 1$

The profit maximising quantities are derived as

$$q^P_{j2|L} = \frac{1}{2}\left(\mu_j - \sigma_j - \frac{\hat{c} + \hat{\tau}_j}{e_{j2}}\right),$$

$$q^L_{j2|L} = \frac{1}{2}\left(\mu_j - \frac{\hat{c} + \hat{\tau}_j}{f_{j2}}\right).$$

Profits are given by

$$\hat{\pi}^P_{j2|L} = e_{j2}\left(\frac{1}{2}\left[\mu_j - \sigma_j - \frac{\hat{c} + \hat{\tau}_j}{e_{j2}}\right]\right)^2 - 1_{\{j=A\}}\hat{G}_{P|L},$$

$$\hat{\pi}^L_{j2|L} = f_{j2}\left(\frac{1}{2}\left[\mu_j - \frac{\hat{c} + \hat{\tau}_j}{f_{j2}}\right]\right)^2 - \hat{F}_{j|L}.$$

The exporter chooses the PCI if $\hat{\pi}^L_{j2|L} < \hat{\pi}^P_{j2|L}$. With the assumption that the expectation for exchange rate follows the static manner and the forward exchange rate is equal to

the expected exchange rate, this condition can be rewritten for markets A and B, respectively, in the following manner:

$$\hat{F}_{A|L} > \hat{G}_{P|L} + \frac{\sigma_A}{4}(e_{A2}[2\mu_A - \sigma_A] - 2[\hat{c} + \hat{\tau}_A]),$$

$$\hat{F}_{B|L} > \frac{\sigma_B}{4}(e_{B2}[2\mu_B - \sigma_B] - 2[\hat{c} + \hat{\tau}_B]).$$

The latter corresponds to equation (3).

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