Export Dynamics and Invoicing Currency

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Abstract: In this paper, using the finely disaggregated firm-level export data in Thailand, we examine how firms' export experience is related to the dynamic choice of invoicing currency. We present an evidence that the majority of exporters do not change invoicing currency for same product/destination during the sample period. This evidence implies that changing invoicing currency requires significant burden of menu cost and renegotiation. We also find that, even after controlling for export size, the probability of choosing export country's currency, or producers' currency (PC), in the first export is significantly higher than in the export of the second and subsequent products/destinations. This finding implies that accumulation of firms' export experience provides better know-hows of exchange rate risk management and enhances the use of currencies other than PC in order to gain better profit. We also propose a theoretical model which provides rationale for these empirical findings.

Keywords: Export dynamics; Invoicing currency; Exchange rate uncertainty; Learning
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1. Introduction

The exchange rate is one of the important sources of the uncertainty in international business. In the practical contract in international trade, invoicing currency is simultaneously determined in addition to unit price and quantity. The invoicing currency can be broadly classified into three types: producers' currency in the export country (PC), local currency in the import country (LC), and third vehicle currency (VC).[1] As Gopinath et al. (2010) and Fabling and Sanderson (2015) discuss, exchange rate changes are mostly passed through into the price denominated in LC (PC) if products are invoiced in 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 exchange rate movement on exporter's profits depends crucially on the type of invoicing currency. Particularly in the case of non-LC invoicing (non-LCI), importers suffer from exchange rate risk and may decrease their demand if they are risk averse.[2] Thus, there is a trade-off of PC invoicing (PCI) for exporters that it frees exporters from exchange rate risk but decreases demand and profit by imposing that risk on importers.

In this paper, we examine how firms choose invoicing currency when they start exporting and then change it once their export experiences are accumulated. 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 in the first export that their oversea business does 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 which they gained on their following behavior. In this context, our focus is how firms' experience affects their choice on the monetary aspect, that is, the 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 agenda both in developed and developing countries. Exploring the over-time change in the choice of invoicing currency will provide us the better understanding of monetary aspects of export dynamics, which have not been argued enough.

For our empirical analysis, we employ transaction-level export data in Thailand from 2007 to 2011. The data are obtained from the Customs Office of the Kingdom of Thailand and cover all commodity exports during this period. Our dataset contains

[1] For VC, US dollar is used most because it is an international key currency.
[2] See Wolak and Kolstad (1991) and Coppejans et al. (2007) for the effect of price uncertainty on demand.

customs clearing date, HS eight-digit code, export destination country, firm identification code, export values in Thai Baht (THB), and invoicing currency. In Thailand, the share of exports under PC (i.e., THB) is around 25% in terms of the number of country-product pairs and around 10% in terms of values (see Appendix A). Namely, despite that THB is not an international currency and Thailand is a developing country, PC plays a certain role in exporting. On the other hand, since THB is not an international currency, exchange rate risk management costs, in the case of non-PCI, are significant for exporters from Thailand. Thus, the case of Thailand will become a good one to examine the above-mentioned trade-off.

By using this finely disaggregated data, we first present two evidences on exporters' choice of invoicing currency that were rarely discussed in the literature: (i) there are only a small number of cases in which exporters change their invoicing currency within a firm-country-product pair during sample period; and (ii) the frequency of transactions under PCI decreases when exporting the second and subsequent products or to the second and subsequent destinations. The evidence (i) indicates that changing invoicing currency is not easy maybe because it requires firms to incur menu costs. Also, it may require significant burden of renegotiation since invoicing currency is one of important contract terms. The evidence (ii) may indicate that accumulation of firms' experience of oversea business enables firms to find better means to manage exchange rate risks with lower costs and enhances the use of currencies other than PC in order to gain better profit.

To more formally understand these findings, particularly the second finding, we develop a theoretical model of dynamic choice of invoicing currency. Our model highlights the possibility that the cost for exchange rate risk management is mitigated by firms' export experience. Once firms start exporting and experience foreign sales, they would look for the means to deal with exchange rate risks and try to find the best way to do it. They may consult with neighboring firms to know how other firms deal with exchange rate risks, or they may ask closely-located banks whether these banks can provide good means such as forward exchange rates and currency options. We simply introduce this type of *search cost* to find a good way to manage exchange rate risks as a form of fixed cost. Importantly, we assume that this fixed search cost is bigger in the first export than subsequent exports with the consideration of learning effect from oversea business experiences. As a result, PCI is more likely to be chosen in the first export than in export to the second and subsequent markets.

Last, we further empirically examine the latter fact by estimating some econometric models. Specifically, we estimate the linear probability model with a large number of fixed effects. The dependent variable is a dummy variable that takes the value one if

invoicing currency is PC, while our main independent variable takes the value one if a concerned transaction is the first one for firms. We found the robust result that the probability of choosing PC in the first export for firms is significantly higher than in the case of the second and subsequent export product/destination, even if controlling for transaction sizes. Furthermore, in our theoretical analysis, we demonstrate that firms are more likely to choose PCI in the first export if LC in the export destination is costlier in terms of the above-mentioned fixed costs for exchange rate management. As is consistent with this hypothesis, we empirically find that the positive coefficient for our main independent variable is larger when exchange rates in firms' first export destination are more volatile.

Our study is related to at least two literatures. One is the literature on the choice of invoicing currency. Devereux et al. (2017) investigate how the exporter's market share in the destination affects the choice of invoicing currency in exports. Goldberg and Tille (2013) also consider the effect of the market share but they focus more on bargaining between exporters and importers in determining invoicing currency. Engel (2006) proposed the explicit condition that determines the invoicing currency. Gopinath et al. (2010) extend the framework of Engel (2006) by introducing the dynamic perspective and examine detailed empirical analysis for the choice of invoicing currency. Chung (2016) not only considers the choice among PC and LC but also introduces VC into the discussion. Against these studies, our paper is the first that focuses on the firm-level over-time choice of invoicing currency. In particular, we shed light on the relationship between firms' export experience and dynamic choice of invoicing currency.

The other is the literature on export dynamics because we examine the over-time change in firm-level exports. The recent studies in this literature have empirically examined how firms' exporting behavior changes over time in terms of volume, duration, export destination countries, and export products.[3] For example, as mentioned above, it is found that *new exporters tend to start small and focus on a single, usually neighboring, 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 PC. However, when they export to the other new countries, PC is less likely to be chosen perhaps due to the accumulation of know-hows for exchange

[3] 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).

rate risk management through their oversea business experience.

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

2. First Look

In this section, we take overview of over-time change of invoicing currency in new exporters. To do that, we employ transaction-level export data in Thailand during 2007-2011 period. There are two kinds of shortcoming in our dataset. One is that the 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, the firm who did not export in 2007 but do after 2007.[4] However, we have to keep in our mind the possibility that such a new exporter may have experience on 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. To keep our analysis as simple as possible, we classify invoicing currency simply into two types, PC or Non-PC. The latter currency includes LC and VC.

=== Figure 1 ===

We start from checking how new exporters change invoicing currency between the first country-product pair and the 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

[4] One may use a more conservative definition, e.g., the firm who did not export during 2007-2009 but do after 2009 (i.e., three-year window). However, in this case, we can investigate the change of 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 over-time change of invoicing currency, we choose one-year window in the definition of first export. Nevertheless, in our estimation works, we also try two- and three-year window cases.

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 PC out of 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 1. For example, a figure in a combination between 2008 of "*First export year for firm*" and 2008 of "First export year for firm-product-country" *roughly* indicates that 46% of firms who for the first time start exporting in 2008 choose PC.[5] On the other hand, a figure in a combination between 2008 of "*First export year for firm*" and 2010 of "First export year for firm-product-country" shows that PC is chosen in 36% of firm-product-country pairs in which the export starts in 2010 by firms who start 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 PC is higher in the first export case than when firms export the subsequent product or to the subsequent country. Indeed, in firms with 2008 of "First export year for firm," the share declines as the "First export year for firm-product-country" increases. Similar trend is observed also in firms with 2009 and 2010 of "First export year for firm."

=== Table 1 ===

Next, we investigate 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 if invoice currency is different between two years. The results are reported in Table 2. It shows how many percentages of firm-product-country pairs use different invoicing currency between two years. From this table, only less than 10% of firm-country-product pairs change invoicing currency. It is worth noting that in those observations, the invoicing currency change may occur due to the change of trading partners within a firm-product-country pair. As mentioned above, our dataset does not enable us to identify such partner changes.

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

Therefore, the figures become smaller if we exclude the case of such partner changes. In short, invoice currency is less likely to change when trading the same product with the same country.

=== Table 2 ===

3. Theoretical Model

This section theoretically examines the relation between 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 in the following period given the experience in the first period. 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) reveal that the degree of ERPT to export prices is almost twice higher for financially constrained firms than unconstrained firms. Although he does not investigate the determination of invoicing currencies directly, it is implied that financially constrained firms may prefer invoicing in their home currency to stabilize the sales value denominated in their home currency since they are not capable to manage exchange rate risks through utilizing financial means.

Based on these findings, a straightforward prediction for dynamic choice of 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 at the following period given the experience at the first period. To see the theoretical accuracy of this prediction and provide a guidance for the empirical analysis, we build a parsimonious model of dynamic choice of invoicing currency. Our theoretical model consists of two periods of time ($t = 1, 2$). At $t = 1$, a firm start exporting to market A, which we call the *first export*. At $t = 2$, the firm expands its business to another market B and export to both markets A and B. Albornoz et al. (2012) investigate the dynamic entry decision of a firm and call our case 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 expanding its business globally. We assume 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.[6]

[6] In the model, we examine how firms determine the invoice currency when they enter into new destinations abstracting from the introduction of new products. Also, we focus on the choice among

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 exchange rates. One 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 maximize the expected profit at the settlement point in terms of their home currency. We also assume that exporters can utilize forward exchange rates to hedge this exchange rate risk between contract and settlement with the payment of positive fixed cost which is required to find an appropriate financial institution. The other is that firms do not know the level of 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 ===

3.1. Importers' Risk Aversion and Local-currency Prices

We assume that each exporting firm is small in destination markets so that the price denominated in the currency of the destination country is exogenous to firms regardless what currency the firm chooses in invoicing. Importers are assumed to be risk-averse. Existing studies such as Wolak and Kolstad (1991) and Coppejans et al. (2007) discuss that risk-averse agents decrease the demand for the products with price uncertainty. If exporters choose their home currency in invoicing, the price in terms of importers' 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 exporters' currency taking the local-currency price as given. Thus, the demand function is presented as

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

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

exporter's and importer's currencies putting aside the possibility of third vehicle currency invoicing.

Destination markets are competitive and importers are risk-averse, thus no importers purchase products invoiced in exporters' currency if the local-currency price is same regardless of invoicing currency. In other words, local-currency price should be discounted for products invoiced in exporters' currency so that the demand for these products become positive. To take this mechanism into account, we present the relation between local-currency prices in cases of PCI (p^P) and LCI (p^L) in the following manner:

$$p^P = (1-a)p^L, \ \ 0 < a < 1.$$

The discount parameter a is expected to be related to the degree of importers' risk aversion. Specifically, it is natural to predict that a is related to σ so that demanded quantities are equalized under PCI and LCI prices. Thus,

$$q^P = q^L \rightarrow a = \frac{\sigma}{p^L}.$$

Therefore,

$$p^P = p^L - \sigma.$$

The intuition of this equation is that PCI price must be discounted depending on the degree of importers' risk aversion so as to realize positive demand comparable to the LCI case.

3.2. Cost Structure

Letting j represent the destination market ($j = A, B$), we assume that an exporter has to incur following four types of costs when they produce and export:

- Unit production cost: $\hat{c}$
- Unit transportation cost: $\hat{\tau}_j$
- If LCI is chosen, fixed cost for exchange rate risk management: $\hat{F}_1$ at $t = 1$, $\hat{F}_{j|I_{A1}}$ at $t = 2$ given that invoicing currency I_{A1} has been chosen at $t = 1$ ($I_{jt} = P, L$)
- If the exporter changes invoicing currency for market A, fixed cost for changing invoicing currency from I_{A1} (at $t = 1$) to I_{A2} (at $t = 2$): $\hat{G}_{I_{A2}|I_{A1}}$

Here, hatted cost variables are denominated in exporters' currency. In the above list, former two, unit production ($\hat{c}$) and transportation ($\hat{\tau}_j$) costs, are standard. Latter two are unique in our model. Fixed cost for exchange rate risk management consists of the burden

to find an appropriate institution and documentation preparation to submit the order of forward exchange rates to the institution. We assume that this fixed cost is mitigated through the export experience at $t = 1$ ($\hat{F}_{j|I_{A1}} < \hat{F}_1$). Fixed cost for changing invoicing currency consists of menu cost and burden for renegotiation.

3.3. Profits and the Choice of Invoicing Currency

We solve for the firm's decisions using backward induction. At $t = 2$, exporters determine export quantities and invoicing currencies in markets A and B given the experience in market A at $t = 1$. At $t = 1$, exporters determine export quantity and invoice currency in market A considering expected profits at $t = 2$. Figure 3 presents the game tree of our theoretical model.

=== Figure 3 ===

3.3.1. Period $t = 2$

Assuming that the exporter chose PCI at $t = 1$, the expected profit in market j at the settlement point is given by

$$\hat{\pi}^P_{j2|P} = \left(e_{j2}p^P_j - \hat{c} - \hat{\tau}_j\right)q^P_{j2} = e_{j2}\left(\mu_j - \sigma_j - \frac{\hat{c} + \hat{\tau}_j}{e_{j2}} - q^P_{j2}\right)q^P_{j2},$$

$$\hat{\pi}^L_{j2|P} = \left(f_{j2}p^L_j - \hat{c} - \hat{\tau}_j\right)q^L_{j2} - \hat{F}_{j|P}$$

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

for cases of PCI and LCI, respectively. f represents the forward exchange rate. $1_{\{j=A\}}$ is the indicator function which takes one for $j = A$. Thus, profit maximizing 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, profits are rearranged as

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

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

The exporter chooses PCI if $\hat{\pi}^{L}_{j2|P} < \hat{\pi}^{P}_{j2|P}$. With the assumption that expectation for exchange rate follows the static manner and forward exchange rate is equal to expected exchange rate (i.e. $f_{j2} = e_{j2}$), this condition can be rewritten for markets A and B, respectively, in the following manner:

$$\hat{G}_{L|P} > \frac{\sigma_A}{4}(e_{A2}[2\mu_A - \sigma_A] - 2[\hat{c}+\hat{\tau}_A]) - \hat{F}_{A|P} \equiv \hat{G}^{A}_{L|P}, \quad (1)$$

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

Analogous derivation can be applied for the case in which the exporter chose LCI at $t = 1$. As a result, profit maximizing 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 LCI if $\hat{\pi}^{L}_{j2|L} > \hat{\pi}^{P}_{j2|L}$. Again, with the assumption that expectation for exchange rate follows the static manner and forward exchange rate is equal to expected exchange rate, this condition can be rewritten for markets A and B, respectively, in the following manner:

$$\hat{G}_{P|L} > \hat{F}_{A|L} - \frac{\sigma_A}{4}(e_{A2}[2\mu_A - \sigma_A] - 2[\hat{c}+\hat{\tau}_A]) \equiv \hat{G}^{A}_{P|L}, \quad (3)$$

$$\hat{F}_{B|L} < \frac{\sigma_B}{4}(e_{B2}[2\mu_B - \sigma_B] - 2[\hat{c}+\hat{\tau}_B]) \equiv \hat{F}^{B}_{B|L} = \hat{F}^{B}_{B|P}. \quad (4)$$

In sum, we can state the following propositions on the choice of invoicing currency at the second period for market A:

Choice of Invoicing Currency at $t = 2$ for Market A

Proposition 1.1. *Based on equation (1), there exists the value* $\hat{G}_{L|P}^{A}$ *such that the exporter keeps using its home currency at* $t = 2$ *for market* A *if* $\hat{G}_{L|P}^{A} < \hat{G}_{L|P}$ *given that the exporter chose its home currency at* $t = 1$ *for market* A.

Proposition 1.2. *Based on equation (3), there exists the value* $\hat{G}_{P|L}^{A}$ *such that the exporter uses its home currency at* $t = 2$ *for market* A *if* $\hat{G}_{P|L} < \hat{G}_{P|L}^{A}$ *given that the exporter chose the local currency at* $t = 1$ *for market* A.

These propositions indicate that an exporter does not change the invoicing currency from the first period to the second period if switching the currency is costly.

We can also derive following statements:

Choice of Invoicing Currency at $t = 2$ for Market B

Proposition 2.1. *Based on equation (2), there exists the value* $\hat{F}_{B|P}^{B}$ *such that the exporter uses the local currency at* $t = 2$ *for market* B *if* $\hat{F}_{B|P} < \hat{F}_{B|P}^{B}$ *given that the exporter chose its home currency at* $t = 1$ *for market* A.

Proposition 2.2. *Based on equation (4), there exists the value* $\hat{F}_{B|L}^{B}$ *such that the exporter uses the local currency at* $t = 2$ *for market* B *if* $\hat{F}_{B|L} < \hat{F}_{B|L}^{B}\left(= \hat{F}_{B|P}^{B}\right)$ *given that the exporter chose the local currency at* $t = 1$ *for market* A.

These propositions imply that the probability that the firm employs LCI becomes higher if the learning effect on second-period cost for exchange rate risk management is larger and $\hat{F}_{B|I_{A1}}$ is smaller.

3.3.2. Period $t = 1$

We assume that firms at the contract point at $t = 1$ do not know the explicit value 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 the binary distribution. Specifically, we suppose two scenarios: strong (e_{j2}^{s}) and weak (e_{j2}^{w}) home currency scenarios where $e_{j2}^{s} < e_{j2}^{w}$. Each scenario realizes with the probability 0.5. With the assumptions

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

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

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

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

it can be proved that

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

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

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

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

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

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

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

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

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 follows:

$$\hat{F}_1 > \frac{\sigma_A}{4}\left(e_{A1}[2\mu_A - \sigma_A] - 2[\hat{c}+\hat{\tau}_A]\right) + \frac{1}{2}\left\{\hat{F}_{A|P} - \hat{F}_{A|L} + \hat{F}_{B|P} - \hat{F}_{B|L} + \hat{G}_{L|P} - \hat{G}_{P|L}\right\} \equiv \hat{F}_1^{P}. \tag{5}$$

Thus, the following proposition can be stated:

Choice of Invoicing Currency at $t = 1$ for Market A (First Export)

Proposition 3. *Based on equation (5), there exists the value $\hat{F}_1^{P}$ such that the firm chooses its home currency as an invoicing currency in the first export if $\hat{F}_1^{P} < \hat{F}_1$.*

3.4. Testable Implications

Primary focus of our theoretical investigation is to replicate evidences (i) and (ii) observed in our dataset and provide additional testable implications. Regarding evidence (i), propositions 1.1 and 1.2 give potential answers, that is, switching invoicing currency is costly for exporters. If switching invoicing currency requires an exporter to revise menus and renegotiate with importers, the exporter may hesitate to switch even if it's potentially beneficial.

For evidence (ii), propositions 2.1 and 3 are implacable. In the extreme case in which the learning effect on the cost for exchange rate risk management does not depend on the currency chosen at the first period ($\hat{F}_{A|P} = \hat{F}_{A|L}$ and $\hat{F}_{B|P} = \hat{F}_{B|L}$) and switching cost is symmetric between PCI and LCI ($\hat{G}_{L|P} = \hat{G}_{P|L}$), equation (5) can be rewritten as

$$\hat{F}_1 > \frac{\sigma_A}{4}\left(e_{A1}[2\mu_A - \sigma_A] - 2[\hat{c}+\hat{\tau}_A]\right). \tag{6}$$

Using the consequence from the learning effect that $\hat{F}_{B|P} < \hat{F}_1$, equations (2) and (6)

implies that PCI is more likely to be employed in the first export (to market A) than in export to new market B at the following period if these markets are symmetric ($\mu_A = \mu_B$, $\sigma_A = \sigma_B$ and $\hat{\tau}_A = \hat{\tau}_B$) and the exchange rate does not change much over time ($e_{B2} \approx e_{B1}$) with the normalization that long-run levels of exchange rates are same across markets ($e_A = e_B$). This is because the cost of exchange rate risk management is larger in the first export than in the following exports as a result of the learning effect from the experience of oversea business in the first export. Also, it implies that the likelihood of firms' choosing PCI in the first export would be higher if the cost for exchange rate risk management is smaller as equation (5) is more likely to hold.

4. Empirical Analysis

This section empirically investigates the relation between export experience and the choice of invoicing currency. After introducing our empirical specification, we show our baseline estimation result in addition to the results in various kinds of robustness checks.

4.1. Specification

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

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

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. Thus, each firm-export destination-HS eight-digit observation appears in our dataset for the estimation only once.[7] The dependent variable is a dummy variable that takes the value one if invoicing currency is PC when firm *f* starts to export product *p* to country *i* in year *t* and zero otherwise. Our main independent variable is a dummy variable of "First," which takes the value one if an observation is the first export to a firm and the value zero otherwise. As demonstrated in Section 3, we expect a positive coefficient for this variable.

We control for various other elements. Equations (2), (4), and (5) in the theoretical section indicate that the threshold value of the fixed cost for exchange rate risk management increases with the demand size (μ), thus PCI is less likely to be chosen when

[7] 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.

the demand size is larger. This is because the negative effect of price discount under PCI on the profit becomes larger when the exogenous demand factor is larger. As a result, exporters prefer employing LCI to PCI when the demand size is larger. Similar argument is stated by Devereux et al. (2017) which show the high probability of choosing 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 invoicing currency choice, we introduce "Value," which indicates export values. The data source for these variables is same as in Section 2.

Furthermore, we 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 export country, e.g., production cost, are captured by the latter fixed effect. Due to our introduction of a large number of fixed effects, we estimate this model by ordinary least square (OLS) method (i.e., as a linear-probability model), rather than by Probit estimation technique (i.e., incidental parameter problems).

4.2. Baseline Result

The estimation result is reported in column (I) in Table 3. The coefficient for *First* is estimated to be significantly positive. Namely, as is consistent with our demonstration in Section 3, PC is more likely to be chosen when firms for the first time start to export than when they export subsequent products or to subsequent destinations. This may be because, the cost of exchange rate risk management is mitigated through the experience of oversea business in the first export as we assume in the model, using LC becomes less costly for exporters through their experience of oversea business and relative benefit of LCI becomes bigger for subsequent products or destinations. As is consistent with the expectation from our theoretical model, the coefficient for a log of *Value* is negatively significant, indicating that PC is likely to be chosen by small-sized firms in terms of export values. Also, as noted above, Devereux et al. (2017) point out that small-sized exporters are more likely to invoice in PC than middle-sized exporters. Our dataset is for Thailand where most companies are not extremely large and do not have dominant market share in destination markets. Thus, our empirical finding for a log of *Value* seems to be consistent with Devereux et al. (2017).

=== Table 3 ===

4.3. Robustness Checks

In the below, we conduct various kinds of robustness checks. In column (II), we exclude exporters who start exporting multiple products or to multiple countries in their first export. A significant drop of the number of observations implies that there are a large number of such export starters. In columns (III) and (IV), we restrict sample export destination countries according to the availability of forward exchange rates for their official currency in Thailand.[8] In developing countries, such as Thailand, unless forward exchange rates are accessible, firms tend to choose PC or VC, not LC. In other words, possible non-PC currency will be different between those two types of destination countries. All these estimations show that the coefficients for *First* and a log of *Value* are again estimated to be significantly positive and negative, respectively.

In Table 4, we use instrumental variable (IV) methods. Since the transaction value and the invoicing currency are simultaneously determined in the negotiation, unobservable shocks to the transaction value will also have influence on the choice of invoicing currency. To address this endogeneity issue, we use as an instrument, import country's total imports of a concerned product from the world except for Thailand. This instrument captures the demand size in import countries and thus will be related to the transaction size in exporting from Thailand. Furthermore, since it does not include demand on the products from Thailand *per se*, this instrument is not directly related to the choice of invoicing currency. The results show that our instrument is not week. The significance and sign in our variables are not changed compared with those in Table 3. The absolute magnitude of the coefficients for *Value* increases a little.

=== Table 4 ===

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. In this robustness check, we adopt a more conservative definition by changing "2007" to "2008" and "2009." Namely, we define as a new transaction for ">2008" (">2009"), the observation that did not appear in both 2007 and 2008 (2007, 2008, and 2009) but did after 2008 (2009). The results for OLS and IV are shown in Table 5. The significance and sign in our variables are not changed compared with the case in the previous tables. Thus, our result is to some extend robustness to the definition of new transactions. The absolute magnitude of the coefficients for *First* increases a little.

[8] Specifically, forward exchange rates for the following currency is available in Thailand; EUR, GBP, JPY, AUD, CHF, HKD, SGD, CAD, DKK, NOK, SEK, NZD, CNY, and USD.

=== Table 5 ===

4.4. VC and LC

In this subsection, we take into account in our analysis that non-PC includes VC and LC. First, we restrict an export destination country to the U.S. because in this case, VC and LC are same, i.e., US dollar. Namely, we do not need to care about the differentiation between two currencies. The result is shown in column (I) in Table 6. We found that the coefficients for *First* and a log of *Value* are again estimated to be significantly positive and negative, respectively. This result does not change even if we exclude observations invoiced under non-US dollar (e.g., Euro or Japanese yen), which account for only 3% of observations for exports to the U.S.

=== Table 6 ===

Next, we estimate the multinomial logit model on the choice of invoicing currency. The categorical dependent variables take into account all pricing strategies, including PC (the default option), LC, and VC. As independent variables, we again include *First* and a log of *Value*. In this logit model, however, we cannot include fixed effects at a detailed level due to the incidental parameter problem. To control for a time-variant export destination country-specific element, we introduce a log of GDP per capita, which will be related to country's economic development level. To control for other parts, we introduce fixed effects at a rough level, including year fixed effects and dummy variables on Section of HS tariff classification. These will control for macro shocks and industry-specific elements.

The results are shown in column (I) in Table 7. The coefficients for *First* are significantly negative in both cases of LC and VC, indicating that, in the first export, PC is again more likely to be chosen than LC and VC. However, the coefficient is larger in absolute value for VC than LC, which is not necessarily consistent with our expectation. This may imply that exporters positively evaluate the benefit of LCI compare to VCI in attracting importers' demand.

=== Table 7 ===

The other results are the following. Both logs of export values and GDP per capita have significantly positive coefficients in both cases of LC and VC. Thus, PC is likely to

be chosen by small-sized firms in terms of export values and when exporting to less developed countries. These results may indicate that PC is more likely to be chosen when exporters are less capable or the currency of the importing country is less internationalized as a result of low degree of development. We also estimate this multinomial logit model for export destination countries for whose official currency the forward exchange rates are available in Thailand. The results are shown in column (II). The significance and sign in all variables, except for GDP per capita in VC, are not changed compared with those in column (I).[9]

4.5. Exchange Rate Management Cost

In this last subsection, we investigate the role of exchange rate management cost in the invoicing currency choice. Equation (5) implies that PCI is more likely to be chosen in the first export if exporters find it more costly to find an appropriate institution which provides the means for exchange rate risk management. If exchange rate is more volatile, exporters may become more careful to find an institution. In other words, firms would pay larger cost to find an appropriate institution when exchange rate is more volatile. Based on this prediction, we use exchange rate volatility index (*Volatility*) as a proxy for exchange rate management cost. Specifically, following Rose (2000), we employ a widely-used indicator, the real exchange rate volatility, which is constructed as the standard deviation of the first-difference of the monthly natural logarithm of bilateral real exchange rates in the five years preceding period. We use the volatility index at the initial year of our sample, i.e., 2007, and introduce the interaction term of *Volatility* with *First* dummy variable. Based on the argument above, we expect the positive coefficient for the interaction term of *Volatility* with *First* dummy variable.

The OLS estimation results are provided in Table 8. As is consistent with the above expectation, the coefficients for the interaction term are estimated to be positive though it is insignificant in column (II) partly because of the less variation in *Volatility* across countries. Thus, it is implied that firms would pay larger cost to find an appropriate institution when exchange rate is more volatile. The results in the other variables are unchanged. The coefficients for First dummy and a log of Value are estimated to be significantly positive and negative, respectively.

=== Table 8 ===

[9] We also estimate the multinomial logit model for all countries by introducing the dummy variable that takes the value one if the forward exchange rates for LC are available in Thailand and zero otherwise. Its coefficient is estimated to be significantly negative in VC and positive in LC.

5. Concluding Remarks

Involvement in international business activities are supposed to affect firms' behavior in many aspects. Among them, we focused on the effect of firms' export experience on the choice of invoicing currency. Employing transaction-level export data in Thailand during 2007-2011 period, we revealed that the majority of exporters do not change invoicing currency for same product/destination during the sample period. This fact indicates that changing invoicing currency requires significant burden of renegotiation because invoicing currency is one of the important terms in the contract, suggesting the presence of sunk or fixed cost to change the invoicing currency. Further, we found that the probability of choosing PC in the first export is significantly higher than in 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 accumulation of firms' export experience provides better know-hows of exchange rate risk management and makes firms diversify their invoicing currencies to keep better export profits.

It is usually discussed that firms in a country gain benefits from the use of their home currency because they can be free from exchange rate risk. On the other hand, our findings imply that the home currency tend *not* to be used in international transactions once home firms get experienced. In other words, it is indicated that exporters feel some benefits to use foreign currencies in their exports to attract their foreign customers. Therefore, mitigating the cost for exchange rate risk management is important not only to directly lower firms' cost payment but also to better off home firms' international competitiveness. If the cost for exchange rate risk management is significantly low, home firms can choose the invoicing currency which is best to attract their customers without being annoyed with the burden to deal with exchange rate risk. This issue would be important especially in emerging countries of which currencies are relatively minor and of which financial environment is still under development.

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Table 1. Invoicing Currency between the First Country-product Pair and the 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 PC out of total exports at a firm-product-country level according to the two kinds of years.

Table 2. Time-series Change of 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 how many percentages of firm-product-country pairs use different invoicing currency between the first and last years with positive exports during our sample period.

Table 3. Estimation Results of 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 the value one if invoicing currency is PC and zero otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. We estimate using the OLS method. All specifications include import country-year and HS six-digit code-year fixed effects. “Single” in sample excludes exporters who start exporting multiple products or doing to multiple countries in their first export. In columns (III) and (IV), we restrict sample export destination countries according to the availability of forward exchange rates for their official currency in Thailand.

Table 4. Estimation Results of 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 the value one if invoicing currency is PC and zero otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. We estimate using the IV method. Our instrument is import 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 sample excludes exporters who start exporting multiple products or doing to multiple countries in their first export. In columns (III) and (IV), we restrict sample export destination countries according to the availability of forward exchange rates for their official currency in Thailand.

Table 5. Estimation Results of Linear-probability Model: 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" of row "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 the value one if invoicing currency is PC and zero otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. In the IV estimation, we use as an instrument, import 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.

Table 6. Estimation Results for the U.S.

	(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 the value one if invoicing currency is PC and zero otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. We estimate by the OLS. We restrict an export destination country to the U.S. In column (II), we exclude observations invoiced under non-US dollar (e.g., Euro or Japanese yen), which account for only 3% of observations for exports to the U.S.

Table 7. 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]
Sample	All		Forward	
Number of observations	1,057,340		569,972	
Pseudo R-squared	0.1257		0.0897	
Log pseudolikelihood	-885864.28		-555280.92	

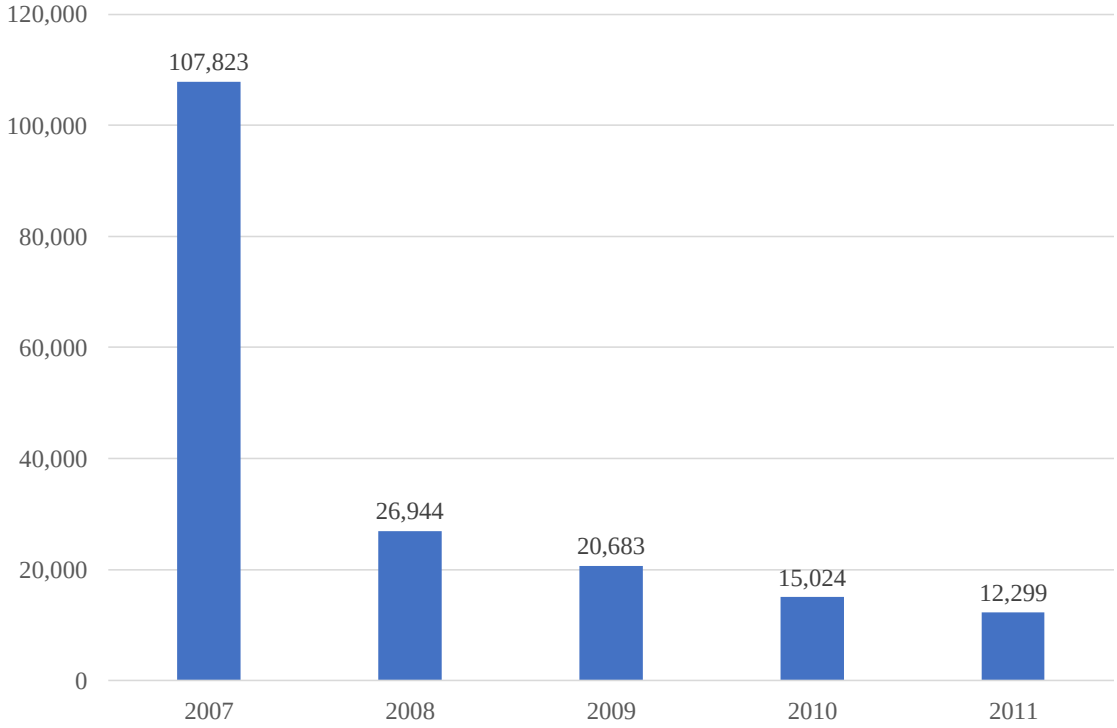
Notes: This table reports the estimation results of the multinomial logit model on the choice of invoicing currency. The categorical dependent variables take into account all pricing strategies, including PC (the default option), LC, and VC. In all specifications, we introduce year fixed effects and 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 error. In column (II), we focus on export destination countries for whose official currency the forward exchange rates are available in Thailand.

Table 8. Exchange Rate Management Cost

	(I)	(II)	(III)	(IV)
First	0.114***	0.041***	0.096***	0.103***
	[0.002]	[0.009]	[0.002]	[0.008]
First * Volatility	0.368***	0.040	0.457***	1.283***
	[0.047]	[0.307]	[0.049]	[0.408]
ln Value	-0.011***	-0.028***	-0.007***	-0.014***
	[0.000]	[0.001]	[0.000]	[0.000]
Sample	All	Single		
Forward rate			NO	YES
Number of observations	921,877	34,422	393,867	525,314
R-squared	0.2316	0.4147	0.3149	0.1948

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 the value one if invoicing currency is PC and zero otherwise. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error. We estimate using the OLS method. All specifications include import country-year and HS six-digit code-year fixed effects. “Single” in sample excludes exporters who start exporting multiple products or doing to multiple countries in their first export. In columns (III) and (IV), we restrict sample export destination countries according to the availability of forward exchange rates for their official currency in Thailand.

Figure 1. The First Appearance Year of Export Firms in Our Sample



Source: Authors' compilation

Figure 2. Theoretical Time Flow

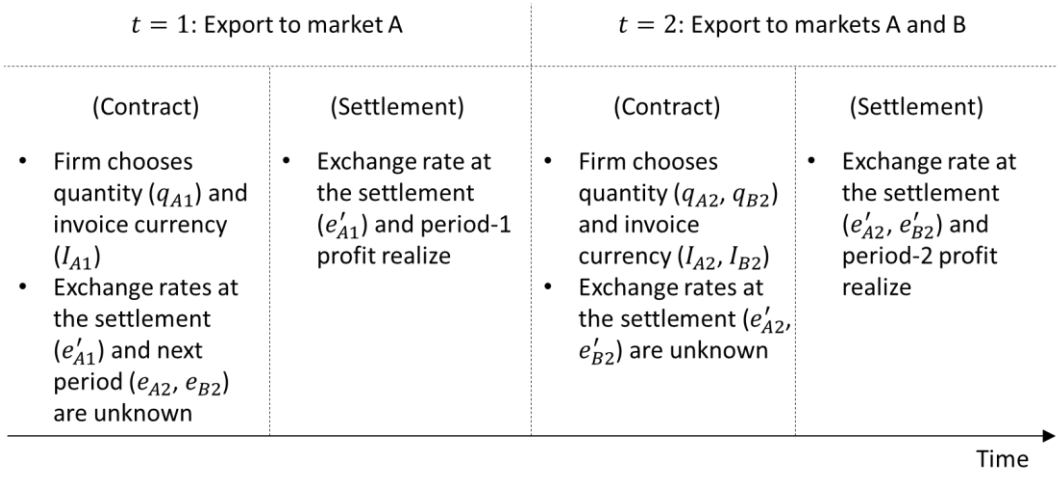
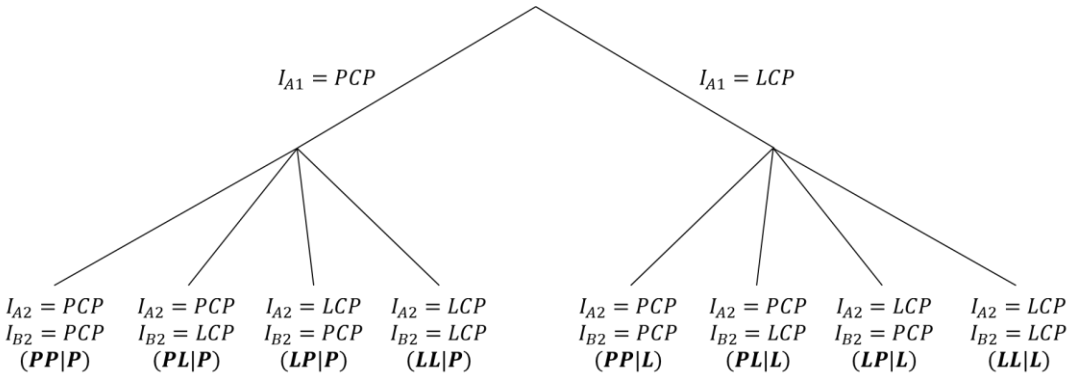


Figure 3. The Game Tree



Appendix. 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 in Kingdom of Thailand