Benefits of Home Currency Invoicing[§]

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***Abstract*:** We present a model of endogenous choice of import frequency and invoice currency to infer the benefits of home currency invoicing. In the model, those benefits are represented by fixed costs of exchange rate risk management paid by importers when they work with foreign currency invoicing. Using a very detailed dataset on Thai imports, we show that those benefits of average Thai importer range between 7.3% (1,500 USD) of one-time shipment value in our most conservative specification and 17.1% (3,600 USD). Those benefits become larger when the share of the export country currency in daily global foreign exchange market turnover is lower, or the export country is one of the partners of Thailand's regional trade agreements. Further, we find that frequency of shipments is higher and the value per shipment is smaller for transactions priced in buyers' currency than those not priced in it. Our model provides a rationale for these empirical findings.

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1. Introduction

Running an international currency provides benefits for a country as it liberates

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home agents from the risk of exchange-rate fluctuations. There has been a long debate on this topic, and huge amount of estimations of those benefits has been provided. One of the major aspects of currency internationalization is trade invoicing. If particular trade is invoiced in the home currency, home agents do not need to pay attention to exchange-rate risk. In contrast, when the international transaction is invoiced in foreign currencies, traders generally utilize some ways of exchange-rate risk management, such as forward exchange rates and currency options, by paying visible and invisible costs. In short, currency internationalization contributes to reducing broadly-defined trade costs for firms in the home country.

In this paper, we quantify the benefits of home currency invoicing (HCI) through measuring the costs for exchange-rate risk management in the case of foreign currency invoicing (FCI). Namely, the benefits of currency internationalization in terms of reducing the trade costs are quantified. To do that, we shed light on the relationship between trade frequency and uncertainty. As theoretically demonstrated in Bekes et al. (2014), firms adjust to increased uncertainty by reducing their number of trade shipments and increasing their size per shipment. In the case of FCI, firms' future revenue/payment for every shipment in terms of its own currency is exposed to unexpected exchange-rate fluctuation. This specific type of uncertainty in FCI motivates us to focus on the trade-off between HCI and FCI. Suppose that importers are invoicing their international transactions in terms of a foreign currency. If payments come after contracts and importers' home currency is depreciating, future payments in importers' home currency will become cheaper. This implies one of the advantages of FCI. On the other hand, FCI requires firms to incur some costs for exchange-rate risk management in every transaction. Using such trade-off in invoice currency, we identify the costs for exchange-rate risk management in FCI.

Specifically, we construct a model of endogenous choice of import frequency and invoice currency to infer those costs. We extend the model developed by Kropf and Sauré (2014) by two ways. First, we focus on the optimization behavior of importers rather than exporters as we like to examine how the adoption of buyers' (importers') currency invoicing helps their just-in-time orders and how it is related to the benefits of HCI. Second, we introduce endogenous choice of invoice currency. As a result, our model proposes a way to infer the costs of FCI. Further, it also provides two new propositions on the relationship of the invoice currency with import frequency and the value per shipment. One is that import frequency of FCI importers is lower than that of HCI ones under some conditions. This consequence becomes more likely when the costs of exchange-rate risk management become larger. The other is that the value per shipment of FCI importers increases with the costs of exchange-rate risk management.

In the empirical part, we infer the costs for such exchange-rate risk management by employing the customs import data in Thailand during 2007 to 2011. Our dataset, which is obtained from the Customs Office, the Kingdom of Thailand, is transaction-level import data and covers all commodity imports in Thailand. It contains not only the usual data items such as Harmonized System (HS) eight-digit code or export country but also import firm identification code, customs clearing date, and invoice currency. For example, we can see that some firms import the same commodity from the same country under the same invoice currency multiple times within the same date. The case of Thailand not only provides us the detailed data necessary for our analysis but also shows the case of large costs for exchange-rate risk management since its home currency is not internationalized. Therefore, there are a sufficient number of import transactions under FCI. By applying these data to our theoretical model, we infer fixed costs per import shipment in the cases of HCI and FCI. We also examine how such costs are related to export country characteristics such as turnover of export country currency. In addition, with this dataset, we empirically investigate the above two propositions derived from our theoretical model.

Our paper is related to literatures on trade frequency and invoice currency. The former literature is recently growing. Eaton et al. (2008) is an early micro-level study on this literature and provides various basic statistics on the number and frequency of export transactions in Columbia. Alessandria et al. (2010) demonstrate that the existence of fixed costs per import shipment leads to the lumpiness of import transactions. The calibration of their inventory model for Chilean import data shows that such fixed costs amount "to approximately 3.6 percent of the average value of an import shipment". Kropf and Sauré (2014), which is the closest paper to ours, also compute fixed costs per export shipment with Swiss export data and found a similar magnitude. In this paper, by applying their method, we compute not only fixed costs per import shipment but also those of exchange-rate risk management in the case of FCI. When importing under home currency, firms do not need to bear the latter costs. Therefore, those costs are interpreted as the benefits of HCI. To the best of our knowledge, such costs have never been quantified by the way driven from micro-founded economic theory using highly disaggregated dataset.

Furthermore, Hornok and Koren (2014) and Bekes et al. (2014) shed more light on the correlation of shipment frequency with several variables. The former study found in the export data in the U.S. and Spain that export shipments are less frequent and larger when exporting to countries with larger per-shipment costs. Using French export data, as mentioned above, the latter study shows that firms adjust to increased uncertainty by reducing their number of shipments and increasing their shipment size. Against these studies, our paper sheds light on the correlation of the shipment frequency and size with a novel element, invoice currency. Nevertheless, as mentioned above, this analysis will be similar to that in Bekes et al. (2014) because the choice of invoice currency is related to one specific type of uncertainty, future unexpected exchange-rate fluctuation. In this sense, our analysis can be compliment to Bekes et al. (2014).

The other related literature is one on the choice of invoice currency. Many researchers have examined how traders determine the invoice currency and have tried to endogenize its choice. For instance, Goldberg and Tille (2008) explore the major driving forces for currency invoicing in international trade with a dataset covering 24 countries. Further, Goldberg and Tille (2009) examine the choice of the invoice currency through bargaining between importers and exporters. Based on a highly disaggregated dataset of Canada, they show that larger transactions are more likely to be invoiced in the importers' currency, which is rationally explained by their model of endogenous choice of invoice currency through a bargaining process. Gopinath et al. (2010) construct a model of endogenous currency choice where importers choose the invoice currency so that realized degree of exchange rate pass-through becomes close to its desired degree.

In this paper, on the other hand, we assume that forward exchange premiums are exogenously offered by financial institutions to each firm and are heterogeneous across firms. Under this setting, we will show that given the fixed cost of exchange rate risk management, importers choose FCI when the home currency is significantly discounted in the suggested forward exchange rate and thus the cost of imported intermediate inputs is supposed to become large when the payment is settled. The advantage of our framework is that it provides a way to infer the difference in broadly-defined trade costs including exchange rate risk between HCI and FCI, which reveals practical benefits of HCI in international transactions.

The level of disaggregation is also one of the advantages of this study. With our data, we can derive detailed information including the frequency of transactions, value per shipment, and the invoice currency for each transaction. Several recent studies also utilize dataset with a comparable level of disaggregation with ours to examine topics on invoice currencies. Chung (2014) reveals that exporters' dependence on imported inputs affects their choice of invoicing currency using a dataset which covers all United Kingdom trade transactions with non-European Union (EU) countries. Fabling and Sanderson (2015) examine how invoice currency is linked to the degree of exchange rate pass-through with New Zealand's data. Reiss (2015) uses Brazilian trade data, and finds that the Brazil-Argentina policy of providing payment orders associated to an exchange transaction between their currencies had significant impacts on the choice of invoice currencies.

Also, our paper is related to a huge literature on the measurement of trade costs because the costs of exchange-rate risk management for FCI are a part of the broadly-defined trade costs. Anderson and van Wincoop (2004) is one of the most influential papers in this literature. Rose and van Wincoop (2001) and the sequential papers estimate the costs of not sharing the same currency in trading. To do that, these papers mainly estimate the gravity equation. As a result, in Rose and van Wincoop (2001), the tariff equivalent of those costs is estimated to 14 percent. Compared with these studies, we compute the more specific costs when using different currency in trading, i.e., fixed costs of exchange-rate risk management for FCI. In terms of measuring the absolute magnitude of fixed costs, our paper is also related to Das et al. (2007) and Cherkashin et al. (2015). These studies structurally estimated fixed costs for exporting (around 400 thousand US dollars (USD)) and certifying the origin of exported goods (around four thousand USD), respectively.

The major results of this paper are summarized as follows. Firstly, the benefits of HCI for average Thai importer are positive and range between 7.3% (1,500 USD) of one-time shipment value in our most conservative specification and 17.1% (3,600 USD). This implies that the adoption of the home currency as an invoice currency provides the benefits for home importers. Secondly, those benefits become larger when the share of the export country currency in daily global foreign exchange market turnover is lower, or the export country one of the partners of Thailand's regional trade agreements (RTAs). Thirdly, the frequency of import shipments is higher and the value per shipment is smaller for transactions priced in importers' currency than those not priced in it, which is rationally interpreted by our theoretical model.

The rest of this paper is organized as follows. In Section 2, we present a model of endogenous choice of import frequency and invoice currency. Section 3 provides a way to infer the benefits of HCI based on our model. In Section 4, we examine the propositions on the relations between invoice currency, import frequency, and the value per shipment. In Section 5, we infer the fixed costs per shipment and the benefits of HCI, and examine their determinants. Finally, Section 6 concludes the paper.

2. The Model

This section presents a partial equilibrium model of endogenous choice of import frequency and invoice currency. As we noted, the most closely-related study to ours is Kropf and Sauré (2014). We extended their model by two ways. Firstly, we focus on the optimization behavior of importers and, exporters are simply assumed to supply the amount of intermediate goods upon the request of final-good producers. Secondly, the choice of invoice currency is endogenous, which helps to figure out the simultaneous determination of invoice currency and import frequency. Figure 1 present a simplified image of our model.

=== Figure 1 ===

2.1. Representative Household

Suppose the economy which is constructed with infinite number of countries. Each country is indexed by j and countries are distributed continuously in the range $[0,1]$. In each country, the representative household, final- and intermediate-good producers, and financial institutions exist. The representative household purchases final goods from local producers and consume them. The final-good market is monopolistically competitive, and each final-good producer supplies particular variety which is indexed by i. The number of final goods is infinite and i is assumed to be distributed in the range $[0,1]$.

The representative household has a linear utility function over the consumption as follows:

$$u = c.$$

Here, c is the consumption index which is defined by a Dixit-Stiglitz function over monopolistic-competitive varieties in the following manner:

$$c \equiv \left[\int_0^1 c_i^{\frac{\theta-1}{\theta}} di\right]^{\frac{\theta}{\theta-1}}, \qquad 1 < \theta < \infty, \tag{1}$$

where c_i is the consumption of the variety i, and θ is the elasticity of substitution between varieties. The optimal allocation of any given consumption of each variety of goods yields the following demand functions:

$$c_i = \left(\frac{p_i}{P}\right)^{-\theta} \frac{Y}{P}, \tag{2}$$

where the consumer price index (CPI) is given by

$$P \equiv \left[\int_0^1 p_i^{1-\theta} di\right]^{\frac{1}{1-\theta}}. \tag{3}$$

Here, we used the assumption $c = Y/P$ which implies that the representative household is endowed with the exogenous amount of nominal income, Y, and expenses it only to current consumption.

2.2. Forward Exchange Rates

Each final-good producer i makes its output using imported or domestically produced intermediate inputs. Final-good producers determine the frequency of transactions with intermediate-good producers. Those which import intermediate inputs from abroad also determine the invoice currency. Particularly, we consider two alternative cases of invoicing, HCI and FCI.[1] The critical difference between these two cases is that importers are free from the risk of exchange-rate fluctuations in the HCI case but they have to manage it in the FCI case. Suppose that home importers and foreign intermediate-good exporters make contracts of international transactions in the current period, and the payment will be taken place after t' periods. If the trade is invoiced in importers' (home) currency, they do not have to care about the risk of exchange rate fluctuations over the gap between contract and payment. On the other hand, they have to consider how they manage the risk when the trade is invoiced in foreign currencies.

Let ε and $\varepsilon(t')$ denote spot exchange rates of home currency in the current period and after t' periods, respectively, against the invoice currency which is used for the trade between home importers and their intermediate-good suppliers. We assume that each importer i manages the risk of exchange rate fluctuations by utilizing the forward exchange rate with the nominal fixed cost, f^f, when the trade is not invoiced in their home currency, i.e. in the HCI case. This cost includes the documentation cost of forward exchange rate contracts, and the transaction cost charged by the financial institutions. Thus, we interpret f^f as the benefits of adopting the home currency as an invoice currency in import. Further, we also assume the existence of the fixed costs per shipment, f. We define $\varepsilon_i^f(t')$ as the forward exchange rate charged by the financial institution which serves for the importer i.

We assume the heterogeneity in the forward exchange premiums offered by financial institutions to each company. It is natural to assume such heterogeneity

[1] In studies such as Chung (2014) and Fabling and Sanderson (2015), vehicle currency invoicing and producer currency invoicing are identified. The purpose of this study is to reveal the benefits of HCI, which corresponds to local currency invoicing, relative to other two invoicing manners. Consequently, in the theoretical part, we jointly consider vehicle and producer currency invoicing as FCI for simplicity, and focus on the comparison between HCI and FCI. In the empirical part, we identify those two types of FCI.

because different financial institutions offer different premiums. Further, even the same bank can offer different premiums depending on the relation with each company. For instance, if a bank has a long relation with a particular company, it might provide special discount for future currency exchanges. Or, if the owner of a company has a knowledge or experience to find a better financial institution, it can make a better forward exchange contract. We denote the forward premium offered by a financial institution to each firm i by ϕ_i, which is assumed to be constant over time. Thus, the forward exchange rate is determined in the following manner:

$$\varepsilon_i^f(t') = \varepsilon e^{\phi_i t'}. \tag{4}$$

2.3. Final-good Producers

Each final-good producer has linear production function over imported intermediate inputs and the productivity in the following manner:

$$x_i = a m_i. \tag{5}$$

Here, x_i is the output of final-good producer i, a is the productivity, and m_i is the unit of imported or domestically produced intermediate inputs. In the model, we assume that each final-good producer imports intermediate inputs from one counterpart for simplicity, although the data shows that one company imports from multiple countries in many cases. We can interpret our model so that multiple importers belong to one company as an importing section and each of them independently determines how to import each product. This interpretation leads to an economy where one company imports from multiple countries, which is consistent with the data. We denote the intermediate-good price denominated in the invoice currency by $z^* \equiv \tau \tilde{z}^*$. Here, τ is the gross tariff rate, and $\tau > 1$ and $\tau = 1$ for final-good producers which use imported and domestic intermediate inputs, respectively. $\tilde{z}^*$ is the mill price. Both τ and $\tilde{z}^*$ are exogenous. Thus, the nominal marginal cost in the home currency is derived as follows:

$$mc_i = \frac{\varepsilon e^{\phi_i t'} z^*}{a}. \tag{6}$$

Final-good producers make their output as soon as they import intermediate inputs. It should be noted that the invoice currency is the home currency and $\varepsilon e^{\phi_i t'} = 1$ for final-good producers which use domestic intermediate inputs.

When there is a time gap between final-good production and the sales, storage costs take place. Following Kropf and Sauré (2014), we assume the existence of the gross ad valorem storage costs, $e^{\sigma t'}$. Given the price markup, marginal cost, and storage cost, the consumer price of the variety i is derived as follows:[2]

$$p_i(t') = \frac{\theta}{\theta-1}\frac{e^{(\sigma+\phi_i)t'}\varepsilon z^*}{a}. \tag{7}$$

The operating profit of per unit sales of each final good is derived in the following manner:

$$p_i(t') - \frac{e^{\phi_i t'}\varepsilon z^*}{a} - (e^{\sigma t'}-1)\frac{e^{\phi_i t'}\varepsilon z^*}{a} = \frac{1}{\theta-1}\frac{e^{(\sigma+\phi_i)t'}\varepsilon z^*}{a}. \tag{8}$$

Combining (2) and (8), the operating profit of total sales at time t' is obtained as

$$\pi_i(t') = \theta^{-\theta}\left(\frac{1}{\theta-1}\frac{e^{(\sigma+\phi_i)t'}\varepsilon z^*}{Pa}\right)^{1-\theta} Y. \tag{9}$$

We denote the time between two shipments by Δ_i. In other words, each final-good producer i sells their output over Δ_i, and makes the order of next shipment after all the inventory stock is sold out. Normalizing one year to unity, the interval Δ_i is expressed as a fraction of years. Consequently, Δ_i^{-1} represents the import frequency or the number of shipments per year between home country and the origin of imported intermediate inputs. Taking P and Y as given, the present value per shipment is derived in the following manner:[3]

$$\Pi_i(\Delta_i) \equiv \int_0^{\Delta_i} e^{-\alpha t'}\pi_i(t')dt' = Z\frac{1-e^{-[\alpha+(\theta-1)(\sigma+\phi_i)]\Delta_i}}{\alpha+(\theta-1)(\sigma+\phi_i)}, \tag{9}$$

where,

$$Z \equiv \theta^{-\theta}\left(\frac{1}{\theta-1}\frac{\varepsilon z^*}{Pa}\right)^{1-\theta} Y, \tag{10}$$

$$\mu_i \equiv e^{-\Delta_i}. \tag{11}$$

Note that $\Delta_i^{-1} \in (0,\infty) \to \mu_i \in (0,1)$.

2.4. Optimal Frequency of Shipments

Import frequency and invoice currency are simultaneously determined. Firstly, final-good producers calculate the optimal frequency of shipments in a given period in HCI and FCI cases. Secondly, they compare present values of profits from all shipments

[2] Sum of σ and ϕ_i can be interpreted as effective storage cost as future depreciation of home currency increases the cost of imported intermediate inputs denominated in the home currency. It is natural to assume $\sigma+\phi_i>0$, which implies storages cannot become beneficial in effect. This leads to a condition $\underline{\phi} > -\sigma$, where $\underline{\phi}$ is the lower bound of ϕ_i. As a result, ϕ_i is supposed to follow a probability distribution with the range $[\underline{\phi},\infty)$.

[3] In Appendix A, we will show that there is a distribution of shipment dates for which P becomes constant.

in both cases, and choose the invoice currency which realizes better outcome. In this subsection, we show the detail of these optimization processes. In the calculation of optimal frequency of shipments, final-good producers face the trade-off between storage costs and fixed costs per shipment. Given the total value of all shipments per period, the higher frequency of shipments is associated with the larger value per shipment. Consequently, total amount of fixed costs per shipment and storage costs in a given period become larger (smaller) and smaller (larger), respectively, if importers make more (less) frequent shipment orders.

We denote total fixed costs for each shipment charged to the importer i by S_i. Recall that S_i corresponds to f and $f+f^f$ in the HCI and FCI cases, respectively. Further, importers do not need to utilize forward exchange rates, and ϕ_i disappears from equations in the case of HCI ($\phi_i = 0$). The present value of profits from all shipments is defined by

$$NPV_i \equiv \sum_{k=0}^{\infty} (e^{-\alpha\Delta_i})^k [\Pi_i(\Delta_i) - S_i] = \frac{1}{1-(\mu_i)^{\alpha}} \left[Z \frac{1-(\mu_i)^{\alpha+(\theta-1)(\sigma+\phi_i)}}{\alpha+(\theta-1)(\sigma+\phi_i)} - S_i \right] \quad (12)$$

Each final-good producer i calculates the optimal frequency by determining μ_i to maximize NPV_i in HCI and FCI cases.

The first order condition is derived as follows:

$$\alpha - \frac{\alpha[\alpha+(\theta-1)(\sigma+\phi_i)]S_i}{Z} - [\alpha+(\theta-1)(\sigma+\phi_i)]\{\overline{\mu}_i\}^{(\theta-1)(\sigma+\phi_i)}$$
$$+(\theta-1)(\sigma+\phi_i)\{\overline{\mu}_i\}^{\alpha+(\theta-1)(\sigma+\phi_i)} = 0 \quad (13)$$

Given that the range of $\overline{\mu}_i$ is $\overline{\mu}_i \in (0,1)$, the left hand side of (13) is proved to be decreasing in $\overline{\mu}_i$. Further, it becomes positive and negative in the limit of $\overline{\mu}_i \to 0$ and $\overline{\mu}_i \to 1$, respectively, given the necessary condition for final-good producers' market entry that $NPV_i > 0$. Thus, $\overline{\mu}_i$ is uniquely determined for both HCI ($\overline{\mu}^H$) and FCI ($\overline{\mu}_i^F$) cases ($\overline{\Delta}^H$ and $\overline{\Delta}_i^F$, henceforth). Note that the optimal frequency in the HCI case does not depend on i. Further, $\overline{\mu}^H$($\overline{\mu}_i^F$) is positively related to the frequency $1/\overline{\Delta}^H$ ($1/\overline{\Delta}_i^F$).

Two consequences are implied by the first order condition. First, the optimal frequency is negatively associated with total fixed costs for each shipment, S_i, for both HCI and FCI cases. Thus, the existence of f^f can be a source of lower frequency in the FCI case than the HCI case. Second, in the case of FCI, the optimal frequency is negatively associated with the forward premium, ϕ_i. Higher premium leads to the rise of the cost of imported intermediate inputs denominated in the home currency. As a result, for a final-good producer which faces higher premium, it is more difficult to cover total costs of each shipment, and thus the frequency becomes lower.

2.5. Choice of the Invoice Currency

Combining (12) and (13), the equilibrium value of NPV_i is written by

$$\overline{NPV}_i = \frac{Z}{\alpha}\{\overline{\mu}_i\}^{(\theta-1)(\sigma+\phi_i)}. \tag{14}$$

Final-good producers compare the $\overline{NPV}_i$ in HCI and FCI cases, and choose the invoice currency which realizes better consequence. Thus, the condition for HCI invoicing is $\overline{NPV}^H \geq \overline{NPV}_i^F$, or

$$\{\overline{\mu}^H\}^{(\theta-1)\sigma} \geq \{\overline{\mu}_i^F\}^{(\theta-1)(\sigma+\phi_i)}. \tag{15}$$

It is straightforward to show that the right hand side of this condition is decreasing in ϕ_i. Thus, final-good producers with high value of forward premium tend to choose their home currency as an invoice currency. The condition (15) determines the cutoff forward premium $\tilde{\phi}$ for which it holds with equality. It is straightforward to show the uniqueness of $\tilde{\phi}$ given the monotonic decrease of the right hand side of (15) in ϕ_i.

Figure 2 depicts the relation between the value of the forward premium and choice of the invoice currency. In the vicinity of the cutoff forward premium, import frequency of FCI importers is lower than that of HCI ones. The FCI curve shifts downward when the fixed cost of utilizing forward exchange rate, f^f, becomes larger. This amplifies the likelihood of lower frequency for FCI importers than HCI ones. Thus, we obtain the proposition on the relation between the invoice currency and frequency of import shipments as follows:

Proposition 1: *Import frequency of FCI importers is lower than that of HCI ones around the cutoff forward premium, which is more likely when the fixed cost of exchange-rate risk management is larger.*

=== Figure 2 ===

Further, we examine the optimal value per shipment in terms of the home currency. Combining (2) and (8), it is derived in the following manner:

$$\overline{q}_i \equiv \int_0^{\overline{\Delta}_i} \varepsilon z^* \frac{c_i(t')}{a} dt' = Z \frac{\theta - 1}{\theta} \frac{1}{\sigma + \phi_i} \left\{ 1 - \left(\overline{\mu}_i\right)^{\theta(\sigma + \phi_i)} \right\}. \tag{16}$$

We found that the optimal frequency becomes higher when the total fixed cost of each shipment becomes lower. This implies, according to (16), that the existence of f^f can lead to the larger value per shipment for FCI importers than HCI ones. However, it depends on parameter values whether the value per shipment for the former is larger than the latter in sum, even in the vicinity of the cutoff forward premium, as the sign of the partial derivative of $\overline{q}_i$ with respect to ϕ_i depends on parameter values. In sum, we derive the following proposition on the relation between the invoice currency and the value per shipment:

Proposition 2: *The existence of the fixed cost of exchange-rate risk management increases the value per shipment of FCI importers over that of HCI importers.*

2.6. Benefits of HCI

By combining (13) and (16) to eliminate Z, we derive the indirect measure for the total fixed cost of each shipment S_i as follows:

$$S_i = \zeta_i \eta_i \tag{17}$$

$$\zeta_i \equiv \frac{\theta}{\theta - 1} \frac{(\sigma + \phi_i)\overline{q}_i}{[\alpha + (\theta - 1)(\sigma + \phi_i)] \left\{ 1 - \left(\overline{\mu}_i\right)^{\theta(\sigma + \phi_i)} \right\}} \tag{18}$$

$$\eta_i \equiv 1 - \left[\left\{ 1 + \frac{(\theta - 1)(\sigma + \phi_i)}{\alpha} \right\} - \frac{(\theta - 1)(\sigma + \phi_i)}{\alpha} \left(\overline{\mu}_i\right)^{\alpha} \right] \left(\overline{\mu}_i\right)^{(\theta - 1)(\sigma + \phi_i)} \tag{19}$$

Recall that S_i is f and $f + f^f$, respectively, for HCI and FCI, and $\phi_i = 0$ for HCI. Thu, the indirect measure of f is derived by

$$f = \zeta^H \eta^H. \tag{20}$$

Further, by eliminating f, we infer the measure for f^f in the following manner:

$$f^f = \zeta^F \eta^F - \zeta^H \eta^H. \tag{21}$$

As we noted, f^f is interpreted as the benefits of using the home currency as an invoice currency in international transactions, more simply the benefits of home currency invoicing.

3. Data Overview

This section takes an overview of invoice currency, import frequency, and imports per shipment in Thailand. As mentioned in the introductory section, our dataset is transaction-level import data from 2007 to 2011 and covers all commodity imports in Thailand. It contains customs clearing date, HS eight-digit code, export country, import firm identification code, invoice currency, import values in Thai Baht (THB), import quantity, and quantity unit.[4] Since our dataset does not include information on export firms, we differentiate import transactions according to import firm, HS eight-digit code, export country, and quantity unit. For example, if a firm has two records on imports of the same HS code from the same export country under *different* quantity units, we regard these two records as showing the import from two different exporters. In addition, in our dataset, there are some firms in which multiple import transactions are recorded in the same HS eight-digit commodity, the same export country, the same invoice currency, the same unit, and the *same* date. We aggregate these data at a daily basis and thus regard this case as one transaction.

We start from the sample distributions of the number of shipments per year and average imports per shipment in 2011, which are depicted in Figures 3 and 4, respectively. The former figure shows that more than a half of all import transactions have only one shipment per year. Compared with the case of developed countries shown in Kropf and Sauré (2014) and Bekes et al. (2014), the share of transactions of one shipment per year is very high. Also, as in the case of developed countries, the density naturally decreases with the increase of the shipment number. Figure 4 shows that the distribution of average imports per shipment seems to follow the log-normal distribution.

=== Figures 3 and 4 ===

Table 1 reports the share of each type of invoice currency in total import, in terms of import transactions and import values. The invoice currency includes local currency (HCI) and non-local currency (FCI). While the former is Thai baht (THB) in our context, the latter is further decomposed into producer currency (i.e., national currency in export countries) and vehicle currency (i.e., neither home nor producer currencies). The table shows that approximately 60% and 80% of import in Thailand are invoiced in the vehicle currency in terms of the number of transactions and of values, respectively. This fact is consistent with the well-known one that a significant part of international transactions in Asia is invoiced in third vehicle currency, particularly, US dollar (USD).

[4] We drop the transactions in which the information on invoice currency, export country, or quantity unit is missing. Therefore, the aggregated figures of our data may not be consistent with the official figures on imports.

The table also shows that the local currency (i.e., THB) invoicing is relatively minor to vehicle and producer currency invoicing. Its share is less than 10 percentages in our sample in terms of both the number of transactions and the values.

=== Table 1 ===

Shares of invoice currencies vary across sectors and regions. Table 2 presents the share of each type of invoice currency by industry, in terms of the number of import frequency and the import values. In almost all industries, as in the case of Table 1, the local currency has the lowest share. In those industries, the share of vehicle currency is higher than that of producer currency in terms of both the number of import frequency and the import values. In particular, footwear and textile industries have significantly high share of vehicle currency. In addition, the extremely high share of vehicle currency in mineral products in terms of values reflects the fact that the prices of such mineral products are determined in the international market in USD. On the other hand, the high share of local currency can be found only in art products probably because of the strong bargaining power of importers (buyers) in this industry.

=== Table 2 ===

Table 3 shows the variety of invoice currencies across exporter continents. In all continents, local currency plays a minor role as an invoice currency. When importing from Africa, the share of vehicle currency, maybe either USD or euro (EUR), is significantly high. The high share of producer currency in importing from America will be due to the frequent use of USD in importing from the U.S. The similar applies to the high share of vehicle currency in Asia. The significant share of producer and vehicle currencies in Europe will be due to the use of EUR and USD, respectively. The observations in Pacific are interesting. Not only vehicle currency but also producer currency have the high share in terms of frequency. Namely, Australian dollar (AUD) and New Zealand dollar (NZD) play some role in invoicing in Thai import from Pacific.

=== Table 3 ===

Next, Table 4 shows the basic statistics on the import transaction-level frequency and average values according to invoice currencies. As shown in Figure 2, regardless of invoice currencies, the median of import frequency is one, implying that most of Thai importers trade once a year. In maximum cases, importers trade every day and the frequency reaches even to 365 times in a year. The mean of frequency in imports invoiced in local currency is significantly highest among three types of invoicing. On the other hand, the mean of imports per shipment shows the reverse order. While the mean in vehicle currency is largest, the case of local currency has the smallest mean of imports per shipment. The same is true for the median of imports per shipment. Also, the standard deviation of values per shipment in addition to their maximum is significantly large in the case of vehicle currency.

=== Table 4 ===

The means of import frequency and imports per shipment are reported by invoice currency and industry in Table 5. There are four noteworthy points. First, the means of import frequency and imports per shipment are significantly different across industries. For example, live animals, vegetable products, and transport equipment have relatively high frequency. Second, in almost all industries, the mean of import frequency is highest in local currency invoicing. The exception includes paper products, textiles, footwear, plastic or glass products, miscellaneous, and art products. Third, in contrast, the mean of imports per shipment is smallest in local currency invoicing. The exception in the case of import frequency can be also applied to the case of imports per shipment. In those industries, local currency invoicing has the largest imports per shipment.

=== Table 5 ===

Last, Table 6 reports the means of import frequency and imports per shipment by exporter continent. In this table, the findings on import frequency are not so uniform compared with the previous table for industries. Namely, its mean in local currency invoicing is highest only in Asia and Europe. The frequency of import from the other continents is not necessarily highest in local currency invoicing. This tendency will be consistent with the findings in Table 3. Also, it might be worth noting that the mean frequency of import from Asian countries is relatively higher in any invoice currencies. This fact will indicate the significant importance of gravity factors (i.e., geographical distance between trading partners) for frequency determination, as shown in Hornok and Koren (2014). On the other hand, the mean of imports per shipment is consistently largest in vehicle currency invoicing.

=== Table 6 ===

4. Empirical Analysis

Using the customs data in Thailand, this section empirically investigates Propositions 1 and 2 specified in Section 2. We first examine how invoice currencies are related to the frequency of shipments. Specifically, we estimate the following simple equation.

$$\ln Frequency_{fipt} = \alpha D_{fipt}^{HCI} + \mathbf{X}_{ft}\boldsymbol{\beta} + u_{ipt} + \epsilon_{fipt} \qquad (22)$$

$Frequency_{fipt}$ represents the frequency of firm *f*'s import of HS eight-digit commodity p from country i in year *t*.[5] D_{fipt}^{HCI} is our main variable, which takes the value one if invoice currency in the concerned transactions is THB and zero otherwise. $\mathbf{X}_{ft}$ is a vector of time-variant import firm characteristics. u_{ipt} is fixed effects for the combination of export country, HS eight-digit commodity, and year. As shown in the previous section, the mean of values per shipment differs by industries and exporter continents. The above fixed effects will contribute to controlling for these differences. We estimate this equation by ordinary least square (OLS) method.

As time-variant import firm characteristics, we introduce two variables. One is firm *f*'s total imports from the world in year *t*. We expect that this variable is related to the size of import firms. This variable is constructed by aggregating the customs data of all imports by firms and years. The other is a dummy variable that takes the value one if firm f gets engaged in exporting activities and zero otherwise. As demonstrated in the previous studies on frequency, firms also optimize the frequency of export. Therefore, exporters may have significantly different frequency of import. This variable is constructed by employing the customs data on export. Those can be integrated by using firm identification code as a key.[6]

There are two empirical issues. First, some firms import the same commodity from the same country under multiple invoice currencies within a year. This observation may be due to their import from different export firms or due to the change of invoice currency during the year. Since we cannot identify either one, such observations, which account for around 10% of all observations, are dropped from estimation sample. Second, as demonstrated in Section 2, the invoice currency and the frequency are simultaneously determined. Therefore, the error term is likely to be correlated with local

[5] More exactly, as in the previous section, we also identify using the information on quantity unit, of which a subscript is omitted in this section.
[6] The basic statistics for our variables are provided in Appendix B.

currency dummy variable. To correct this endogeneity bias, we also estimate the above equation by instrument variable (IV) method. As an instrument, we use the share of exports under local currency invoicing in total exports. In the case of non-exporters, this share is set to zero. As demonstrated theoretically and empirically in Chung (2014), invoice currency in import is highly correlated with that in export. However, the share of exports under local currency will be not directly related with the frequency of import. This variable is also constructed by employing the customs data on export.

Table 7 presents the baseline result on the relation between invoice currencies and import frequency represented by the model (22). Columns (I) and (II) report the results by the OLS. The models without and with a vector of time-variant import firm characteristics are respectively estimated. The coefficient for Local Currency Dummy is estimated to be significantly in both models. Specifically, the frequency of import shipments is 9-14% higher when those shipments are invoiced in the local currency, i.e. THB. As implied in Proposition 1, this result indicates that importers can make frequent orders without consideration on the risk of exchange-rate fluctuations when transactions are invoiced in their home currency. While the coefficient for Total Imports is significantly positive, Exporter Dummy has a significantly negative coefficient. These results indicate that the smaller-sized importers in terms of import values or the exporters have the lower frequency of import transactions.

=== Table 7 ===

As mentioned above, the invoice currency and frequency of import transactions are simultaneously determined. To correct the endogeneity biases from this simultaneity, we estimate the model by the IV method and report the results in columns (III) and (IV). The Cragg-Donald Wald F and Kleibergen-Paap Wald rk F test statistics, which are used for the test of weak instruments as a null hypothesis, have significantly high values. Also, in the first stage regression, the coefficients for THB Export Share are estimated to be significantly positive, indicating that the importers who intensively use THB in their exporting are likely to use THB also in importing, as is consistent with the results in Chung (2014). The results in the second stage regression are qualitatively unchanged with those reported in columns (I) and (II). The result in column (IV) shows the import frequency is 26% higher when it is invoiced in the local currency.

We conduct some more robustness checks on the above results. First, we restrict to import transactions that exist in the previous year. Since we count the number of dates with import transactions from January to December in each year, we may underestimate the frequency in firms who for the first time start to import on, say, November. To avoid this underestimation, the estimation sample is restricted only to import firm-export country-commodity observations that exist in the previous year. The result is reported in column (I) in Table 8. Second, as explained in Section 3, we have used import transaction data aggregated at a daily basis (called daily data). We relax this restriction and define the raw number of import transactions as import frequency (called full data). The result is provided in column (II). Both columns (I) and (II) show qualitatively unchanged results with Table 7. Third, we differentiate non-local currency between vehicle currency and producer currencies because the import frequency may be systematically different between two kinds of currency. To do that, we introduce two dummy variables on the use of those currencies as invoice currencies (Vehicle Currency Dummy and Producer Currency Dummy) instead of Local Currency Dummy (and use the daily data). The results by the OLS method are shown in columns (III) and (IV) and show the significantly higher import frequency when the invoice currency is home currency.

=== Table 8 ===

Next, we empirically investigate how invoice currencies are related to the average values per shipment, i.e., Proposition 2. To do that, we again estimate the following simple equation.

$$\ln Value_{fipt} = \alpha D_{fipt}^{HCI} + \mathbf{X}_{ft}\boldsymbol{\beta} + u_{ipt} + \epsilon_{fipt} \tag{23}$$

$Value_{fipt}$ represents the annual average values per shipment in firm *f*'s import of HS eight-digit in year t, which is computed by dividing total annual imports by annual import frequency. Due to our use of import values in dependent variable, import firm characteristics do not include firms' total imports. We use the daily data. The estimation results by the OLS and the IV are reported in columns (I) and (II) in Table 9, respectively. The coefficients for Local Currency Dummy are estimated to be significantly negative, as implied in Proposition 2. Namely, the value per shipment is significantly smaller for import transactions invoiced in the home currency. However, the absolute magnitude of its coefficient looks too large in column (II), showing the 471% smaller average shipment of import transactions invoiced in local currency.

=== Table 9 ===

The other results are as follows. First, the coefficients for Exporter Dummy are estimated to be significantly positive, indicating that the exporters have the larger average shipment values of import transactions. Second, the estimation result of the equation with Vehicle Currency Dummy and Producer Currency Dummy instead of Local Currency Dummy is reported in column (III). Consistent with the result for Local Currency Dummy, both those two dummy variables have the significantly positive coefficients. Jointly with the above findings on the frequency, these contrasting results between the frequency of import transactions and their average shipment values imply that importers make just-in-time orders and shipments when the import transactions are invoiced in their own currency. Our model provided a rationale for these results by shedding the light on the role of the cost of exchange-rate risk management.

5. Benefits of an Invoice Currency

In this section, using equations (17)-(21), we compute per-shipment fixed costs for FCI management (f^f). To do that, we need to specify three parameters, i.e., θ, σ, ϕ, and α. The elasticity of substitution between varieties (θ) is obtained from Broda and Weinstein (2006), which provides the elasticity at an HS three-digit level for Thailand. We use the same values for gross ad valorem storage costs (σ) and discount rate (α) as Kropf and Sauré (2014), which are respectively 0.35 and 0.05. The forward premium offered by a financial institution to each firm is an important parameter in our analysis but unobservable. We simply assume that this parameter can be well approximated by the change rate of exchange rates with THB from the current to the next year (average). Therefore, this parameter is defined at an export country-year level.

Applying these parameters, we can compute S_i, i.e., f or $f + f^f$, for each import transaction. Importantly, we cannot observe both cases of HCI and FCI for each transaction. Namely, we infer f from import transactions under HCI and $f + f^f$ from those under FCI. To obtain f^f, we estimate the following simple equation.

$$S_{fipt} = \beta_0 + \beta_1 D_{fipt}^{FCI} + u_t + u_i + \epsilon_{fipt} \qquad (24)$$

We re-label subscripts for S; f, i, p, and t stand for import firm, export country, HS eight-digit code, and year, respectively. S is equal to f for the case of HCI and $f + f^f$ for the case of FCI. D_{fipt}^{FCI} takes the value one if invoice currency in the concerned transaction is foreign currency (i.e., not THB) and zero otherwise. In this estimation, coefficient β_1 shows the fixed costs for FCI management (f^f). We also include year and export country fixed effects.

The estimation results are reported in Table 10. For rescale, we divide S by one thousand. Coefficient β_1 is shown as “Difference”. In column (I), we do not include any fixed effects. The constant term is estimated to be 27, indicating that the average per-import shipment fixed costs are 27 thousand THB (approximately 800 USD). This magnitude is one-tenth of the average per-*export* shipment fixed costs in Swiss (5,723CHF). Therefore, we may say that fixed costs per-import shipment are much lower than those per-export shipment. The "difference" is 51, which indicates that the average per-shipment fixed costs for FCI management are 51 thousand THB (approximately 1,500 USD) and are around twice higher than the average per-import shipment fixed costs. This magnitude of the difference is unchanged even if controlling for year fixed effects, as shown in column (II). However, when controlling for export country fixed effects, it becomes 119 thousand THB (approximately 3,600 USD). This change will be because export country fixed effects control for the differences in per-shipment import fixed costs (f) across export countries and such differences are significant.

=== Table 10 ===

Next, we examine the correlation of fixed costs for FCI management with export country characteristics. To do that, by estimating equation (24) by export country (no fixed effects), we infer those costs by export country, of which estimates are available in Appendix. Then, we regress a log of those costs on various characteristics of export country in year 2007. Those include gravity variables, namely, GDP, GDP per capita, and the geographical distance with Thailand. Also, we introduce RTA dummy variable, which takes the value one for partner countries of Thailand's RTAs.[7] Our main variable in this estimation is Turnover Share, which is the share of the export country currency in daily global foreign exchange market turnover, of which data are obtained from the BIS Triennial Central Bank Survey in 2007. Currencies not listed in the survey are assigned zero shares. As suggested in Goldberg and Tille (2011) and Chung (2014), its higher share values will indicate the lower transaction costs for the export country currency.

The estimation results are reported in Table 11. Based on the high correlations between GDP and GDP per capita and between Distance and RTA Dummy, we also estimate the equations separately including those variables. There are three noteworthy points. First, the export country's GDP, GDP per capita, and distance with Thailand do not affect the fixed costs for FCI management. Second, those costs are lower in importing from RTA partners. The majority of the RTA partners are ASEAN plus three

[7] As of 2007, RTA partners include ASEAN countries, Australia, China, India, Japan, and New Zealand. We also include Korea, with which the RTA was entry into force in 2010.

countries (i.e., China, Japan, and Korea). Among those countries, there exist some currency cooperation schemes such as Chiang Mai Initiative. Therefore, the significant correlation may come from the effects of such schemes rather than the effects of RTAs. Last, as is consistent with our expectation, the higher turnover share of export country currency is associated with the lower fixed costs for FCI management.

=== Table 11 ===

6. Concluding Remarks

In this study, we examined the benefits of home currency invoicing, which are represented by fixed costs of exchange rate risk management paid by importers when they work with foreign currency invoicing. We revealed that those benefits for average Thai importer are significantly positive, and range between 7.3% (1,500 USD) of one-time shipment value and 17.1% (3,600 USD). Further, those benefits become larger when Turnover Share is lower, or the export country is one of Thailand's RTA partners. It is also found that frequency of shipments is higher and the value per shipment is smaller for import transactions priced in buyers' currency than those not priced in it. Our results propose clear qualitative policy implication on internationalization of currencies from a microeconomic point of view.

Appendix A. Constancy of the Price Index

The price index is rewritten as

$$P = [P^F + P^H]^{\frac{1}{1-\theta}}, \tag{A1}$$

where

$$P^F \equiv \int_0^1 \int_{\underline{\phi}(j)}^{\tilde{\phi}(j)} \{p_i^F(j)\}^{1-\theta} d\phi_i(j)\, dj, \tag{A2}$$

$$P^H \equiv \int_0^1 \left[\int_{\tilde{\phi}(j)}^{\infty} \{p_i^H(j)\}^{1-\theta} d\phi_i\,(j)\right] dj. \tag{A3}$$

According to (7), prices of final goods which are produced at t_k and sold at t are written as

$$p_i(j) = \frac{\theta}{\theta-1}\frac{e^{(\sigma+\phi_i(j))(t-t_i(j))}\varepsilon_j z_j^*}{a}. \tag{A4}$$

Thus, P^H is rewritten as

$$P^H = \left[\frac{\theta}{\theta-1}\frac{1}{a}\right]^{1-\theta} \int_0^1 \left[\left\{\varepsilon_j z_j^*\right\}^{1-\theta} \int_{\tilde{\phi}(j)}^{\infty} e^{\sigma(t-t_i(j))(1-\theta)} d\phi_i\,(j)\right] dj. \tag{A5}$$

For HCI importers, we proved that the equilibrium interval does not depend on i, which implies

$$t - t_i(j) = \overline{\Delta}(j). \tag{A6}$$

Thus,

$$P^H = \left[\frac{\theta}{\theta-1}\frac{1}{a}\right]^{1-\theta} \int_0^1 \left[\left\{\varepsilon_j z_j^* e^{\sigma\overline{\Delta}(j)}\right\}^{1-\theta} \int_{\tilde{\phi}(j)}^{\infty} (1) d\phi_i\,(j)\right] dj, \tag{A7}$$

and P^H does not depend on t and constant over time.

Similarly, P^F is rewritten as follows:

$$P^F = \left[\frac{\theta}{\theta-1}\frac{1}{a}\right]^{1-\theta} \int_0^1 \left[\left\{\varepsilon_j z_j^*\right\}^{1-\theta} \int_{\underline{\phi}(j)}^{\tilde{\phi}(j)} e^{(\sigma+\phi_i(j))(t-t_i(j))(j)(1-\theta)} d\phi_i\,(j)\right] dj. \tag{A8}$$

Arranging producer indices so that $\overline{\Delta}_i^F(j)$ is increasing in i. For $d > 0$, consider the distribution where $i \in [\underline{i}, \overline{i}]$ is shipped at time $d(i - \underline{i})$. For given t, the date of the last shipment t_i is derived as

$$t_i = d(i - \underline{i}) + \overline{\Delta}_i^F \max_o \left\{o \in I \middle| d(i - \underline{i}) + o\overline{\Delta}_i^F \le t\right\}. \tag{A9}$$

Here, I is the set of integers. Suppose importers which make shipments at time t. The following relation holds for these importers:

$$t = d\left(i - \underline{i}\right) + o\overline{\Delta}_i^F. \tag{A10}$$

Define the solution by $i(o,d,t)$. The solution is uniquely determined as $\overline{\Delta}_i^F$ is increasing in i. Thus, the following relation holds for $i \in [i(o,d,t), i(o-1,d,t)] \cap \Omega^F$, where Ω^F is the set of FCI importers:

$$\overline{\Delta}_{i(o,d,t)}^F \leq t - t_i \leq \overline{\Delta}_{i(o-1,d,t)}^F. \tag{A11}$$

Further,

$$e^{(R+\phi_i)\overline{\Delta}_{i(o,d,t)}^F(1-\sigma)} \leq e^{(R+\phi_i)(t-t_i)(1-\sigma)} \leq e^{(R+\phi_i)\overline{\Delta}_{i(o-1,d,t)}^F(1-\sigma)}. \tag{A12}$$

(A10) leads to $\lim_{o\to\infty} i(o,d,t) = \lim_{o\to\infty} i(o-1,d,t)$, which jointly implies with (A12) that $e^{(R+\phi_i)(t-t_i)(1-\sigma)}$ does not depend on t in this limit. According to (A8), P^F does not depend on t and constant over time, and P is so, too.

Appendix B. Other Tables

Table B1. Basic Statistics

	Obs	Mean	Std. Dev.	Min	Max
ln Frequency (Daily)	4,980,162	0.5900	0.9095	0	5.8972
ln Frequency (Full)	4,980,162	0.8156	1.1362	0	12.0622
ln Values	4,980,162	10.2618	2.4298	0	22.8140
Local Currency Dummy	4,980,162	0.0601	0.2377	0	1
ln Total Imports	4,980,162	17.6609	3.1781	2.5649	26.4119
Exporter Dummy	4,980,162	0.6724	0.4693	0	1
THB Export Share	4,980,162	0.0981	0.2571	0	1
Vehicle Currency Dummy	4,980,162	0.5304	0.4991	0	1
Producer Currency Dummy	4,980,162	0.4095	0.4917	0	1

Source: Authors' computation

Table B2. Estimates on Fixed Costs by Export Country

	Difference		Constant		Obs.
	Coef.	S.D.	Coef.	S.D.	
AFG	25	24	2	22	395
AGO	6,697	14,472	13	13,939	180
ALB	6	13	9	13	159
ARE	515	156	4	129	10,705
ARG	533	307	14	300	3,646
ARM	104	101	4	90	56
ATG	70	242	1	240	70
AUS	120	38	10	35	83,867
AZE	14,496	19,180	3	17,824	88
BDI	283	249	3	213	15
BEN	585	769	13	765	95
BGD	171	129	3	122	2,721
BGR	86	102	5	98	2,328
BHR	1,722	554	3	413	1,365
BHS	77	79	3	78	76
BIH	6	12	5	12	150
BLR	1,958	1,956	1	1,862	160
BLZ	841	2,147	67	2,033	251
BMU	-1	2	3	2	43
BOL	54	63	15	61	85
BRA	648	239	32	226	11,068
BRB	165	680	0.2	674	56
BRN	2,922	2,268	3	2,066	778
BTN	2,374	1,389	2	1,091	141
BWA	798	512	1	481	69
CAN	114	64	15	62	29,634
CHE	49	13	12	13	76,782
CHL	175	186	42	183	1,810
CHN	14	8	28	8	937,035
CMR	358	773	8	757	359
COG	385	211	4	176	146
COK	207	597	6	586	28
COL	317	722	4	700	1,000
COM	38	15	3	9	13
CRI	47	48	5	47	1,186
CZE	41	12	9	12	13,914
DJI	65	36	6	27	43
DMA	-9	76	85	73	73
DNK	28	8	12	7	29,479

Note: "Coef.", "S.D." and "Obs." are coefficient estimate, standard deviation, and the number of observations, respectively.

Table B2. Estimates on Fixed Costs by Export Country (Cont.)

	Difference		Constant		Obs.
	Coef.	S.D.	Coef.	S.D.	
DOM	18	20	21	19	688
DZA	27,889	24,927	208	22,641	80
EGY	311	200	6	185	1,729
ERI	54	55	0.4	50	41
ETH	83	120	6	114	320
FJI	134	54	2	45	165
GAB	7,210	6,126	18	5,255	106
GBR	53	11	9	11	155,685
GEO	137	103	5	97	457
GHA	354	171	3	160	190
GIN	109	161	1	157	78
GMB	101	97	2	91	80
GTM	100	65	2	64	298
HKG	35	16	9	16	105,788
HND	18	20	14	20	290
HRV	126	549	17	539	646
HUN	71	63	6	57	8,644
IDN	151	60	27	58	59,265
IND	88	36	16	35	84,948
IRN	1,521	835	10	759	1,231
IRQ	2,208	7,532	3	7,395	305
ISL	298	173	2	164	609
ISR	77	48	16	48	14,906
JAM	70	39	35	35	197
JOR	181	134	6	123	553
JPN	2	4	45	4	886,728
KAZ	955	3,053	191	3,037	192
KEN	34	13	3	12	1,033
KGZ	5,395	7,659	14	6,434	34
KHM	-5	6	33	5	3,513
KNA	36	133	9	128	14
KOR	79	23	27	23	177,722
KWT	2,427	774	3	627	1,114
LAO	-16	8	73	6	7,126
LBN	101	62	9	55	312
LBR	81	63	1	55	46
LBY	38,538	35,732	3	30,565	41
LKA	38	37	4	36	4,116
LSO	37	108	14	105	34

Note: "Coef.", "S.D." and "Obs." are coefficient estimate, standard deviation, and the number of observations, respectively.

Table B2. Estimates on Fixed Costs by Export Country (Cont.)

	Difference		Constant		Obs.
	Coef.	S.D.	Coef.	S.D.	
LTU	54	105	2	102	921
LVA	44	19	2	19	529
MAC	11	21	10	20	759
MAR	197	446	7	434	2,568
MDA	4	6	3	6	223
MDG	16	14	2	14	601
MDV	345	98	2	86	331
MEX	81	92	18	90	18,819
MKD	33	100	1	99	174
MLI	163	128	4	126	310
MMR	3,374	1,831	15	1,075	7,085
MNG	1,048	2,638	24	2,509	73
MNP	182	258	5	214	19
MOZ	249	125	1	122	294
MRT	88	87	62	83	82
MSR	15	39	7	38	16
MUS	29	24	5	23	709
MWI	320	246	3	237	76
MYS	63	26	30	25	140,239
NAM	188	183	9	176	236
NCL	147	52	3	39	84
NER	82	28	5	20	47
NGA	1,559	1,528	4	1,433	898
NIC	4	90	23	89	204
NIU	-2	2	3	2	45
NOR	124	107	78	98	7,124
NPL	10	10	3	10	1,347
NRU	314	480	5	440	25
NZL	81	35	6	33	13,263
OMN	3,668	803	3	566	1,080
PAK	110	106	10	101	6,018
PAN	1,423	2,832	164	2,767	267
PER	276	593	6	581	1,173
PHL	139	101	16	97	26,986
PNG	1,912	2,165	6	2,046	394
POL	61	29	12	27	9,064
PRI	-246	71	349	67	767
PYF	-209	71	271	65	172
QAT	3,374	934	23	676	1,689

Note: "Coef.", "S.D." and "Obs." are coefficient estimate, standard deviation, and the number of observations, respectively.

Table B2. Estimates on Fixed Costs by Export Country (Cont.)

	Difference		Constant		Obs.
	Coef.	S.D.	Coef.	S.D.	
ROM	52	49	9	47	3,821
RUS	2,649	1,045	4	1,001	2,996
SAU	2,287	635	6	488	3,970
SDN	1,814	3,858	2	3,774	443
SEN	297	200	8	190	140
SGP	46	12	17	11	198,006
SLB	1,473	2,249	7	2,240	123
SLE	42	38	1	36	97
SLV	276	1,747	14	1,745	372
STP	115	446	1	440	35
SUR	121	177	0.3	174	30
SWE	70	16	16	15	41,393
SWZ	108	112	67	106	1,820
SYC	1,295	962	73	872	163
SYR	-5	47	72	41	137
TCA	98	286	1	282	36
TCD	1,807	4,516	14	4,370	47
TGO	393	324	1	317	90
TJK	344	244	22	207	25
TKL	51	61	8	60	158
TON	8	6	3	4	11
TTO	148	126	1	121	81
TUN	20	8	2	7	2,084
TUR	165	231	9	224	14,888
TUV	1,472	1,214	0	1,184	41
TWN	3	7	40	7	311,303
TZA	104	53	5	51	1,023
UGA	155	75	3	70	150
UKR	3,997	3,163	9	3,062	1,356
URY	-358	203	539	201	364
USA	40	9	13	9	511,402
VEN	881	893	4	760	213
VGB	88	174	48	170	80
VNM	101	61	12	59	35,566
WLF	17	21	0.1	20	13
WSM	64	181	7	178	34
YEM	9,170	7,997	8	7,706	266
ZAF	260	91	6	86	7,924
ZMB	657	1,030	4	1,019	198

Note: “Coef.”, “S.D.” and “Obs.” are coefficient estimate, standard deviation, and the number of observations, respectively.

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Table 1. The Decomposition of Import Transactions According to Invoice Currencies

	Local		Producer		Vehicle	
	Number/Value	Share	Number/Value	Share	Number/Value	Share
Import Transactions						
2007	315,220	0.07	1,810,002	0.39	2,518,534	0.54
2008	345,968	0.07	1,910,047	0.38	2,788,492	0.55
2009	354,500	0.07	1,678,244	0.35	2,762,252	0.58
2010	427,163	0.08	1,967,099	0.35	3,288,345	0.58
2011	479,208	0.08	2,017,907	0.34	3,406,764	0.58
Import Values (Million THB)						
2007	210,254	0.04	987,052	0.20	3,645,962	0.75
2008	220,038	0.04	1,082,668	0.19	4,467,971	0.77
2009	182,519	0.04	825,785	0.19	3,385,206	0.77
2010	255,404	0.05	1,042,832	0.18	4,340,484	0.77
2011	289,262	0.04	1,196,530	0.18	5,129,073	0.78

Source: Authors' computation

Table 2. Import Frequency and Imports per Shipment by Invoice Currency and Industry

	Local		Producer		Vehicle	
	Frequency	Value	Frequency	Value	Frequency	Value
Live animals	0.08	0.02	0.45	0.19	0.47	0.79
Vegetable products	0.07	0.02	0.24	0.22	0.69	0.76
Animal/vegetable fats and oils	0.03	0.02	0.45	0.08	0.52	0.90
Food products	0.05	0.10	0.47	0.20	0.49	0.71
Mineral products	0.08	0.00	0.40	0.01	0.51	0.98
Chemical products	0.10	0.10	0.37	0.18	0.53	0.72
Plastics and rubber	0.07	0.05	0.38	0.30	0.55	0.65
Leather products	0.07	0.06	0.18	0.21	0.75	0.73
Wood products	0.14	0.05	0.34	0.18	0.52	0.77
Paper products	0.08	0.03	0.39	0.21	0.53	0.76
Textiles	0.07	0.02	0.19	0.20	0.74	0.77
Footwear	0.04	0.02	0.17	0.05	0.79	0.93
Plastic or glass products	0.08	0.04	0.37	0.35	0.54	0.61
Precision metals	0.03	0.00	0.30	0.11	0.66	0.88
Base Metal	0.09	0.03	0.41	0.18	0.50	0.80
Machinery	0.08	0.06	0.31	0.25	0.61	0.69
Transport equipment	0.11	0.12	0.40	0.34	0.49	0.54
Precision machinery	0.08	0.09	0.43	0.41	0.49	0.50
Miscellaneous	0.07	0.05	0.24	0.30	0.68	0.66
Art products	0.26	0.12	0.31	0.47	0.43	0.42

Source: Authors' computation

Table 3. Import Frequency and Imports per Shipment by Invoice Currency and Exporter Continent

	Local		Producer		Vehicle	
	Frequency	Value	Frequency	Value	Frequency	Value
Africa	0.10	0.01	0.01	0.00	0.89	0.99
America	0.06	0.04	0.77	0.65	0.17	0.31
Asia	0.07	0.04	0.25	0.12	0.69	0.84
Europe	0.14	0.08	0.49	0.29	0.37	0.64
Pacific	0.09	0.01	0.50	0.06	0.41	0.93

Source: Authors' computation

Table 4. Basic Statistics for Import Frequency and Imports per Shipment by Invoice Currency

	Mean	S.D.	Median	Maximum
Frequency				
Local	5.559	16.224	1	331
Producer	4.227	11.324	1	365
Vehicle	5.174	14.359	1	364
Total	4.831	13.416	1	365
Values per shipment (Thousand THB)				
Local	282	2,494	10	254,875
Producer	421	6,169	27	1,961,622
Vehicle	947	25,995	37	7,805,302
Total	695	19,479	30	7,805,302

Source: Authors' computation

Table 5. The Means of Import Frequency and Imports per Shipment by Invoice Currency and Industry

	Frequency			Values per shipment (Thousand THB)		
	Local	Producer	Vehicle	Local	Producer	Vehicle
Live animals	10.718	9.728	5.289	301	1,515	3,124
Vegetable products	11.613	5.922	8.768	493	1,421	1,658
Animal/vegetable fats and oils	4.878	3.913	4.439	436	262	2,681
Food products	7.496	4.045	4.416	1,099	354	1,466
Mineral products	7.718	3.987	4.663	1,117	762	45,256
Chemical products	9.858	4.577	4.761	1,065	439	1,407
Plastics and rubber	9.533	5.761	5.746	192	171	306
Leather products	7.406	2.624	5.017	111	98	226
Wood products	6.634	4.926	3.516	129	178	524
Paper products	2.764	3.091	3.926	39	90	274
Textiles	2.110	2.917	5.145	45	150	304
Footwear	4.213	2.240	5.315	46	39	123
Plastic or glass products	2.174	3.845	4.085	37	200	248
Precision metals	7.933	6.181	5.315	453	1,640	4,886
Base Metal	8.488	4.914	4.784	169	246	971
Machinery	5.871	3.952	5.709	380	621	509
Transport equipment	10.516	6.104	6.319	672	829	1,707
Precision machinery	6.153	3.455	3.903	467	344	315
Miscellaneous	1.776	2.495	3.806	40	126	153
Art products	1.013	1.155	1.302	12	119	85

Source: Authors' computation

Table 6. The Means of Import Frequency and Imports per Shipment by Invoice Currency and Exporter Continent

	Local	Producer	Vehicle
Frequency			
Africa	2.835	1.309	4.218
America	3.102	4.001	3.569
Asia	6.267	5.304	5.576
Europe	6.110	3.219	3.805
Pacific	1.313	2.924	3.413
Values per shipment (Thousand THB)			
Africa	101	38	4,703
America	183	492	1,599
Asia	364	426	884
Europe	215	380	688
Pacific	75	311	4,009

Source: Authors' computation

Table 7. Determinants of Import Frequency

	OLS		IV	
	(I)	(II)	(III)	(IV)
Second stage				
Local Currency Dummy	0.0893***	0.1328***	0.6000***	0.2310***
	[0.0023]	[0.0022]	[0.0133]	[0.0124]
ln Total Imports		0.0763***		0.0766***
		[0.0002]		[0.0002]
Exporter Dummy		-0.0618***		-0.0620***
		[0.0011]		[0.0010]
Number of Observations	4,980,162	4,980,162	4,744,619	4,744,619
R-squared (Centered)	0.1948	0.2354	-0.0131	0.050
First stage				
THB Export Share			0.1293***	0.1418***
			[0.0006]	[0.0006]
Centered R-squared			0.027	0.0321
Cragg-Donald Wald F			1.20E+05	1.40E+05
Kleibergen-Paap Wald rk F			44547.07	5.10E+04

Notes: The dependent variable is a log of the frequency of import shipments. The parentheses are robust standard errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. We include fixed effects for the combination of export country, HS eight-digit commodity, and year. In the results for the first stage regression of IV method, we report the result of the excluded variable, THB Export Share, which is the share of exports under local currency invoicing in total exports. Various test statistics are also presented.

Table 8. Robustness Checks on Import Frequency

	(I)	(II)	(III)	(IV)
Estimation Method	IV	IV	OLS	OLS
Data type	Daily	Full	Daily	Daily
Second stage				
Local Currency Dummy	0.2870***	0.2804***		
	[0.0202]	[0.0156]		
Vehicle Currency Dummy			-0.0743***	-0.1511***
			[0.0024]	[0.0024]
Producer Currency Dummy			-0.1006***	-0.1193***
			[0.0023]	[0.0023]
ln Total Imports	0.0930***	0.0905***		0.0766***
	[0.0004]	[0.0002]		[0.0002]
Exporter Dummy	-0.0633***	-0.0616***		-0.0620***
	[0.0021]	[0.0013]		[0.0011]
Number of Observations	1,632,779	4,744,619	4,980,162	4,980,162
R-squared (Centered)	0.0444	0.045	0.1948	0.2355
First stage				
THB Export Share	0.1657***	0.1418***		
	[0.0011]	[0.0006]		
Centered R-squared	0.0283	0.0321		
Cragg-Donald Wald F	9.08E+04	1.40E+05		
Kleibergen-Paap Wald rk F	24713.77	51233.44		

Notes: The dependent variable is a log of the frequency of import shipments. The parentheses are robust standard errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. We include fixed effects for the combination of export country, HS eight-digit commodity, and year. In the results for the first stage regression of IV method, we report the result of the excluded variable, THB Export Share, which is the share of exports under local currency invoicing in total exports. Various test statistics are also presented.

Table 9. Determinants of Average Import Values per Shipment

	(I)	(II)	(III)
Estiamtion Method	OLS	IV	OLS
Second stage			
Local Currency Dummy	-0.5679***	-1.7425***	
	[0.0050]	[0.0291]	
Vehicle Currency Dummy			0.6341***
			[0.0054]
Producer Currency Dummy			0.5179***
			[0.0052]
Exporter Dummy	0.3248***	0.3144***	0.3215***
	[0.0024]	[0.0023]	[0.0024]
Number of Observations	4,980,162	4,806,105	4,980,162
R-squared (Centered)	0.3948	-0.0054	0.3950
First stage			
THB Export Share		0.1431***	
		[0.0006]	
Centered R-squared		0.0312	
Cragg-Donald Wald F		1.40E+05	
Kleibergen-Paap Wald rk F		52865.43	

Notes: The dependent variable is a log of the average import values per shipment. The parentheses are robust standard errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. We include fixed effects for the combination of export country, HS eight-digit commodity, and year. In the results for the first stage regression of IV method, we report the result of the excluded variable, THB Export Share, which is the share of exports under local currency invoicing in total exports. Various test statistics are also presented.

Table 10. Fixed Costs for FCI Management

	(I)	(II)	(III)
Difference	51.0769***	50.8037***	119.2677***
	[7.1360]	[7.1412]	[8.0531]
Constant	26.5147***		
	[6.8806]		
Year Dummy	NO	YES	YES
Export Country Dummy	NO	NO	YES
Number of Observations	4,171,649	4,171,649	4,171,649

Notes: The parentheses are standard errors. *** indicate 1% significance.

Table 11. Correlation of Fixed Costs for FCI Management with Export Country Characteristics

	(I)	(II)	(III)	(IV)	(V)
ln GDP	0.0524		0.0618	0.0549	0.0102
	[0.0915]		[0.0793]	[0.0915]	[0.0865]
ln GDP per capita	0.027	0.0622		0.0213	0.0256
	[0.1184]	[0.1015]		[0.1145]	[0.1147]
ln Distance	-0.1797	-0.1876	-0.1749		0.0722
	[0.3196]	[0.3159]	[0.3115]		[0.2483]
RTA Dummy	-1.2538*	-1.1481*	-1.2528*	-1.0567*	
	[0.6827]	[0.6182]	[0.6825]	[0.5540]	
Turnover Share	-6.3278**	-5.7026**	-6.2606**	-6.6050**	-6.2948**
	[2.7204]	[2.4059]	[2.6892]	[2.7919]	[3.1262]
Constant	5.1765	6.2658**	5.1945	3.5555*	3.9992
	[3.4003]	[2.7313]	[3.4133]	[2.1429]	[3.2014]
Number of Observations	137	137	137	137	137
R-squared	0.0402	0.0376	0.0398	0.0375	0.0159

Notes: The parentheses are robust standard errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Figure 1. Structure of the Model (Simplified Three-Country Example)

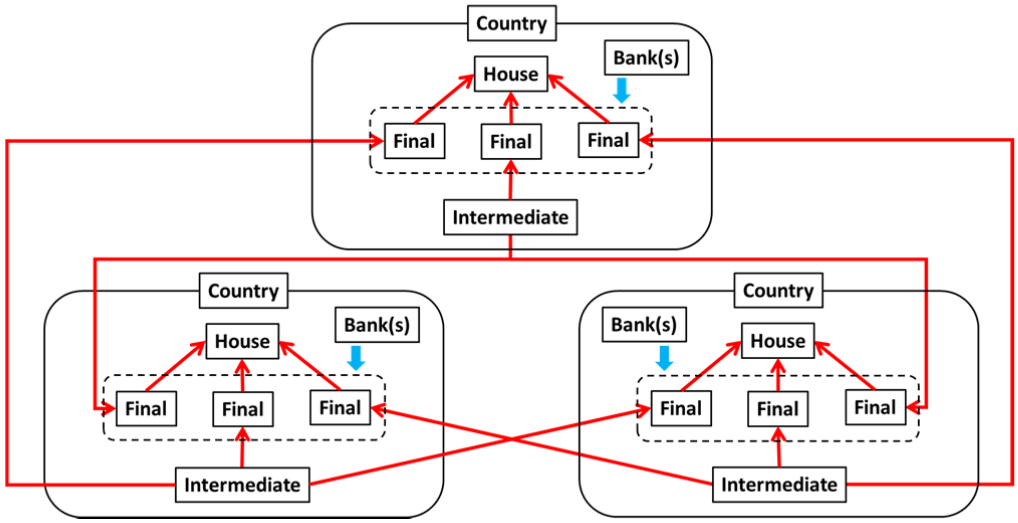


Figure 2. Import Frequency and Invoice Currency

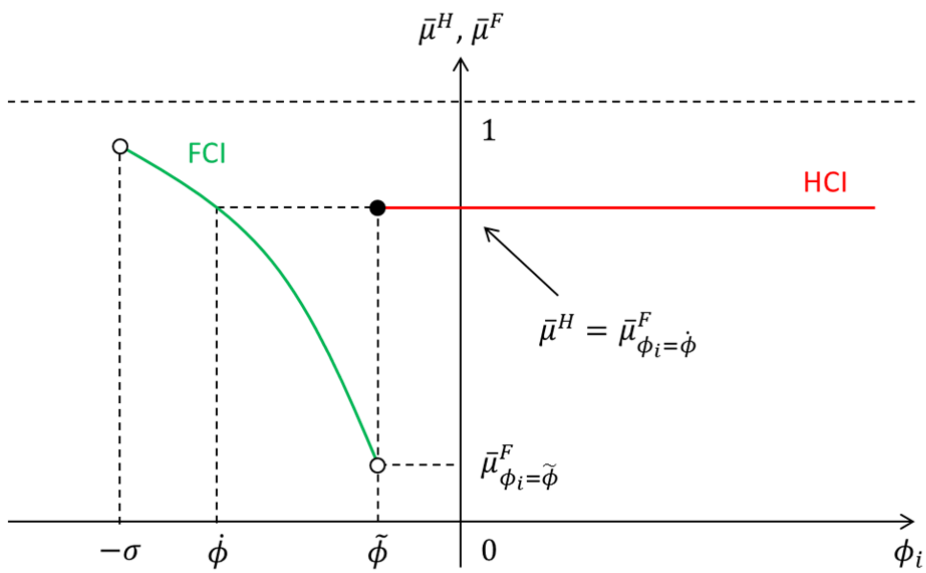
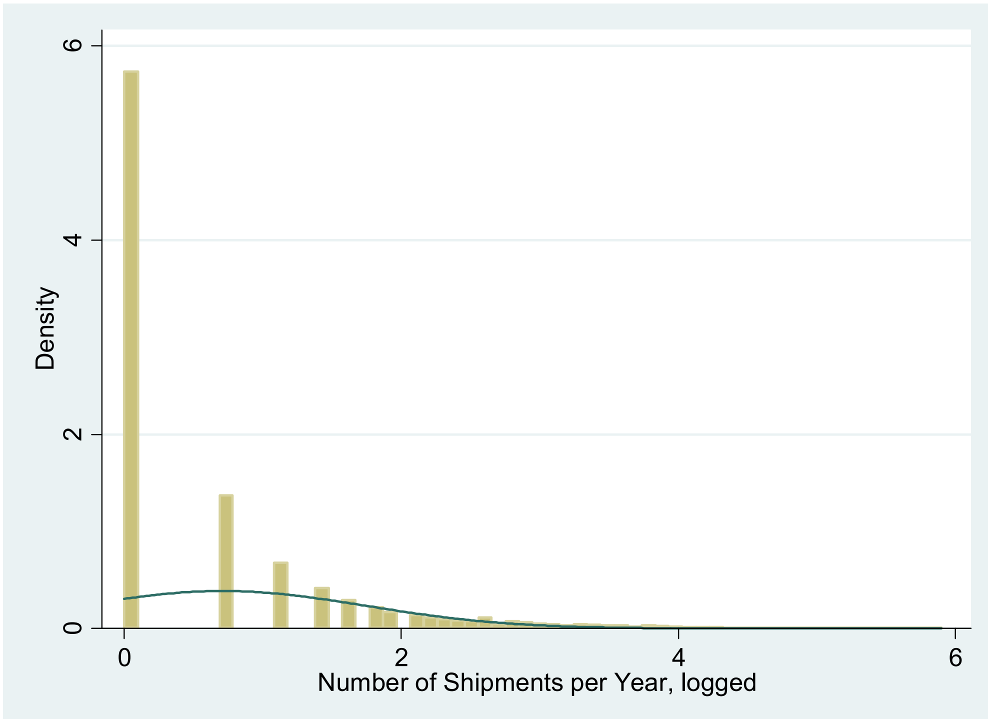
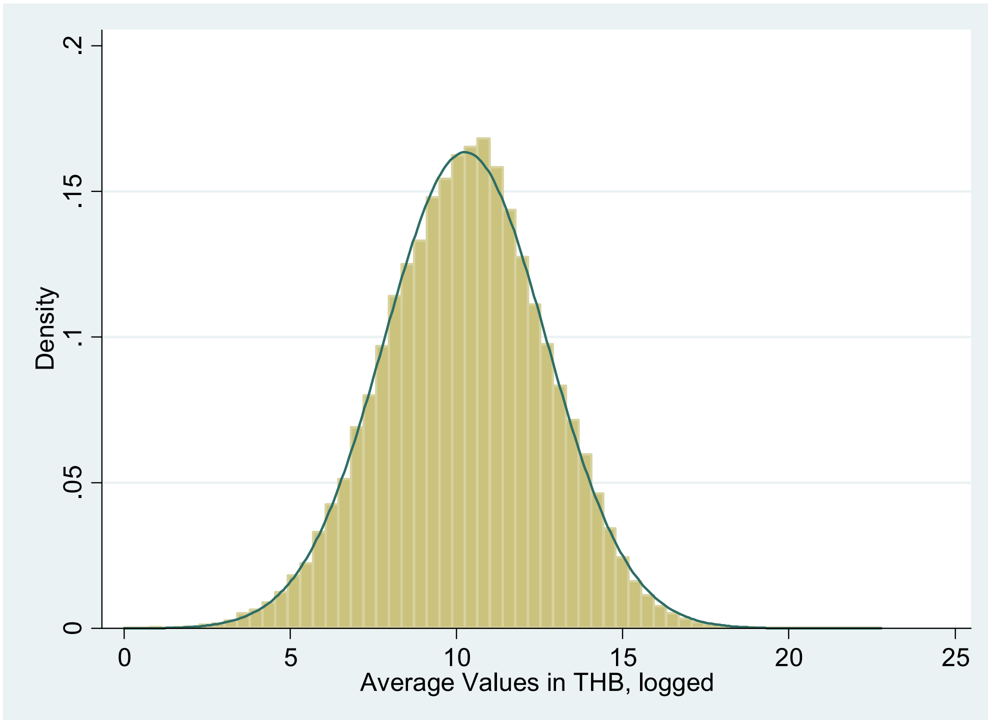


Figure 3. Sample Distribution of Number of Shipments per Year



Source: Authors' compilation

Figure 4. Sample Distribution of Average Import Values per Shipment



Source: Authors' compilation