Costs of Foreign Currency Invoicing

Kazunobu Hayakawa (Institute of Developing Economies)

Nuttawut Laksanapanyakul (Thailand Development Research Institute)

Taiyo Yoshimi (Nanzan University)

Outline

1. Motivation
2. Major Findings
3. The Model
4. Data
5. Invoice Currency, Import Frequency and Value per Shipment
6. Costs of FCI
7. Conclusion

1. Motivation

- Benefits of running an international currency?
  - View of invoice currency in imports.
  - How much is FCI costly?
- FCI vs HCI
  - FCI:
    - Disadvantage -> Cost to manage ER risk.
    - Advantage -> Lower future payment for imports when importers' currency is appreciating.
  - HCI: No ER risk for importers.

What we do

- Theory
  - ➢ Endogenous choice of invoice currency.

- Empirics
  - ➢ We infer the costs of FCI with observable information.
  - ➢ Data: A highly disaggregated dataset on Thai imports: company code, transaction date, trade value and quantity, invoice currency in each transaction, etc…
  - ➢ Relation between invoice currency, import frequency, and value per shipment.

2. Major Findings

- Those costs of FCI of average Thai importer range between 7.3% (1,500USD) and 17.1% (3,600USD) of one-time shipment value.

- Those costs become smaller when
  - Turnover Share of the export country currency is higher,
  - or the export country is one of partners of Thailand's RTA.

- Import frequency is higher and the value per shipment is smaller for products invoiced in customers' (importers') currency than those not priced in it.
  - HCI contributes for importers' just-in-time orders.

Literature

- Trade frequency
  - Kropf and Sauré (2014) infer fixed costs per shipment, and examine determinants of shipment frequency and the value per shipment.
  - Bekes et al. (2014) introduce uncertainty into consideration.
- Choice of invoice currency
  - Goldberg and Tille (2009) examine the choice of the invoice currency through bargaining btw exporters and importers.
  - Gopinath et al. (2010) construct a model where importer choose the invoice currency.
- We combine these two literature to infer the costs of HCI.

3. The Model

- Partial equilibrium model a la Kropf and Sauré (2014) with infinite number of countries.
- Two differences:
  - ➤ Importers optimize in our model.
  - ➤ Invoice currencies are endogenously determined.
- Agents
  - ➤ Representative household
  - ➤ Final-good producers (importers of intermediate inputs)
  - ➤ Financial institution (implicit)
  - ➤ Intermediate-good producer (implicit)

Structure (simplified)
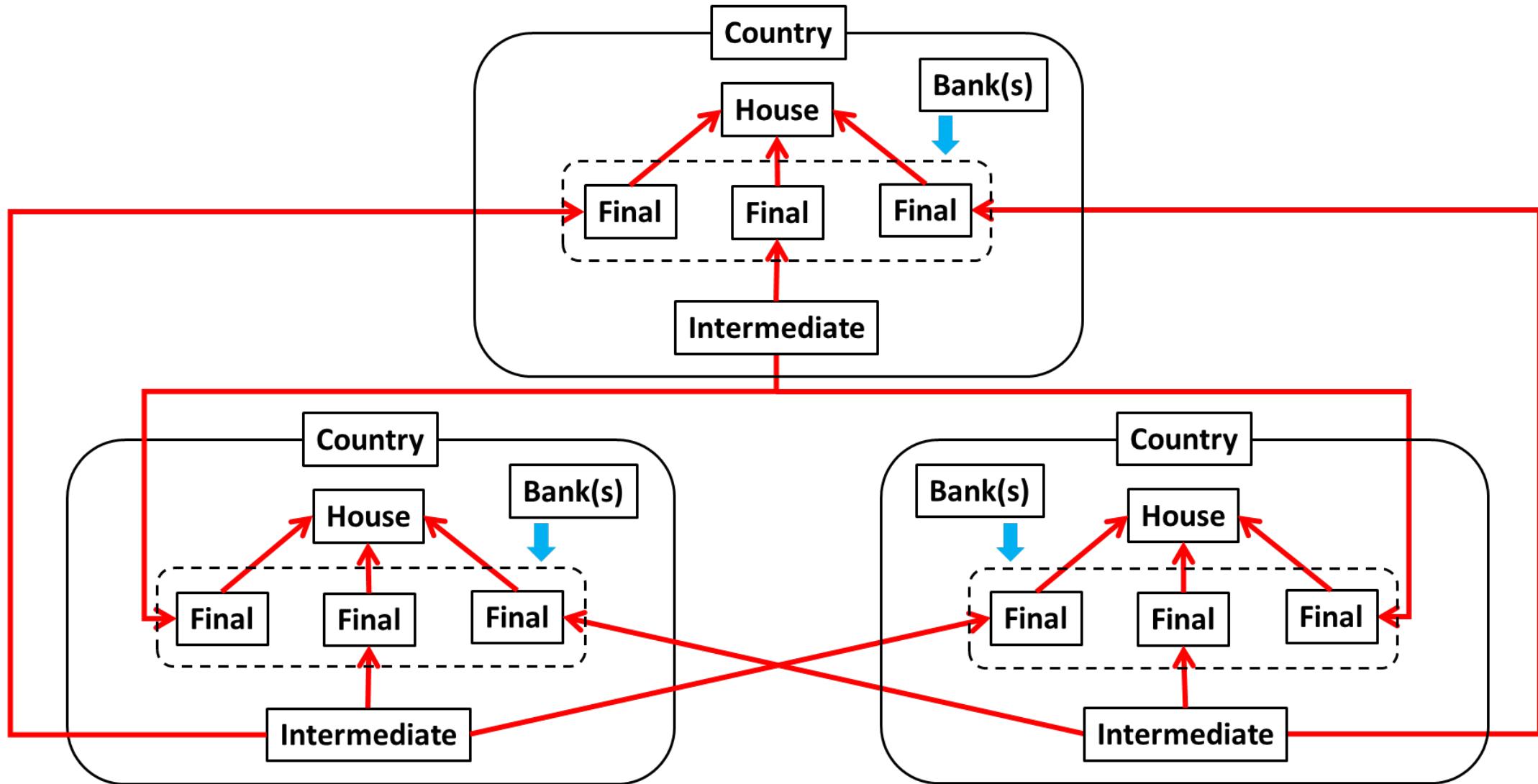
Intuition for import frequency and invoice currency

- Import frequency
  - Trade off: **Storage cost** and **fixed cost per shipment (f)**
  - More frequent shipment -> less storage cost & more shipment cost

- Invoice currency
  - Trade off: **Future payments for imports** and **ER risk management fixed cost per shipment (f^f)**
  - FCI -> more f^f and possibility of future discount on the payment of imported intermediate input

3.1. Representative Household

- Preference
  - ➢ $u = c$
  - ➢ $c \equiv \left[\int_0^1 c_i^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}}, \quad 1 < \theta < \infty$

- Demand and Price Index
  - ➢ $c_i = \left(\frac{p_i}{P} \right)^{-\theta} \frac{Y}{P}$
  - ➢ $P \equiv \left[\int_0^1 p_i^{1-\theta} di \right]^{\frac{1}{1-\theta}}$

3.2. Forward Exchange Rates

- FCI and HCI
  - ➢ FCI: $\varepsilon_i^f(t') = \varepsilon e^{\phi_i t'}$ and $f^f > 0$
  - ➢ HCI: $\varepsilon = 1$, $\phi_i = 0$ and $f^f = 0$

- Firm heterogeneity in provided forward Premium
  - ➢ ϕ_i depends on i.
  - ➢ Interpretation: Depending on countries of origin and firm owner's knowledge and experience, premium can vary across firms.
  - ➢ Example: More experienced owner can find better bank, which provides better premium.

3.3. Final-good Producers

- Technology
  - $\quad \triangleright \ x_i = am_i$
- Marginal Cost
  - $\quad \triangleright \ mc_i = \dfrac{\varepsilon e^{\phi_i t'} \tau \tilde{z}^*}{a}$

  Storage Cost

- Consumer Price
  - $\quad \triangleright \ p_i(t') = \dfrac{\theta}{\theta-1} \dfrac{e^{(\sigma+\phi_i)t'} \tau \varepsilon \tilde{z}^*}{a}$
- Shipment interval is denoted by Δ_i. Normalizing one period by 1, Δ_i^{-1} is interpreted as import frequency.

Profits

- Operating Profit

  ➢ $\pi_i(t') = \theta^{-\theta} \left(\dfrac{1}{\theta-1} \dfrac{e^{(\sigma+\phi_i)t'} \tau\varepsilon\tilde{z}^*}{Pa} \right)^{1-\theta} Y$

- Present Value per Shipment

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

- Present Value of all shipments in a period

  ➢ $NPV_i \equiv \sum_{k=0}^{\infty} \left(e^{-\alpha\Delta_i} \right)^k [\Pi_i(\Delta_i) - S_i]$

  ➢ $S^H = f$ and $S^F = f+f^f$

3.4. Frequency and Value per Shipment

- Frequency and invoice currency are simultaneously determined.
  - Each importer prefers HCI if and only if $\overline{NPV}_i^H \geq \overline{NPV}_i^F$.

- Optimization
  - $\max\limits_{\mu_i} NPV_i,$ where $\mu_i \equiv e^{-\Delta_i}$

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

Threshold Forward Premium

- Threshold premium $\tilde{\phi}$ is defined by $\overline{NPV}_i^H = \overline{NPV}_i^F$.

  ➢ $\tilde{\phi}$ is uniquely determined.

- Choice of invoice currency

  ➢ $\tilde{\phi} \leq \phi_i \rightarrow$ HCI: Costs of ER risk management f^f motivate importers to choose the home currency in invoicing.

  ➢ $\phi_i < \tilde{\phi} \rightarrow$ FCI: Home currency will become significantly expensive at the future payment date. FCI lowers importing costs in terms of home currency.

Forward Premium and Import Frequency
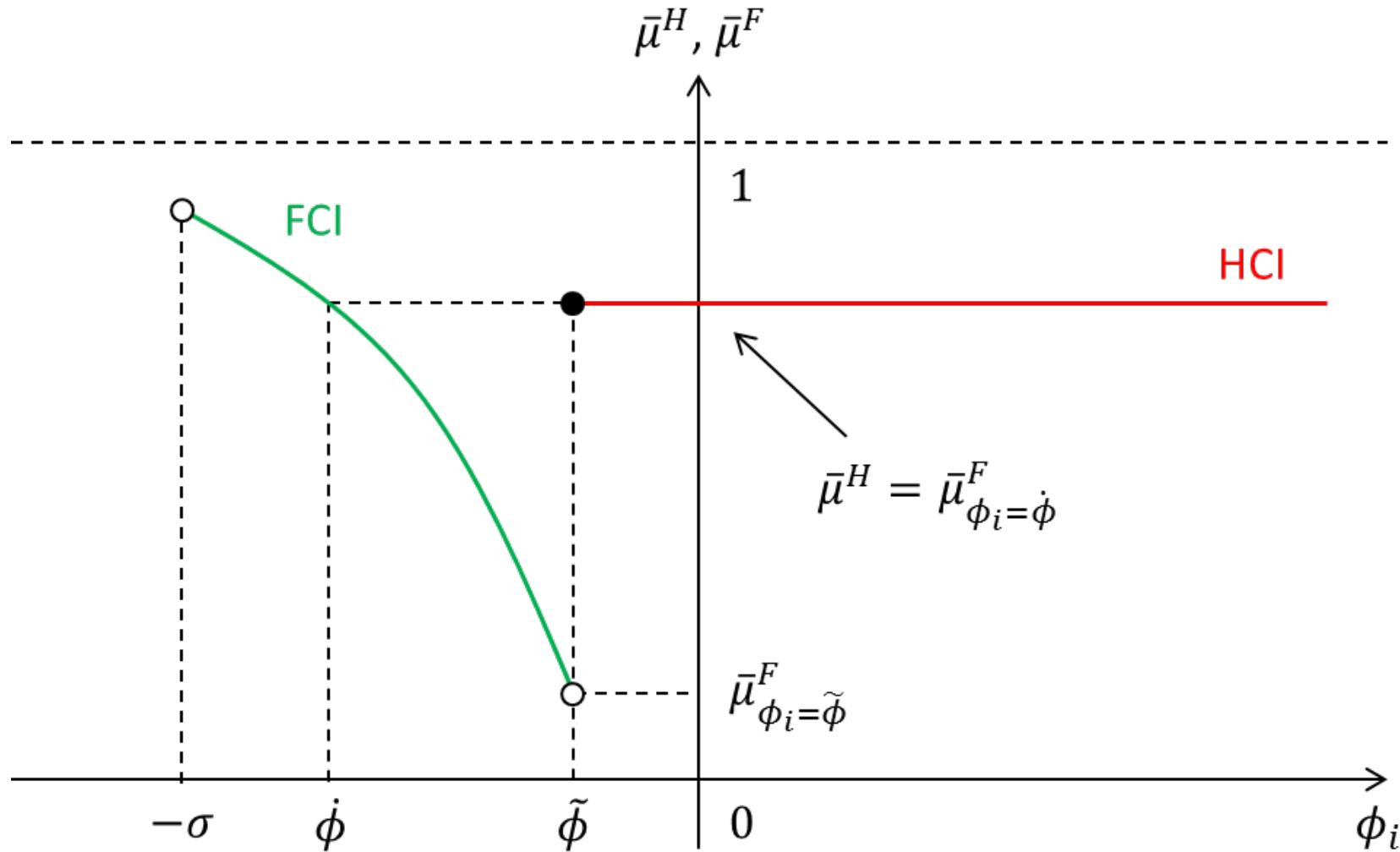
Proposition 1:

- *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.*

Value per Shipment

- Value per shipment in terms of the home currency

$$\overline{q}_i \equiv \int_0^{\overline{\Delta}_i} \varepsilon\tau\tilde{z}^* \frac{c_i(t')}{a} dt' = Z\frac{\theta-1}{\theta}\frac{1}{\sigma+\phi_i}\left\{1 - (\overline{\mu}_i)^{\theta(\sigma+\phi_i)}\right\}$$
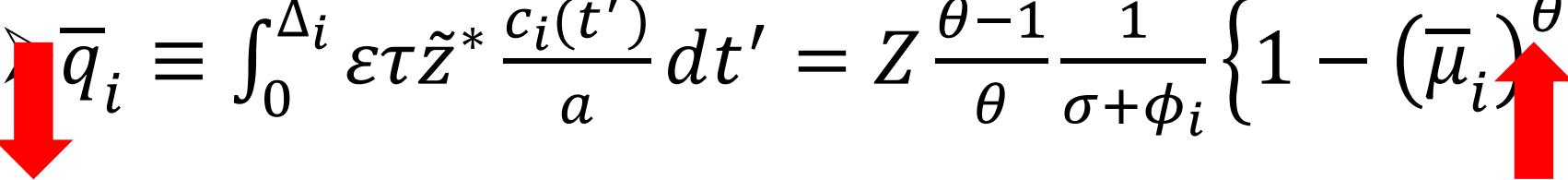
Proposition 2:

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

3.5. Costs of FCI

- Inferring S_i ($S^H = f$ and $S^F = f + f^f$)
  - $S_i = \zeta_i \eta_i \cdots (* 1)$
  - $\zeta_i \equiv \dfrac{\theta}{\theta-1} \dfrac{(\sigma+\phi_i)\overline{q}_i}{[\alpha+(\theta-1)(\sigma+\phi_i)]\left\{1-(\overline{\mu}_i)^{\theta(\sigma+\phi_i)}\right\}}$
  - $\eta_i \equiv 1 - \left[\left\{1 + \dfrac{(\theta-1)(\sigma+\phi_i)}{\alpha}\right\} - \dfrac{(\theta-1)(\sigma+\phi_i)}{\alpha}(\overline{\mu}_i)^\alpha\right](\overline{\mu}_i)^{(\theta-1)(\sigma+\phi_i)}$
- Inferring f^f
  - $f^f = \zeta^F \eta^F - \zeta^H \eta^H \cdots (* 2)$
  - f^f is interpreted as the costs of FCI.

4. Data

- Transaction-level import data from 2007 to 2011, which covers all commodity imports in Thailand.

- Customs clearing date, HS eight-digit code, export country, import firm ID, invoice currency, import values in Thai Baht (THB), import quantity, and quantity unit.

# Figure 2. Sample Distribution of Number of Shipments per Year

Number of Shipments per Year, logged
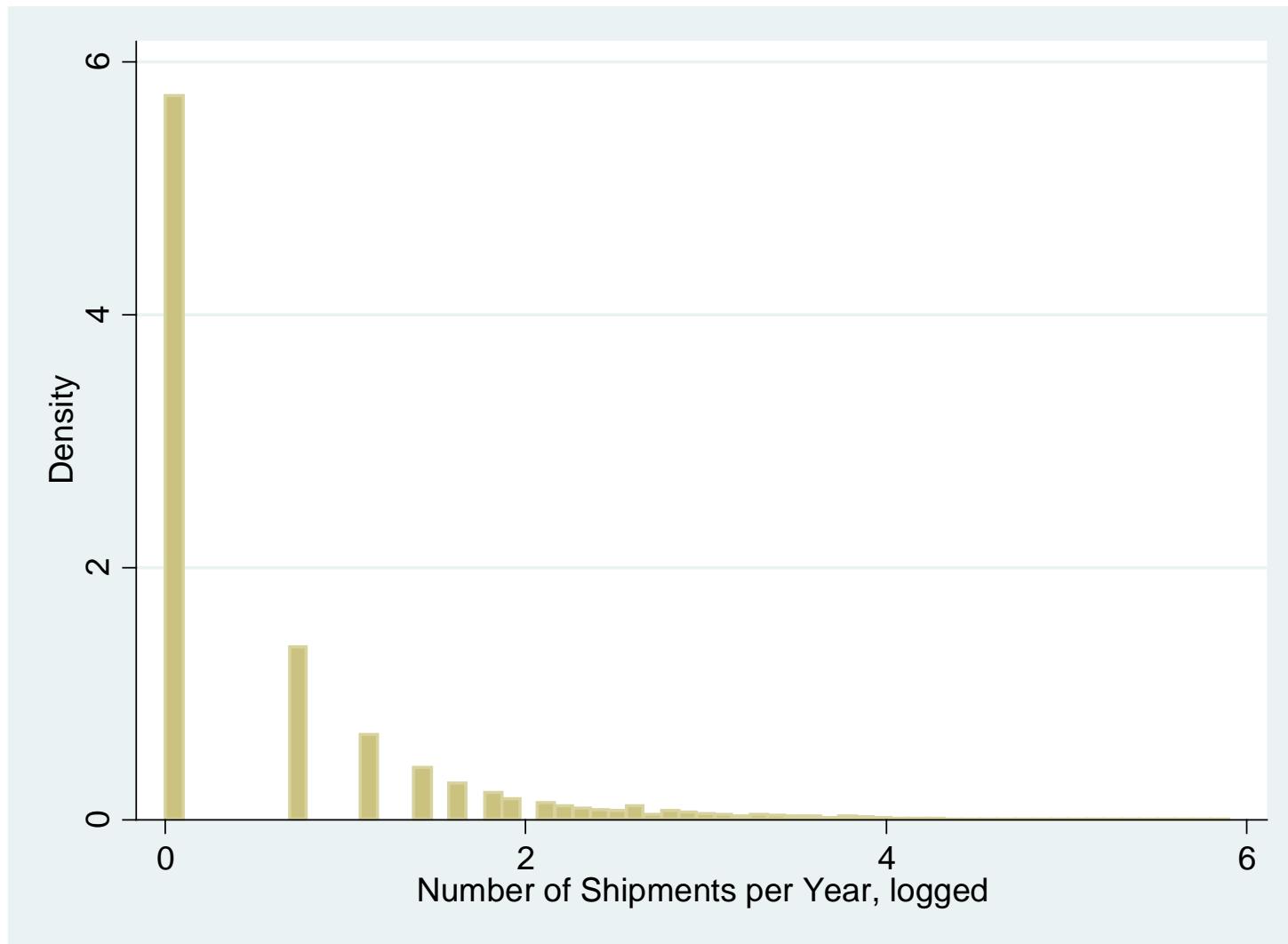
Figure 3. Sample Distribution of Average Import Values per Shipment
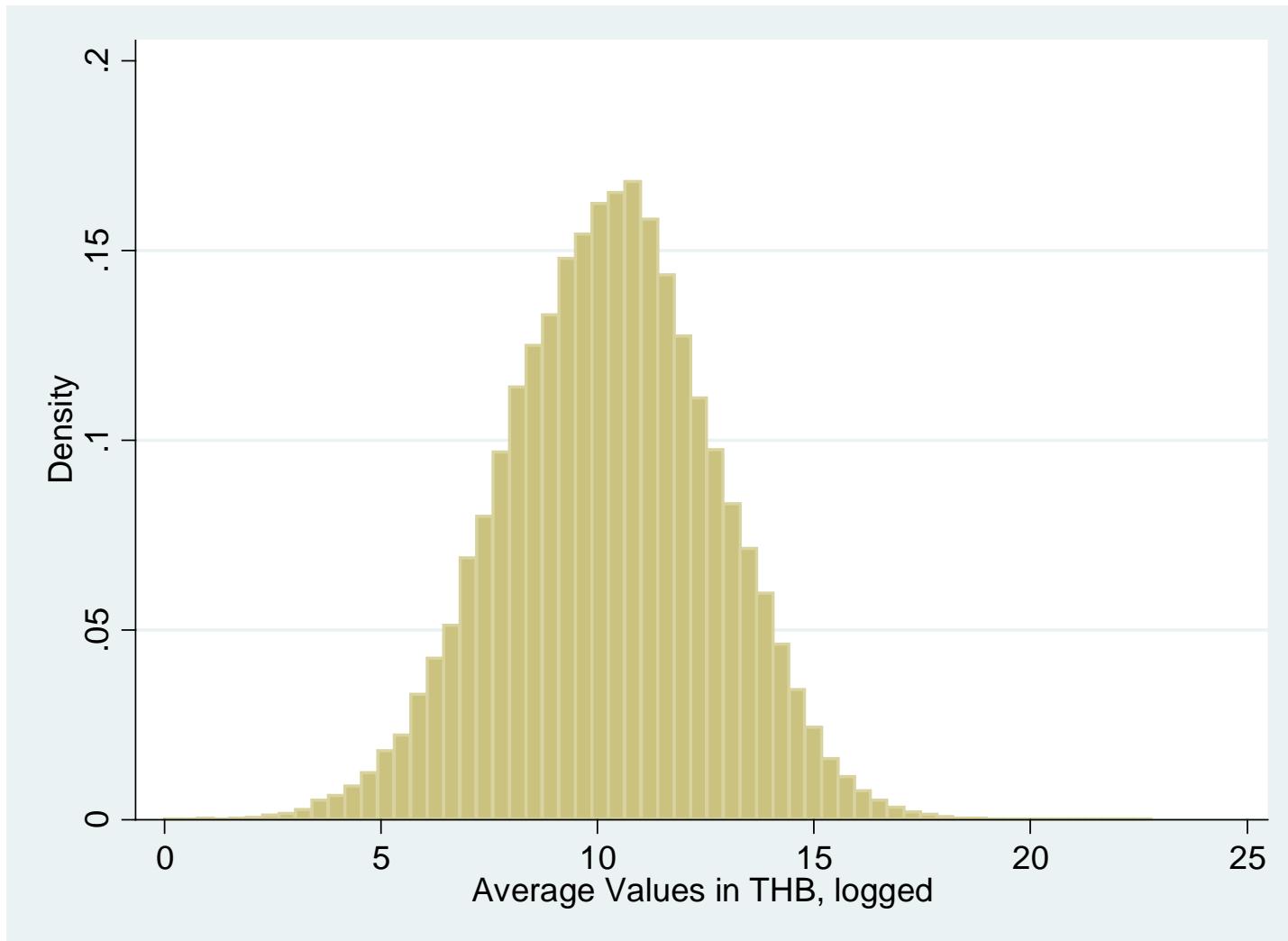
Table 1. The Decomposition of Import Transactions According to Invoice Currencies

	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

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

Data Overview

- More than a half of all import transactions have only one shipment per year.

- 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.

5. Invoice Currency, Import Frequency and Value per Shipment

- •Invoice Currency and Import Frequency
  - ➢ $\ln Frequency_{fipt} = \alpha D_{fipt}^{HCI} + \mathbf{X}_{ft}\boldsymbol{\beta} + u_{ipt} + \epsilon_{fipt}$
- • Invoice Currency and Value per Shipment
  - ➢ $\ln Value_{fipt} = \alpha D_{fipt}^{HCI} + \mathbf{X}_{ft}\boldsymbol{\beta} + u_{ipt} + \epsilon_{fipt}$

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

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		

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	

Invoice Currency, Import Frequency and Value per Shipment

- Invoice Currency and Import Frequency
  - ➢ Frequency is higher for HCI than FCI.
  - ➢ Proposition 1 provides a rationale.

- Invoice Currency and Value per Shipment
  - ➢ Value per shipment is smaller for HCI than FCI.
  - ➢ Proposition 2 provides a rationale.

- Just-in-time orders are observed for HCI.

6. Costs of FCI

1. Compute S_{fipt} based on $(*1)$ and $(*2)$.

2. Estimate the following equation:
   - $S_{fipt} = \beta_0 + \beta_1 D_{fipt}^{FCI} + u_t + u_i + \epsilon_{fipt}$
   - β_0: inferred f (fixed costs per shipment)
   - β_1: inferred f^f (excess fixed costs of FCI to HCI)

Table 10. Fixed Costs of 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

Benefits of HCl

- Fixed costs per shipment and costs of FCI are significantly positive.

- Quantitative implications:
  - Inferred f : 800USD (3.9%). One-tenth of the average per-export shipment fixed costs in Swiss estimated by Kropf and Sauré (2014).
  - Inferred f^f : ranges between 1,500USD (7.3%) and 3,600USD (17.1%).

Determinants of f^f

1. Compute f^f for each exporting country based $(* 1)$ and $(* 2)$.

2. Examine the correlation between f^f and exporting countries' characteristics.

   ➢ GDP, GDP per capita, distance, RTA dummy, and Turnover Share.

Table 11. Correlation of Fixed Costs of FCI 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

7. Conclusion

- Costs of FCI in imports are positive, and range btw 7.3% and 17.1% of value per shipment.

- Those costs are negatively correlated with Turnover Share of export country's currency and RTA dummy.

- Just-in-time orders with high frequency and small value per shipment are associated with HCI.