Exchange Rate Pass-through at the Individual Product Level: Evidence from Japan and Thailand

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Outline

1. Motivation
2. Major Findings
3. Theoretical Framework
4. Data Overview
5. Empirical Results
6. Concluding Remarks

1. Motivation

- **(1) Resolve the aggregation bias in the estimation of ERPT**
  - Typical calculation of the unit price

$$Unit\ Price = \frac{Total\ Value\ of\ Import}{Total\ Unit\ of\ Import}$$

  - If products in the same HS code are heterogeneous, the unit price is biased
  - Model- or brand-level analysis: Yoshida and Sasaki (2015), and Chen and Juvenal (2016)
- Ours -> Individual product level
  - Used construction machinery exports from Japan to Thailand

Used construction machinery exports

Japan

Thailand

Used but still works!

Purchase, export, and resale!

International traders

Used again in domestic construction sites.

Purchase price

Exchange rate change

Resale price

Motivation

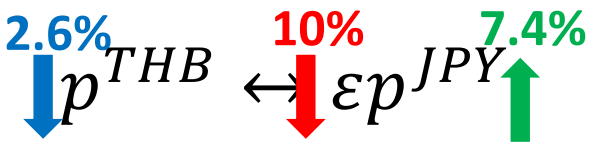
- **(2) Add new evidences on ERPT in Asia**
  - Ca'Zorzi, Hahn, and Sánchez (2007): ERPT into import and consumer prices is higher for emerging countries than developed countries
- ERPT is a big issue for well-integrated regions
- Economic integration in Asia
  - *De-jure* integration: ASEAN FTA (AFTA) from 1993, ASEAN-Korea FTA (AKFTA) from 2007, and ASEAN-Japan CEP (AJCEP) from 2008
  - *De-facto* integration: Nearly doubled regional trade in this decade

What we do

- Theoretical Framework
  - ➢Discuss how to examine ERPT at the individual product level
- Empirical Analysis
  - ➢Newly built matched dataset
    - ■ Used construction machinery exports from Japan to Thailand
    - ■ Based on primary auction price data: Japan (296,032obs from 2003 to 2015) and Thailand (128,011obs from 2000 to 2015)
    - ■ Matched dataset (1,606obs from 2003 to 2015)

2. Major Findings

- **(a) Baseline Results**
  - ERPT elasticity ≈ 0.26



Note: rise of ε is THB depreciation

  - Slightly higher than findings for developed countries with product level data
    - Gopinath et al. (2010) : approximately 0.2 short-run ERPT elasticity into import price of the U.S.
- Intuition
  - Consumers in emerging countries significantly suffer from exchange rate risk
    - Can be interpreted by the bargaining perspective suggested by Friberg and Wilander (2008) and Ito et al. (2012)?

Major Findings

- **(b) Asymmetric ERPT**
  - ➢ ER changes are passed through into the resale price only when THB appreciates to JPY
    - ■ ERPT is observed only when the resale price is lowered
  - ➢ ERPT elasticity ≈ 0.62 for THB appreciation
- Intuition
  - ➢ It is easier for exporters to lower than to raise the resale price

Major Findings

- **(c) Trading Lag and ERPT**
  - ➢Longer months spent from purchase in Japan to resale in Thailand result in lower ERPT
    - ■ One month delay leads to 0.01 fall of ERPT elasticity
- Intuition
  - ➢Exporters accept larger exchange rate risk and try to sell a machinery smoothly so that they avoid additional payments of the cost for depreciation and storage

3. Theoretical Framework

- An exporter purchases a machinery in Japan at time t' and resale it in Thailand at time t
  - Yen purchase cost: $P_{t'}^{JPY}$
  - Baht purchase cost: $P_{t'}^{THB} = \varepsilon_{t'} P_{t'}^{JPY}$
  - Baht resale price: $P_t^{THB} = \tau\mu e^{-\delta(t-t')}\varepsilon_t P_{t'}^{JPY}$
    - τ: transportation cost (ice-berg)
    - μ: price margin
    - δ: depreciation rate

Theoretical Framework

- Combine, log-linearize and take the difference
  - $\Delta \ln P^{THB} = \Delta \ln \varepsilon + \ln \tau + \ln \mu - \delta(t - t')$
    - $\Delta \ln P^{THB} \equiv \ln P_t^{THB} - \ln P_{t'}^{THB}$
    - $\Delta \ln \varepsilon \equiv \ln \varepsilon_t - \ln \varepsilon_{t'}$
- The coefficient on $\Delta \ln \varepsilon_t$ is one if ERPT is complete
  - We estimate the above equation with our matched dataset

4. Data Overview

- Primary auction data
  - Japan: 296,032obs from 2003 to 2015
  - Thailand: 128,011obs from 2000 to 2015
  - Model, serial number, manufactured year, operation hour, port location, and additional detailed specifications each product
  - Auction date, auction method, name of auctioneer, and sold price
- Matched dataset
  - 1,606obs from 2003 to 2015
  - ΔP, *Lag,* and *Hour*

Table 1. Basic Statistics and Variable Definitions

Variable	Mean	Std. Dev.	Min	Max	Definition
P^{THB}	425704.9	317218.0	26000	3600000	Trading price in Thailand (Thai baht)
P^{JPY}	1006309.0	840284.6	10000	9300000	Trading price in Japan (Japanese yen)
ΔP	0.2726	0.2872	-2.5707	4.6304	The difference between the logarithm of Thai baht purchase price in Thailand and the logarithm of baht-denominated resale price in Japan
$\Delta\varepsilon$	0.3405	0.0392	0.2711	0.4102	THB/JPY Exchange Rate (monthly average)
$\Delta\varepsilon_{EOP}$	0.3413	0.0403	0.2710	0.4078	THB/JPY Exchange Rate (end of month)
Lag	5.3234	11.0494	0	91	Lag of trading month in Japan to trading month in Thailand [Months]
Hour	53.9525	41.9089	0	886.5800	Operating hours [hundred hours]

Figure 1. Share of Each Type of Machinery in Matched Dataset

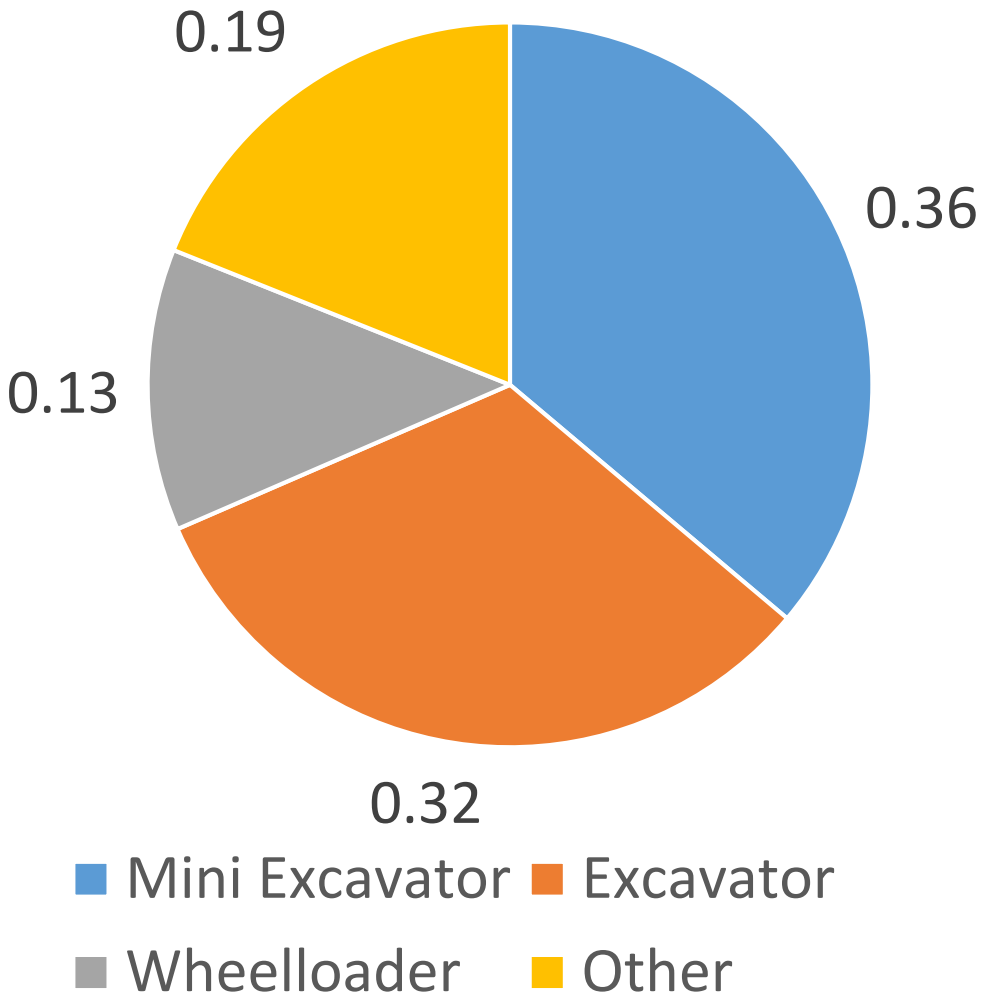


Figure 2. Purchase price in Japan and resale price in Thailand

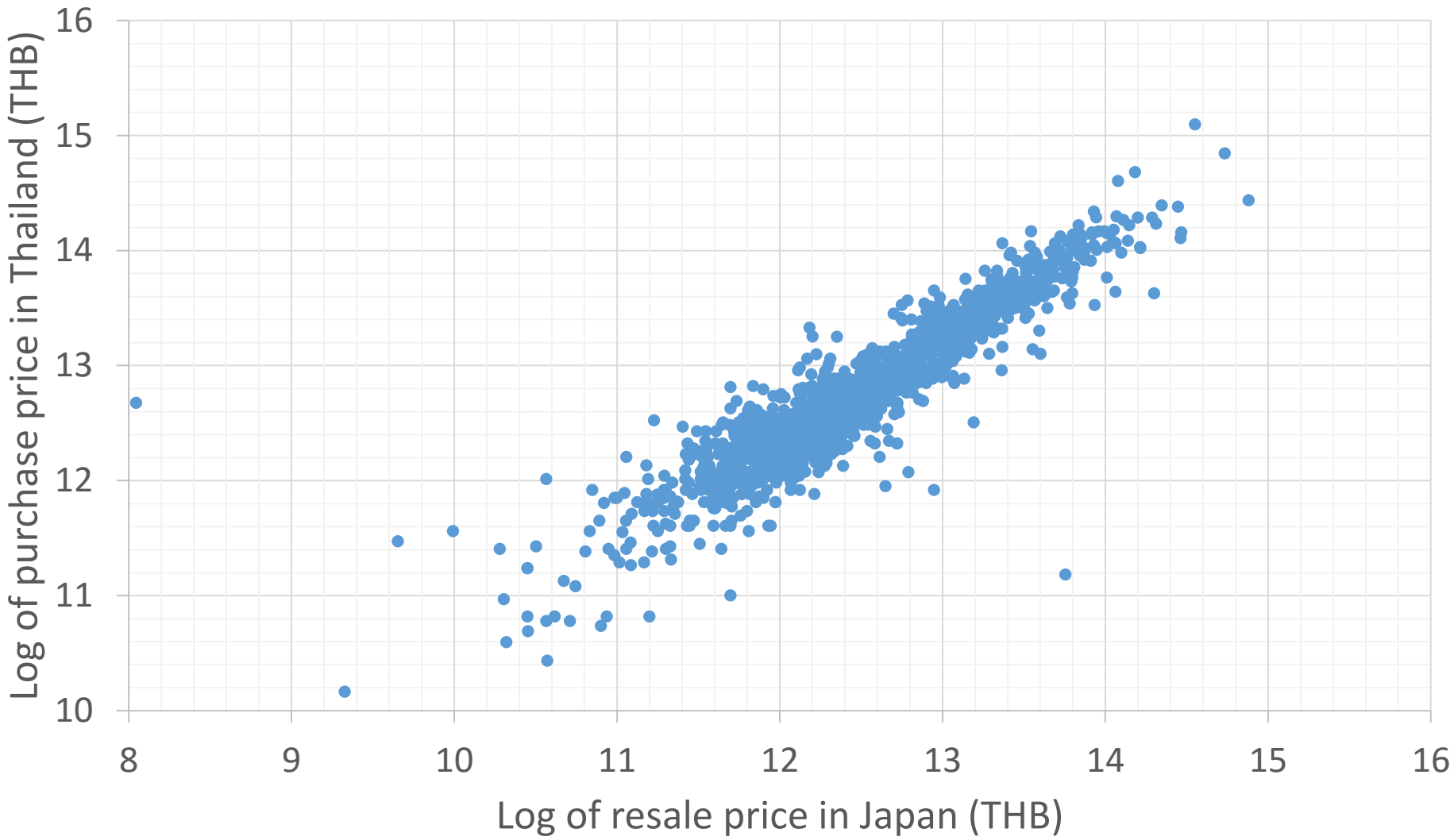


Figure 3. Distribution of Months Passed from Trading Date in Japan to Trading Date in Thailand (*Lag*)

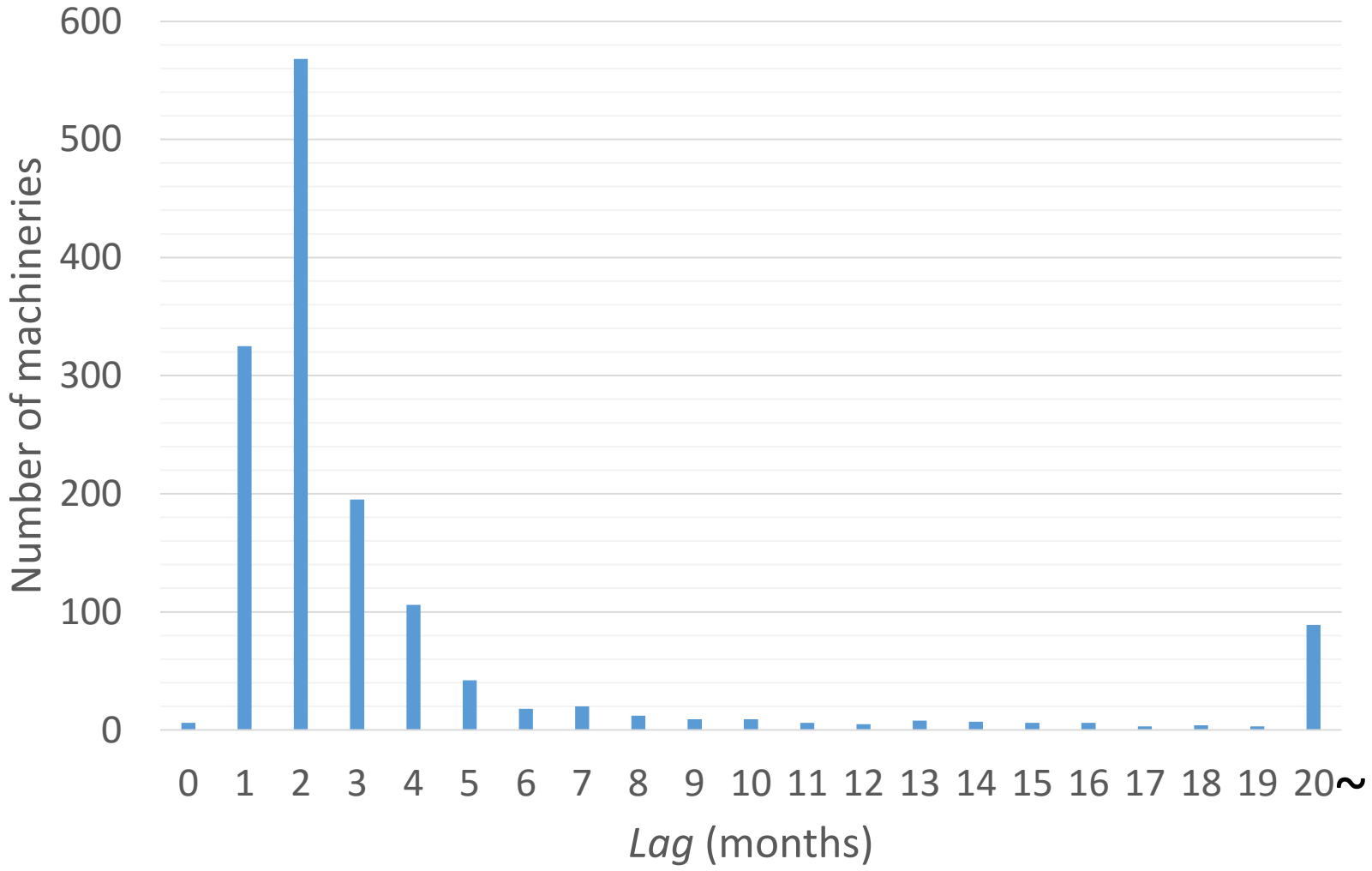
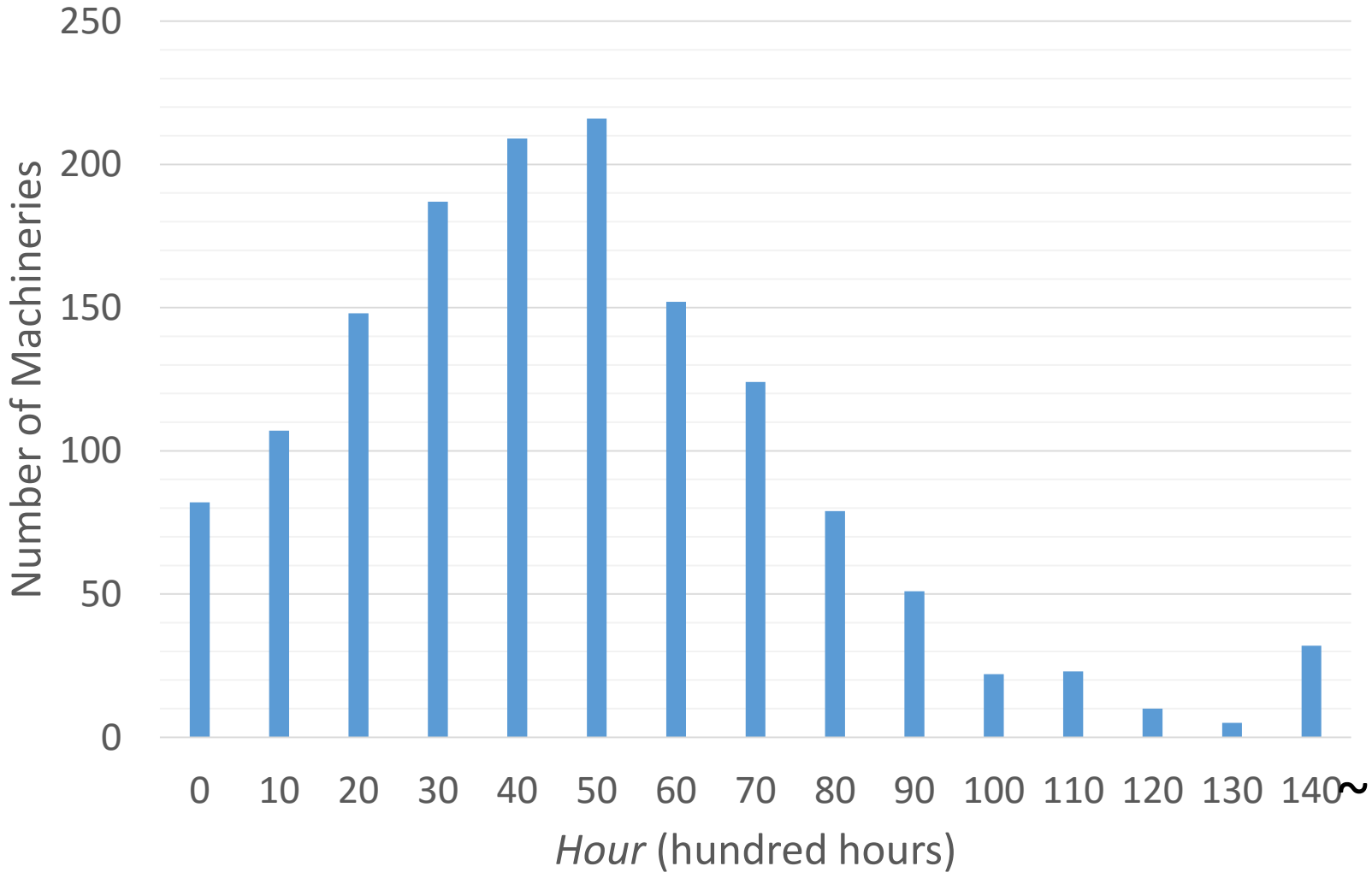


Figure 4. Distribution of Operating Hours (*Hour*)



5. Empirical Results
5-1. Baseline Results

- Estimation Equation

$$\Delta P_i = \alpha_0 + \alpha_1 \Delta \varepsilon_i + \alpha_2 Lag_i + \alpha_3 Hour_i + D_i + u_i$$

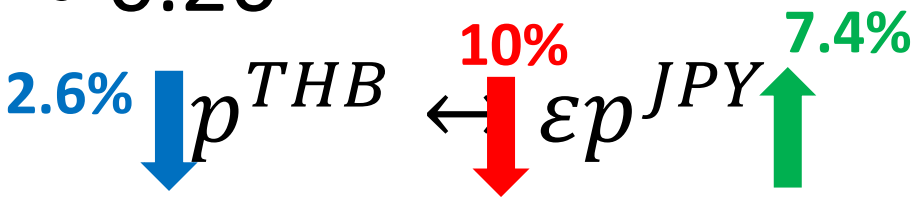
  - α_1: degree of ERPT
  - $0 < \alpha_1 < 1 \rightarrow$ ERPT is incomplete
- We use robust standard error to deal with the heteroscedasticity problem in all regressions

Table 2. Baseline Results

	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)
Const.	0.3180***	0.3331***	0.3088***	0.3073***	0.3299***	0.3322***
	(0.0328)	(0.0163)	(0.0322)	(0.0084)	(0.0275)	(0.0162)
$\Delta\varepsilon$	0.2744**	0.2777**	0.2637**	0.2768**		
	(0.1305)	(0.1278)	(0.1313)	(0.1285)		
$\Delta\varepsilon_{EOP}$					0.2555**	0.2652**
					(0.1182)	(0.1165)
Lag	-0.0062***	-0.0065***	-0.0062***	-0.0065***	-0.0063***	-0.0065***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Hour	-0.0003	-0.0004*			-0.0003	-0.0004*
	(0.0002)	(0.0002)			(0.0002)	(0.0002)
Type dummies	Yes	No	Yes	No	Yes	No
R-squared	0.1190	0.0680	0.1163	0.0619	0.1190	0.0680

Baseline Results

- ERPT elasticity ≈ 0.26



- Slightly higher than findings for developed countries with product level data
  - ➢ Gopinath et al. (2010) : approximately 0.2 short-run ERPT elasticity into import price of the U.S.
- Longer *Lag* leads to price decrease
  - ➢ Depreciation and exporters' discount

5-2. Asymmetric ERPT

- Estimation Equation

$$\Delta P_i = \alpha_0 + \alpha_1 \Delta \varepsilon_i^+ + \alpha_2 \Delta \varepsilon_i^- + \alpha_3 Lag_i + \alpha_4 Hour_i + D_i + u_i$$

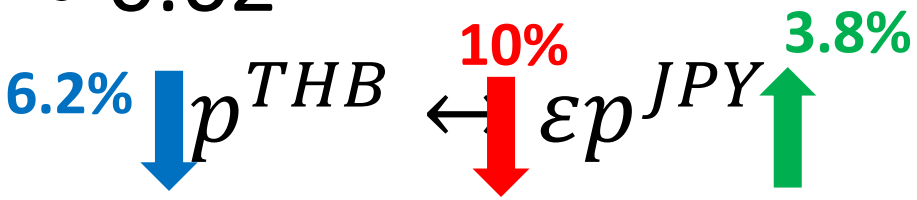
  - $\Delta \varepsilon_i^+$: baht depreciation
  - $\Delta \varepsilon_i^-$: baht appreciation

Table 3. Asymmetric Exchange Rate Pass-through

	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)
Const.	0.1067***	0.3476***	0.1066***	0.3235***	0.1008***	0.3483***
	(0.0059)	(0.0168)	(0.0058)	(0.0096)	(0.0054)	(0.0171)
$\Delta\varepsilon^{+}$	-0.1583	-0.1718	-0.1410	-0.1496		
	(0.3383)	(0.3362)	(0.3385)	(0.3360)		
$\Delta\varepsilon^{-}$	0.6094***	0.6246***	0.6121***	0.6344***		
	(0.1488)	(0.1460)	(0.1492)	(0.1469)		
$\Delta\varepsilon^{+}_{EOP}$					-0.1978	-0.2058
					(0.2857)	(0.2847)
$\Delta\varepsilon^{-}_{EOP}$					0.6209***	0.6442***
					(0.1537)	(0.1516)
Lag	-0.0052***	-0.0055***	-0.0052***	-0.0055***	-0.0052***	-0.0055***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0008)	(0.0008)
Hour	-0.0003	-0.0004*			-0.0003	-0.0004*
	(0.0002)	(0.0002)			(0.0002)	(0.0002)
Type dummies	Yes	No	Yes	No	Yes	No
R-squared	0.1225	0.0730	0.1207	0.0688	0.1240	0.0746

Asymmetric ERPT

- ERPT elasticity ≈ 0.62



- ERPT elasticity becomes higher when considering asymmetric response of resale price
  - ➢ ERPT is observed only when the resale price can be lowered
- Longer *Lag* leads to price decrease
  - ➢ Depreciation and exporters' discount

5-3. Trading Lag and ERPT

- Estimation Equation

$$\Delta P_i = \alpha_0 + \alpha_1 \Delta \varepsilon_i + \alpha_2 \Delta \varepsilon_i Lag_i + \alpha_3 Lag_i + \alpha_4 Hour_i + D_i + u_i$$

  - α_2: interaction effect of *Lag* on ERPT

Table 4. Interaction Effect of Time Lag on ERPT

	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)
Const.	0.3577***	0.3355***	0.3531***	0.3118***	0.3592***	0.3341***
	(0.0389)	(0.0164)	(0.0382)	(0.0086)	(0.0318)	(0.0163)
$\Delta\varepsilon$	0.4905***	0.4867***	0.4991***	0.5025***		
	(0.1698)	(0.1684)	(0.1711)	(0.1696)		
$\Delta\varepsilon \times Lag$	-0.0109**	-0.0106**	-0.0109**	-0.0107**		
	(0.0054)	(0.0053)	(0.0054)	(0.0053)		
$\Delta\varepsilon_{EOP}$					0.4282***	0.4367***
					(0.1508)	(0.1518)
$\Delta\varepsilon_{EOP} \times Lag$					-0.0089*	-0.0089*
					(0.0053)	(0.0053)
Lag	-0.0062***	-0.0065***	-0.0062***	-0.0065***	-0.0063***	-0.0066***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Hour	-0.0003	-0.0004*			-0.0003	-0.0004*
	(0.0002)	(0.0002)			(0.0002)	(0.0002)
Type dummies	Yes	No	Yes	No	Yes	No
R-squared	0.1206	0.0694	0.1190	0.0653	0.1208	0.0698

Asymmetric ERPT

- ERPT elasticity ≈ 0.47 when *Lag* is 0

- ERPT elasticity is lower when Lag is longer
  - ➢ Reduction of bargaining power implied by Friberg and Wilander (2008) and Ito et al. (2012)?
  - ➢ Timely trading flow would provide benefits to exporters
- Longer *Lag* leads to price decrease
  - ➢ Depreciation and exporters' discount

6. Concluding Remarks

- ERPT is found to be incomplete with the individual product level dataset
  - ➢PTM is implied consistently with the existing studies
- ERPT seems slightly higher than findings in existing studies for developed countries
  - ➢This tendency becomes more significant when considering asymmetric ERPT and the interaction effect of *Lag*
- Delays in international trading flow would lead to loss of price mechanism by enhancing PTM