Industry-Specific Real Effective Exchange Rates for Japan and China

RIETI-CASS-CESSA Joint workshop
Oct 27-28, 2012

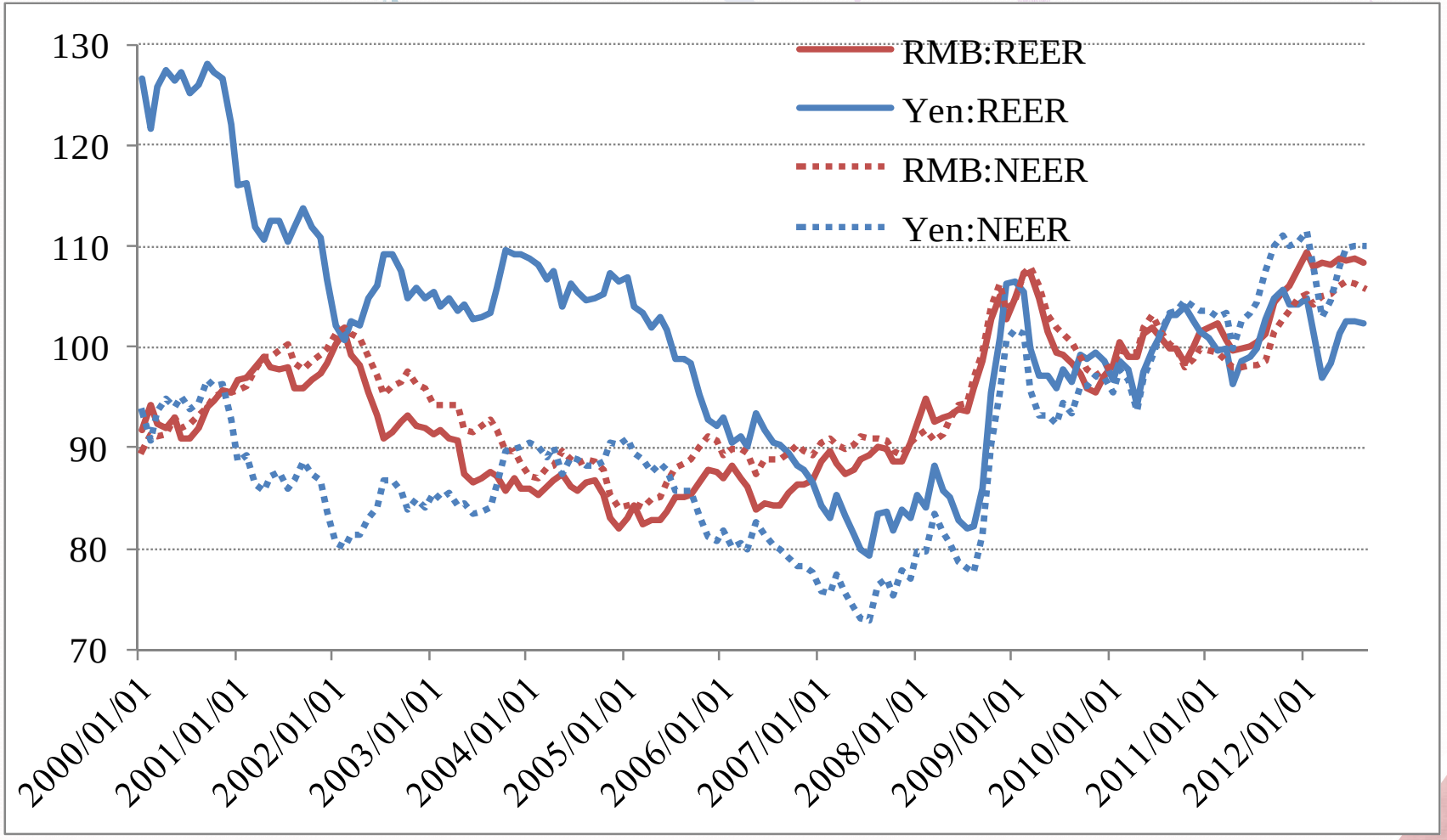
Kiyotaka Sato (*Yokohama National University*)
Junko Shimizu (*Gakushuin University*)
Nagendra Shrestha (*Yokohama National University*)
Shajuan Zhang (*Yokohama National University*)

Motivation

- Recent Yen appreciation:
  - Japanese exporting firms have serious concerns about negative impacts of the yen appreciation on their business performance and profitability.
- Renminbi's currency regime change since 2005:
  - To check whether and to what extent Chinese firms' export price competitiveness is affected across industries.
- Question:
  - Is it true that Japanese firms lose export competitiveness against other Asian countries?

  - Bilateral nominal exchange rate is not a good measurement.
  - Need to look at the real effective exchange rate (REER).

NEER and REER of Yen and RMB (BIS, 2010=100)



Objectives

- Industry-specific REER:
  - To check whether and what extent export price competitiveness of industries are different.
- Factor decomposition analysis:
  - To investigate driving factors of the REER movement and compare these factors across the industries and countries.
- Cointegration test:
  - To check whether there is a long-term stationary relationship in terms of the same industry between Japan and China

Industry-Specific REER

$$REER_{it} = \prod_{j=1}^{n} \left(RER_{it}^{j} \right)^{\alpha_{it}^{j}}$$

$$RER_{it}^{j} = NER_{jt/k} \cdot \left(\frac{P_{it}^{k}}{P_{it}^{j}} \right)$$

Note

$i \rightarrow$ *industry* $\quad j \rightarrow$ *partner* $\quad k \rightarrow Japan, China \quad t \rightarrow$ *Sample date*

$\alpha_i^j \rightarrow$ *the share of Japanese exports of industry i to country j*

Data Frequency:

Exchange Rate: Daily, Prices: Monthly and Partners' Weight: Annual

Calculation process

We employ the BOJ's method of calculation of real effective exchange rate (REER)

$$E^{2005}_{2006,1} = \prod_i \left(\frac{RER_{i,2006,1}}{RER_{i,2005,1}} \right)^{W_{i,2005}}$$

$$E^{2011}_{2011,m} = \prod_i \left(\frac{RER_{i,2011,m}}{RER_{i,2011,1}} \right)^{W_{i,2010}}$$

$$REER_{2011,m} = E^{2005}_{2006,1} * E^{2006}_{2007,1} * \ldots * E^{2010}_{2011,1} * E^{2011}_{2011,m}$$

Availability of the Price Data

(24 economies)

ISIC	Industry Classification	AUS	BLX	CAN	CHN	GER	GRC	ESP	FRA	IDN	IND	ITA	JPN	KOR	MYS	NLD	NOR	PHL	RUS	SGP	THA	TUR	TWN	UK	USA	ZAF
15	Food and Beverage	▲	▲	●	○	○	▲	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	▲	▲	○	▲
16	Tobabcoo		○		○	○	○	○	○		○		○	○	○	○		○		○		○	○	○	○	○
17	Textiles	○	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
18	Wearing Appeal, Fur		X	○	○	○	○	○	○	○	X	○	●	○	○	○	○	○	○	●	○	○	○	○	○	○
19	Leather, Footwear		○	○	○	○	○	○	○		○		●	○	○	○		○	○	○	○	○	○	○	○	▲
20	Wood products (excl. furniture)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
21	Paper and Paper products	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
22	Printing and Publishing	○	X	○	○	X	○	○	○		○	○	●	○	○	○	○	○	○	X	○	○	○	○	○	
23	Coke, Refined Petroleum product	○	○	○	○	○	○	○	○	○	X	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
24	Chemicals and Chemical products	○	○	○	▲	○	○	●	○	○	○	○	○	○	○	●	●	○	○	○	○	○	○	○	○	○
25	Rubber and Plastics products	○	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	○	▲	○	●	○	○	○	○	○	○
26	Non-metallic Mineral products	○	○	○	○	▲	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○
27	Basic Metals	○	○	○	▲	○	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○	○	○	○	○	○
28	Fabricated Metal products	○	○	○	○	X	○	○	X	X	X	○	X	X	○	○	○	○	○	X	○	○	○	○	○	○
29	Machinery and Equipment n.e.c.	○	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○	○	○	○	○	○
30	Office,Accounting and Computing Machinery	X	○	○	○	X	○	○	X	X	X	○	○	X	○	○	X	X	○	○	○	○	○	○	X	X
31	Electrical Machinery and Apparatus n.e.c.	▲	○	○		○	○	○	○		●			○	○	○	○	○		○	○	○	○	○	○	○
32	Communication Equipment and Apparatus	○	○	X	○	X	○	X	○	○	X	○	○	○	○	X	X	X	○	○	○	○	○	X	○	○
33	Optical Instruments	○	○	X	○	X		X	X		X		○	○	○	X	X	X		●	○	○		X	X	X
34	Motor Vehicles, Trailers and Semi-trailers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
35	Other Transport Equipment					○	○	○	○						○	○			○			○	○	○		○
	Weight	○	X	○	X	X	X	○	X	X	○	X	○	○	X	○	○	X	X	○	X	X	X	X	X	X

○ means that the data is available but not exactly corresponds to ISIC.

● means that more detailed data is available, and the industry weight data is also available.

▲ means that more detailed data is available, but the industry weight data is not available.

X means that the data is not available.

Asia: 9
Europe: 9
Others: 6

Industry Classification

Aggregate 22 ISIC manufacturing industries into 12 industries:

Code	ISIC.rev3	Industry Name	Description
1	15-16	Food	Food, Beverage, Tobabcoo
2	17-19	Textile	Textiles, Textile Products, Leather and Footwear
3	20	Wood	Wood Products(excl. furniture)
4	21-22	Paper	Paper, Paper Products, Printing and Publishing
5	23	Petroleum	Coke, Refined Petroleum Products,Nuclear Fuel
6	24	Chemical	Chemicals and Chemical Products
7	25	Rubber	Rubber and Plastics Products
8	26	Non-Metal	Non-metallic Mineral Products
9	27-28	Metal	Basic Metals and Fabricated Metal Products
10	29	General Machinery	Machinery and Equipment n.e.c.
11	30-33	Electric Machinery	Electrical Machinery and Apparatus n.e.c.
12	34-35	Transport Equipment	Transport Equipment

Data Source

Country	Datasource	Link
American	FEDSTATS	
	U.S. Bureau of Labor Statistics (BLS)	http://www.bls.gov/ppi/#data
Australian	Australian Bureau of Statistics	http://www.abs.gov.au/
Belgium	CEIC	
Canada	Statistics Canada	http://www5.statcan.gc.ca
China	1. CEIC	
	2. *China Monthly Statistic*	
	3. *China Statistical Yearbook*	
France	National Institute of Statistics and Economic Studies	http://www.bdm.insee.fr
German	GENESIS-Online Database	https://www-genesis.destatis.de
Greece	CEIC	
India	Office of Economic Adviser to Government of India	http://eaindustry.nic.in/
Indonesia	1. BPS, *Indikator Ekonomi (Economic Indicators)*	
	2. CEIC	
Italy	CEIC	
Japan	Bank of Japan	http://www.boj.or.jp/
Korea	The Bank of Korea	http://eng.bok.or.kr/eng/engMain.action
Malaysia	CEIC	
Netherlands	Statistics Netherlands Statline Database	http://statline.cbs.nl/StatWeb/?LA=en
Norway	Statistics Norway	http://statbank.ssb.no
Philippines	1. Republic of Philippines National Statistics Office	http://www.census.gov.ph
	2. *Philippine Yearbook*	
Russia	CEIC	
Singapore	CEIC	
	Statistics Singapore	http://www.singstat.gov.sg/
South Africa	CEIC	
Spain	National Statistics Institute	http://www.ine.es
Thailand	CEIC	
Taiwan	CEIC(include output data)	
Turkey	CEIC	
UK	CEIC	
Trade Data	UN Comtrade	http://comtrade.un.org/

Trade Weight in 2010 for Japan

	AUS	BLX	CAN	CHN	GER	GRC	ESP	FRA	IDN	IND	ITA	KOR	MYS	NLD	NOR	PHL	RUS	SGP	THA	TUR	TWN	UK	USA	ZAF	WOR
Food	3.3	0.5	1.7	15.4	0.9	0.0	0.4	1.1	1.4	0.1	0.3	11.5	1.3	1.1	0.1	1.5	1.8	4.4	7.8	0.1	18.6	1.2	25.1	0.4	66.6
Textile	0.5	0.6	0.5	59.8	1.9	0.1	0.4	1.5	1.5	0.6	2.2	6.8	1.6	0.3	0.0	1.1	0.2	1.5	3.9	0.3	4.7	1.0	8.9	0.1	73.5
Wood	0.3	1.1	0.5	27.4	2.1	0.0	0.1	1.1	2.9	0.1	0.2	15.5	1.5	1.1	0.0	16.8	0.7	0.6	3.2	0.0	5.2	1.8	17.8	0.0	91.0
Paper	3.1	0.4	0.8	28.5	2.5	0.0	0.4	1.0	2.7	1.1	0.6	10.1	4.3	2.2	0.0	1.9	1.1	3.0	6.9	0.2	9.6	1.4	17.9	0.3	86.7
Petroleum	0.5	0.0	0.0	13.7	0.4	0.0	2.3	2.0	1.2	12.4	1.2	26.4	0.5	4.3	0.0	0.7	0.0	0.1	1.9	0.0	3.5	0.7	27.6	0.4	78.4
Chemical	1.0	1.9	0.3	26.1	3.2	0.0	0.6	1.5	2.0	1.5	1.4	16.7	2.0	2.3	0.1	1.4	0.2	2.5	5.0	0.4	13.5	1.4	14.8	0.2	89.1
Rubber	3.3	2.8	1.9	19.0	3.4	0.2	0.6	1.4	2.5	0.9	1.1	18.8	1.5	1.7	0.1	1.9	1.7	2.1	4.0	0.6	11.5	2.0	16.3	0.8	80.9
Non-Metal	1.3	1.2	0.5	17.5	4.1	0.0	0.2	1.0	1.2	0.8	0.6	24.2	2.6	2.8	0.1	2.9	0.3	2.3	4.0	0.1	18.5	1.0	11.4	1.6	89.7
Metal	1.8	0.6	1.1	25.0	1.4	0.1	0.2	0.4	3.5	2.1	0.4	17.1	5.5	0.8	0.6	2.4	0.5	5.0	8.5	0.3	10.5	3.6	8.7	0.2	84.7
General	2.1	1.9	1.3	21.4	3.6	0.2	0.8	1.9	2.7	2.4	1.5	10.4	2.2	3.2	0.1	1.3	1.4	3.4	5.4	0.8	9.7	2.1	19.7	0.6	86.3
Electric	1.2	1.1	1.2	25.5	7.1	0.1	0.8	1.4	1.2	1.1	0.9	8.5	3.7	3.6	0.1	2.7	0.4	3.2	4.1	0.3	6.8	2.8	22.1	0.3	80.8
Transport	6.0	1.4	4.6	8.6	3.2	0.6	1.5	2.0	1.7	0.5	1.8	1.7	1.9	2.1	0.5	0.8	5.6	2.3	3.2	0.6	1.5	4.3	41.6	2.0	68.5

General = General Machinery
Electric = Electric Machinery
Transport = Transport Equipment

Note: See Table 2 for the industry code. "WOR" represents the share of the 24-total exports in the Japanese overall exports including all partner countries for each industry.
Source: Authors' calculation from the UN Comtrade Database.

Trade Weight in 2010 for China

	AUS	BLX	CAN	GER	GRC	ESP	FRA	IDN	IND	ITA	JPN	KOR	MYS	NLD	NOR	PHL	RUS	SGP	THA	TUR	TWN	UK	USA	ZAF	WOR
Food	6.9	1.1	2.5	4.7	0.1	2.1	1.5	1.3	0.3	1.4	29.6	9.5	2.9	2.8	0.2	1.7	3.8	1.3	2.0	0.2	2.0	2.3	19.4	0.6	79.4
Textile	2.6	1.7	3.3	6.3	0.4	2.9	3.3	1.2	1.5	4.1	17.5	4.2	1.7	2.6	0.5	0.8	6.6	1.9	0.8	1.2	0.6	4.9	27.5	1.6	65.4
Wood	1.8	2.4	4.1	5.3	0.6	2.3	2.8	0.8	0.7	2.6	19.5	4.4	2.2	3.4	0.2	0.3	1.7	2.9	1.2	0.5	1.9	6.7	31.2	0.5	79.6
Paper	5.5	1.2	2.1	3.1	0.6	1.4	2.3	1.5	4.1	2.0	12.2	4.3	2.7	2.1	0.2	1.5	2.1	1.9	2.1	1.8	4.1	7.2	33.0	0.9	64.6
Petroleum	3.3	6.4	1.9	1.1	0.0	0.4	3.2	1.3	11.4	1.4	19.9	4.8	1.0	4.8	0.0	3.4	2.2	4.9	1.5	2.4	3.0	1.1	17.0	3.4	58.8
Chemical	2.5	2.5	1.3	5.6	0.2	2.2	1.6	3.3	10.6	2.7	13.1	9.3	2.4	4.2	0.2	1.4	2.4	2.1	3.7	2.3	6.2	2.2	16.7	1.2	71.6
Rubber	4.0	1.9	3.3	4.4	0.5	2.0	2.5	1.3	2.4	2.4	11.4	2.7	1.7	2.8	0.3	1.6	3.3	1.6	1.3	0.8	1.8	5.3	39.5	1.2	66.3
Non-Metal	3.3	2.2	2.8	5.3	0.8	3.7	1.9	1.8	4.1	3.8	11.4	10.8	2.7	3.0	0.3	1.4	5.5	2.5	2.0	1.7	2.4	3.9	21.3	1.5	62.9
Metal	2.9	2.9	2.7	3.8	0.6	2.5	1.4	2.7	5.4	3.8	8.7	15.7	2.0	3.8	0.3	1.2	3.3	3.2	2.5	1.4	3.6	3.3	21.1	0.9	66.2
General	3.0	1.5	2.7	6.2	0.7	2.5	2.9	2.9	5.9	4.2	12.1	4.2	2.1	2.6	0.3	0.8	4.1	2.4	2.3	2.1	2.0	4.2	26.9	1.4	65.8
Electric	2.0	0.7	1.8	8.0	0.2	1.8	2.9	1.1	3.2	1.7	10.4	6.0	2.7	7.6	0.1	0.6	1.7	3.8	1.6	1.0	3.1	3.7	33.6	0.6	62.6
Transport	2.5	1.0	2.6	10.4	1.7	0.8	3.6	2.0	1.8	3.2	10.6	5.5	2.0	3.2	1.2	0.8	4.1	11.3	1.1	0.9	1.9	4.3	22.3	1.1	52.8

General = General Machinery
Electric = Electric Machinery
Transport = Transport Equipment

Note: See Table 2 for the industry code. "WOR" represents the share of the 24-total exports in the Chinese overall exports including all partner countries for each industry.
Source: Authors' calculation from the UN Comtrade Database.

Transport Shares in 2010 for other Japanese Partner Countries

Partner	transport share
Saudi Arabia	0.019
Mexico	0.016
Hong Kong	0.012
Brazil	0.009
Chile	0.006
Israel	0.006
New Zealand	0.005
Switzerland	0.004
Finland	0.004
Poland	0.004
Rest of world	0.208
Total	0.294

Note:
Data source: UN Comtrade
Share data is an average of last three year.(2008.2009.2010)

Export Shares in 2010 for other Chinese Partner Countries

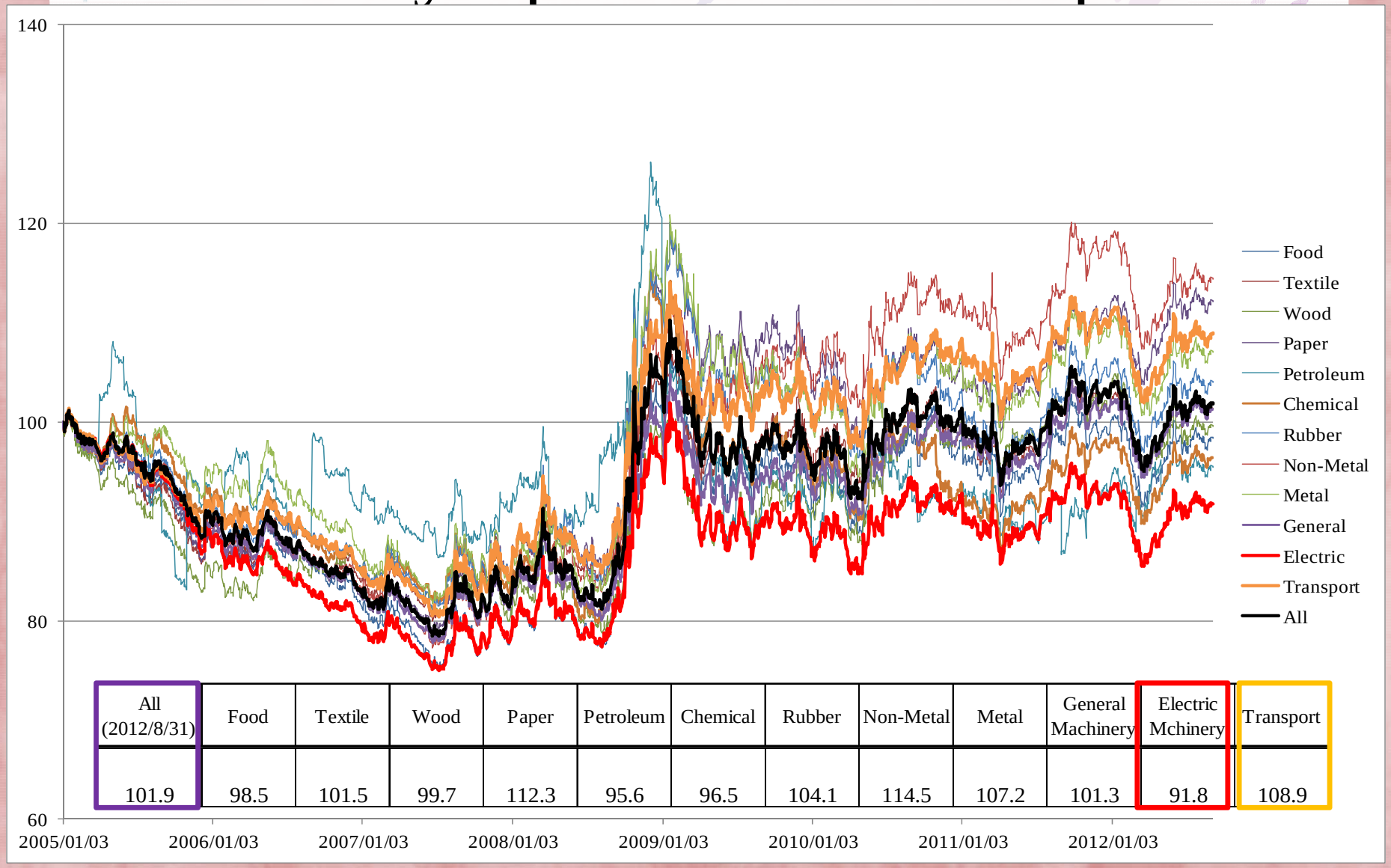
Partner	Export Share
Hong Kong	0.137
Brazil	0.014
Vietnam	0.013
Mexico	0.010
Saudi Arabia	0.007
Poland	0.006
Chile	0.005
Hungary	0.004
Czech republic	0.004
Finland	0.004
Sweden	0.004
Denmark	0.004
Rest of the world	0.118
Total	0.329

Note:
Data source: UN Comtrade
Share data is an average of last three year.(2008.2009.2010)

Industry Weight by export in 2010 (percent)

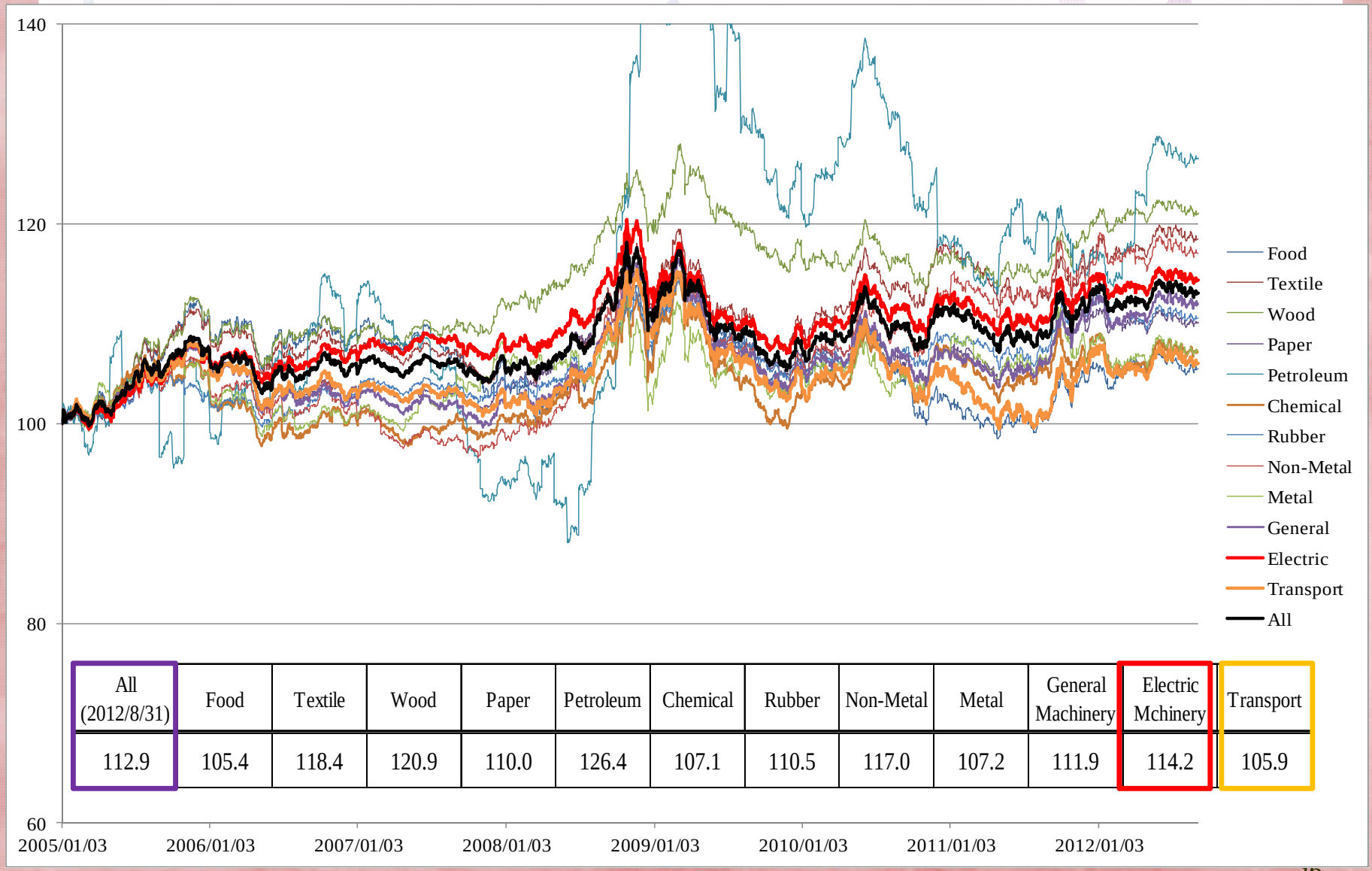
	Japan	China	Korea
1 Food	0.6	2.3	0.9
2 Textile	1.0	**18.3**	3.1
3 Wood	0.0	0.9	0.0
4 Paper	1.1	0.9	0.8
5 Petroleum	1.9	1.4	7.4
6 Chemical	**10.3**	6.0	**10.9**
7 Rubber	3.3	2.7	2.1
8 Non-Metal	1.3	1.9	0.4
9 Metal	**10.0**	**9.6**	**9.9**
10 General Machinery	**16.0**	**10.0**	8.3
11 Electric Machinery	**27.0**	**40.5**	**34.3**
12 Transport Equipment	**27.6**	5.4	**21.9**

Industry-Specific REER–Japan



All (2012/8/31)	Food	Textile	Wood	Paper	Petroleum	Chemical	Rubber	Non-Metal	Metal	General Machinery	Electric Mchinery	Transport
101.9	98.5	101.5	99.7	112.3	95.6	96.5	104.1	114.5	107.2	101.3	91.8	108.9

Industry-Specific REER–China



All (2012/8/31)	Food	Textile	Wood	Paper	Petroleum	Chemical	Rubber	Non-Metal	Metal	General Machinery	Electric Mchinery	Transport
112.9	105.4	118.4	120.9	110.0	126.4	107.1	110.5	117.0	107.2	111.9	114.2	105.9

Comparison of REERs between Japan and China

Factor Decomposition Analysis

in selected industries

Industry-Specific REER

$$REER_{it} = \prod_{j=1}^{n} \left(RER_{it}^{j} \right)^{\alpha_{it}^{j}}$$

$$RER_{it}^{j} = NER_{jt/k} \cdot \left(\frac{P_{it}^{k}}{P_{it}^{j}} \right)$$

Domestic Price

Foreign Price

Note

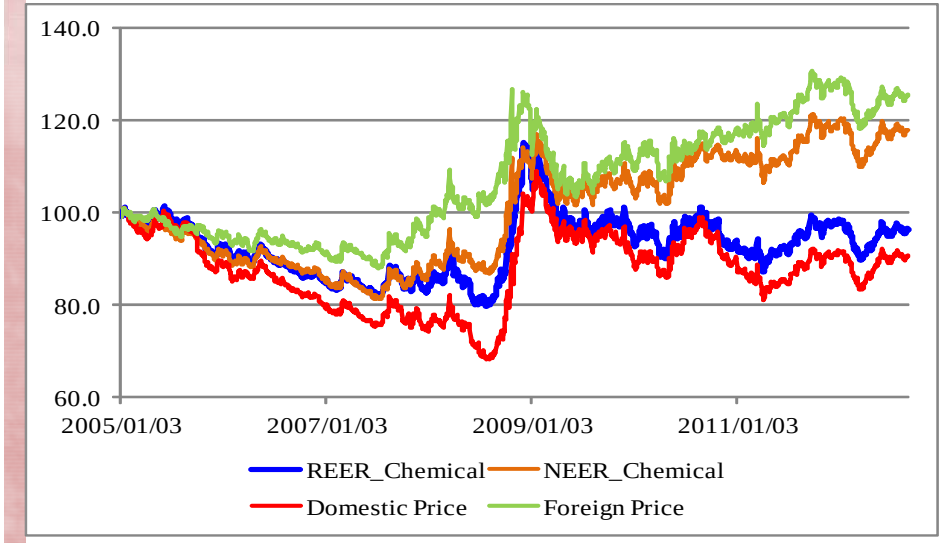
i → *industry* *j* → *partner* *k* → *Japan* & *China* *t* → *Sample* *date*

Factor Decomposition Analysis

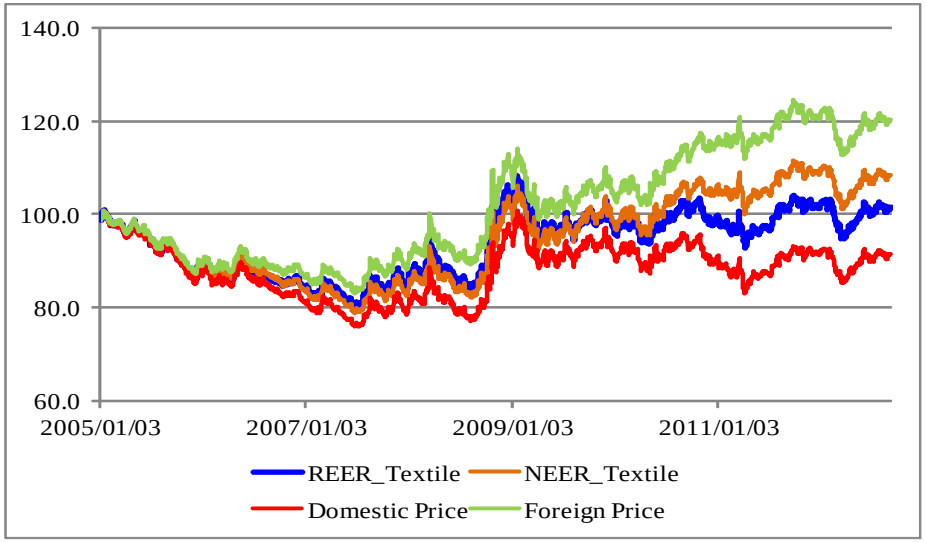
- The differences between domestic and foreign price lead the deviation between REER and NEER.
- Factor Decomposition Analysis
  - "Domestic_Price" represents the simulated REER if the domestic price (producer price) is assumed to be constant at the initial observation (January 2005) over the sample period.
  - "Foreign_Price represents the simulated REER if the weighted average of partner country's price (producer price) is assumed to be constant at the initial observation (January 2005) over the sample period.

Factor Decomposition of REER Fluctuations: the Case of Japan

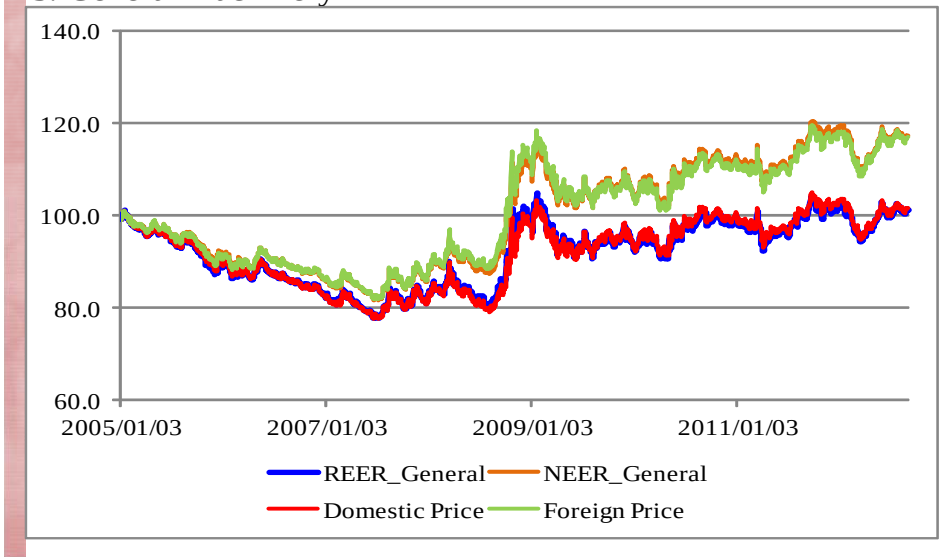
1. Chemicals



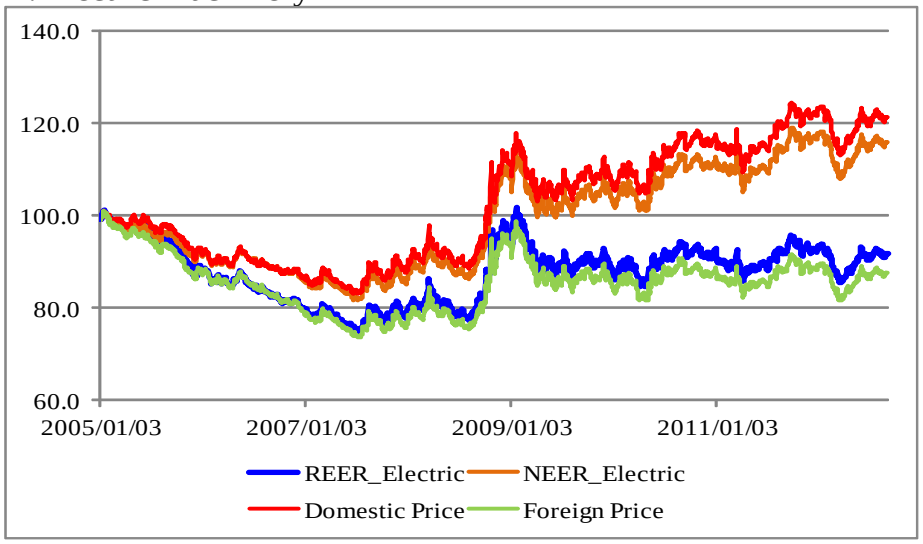
2. Textile



3. General Machinery

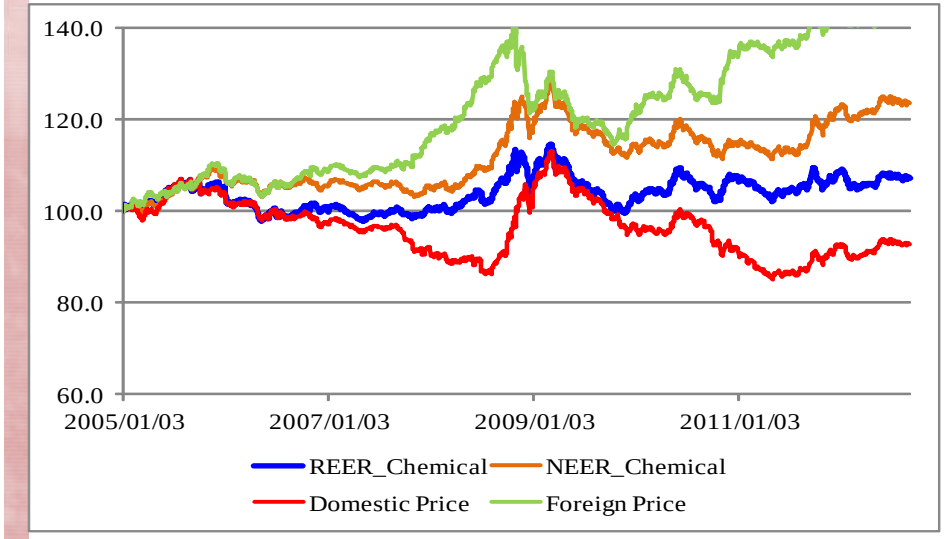


4. Electric Machinery

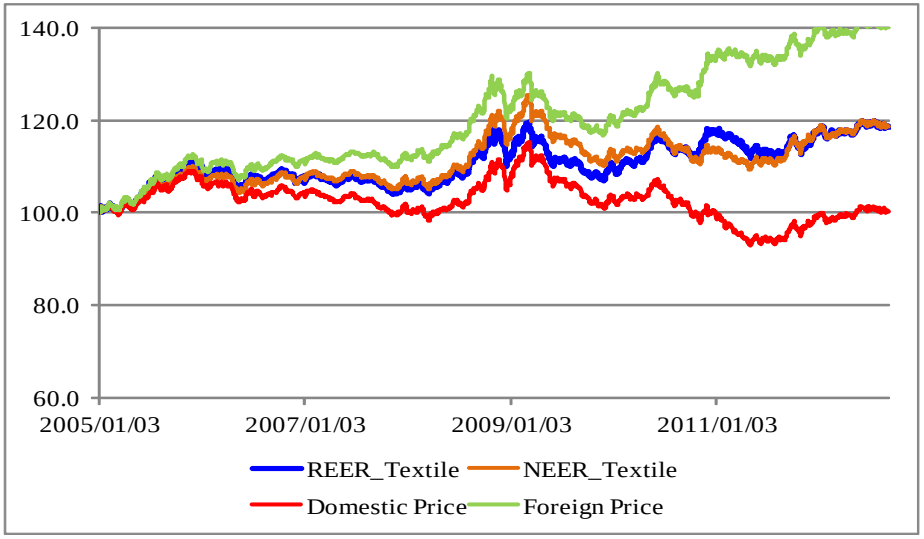


Factor Decomposition of REER Fluctuations: the Case of China

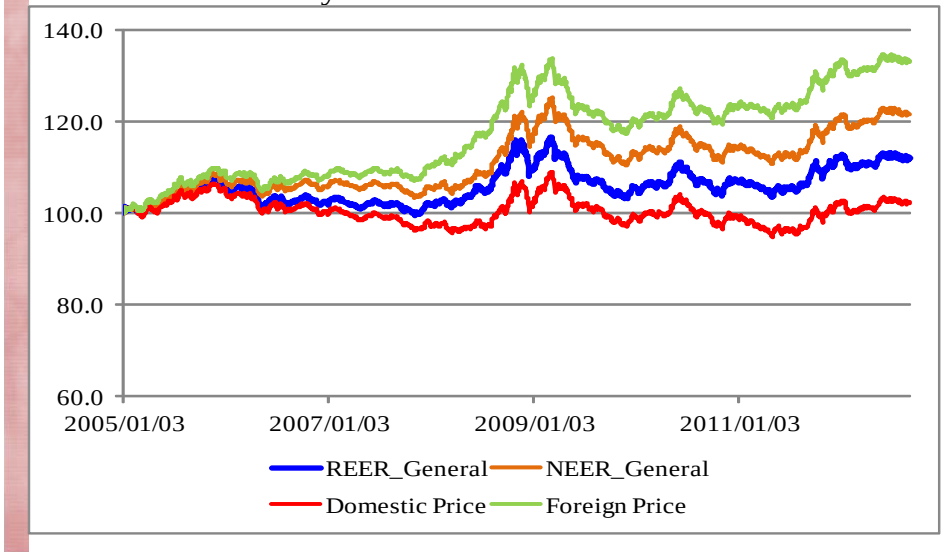
1. Chemicals



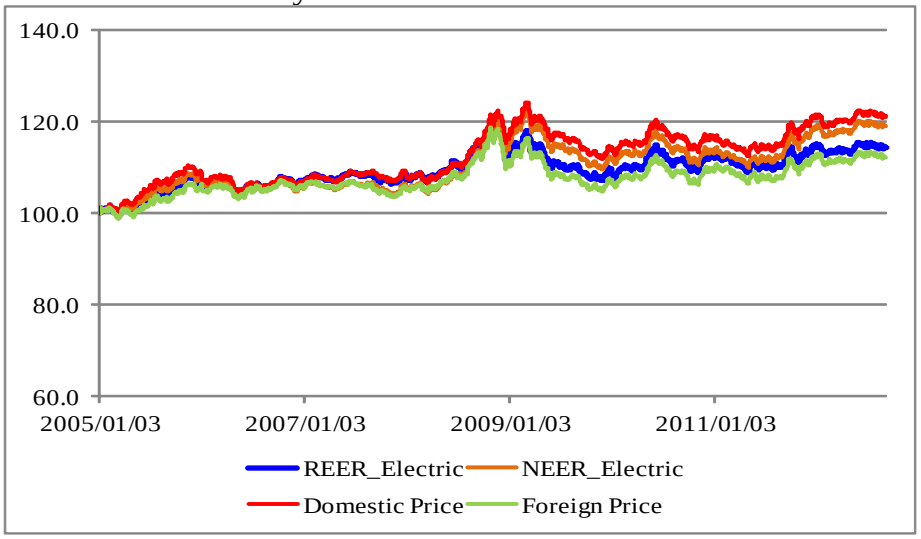
2. Textile



3. General Machinery



4. Electric Machinery



Cointegration Test of REERS

Motivation

- Given growing and deepening production network in Asia, the regional intra-industry trade along the production-chain increases actively .
- Such stable relationship can mitigate the effect of macroeconomic shocks on regional economies.
- We conduct cointegration test to investigate whether there exists an equilibrium relationship of REERs at an industry level between Japan and China.

Analytical Framework

- We conduct VAR-based cointegration tests using the methodology developed in Johansen (1990, 1991).
  - By SIC, the lag order chosen is two; that is,

$$\Delta X_t = \Pi X_{t-1} + \Gamma_1 \Delta X_{t-2} + \mu + \varepsilon_t$$

- In order to distinguish the affect of the Lehman Brothers collapse in September 2008, we divide the full sample period (6/1/2005 to 31/8/2012) into two sub-sample periods:
  - Before the Lehman Brothers collapse (6/1/2005 to 31/8/2008)
  - After the Lehman Brothers collapse (5/1/2009 to 31/8/2012).

The results of the cointegration test

Sample Period Observations		1/06/2005 - 8/31/2012 1997			1/06/2005 - 8/29/2008 952			1/05/2009 - 8/31/2012 955		
Indsutry	Hypothesized No. of CE(s)	Trace Statistic	Max-Eigen Statistic	Prob.**	Trace Statistic	Max-Eigen Statistic	Prob.**	Trace Statistic	Max-Eigen Statistic	Prob.**
All Industries	None	16.1029 *	13.6308 *	0.0405	6.3676	4.4562	0.6521	19.9451 *	15.6375 *	0.0100
	At most 1	2.4722	2.4722	0.1159	1.9114	1.9114	0.1668	4.3076 *	4.3076 *	0.0379
Electric Machinery	None	15.7933 *	11.2642 *	0.0451	5.3081	5.1367	0.7753	19.3072 *	15.0332 *	0.0127
	At most 1	4.5291 *	4.5291 *	0.0333	0.1715	0.1715	0.6788	4.2740 *	4.2740 *	0.0387
General Machinery	None	12.0077	15.4947	0.0929	6.4661	4.6351	0.6404	14.6623	11.8552	0.0665
	At most 1	1.6489	3.8415	0.1991	1.8311	1.8311	0.1760	2.8070	2.8070	0.0938
Food	None	9.2045	6.3019	0.3468	10.8479	7.9428	0.2210	16.0723 *	13.0709 *	0.0409
	At most 1	2.9026	2.9026	0.0884	2.9050	2.9050	0.0883	3.0015	3.0015	0.0832
Chemical	None	21.5579 *	17.5266 *	0.0054	6.4384	4.0046	0.6437	16.7097 *	12.0511 *	0.0327
	At most 1	4.0313 *	4.0313 *	0.0447	2.4338	2.4338	0.1187	4.6586 *	4.6586 *	0.0309
Metal	None	23.4119 *	20.0578 *	0.0026	6.0185	3.9210	0.6934	25.1670 *	16.6353 *	0.0013
	At most 1	3.3541	3.3541	0.0670	2.0975	2.0975	0.1475	8.5317 *	8.5317 *	0.0035
Non-Metal	None	11.1849	10.6925	0.2004	5.7844	5.0530	0.7208	12.8254	10.9169	0.1214
	At most 1	0.4924	0.4924	0.4829	0.7314	0.7314	0.3924	1.9085	1.9085	0.1671
Paper	None	13.7931	11.9241	0.0888	7.2012	7.1440	0.5544	16.5368 *	12.7502 *	0.0347
	At most 1	1.8690	1.8690	0.1716	0.0572	0.0572	0.8110	3.7866	3.7866	0.0517
Petroleum	None	30.5775 *	27.0906 *	0.0001	17.0146 *	12.8524 *	0.0293	25.2821 *	21.4248 *	0.0012
	At most 1	3.4868	3.4868	0.0619	4.1622 *	4.1622 *	0.0413	3.8572 *	3.8572 *	0.0495
Rubber	None	14.6085	12.4526	0.0677	6.2978	5.2962	0.6603	16.8174 *	12.6695 *	0.0314
	At most 1	2.1559	2.1559	0.1420	1.0016	1.0016	0.3169	4.1479 *	4.1479 *	0.0417
Textile	None	14.4901	13.5825	0.0704	10.6615	7.6840	0.2332	20.3925 *	17.8557 *	0.0084
	At most 1	0.9076	0.9076	0.3408	2.9774	2.9774	0.0844	2.5368	2.5368	0.1112
Tranport Equipment	None	10.5122	8.6981	0.2434	8.6492	5.4327	0.3988	15.4507	11.0677	0.0508
	At most 1	1.8140	1.8140	0.1780	3.2165	3.2165	0.0729	4.3829 *	4.3829 *	0.0363
Wood	None	13.0089	11.1967	0.1145	10.0362	10.0341	0.2780	12.3800	8.4066	0.1396
	At most 1	1.8122	1.8122	0.1782	0.0021	0.0021	0.9600	3.9734 *	3.9734 *	0.0462

Trace test and Max-eigenvalue test indicate no cointegration at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.
Lags interval (in first differences): 1 to 2. Trend assumption: Linear deterministic trend.

Conclusion

- Industry-Specific REERS between countries:
  - A large difference between countries at level, Japan is lower than China based on 2005 as a benchmark year.
  - Japanese firms' efforts of adjusting price level is much obvious.
    - Electric Machinery: lowering price
    - Transport Equipment , General Machinery: keeping price
- The presence of cointegrating relationships in all industries and 7 industries is confirmed in the post-Lehman Brothers collapse period.
  - These results indicate that the equilibrium relationship between Japan and China has expanded in various industries after the Lehman Brothers collapse, which suggests us the widening of the production-chain network between Japan and China.

References

- Blanchard, O.J. and D. Quah, 1989, "The Dynamic Effects of Aggregate Demand and Supply Disturbances," *American Economic Review*, 79, pp.655-673.
- Chang, S. C., 2008, "Asymmetric cointegration relationship among Asian exchange rates," *Economic Change and Restructuring*, 41, pp.125–141.
- Cushman, David O. and Tao Zha, 1997, "Identifying Monetary Policy in a Small Open Economy under Flexible Exchange Rates," *Journal of Monetary Economics*, 39, pp.433-448.
- Engel, R. F. and Granger, C. W. J., 1987, "Co-integration and Error Correction: Representation, Estimation, and Testing," *Econometrica*, 55, pp.251-276.
- Johansen, S., 1991. "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models," *Econometrica*, 59, pp.1551-1581.
- Johansen, S. and Juselius, K., 1990. "Maximum Likelihood Estimation and Inference on Cointegration - With Applications to the Demand for Money," Oxford Bulletin of Economics and Statistics, 52, pp.169-210.
- Maćkowiak, Bartosz, 2007, "External Shocks, U.S. Monetary Policy and Macroeconomic Fluctuations in Emerging Markets," *Journal of Monetary Economics*, 54, pp.2512-2530.
- MacKinnon, J.G., A.A. Haug, and L. Michelis (1999), "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration," *Journal of Applied Econometrics*, 14, pp.563-577.
- Mollick, A.V., 2009, "Crisis and Volatility in Asian versus Latin American Real Exchange Rates," *Économie internationale*, 117 (2009), pp. 5-29.
- Sato, K., Shimizu J., Shrestha N., and Zhang Z., 2012a, "Industry-specific Real Effective Exchange Rates for Japan," RIETI Discussion Paper, 12-E-044.
- Sato, K., Shimizu J., Shrestha N., and Zhang Z., 2012b, "The Construction and Analysis of Industry-specific Effective Exchange Rates in Japan," RIETI Discussion Paper, 12-E-043.
- Sims, C.A. and Tao Zha, 1999, "Error Bands for Impulse Responses," *Econometrica*, 67, pp.1113-1156.
- Zha, Tao, 1999, "Block Recursion and Structural Vector Autoregression," *Journal of Econometrics*, 90, pp.291-316.