'Abenomics', Yen Depreciation, Trade Deficit and Export Competitiveness

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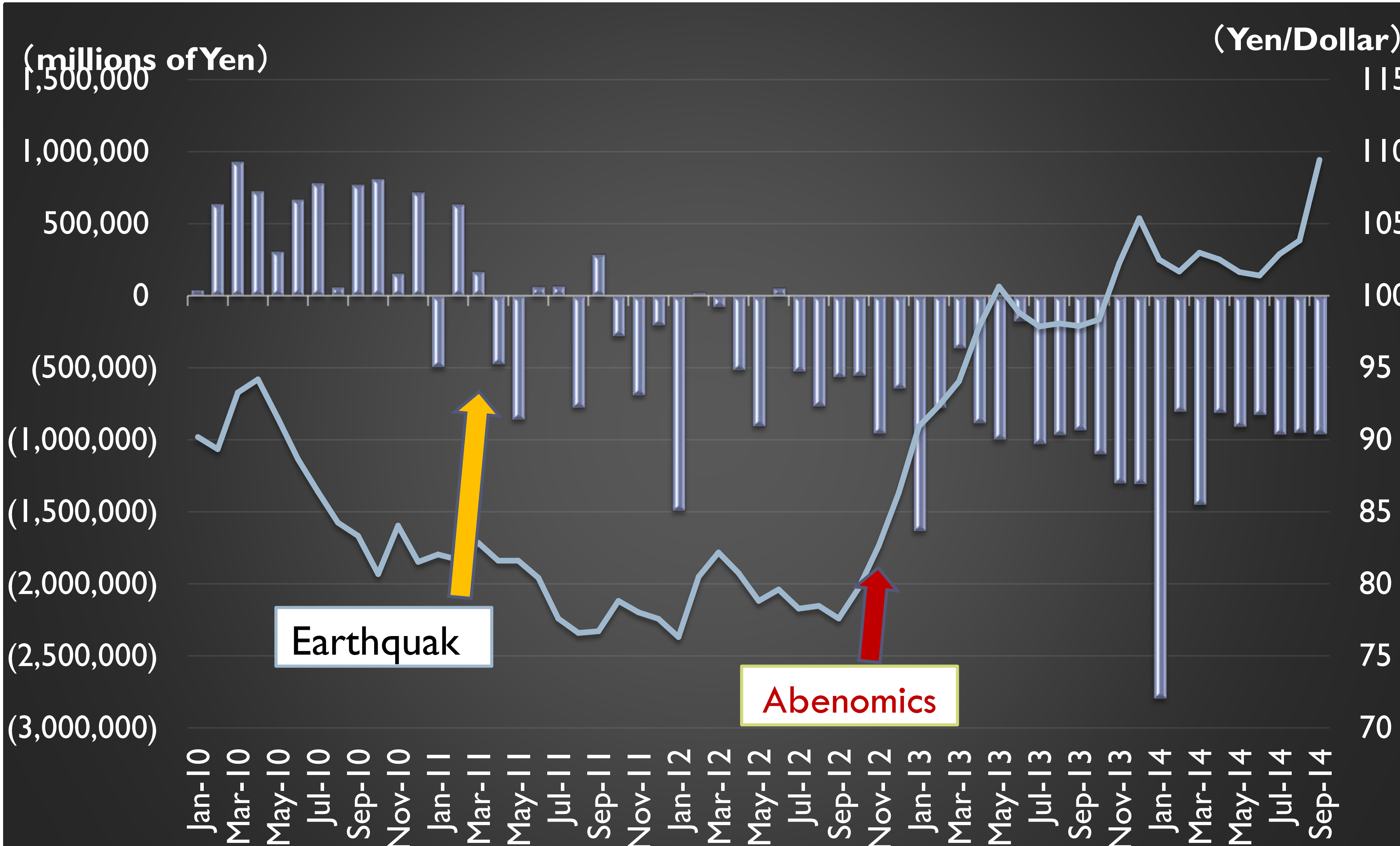
Motivation

- The rapid depreciation of the yen since the end of 2012 was expected to improve Japan's trade balance.
  - In line with **"J-curve effect",** a weaker yen increases import prices and causes the trade deficit to expand in the short run.
  - Over time, it was expected that Japan's trade balance would improve.
- In reality, Japan's trade balance has worsened rather than improved in 2013 to 2014.
  - Are Japanese products losing their international competitive in the global market?

Trade Balance and Yen/Dollar



Purpose of this paper

- This paper empirically demonstrates why Japanese trade deficit continues to grow despite the yen's depreciation brought by '*Abenomics*'.
- We try to make the explanation from following different approaches.
  - J-Curve Analysis
  - Pass-through Analysis
  - Industry-Specific REER

Our findings 1: No J-curve effect

A sharp appreciation of the yen after Lehman shock promoted Japanese firms to expand their production networks in Asian countries.

An increase in Japan's export of industrial products is accompanied with an increase in the import of parts and components from Asian countries.

We confirm that exchange rate fluctuations in the 2000s had a weaker impact on the trade balance than the 1990s (No J-Curve effect).

Our findings 2: No Price Revision

Japanese manufacturing export prices in terms of the contract currency (mainly US$) have not changed in response to the Yen' movement (=PTM Behavior).

The proportion of yen-denominated export has been on a decline in recent years (Firms choose USD invoicing).

Japan's export structures have changed, and the yen's depreciation no longer leads the trade balance improvement.

Our findings (3)

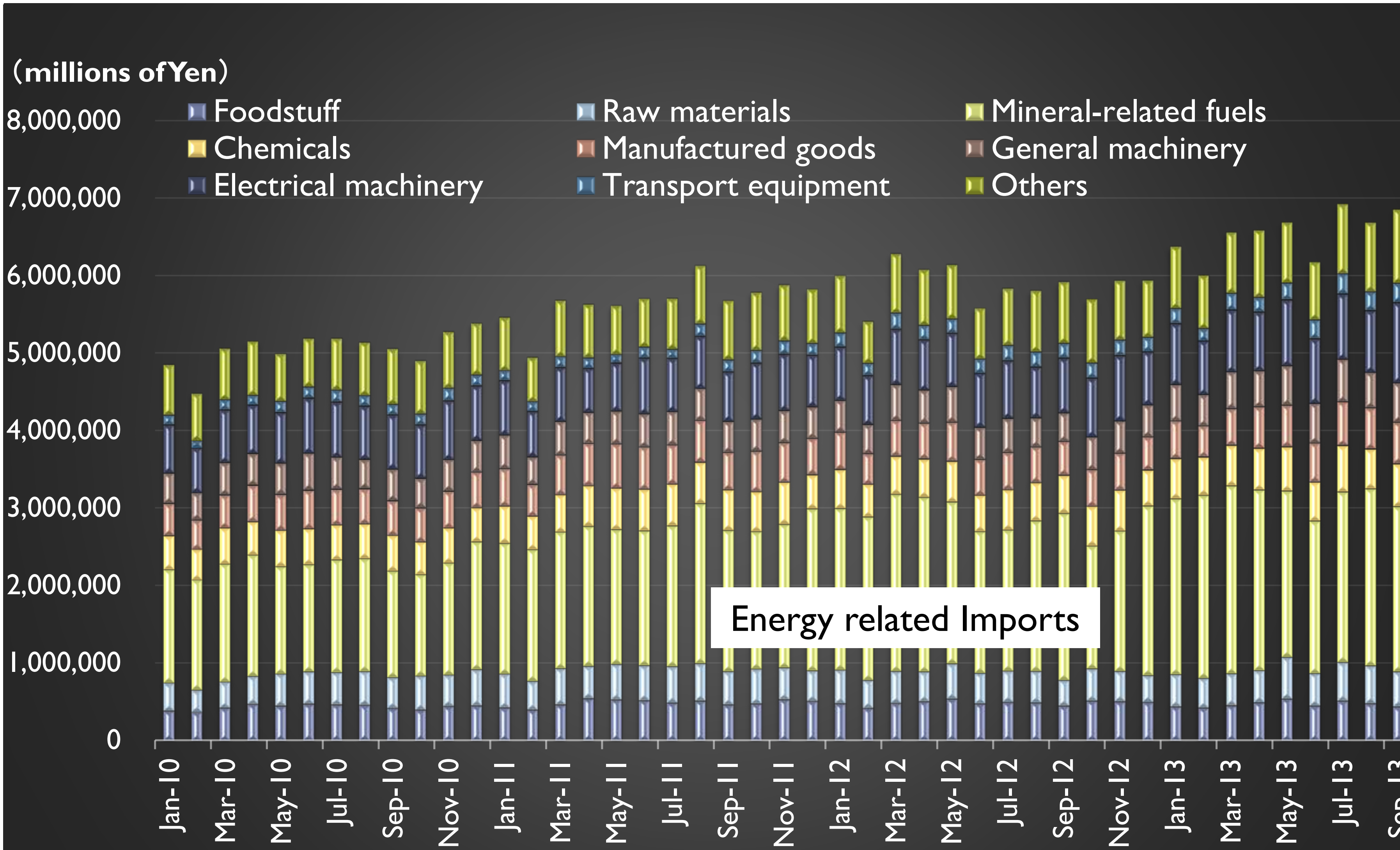
- A comparative analysis of the industry-specific REER between Japan and Korea shows:
  - The recent yen’s depreciation has improved the export price competitiveness of the Japanese manufacturing firms compared with Korean firms.

Contents

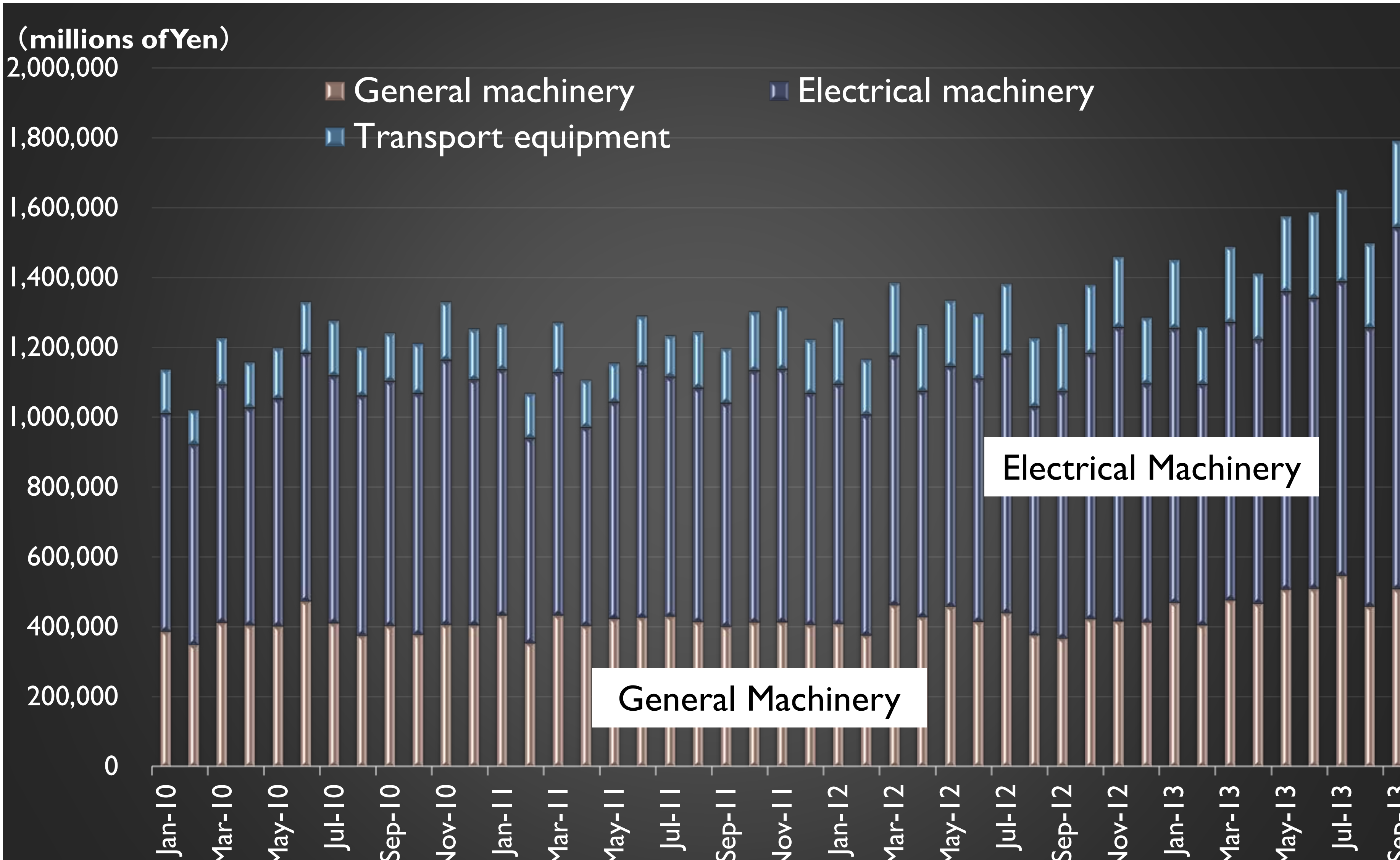
I. Current characteristics Japanese trade by data
II. J-curve effects analysis by using an auto-regressive distributed lag (ARDL) model
III. Time-varying parameter estimation of the exchange rate pass-through in Japanese manufacturing exports
IV. The export competitiveness between Japan and Korea by using the industry-specific REER
V. Conclusion and policy implication

1. Current characteristics Japanese trade

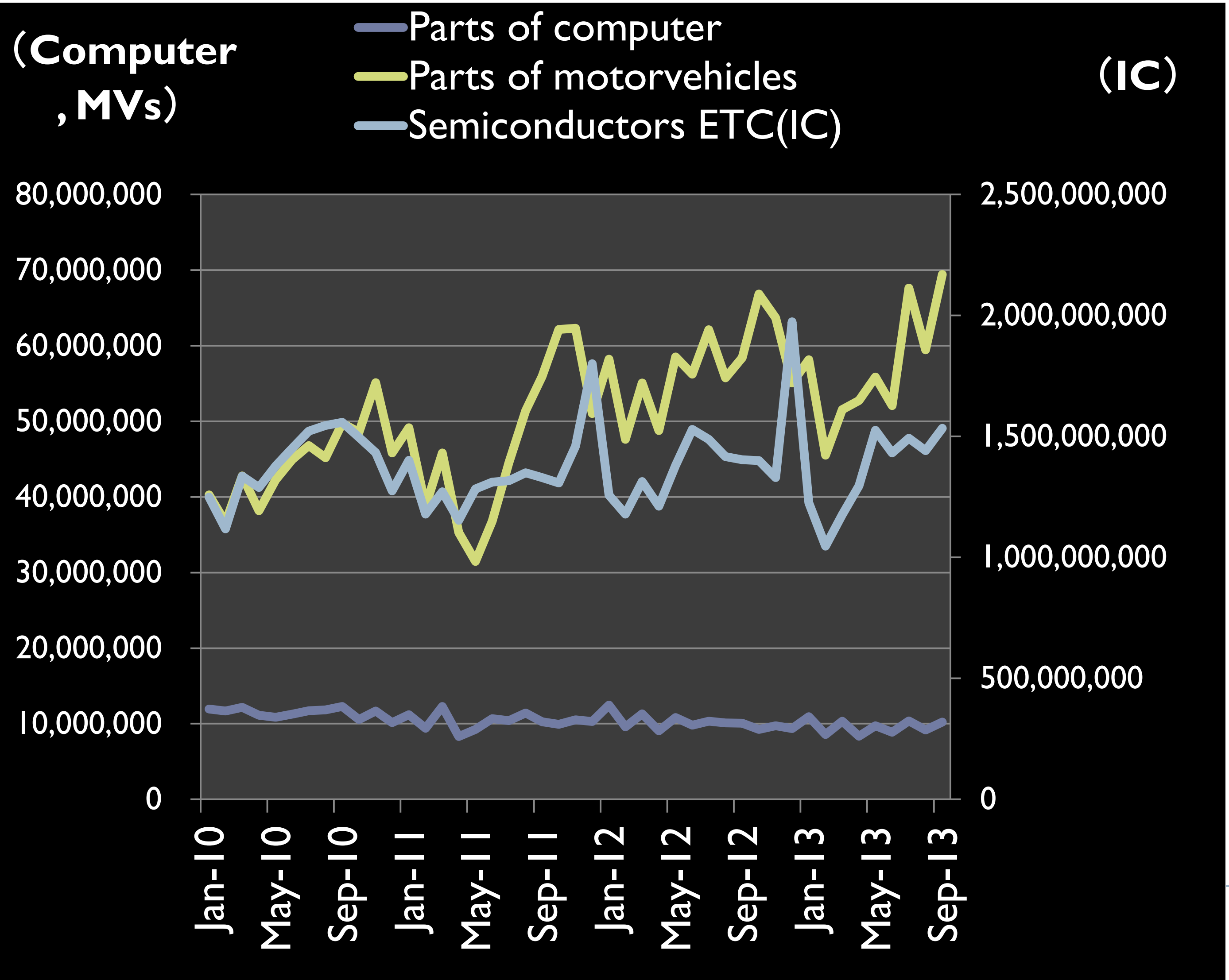
Import Value by Industry



Import Value by Selected Industry



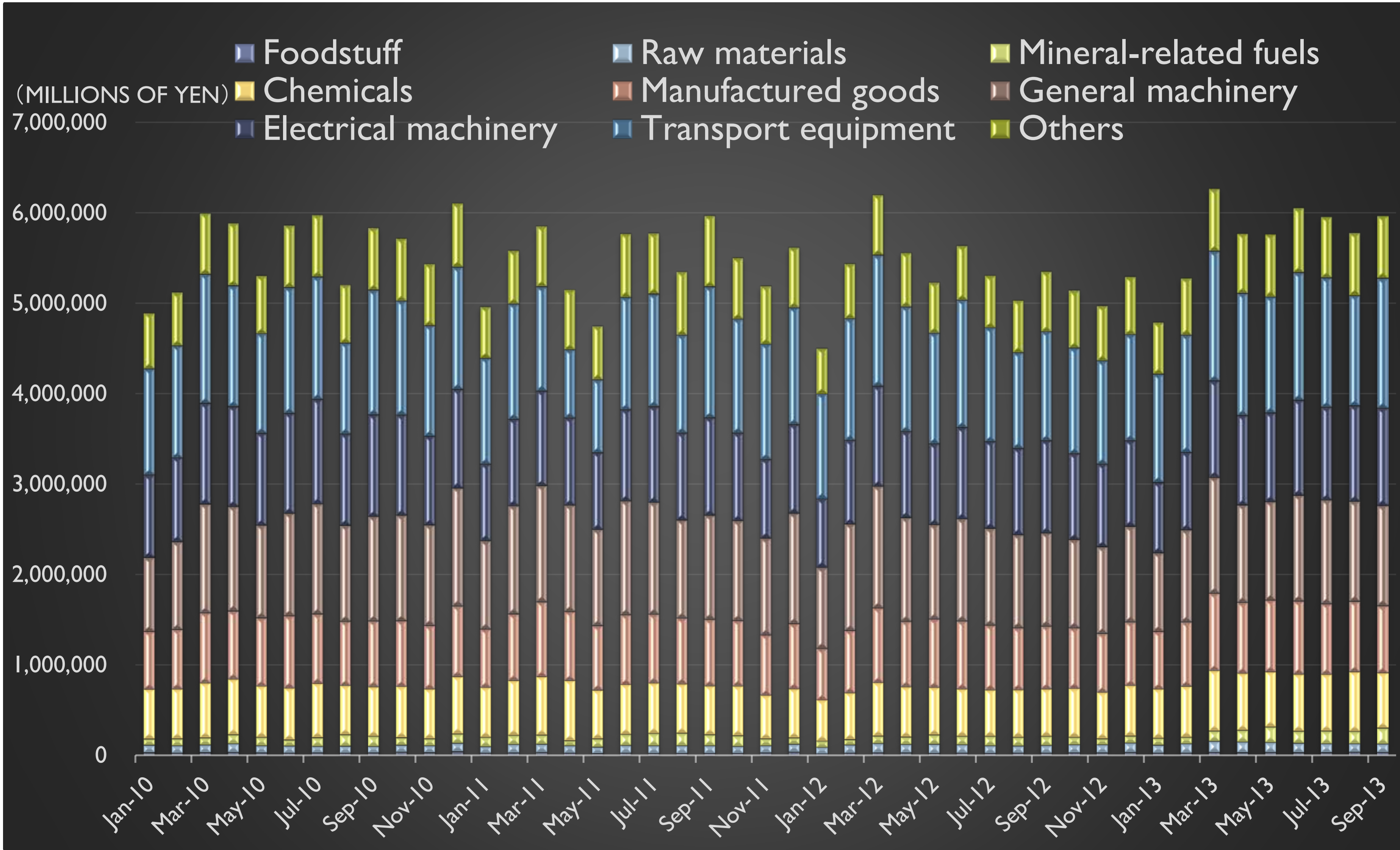
Import Volume of Parts



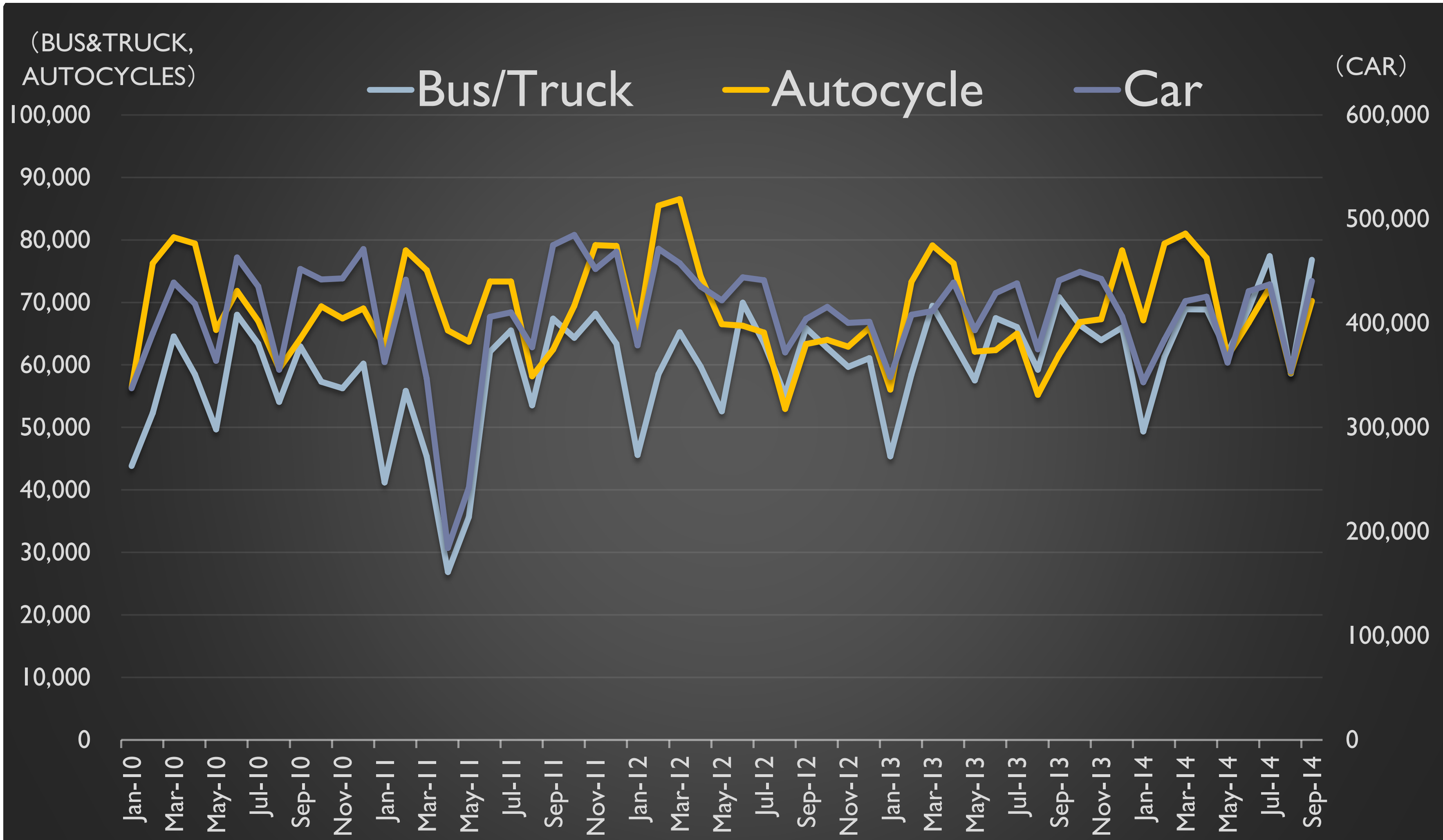
Import increased 16.4% in general machinery 19.8 % in electrical machinery 15.6 % in transport equipment

Higher than mineral-related fuels (8.3 %)

Export Value by Industry(2010/1-2014/9)



Export Volume by Transport Equipment



Source: 財務省貿易統計より作成

Our trade data's explanation

- All graphs indicate the current situation of Japan's trade deficit as follows:
  - Imports of manufacturing goods are increasing.
  - An increase in Japan's export of industrial products is accompanied with an increase in parts and components imports.
- A sharp appreciation of the yen after Lehman shock promoted Japanese firms to expand their production networks in Asia.

2. Empirical Analysis on J-curve effect

J-curve Effect in Japan

- J-Curve effect was observed in Japan several times.
  - After the Plaza Accord in 1985 to 1989:
    - Japanese trade surplus expanded temporarily and continued to expand till 1988 despite of the strong yen, and then it started to reduce in 1989
  - At the time of a strong yen from 1990 to 1995:
    - Japanese trade surplus expanded at first followed by the reduction of trade surplus later.
  - After hitting the postwar highest yen at 79 in 1995 to 1998:
    - USD/Yen rate turned to depreciate. At that time, Japanese trade surplus decreased in 1996 and then improved in 1998.
- Empirical studies exploring J-Curve effects:
  - Bahmani-Oskooee and Brooks (1999)
  - Bahmani-Oskooee and Goswami (2003)

Model

- Log-linear equation model as a long-run relationship between trade balance and REER.

$$\ln TB_{Japan,t} = a + b \cdot \ln Y_{Japan,t} + c \cdot \ln Y_{foreign,t} + d \cdot \ln REER_{Japan,t} + \varepsilon_t$$

$$TB_{Japan,t} = Real\ Export_t / Real\ Import_t$$

Expected sign: **b<0, c>0** and **d<0**

- Data source :
  - Trade Balance (Real export & Real import data): BOJ
  - Y: Industrial Production Index of Japan(monthly)
  - Foreign Y: World IPI calculated by 20 trading partner countries' IPI data
  - REER: BIS REER (narrow indices)

Two Sample Periods

- For the division of sample period, we consider the following two factors :
  - Overseas production ratio of Japanese manufacturing companies exceeded 10 percent in the end of 1998.
  - The revised Foreign Exchange Law in April 1998 totally liberalized cross-border transactions.
- Accordingly, we divide as follows:
  - Former period: January 1985 to December 1998
  - Latter period: January 1999 to June 2014

ARDL Model by Pesaran et al.(2001)

- Following Pesaran *et al*. (2001) , we specify "Conditional ECM Model" which places both the levels and the first differences of each variable in a single-equation ECM;
  - We confirm that all variables are I (1) and there are at least one cointegration relationship among them.

$$\Delta \ln TB_{\mathrm{Japan},t} = a + \sum_{k=1}^{n} b_k \cdot \Delta \ln TB_{Japan,t-k} + \sum_{k=0}^{n} c_k \cdot \Delta lnY_{Japan,t-k} + \sum_{k=0}^{n} d_k \cdot lnY_{foreign,t-k}$$
$$+ \sum_{k=0}^{n} e_k \cdot \Delta lnREER_{Japan,t-k}$$
$$+ \delta_1 \cdot lnY_{Japan,t-1} + \delta_2 \cdot lnY_{foreign,t-1} + \delta_3 \cdot lnREER_{Japan,t-1} + \delta_4 \cdot D_{shinsai}$$
$$+ \mu_t$$

  - e_k: *short-term effect,* δ_3 *: long-term effect*
  - If negative values are obtained for δ_3 followed by positive values for e_k , the J-curve phenomenon will be confirmed.

Conditional ECM (ARDL) Model of Pesaran et al. (2001)

January 1985- December 1998

Explained variable : ⊿log(Real Export/Real Import)

Method: Least Squares (Included observations: 168)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	1.209	(0.430)	2.810	0.006
⊿log(Real Export(-1)/Real Import(-1))	-0.331	(0.117)	-2.820	0.006
⊿log(Real Export(-2)/Real Import(-2))	-0.234	(0.093)	-2.532	0.012
⊿log(IPIJapan)	-0.347	(0.242)	-1.430	0.155
⊿log(IPIJapan(-1))	0.113	(0.224)	0.505	0.614
⊿log(IPIWorld)	0.517	(0.338)	1.530	0.128
⊿log(IPIWorld(-1))	0.228	(0.403)	0.567	0.572
⊿log(REER)	0.197	(0.118)	1.667	0.098
⊿log(REER(-1))	0.222	(0.122)	1.819	0.071
⊿log(REER(-2))	0.221	(0.131)	1.681	0.095
⊿log(REER(-3))	0.134	(0.131)	1.023	0.308
⊿log(REER(-4))	0.142	(0.151)	0.937	0.350
⊿log(REER(-5))	0.146	(0.129)	1.133	0.259
⊿log(REER(-6))	0.177	(0.149)	1.192	0.235
⊿log(REER(-7))	0.306	(0.149)	2.051	0.042
⊿log(REER(-8))	0.171	(0.135)	1.267	0.207
⊿log(REER(-9))	0.075	(0.147)	0.509	0.611
⊿log(REER(-10))	-0.075	(0.127)	-0.593	0.554
⊿log(REER(-11))	0.387	(0.128)	3.024	0.003
log(Real Export(-1)/Real Import(-1)) 1)	-0.400	(0.099)	-4.023 **	0.000
log(IPIJapan(-1))	-0.265	(0.106)	-2.495	0.014
log(IPIWorld(-1))	0.196	(0.057)	3.435	0.001
log(REER(-1))	-0.204	(0.046)	-4.413	0.000
Adjusted R-squared	0.367			
Durbin-Watson stat	2.032			
F-statistic	5.410			
Prob(F-statistic)	0.000			
Wald Test (H_0: δ_1=δ_2=δ_3=δ_4=0) 2)				
F-statistic	5.670 ***			
Prob(F-statistic)	0.000			

(Authors' calcuulation)

1) p.303 of Pesaran et al. (2001), in the case of k=3, the I(0) and I(1) bounds for the t-statistic at the 10%, 5%, and 1% significance levels are [-2.57 , -3.46], [-2.86 , -3.78], and [-3.43 , -4.37], respectively.

2) p.300 of Pesaran et al. (2001), in the case of k=3, the lower and upper bounds for the F-test statistic at the 10%, 5%, and 1% significance levels are [2.72 , 3.77], [3.23 , 4.35], and [4.29 , 5.61], respectively.

Conditional ECM (ARDL) Model of Pesaran et al. (2001)

January 1999 - June 2014

Explained variable ⊿log(Real Export/Real Import)

Method: Least Squares (Included observations: 186)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.207	(0.428)	0.483	0.630
⊿log(Real Export(-1)/Real Import(-1))	-0.582	(0.085)	-6.846	0.000
⊿log(Real Export(-2)/Real Import(-2))	-0.251	(0.090)	-2.792	0.006
⊿log(Real Export(-3)/Real Import(-3))	-0.139	(0.076)	-1.834	0.069
⊿log(IPIJapan)	0.224	(0.118)	1.908	0.058
⊿log(IPIJapan(-1))	0.562	(0.116)	4.849	0.000
⊿log(IPIJapan(-2))	0.096	(0.115)	0.829	0.408
⊿log(IPIWorld)	0.736	(0.210)	3.507	0.001
⊿log(IPIWorld(-1))	0.386	(0.262)	1.476	0.142
⊿log(IPIWorld(-2))	0.063	(0.228)	0.275	0.784
⊿log(REER)	-0.132	(0.114)	-1.160	0.248
⊿log(REER(-1))	0.084	(0.114)	0.739	0.461
⊿log(REER(-2))	0.008	(0.111)	0.077	0.939
⊿log(REER(-3))	-0.103	(0.105)	-0.987	0.325
⊿log(REER(-4))	0.201	(0.103)	1.946	0.054
⊿log(REER(-5))	0.016	(0.107)	0.151	0.880
⊿log(REER(-6))	0.244	(0.103)	2.362	0.019
⊿log(REER(-7))	-0.064	(0.101)	-0.636	0.526
⊿log(REER(-8))	0.005	(0.099)	0.050	0.960
⊿log(REER(-9))	-0.002	(0.100)	-0.021	0.983
⊿log(REER(-10))	0.081	(0.101)	0.795	0.428
⊿log(REER(-11))	0.174	(0.104)	1.672	0.097
log(Real Export(-1)/Real Import(-1)) 1)	-0.117	(0.051)	-2.295	0.023
log(IPIJapan(-1))	-0.036	(0.042)	-0.872	0.384
log(IPIWorld(-1))	0.084	(0.062)	1.353	0.178
log(REER(-1))	-0.094	(0.028)	-3.305	0.001
Shinsai Dummy	-0.029	(0.014)	-2.122	0.035
Lehman Dummy	-0.043	(0.021)	-2.044	0.043
Adjusted R-squared	0.441			
Durbin-Watson stat	2.044			
F-statistic	6.400			
Prob(F-statistic)	0.000			
Wald Test (H_0: δ_1=δ_2=δ_3=δ_4=0) 2)				
F-statistic	3.752			
Prob(F-statistic)	0.006			

(Authors' calcuulation)

1) p.303 of Pesaran et al. (2001), in the case of k=3, the I(0) and I(1) bounds for the t-statistic at the 10%, 5%, and 1% significance levels are [-2.57 , -3.46], [-2.86 , -3.78], and [-3.43 , -4.37], respectively.

2) p.300 of Pesaran et al. (2001), in the case of k=3, the lower and upper bounds for the F-test statistic at the 10%, 5%, and 1% significance levels are [2.72 , 3.77], [3.23 , 4.35], and [4.29 , 5.61], respectively.

Error Correction Model Estimation

- Assuming that the bounds test (Pesaran *et al*. 2001) leads to the long run relationship between variables, we can meaningfully estimate the usual ECM model:
- Long-run equilibrium relationship ：

$$\ln TB_{\text{Japan},t} = \alpha_0 + \alpha_1 \cdot \ln Y_{\text{Japan},t} + \alpha_2 \cdot \ln Y_{\text{World},t} + \alpha_3 \cdot \ln REER_{\text{Japan},t}$$

$$+\alpha_4 \cdot D_{\text{shinsai}} + \alpha_5 \cdot D_{\text{Lehman}} + \varepsilon_t$$

- Usual ECM Model: ：

$$\Delta\ln TB_{\text{Japan},t} = \beta_0 + \beta_1 \cdot EC_{t-1} + \sum_{k=1}^{n} \gamma_k \cdot \Delta\ln TB_{Japan,t-k} + \sum_{k=0}^{n} \theta_k \cdot \Delta ln Y_{Japan,t-k}$$

$$+\sum_{k=0}^{n} \rho_k \cdot \Delta\ln Y_{World,t-k} + \sum_{k=0}^{n} \varphi_k \cdot \Delta\ln REER_{Japan,t-k} + \mu_t$$

ECM Model with Error Collection Term

January 1985- December 1998

＜Long-term＞

Explained variable： log(Real Export/Real Import)

Method: Least Squares (Included observations: 168)

Variable	Coefficient		Std. Error	t-Statistic	Prob.
Constant	4.600	***	(0.269)	17.126	0.000
log(IPIJapan)	-0.989	***	(0.067)	-14.842	0.000
log(IPIWorld)	0.178	***	(0.064)	2.774	0.006
log(REER)	-0.242	***	(0.034)	-7.104	0.000
Adjusted R-squared	0.693				
Durbin-Watson stat	0.722				
F-statistic	126.388				
Prob(F-statistic)	0				

＜Short-term＞

Explained variable： ⊿log(Real Export/Real Import)

Method: Least Squares

Variable	Coefficient		Std. Error	t-Statistic	Prob.
C	-0.002		(0.003)	-0.770	0.442
ECT(-1)	-0.220	**	(0.090)	-2.435	0.016
⊿log(Real Export(-1)/Real Import(-1))	-0.404	***	(0.098)	-4.148	0.000
⊿log(Real Export(-2)/Real Import(-2))	-0.256	***	(0.080)	-3.153	0.002
⊿log(IPIJapan)	-0.625	**	(0.247)	-2.599	0.010
⊿log(IPIJapan(-1))	-0.162		(0.227)	-0.702	0.484
⊿log(IPIWorld)	0.438		(0.326)	1.258	0.211
⊿log(IPIWorld(-1))	0.161		(0.332)	0.478	0.633
⊿log(REER)	0.232	*	(0.114)	1.967	0.051
⊿log(REER(-1))	0.037		(0.128)	0.339	0.735
⊿log(REER(-2))	0.082		(0.129)	0.621	0.536
⊿log(REER(-3))	-0.045		(0.134)	-0.350	0.727
⊿log(REER(-4))	-0.075		(0.133)	-0.595	0.553
⊿log(REER(-5))	-0.009		(0.132)	-0.076	0.940
⊿log(REER(-6))	0.009		(0.130)	0.121	0.904
⊿log(REER(-7))	0.142		(0.130)	1.121	0.264
⊿log(REER(-8))	0.049		(0.131)	0.337	0.737
⊿log(REER(-9))	-0.106		(0.130)	-0.810	0.419
⊿log(REER(-10))	-0.226		(0.132)	-1.740	0.084
⊿log(REER(-11))	0.204		(0.121)	1.764	0.080
Adjusted R-squared	0.306				
Durbin-Watson stat	1.982				

ECM Model with Error Collection Term

January 1999 - June 2014

＜Long-term＞

Explained variable： log(Real Export/Real Import)

Method: Least Squares (Included observations: 186)

Variable	Coefficient		Std. Error	t-Statistic	Prob.
Constant	-6.154	***	(0.502)	-12.258	0.000
log(IPIJapan)	0.299	***	(0.062)	4.812	0.000
log(IPIWorld)	1.083	***	(0.056)	19.247	0.000
log(REER)	-0.047		(0.040)	-1.166	0.245
Shinsai Dummy	-0.207	***	(0.017)	-12.002	0.000
Lehman Dummy	-0.005		(0.023)	-0.220	0.827
Adjusted R-squared	0.784				
Durbin-Watson stat	0.485				
F-statistic	135.235				
Prob(F-statistic)	0				

＜Short-term＞

Explained variable： ⊿log(Real Export/Real Import)

Method: Least Squares

Variable	Coefficient		Std. Error	t-Statistic	Prob.
C	0.000		(0.003)	0.025	0.980
ECT(-1)	-0.111	**	(0.053)	-2.118	0.036
⊿log(Real Export(-1)/Real Import(-1))	-0.514	***	(0.085)	-6.055	0.000
⊿log(Real Export(-2)/Real Import(-2))	-0.133	*	(0.077)	-1.734	0.085
⊿log(IPIJapan)	0.305	**	(0.121)	2.511	0.013
⊿log(IPIJapan(-1))	0.562	***	(0.122)	4.593	0.000
⊿log(IPIJapan(-2))	-0.028		(0.119)	-0.232	0.817
⊿log(IPIWorld)	0.874	***	(0.213)	4.105	0.000
⊿log(IPIWorld(-1))	0.353		(0.249)	1.415	0.159
⊿log(IPIWorld(-2))	0.004		(0.224)	0.020	0.984
⊿log(REER)	-0.191		(0.116)	-1.646	0.102
⊿log(REER(-1))	0.017		(0.115)	0.150	0.881
⊿log(REER(-2))	-0.044		(0.109)	-0.397	0.692
⊿log(REER(-3))	-0.209	*	(0.109)	-1.924	0.056
⊿log(REER(-4))	0.145		(0.105)	1.377	0.171
⊿log(REER(-5))	0.009		(0.107)	0.089	0.930
⊿log(REER(-6))	0.210	**	(0.103)	2.036	0.043
⊿log(REER(-7))	-0.116		(0.103)	-1.127	0.261
⊿log(REER(-8))	-0.039		(0.102)	-0.383	0.702
⊿log(REER(-9))	-0.044		(0.101)	-0.435	0.664
⊿log(REER(-10))	0.106		(0.102)	1.039	0.301
⊿log(REER(-11))	0.093		(0.104)	0.894	0.373
Shinsai Dummy	-0.009		(0.006)	-1.457	0.147
Lehman Dummy	-0.011		(0.020)	-0.570	0.570
Adjusted R-squared	0.411				
Durbin-Watson stat	1.903				
F-statistic	6.572				

Results ECM

- In former period, we can get the expected signs and significant results in long-run relationship.
  - Coefficient of Japanese IPI: -939
  - Coefficient of World IPI: +0.178
  - REER: -0.242 (Yen' depreciation improves the trade balance in Japan)
  - It is clear again that there is evidence of the J-curve phenomenon only in the former period.
- In latter period, trade balance was largely affected by OECD IPI, but no significant effect by REER.
  - Coefficient of Japanese IPI: + 0.299
  - Coefficient of World IPI: +1.083
  - REER: Plus and not significant

Summarize the ECM Results

- There is the evidence of the J-curve phenomenon only in the former period.
- In the 2000s, Japan’s trade balance is largely affected by World IPI.

3. Export Price Index and Exchange Rate Pass-through

Does Japanese Export Price Decline due to Yen's depreciation?

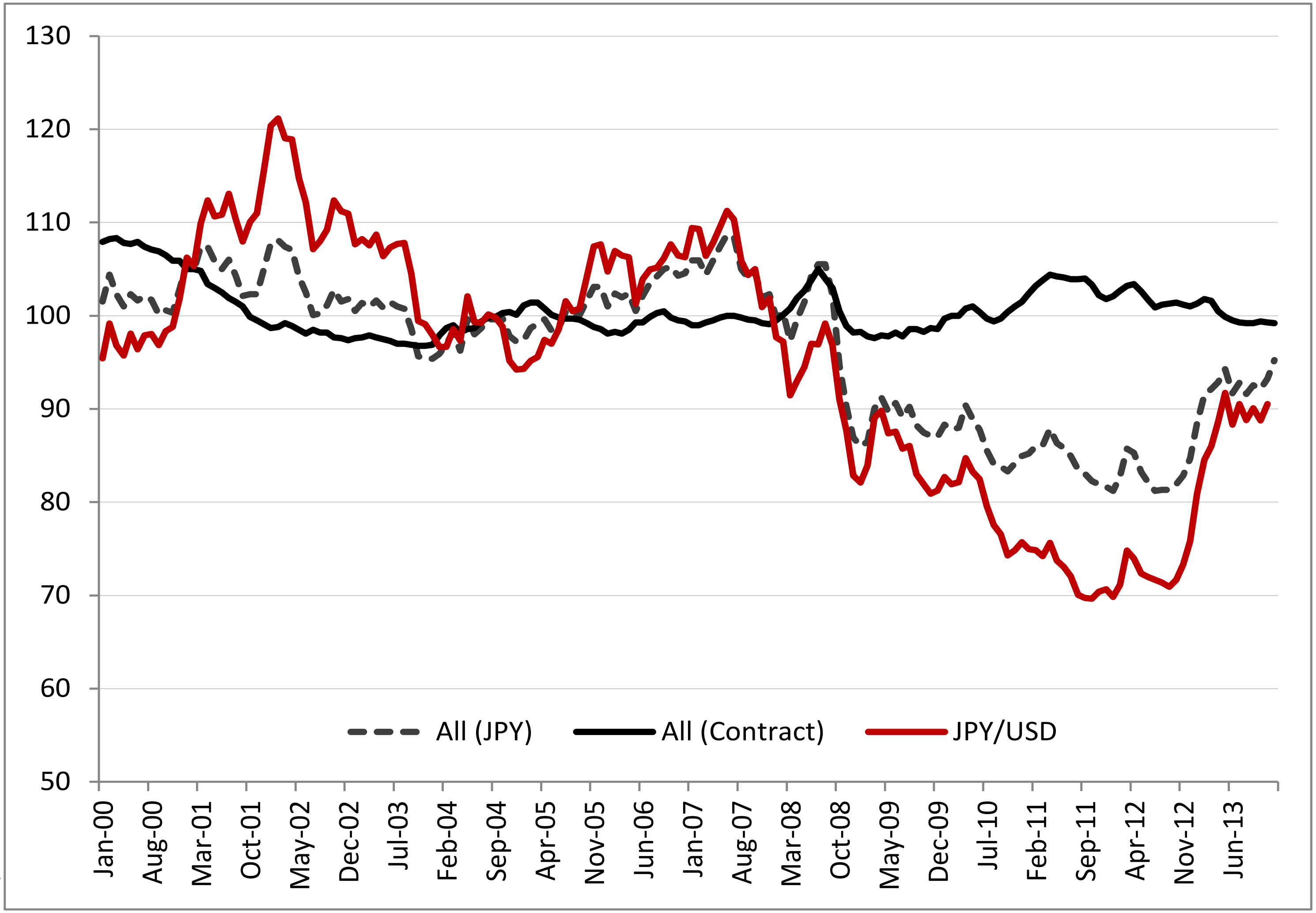
- J-curve effect:

- Export demand function:

$$X = X\left(P^*, Y^*\right) = X\left(P/S, Y^*\right)$$

  - Does $\boxed{P^*(=P/S)}$ decline?
  - Need to check the export price index (yen-base and contract currency base) published by BOJ.

Japan's Export Price Index and Nominal Yen-US Dollar Exchange Rate (2000M1-2013M12)



Source: Website of the Bank of Japan.

Exchange Rate Pass-Through Analysis
—Constant Parameter Estimation—

- Constant Parameter Model:

$$\Delta \ln(P_{yen}^{EX})_t = \beta_0 + \beta_1 \Delta \ln NEER_t + \beta_2 \Delta \ln(P_{input})_t + \beta_3 \Delta \ln(Y_{World})_t + \varepsilon_t$$

Yen-base export price by industry (Source: BOJ)	NEER (contract currency base) (by industry) (calculated from BOJ price index, an increase means depreciation)	Input price Index (BOJ) (by industry)	World IPI (weighted avg. of 20 countries) (data taken from CEIC and IMF DOT)

Exchange Rate Pass-Through Analysis —Time-Varying Parameter Estimation—

- Time-Varying Parameter Model:

to capture the possible change of Pass-through ratio

Observation Equation:

β_1=1 : perfect PTM (zero pass-through)
β_1=0 : no PTM (100% pass-through)

$$\Delta \ln(P_{yen}^{EX})_t$$

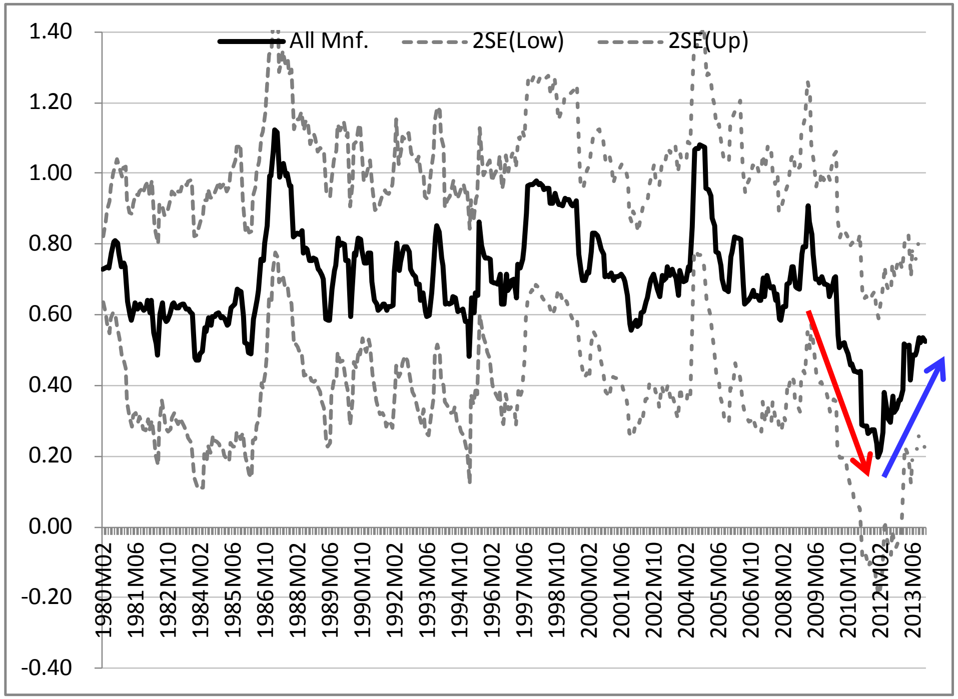
$$= \beta_{0,t} + \beta_{1,t} \Delta \ln NEER_t + \beta_{2,t} \Delta \ln(P_{input})_t + \beta_{3,t} \Delta \ln(Y_{World})_t + \varepsilon_t$$

State Equations:

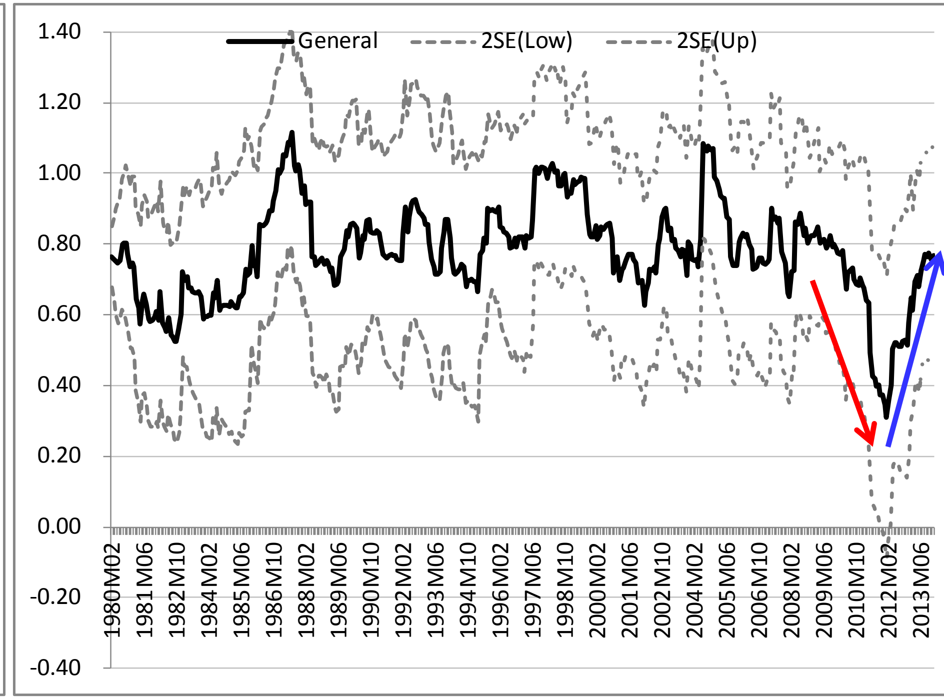
$$\beta_{i,t} = \beta_{i,t-1} + \nu_{\beta_i,t} \qquad \text{for } i = 0, 1, 2, \text{ and } 3.$$

Results of TVP Estimation (1)

(1) All Manufacturing



(2) General Machinery



From early 2009 to 2012:

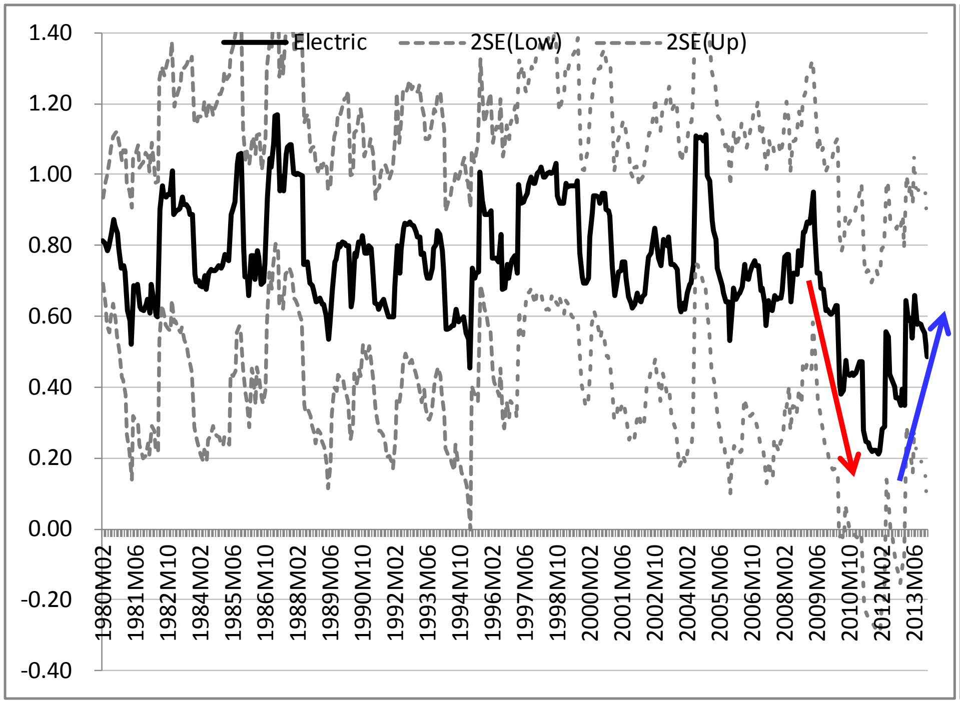
Less PTM and more exchange rate pass-through.

From 2012 to 2013:

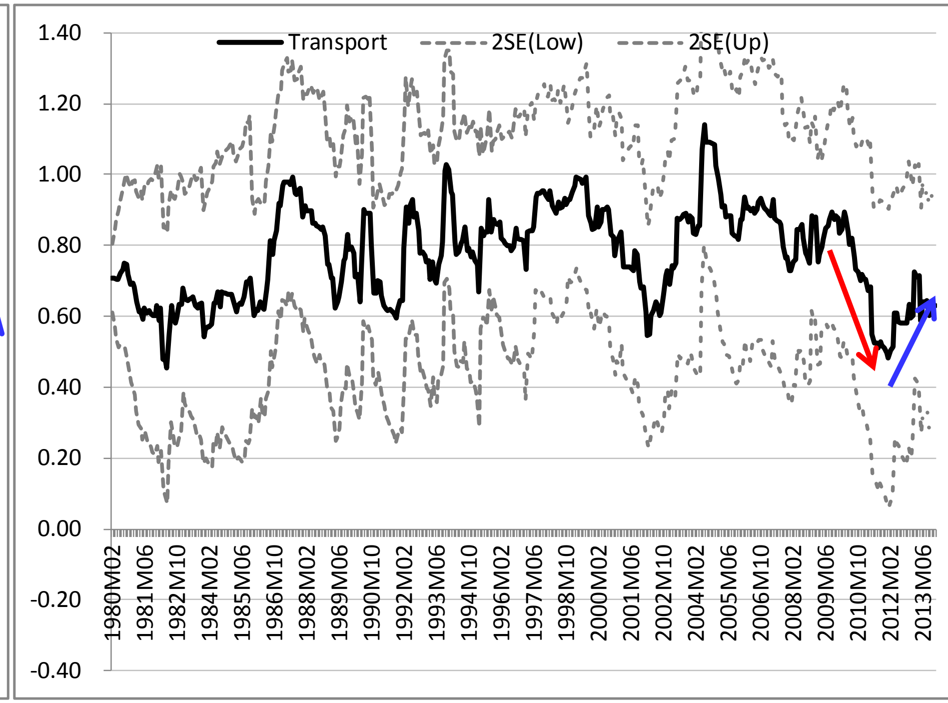
Return to the previous level of PTM behavior.

Results of TVP Estimation (2)

(3) Electric Machinery



(4) Transport Equipment



$$\Delta \ln(P^{EX}_{yen})_t$$

- $= \beta_{0,t} + \beta_{1,t} \Delta \ln NEER_t + \beta_{2,t} \Delta \ln(P_{input})_t + \beta_{3,t} \Delta \ln(Y_{World})_t + \varepsilon_t$

Japanese Firms' Price Strategy

- Japanese exporters generally tend to lower pass-through (conduct the PTM behavior).
  - In response to the strong yen in 2010-11, they increased the exchange rate pass-through (**price hike**).
  - At the same time, however, those unable to do so were left with no choice but to shift to overseas production.
  - After the sharp depreciation of the yen from the end of 2012, they started to lower the exchange rate pass-through again. **No Price change**
- Highly competitive products left in Japan are now able to enjoy foreign exchange gains.

4. Industry-Specific REER and Export competitiveness

Industry-Specific REER

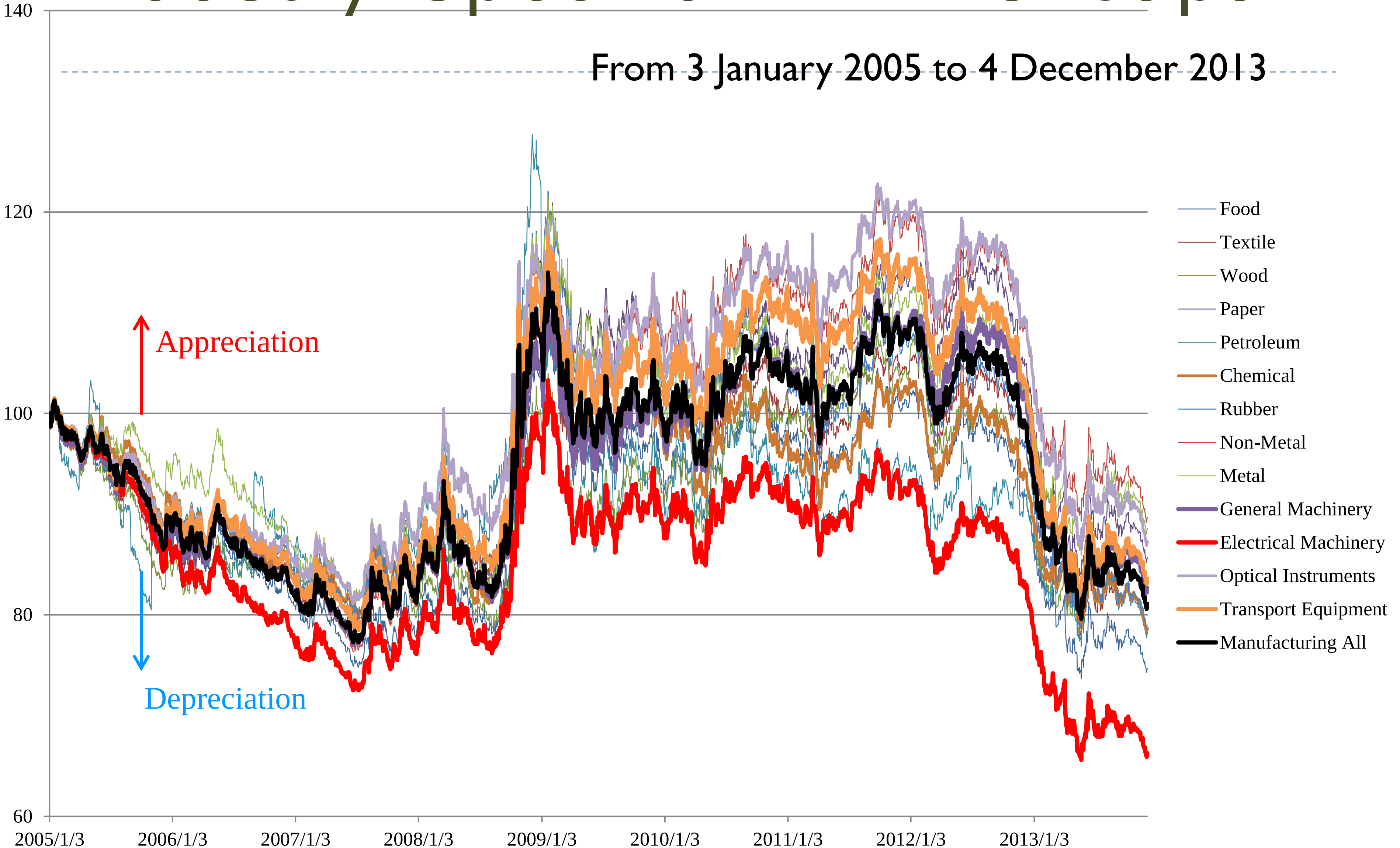
$$\boxed{REER_{kit} = \prod_{j=1}^{n} \left(RER_{kit}^{j} \right)^{\alpha_{kit}^{j}}}$$

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

Note: i : Industry. j : Partner country. k : Home country.
α_i^j: Trade weight of country *j* in the *k*'s total exports. t : Time.

Data Frequency:
Exchange Rates (daily), Prices (monthly), and Trade Weight (annual).

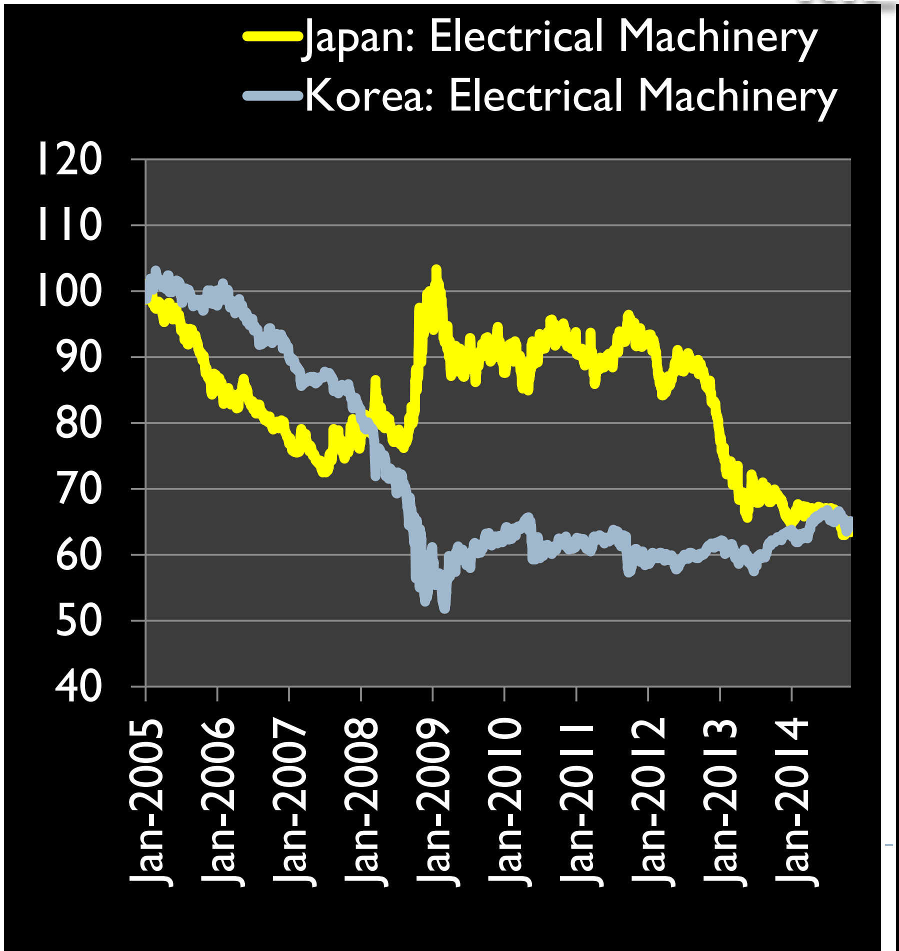
Industry-Specific REER for Japan

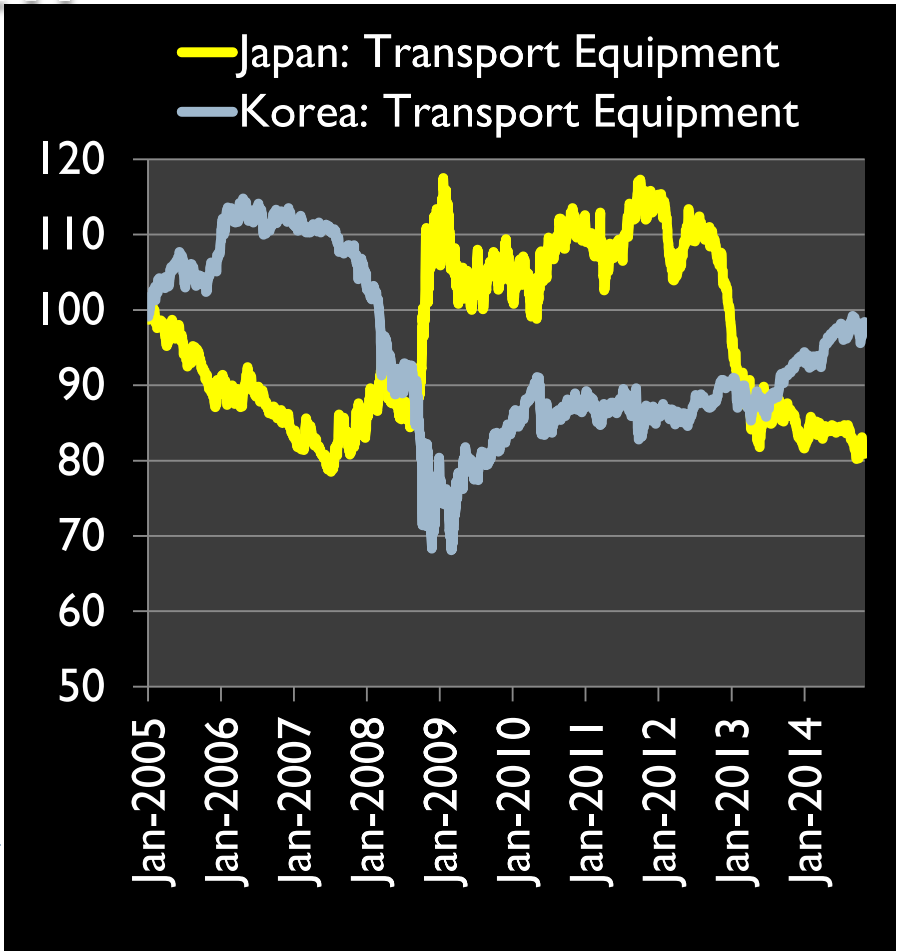


Source: Source: Website of RIETI (Authors' calculation).
Data is available at http://www.rieti.go.jp/users/eeri/en/index.html

Industry-Specific REER: Japan and Korea Electrical Machinery & Transport Equipment

Industry Specific Real Effective Exchange Rate by RIETI





Industry-Specific REER and Export competitiveness

- RIETI’s Industry-specific REERs indicate that both Japanese electrical machinery and transport equipment industries have rapidly recovered their export price competitiveness compared with the Korean counterparts after the Yen’s depreciation by “Abenomics”.

Summarize Our Findings

- The impact of yen depreciation on the trade balance has weakened in recent years.
  - US and other trading countries' economic recoveries only help Japanese export recovery.
  - Japanese manufacturing export prices in terms of the contract (invoice) currency have not changed in response to resent Yen's depreciation.
- Prolonged high-yen trend in 2009 to 2012 have forced manufacturers' off-shoring, and highly competitive products left in Japan are now able to enjoy foreign exchange gains.

Policy Implication

- Without J-curve effect, Japan’s trade deficit may become chronic.
  - In order to prevent this, Japan should reexamine its long-term energy policy.
- In order to offset trade deficit by increasing income surplus, it is necessary to maintain the flows of overseas earnings repatriated to Japan.
  - The government should implement measures designed to encourage companies to undertake R&D activities in Japan.
  - In addition, the government should remove tax impediments for the repatriation of overseas earnings.
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Thank you!