# Factor decomposition of Japan's Trade Balance

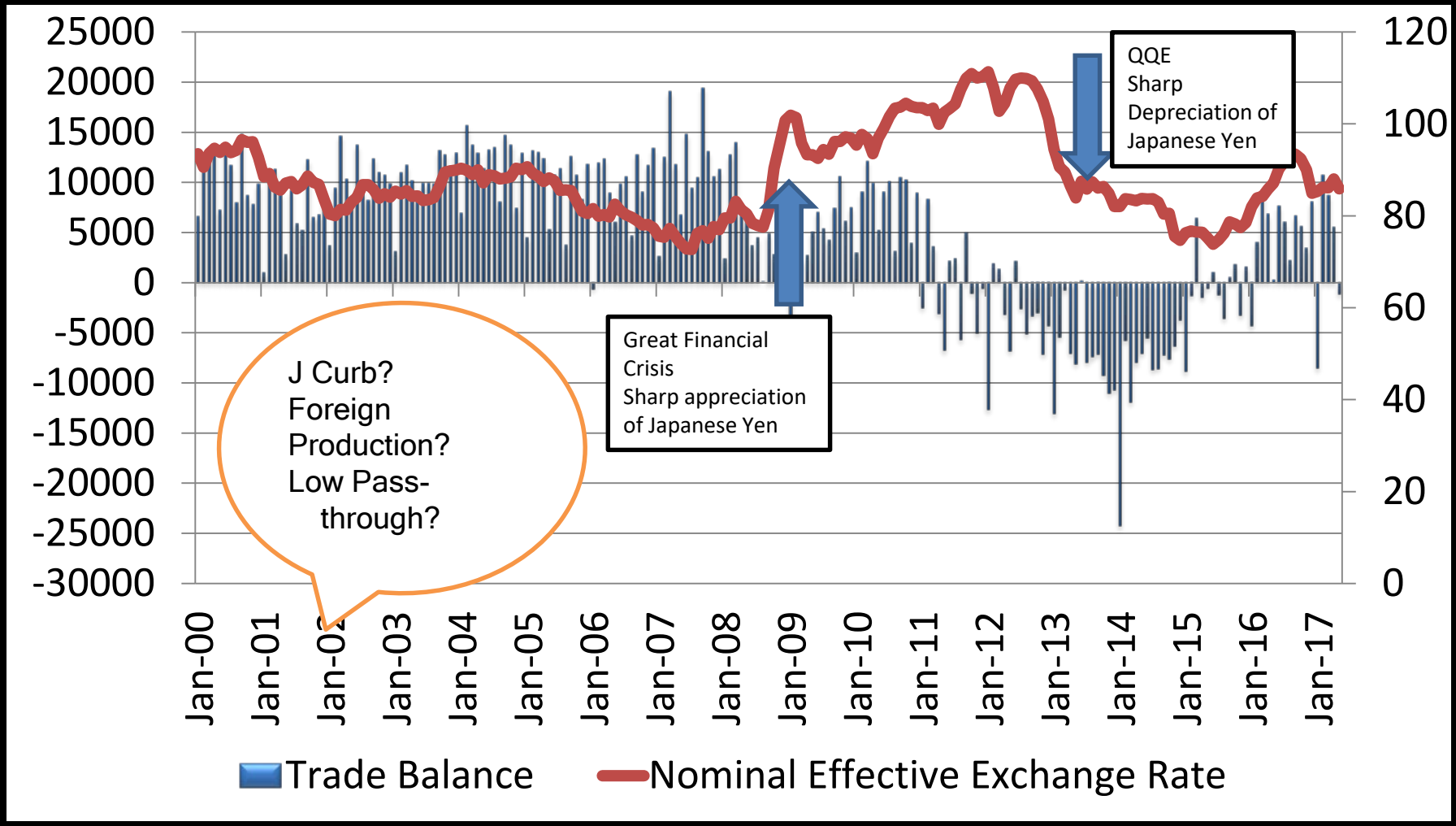
Yuri Sasaki, Meiji Gakuin University
Yushi Yoshida, Shiga University

Dec, 2017 Rieti Joint

We acknowledge financial supports from KAKENHI 15K03557 and KAKENHI C26380295

# The back ground of this paper

- Global Financial Crisis (2008-), Sharp appreciation of JPY
- Abenomics(2012-)QQE(2013-), sharp depreciation of JPY



# The Purpose of this paper

- To investigate the reason why Japanese export and import don't change when the exchange rate changes in conventional way.

- Shimizu and Sato（2014）、Nawada（2014）、Koizumi et al.（2014）、Noguchi（2015）、Toma et al.(2013)

  - The substitution effect of foreign production
  - The structural change of electronics industry

- We want to capture what is happening in Japanese Import and export as a whole in simple and basic way.

# The Features of this paper

- DATA: We made import and export price and quantity data for 97 industries X destination countries, to capture the macro level changes in Japanese imports and exports.

- Estimations: Pass-through, price elasticity and income elasticity for 97 industries X destination countries.

- Focusing on the change of those variables from pre crisis to post crisis period.

# Previous works on Pass-through by Sasaki and Yoshida

Sasaki, Y. and Yoshida, Y., 2015. Automobile exports: Export price and retail price. RIETI

Discussion Paper, 15-E024.

Ueda, K. and Sasaki, Y.N., 1998. The import behavior of Japanese corporate groups:

Evidence from micro-survey data. *Japan and the World Economy*, 10(1), 1-11.

Yuri Sasaki, 2002, "The Pricing-to-Market Behavior: Japanese Exports to the US, the EU and Asia," Review of International Economics, Volume 10, Issue 1, February 2002, 140-150.

Yoshida, Y., 2010. New evidence for exchange rate pass-through: Disaggregated trade

data from local ports. *International Review of Economics & Finance*, 19(1), 3-12.

Takagi, S. and Yoshida, Y. (2001). Exchange Rate Movements and Tradable Goods Prices in East Asia: An Analysis Based on Japanese Customs data, 1988-1999. *IMF Staff Papers* 48(2), 266-289.

Yoshida, Y. (2010). New Evidence for Exchange Rate Pass-Through: Disaggregated Trade Data from Local Ports. *International Review of Economics and Finance*, 19, 3-12.

And more…

This paper: not micro, not only Pass through but also including price elasticity and income elasticity.

# Data

# Data used in previous studies on Exchange rate pass-through

- BOJ
  - Considering the quality change, but Macro
- Firm level data
- Customs data
  - 9 digit data
    Detailed data, By country and by port, Value and quantity
  - 2,4,6digit
    By country, Value

=> To capture what is happening in Japanese trade, this paper makes unit value and quantity data for 2 digit data. (About 100 industries)

# Estimation

# The main factors of trade balance adjustment

TB=TB(q, Y*)

- Real exchange rate
  - Exchange rates >> Prices >> quantities
  - Pass through and Price elasticity
- Foreign Income
  - Income effects

# Constructing Data

# Why do we need to construct index?

- The Ministry of Finance (The Japan Customs) provides HS9 digit data (Value and Quantity) but it's too fine (about ten thousands indusries) to capture the Japanese Import and Export at macro level.
  - We focus on HS 2 digit data (97 industries)
  - HS: Harmonized Commodity Description and Coding System

- As for 2 digit data, they provide value data by country and by industry, but quantity data are not fully provided.

- We provide price and quantity indices at HS 2 level for all trade partners at the industry level.

# Japanese Customs Data & Unit value

- At 9-digit code level, value and quantity are available for each destination country.
- By dividing value by quantity, we can obtain 'unit value' price.

where *c* is trading partner country, *i* is a HS 9-digit products within HS 2-digit industry k.

# Price index at HS 2-digit codes

- Using price indices at the HS 9-digit level, we can construct a more aggregate price index.

$$P_{c,k,t}^{HS-2} = \sum_{i \in k} \left( \frac{value_{c,i,t}}{\sum_{i \in k} value_{c,i,t}} \right) \left( P_{c,i,,t}^{HS-9} \right),$$

and *i* is a HS 9-digit products within HS 2-digit industry k.

# Quantity index at HS 2-digit

$$Q_{c,k,t}^{HS-2} \equiv \frac{value_{c,k,t}}{P_{c,k,t}^{HS-2}}$$

We aggregate these indices over all industries to obtain Price and Quantity indices for **specific destination country.**

We aggregate these indices over all countries to obtain Price and Quantity indices for **specific industry**.

# Empirical model

# Empirical Model(1)

- Trade balance decomposition by industries

$$TB = EX - IM = \sum_{k \in K} EX_k - \sum_{k \in K} IM_k$$

- Decomposition of export (import) into price & quantity

$$EX_k = P_k^{EX}(s) \cdot Q_k^{EX}(P_k^{EX}, Y^*)$$

$$TB(s, P_1^{EX}, .., P_K^{EX}, P_1^{IM}, .., P_K^{IM}, Y, Y^*) =$$
$$\sum_{k \in K} P_k^{EX}(s) \cdot Q_k^{EX}(P_k^{EX}, Y^*) - \sum_{k \in K} P_k^{IM}(s) \cdot Q_k^{IM}(P_k^{IM}, Y)$$

# Empirical model(2)

- Total differentiation by s, Y, Y*

Price elasticity of export demand

ERPT of exports

Income elasticity of export demand

$$dTB = \sum_{k\in K}\left(Q_k^{EX} + P_k^{EX}\frac{\partial Q_k^{EX}}{\partial P_k^{EX}}\right)\frac{\partial P_k^{EX}}{\partial s}ds + \sum_{k\in K}\left(P_k^{EX}\right)\frac{\partial Q_k^{EX}}{\partial Y^*}dY^*$$

$$-\sum_{k\in K}\left(Q_k^{IM} + P_k^{IM}\frac{\partial Q_k^{IM}}{\partial P_k^{IM}}\right)\frac{\partial P_k^{IM}}{\partial s}ds + \sum_{k\in K}\left(P_k^{IM}\right)\frac{\partial Q_k^{IM}}{\partial Y}dY$$

Price elasticity of import demand

ERPT of imports

Income elasticity of import demand

# Empirical model(3)

- Export (quantity) demand equation

$$\tilde{Q}^{EX}_{c,k,t} = \alpha_0 + \alpha_1 \tilde{P}^{EX}_{c,k,t} + \alpha_2 Y_{c,t} + \lambda_c + \varepsilon_{c,k,t}$$

**Price elasticity** **Income elasticity**

- Export Price equation (ERPT equation)

$$\tilde{P}^{EX}_{c,k,t} = \beta_0 + \beta_1 S_{c,t} + \lambda_c^{'} + \eta_{c,k,t}$$

**ERPT elasticity**

- Similarly for import,

$$\tilde{Q}^{IM}_{c,k,t} = \alpha_0 + \alpha_1 \tilde{P}^{IM}_{c,k,t} + \alpha_2 Y_{JPN,t} + \lambda_c + \varepsilon_{c,k,t}$$

# Estimation Results

# Price (pass-through)equation

## For fixed industry k, panel (c,t)

ERPT elasticity

$$\tilde{P}^{EX}_{c,k,t} = \beta_0 + \beta_1 S_{c,t} + \lambda'_c + \eta_{c,k,t}$$

$\tilde{P}^{EX}_{c,k,t}$ is the log difference of price index of Japanese exports

$S_{c,t}$ is the log difference of nominal bilateral exchange rate of Japanese yen in terms of the currency of the destination country

# Quantity (demand) equation
## For fixed industry k, panel (c,t)

price elasticity

income elasticity

$$\tilde{Q}^{EX}_{c,k,t} = \alpha_0 + \alpha_1 \tilde{P}^{EX}_{c,k,t} + \alpha_2 Y_{c,t} + \lambda_c + \varepsilon_{c,k,t}$$

is the log difference of quantity index of Japanese exports

is the log difference of price index of Japanese exports

is the log difference of income of destination country $c$

# Estimation strategy, sample split

- Full sample (1988-2014)
  - Export (ERPT elasticity, Income elasticity)
  - Import (ERPT elasticity,  Income elasticity)

- Sub-samples
  - (Pre-crisis: 1988-2008)
    - Export (ERPT elasticity, Income elasticity)
    - Import (ERPT elasticity, Income elasticity)

  - (Post-crisis: 2009-2014)
    - Export (ERPT elasticity, Income elasticity)
    - Import (ERPT elasticity, Income elasticity)

# Notes

- For ERPT elasticities, the meaning of estimated coefficients change between exports and imports.

  - Export: 0 (complete) < ERPT < 1

  Coefficient 0 (complete pass-through)

  => Yen export price not change when FX changes

  => dollar import price change

  - Import: 0 < ERPT < 1 (complete)

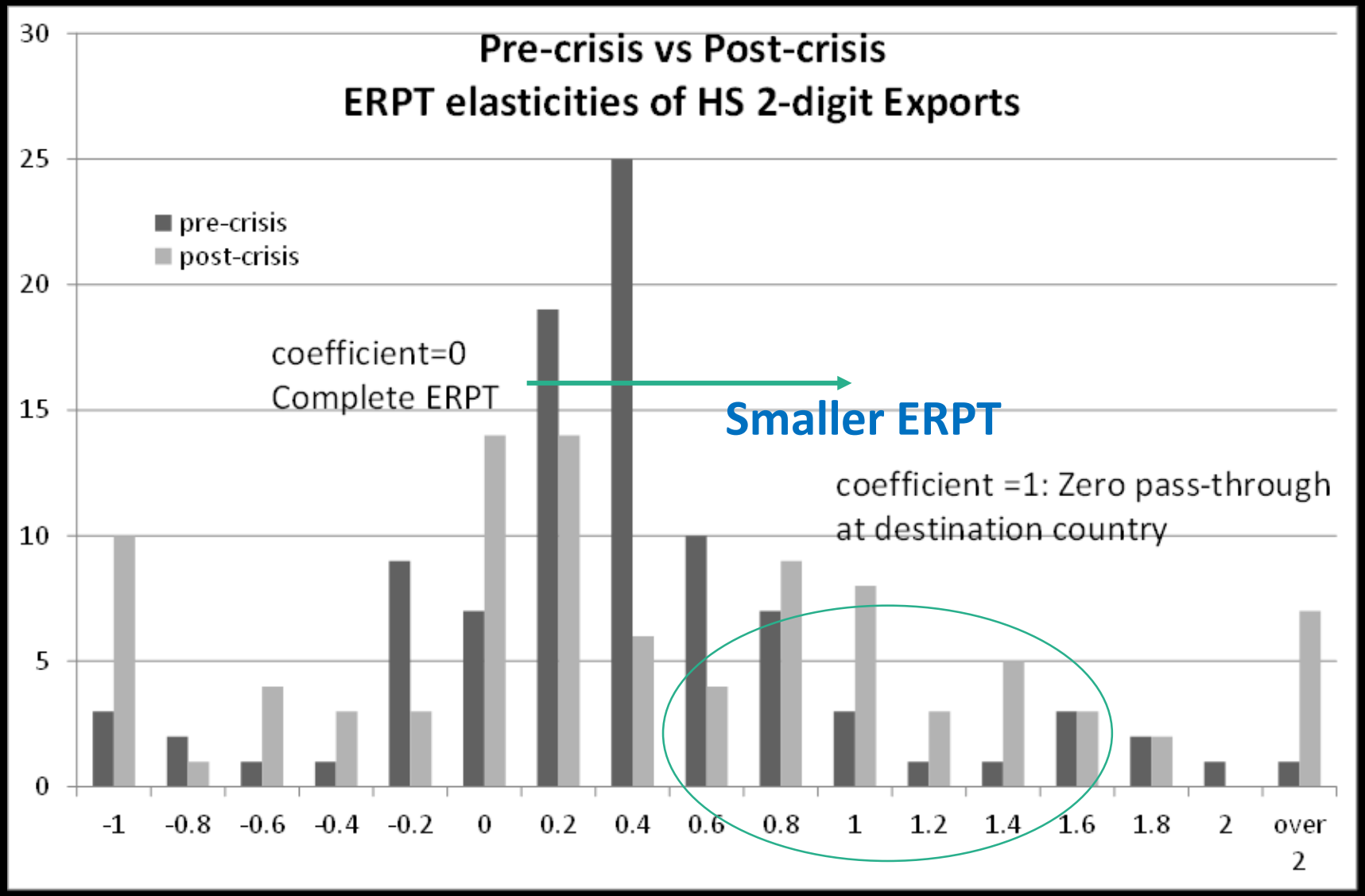
  Coefficient 1 (complete pass-through)

  => Yen import price change when FX changes

# Results

- Please see Table 1 – 4 !

# Export ERPT(1/2) Figure 7

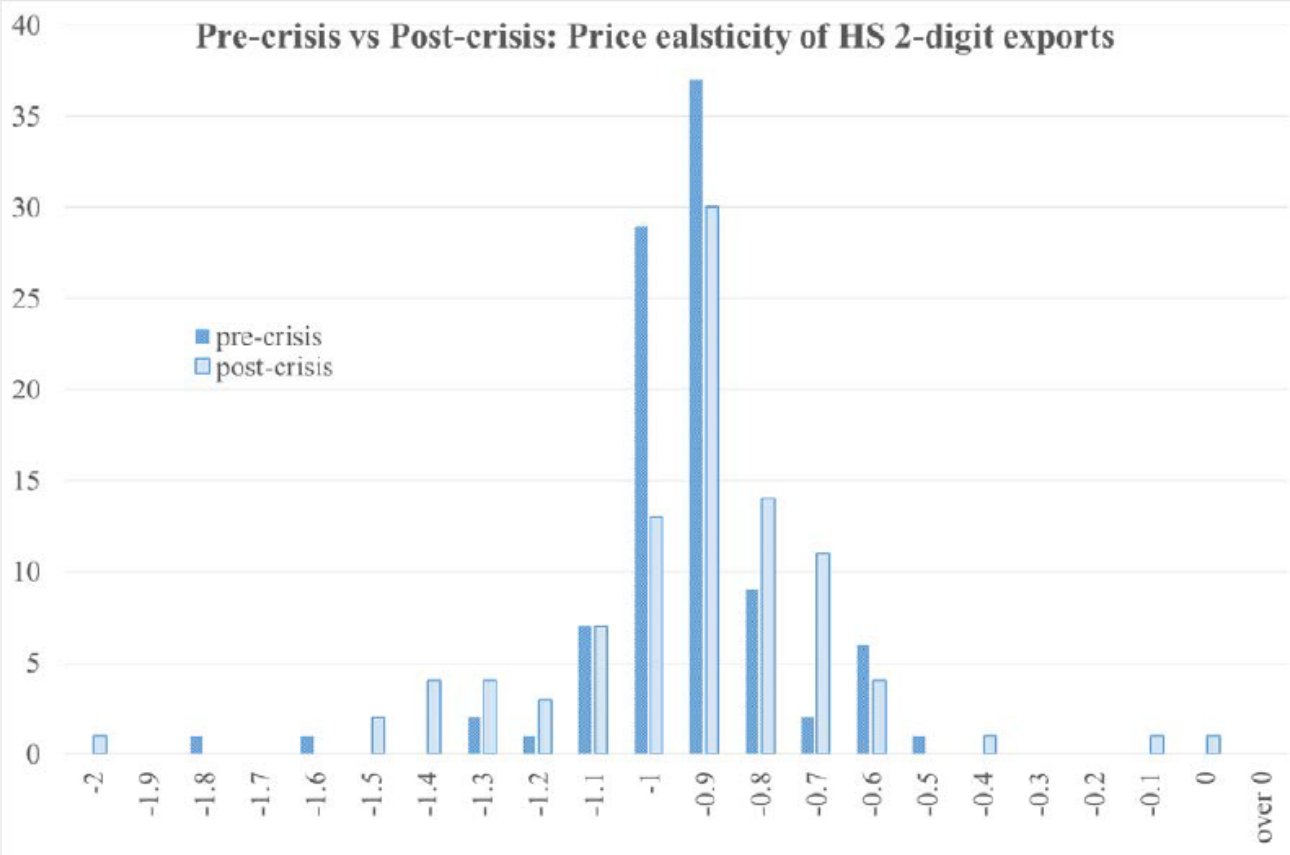


# Export ERPT (2/2)

- More industries with **smaller** ERPT in the post-crisis.
  - Fatter right-tail for the post-crisis in the Figure 7.
  - The null of complete pass-through (not rejected)
    - 50 industries in the pre-crisis
    - 38 industries in the post-crisis
  - The null of zero pass-through (not rejected)
    - 11 industries in the pre-crisis
    - 20 industries in the post-crisis
- Despite the depreciation of JPY from 2012 to 2014(2015), export price in the destination countries did not fall.

# Export Price Elasticity (1/2) Figure11

Figure 11. Pre-crisis versus post-crisis, price elasticity of HS 2-digit Exports

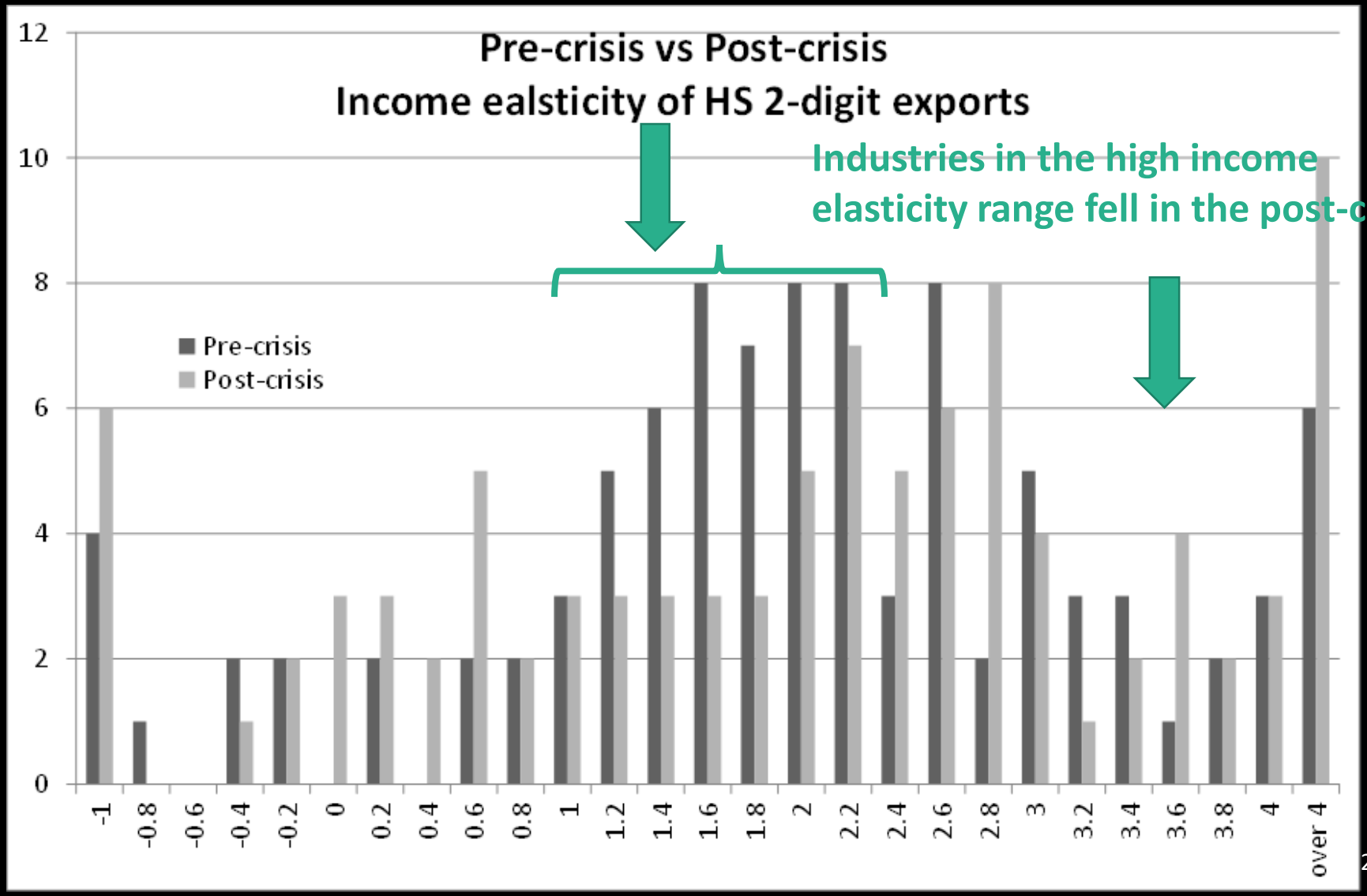



Note: The point estimates of price elasticity coefficients of HS 2-digit Japanese exports are summarized for pre-crisis and post-crisis subsamples.

# Export Price Elasticity (2/2)

- Around -1 as expected.
- Not so changed from pre crisis to post crisis.

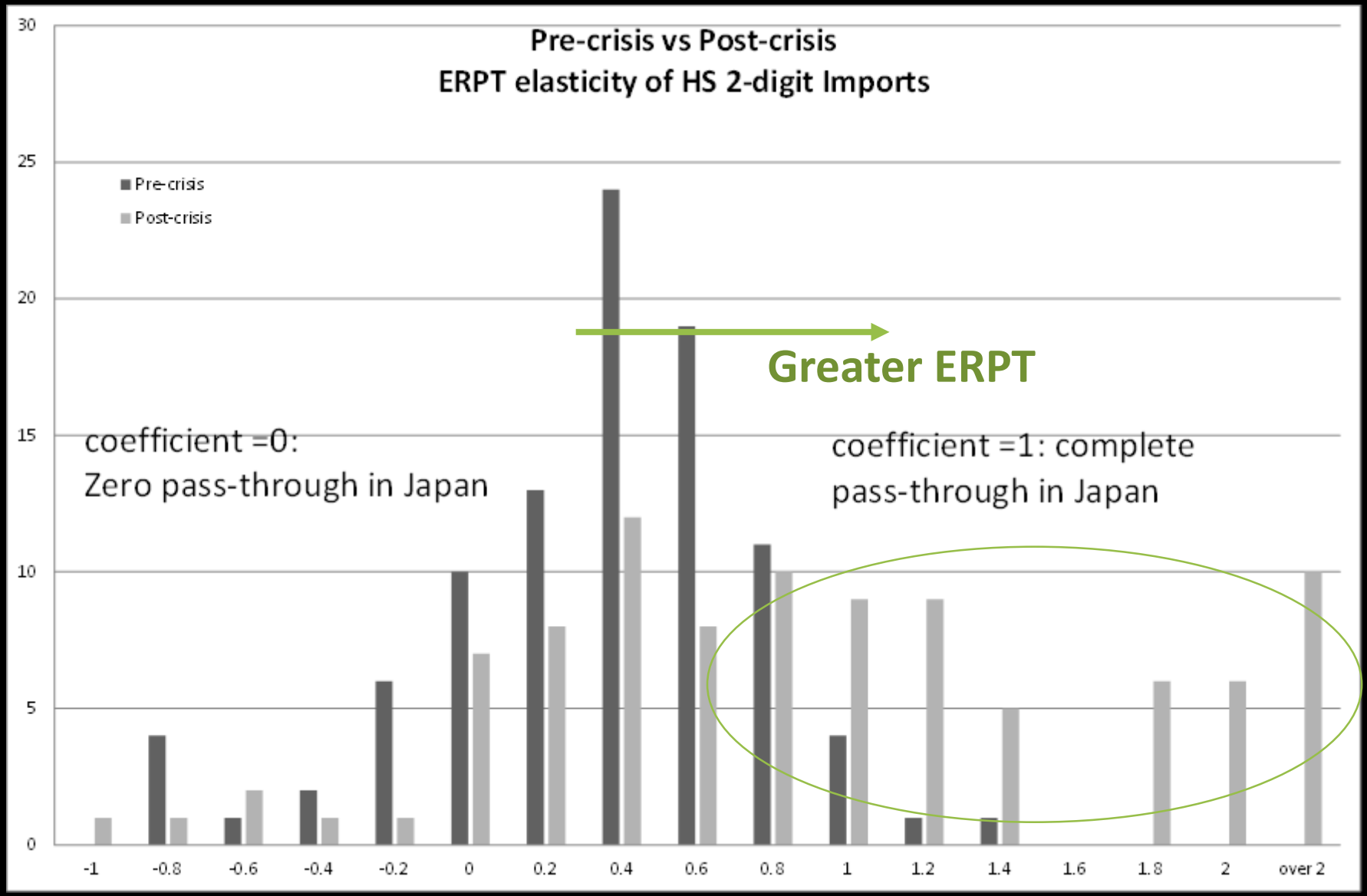
# Export income elasticity (1/2) Figure 9



# Export income elasticity (2/2)

- Income elasticity fell in the post-crisis
  - The number of industries in the high income elasticity range fell substantially.
  - The null of no income effect (rejected)
    - 61 industries in the pre-crisis
    - 32 industries in the post-crisis
- This evidence suggests that the transmission channel from the post-crisis recovery of the rest of world to the Japanese export growth did not function effectively.

# Import ERPT (1/2)

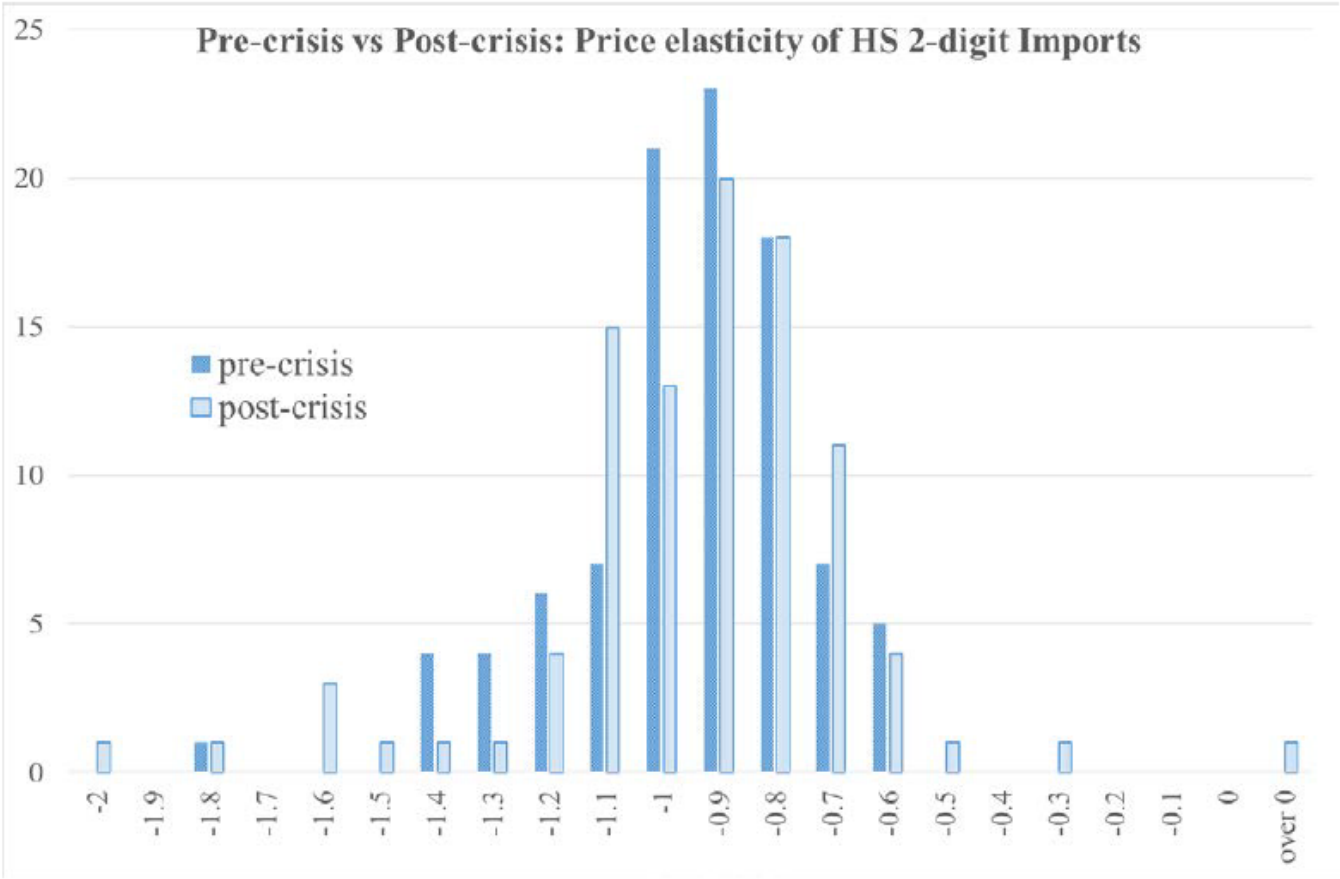


# Import ERPT (2/2)

- More industries with **greater** ERPT in the post-crisis.
  - Fatter right-tail for the post-crisis in the Figure 11.
  - The null of complete pass-through (not rejected)
    - 11 industries in the pre-crisis
    - 39 industries in the post-crisis
  - The null of zero pass-through (not rejected)
    - 47 industries in the pre-crisis
    - 11 industries in the post-crisis
- The depreciation of JPY from 2012 to 2014(2015) is full reflected on import price, i.e., more expensive imports.

# Import Price Elasticity (1/2)

Figure 17. Pre-crisis versus post-crisis, price elasticity of HS 2-digit Imports

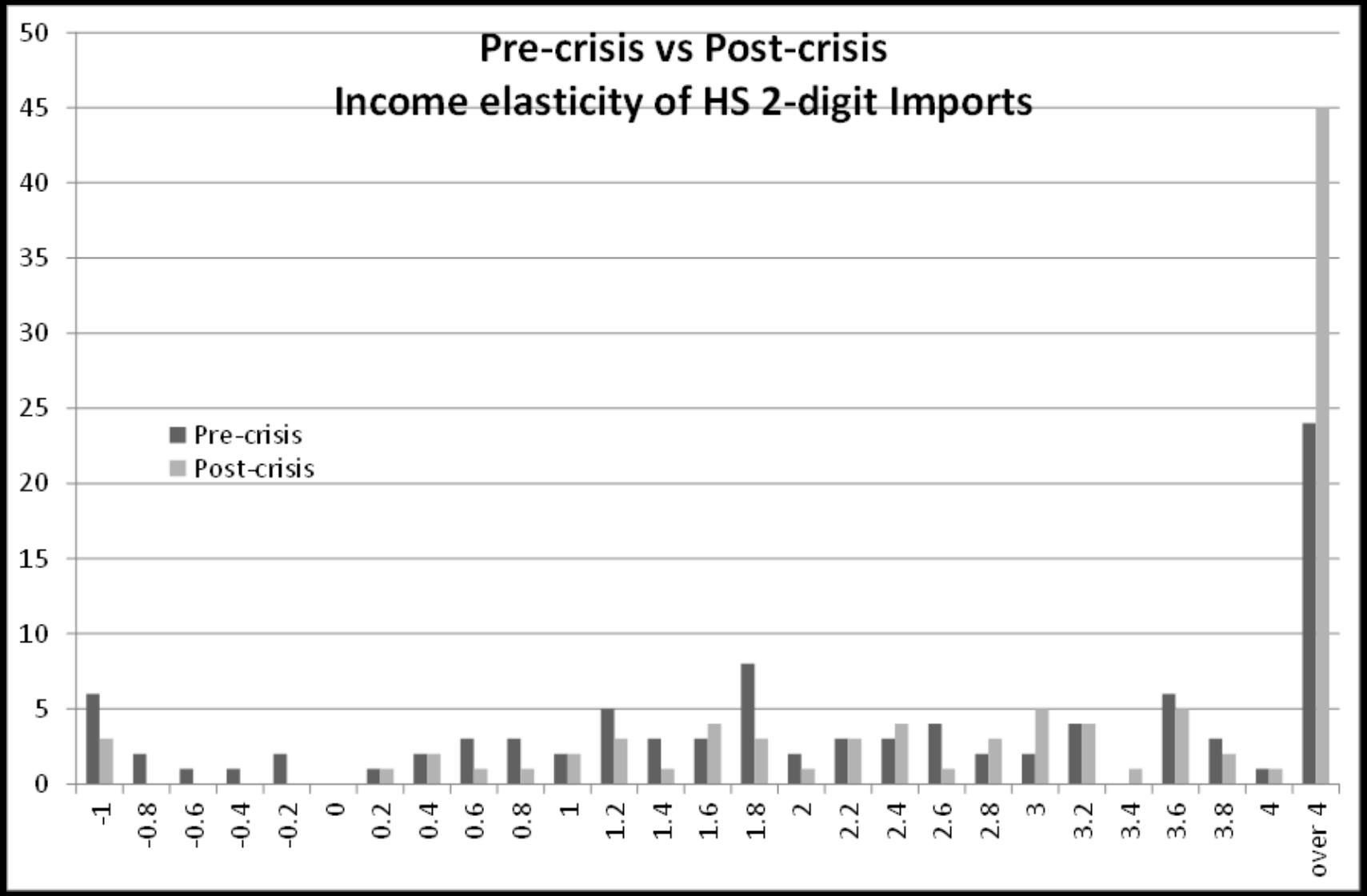



Note: The point estimates of price elasticity coefficients of HS 2-digit Japanese imports are summarized for pre-crisis and post-crisis subsamples.

# Import Price Elasticity (2/2)

- Around -1 as expected.
- Not so changed from pre crisis to post crisis.

# Import income elasticity (1/2)



# Import income elasticity (2/2)

- Very high income elasticity of imports
  - Especially, in the post-crisis sample, a large cluster of industries appears at the right end, i.e., income elasticity > 4.
    - 24 industries in the pre-crisis
    - 45 industries in the post-crisis
  - On the export side, at this level of high income elasticity
    - Only 6 in the pre-crisis
    - Only 10 in the post-crisis
- Houthakker-Magee asymmetry effect
  - If Japan and the rest of world grow at the same rate, trade balance must deteriorate for Japan.

# Our explanation (Main conclusions)

- Japanese trade experienced a structural change in income elasticity and exchange rate pass-through elasticity.
  - After the crisis, Japanese exports become more unresponsive to exchange rate fluctuations and foreign growth whereas Japanese import prices rose more proportionately with the depreciation of Japanese yen.
  - The difference in income elasticity between Japan and the rest of world is a reminiscent of Houthakker-Magee asymmetry effect. (If Japan and the rest of world grow at the same speed, the trade balance of Japan must deteriorate.)
  - The decomposition of Japanese trade revealed that almost every element shifted to help the external balance to deteriorate.

# Related studies

- A paper presented at 2016 ETSG (European Trade Study Group) conference (@Helsinki)
  - "The cyclicality of the income elasticity of trade"
  - (By A. Borin, V. Di Nno, M. Mancini, and M. Sbracia: All authors affiliated with the Bank of Italy)
  - They investigate whether income elasticity of trade is procyclical.
  - The main result: positive correlation between income elasticity and investments.
- Other related papers
  - Engel and Wang (2011)... procyclicality of international trade
  - Constantinescu, Mattoo, and Ruta (2015)… short- and long-run income elasticity

# Thank you