International Competitiveness: A Comparison of the Manufacturing Sector in Korea and Japan

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Motivation

- During the two lost decades, Japan's manufacturing sector suffered from a deterioration of its international competitiveness caused by currency appreciation and a slowdown of TFP growth (Dekle and Fukao 2011, Jorgenson, Nomura and Samuels 2015).
- In recent years, Korean firms such as Samsung Electronics and Hyundai Motors have captured markets from Japanese firms.
- Because the two countries share a similar level of economic development and similar factor endowments (abundant skilled labor and technical knowledge, scarce natural resources, *etc.*), have limited mutual foreign direct investment, and are located in close proximity, firms from the two countries frequently produce close substitutes and stand in fierce competition in world markets. The relative competitiveness of firms from the two countries has important implications for the two countries' trade balance and final demand in the economy.

What we do:

- This study compares the manufacturing-sector competitiveness of the two countries using firm-level data covering the period from 1994 to 2010.
- As Dekle, and Fukao (2011) and Demian, and di Mauro (2015) have shown, changes in relative competitiveness can differ substantially across subsectors. We therefore examine competitiveness at a subsector level.
- We take account of the possibility that changes in international competitiveness may differ across different firm-size groups. we compare the competitiveness of the two countries across different firm-size groups.

What we find:

- During the period 1994–2010, Korean workers enjoyed a doubling of real wage rates in most industries. However, the competitiveness of Korean firms relative to Japanese firms did not deteriorate. The main factors canceling out the impact of real wage increases were Korea's higher TFP growth in many industries such as motor vehicles and the sharp decline in Korean intermediate input prices in some industries such as electrical and electronic machinery.
- In many industries the competitiveness of Korean small and medium-sized firms vis-à-vis their Japanese counterparts increased by more than that of large firms. Two important developments can be observed which likely contributed to the improved competitiveness of small and medium-sized firms in Korea vis-à-vis their Japanese counterparts. First, in Korea, small and medium-sized firms registered higher TFP growth rates than large firms during 1994–2010; and second, wage gaps across firm-size groups narrowed in Japan, while they widened in Korea.

Methodology: Production Cost Approach(1)

We assume constant returns to scale and the following production function for a representative firm *f* in industry *i* in country *κ* at time *t*

$$Y_{f,i,\kappa}(t) = F_{i,\kappa}(L_{f,i,\kappa}(t), K_{f,i,\kappa}(t), X_{f,i,\kappa}(t), T_{f,i,\kappa}(t))$$

The average production cost of firm *f*, $C_{f,i,K}$, is given by

$$C_{f,i,\kappa}(t) = \frac{\tau_{f,i,\kappa}(t)}{Y_{f,i,\kappa}(t)} = \frac{w_{f,i,\kappa}(t)L_{f,i,\kappa}(t) + r_{i,\kappa}(t)K_{f,i,\kappa}(t) + q_{i,\kappa}(t)X_{f,i,\kappa}(t)}{Y_{f,i,\kappa}(t)}$$

By differentiating the above equation over time and using cost minimization conditions, we obtain

$$\hat{C}_{f,i,\kappa}(t) = s^{L}_{f,i,\kappa}(t)\hat{w}_{f,i,\kappa}(t) + s^{K}_{f,i,\kappa}(t)\hat{r}_{i,\kappa}(t) + s^{X}_{f,i,\kappa}(t)\hat{q}_{i,\kappa}(t) - \hat{A}_{f,i,\kappa}(t)$$

Methodology: Production Cost Approach(2)

In order to apply the above equation to discrete time-series data, we use the following Törnqvist approximation of this equation:

$$\begin{aligned}\hat{C}_{f,i,\kappa}^{t-1,t} &\equiv \ln(C_{f,i,\kappa}(t)) - \ln(C_{f,i,\kappa}(t-1)) \\ &= \frac{s_{f,i,\kappa}^{L}(t) + s_{f,i,\kappa}^{L}(t-1)}{2}\{\ln(w_{f,i,\kappa}(t)) - \ln(w_{f,i,\kappa}(t-1))\} \\ &\quad + \frac{s_{f,i,\kappa}^{K}(t) + s_{f,i,\kappa}^{K}(t-1)}{2}\{\ln(r_{i,\kappa}(t)) - \ln(r_{i,\kappa}(t-1))\} \\ &\quad + \frac{s_{f,i,\kappa}^{X}(t) + s_{f,i,\kappa}^{X}(t-1)}{2}\{\ln(q_{i,\kappa}(t)) - \ln(q_{i,\kappa}(t-1))\} \\ &\quad - \{\ln(A_{f,i,\kappa}(t)) - \ln(A_{f,i,\kappa}(t-1))\}\end{aligned}$$

We can decompose changes in average costs into changes in capital services prices, changes in wage rates, changes in intermediate input prices, and changes in TFP.

Differentiating production function over time and applying the Törnqvist approximation, we can derive the following growth accounting relationship

$$\begin{aligned}\hat{A}_{f,i,\kappa}^{t-1,t} &\equiv \ln(A_{f,i,\kappa}(t)) - \ln(A_{f,i,\kappa}(t-1)) \\ &= \ln(Y_{f,i,\kappa}(t)) - \ln(Y_{f,i,\kappa}(t-1)) \\ &\quad - \frac{s_{f,i,\kappa}^{L}(t) + s_{f,i,\kappa}^{L}(t-1)}{2}\{\ln(L_{f,i,\kappa}(t)) - \ln(L_{f,i,\kappa}(t-1))\} \\ &\quad - \frac{s_{f,i,\kappa}^{K}(t) + s_{f,i,\kappa}^{K}(t-1)}{2}\{\ln(K_{f,i,\kappa}(t)) - \ln(K_{i,\kappa}(t-1))\} \\ &\quad - \frac{s_{f,i,\kappa}^{X}(t) + s_{f,i,\kappa}^{X}(t-1)}{2}\{\ln(X_{i,\kappa}(t)) - \ln(X_{i,\kappa}(t-1))\}\end{aligned}$$

Methodology: Production Cost Approach(3)

We aggregate the variables over all firms in industry *i* in country *κ* using the total costs of each firm *f*.

$$\hat{C}_{i,\kappa}^{t-1,t} = \hat{W}_{i,\kappa}^{t-1,t} + \hat{K}_{i,\kappa}^{t-1,t} + \hat{Q}_{i,\kappa}^{t-1,t} - \hat{A}_{i,\kappa}^{t-1,t}$$

We can examine the sources of changes in the relative competitiveness of the two countries in a particular industry by calculating the difference between the two countries in each of the terms on both sides of above Equation and taking account of changes in the real exchange rate

$$\hat{C}_{i,Korea}^{t-1,t} - \hat{C}_{i,Japan}^{t-1,t} + \hat{\pi}^{t-1,t} = \hat{W}_{i,Korea}^{t-1,t} - \hat{W}_{i,Japan}^{t-1,t} + \hat{K}_{i,Korea}^{t-1,t} - \hat{K}_{i,Japan}^{t-1,t}$$
$$+ \hat{Q}_{i,Korea}^{t-1,t} - \hat{Q}_{i,Japan}^{t-1,t} - \hat{A}_{i,Korea}^{t-1,t} + \hat{A}_{i,Japan}^{t-1,t} + \hat{\pi}^{t-1,t}$$

When we compare competitiveness across firm-size groups, we aggregate the variables for each firm-size group.

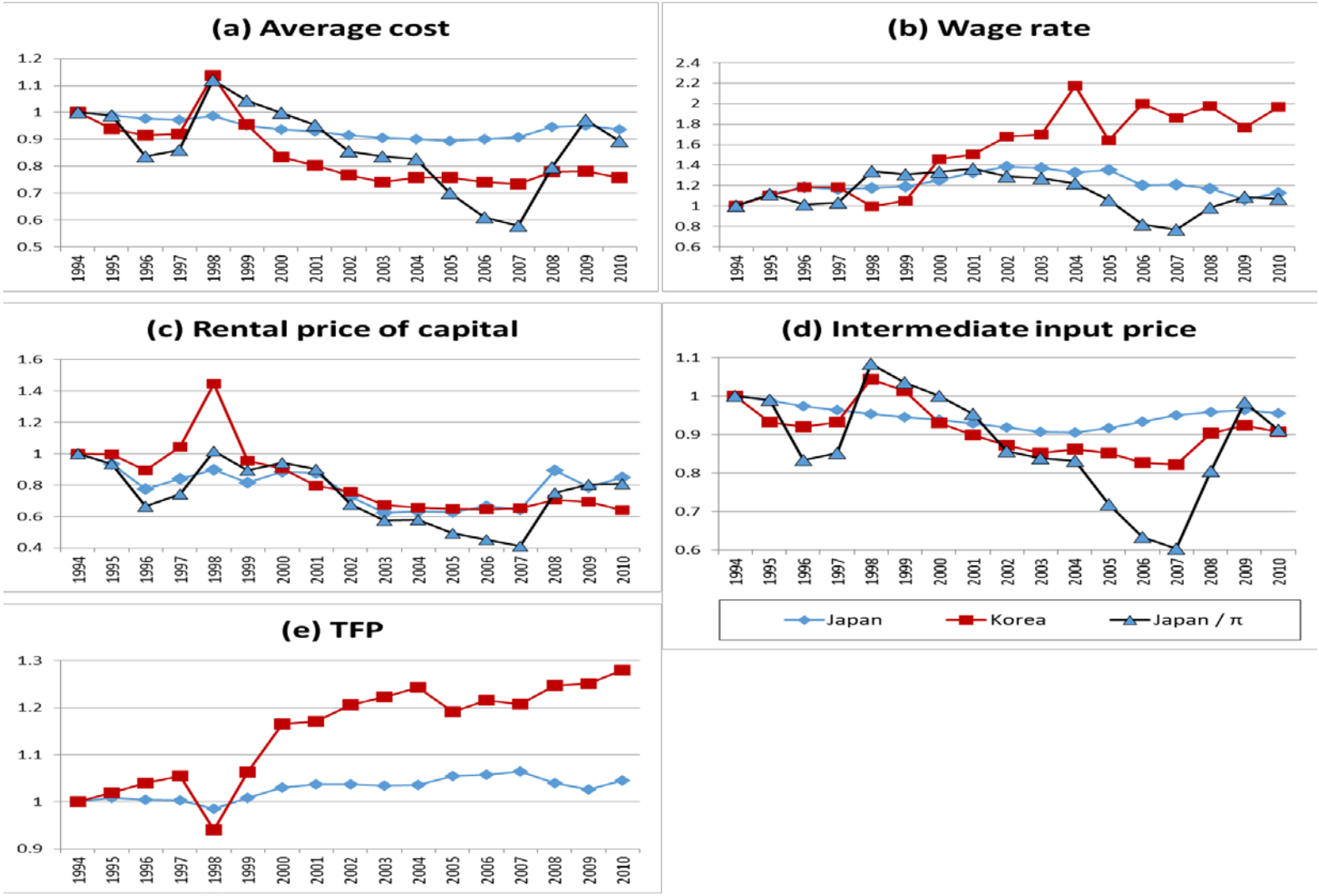
Data : Japan

- The panel data on Japan is compiled from the annual *Basic Survey of Japanese Business Structure and Activities*, which covers all firms with 50 or more employees and paid-up capital or invested funds of more than 30 million yen. The survey contains information on sales, the number of employees, the book value of tangible fixed assets, the wage bill, and other values.
- To deflate most of the input and output variables we employ industry-level deflators from the Japan Industrial Productivity Database 2014 (JIP 2014). CPI data are obtained from the Statistics Bureau, Ministry of Internal Affairs and Communications.

Data : Korea

- The panel data for Korea are obtained from the firm-level dataset compiled by NICE GROUP (formerly National Information and Credit Evaluation, Inc., NICE). The dataset covers firms subject to statutory audit as well as firms listed on the Korea Stock Exchange. Firms are subject to statutory audit if they have assets of more than 7 billion Korean won.
- Industry-level deflators are compiled from two data sets. Output and intermediate input deflators are taken from the Korea Industrial Productivity Database 2012 (KIP 2012) provided by the Korea Productivity Center. As the deflator for capital we use the investment goods deflator provided by the Bank of Korea (BOK). The depreciation rate for capital is also taken from the BOK. Meanwhile, CPI data are taken from the Korean Statistical Information Service (KOSIS).

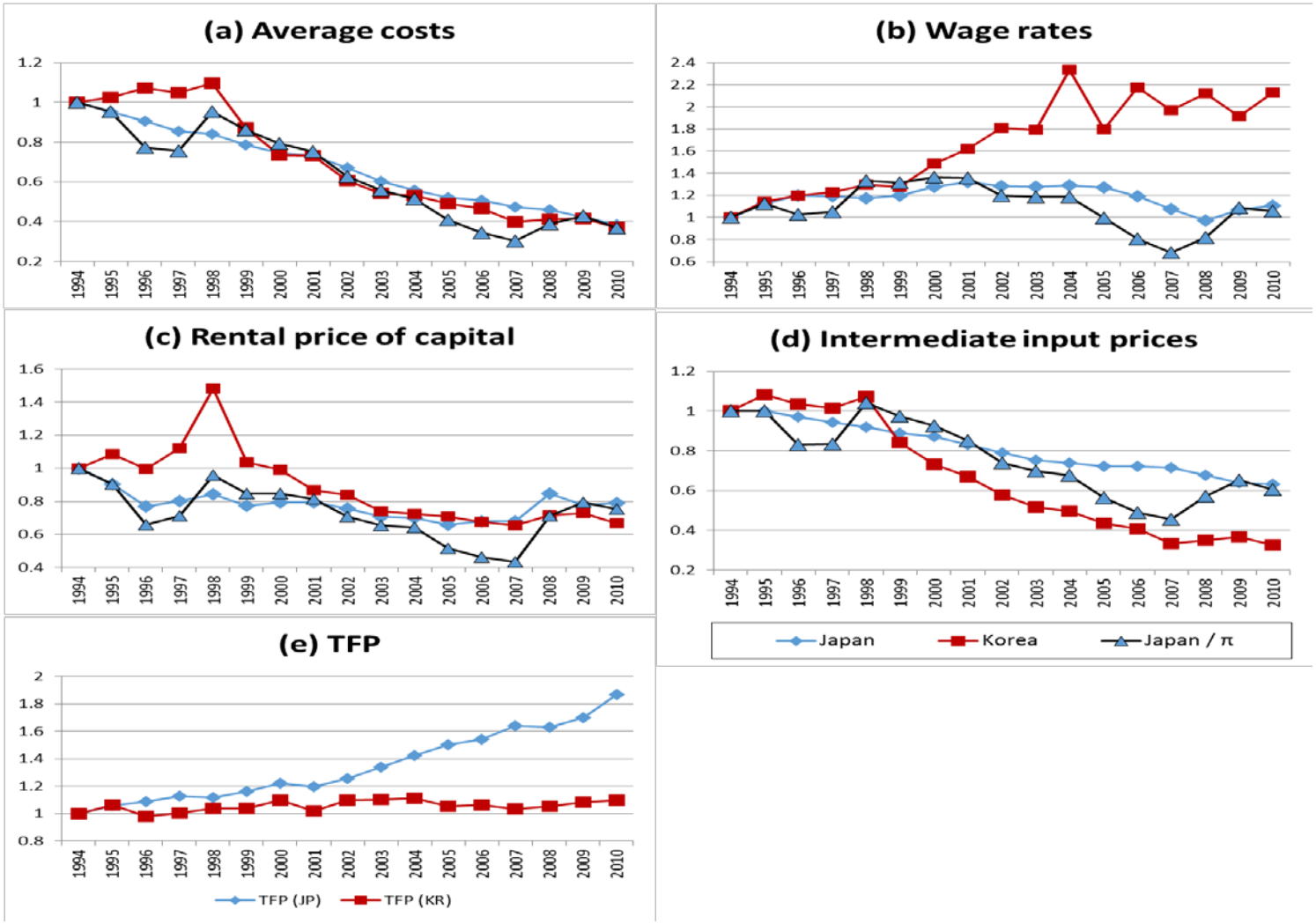
Average Production Costs and Constituent Components, Motor Vehicle Industry: Korea-Japan Comparison



Results (Motor Vehicle)

- Korean firms' competitiveness vis-à-vis their Japanese counterparts, measured in terms of their average production costs, improved by about 5% during the period 1994–2010. The main engine for this gain in competitiveness was the higher TFP growth of Korean firms. Over the 16-year period, Korean firms' TFP growth was 20 percentage points higher than that of their Japanese counterparts.
- Real wage rates in Korea doubled during this period, reducing the competitiveness of Korean firms. In contrast, real wage rates in Japan hardly increased at all.

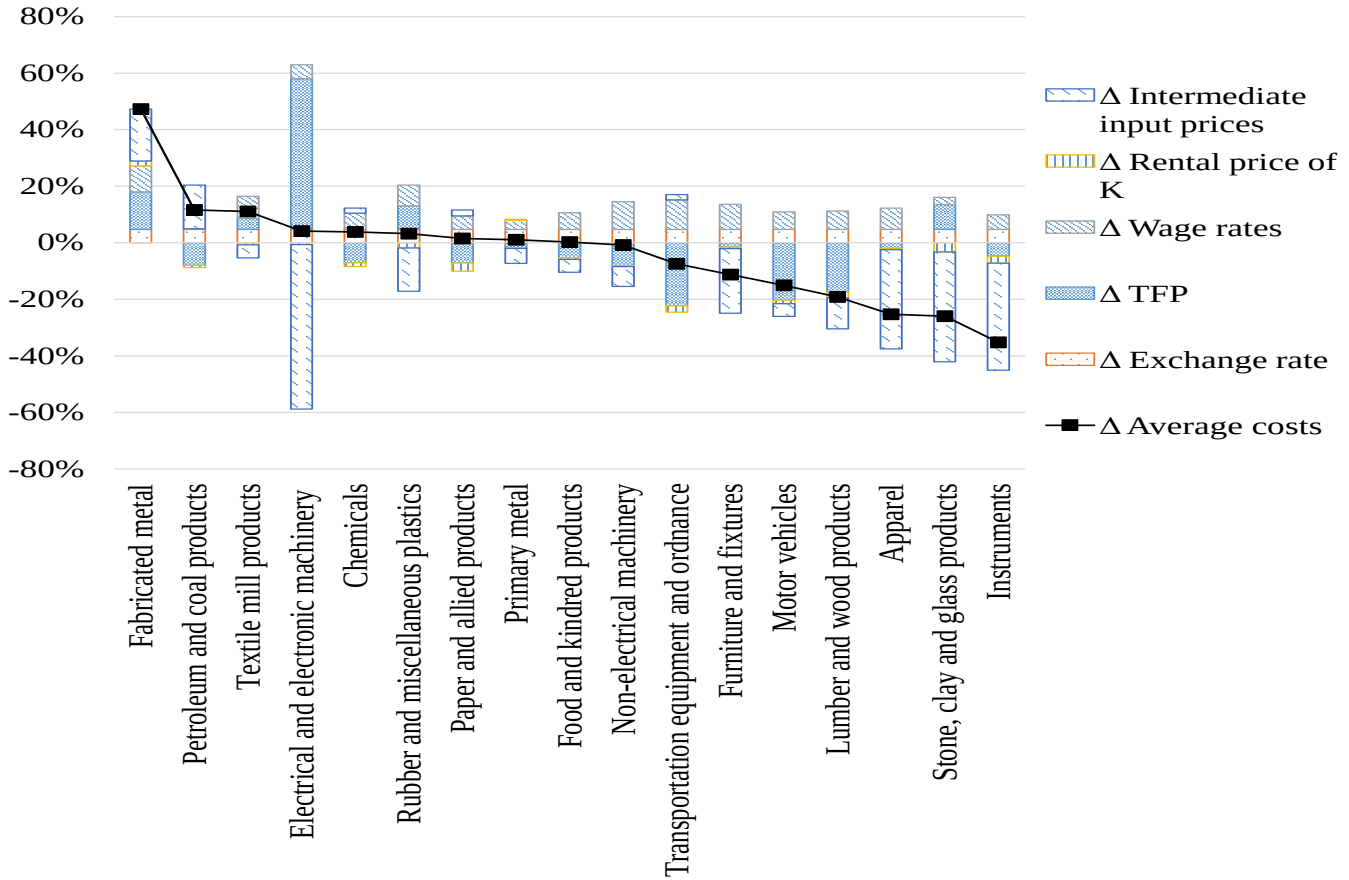
Average Production Costs and Constituent Components, Electrical and Electronic Machinery Industry: Korea-Japan Comparison



Results (Electrical and Electronic Machinery)

- Korean workers enjoyed a doubling of the real wage rate almost without a loss in Korean firms' competitiveness, as in the case of the motor vehicle industry.
- TFP growth in Korea's electrical and electronic machinery industry was much lower than that in Japan. The main factor underpinning Korean firms' competitiveness in this sector was the very sharp decline in intermediate input prices.

Changes in Average Production Costs and Constituent Components by Sector: Korea-Japan Comparison, 1994-2010



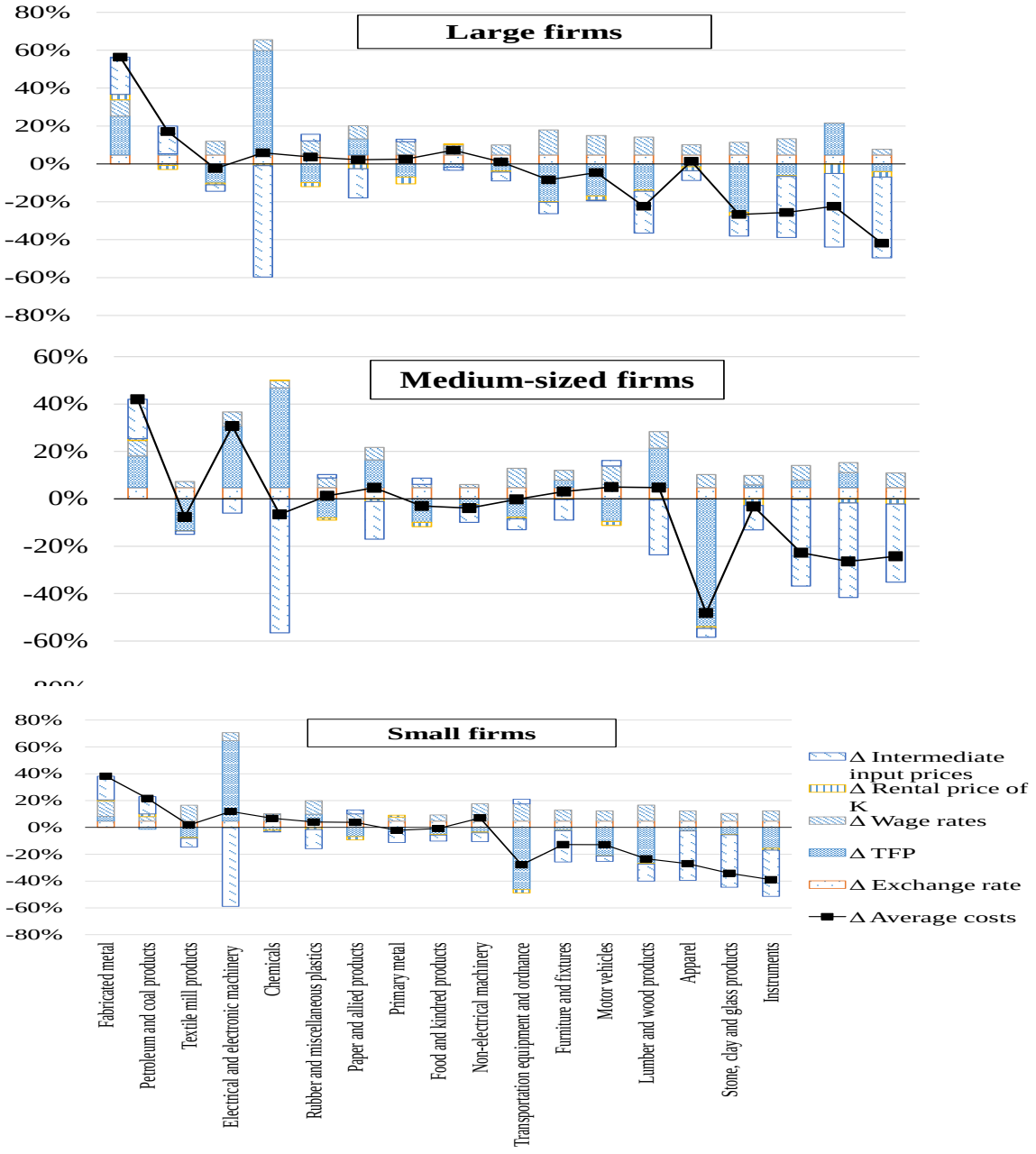
Results (All manufacturing sector) (1)

- The main sources of the improvement in the competitiveness of Korean firms were higher TFP growth and a larger decline in intermediate input prices.
- In eight sectors – transportation equipment and ordnance, motor vehicles, lumber and wood products, non-electrical machinery, petroleum and coal products, paper and allied products, chemicals, and food and kindred products – the industry average TFP growth of Korean firms was more than 5% higher than that of Japanese firms.
- The decline of the ratio of Korean firms' intermediate input prices to Japanese firms' intermediate input price reduced Korea's relative average production costs by more than 10 percentage points in six sectors: electrical and electronic machinery, stone, clay and glass products, instruments, apparel, furniture and fixtures, rubber and miscellaneous plastics, and lumber and wood products.

Results (All manufacturing sector) (2)

- Real wages in Korea increased relative to those in Japan in all 17 sectors. In four sectors – transportation equipment and ordnance, non-electrical machinery, fabricated metal, and furniture and fixtures – the large wage increases in Korea raised the ratio of Korea's average production costs to Japan's average production costs by more than 8 percentage points.
- In addition, the real exchange rate appreciated by 5% during the period 1994–2010.
- However, these two factors were canceled out by the higher TFP growth and larger decline in intermediate input prices of Korean firms in most sectors.

Changes in Average Production Costs and Constituent Components by Sector and Firm Size: Korea-Japan Comparison , 1994-2010



Results (All manufacturing sector and firm size group)

- Firm size is measured in terms of the number of workers, and we divide firms into these three firm groups such that each group has about the same number of workers within each industry in each country and in each year.

- the industry ranking of industries is quite similar across the different firm-size groups.

Results (All manufacturing sector and firm size group)

- In the case of the motor vehicle industry, small and medium-sized Korean firms experienced an improvement in their relative competitiveness against Japanese firms, with the main factor being improvements in TFP. On the other hand, the competitiveness of large Korean firms did not improve at all vis-à-vis their Japanese counterparts.

- In about half of the 17 industries, the improvement in small Korean firms' competitiveness vis-à-vis their Japanese counterparts is greater than the improvement in large Korean firms' relative competitiveness.

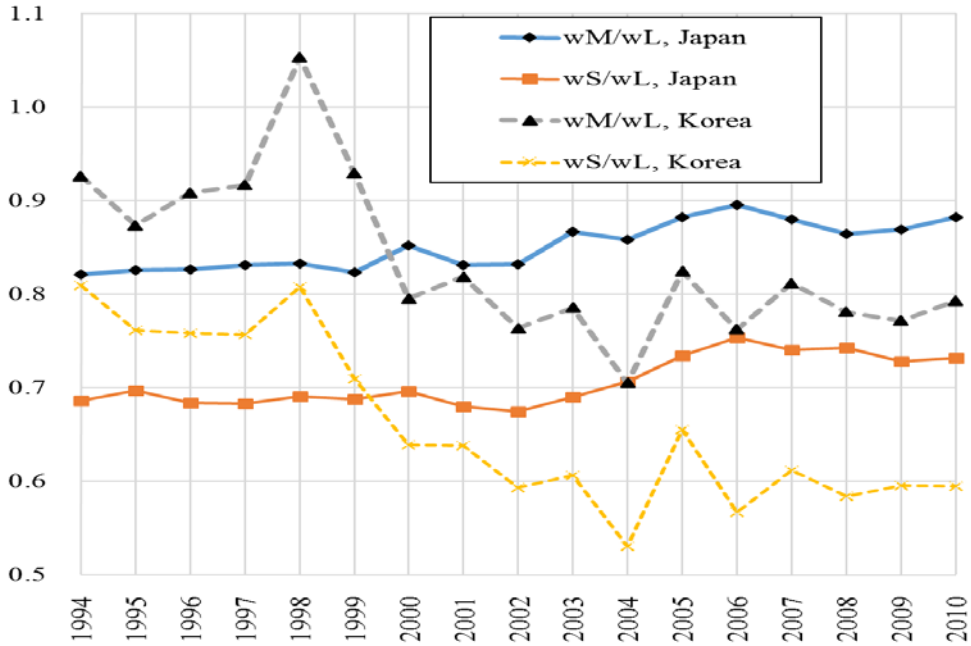
Why small and medium-sized firms in Korea are higher competitiveness than their Japanese counterparts? (1)

TFP Growth by Firm Size and Period: Korea-Japan Comparison

Year	Korea			Japan		
	Large firms	Medium-sized firms	Small firms	Large firms	Medium-sized firms	Small firms
1994-2000	6.7%	4.0%	7.0%	3.6%	2.3%	2.6%
2000-2005	-0.4%	4.6%	1.0%	4.1%	3.1%	2.7%
2005-2010	3.0%	1.8%	2.6%	-4.2%	-0.5%	-1.1%
1994-2010	3.3%	3.5%	3.8%	1.3%	1.7%	1.5%

Over the observation period as a whole, small and medium-sized firms in Korea did indeed register higher TFP growth than large firms.

Why small and medium-sized firms in Korea are higher competitiveness than their Japanese counterparts? (2)



We can see that wage rate gaps across firm-size groups moved in opposite directions in the two countries. In Japan, wage gaps narrowed, while in Korea, wage gaps widened. These developments likely also contributed to improvements in the competitiveness of small and medium-sized Korean firms vis-à-vis their Japanese counterparts.

Future research

- According to OECD (2015), Ito and Lechevalier (2009), and Syverson (2004), productivity differences among firms are widening in many OECD countries. Why was this not the case in Korea, so that small and medium-sized firms were able to catch up with larger firms?
- In this age of global division of labor and offshoring, how to procure cheap but high-quality intermediate inputs is becoming more and more important for firms' competitiveness. Why do Korean firms in the electrical and electronic machinery sector seem to have been so successful in this regard?
- We should note that a large exchange rate appreciation might immediately wipe out all the gains in international competitiveness brought about by TFP growth achieved over many years.