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regarding Auto-parts in China, Korea,
and Japan

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Changes in International Competition regarding Auto-parts in China, Korea, and Japan

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Abstract

This paper considers the international and mutual competitiveness of the auto-parts industry in China, Korea, and Japan, using the “Global Competitiveness Index” (GCI) calculated by international trade statistics of around 30 auto-parts items. According to the analysis of the changes in mutual auto-parts dependence structures and competitiveness in China, Korea and Japan from 1992 to 2013, the author describes the detail change of supply chain of auto-parts. That is, although in 1992 the automobile industry in both China and Korea greatly depended upon Japan, their international competitiveness in auto-parts has improved significantly. The supply chain of auto-parts in these countries changed from being one-way from Japan to two-way with each other and multipolar. Although the auto-parts trade between China and Korea was quite limited in 1992, it has recently become much more active. Analysis shows that the international competitiveness in auto-parts and the international procurement structure in China, Korea, and Japan, have changed dramatically. Then the author analyze more deeply this issue in several aspects such as follows; 1. The changes of major trade partners in China, Korea and Japan. 2. The international competitiveness of each auto-part in China, Korea and Japan, in 1992 and in 2013. 3. Categorizing changes of the international competitiveness of auto-parts in China and Korea.

Keywords: automobile industry, auto-parts industry, supporting industry, international trade, supply chain, international competitiveness, economic development

JEL Classifications: C00, F10, O40

1. Introduction

The purpose of this paper is to consider the international and mutual competitiveness of the auto-parts industry in China, Korea, and Japan. These days, the automobile industry in East Asia is undergoing big changes. Although Japan was the only leader in the automobile industry in Asia before the 1990s, we have recently been able to observe progress in the automobile industry in many countries in Asia. The progress of China and Korea has been especially remarkable. The quality of Korean cars has been judged the equal of Japanese cars, and China now produces the most cars in the world.

When producing competitive good quality cars, one must use auto-components of good quality. How competitive are Chinese and Korean auto-components? The author would like to analyse the

changes in international and mutual competitiveness between China, Korea and Japan by using trade statistics.

2. Objectives and Method

The data used in this analysis is based on the UN Comtrade database, which provides useful data on time series and a cross-section of information about almost every country in the world, although one flaw is that “Taiwan” is included among “other Asian countries”. The author considers “other Asian countries” to stand for “Taiwan”. This seems a reasonable assumption in the light of the current situation in the Asian auto-industry.

The author use the “Global Competitiveness Index” (GCI) to analyse international competitiveness. The GCI is shows the trade competitiveness of a specific trade item in a country. It is also called the “Trade Specialization Coefficient” (TSC) or the “Export Specialization Coefficient” (ESC). The GCI is calculated as the ratio of a country’s trade surplus (exports - imports) to its total trade (exports + imports). The GCI ranges from -1 to 1, with values close to 1 indicating strong international competitiveness and values close to -1 indicating weak international competitiveness. The author roughly classified international competitiveness for each range of GCI values as shown in table1.

Analyzing these trade statistics, the author used the 4-digit and 6-digit HS (Harmonized Commodity Description and Coding System). These auto-components include auto-tires, friction material, springs, gasoline engines, diesel engines, engine parts, air conditioners, ignitions/starters, lights/wipers, chassis, bodies and other automobile parts, as shown in Table 2. For auto-tires, the author added the 6-digit figures for HS401110 (for passenger cars) to HS401120 (for buses and commercial vehicles), because 4-digit tires include tires for airplanes and bicycles.

Please note that this analysis contains problems. Trade items using the HS code may include items that are not for automobiles. Exporters are not classified into global and local companies. Quality is not directly measured. The procurement strategies of auto-companies are not considered nor are government policies or tariff systems. The comparison between the values for each year is not rigorous, because the values for each year are nominal¹.

Table 1. GCI value and international competitiveness

Value of GCI	International competitiveness	Situation of import/export
Over 0.75	Very Strong	Most of the applicable items are for export, and there are very few imports.
0.50~0.74	Strong	Many of the applicable items are for export, and there are few imports.
0.10~0.49	Slightly Strong	There are comparatively more exports.
-0.09~0.09	Moderate	Exports and imports are almost the same.
-0.10~-0.49	Slightly Weak	There are comparatively more imports.
-0.50~-0.74	Weak	Many of the applicable items are imports, and there are few exports.
Below -0.75	Very Weak	Most of the applicable items are for import, and there are very few exports.

Source: Author

¹ GDP deflators for the US dollar are 70.64 in 1992 and 106.73 in 2013, with 2009=100, according to the BEA (Bureau of Economic Analysis, US Government).

Table 2. Auto-parts using this analysis

HS Codes	Definitions of HS Codes	Short Names
4011	New pneumatic tires of rubber	Tires
401110	Of a kind used on motor cars (including station wagons and racing cars)	Of passenger cars
401120	Of a kind used on buses or lorries	Of buses of lorries
401110+20	Not in HS code. Calculate for “Automobile Tires”	Tires for automobiles
6813	Friction material and articles thereof (for example, sheets, rolls, strips, segments, discs, washers, pads), not mounted, for brakes, for clutches or the like, with a basis of asbestos, of other mineral substances or of cellulose, whether or not combined with textiles or other materials.	Friction Material
7320	Springs and leaves for springs, of iron or steel	Springs
8407	Spark ignition reciprocating or rotary internal combustion piston engines.	Gasoline Engines
8408	Compression-ignitions internal combustion piston engines (diesel or semi-diesel engines).	Diesel Engines
8409	Parts suitable for use solely or principally with the engines of headings 8407 or 8408.	Engine Parts
8415	Air conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated.	Air Conditioners
841520	Of a kind used for persons, in motor vehicles	Of automobiles
8511	Electrical ignition or starting equipment of a kind used for spark ignitions or compression-ignitions internal combustion engines (for example, ignition magnetos, magneto-dynamos, ignition coils, sparking plugs and glow plugs, starter motors); generators (for example, dynamos, alternators) and cut-outs of a kind used in conjunction with such engines	Ignitions/Starters
8512	Electrical lighting or signalling equipment (excluding articles of heading 8539), windscreen wipers, defrosters and demisters, of a kind used for cycles or motor vehicles	Lights/ Wipers
8706	Chassis fitted with engines, for the motor vehicles of headings 8701 to 8705	Chassis
8707	Bodies (including cabs), for the motor vehicles of headings 8701 to 8705	Bodies
8708	Parts and accessories of the motor vehicles of headings 8701 to 8705	General auto-parts

HS Codes	Definitions of HS Codes	Short Names
870810	Bumpers and parts thereof	Bumpers
870821	Safety seat belts	Seat Belts
870829	Other	Body Parts
870830	Brakes and servo-brakes; parts thereof	Brakes
870840	Gear boxes and parts thereof	Gear Boxes
870850	Drive-axles with differential, whether or not provided with other transmission components, and non-driving axles; parts thereof	Driving-Axles
870870	Road wheels and parts and accessories thereof	Wheels
870880	Suspension systems and parts thereof (including shock-absorbers)	Suspensions
870891	Radiators and parts thereof	Radiators
870892	Silencers (mufflers) and exhaust pipes; parts thereof	Exhaust Pipes
870893	Clutches and parts thereof	Clutches
870894	Steering wheels, steering columns and steering boxes; parts thereof	Steering Wheels
870895	Safety airbags with inflator system; parts thereof	Airbags
870899	Other	Others

Source: Based on the Ministry of Finance of Japan

3. The Changes in International and Mutual Competitiveness for China, Korea and Japan

Recently, the auto-industry of China and Korea has grown remarkably. Each country actively introduced technologies from advanced countries such as Japan, USA, Germany or France. Previously, each country imported many auto-components from Japan or other countries. They made efforts to develop a domestic auto-parts industry. Now, they can procure almost all their auto-parts from their domestic market.

Fig. 1 shows a comparison between the mutual procurement and competitiveness of “Automobile general parts (HS8708)” in 1992 and in 2013. As of 1992, Japanese imports from China (10 mil. USD) and Korea (35 mil. USD) were very few, compared to Japanese exports to China (150 mil. USD) and Korea (430 mil. USD). As of 1992, the value of bilateral GCI between China and Japan was 0.88 for Japan, between Korea and Japan it was 0.85 for Japan. Japanese competitiveness in auto-parts was very strong at that time. The trade in auto-parts between China and Korea was quite small in 1992.

By 2013, the situation had changed completely. Japanese imports from China totalled 2,632 mil USD, while Japanese exports to China were 7,184 mil. USD. The value of bilateral GCI between China and Japan was 0.46 for Japan. The trade situation in auto-parts in these countries has changed from being one-sided. Japanese imports from Korea amounted to 637 mil. USD, while Japanese exports to Korea came to 519 mil. USD. The value of bilateral GCI between Korea and Japan was -0.1 for Japan. Korean bilateral competitiveness has changed dramatically, becoming slightly stronger than Japan’s.

Korean exports to China totalled 5,178 mil. USD, while Korean imports from China were 1,244 mil. USD. Bilateral trade in auto-parts between China and Korea became active. The value of bilateral GCI between China and Korea was 0.61 for Korea, which indicates Korean strength.

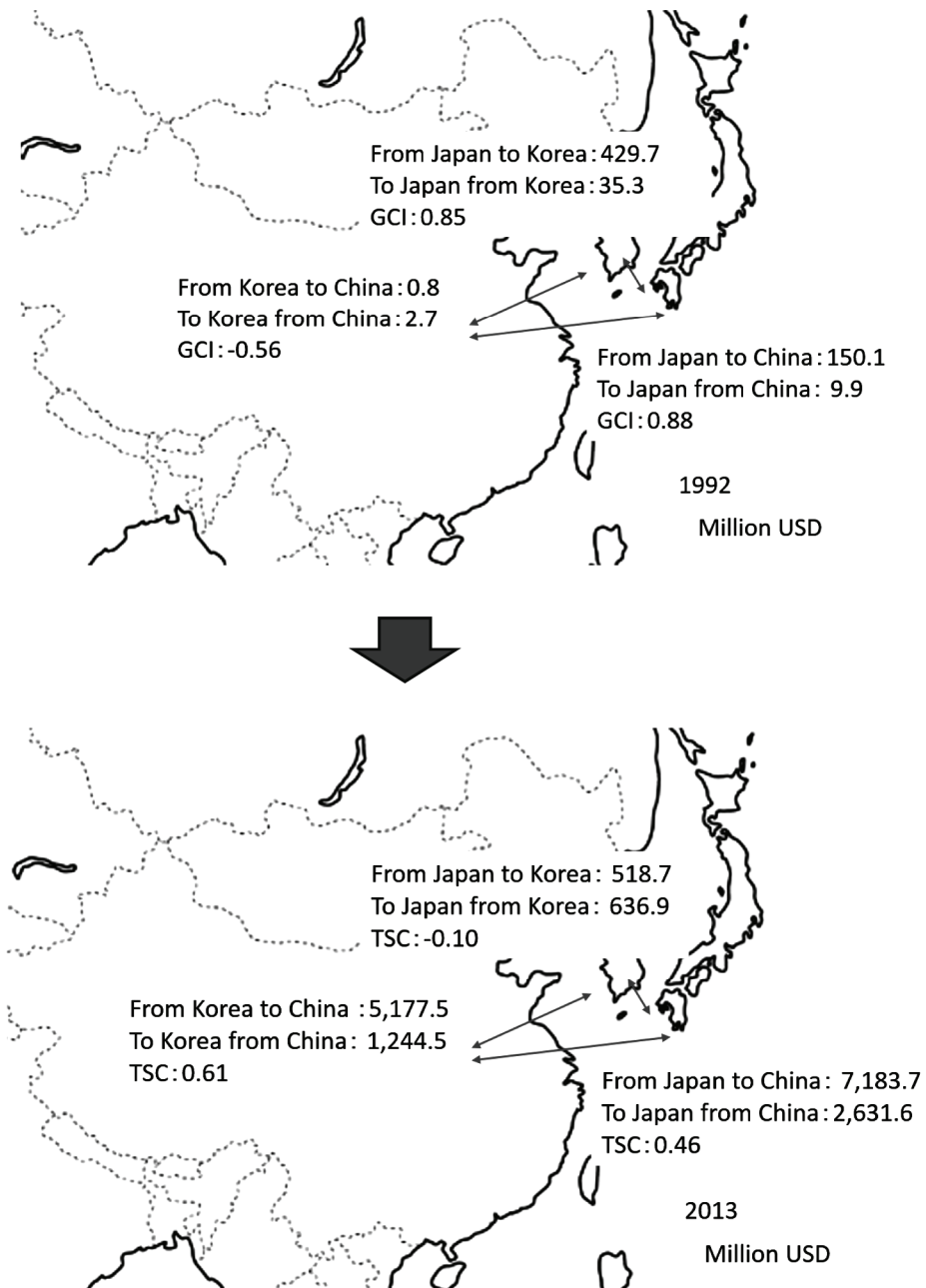


Figure 1. The changes in mutual auto-parts dependence structures and competitiveness in China, Korea and Japan from 1992 to 2013

Source: Calculated using trade data from UN Comtrade

4. Changes of Major Trade Partners in China, Korea and Japan

4.1 China

Table 3 shows China's major trade partners, their shares and the GCI of general auto-parts (HS8708) for 1992 and 2013. China's international trade in general auto-parts grew dramatically between 1992 and 2013 in both exports and imports. Although the GCI of this item was -0.74 in 1992, it was 0.03 in 2013. The international competitiveness of general auto-parts changed from "weak" to "moderate".

Regarding exports, major partners included the USA, Hong Kong, Singapore, Japan and Germany in 1992. The reason why Hong Kong was ranked no.2 was that China exported to foreign countries through Hong Kong. In 2013, the no.1 export partner was the USA, then Japan, Korea and Germany.

Regarding imports, there were many more imports from Germany and Japan in 1992. In 2013, in addition to Germany and Japan, imports from Korea have increased.

The Korean presence has increased in both exports and imports.

Table 3. Major trade partners and their shares in general auto-parts (HS8708) in China, 1992 and 2013

China		GCI (1992:-0.74→2013:0.03)									
Export (Total 1992:0.12 Billion USD→2013:25.52 Billion USD)											
	1st	Share	2nd	Share	3rd	Share	4th	Share	5th	Share	
1992	USA	43.3%	Hong Kong	11.1%	Singapore	10.2%	Japan	9.8%	Germany	2.6%	
2013	USA	30.5%	Japan	10.1%	Korea	4.7%	Germany	4.3%	Russia	3.9%	

Import (Total 1992:0.81 Billion USD→2013:24.16 Billion USD)										
	1st	Share	2nd	Share	3rd	Share	4th	Share	5th	Share
1992	Germany	46.0%	Japan	34.4%	USA	4.6%	Austria	3.1%	Russia	1.9%
2013	Germany	35.4%	Japan	30.0%	Korea	13.9%	USA	4.5%	France	2.8%

Source: Same as Fig.1

4.2 Korea

Table 4 shows Korea's trade in general auto-parts significantly increased between 1992 and 2013. The GCI became 0.74 in 2013 from a level of -0.37 in 1992. The international competitiveness of this item changed dramatically from "weak" to "strong".

Regarding exports, the major export partners in 1992 included the USA, Japan and Canada. In 2013, although the USA was still the no.1 export partner, China became the no.2 partner followed by Russia, Brazil and India. In these countries, Hyundai Motors manufactures automobiles. These days, many auto-parts are exported to these countries from Korea.

Regarding imports, the major import partners in 1992 included Japan, the USA and Germany. It should especially be noted that almost 70% of items were imported from Japan. This shows that Korea's automotive industry was highly dependent on Japan. In 2013, China was Korea's biggest import partner. Then came Japan, Germany and the USA. China's share of 35% was significantly bigger than that of Japan at 18%, the second country. Although, formerly, Korea's international procurement of general auto-parts greatly depended on Japan, these days it has changed greatly and become multipolar. It should be noted that China's presence dramatically increased during this period.

Table 4. Major trade partners and their shares in general auto-parts (HS8708) in Korea, 1992 and 2013

Korea GCI (1992:-0.37→2013:0.74)

Export (Total 1992:0.31 Billion USD→2013:23.84 Billion USD)

	1st	Share	2nd	Share	3rd	Share	4th	Share	5th	Share
1992	USA	39.3%	Japan	14.4%	Canada	5.2%	Taiwan	4.2%	Australia	3.6%
2013	USA	23.9%	China	21.7%	Russia	6.5%	Brazil	6.0%	India	5.0%

Import (Total 1992:0.67 Billion USD→2013:3.57 Billion USD)

	1st	Share	2nd	Share	3rd	Share	4th	Share	5th	Share
1992	Japan	68.9%	USA	16.3%	Germany	5.4%	UK	1.7%	Canada	1.4%
2013	China	34.8%	Japan	17.9%	Germany	15.0%	USA	9.0%	Austria	3.6%

Source: Same as Fig.1

4.3 Japan

Table 5 shows that Japan's trade in general auto-parts was quite strong in 1992; exports were 12.4 billion USD and imports 1 billion USD. The GCI in 1992 was 0.85, which meant that Japan's international competitiveness in general auto-parts was "very strong". In 2013, the GCI decreased to 0.66 (a strong level). Japan's automobile industry has increased its global procurement during this period. Of course, one reason is costs, others are globalization and the political need to avoid trade friction. Therefore, the decline in Japan's GCI for auto-parts does not simply indicate the degradation of the country's international competitiveness in terms of quality and costs, it also indicates the advance of globalization in Japan's automobile and parts industries.

Regarding exports, as the top export partner in 1992, the share of the USA at 47% was quite big compared to the countries that followed, such as Taiwan (7%), Thailand (5%), and Canada (4%). In 2013, although the no.1 country was still the USA, the no.2 country was now China and its share of 20% was quite closed to that of the USA at 24%. These two shares were quite big as can be seen if one compares them with the next countries, such as Thailand (10%), Indonesia (5%) and Mexico (4%).

Regarding imports, as major import partners in 1992, the share of the USA at 30% and Germany at 24% were quite large compared to the next countries, Taiwan (8%), Australia (7%) and Italy (6%). By 2013, imports from USA had declined in both ranking and share. The no.1 country in 2013 was China and its share of 37% was quite big compared to the countries that followed: Germany (10%), Thailand (10%), Korea (9%) and the USA (7%).

Table 5. Major trade partners and their shares in general auto-parts (HS8708) in Japan, 1992 and 2013

Japan GCI (1992:0.85→2013:0.66)

Export (Total 1992:12.42 Billion USD→2013:35.3 Billion USD)

	1st	Share	2nd	Share	3rd	Share	4th	Share	5th	Share
1992	USA	46.5%	Taiwan	6.6%	Thailand	4.5%	Canada	4.1%	Mexico	3.7%
2013	USA	24.3%	China	20.3%	Thailand	9.7%	Indonesia	5.0%	Mexico	4.0%

Import (Total 1992:1.03 Billion USD→2013:7.13 Billion USD)

	1st	Share	2nd	Share	3rd	Share	4th	Share	5th	Share
1992	USA	29.8%	Germany	24.0%	Taiwan	8.3%	Australia	6.5%	Italy	5.8%
2013	China	36.9%	Germany	9.9%	Thailand	9.5%	Korea	8.9%	USA	7.3%

Source: Same as Fig.1

5. The Change of International Competitiveness in Each Auto-part in Detail

We have described the progress of automobile industries and international competitiveness in both China and Korea, and the increase in the global procurement of Japan's auto-industry. Now, the author would like to look at the changes of international competitiveness of each auto-part in detail, as shown in Table 6.

Table 6. The international competitiveness of each auto-part in China, Korea and Japan, 1992 and 2013

GCI	Below -0.75	-0.50~-0.74	-0.10~-0.49	-0.09~0.09	0.10~0.49	0.50~0.74	Over 0.75
International Competitiveness	Very Weak	Weak	Slightly Weak	Moderate	Slightly Strong	Strong	Very Strong
China (1992)	Engine Parts, Chassis, Bodies, Body Parts, Gear Boxes, Driving-Axles, Suspensions, Steering Wheels, Others	Gasoline Engines, Diesel Engines, Bumpers, Exhaust Pipes	Friction Material, Springs, Lights/Wipers, Seat Belts, Clutches	-	Wheels, Radiators	-	Automobile Tires
China (2013)	-	Gear Boxes	Springs, Gasoline Engines, Diesel Engines, Chassis, Bumpers, Body Parts, Steering Wheels	Friction Material, Engine Parts, Seat Belts, Exhaust Pipes, Airbags	Air Conditioners, Lights/Wipers, Driving-Axles, Suspensions, Clutches, Others	Bodies, Brakes, Radiators	Automobile Tires, Wheels
Korea (1992)	Diesel Engines, Bodies, Seat Belts, Gear Boxes, Suspensions, Steering Wheels	Springs, Engine Parts, Chassis, Driving-Axles	Friction Material, Gasoline Engines, Body Parts, Wheels, Others	Bumpers	Lights/Wipers, Clutches	-	Automobile Tires, Radiators, Exhaust Pipes
Korea (2013)	-	-	Friction Material, Airbags	Springs, Diesel Engines, Bumpers	Gasoline Engines, Engine Parts, Gear Boxes	Air Conditioners, Lights/Wipers, Seat Belts, Brakes, Driving-Axles, Wheels, Suspensions, Radiators, Exhaust Pipes, Clutches, Steering Wheels	Automobile Tires, Chassis, Bodies, Body Parts, Others
Japan (1992)	-	-	Wheels	-	-	Automobile Tires, Friction Material, Bodies, Radiators, Steering Wheels	Springs, Gasoline Engines, Diesel Engines, Engine Parts, Lights/Wipers, Chassis, Bumpers, Seat Belts, Body Parts, Gear Boxes, Driving-Axles, Suspensions, Exhaust Pipes, Clutches, Others
Japan (2013)	-	Seat Belts	Wheels, Airbags	-	Lights/Wipers, Radiators	Automobile Tires, Springs, Diesel Engines, Engine Parts, Air Conditioners, Bumpers, Body Parts, Brakes, Suspensions, Exhaust Pipes, Clutches, Steering Wheels	Friction Material, Gasoline Engines, Chassis, Bodies, Gear Boxes, Driving-Axles, Others

Note: Air conditioners for automobiles, brakes and airbags are not in the 1992 figures in this table because there are no data available for this year.

Source: Author

5.1 *China*

In 1992, most auto-parts were categorized in the range from “very weak” to “slightly weak”. The only items categorized as “strong” or “very strong” were automotive tires, wheels and radiators.

In 2013, we can see that many items have raised their international competitiveness. One example is bodies which have dramatically changed from being “very weak” in 1992 to being “strong” in 2013. The only item which was still “weak” in 2013 was gear boxes. Items categorized as “slightly weak” in 2013, included springs, gasoline engines, diesel engines, chassis, bumpers, body parts, and steering wheels.

The GCI for all auto-parts in Table 6 improved from -0.63 (weak) in 1992 to 0.17 (slightly strong) in 2013. Generally speaking, the international competitiveness of Chinese auto-parts became stronger.

5.2 *Korea*

In 1992, Many Korean auto-parts were categorized in the range from “very weak” to “slightly weak”. The only items categorized as “very strong” in 1992 were automobile tires, radiators and exhaust pipes. Items categorized as “slightly strong” were lights/wipers and clutches.

In 2013, most items were categorized in the range from “very strong” to “slightly strong”. No items were categorized in the range from “very weak” to “weak”. The only items categorized as “slightly weak” were friction material and airbags.

The GCI for all the auto-parts in this table improved from -0.03 (moderate) in 1992 to 0.65 (strong) in 2013. We find that the international competitiveness of Korean auto-parts clearly became stronger.

5.3 *Japan*

In Japan in 1992, most auto-parts were categorized in the range from “strong” to “very strong”. The only exception was wheels as “slightly weak”.

In 2013, although most items were categorized in the “strong” to “very strong” range, some fell from “very strong” to “strong”. Items categorized in the range from “slightly weak” to “weak” were wheels, airbags and seat belts.

The GCI for all the items in this table was down from 0.84 (very strong) in 1992 to 0.67 (strong) in 2013. Although the international competitiveness of Japanese auto-parts was still strong, we find that Japanese imports of auto-parts increased during this period.

6. Discussion and Summary

6.1 *The change in the international competitiveness and interdependence in auto-parts in China, Korea and Japan*

The author calculated the GCI for every country for all the auto-parts in this paper. China’s GCI in 1992 was -0.63 (weak). By 2013, it had improved to 0.17 (slightly strong). Korea’s GCI in 1992 was -0.03 (moderate) but by 2003 it had dramatically changed to 0.65 (strong). In the case of Japan’s GCI, in 1992 it was 0.84 (very strong) but by 2013 it was down to 0.67 (strong) because of increased imports.

Regarding the GCI for general parts (HS8708) between China, Korea and Japan, this can be seen in Fig.1. In 1992, Japan’s GCI to China was 0.88 (very strong), and its GCI to Korea was also

very strong at 0.85. We find that China and Korea one-sidedly depended upon Japan's auto-industry, at that time. In 1992, Japan was China's second largest exporter with a share of 34%. In Korea, Japan was the top exporter with a share of 69%. The trade in auto-parts between China and Korea in 1992 was not active.

By 2013, this one-sided dependence on Japan had completely changed to interdependence. In 2013, Japan's GCI to China became 0.46 (slightly strong), and its GCI with Korea became -0.1 (slightly weak). Korea's exports of general auto-parts to Japan exceeded Japan's exports to Korea. The trade between China and Korea became more active, and the value of trade in general auto-parts between the two countries surpassed the value between Japan and Korea. Thus, we find that since the 1990s the international competitiveness of the automobile industry has improved significantly in China and Korea. The mutual dependence between China, Korea and Japan has become much more active. The factors behind this change are not only active foreign direct investment in China and Korea, or global procurement by their global groups, but also the enhanced quality of local auto-parts suppliers' product and their active willingness to export.

6.1.1 What has happened in this period?

(1) China

Many foreign automobile manufactures and auto-parts manufacturers invested in China and actively transferred technology to China, as China's automobile market became bigger. They supply auto-parts in China and also export auto-parts for OEM manufactures or their related auto-parts manufacturers for their global supply chain. Although many of these suppliers were foreign-affiliated parts manufactures, recently local Chinese manufactures participating in this type of trade have an increasing presence. Chinese auto-parts manufacturers also actively export for the after-sales market at cheap prices. Thus, Chinese exports have gradually increased.

(2) Korea

Since the 1990s, Korean automobile manufactures have actively moved abroad to produce automobiles. Unable to procure many auto-parts locally so they had to import parts from Korea. The more they went abroad to produce their automobiles, the more they increased their auto-part exports to the countries where they had invested.

The Korean auto-parts industry has developed well. They can reduce imports of auto-parts which had previously been difficult to produce in Korea. They can also actively export auto-parts for automobile manufacturers or retailers for after-sales markets.

(3) Japan

Since the 1980s, Japan's automobile manufacturers have actively gone abroad to produce automobiles. They could not procure many auto-parts locally, so they had to import parts from Japan. Many foreign automotive manufacturers admitted that Japan's auto-parts manufacturers produced good QCD (quality, cost, delivery) and they imported parts from Japan. Thus exports of Japanese auto-parts have increased.

Gradually, many Japanese auto-parts manufacturers went abroad to produce in foreign countries, because of foreign government policies aimed at protecting their domestic industries, requests from auto-manufacturers, or the desire to enter new and promising markets. Of-course, domestic local auto-parts manufacturers also developed. Then Japanese automobile manufacturers in foreign countries increased their local procurement and reduced their imports from Japan.

On the other hand, Japanese automobile manufacturers have increased their imports from

foreign countries for cost reasons or because they wanted to avoid trade friction. Japanese players in after-sales markets also increased their imports from foreign countries to reduce costs. Thus, Japanese exports have decreased and imports increased.

6.2 *Categorizing changes in the international competitiveness of auto-parts in China and Korea.*

The author would like to provide some detail about changes in the auto-parts industry based on 5 levels of international competitiveness in China and Korea from 1992 to 2003, as shown in Table 7. The term “OEM auto-parts” means “genuine auto-parts” for the production of automobiles.

Table 7. Category of change in international competitiveness

Category type 1	Strong→Weak
Category type 2	Weak→Strong
Category type 3	Weak→Moderate
Category type 4	Weak→Weak
Category type 5	Strong→Weak

Note: “Strong/Weak” in this table includes “Slightly Strong/Weak”, “Strong/Weak” and “Very Strong/Weak”.

Source: Author

(1) Type 1 : Strong → Strong

Items in type 1 include automobile tires (0.79→0.91), wheels (0.22→0.89), and radiators (0.38→0.56) in China, and automobile tires (0.91→0.81), air conditioners (1997:0.73→0.73), lights/wipers (0.39→0.59), radiators (0.94→0.70), exhaust pipes(0.89→0.74) and clutches(0.39→0.52) in Korea.

Common items in both countries are automobile tires and radiators. Automobile tires are representative parts in the after-sales markets. They are easy to export and they vary greatly in quality and price. Regarding tires for passenger cars (HS401110), the top export partner was the USA for both China and Korea in 1992 and 2013. In the case of Japan, although we cannot find China and Korea in the top 5 in 1992, in 2013 China (21%) became the top import partner and Korea (12%) ranked 4th followed by Thailand and Taiwan.

Concerning radiators, there are many labor intensive processes in their manufacture such as brazing or assembly. It is relatively easy to make radiators unless they are for high power vehicles or are heteromorphic. We find that China (23%) became the top partner and Korea (22%) ranked 2nd for Japanese imports of this item in 2013.

(2) Type 2 : Weak → Strong

Items in type 2 include air conditioners (1997:-0.64→0.11), lights/wipers (-0.24→0.39), bodies (-0.91→0.69), driving axles (-0.99→0.19), suspensions (-0.86→0.45), and clutches (-0.47→0.18) in China, and gasoline engines (-0.1→0.38), engine parts (-0.71→0.26), chassis (-0.59→0.97), bodies (-0.77→0.92), seat belts (-0.91→0.72), body parts (-1.0→0.81), gear boxes (-0.98→0.49), driving axles (-0.56→0.63), wheels (-0.44→0.59), suspensions (-0.78→0.65), steering wheels(-0.91→0.62), and others (-0.17→0.88) in Korea. The improvement in the international competitiveness of Korea is particularly remarkable.

Common items in both countries are bodies, driving axles and suspension systems. With respect to driving axles, they are an important auto-part because they transmit the power of the

engine to the wheels. Unusually, they turn at a very high speed. They need precision, balance, a perfect center of gravity, shape and strength. Domestic procurement for advanced foreign automobile manufactures is possible with foreign manufacturers' direct investment or technical cooperation in local parts manufacture.

Major Chinese export partners in driving axles in 2013 were the USA, Korea, India, Japan and Thailand. There are many global OEM automobile manufactures in those countries. They actively export this item from China for their global supply chain.

Major Korean export partners in driving axles in 2013 were the USA, Slovenia, China, Brazil and the Czech Republic. Korean automobile manufacturers have already invested and started production in these countries. This probably includes significant volumes for OEM supply to the production sites of the Korean automobile manufacturers.

In Korea, many key auto-parts are in type 2. A big factor in Korea's improved international competitiveness in auto-parts is the fact that the domestic procurement of these key parts has become possible, which means reduced imports of these key parts, and an increased supply in the OEM production of Korean automobile manufacturers, which means increased exports of auto-parts from Korea.

(3) Type 3: Weak → Moderate

Items in type 3 include friction material (-0.30→0.00), engine parts (-0.78→0.09), seat belts (-0.34→0.06), exhaust pipes (-0.61→0.06) in China, and springs (-0.71→-0.03) and diesel engines (-0.80→0.08) in Korea.

The items in this type include improved auto-parts that have increased international competitiveness between 1992 and 2013 in both China and Korea, although in 2013 they were classified as "moderate", they might climb to "strong" in the near future.

(4) Type 4: Weak → Weak

Items categorized in type 4 include springs (-0.24→-0.15), gasoline engines (-0.70→-0.12), diesel engines (-0.63→-0.38), chassis (-0.90→-0.24), bumpers (-0.60→-0.12), body parts (-0.87→-0.23), gear boxes (-0.88→-0.70), and steering wheels (-0.97→-0.18) in China, and friction material (-0.31→-0.36) in Korea.

Looking at the items in this type 4 in China, we find that many key items for automobile production are included, such as engines, chassis, bumpers, gearboxes, and steering wheels. It seems that imports of these items continue because there is a certain degree of difficulty involved in their production and the transfer of their technology, as well as security issues. Although many parts in this type have improved and have now attained a "slightly weak" rank, gear boxes are still "weak".

A gear box is an important auto-part that transmits the converted rotating speed or torque to other devices through a large number of gear wheels. A transmission is a particularly representative example. A transmission is quite difficult to produce as it has a very complicated internal structure, requires precision and needs advanced heat-treatment technology. Although the localization of a manual type of transmission has improved to some degree in China, it is a big problem to procure and produce an automatic transmission (AT) locally. Recently, a famous Japanese AT manufacturer announced that it is going to extend its AT production capacity sevenfold to 700 thousand units per year in a Chinese factory, because of the rapid increase in domestic demand in China. The situation might therefore change greatly in the near future.

In Korea, friction material is classified in this category. A brake pad is a representative example. A disk brake works using the braking force brought about by pushing the brake pad against a brake rotor incorporated in a brake caliper. The positioning and design involved are quite strict. It goes

without saying that precision is essential, and there is also a lot of know-how involved in the manufacture of the friction material itself. Someone in the auto industry said that this type of production is weak in Korea. They copied the technology and modified it without doing enough R&D. However, this makes up only 0.1% of all the auto-parts trade in Korea.

(5) Type 5: Strong → Weak

There are no auto-parts in type 5 in either China or Korea.

7. Finally

The research question of this paper was to consider international competitiveness in auto-parts in China, Korea, and Japan. To summarize, although in 1992 the automobile industry in both China and Korea depended greatly upon Japan, their international competitiveness in auto-parts has improved significantly. The supply chain of auto-parts in these countries changed from being one-way from Japan to two-way with each other and multipolar. Although the auto-parts trade between China and Korea was quite limited in 1992, it has recently become much more active. Analysis shows that the international competitiveness in auto-parts and the international procurement structure in China, Korea, and Japan, have changed dramatically.

20~40 thousand auto-parts are needed to produce one automobile. Many materials are needed, such as metals, resins, rubber, glass, hides, fibers, and carbon materials. There is a wide range of technologies involved. The automobile industry is very important for a country that wants to enhance its technology, broaden and deepen technological linkages and increase employment. Indeed, many developing countries wanted to develop an automobile and auto-parts industry. Although it was relatively easy to introduce automobile assembly, it proved very difficult to build an auto-parts industry.

Korean cars are highly rated in international markets. Regarding auto-parts, they have made good efforts and enhanced their technologies through active implementation or reverse engineering. The cluster in the country's industry has also grown. The results of the analysis in this paper show that Korea is also highly competitive internationally in auto-parts.

In China, foreign-affiliated automobile assemblers and auto-parts manufacturers actively invested and transferred their technology as China developed economically and its market grew bigger. Also, in China, clusters of the automobile industry formed in some districts. Although the local procurement ratio climbed, there still remain problems in quality and durability with parts produced by local manufacturers.

Although many countries faced difficulties in developing their automobile parts industry, Korea and China have succeeded. Recently, foreign currency rates are changing, like with the weak Japanese yen and the strong Korean won. How does this affect these countries' international competitiveness in auto-parts and the global procurement structure of global automobile manufacturers? The author would like to continue to observe trade statistics.

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◆ Data

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