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An Analysis on the Competitiveness of Japanese Steel Products in Korea: Focus on the Structural Changes of Supply and Demand in Korea Steel Industry*

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Abstract

Purpose – This study reviews changes in the steel export-import structure between Korea and Japan to strengthen the competitive advantage of the Korea Steel industry using a trade-related index.

Design/methodology – This study focuses on analyzing comparative advantage based on the trade intensity index (TII), revealed comparative advantage index (RCA), and trade specialization index (TSI).

Findings – Korea's steel import from Japan increased due to the domestic supply shortage of HR (Hot Rolled Coil) and Plate, rather than the sharp decline of the domestic steel industry's competitiveness in 2010. However, after the completion of Hyundai Steel's blast furnace, the Korea Steel industry solved the supply shortage. Additionally, the import of Japanese steel products had decreased significantly from 2009 to 2019.

Originality/value – This study attempts to analyze Japanese steel products' competitiveness in trade and the domestic influence of high-quality Japanese steel products. These results are connected to domestic steel supply and demand structure and relations with the Japanese steel industry. After completing Hyundai Steel's blast furnace, the Korea Steel industry solved the supply shortage, and the import of Japanese steel products has decreased significantly from 2009 to 2019.

Keywords: Steel, Export, Japan, Competitiveness
JEL Classifications: D12, F23, M52

1. Introduction

The steel industry is the nation's key industry with a high impact on the inter-industries and has played a crucial role in Korea's economic growth by steadily providing materials to automobile, shipbuilding, and construction industries. The steel industry production marked 2.3% of the entire industry and 3.4% of the manufacturing industry in 2017. The steel industry has been trying to increase self-sufficiency in steel and improve trade balance by raising export. Therefore, exports have increased from USD 7.8 billion in 2000 to USD 31 billion in 2019, marking 5.7% in export of the entire industry in Korea. Similarly, imports have tripled from USD 7 billion in 2000 (KOSA) to USD 20 billion in 2019.

The development of the steel industry in Korea is very closely related to Japan. The Korean government had built Pohang Iron & Steel Co. in 1969 (POSCO). It produced one million tons of crude steel with financial support from the Japanese government and technical support from three companies; Yahata Steel, Fuji Iron & Steel Co., and NKK Steel Co., Ltd.

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In the period of rapid growth in 1973, HR Coil that lacked supply was procured from Japan to solve difficulties in the supply and demand of raw materials such as Bloom, Billet, and HR Coil from domestic demand industries and rolling companies. Additionally, POSCO and Nippon Steel have increased their interdependencies through a partnership stake.

Japan's METI (Ministry of Economy, Trade, and Industry) has changed relevant bulk licenses to an individual export license for the export of Fluorinated polyimide, Resist, and Hydrogen Fluoride, and their relevant technologies, which may include technology transferred with exports of manufacturing equipment to the Republic of Korea on July 1, 2019. Steel products used as major materials in Japan's controlled items, such as military items and dual-use items, could also be indirectly affected by trade disputes. There is also a possibility that the closed distribution structure of the Japanese steel industry, represented by Himotsuki, could negatively affect the steel trade between Korea and Japan.

Therefore, this study analyzes changes to Japanese steel products' competitiveness in trade and estimates the domestic influence of high-quality Japanese steel products. For this purpose, this study will use steel trade data from Steel Data of Korea Iron & Steel Association between 2009 and 2019 based on the trade intensity index (TII), reveal comparative advantage index (RCA), and trade specialization index (TSI). These results will be connected to domestic steel supply, and demand structure and relations with the Japanese steel industry to provide different views and implications.

2. Literature Review

2.1. Foreign Literature

According to Mattera(2018), China's degree of trade specialization in bars, flat alloy products, and other metallic coated sheets was much higher in 2014 than in 2004, while its RCA values remained well below one for various steel products such as plates, cold-rolled sheet strips, and galvanized sheets. Japan's RCA values remained significantly high for electrical sheets and increased substantially for hot-rolled sheets and plates in the period considered. However, Japan decreased its exports of galvanized sheets and pipes and tubes, with the latter RCA value falling below one.

Pervej and Anjum (2017) analyzed the comparative advantage of Indian Steel exports as revealed regarding that of the world. Secondly, though the export potential (capacity to export) of Indian steel has strengthened, it has been fluctuating downwards due to an overall improvement in the total global trade. Despite many existing shortcomings in the industry like fluctuating demand in the global market, shortage of raw materials, usage of outdated technology, labor-intensive market, etc., it possesses several inherent strengths that make it competitively strong on the global front, comparable to global giants like China, Japan, and the USA.

Fojtikova (2017) showed that China's exports of iron and steel articles recorded a higher value of the RCA index and were usually higher than the exports of iron and steel. However, a more detailed analysis showed the differences in China's trade competitiveness with respect to steel products and time. China's competitiveness in steel trade raises doubts on whether it is fair trade supported by the WTO.

2.2. Korean Literature

Kim and others (2005) selected Korea·China·Japan FTA sensitive product group, categorized products into export specialization, absolute import specialization, competitiveness

vulnerable, and safeguard product groups, then appointed the last two product groups as the FTA sensitive groups. In this study, the critical value that is the basic standard for each product group is used asymmetrically.

Lee & Jae-sung (2014) reviewed changes in the steel export-import structure between Korea and Japan using a trade-related index based on time-series analysis statistics data using revealed comparative advantage index (RCA) and trade specialization index (TSI). The Korean steel industry has had a high comparative advantage against Japan for more than ten years from 2000.

Han & Liu (2010) classified international division of labor into; 1) export specialized vertical international specialization, 2) surplus-based horizontal international specialization, 3) balance, 4) deficit-based horizontal international specialization, and 5) import specialized vertical international specialization.

Noh, Hyun-Soo et al. (2014) figure out that even though the Japanese export ratio against the USA is getting bigger and Japan's export specialization is high, the Japanese steel industry has no strong comparative advantage against the USA and other industries throughout the whole research period even though its degree is different.

3. Competitiveness Analysis

3.1. Methodology

Major precedent studies on the competitiveness analysis of the steel industry[1] used steel trade data from 'UN COMTRADE' or 'ISSB world steel export.'[2] However, the data used in the studies are different from the domestic industry's classification, which may create small differences from a comprehensive view and large differences from individual items. Therefore, throughout this section, Korea Custom data and Japan Customs data, as the primary data source, will be used following the Korea Iron & Steel Association's steel classification standard. Furthermore, while previous studies include steel products and raw materials, this study focuses on 'steel' as a standard. The domestic steel industry and the Korea Iron & Steel Association commonly use to classify steel and analyze it from a different view.

If a certain product's trade specification index is above the steel industry's average, Kim and others (2005) classified them as export specialization groups. If less than the average and more than –0.5, they have classified them as a vulnerable group, if less than –0.5 and more than –0.9, classified as a safeguard product group, and if less than –0.9, then classified as absolute import specialization group. Thus, asymmetrical classification was set to find out competitiveness vulnerable and safeguard product groups. Han & Liu (2010) categorized to an absolute advantage when trade specification index to the world is above 0.34, to a competitive advantage when above 0.03 and below 0.34, to a competitive (balanced) when between –0.03 and 0.03, to a competitive inferior when above –0.34 and below –0.03, and to an absolute disadvantage when below –0.34. Classifying deficit-based horizontal international specialization as a competitive advantage was considered improper when the average trade specification index is between –0.34 and 0.03.

However, this paper will follow Im (2007)'s methodology, that even if the TSI value appears

[1] Analysis on trade competitiveness of Korea, China, and Japan by You, et al. (2004), Kim (2005), Im (2007), and Han(2010).

[2] Survey in 34 countries covering over 95% of total steel trade based on classification of ECSC established by the Treaty of Paris 1951. One of the representative researches providing long-term steel trade insights between the countries all over the world.

negative, the deficit range can be small and relatively competitive compared to given examples. Additionally, considering Japan as a steel export country, the export of steel materials exceeded its import, and the average global trade specification index was above 0. Therefore, this study will symmetrically use the steel industry average, and 0.8 or –0.8, as a critical value of trade specification index, for an objective competitiveness analysis and comparison. Applying research methods from Im (2007), items will be divided into 4 product groups by China's competitiveness against Korea; product group 1 – absolute advantage, product group 2 – competitive advantage, product group 3 – competitive inferior, product group 4 – absolute disadvantage. These classifications were carried out by 4-step processes, using the number of trade indexes. Each step was done as follows.

3.2. Competitive Analysis

1st step: Classifying Japan's trade specification index to the world

First, the trade specification index to the world (TSI^{i}_{jw}) is used. TSI^{i}_{jw} is the value of the differences between global import and export of a particular Chinese steel product divided by the trade volume of that specific product, which indirectly indicates global competitiveness of the product through the relative volume of export and import.

$$RCA^{i}_{jk} = \frac{X^{i}_{ck} / X^{i}_{cw}}{X_{ck} / X_{cw}}$$

where X^{i}_{jw} is Japan's i product export to the world,
and M^{i}_{jw} is Japan's i product import from the world.

If the value of TSI^{i}_{jw} is 0.8 or higher[3], it is classified as an absolute competitive item. If it is less than 0.8 and equal to or higher than the average of the Japanese steel industry's global trade specification index, it is classified as a competitive advantage item. If it is higher than –0.8 and less than the average of the Japanese steel industry's global trade specification index, it is classified as a competitive inferior item. Lastly, if it is –0.8 or less, it is classified as an absolute disadvantage item.

Table 1. 1st step: Classifying product groups by trade specification index to the world

Product group	Standard	Description
Product group 1	$0.8 \leq TSI^{i}_{jw}$	Absolute advantage
Product group 2	$mTSI_{jw} \leq TSI^{i}_{jw} < 0.8$	Competitive advantage
Product group 3	$-0.8 < TSI^{i}_{jw} < mTSI_{jw}$	Competitive inferior
Product group 4	$TSI^{i}_{jw} \leq -0.8$	Absolute disadvantage

2nd step: Adjustment by Japan's export rate of increase to the world

Second, among the product group 4 classified as an absolute disadvantage in the first step, if the corresponding item's current increase in the global export rate was more than twice that of the entire Japanese steel industry, the group was adjusted to one upper level, considering its possibility of growth in near future.

[3] If trade specification index shows 0.8, it would mean that the export to the world is about 9 times bigger than the import, which implies it has absolute advantage. Im(2007)

Table 2. 2nd step: Adjustment by export rate of increase

Standard	1st step	2nd step
n.a	Product group 1	Product group 1
n.a	Product group 2	Product group 2
n.a	Product group 3	Product group 3
$rate^{i}_{jw} \geq 2 \times m \cdot rate_{jw}$	Product group 4	Product group 3

*$rate^{i}_{jw}$ is i product group global export increase from 2009 to 2019.

**$m \cdot rate_{jw}$ is Japanese steel industry's global export increase during 2009 – 2019.

3rd step: Adjustment by Japan's trade specification index to Korea

While the items were classified according to their global competitiveness in the first and second steps, the competitiveness of each item was reclassified using Japan's trade specification index to Korea (TSI^{i}_{jk}) in the third step. When analyzing the competitiveness of partner countries, global competitiveness is considered because specific items' global competitiveness of Japan and Korea do not match. When analyzing the competitiveness of a partner country's particular item against Korea, global competitiveness can provide objectivity.

Using the trade specification index to Korea, 4 product groups were formed based on the critical value used in the first step. Comparing the items sorted in the second step and by TSI^{i}_{jk}, if the item shows in product group 1 of the second step and product group 4 by TSI^{i}_{jk}, it is reclassified into product group 3. If the item shows in product group 2 of the second step and product group 3 or 4 by TSI^{i}_{jk}, it is reclassified into product group 3. Others are also reclassified, as Table 4 shows

Table 3. 3rd step: Adjustment by trade specification index to Korea

Standard	2nd step	3rd step
if TSI^{i}_{jk} is categorized into product group 4	Product group 1	Product group 3
if TSI^{i}_{jk} is categorized into product group 3 or 4	Product group 2	Product group 3
if TSI^{i}_{jk} is categorized into product group 1 or 2	Product group 3	Product group 2
if TSI^{i}_{jk} is categorized into product group 1	Product group 4	Product group 2

Fourth, revealed comparative advantage (RCA^{i}_{jk}) is used. Revealed comparative advantage is an index used for calculating the relative advantage or disadvantage of goods or services evidenced by trade flows. A share of a country's particular item export from that of the world is divided by a country's total global exports. If the RCA of a particular item is greater than 1, it can be considered a global comparative advantage. Hence, to apply the RCA index to trade between Japan and Korea, the following variations were made[4].

$$RCA^{i}_{jk} = \frac{X^{i}_{ok} / X^{i}_{ow}}{X_{ok} / X_{ow}}$$

where X^{i}_{jk} is Japan's i product export to Korea, X^{i}_{jw} is Japan's i product export to the world, X_{jk} is Japan's export to Korea, and X_{jw} is Japan's export to the world.

[4] In the preceding studies, RCA of China to the world was calculated first, which requires the total world export value. However, as 2010 data is not available, the method in Han (2010)'s study will be modified in this paper.

This shows the weight of export to Korea from the total Japanese export and the weight of a particular industry's export to Korea, in percentages. Therefore, if this value is greater than 1, it means the export of that particular item to Korea is larger than other items. Thus, that particular item can be considered as having a comparative advantage over other items from Japan.

Table 4. 4th step: Adjustment by revealed comparative advantage to Korea

Standard	3rd step	4th step
$RCA^{i}_{jk} \geq 2 \times mRCA_{jk}$	Product group 1	Product group 1
$RCA^{i}_{jk} \geq 2 \times mRCA_{jk}$	Product group 2	Product group 1
$RCA^{i}_{jk} \geq 2 \times mRCA_{jk}$	Product group 3	Product group 2
$RCA^{i}_{jk} \geq 2 \times mRCA_{jk}$	Product group 4	Product group 3

* $mRCA_{jk}$ is the average of Japanese steel industry revealed comparative advantage to Korea.

4. Analysis Result

4.1. Change to the Competitiveness of the Japanese Steel Industry against Korea

Table 5 shows the Japanese steel competitiveness analysis against Korea, using the previous section's approach. Japan's steel exports to Korea recorded USD 5.24 billion in 2009, USD 4.2 billion in 2014, and USD 3.18 billion in 2019, showing a 39.3% decrease. However, Japan's steel imports from Korea recorded USD 1.67 billion in 2009, USD 2.94 billion in 2014, and USD 2.74 billion in 2019. Therefore, in 2003, Japan's steel export to Korea recorded USD 3.58 billion surpluses. However, in 2019, it recorded a USD 450 million surplus, trade surplus of Japanese steel products has decreased significantly.

The competitiveness of Japan's steel industry against Korea per product group is as follows. Regarding product group 1, having an absolute advantage, 48 items recorded USD 4.63 billion, taking 88.2% of the total export amount in 2009, decreased to 41 items with USD 2.56 billion taking 61.1% in 2014. Moreover, it further decreased to 39 items with USD 2.25 billion taking 70.8% in 2019. This makes a -6.96% annual growth rate of the amount of absolute advantage product group export. Meanwhile, import of product group 1 recorded USD 370 million in 2009 and increased slightly to USD 380 million in 2019, yet this was good compared to the decrease in export. Likewise, the number of absolute advantage items had decreased rapidly, resulting in a trade balance recorded at -18.73 annually, from USD 3.58 billion in 2009 to USD 450 million in 2019. This may confirm that Japan's exports of major items that have lost competitiveness since 2009 to Korea increased.

Regarding product group 2, which has a competitive advantage, 11 items recorded USD 150 million taking 2.8% of the total export amount in 2003, which increased to 11 items, with USD 1.05 billion taking 25.2% in 2014, showing the highest share. However, this was rapidly decreased to 10 items, with USD 610 million taking 19.2% in 2019. However, the import amount of product group 2 was different; USD 43 million taking 2.5% of the total import amount in 2009, which increased to USD 610 million taking 20.6% in 2014, which was reduced to USD 300 million, making it 19.2% in 2019. To sum up, the trade balance of product group 2 recorded USD 100 million in 2009, USD 460 million in 2014, reaching the highest, and then decreased to USD 310 million in 2019.

Table 5. Competitiveness of Japanese steel product to Korea (unit: million U$, %)

	product group	export	import	trade balance	number of products
2009	product group 1	4,632(88.2)	369(22.1)	4,263	48
	product group 2	147(2.8)	43(2.5)	104	11
	product group 3	471(9.0)	1,260(75.4)	△787	26
	product group 4	0(0.0)	0(0.0)	0	0
	total	5,252	1,672	△3,580	85
2014	product group 1	2,567(61.1)	238(8.1)	2,329	41
	product group 2	1,054(25.1)	614(20.9)	440	11
	product group 3	579(13.8)	1,931(65.8)	△1,352	31
	product group 4	0(0.0)	153(5.2)	△153	1
	total	4,200	2,936	1,264	84
2019	product group 1	2,254(70.8)	384(14.1)	1,870	39
	product group 2	610(29.2)	300(11.0)	310	10
	product group 3	318(10.0)	2,041(74.8)	△1,723	34
	product group 4	0(0.0)	4(0.1)	△4	1
	total	3,182	2,729	453	84

* summarized by the author based on China Customs Statistics 2010, percentages in parenthesis.

Regarding product group 3, which has a competitive inferior, USD 470 million taking 9.0% of the total export amount was recorded in 2009, USD 600 million taking 13.8% in 2014, and USD 320 million taking 10.0% in 2019. Between 2009 and 2014, a steady increase in exports to Korea was observed, but a sharp increase in China's total exports caused a reduction in the export amount and share. The portion of the export amount to Korea has been maintaining a similar level. In the meantime, Korea's imports recorded USD 1.26 billion in 2009, USD 1.93 billion in 2014, and USD 2.04 million in 2019, showing a continuous increase. Hence, the trade balance deficit increased from USD 800 million in 2009 to USD 1.72 billion in 2019. Regarding product group 4, significantly, only one item was recorded in 2014 and 2019.

Table. 6 shows, in 2009, product group 1 was the biggest, which accounted for 88.2% of the total export. Still, in 2019, many product group items transferred to product group 2, and their competence has been weakened. For product group 3, there has been no significant change in the proportion of exports, such as product group 1, but exports declined. This is due to the relatively low demand for Japanese steel products as Chinese steel exports to Korea have expanded because of the continued expansion of facilities and high technology. Particularly, the change in trade structure over the last decade clearly shows the rapid growth of its global competitiveness. It expanded exports to geographically close countries and Korea.

Table. 6 shows the rapid decrease in the competitiveness of Japanese flat products from 2009 to 2014. Among the flat products, the export of product group 1 was about USD 3.84 billion in 2009, which was decreased by 57.8% in 2014 to USD 1.48 billion, and product group 2 increased by USD 840 million. The level is similar to that of 2014 and 2019. Additionally, among the pipe & tubes, the export of items in product groups 1 and 2, having advantages in competitiveness, was USD 330 million in 2009 and increased to USD 510 million in 2014 and then again decreased to USD 240 million.

However, import shows a moderate growth rate. The largest share of the import amount is in flat products, which increased about 200% in 2014 compared to 2009, as Korea's steel industry has expanded its capacity for flat products.

Other items, such as long products and steel pipes and tubes, remain at a certain level, unlike flat products.

Table 6. Changes in Japan's export and import to Korea (unit: million U$)

		Export					Import				
		G1	G2	G3	G4	total	G1	G2	G3	G4	total
2009	Long Products	827	133	161	0	1,121	54	38	175	0	269
	Flat Products	3,483	5	151	0	3,639	295	1	716	0	1,012
	Pipe & Tubes	322	9	6	0	337	20	4	48	0	72
	Casting & Forgings	0	0	155	0	155	0	0	321	0	321
	Steel Wire	0	0	0	0	0	0	0	0	0	0
	Total	4,632	147	473	0	5,252	369	43	1,260	0	1,672
2014	Long Products	567	213	90	0	870	66	65	110	0	241
	Flat Products	1,484	841	315	0	2,640	148	549	1,364	153	2,214
	Pipe & Tubes	516	0	12	0	528	24	0	151	0	175
	Casting & Forgings	0	0	162	0	161	0	0	306	0	306
	Steel Wire	0	0	0	0	0	0	0	0	0	0
	Total	2,567	1054	579	0	4,200	238	614	1,931	153	2,936
2019	Long Products	580	50	42	0	672	160	26	121	0	307
	Flat Products	1,473	261	164	0	1,898	203	154	1,526	0	1,883
	Pipe & Tubes	200	41	8	0	249	21	13	118	4	156
	Casting & Forgings	0	259	104	0	363	0	108	275	0	383
	Steel Wire	0	0	0	0	0	0	0	0	0	0
	Total	2,253	611	318	0	3,182	384	300	2,040	4	2,729

* summarized by the author based on Japan Customs Statistics 2019 in KOSA Steel database.
** G1, G2, G3, and G4 refer to product groups 1, 2, 3, and 4, respectively.

4.2. Status and Characteristics of Competitive Advantage Items against Korea

In 2009, product group 1 was formed with 39 items, including Plate, H·R Coil, Section, and others[5]. Some of these exceeded USD 100 million of the export amount to Korea; Plate, H·R Coil, HR Coil for Special Use, Section, HR Strip, Other Section, Reinforcing Bar, Structural Seamless Pipes, etc. These items show very high trade specialization (TSI) indexes to the world, TSI to Korea, and RAC, meaning that export competitiveness is very strong against Korea and the world. However, only HR Coil, Plate, Section exceeded USD 100 million of the export amount to Korea. HR Coil for Special Use, Other Pipe, included in product group 1, was located in product group 2. Notably, product group 1 contains other seamless pipes for special pipelines. This resulted from the circumstances where only SeAH css has a special seamless pipe manufacturing facility, which cannot meet all the domestic demands.

Product group 2 was formed with nine items, including H-beam, STS Wire Rod(S), and others, in 2009. Like product group 1, most product group 2 items recorded a surplus in the trade balance, but the trade amount was insignificant. The items that exceed USD 10 million of the export amount to Korea were STS Wire Rod(S) only. In 2019 Forging, High Carbon & Alloy Steel H·R Coil for Special Use(S), STS Plate(S), Other Tube (Seamless), Bars for Other Special Use(S), Other Plate for Special Use(S), etc. are included in the product group 2. Forging, which was included in product group 3, were shifted to product group 2, and the export amount to Korea increased relatively.

[5] Hereafter steel for special use will be marked with S (Specialty).

Table 7. Japan's competitive advantage steel products against Korea 2009 (unit: million U$)

Group	Item	Export to Korea	Import from Korea	Trade Balance	To the world TSI	To Korea TSI	RCA
1	Plate(general)	1,197	9	1,192	0.99	0.99	3.41
1	H·R Coil	1,073	94	979	0.84	0.84	2.19
1	HR Coil for Special Use(S)	417	71	346	0.71	0.87	1.69
1	Section	346	34	313	0.82	0.86	2.34
1	H·R Strip	214	0	214	1.00	1.00	2.06
1	Other Section (Large)	207	0	207	1.00	1.00	3.32
1	Reinforcing Bar	180	0	180	1.00	0.99	4.40
1	Structural Seamless Pipes	131	0	131	1.00	0.81	1.21
1	Plate (High Strength)	124	48	76	0.44	0.25	2.59
1	Other Tube and Pipe (Seamless)	110	0	109	0.99	0.92	0.75
1	H·R Sheet	79	0	78	0.99	0.99	1.39
1	Clad Sheet	74	0	74	1.00	0.99	2.80
1	STS Plate(S)	68	12	56	0.70	0.74	1.73
1	Grain Oriented Electrical Sheet	60	0	60	0.99	1.00	0.17
1	STS Seamless Pipe(S)	58	3	55	0.90	0.97	0.20
1	Hot Dipped Zinc Coated Sheet(S)	45	0	45	1.00	1.00	0.42
1	Bars for Other Special Use(S)	30	6	25	0.68	0.88	0.82
1	Other Surface Treatment Plate	27	3	24	0.78	0.96	0.45
1	Other Plate of Special Use(S)	23	0	23	1.00	0.87	0.77
1	STS High Carbon & Alloy Steel H·R Strip(S)	20	13	7	0.21	0.93	0.23
1	Seamless Pipe for OCTG	19	15	5	0.13	1.00	0.22
1	Cold Drawn Bar(S)	18	1	17	0.91	0.87	0.39
1	Other High Carbon & Alloy Steel C·R Sheet for Special Use(S)	18	1	7	0.93	0.88	1.18
1	Steel Sheet Pile	13	6	10	0.36	0.91	0.43
1	Channel Section (Large)	12	1	6	0.81	0.91	1.80
1	Non-Oriented Electrical Sheet	10	4	4	0.40	0.92	0.15
1	Color Sheet	9	5	9	0.28	0.91	0.19
1	Other High Carbon & Alloy Steel C·R Coil for Special Use	9	0	6	0.99	1.00	0.17
1	Other Section (Medium)	7	0	6	0.95	0.74	2.06
1	STS High Carbon & Alloy Steel C·R Sheet(S)	9	0	9	1.00	0.80	0.44
1	Flat Bar	5	1	4	0.62	0.91	0.82
1	H-beam	92	23	69	0.61	0.65	2.36
2	STS Wire Rod(S)	33	15	17	0.37	0.76	0.82
2	STS Welded Pipes for OCTG(S)	9	4	5	0.42	0.48	0.76
2	High Speed Tool Steel Bars(S)	6	0	6	1.00	0.17	1.06
2	Other Surface Treatment Plate(S)	4	0	3	0.82	0.74	0.48
2	STS Section(S)	2	1	1	0.35	0.70	0.70
2	Cold Drawn Bar	1	0	1	0.58	0.68	0.19
2	Other Medium Plate	1	0	0	0.39	0.76	0.75
2	Other H·R Sheet for Special Use(S)	0	0	0	1.00	-0.11	0.29
2	Section for Other Special Use(S)	0	0	0	1.00	0.50	0.44

* summarized by the author based on Steel data 2019.

Table 8. Japan's competitive advantage steel products against Korea 2019 (unit: million U$)

Group	Item	Export to Korea	Import from Korea	Trade Balance	To the world TSI	To Korea TSI	RCA
1	H·R Coil	821	150	671	0.69	0.87	1.74
1	Plate(general)	385	5	380	0.98	0.98	3.85
1	Section	202	88	114	0.39	0.63	3.10
1	STS Seamless Pipe(S)	96	16	81	0.72	0.94	0.43
1	Reinforcing Bar	95	0	95	1.00	0.94	5.98
1	Other Section	77	0	77	1.00	1.00	3.58
1	Structural Seamless Pipe(S)	74	1	72	0.97	0.84	2.45
1	H-beam	73	51	22	0.18	039	3.52
1	Clad Sheet	50	0	50	1.00	0.97	2.43
1	STS Wire Rod(S)	49	13	36	0.58	0.82	1.46
1	Other Surface Treatment Plate	46	3	42	0.87	0.94	092
1	Channel Section (Large)	33	0	33	1.00	0.94	4.64
1	Hot Dipped Zinc Coated Sheet(S)	29	0	29	1.00	1.00	0.42
1	H·R Sheet	29	0	28	0.97	0.90	0.35
1	Seamless Pipe for OCTG	28	1	27	0.96	0.99	0.96
1	STS High Carbon & Alloy Steel H·R Strip(S)	21	10	12	0.37	0.94	0.42
1	H·R Strip	20	1	20	0.93	0.99	0.53
1	C·R Strip	18	18	0	0.00	0.84	0.22
1	Cold Drawn Bar(S)	17	5	12	0.56	0.84	0.44
1	Flat Bar	15	0	14	0.96	0.89	3.07
1	Grain Oriented Electrical Sheet	14	0	14	0.99	0.99	0.19
1	Other Surface Treatment Plate(S)	12	2	11	0.75	0.91	0.40
1	H·R Sheet for Alloy Tool Steel(S)	10	0	10	1.00	0.90	1.51
1	Angle Section (Medium)	7	1	6	0.85	0.87	4.69
1	Other High Carbon & Alloy Steel C·R Sheet for Special Use	5	1	4	0.65	0.91	0.37
1	Other Bars(s)	5	0	5	1.00	0.74	5.04
1	Tin Plate	4	0	4	1.00	1.00	0.07
1	H·R Sheet for High Speed Tool Steel	4	0	4	1.00	0.78	3.19
1	Other Section (Medium)	3	0	3	0.92	0.83	2.60
1	Other High Carbon & Alloy Steel C·R Coil for Special Use(S)	3	13	△10	-0.67	0.94	0.03
1	Electric Welded Square Pipe	2	3	△1	-0.22	0.80	0.35
1	Free Cutting Bar	2	0	2	1.00	0.98	0.32
1	Other H·R Sheet for Special Use(S)	2	0	1	0.73	0.88	0.61
1	Spring Steel Bar(S)	1	0	1	0.86	0.83	0.26
1	Rail	1	3	△2	-0.42	0.95	0.02
1	Other Seamless Pipe for Special Use(S)	1	0	1	0.40	0.98	0.02
1	Electrolytic Zinc Coated Sheet(S)	0	0	0	-0.42	0.99	0.01
1	High Speed Tool Steel Wire Rod(S)	0	0	0	1.00	1.00	1.99
1	Other Medium Plate	0	0	0	0.43	0.91	0.09

Table 8. (Continued)

Group	Item	Export to Korea	Import from Korea	Trade Balance	To the world TSI	To Korea TSI	RCA
2	Forging	258	107	160	0.41	-0.13	1.45
2	High Carbon & Alloy Steel H·R Coil for Special Use(S)	189	127	62	0.20	0.74	1.36
2	STS Plate(S)	50	21	28	0.40	0.70	1.84
2	Other Tube (Seamless)	41	13	28	0.52	0.79	0.89
2	Bars for Other Special Use(S)	33	25	8	0.14	0.62	0.84
2	Other Plate for Special Use(S)	22	5	16	0.62	0.02	1.01
2	High Speed Tool Steel Bars(S)	7	0	7	0.99	0.48	1.28
2	STS Section	7	0	7	0.87	0.74	2.24
2	Cold Drawn Bar	2	1	1	0.41	0.77	0.32
2	Other Steel Wire	1	0	1	0.76	0.13	0.83

4.3. Status and characteristics of competitive inferior items against Korea

Product group 3 (competitive inferior) comprises mainly flat products in 2009. Flat products, such as hot dipped zinc coated sheet (USD 80 million), C·R Strip (USD 36 million), STS C·R Strip (USD 26 million), and others, take a high share of import. Additionally, Wore Rod, Forging, and other technically developed Korean steel products are steadily imported, although the amount itself is rather small. In 2019, flat products such as Hot Dipped Zinc Coated Sheet, Plate (High Strength), and STS C·R Strip(S) were included in product group 3.

Japan ranks inferior in cold-rolled steel sheets, which are high value-added products because Korean steel companies have secured export competitiveness by pursuing advanced strategies consistent with the continued growth of domestic demand businesses such as automobiles and home appliances.

Product group 4 (absolute disadvantage) is neither in 2009 nor in 2019.

Table 9. Japan's competitive inferior steel products against Korea in 2009 (unit: million U$)

Group	Item	Export to Korea	Import from Korea	Trade Balance	To the world TSI	To Korea TSI	RCA
3	Wire Rod	145	99	45	0.19	0.53	1.05
3	Hot Dipped Zinc Coated Sheet	82	139	△57	-0.26	0.76	0.28
3	Forging	71	89	△18	-0.11	-0.09	0.36
3	Other Steel Wire for Special Use(S)	42	90	△48	-0.36	0.62	0.42
3	C·R Strip	36	322	△285	-0.80	0.33	0.19
3	STS C·R Strip(S)	26	95	△69	-0.57	0.73	0.17
3	Casting	17	52	△36	-0.51	0.03	0.30
3	Casting(S)	13	13	△1	-0.04	-0.21	0.52
3	Bar	10	8	2	0.12	0.61	0.70
3	STS Steel Wire(S)	8	29	△21	-0.58	0.18	0.29
3	Non-Planting Steel Wire	5	15	△10	-0.53	0.28	0.32
3	STS Bar(S)	4	16	△13	-0.62	0.22	0.36
3	Electric Welded Tube (Medium·Small)	4	40	△36	-0.83	0.63	0.05
3	ZN-AL Alloy Sheet	3	15	△11	-0.62	0.57	0.24

Table 9. (Continued)

Group	Item	Export to Korea	Import from Korea	Trade Balance	To the world TSI	To Korea TSI	RCA
3	Wire Rod	3	51	△49	-0.90	-0.54	0.32
3	Electric Welded Square Pipe	2	6	△4	-0.44	0.57	0.36
3	STS High Carbon & Alloy Steel C·R Coil(S)	2	14	△12	-0.78	0.32	0.23
3	STS High Carbon & Alloy Steel H·R Sheet(S)	1	4	△3	-0.68	-0.07	0.29
3	C·R Sheet	0	6	△6	-0.89	-0.04	0.11
3	Aluminum Coated Sheet	0	10	△9	-0.94	0.59	0.03
3	Other Steel Wire	0	0	0	-0.31	0.09	0.16
3	Other Welded Tube for Special Line(S)	0	0	0	0.07	0.34	0.04
3	Spiral Pipe (Large)	0	2	△2	-0.96	0.38	0.02
3	Galvanized Hard Drown Wire	0	32	△32	-1.00	-0.70	0.01
3	C-Section	0	1	△1	-0.95	0.55	0.02
3	H·R strip (High Strength)	0	113	△113	-1.00	-0.77	0.00

* summarized by the author based on KOSA Steel Data 2019.

Table 10. Japan's competitive inferior steel products against Korea in 2019 (unit: million U$)

Group	Item	Export to Korea	Import from Korea	Trade Balance	To the world TSI	To Korea TSI	RCA
3	Other Steel Wire for Special Use(S)	69	89	△20	-0.12	0.52	1.09
3	Hot Dipped Zinc Coated Sheet	56	494	△438	-0.80	-0.05	0.56
3	Plate (High Strength)	54	277	△224	-0.68	-0.44	3.10
3	STS C·R Strip(S)	39	177	△139	-0.64	0.44	0.41
3	Bar	18	22	△5	-0.11	0.49	0.74
3	STS Steel Wire(S)	18	41	△23	-0.40	0.53	0.86
3	Wire Rod	11	50	△39	-0.63	-0.18	0.70
3	STS Bar(S)	9	17	△8	-0.29	0.05	0.98
3	Casting	8	72	△64	-0.81	-0.13	0.22
3	Casting(S)	7	21	△14	-0.48	-0.31	0.34
3	Color Zinc Coated Sheet	5	27	△22	-0.67	0.63	0.23
3	Electric Welded Tube(Medium·Small)	5	94	△89	-0.90	0.36	0.11
3	Non-Oriented Electrical Sheet	4	16	△12	-0.59	0.69	0.12
	Steel Sheet Pile	3	27	△23	-0.77	0.68	0.30
3	STS Welded Pipe(S)	3	16	△13	-0.70	-0.07	0.39
3	STS High Carbon & Alloy Steel C·R Sheet(S)	2	19	△17	-0.78	0.66	0.27
3	Electrolytic Galvanized Iron	1	37	△36	-0.93	0.82	0.03
3	Non-Plating Steel Wire	1	28	△26	-0.91	0.11	0.13
3	STS High Carbon & Alloy Steel H·R Sheet(S)	1	7	△6	-0.77	-0.54	0.80
3	STS C·R Coil(S)	1	34	△33	-0.94	-0.20	0.25
3	Chrome Coated Sheet	0	20	△20	-0.96	0.79	0.01
3	Electric Welded Tube (Large)	0	5	△4	-0.84	0.73	0.09
3	C-Section	0	1	△1	-0.71	0.12	0.65

Table 10. (Continued)

Group	Item	Export to Korea	Import from Korea	Trade Balance	To the world TSI	To Korea TSI	RCA
3	Other Welded Tube for Special Line(S)	0	2	△2	-0.83	0.82	0.03
3	Galvanized Steel Wire	0	24	△24	-0.99	-0.60	0.06
3	C·R Sheet	0	24	△24	-0.99	-0.62	0.10
	Aluminum Coated Sheet	0	6	△6	-0.96	0.47	0.06
	C·R Coil	0	274	△274	-1.00	-0.50	0.00
	Structural Welded Pipes(S)	0	1	△1	-0.94	0.99	0.00
	Other Section for Special Use(S)	0	0	0	-0.96	-0.10	7.13
	H·R Strip(High Strength)	0	114	△114	-1.00	-1.00	0.00
	ZN-AL Alloy Sheet	0	0	0	1.00	-0.57	0.00
	Roll Bending Pipes (Large)	0	0	0	1.00	1.00	

* summarized by the author based on KOSA Steel Data 2019.

4.4. Analysis Result

As mentioned earlier, the competitiveness of Japan's export to Korea has decreased rapidly from 2009 to 2019; the export of products with competitive advantages decreased, both in terms of quantity and quality, from USD 4.78 billion in 2009 (share: 88.2%) to USD 2.86 billion in 2019 (share: 70.3%). This was possible with overall technology development and capacity expansion of the Chinese steel industry, resulting in increased exports of oversupplied products to Korea. However, a thorough analysis of the Korean steel industry is required before judging whether the export increase has occurred solely by strengthening Chinese steel product competitiveness.

Table 11. Korea's major steel production ability[6] (unit : one thousand ton, %)

Classification	1962	1970	1980	1990	2000	2005	2010
H·R Coil (A)	56	156	6,554	12,946	28,890	33,435	38,810
Down Stream (B)	6	10	4,779	12,202	30,507	36,842	50,641
CR Sheet & Strip	6	10	1,801	5,994	16,455	18,023	24,463
Surface Treatment Plate	-	-	724	3,059	7,715	11,250	16,175
Pipe & Tubes	-	-	2,254	3,149	6,337	7,569	10,003
Difference (B-A)	-50	-146	-1,775	-744	1,617	3,407	11,831

As shown in Table 11, based on the development of automotive and electronics, Korean C·R sheet & strip production capacity increased since 1980 from 1.8 million ton to 16 million ton in 2000, to 25 million ton in 2010, and surface treatment plate increased from 7.2 million ton in 1980 to 16.2 million in 2010. Additionally, the construction business-enhancement such as the government building 2 million households, and high pipe & tubes consumption of major oil-producing countries due to rising oil prices, has led to the production capacity of steel for ordinary piping for construction and oil country tubular goods (OCTG) increased from 3 million ton in 1990 to 10 million ton in 2010.

Meanwhile, the steel production capacity of downstream companies increased from 30.5

[6] Korea Iron & Steel Association, 『Steel Production Capacity 2009』, 2010.

million tons in 2000 to 50.64 million tons in 2010, H·R coil production capacity merely increased from 28.89 million tons to 38.81 million tons, causing a supply shortage of 11.83 million ton on facility capacity basis. As HR coil is produced through a blast furnace, the Korean steel industry suffered from this short supply until the 2000s due to the government policies, major facility investments to downstream steel mills, delay in blast furnace construction, and the bankruptcy of Hanbo Steel. Hence, the shortage has been fulfilled by imports from Japan.

Table 12. Changes in H·R coil supply and demand[7] (unit : one thousand ton, %)

Classification	2006	YOY	2010	YOY	2013	YOY	2019	YOY
Total demand	23,334	14.8	35,828	26.0	37,564	-2.8	37,272	-4.6
Nominal consumption	25,230	3.7	31,583	-2.1	32,545	-0.3	32,602	-2.7
Export	3,104	26.4	4,245	11.2	5,019	-16.9	6,670	19.4
Production	21,600	-1.2	28,605	26.7	33,083	-2.0	35,910	0.0
Import	6,734	23.5	7,223	23.4	4,481	-8.7	3,362	6.5

Moreover, since 2005, there have been significant changes to domestic H·R coil import structure, as low-cost Chinese H·R coil imports surged due to its rapid capacity expansion. However, the plate, produced through the hot rolled process from the semi-finished products such as slab, bloom, and billet, required separate facility investment as its manufacturing process is different from the H·R coil.

However, Korean steel companies could not actively respond to increasing demand. As one of the major steel industries, domestic shipbuilding companies had to import many plates from Japan and China to cope with its industry uptrend. Thus, even after the completion of Hyundai Steel's blast furnace, the Korean steel industry faces a constant shortage of plate and H·R coil. Simultaneously, China's increased import seems to be caused by replacing the majority of steel imports from Japan. Thus, the major products that show China's rapid rise in competitiveness against Korea, such as H·R coil and plate, are the domestic short-supplied items. Therefore, it can be considered that Japanese and Chinese steel imports to Korea increased due to the domestic supply shortage of some steel products, rather than the sharp decline of the domestic steel industry's competitiveness.

Table 13. Changes in the Import of Steel Products in Korea (unit: million U$)

Classification	2003	Weight	2010	Weight	2014	Weight	2019	Weight
World Total	6,411	100.0	21,112	100.0	20,525	100.0	14,707	100.0
China	649	10.1	6,839	32.4	9,673	47.1	6,523	44.4
Japan	3,710	57.9	9,054	42.9	6,350	30.9	4,554	31.0
Others	2,052	32.2	5,220	24.7	4,501	21.9	3,630	24.6

However, as Hyundai Steel's integrated blast furnace steel mill was completed in 2010, it is expected to solve the imbalance of supply and demand between upstream and downstream. It expects the synergy effect in the steel industry with the transition in the competitive system.[8] POSCO and Hyundai, being the two major integrated steel companies, competing mutually

[7] Korea Iron & Steel Association, 『Steel Supply and Demand Prospects 2011』, 2010, excluding stainless
[8] Ministry of Trade, Industry & Energy press release, Oct. 28, 2006.

in technological development and the international competitiveness improvements, automotive, shipbuilding, and other steel-intensive industries will achieve price stability and improvements in quality and service. The imports from Japan and China will possibly be reduced significantly.[9]

5. Conclusion

Even though the steel production capacity of downstream companies increased due to the strong demand from the steel-using industries, the Korean steel industry delayed investment upstream (processing semi-finished products such as pig iron). Therefore, it caused lasting structural imbalances of supply and demand in the Korean steel market, inevitably increasing imports of the high-quality slab, H·R coil, and other semi-finished steel products from Japan and China. Therefore, due to the domestic supply shortage of some steel products, Japanese steel imports to Korea increased, rather than the sharp decline of the domestic steel industry's competitiveness. However, Hyundai Steel's entry into the blast furnace business created opportunities to resolve imbalances in steel supply and demand by providing the basis for competition and increasing steel production capacity. Thereby, a significant part of increasing steel imports was solved, while finding new demand sources for increased steel production became the challenge.

Ever since the Pohang steel mill produced its first pig iron on June 9, 1973, the domestic steel industry became the foundation of Korean economic growth. Construction, shipbuilding, automotive, electronics, machinery, and other steel-intensive industries made remarkable growth based on the stable supply of high-quality steel by domestic blast furnace mills. Additionally, the steel demand rapidly grew with rising demand and exports in automotive production, increasing shipbuilding volume, and expanding the global market share of high-end electronics.

Hence, adapting to such changes, the Korean steel industry should continue managing the long-term and sustainable demand by maintaining the existing domestic demand sources. It is expected that the expansion of the domestic facility will ease the supply shortage, but the possibility of Japanese and Chinese steel inflow remains. An accurate understanding of key customers' needs in quality and service and efforts to develop products are required to overcome these risks. Then, a long-term trust relationship, sharing core information, can be formed. Steel industries can avoid the risk of demand fluctuation by sudden changes in the external environment, sharing information with steel industries on the environment and production planning, and production based on its supply and demand prospects.

Additionally, a distribution program should be conducted to plan and manage systematically and professionally, satisfying both manufacturers' and distributors' needs. Hence, steel companies require establishing distribution management departments, clarifying its necessity, planning sales targets, inventory levels, sales training, advertising, and promotion. Distributors need to understand that they can promote joint sales activities and not purchase steel products through tough negotiations with manufacturers. Additionally, steel manufacturers need to recognize distributors as partners with a common goal, not as mere buyers of the products. Furthermore, it should focus on exports; it needs to strengthen global distribution networks and customer-oriented marketing to expand exports. It needs to expand

[9] As Korean steel supply and demand structure changes due to Hyundai Steel's integrated steel mill operation, there needs fundamental changes to Japanese steel export paradigm to Korea, says the Masaki Moito, the head of department of steel industry in Japanese Ministry of Economy, Trade and Industry at 'the 12th Korea-Japan Steel Dialogue' May 23, 2011. Japanese Industry News, May 25, 2011.

steel processing centers in major exporting markets like China and India to build a stable export network and strengthen marketing strategies to the core and long-term customers by providing personalized services and value creation.

Therefore, it may lead to achieving the status of a global steel power by actively responding to the changes in the competitive structure of the domestic steel industry and the increase in the supply, by forming long-term trust relationship with the customers, by ensuring stable demand sources via efficient distribution management, and through aggressive development of foreign markets.

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