CHAPTER 3

Changes in the Competitive Environment and Division of Labor Structure in Northeast Asia: A Focus on the Iron and Steel Industry

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1 Introduction

Since the global economic crisis in 2008, international trade communities have worried about rising protectionism, as protectionist measures such as import restrictions and tariff increases have been historically prevalent during periods of economic slowdown. Recently, "neoprotectionism," focusing on nontariff measures and trade frictions, has become intense.[1]

The iron and steel industry is one of the industries that have been most strongly affected by such changes in international trade and the competitive environment. In addition, the iron and steel industry has been facing

[1] Protectionism in the process of economic globalization has evolved from trade policy based on the introduction of tariff limitations and, later, from nontariff protection instruments into a complex, comprehensive state mechanism for increasing the competitiveness of the national economy in the process of globalization, which we call neoprotectionism.

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a severe competitive environment of overcapacity, mainly from China, and a slowdown in global demand since the 2010s. The double shock of the expansion of protectionism and the spread of coronavirus disease 2019 (COVID-19) has severely damaged the manufacturing industry and the world economy. In other words, the growth momentum of the global iron and steel industry is weakening, and the competition to survive is becoming even more intense in global markets.

In the iron and steel industry, three countries, i.e., the Republic of Korea (ROK), Japan, and China,[2] show different development patterns and supply–demand structures but have developed while "competing and cooperating" with each other. Moreover, these three countries have become dominant players in the global steel industry by producing more than 60% of the world's crude steel and consuming more than 50% of the steel produced. In particular, since the 2010s, intraregional specialization has intensified, accompanied by the rapid improvement in the technological development capability of the ROK and China. Under the current difficult business environment surrounding the iron and steel industry of KJC, it is expected that the competition to survive will become more intense in global markets.

The purpose of this article is to examine the ideal ways in which the intraregional division of labor can overcome the current difficult business environment and strategic challenges to survive in the future, focusing on the iron and steel industry. In addition, this article explores policy issues related to the future direction of the intraregional specialization structure in the iron and steel industry.

Regarding the structure of this article, Sect. 2 provides an overview of the development trends and supply–demand structure of the iron and steel industry in KJC, and Sect. 3 examines the trade structure and competitiveness of their iron and steel industry. Then, Sect. 4 draws conclusions and discusses prospects for future research.

Unless otherwise stated, data on production, consumption, and trade are obtained from the Worldsteel database (World Steel Association 1980–2020) and the United Nations Comtrade database (United Nations 2000–2019) as an original source with the customs statistics for each economy. Data on production capacity are obtained from the Organization for Economic Cooperation and Development (OECD) database

[2] Hereafter, Republic of Korea (ROK), Japan, and China are denoted as KJC.

(OECD 2000–2020). For detailed trade data, we mainly rely on the official statistics of the national industry associations.

2 Overview of the Iron and Steel Industry in Northeast Asia

The iron and steel industry is one of the most basic material industries supporting industrialization in each country, and it has the following characteristics.

First, it is an industry with large "economies of scale" in the production process.[3] In the iron and steel industry, two major production systems are observed: integrated production with a blast furnace (BF) and semi-integrated production with an electric arc furnace (EAF, as in a mini mill). An integrated steel mill is an enterprise that adopts an integrated production system to integrate ironmaking, steelmaking, and rolling processes vertically in the same enterprise. This system needs economies of scale, especially in the ironmaking and steelmaking processes, and it fits mass production. Second, the supply and demand of the steel industry are inelastic to prices in the short term; thus, prices fluctuate greatly in response to economic fluctuations. Third, regarding the trade of steel products, short-distance or intraregional trade accounts for a high proportion because the transportation costs are high due to the size and weight of steel products. The high proportion of intraregional trade is another reason for the price inelasticity of steel supply and demand.

Table 1 shows the trends in the supply and demand volume of crude steel in KJC.

Regarding the ROK, crude steel production and consumption[4] have gradually been increasing for 10 years since the 2000s. Crude steel production has been rising at an average annual growth rate of 2.6%, from 43.1 million tons in 2000 to 58.1 million tons in 2010. However,

[3] According to the empirical rule, the minimum optimal scale of newly constructed integrated steelworks is 3 million tons of annual production in crude steel (Kawabata 2017, interview with the Korea Iron and Steel Association by the author, November 2019).

[4] Apparent consumption is calculated by production plus imports minus exports. It is the most important indicator of consumption. Fluctuation in inventory and indirect trade is neglected. Apparent consumption is calculated after converting exports and imports, recorded as weights for various steel products, into crude steel by using a certain coefficient.

Table 1 Trend of crude steel production and consumption in KJC (unit: billion tons)

	Production			*CAGR*	*Apparent consumption*			*CAGR*
	2000	*2010*	*2018*		*2000*	*2010*	*2018*	
Korea	43.1 (5.1%)	59.0 (4.1%)	72.5 (4.0%)	2.9%	40.1 (4.7%)	54.3 (3.8%)	56.0 (3.1%)	1.9
Japan	106.4 (12.5%)	109.6 (7.6%)	104.3 (5.7%)	−0.1	79.6 (9.4%)	67.4 (4.8%)	71.3 (3.9%)	−0.6
China	128.5 (15.1%)	638.7 (44.6%)	928.3 (50.7%)	11.6	138.6 16.4%	612.1 (43.2%)	869.8 (47.9%)	10.7
World	848.9	1,433.4	1,818.6	4.4	846.9	1,416.4	1,830.8	4.3

Note CAGR is the compound annual growth rate, which is the average annual growth rate from 2010 to 2018; the numbers in parentheses are the global share
Source Compiled by the author based on data from World Steel Association (1980–2020)

it increased at an average annual growth rate of only 0.3% from 2011 to 2018, reaching 72.5 million tons in 2018. Moreover, crude steel consumption increased by 3.2% on an annual average basis up to 2010, but thereafter, through 2018, consumption decreased by 0.7% on an annual average basis due to sluggish domestic demand.

Domestic consumption rapidly increased from 40.1 million tons in 2000 to 54.3 million tons in 2010, but thereafter, the growth rate decreased, reaching 56.0 million tons in 2018.

Regarding the Japanese iron and steel industry, the growth rate of production and consumption has followed a slightly downward trend since the 2000s. The crude steel production volume in Japan increased at an average annual growth rate of 0.3% from 2000 to 2010 and decreased at an average annual growth rate of 0.4% from 2011 to 2018. Crude steel consumption decreased by 2.0% on an annual average basis from 2000 to 2010 and increased by 0.3% on an annual average basis from 2011 to 2018. In response to the deterioration in profitability due to such a decrease in demand, Japanese steel enterprises have continued to restructure and integrate since the 1990s to improve their profit structure, and currently, there are three BF manufacturers.[5]

[5] The three companies are Nippon Steel, JFE, and Kobe Steel (Japan Iron and Steel Federation [JISF]. www.jisf.or.jp/).

Regarding China, unlike Japan and the ROK, crude steel production and consumption have increased rapidly since the 2000s. Crude steel production in China increased approximately 5 times (at an average annual growth rate of 17.3%) in the 10 years since 2000, and crude steel consumption also increased approximately 6 times (at an average annual growth rate of 19.5%). Then, it recorded increases at average annual growth rates of 4.1 and 3.8 from 2011 to 2018.

In 2018, regarding the share of global crude steel production and consumption, China ranked first in the world, accounting for 50.7 and 45.9, respectively; Japan accounted for 5.7% and 3.9%, respectively; and the ROK accounted for 4.0 and 3.1, respectively. In other words, these three countries produce more than 60% of the world's crude steel and consume more than half of the crude steel produced (Table 1).

Regarding the ranking of world steel enterprises in 2018, two Japanese companies (Nippon Steel and JFE Steel), one Korean company (POSCO), and six Chinese companies (Baowu Group, HBIS Group, Shagang Group, etc.) are among the global top ten in crude steel production (World Steel Association 1980–2020). In other words, except for ArcelorMittal, which is the world's No. 1 producer, all nine companies are located in Japan, China, and the ROK, and the three countries have become dominant players in the global steel industry. In particular, since the 2000s, compared to their Japanese counterparts, the growth of steel companies in the ROK and China has been remarkable.

Regarding the export dependence (exports/production) of the three countries in 2018, the export dependence of the ROK is 41.5%, that of Japan is 34.4%, and that of China is only 7.4%. These figures show that the ROK and Japan have a considerably higher export dependence than China. In other words, compared to China, Japan and the ROK have an export-oriented production structure. In the three countries, the ROK is a smaller net exporter than China and Japan in terms of the export scale. However, regarding export dependency, the ROK has maintained a high degree of more than 40% since the 2010s due to the stagnation of domestic demand industries, such as the automotive, shipbuilding, and construction industries, and excessive domestic supply due to a new entry.[6]

[6] In 2020, Hyundai Steel became the ROK's second largest BF manufacturer after POSCO (Kim 2020, p. 5).

As of 2018, regarding import dependency (imports/domestic demand), the import dependency of the ROK was 26.6%, which was considerably higher than that of Japan, 8.4%, and that of China, 1.7%. However, regarding the import volume, the ROK is larger than Japan and China, where domestic demand is larger than in the ROK. In 2018, the import volume of the ROK was 14.93 million t, that of China was 14.4 million t, and that of Japan was 6 million t. That is, the ROK is characterized by a structure with a high degree of dependence on imports, despite its high degree of dependence on exports.

3 The Intraregional Division of Labor Structure of the Iron and Steel Industry of KJC

This subsection analyzes the trade structure and structure of international specialization in the iron and steel industry of KJC. Then, we analyze export competitiveness by comparing the trade specialization coefficient in the iron and steel industry of KJC.

3.1 International Trade Structure

The export of steel products[7] from the ROK increased by an annual average growth rate of 5.9% in the 2000s to 24.5 million tons in 2010. Thereafter, the export volume increased by an annual average growth rate of 2.5% to 30.1 million tons in 2018. The ROK accounts for 6.6% of the world's total exports. Specifically, the export volume began to decline after peaking at 31.9 million tons in 2014. As of 2018, its export volume made the ROK the world's fourth largest exporter, followed by China (68.8 million tons), Japan (35.8 million tons), and Russia (33.3 million tons).

Regarding the ROK's exports by destination, the proportion of exports to Asian economies was approximately 50%. In 2018, the largest export destination was China (13.3%), followed by Japan (12.4%), India (10.3%), the United States (8.2%), and Mexico (7.0%) in 2018. In particular, since the 2010s, exports to Association of Southeast Asian Nations (ASEAN) economies such as Thailand, Malaysia, Indonesia, and Vietnam have

[7] Steel products based on the four-digit HS code classification include semifinished products and final steel products. The range of steel products is HS 7201–7229 and HS 7301–7307.

increased rapidly, while exports to China have decreased. One feature of the ROK that is not observed in Japan or China is the high share of exports to North American countries, such as the United States and Mexico.

Regarding the ROK's share of exports by product, in 2017, flat products accounted for the largest share, 68.7%, followed by pipes and tubes at 14.8%, long products at 10.9%, and primary materials and semifinished products at 5.6% (Table 2). Looking closely at higher value-added products such as cold-rolled steel sheets and galvanized steel sheets for automobiles, we find that such products have become the main export products since the mid-2000s. In particular, exports of cold-rolled steel sheets and galvanized steel sheets increased by an annual average growth rate of 10.0% from 2005 to 2015, reaching 14.93 million tons in 2017.

Regarding imports, the import volume of the ROK increased by an annual average of 8.0% in the 2000s to a record high of 24.8 million tons in 2010 due to the rapid expansion of domestic demand. Thereafter, the ROK's imports began to decline in line with the increase in domestic production. The import volume declined by an annual average rate of 2.5% in the 2010s to 14.93 million tons in 2017.

Table 2 Global trade balance of the ROK, Japan, and China (2017) (unit: million dollars)

Product group	*JAPAN*			*CHINA*			*ROK*		
	Export	*Import*	*Balance*	*Export*	*Import*	*Balance*	*Export*	*Import*	*Balance*
Primary materials	3,531	3,113	418	1,503	8,052	−6,549	1,039	4,161	−3,122
Semifinished products	1,764	153	1,611	9	604	−594	437	1,092	−655
Flat products	18,263	3,174	15,089	29,398	10,348	19,050	18,111	7,925	10,186
Long products	4,947	946	4,001	12,649	2,639	10,011	2,870	3,408	−538
Pipe and tube products	3,736	1,027	2,709	12,454	2,184	10,270	3,898	1,374	2,524
Total	32,241	8,413	23,827	56,014	23,826	32,188	26,355	17,960	8,394

Note The range of steel products is HS 7201–7229 and HS 7301–7307
Source Compiled by the author based on the database from the United Nations (2000–2019), Korea Iron and Steel Association (2000–2019)

By import destinations, in 2018, China was the largest import destination (48.6%), followed by Japan (36.3%), Taiwan (3.2%), and Vietnam (2.2%). In particular, the ROK's imports are concentrated in China and Japan, which account for more than 80% of its total imports. The share of imports by product was 44.1% for flat products, 23.2% for primary materials, 19.0% for long products, 7.7% for pipes and tubes, and 6.1% for semifinished products. Additionally, nonalloyed steel products such as hot-rolled steel sheets account for more than 60% of the imports of flat products (Table 2).

Japan was the largest exporter in the world until 2010, but its exports began to decline in 2011, and it is now the second largest exporter in the world. Steel product exports from Japan increased by an annual average growth rate of 4.1% in the 2000s to 42.7 million tons in 2010. Thereafter, the export volume continued to show a downward trend, decreasing by an annual average rate of 2.2% in the 2010s to 35.8 million tons in 2018. Regarding exports by destination, in 2018, Asian economies were the main export trading partners with China (15.2%), South Korea (14.9%), Taiwan (7.8%), and Vietnam (6.2%). In 2017, the share of exports from Japan by product was 56.7% for flat products, 15.4% for long products, 11.6% for pipes and tubes, 11.0% for primary materials, and 5.5% for semifinished products.

Regarding imports, the import volume of Japan decreased by an annual average of 1.5% in the 2000s to a record high of 4.4 million tons in 2010. Thereafter, the import volume increased by an annual average growth rate of 4.0% in the 2010s to 6.6 million tons in 2018. In terms of imports by destination, in 2018, the ROK was the largest import trading partner (62.3%), followed by China (15.9%), Taiwan (17.4%), and Vietnam (1.8%). Japan's imports are concentrated in the ROK and China, which account for more than 80% of its total imports. By product, in 2017, the share of import items was 37.7% for flat products, 12.2% for pipes and tubes, 11.2% for long products, 11.0% for primary materials, and 1.8% for semifinished products (Table 2).

However, there are unusual observations in the share of export items of Japan and the ROK.

Regarding flat products, the ratio of hot-rolled sheets and strips with relatively low value added is very high in the middle classification in the ROK and Japan. This unique export structure is based on exporting high-grade host materials to downstream subsidiaries and affiliated companies in various economies.

China is the top export country worldwide, leading the global steel trading market. China was the world's largest importer until 2005; thereafter, exports increased sharply due to a surge in production accompanying the expansion of capital investment, and since 2011, China has become the world's largest exporter. Steel exports from China increased by an annual average growth rate of 14.1% in the 2000s to 41.6 million tons in 2010. Thereafter, the export volume increased by an annual average growth rate of 6.5% in the 2010s to 68.8 million tons in 2018.

Regarding export destinations, China is more diversified than Japan and the ROK, and the ROK (10.6%) and Vietnam (10.3%) are countries to which China's share of exports exceeds 10%. By product, in 2017, flat products accounted for 56.7%, long products accounted for 15.4%, pipes and tubes accounted for 11.6%, primary materials accounted for 11.0%, and semifinished products accounted for almost zero. The high export ratio of long products is one of the important features. Most of these products are commodity-grade construction steel, such as bars and wire rods, which can be manufactured without technological difficulty. In addition, some of the bars are actually billets, which have a lower value added than bars. Some alloy steel sheets are functionally equivalent to nonalloy hot-rolled sheets. Because a value-added tax (VAT) refund can be received if an export item is an alloy steel, export companies in China have declared to customs billets as alloyed bars and declared hot-rolled sheets as alloy steel sheets by adding a small amount of boron.[8] Manipulating the VAT refund rate for export items is one of China's important export policies.

Regarding imports, China's import volume decreased by an annual average rate of 1.9% in the 2000s to a record high of 17.2 million tons in 2010. Thereafter, the import volume continued to show a downward trend, decreasing by an annual average rate of 2.2% in the 2010s to 14.4 million tons in 2018.

In terms of imports by destination, in 2018, Japan was the largest import trading partner (39.8%), followed by the ROK (27.1%), Taiwan (10.0%), and Indonesia (8.0%). In particular, China's imports are concentrated in Japan and the ROK, which account for more than 60% of its total imports. By product, in 2017, China's share of import items was 43.4%

[8] Kawabata (2017, pp. 22–23) and JETRO (2018).

for flat products, 33.8% for primary materials, 11.1% for long products, 9.2% for pipes and tubes, and 2.5% for semifinished products.

3.2 The Intraregional Trade Structure in the ROK, Japan, and China

The analysis thus far confirms that intraregional trade accounts for a large proportion of the global steel trade. Such characteristics can be confirmed between Japan, China, and the ROK.

Based on World Steel Association (1980–2020), which supplies data on the global steel industry, we see that intraregional trade in both Europe and Asia accounts for a large proportion of the global steel trade. The former has reached 118.5 million tons; the latter has reached 117.2 million tons. Combined, their share in the global trade accounted for 52.5% in 2018.

Table 3 shows the proportion of intraregional trade in the total steel trade value (exports + imports) between the three countries. The proportion of intraregional trade of Japan was 47.6% in 2010 but declined

Table 3 Intraregional steel trade in KJC (2017) (unit: million dollars, %)

		ROK	*Japan*	*China*	*Total*	*World*
ROK	Exports		2,989 (11.3)	3,664 (13.9)	6,653 (25.2)	26,355
	Imports		5,430 (30.2)	7,811 (43.5)	13,241 (73.7)	17,960
	Total		8,419 (19.0)	11,475 (28.7)	19,894 (44.9)	44,315
Japan	Exports	5,202 (16.1)		6,008 (18.6)	11,210 (34.8)	32,241
	Imports	3,016 (35.8)		1,469 (17.5)	4,485 (53.3)	8,414
	Total	8,218 (25.9)		7,477 (18.4)	15,695 (38.6)	40,654
China	Exports	7,202 (12.9)	1,340 (2.4)		8,542 (15.3)	56,014
	Imports	3,899 (16.4)	6,631 (27.8)		10,530 (44.2)	23,826
	Total	11,101 (13.9)	7,971 (10.0)		19,296 (30.2)	79,840

Note The range of steel products is HS 7201–7229 and HS 7301–7307
Source Compiled by the author based on the database from the United Nations (2000–2019)

to 38.6% in 2017. In the same period, the proportion of intraregional trade of the ROK declined from 45.7 to 44.9%, and China's proportion decreased from 34.6 to 30.2%. In other words, since the beginning of the 2010s, the proportion of intraregional trade of the three countries has gradually decreased, mainly in line with the decrease in intraregional exports. However, they are still highly dependent on intraregional trade compared to extra-regional trade.

Examining the breakdown of intraregional trade, we see that the dependence on intraregional imports is much higher than the dependence on exports in all three countries, and the ROK and Japan have a higher share of intraregional trade than China. In terms of their dependence on intraregional exports, Japan has the highest share at 34.8%, followed by the ROK at 25.2% and China at 15.3%. Regarding their dependence on intraregional imports, the ROK has the highest share at 73.7%, followed by Japan at 53.3% and China at 44.2%. In particular, the ROK and Japan have a much higher proportion of intraregional imports than China. This finding means that both the ROK and Japan have much higher intraregional procurement rates than China.

In the following, we examine the trade between the three countries to confirm the intraregional division of labor structure in Northeast Asia in detail.

First, the ROK's dependence on trade with Japan has been declining in recent years. The ROK's dependence on exports declined from 16.4% in 2005 to 12.5% in 2010 and 11.3% in 2017. In contrast, the ROK's dependence on imports to Japan rose from 38.4% in 2005 to 40.0% in 2010. Thereafter, it began to decline, falling to 30.2% in 2017.

Regarding the ROK's dependence on trade with China, the export dependency declined from 15.6% in 2010 to 13.9% in 2017, but the import dependency increased sharply from 23.9% in 2010 to 43.5% in 2017. In particular, for the ROK, China was the largest export partner in the first half of the 2000s, but it became the largest import partner after 2007. However, the ROK's dependence on trade with China also rose sharply from 19.7% in 2010 to 28.7% in 2017, and China has become an important trading partner of the ROK.

In short, since the 2010s, the ROK's dependence on exports to Japan has declined, while its dependence on exports to China has risen sharply.

Second, regarding Japan's dependence on trade with China, its export dependence declined from 21.1% in 2010 to 18.6% in 2017, and its import dependence fell from 18.7% in 2010 to 17.5% in 2017. Moreover, regarding the dependence on trade with the ROK, Japan's export dependence declined from 22.4% in 2010 to 16.1% in 2017, while its import dependence rose from 32.9% to 35.8% in 2017. One of the main reasons Japan's dependence on imports to the ROK increased was the increase in imports of high-grade steel products, such as steel sheets for automobiles, accompanied by the improvement in the ROK's technological development capability.[9]

Third, regarding China's dependence on trade with Japan, its export dependence fell from 4.6% in 2010 to 2.4% in 2017, while its import dependence declined from 34.6% in 2010 to 27.8% in 2017. Regarding China's dependence on trade with the ROK, China's export dependence decreased from 15.6% in 2010 to 12.9% in 2017, while its import dependence increased from 14.4% in 2010 to 16.4% in 2017.

Concerning the trade balance among the three countries, the ROK has run a trade deficit with Japan and China since the 2010s. In particular, the ROK's trade deficit with Japan has been decreasing, but its trade deficit with China has been increasing rapidly. On the other hand, since the 2010s, China has had a trade surplus with the ROK and a trade deficit with Japan, and Japan continues to have a trade surplus with the ROK and China.

In the intraregional trade structure between Japan, China, and the ROK, the dependence on intraregional exports has been decreasing, while the dependence on intraregional imports has been increasing in all three countries. By country, since the 2010s, the proportion of Japan in intraregional trade among the three countries has decreased, and the proportions of China and the ROK have increased. In particular, Japan's and the ROK's dependence on trade with China has been increasing rapidly, accompanied by the rapid growth of the Chinese steel industry. This finding means that the "competition and cooperation" relationship in the intraregional division of labor has deepened, accompanied by the production expansion and technological progress of the Korean and Chinese iron and steel industries.

Table 4 shows the degree of intraregional trade dependency by product between the ROK, Japan, and China.

Regarding the ROK's intraregional trade by product, its dependence on exports is the highest at 30.3% for semifinished products, followed

[9] For the technological progress of POSCO, see POSCO (2018).

Table 4 Intraregional trade dependence in KJC (unit: %)

	Exports						*Imports*					
	ROK		*Japan*		*China*		*ROK*		*Japan*		*China*	
	2010	*2017*	*2010*	*2017*	*2010*	*2017*	*2010*	*2017*	*2010*	*2017*	*2010*	*2017*
Primary raw materials	45.8	25.4	85.0	70.4	62.0	39.4	35.0	40.8	25.3	18.0	28.3	15.8
Semifinished products	10.1	30.3	52.1	33.5	6.7	12.2	43.4	63.8	79.2	85.9	26.7	15.4
Plate products	30.2	28.2	43.3	30.8	21.6	16.2	87.6	87.6	75.9	77.0	71.1	67.3
Long products	27.5	24.6	37.9	36.9	18.5	18.9	69.9	85.4	80.6	78.3	26.8	54.7
Tubes and pipes	9.8	10.9	15.9	18.4	7.9	8.1	55.9	72.1	61.5	59.3	37.6	34.6
Total	27.4	25.2	43.5	34.8	20.1	15.3	63.8	73.7	51.6	53.3	48.9	44.2

Note The range of steel products is HS 7201–7229 and HS 7301–7307
Source Compiled by the author based on the database from the United Nations (2000–2019)

by 28.1% for long products and 25.7% for plate products. By country, the ROK's semifinished products are highly dependent on Japan, and the ROK's plate products are highly dependent on China. Moreover, the ROK's dependence on imports is the highest at 68.1% for plate products, followed by 64.3% for semifinished products and 2.2% for long products. The intraregional trade structure of the ROK by product shows similarities to its global trade structure.

Regarding Japan's dependence on intraregional exports by product, primary materials account for the highest percentage at 70.4%, long products account for 36.9%, semifinished products account for 33.5%, and plate products account for 30.8%. By country, exports to the ROK represent a high proportion of semifinished products and nonalloyed long products, while exports to China represent a high proportion of stainless plate products. Regarding Japan's dependence on intraregional imports, semifinished products are the highest at 85.9%, followed by bar steel products at 78.3% and plate products at 77.0%. Most of them are imported from the ROK. By product, nonalloyed semifinished products account for approximately 95%, stainless plate products account for approximately 70%, and nonalloyed long products account for 61%. Japan imports approximately 95% of nonalloyed semifinished products, approximately 70% of stainless plate products and 61% of nonalloyed long products from the ROK.

Finally, concerning China's dependence on intraregional exports by product, primary raw materials account for the highest percentage at 39.4%, followed by long products (18.9%), plate products (16.2%), and semifinished products (12.2%). More specifically, primary raw materials and semifinished products are mostly exported to Japan, and plate products and bar steel are mostly exported to the ROK.

Moreover, in terms of China's dependence on intraregional imports, plate products account for the highest at 67.3%, followed by long products at 54.7%, primary raw materials at 15.8%, and semifinished products at 15.8%. More specifically, bar steel and steel pipe products are mostly imported from Japan, and approximately 30% of plates are imported from Japan and the ROK.

Regarding the intraregional trade structure by product in KJC, intraindustry trade is developing. As described above, the ROK and Japan mainly depend on intraregional markets for semifinished products and plate products, and China depends on such markets for plate products and long products. In particular, in the case of Japan and the ROK, imports from China have been increasing sharply, but most of these imports have mainly been nonalloy hot-rolled sheets used for ships and trucks, commodity-grade construction steel such as bars and wire rods that can be manufactured without technological difficulty, and long products such as rails, which do not have a high value added.

As described above, the intraindustry trade structure through product differentiation can also be confirmed by comparing the export unit prices among the three countries. The intraindustry trade structure is analyzed in detail in the following section. Regarding total steel products, Japan has the highest export unit price, followed by the ROK and China. In most product categories, Japan or the ROK shows a higher export unit price than China. This finding indicates that China is exporting low valued-added, commodity-grade products on the basis of price.

In short, the three KJC countries have grown while cooperating and competing with each other, and they have emerged as the leading countries for the growth of the global steel industry.

3.3 The International Competitiveness of the Iron and Steel Industry of KJC

Below, we examine the trends in international competitiveness by comparing the trade specialization coefficient[10] of main products based on the four-digit HS classification codes. The trade specialization coefficient is calculated as the ratio of the trade surplus (exports − imports) to total trade (exports + imports and taking a value between −1 and +1). When the index is greater than zero and approaches one, it indicates that the product has a comparative advantage in the international market. A value of "+1" means full specialization in exports, while a value of "−1" means full specialization in imports. If exports and imports are in equilibrium, the coefficient is zero, which is complete intraindustry trade.

First, the value added and international competitiveness of iron and steel products are closely related to the production process. The production of iron and steel involves multistage processes. In the iron and steel

[10]TSC is measured based on the degree of specialization in exports. However, the index has some limitations due to the government's export promotion measures and import restrictions.

Table 5 Global trade specialization coefficient of KJC

	Japan		*ROK*		*China*	
	2010	*2017*	*2010*	*2017*	*2010*	*2017*
Primary materials	−0.02	0.06	−0.70	−0.60	−0.44	−0.69
Semifinished products	0.89	0.84	−0.69	−0.43	−0.75	−0.97
Flat products	0.80	0.70	0.20	0.39	0.13	0.48
Long products	0.73	0.68	−0.02	−0.09	0.27	0.65
Pipe and tube products	0.75	0.57	0.34	0.48	0.61	0.70
Total	0.66	0.59	−0.03	0.19	0.16	0.40

Source Compiled by the author based on the database from the United Nations (2000–2019)

industry, two major production systems are observed (Sect. 2).[11] Apart from integrated and mini mills, there is some variety in the enterprises in downstream processes, such as hot rolling companies and surface treating companies. In KJC, integrated enterprises are major producers. The share of integrated production with a BF was 71.9% worldwide, 68.6% in the ROK, 75.5% in Japan, and 89.6% in China.[12]

Table 5 shows the trade specialization coefficient of the iron and steel industries of KJC.

Japan's trade specialization coefficient has been consistently positive and is the highest of the three countries. This finding indicates that Japan's trade balance remains in surplus and that Japan continues to maintain a stable competitive advantage. Since the 2010s, Japan's exports have gradually declined due to increased production and sluggish demand in China and the ROK, which are major export destinations. Therefore, Japan's relative superiority in terms of export competitiveness has been declining. Japan's trade specialization coefficient dropped from 0.66 in 2010 to 0.59 in 2017. However, Japan's trade specialization coefficient remains at a high level of more than 0.5.

Regarding the trade specialization coefficient by product, only semifinished stainless products record a negative figure (−0.67). The other items

[11] The ironmaking process converts iron ore into pig iron with a BF or other types of reducing furnaces. The steelmaking process refines pig iron and/or scrap into crude steel with a basic oxygen furnace (BOF) or an EAF, and it continuously casts the melted crude steel into semifinished products (Kawabata 2017, pp. 7–9).

[12] World Steel Association (2020, p. 11).

remain more than 0.5. In Japan, there is an unusual observation. As described above, although Japan is considered to specialize in the production of high value-added steel products, the export competitiveness of low value-added products such as semifinished products and hot-rolled steel sheets (HS 7207 and 7208) is relatively high. This phenomenon is based on exporting to overseas downstream subsidiaries. Moreover, Japanese steel companies have continued to strengthen their overseas production and sales networks, and they have made domestic structural adjustments to improve their profit structure.

In other words, the high international competitiveness of the Japanese steel industry results from the securing of economies of scale, the technological development capability of high value-added products, and the optimization of the global value chain.

China's trade specialization coefficient also increased from −0.4 in 2000 to 0.16 in 2010 and to 0.40 in 2017. The reason is that exports from China began to increase sharply from the mid-2000s, and, thereafter, the trade balance became a surplus. Regarding China's trade specialization coefficient by product, primary materials and semifinished products show negative figures, but other products continue to show positive figures due to the increase in exports since the mid-2000s. In particular, the trade specialization coefficient for hot-rolled steel sheets, thick plates, and bars and wire rods, which are long products, increased rapidly; notably, most of these products have low value added. Underlying this increase was the rapid increase in production and exports accompanying the expansion of capital investment since the late 2000s. In addition, China mostly depends on imports for semifinished products (−0.97) such as billets, slabs, and blooms as well as primary raw materials (−0.70).

Regarding the structure of the Chinese steel industry thus far, it has developed around medium-sized BF companies rather than large-scale BF for economies of scale, and there is an extremely large number of medium-sized companies. China's iron and steel industry is not superior in either resources or technological ability, and it does not adopt a production method utilizing an abundant labor force for economies of scale. This phenomenon means that China imports semifinished products and primary materials to produce low value-added products and export them.

In other words, the source of Chinese companies' international competitiveness is that many small and medium-sized steel manufacturers have enhanced the productivity of low-priced products by specializing in specific production processes and specific products. In addition, since the 2010s, the Chinese government has been promoting the structural adjustment of the steel industry to secure economies of scale and to strengthen its international competitiveness through the consolidation of small and medium-sized manufacturers. The steelmaking capacity of China has declined significantly in recent years. OECD data show that China's capacity fell by 87.0 mmt between 2016 and 2018.[13]

Regarding the ROK, the global trade balance ran a deficit until the 2000s, and the trade specialization coefficient also recorded a negative figure. However, the trade balance of the ROK has returned to a surplus due to the increase in domestic production and exports from 2011, and since then, the trade specialization coefficient has become positive and continued to increase.

Regarding the trade specialization coefficient by product, primary materials and semifinished products show negative figures, but other products continue to show positive figures. In particular, the trade specialization coefficients of primary raw materials, nonalloyed steels, semifinished alloy steels, nonalloyed steel rods, and other alloyed steel rods continue to be negative. However, plate products increased from 0.15 in 2005 to 0.39 in 2017, and pipe and tube products increased from 0.34 to 0.48 during the same period. In other words, the trade specialization coefficients for high value-added products such as surface-treated steel sheets and stainless sheets for automobiles have become positive and have continued to increase due to the rapid increase in exports since the mid-2000s.

The international competitiveness of the ROK's steel companies results from the securing of economies of scale, the development of high value-added products, and the optimization of the global value chain.[14]

Now, we turn to the ROK's export competitiveness in relation to Japan and China.

As mentioned above, the global trade specialization coefficient of the ROK by products is positive, but in relation to China and Japan, the coefficient has remained negative for most products since the 2000s.

Table 6 shows the ROK's trade specialization coefficient in relation to

[13] OECD (2020).

[14] Kim (2020, pp. 5–7).

Table 6 The ROK's trade specialization coefficient in relation to Japan and China

	Japan			*China*		
	2005	*2010*	*2017*	*2005*	*2010*	*2017*
Primary materials	−0.84	−0.68	−0.82	−0.73	−0.45	−0.45
Semifinished products	−0.95	−0.94	−0.63	−0.90	0.42	−0.93
Nonalloy steel	−0.95	−0.94	−0.60	−0.96	0.50	−0.89
Stainless steel	0.63	0.85	0.56	0.81	−0.14	0.56
Alloy steel	−0.99	−0.99	−0.99	−0.98	−0.48	−0.93
Flat products	−0.38	−0.47	−0.05	0.27	−0.11	−0.21
Nonalloy steel	−0.42	−0.51	−0.08	−0.07	−0.12	−0.12
Stainless steel	0.04	−0.15	0.21	0.93	−0.27	−0.44
Alloy steel	−0.89	−0.83	−0.20	0.83	0.55	−0.26
Long products	−0.32	−0.45	−0.38	−0.54	−0.64	−0.74
Nonalloy steel	−0.44	−0.52	−0.43	−0.62	−0.67	−0.82
Stainless steel	0.08	−0.12	−0.22	−0.02	−0.37	−0.12
Alloy steel	−0.21	−0.42	−0.39	−0.45	−0.75	−0.74
Pipe and tube products	−0.32	−0.48	−0.16	−0.32	−0.48	−0.16
Total	−0.13	−0.56	−0.29	−0.05	−0.26	−0.36

Note Primary materials (HS 7201–7205); Semifinished products: nonalloy steel (HS 7206–7207), stainless steel (HS 7218), alloy steel (HS 7224); Flat products: nonalloy steel (HS 7208–7212), stainless steel (HS 7219–7220), alloy steel (HS 7225–7226); Long products: nonalloy steel (HS 7213–7217), stainless steel (HS 7221–7223), alloy steel (HS 7227–7229); Pipe and tube products (HS 7303–7307)
Source Compiled by the author from data in the United Nations Comtrade database

Japan and China.

Regarding trade with Japan, the ROK's trade specialization coefficient was −0.56 in 2010 but rose to −0.29 in 2017, which means that the overall competitiveness of most products has gradually increased. While the trade specialization coefficient of most products is negative, products with positive figures in relation to Japan include iron and nonalloy steel in ingot form (HS 7206), cold-rolled steel sheets (HS 7209–7210), stainless steel semifinished products (HS 7218–7219), stainless steel wire (HS 7223), wire of other alloy steel (HS 7229), other tubes and pipes (HS 7305), and tube or pipe fittings (HS 7307). However, some products, such as ferrous scrap and electrode rods, are highly dependent on imports from Japan, accounting for approximately 63% of total imports.

Regarding trade with China, which is the largest trading partner, the trade specialization coefficient ranged from −0.13 in 2005 to −0.26 in

2010 and −0.27 in 2017. It can be confirmed that in relation to Japan and China, the export competitiveness of most of the ROK's products has declined since the 2000s.

Regarding the trade specialization coefficient in relation to China, the main products that show a positive figure are high value-added products, which maintain a competitive advantage over China. Concerning the trade specialization coefficient for major products, the figure for ferrous waste and scrap (HS 7204) is 0.52; that for stainless steel flat-rolled products (HS 7220) is 0.76; that for stainless steel semifinished products (HS 7218) is 0.99; that for cold-rolled steel sheets (HS 7209 and HS 7211) is 0.76; that for plate-rolled products of silicon-electrician steel (HS 7226) is 0.28; that for wire of other alloy steel, specifically silicon-manganese steel (HS 7229) is 0.25; and that for other tubes and pipes (HS 7305) is 0.92.

The ROK's trade specialization coefficient in relation to the world and China is lower than that of China.

The main reasons for this finding are the Chinese government's export promotion policy, such as the VAT refund; China's export structure, which is centered on low-priced products; and China's lower import dependence (1.7%) compared to the ROK (26.6%). As mentioned above, in relation to Japan and China, while the ROK has continued to run a trade deficit for most products since the 2010s, the international competitiveness of some high value-added products, such as stainless steel and alloy steel, is increasing.

The analysis above confirms that the international division of labor structure in terms of technology and products has been established and developed between the ROK, Japan, and China. In other words, Japan specializes in high value-added products developed to meet the needs of end users. The ROK has a composition similar to that of Japan, but it mainly specializes in medium value-added products. China mainly specializes in low value-added products.

Such a division of labor structure is made clear by comparing the unit prices of exports by product in the three countries. In 2017, Japan's export unit price was the highest at $1,130, followed by the ROK at $1,050 and China at $999.[15] However, since the early 2010s, the technological development capability of the ROK and China has progressed

[15] Compiled by the author based on the data from the Unites Nations (2000–2019).

rapidly; as a result, intraregional competition is intensifying as the number of competing products in the three countries is increasing.

4 Changes in the Trade Environment Surrounding the Iron and Steel Industry

4.1 Strengthening New Protectionism

Since the global economic crisis in 2008, all countries worldwide have worried about rising protectionism in international trade, as protectionist measures such as import restrictions and tariff increases have been historically prevalent during periods of economic slowdown. Since the mid-1990s, tariffs have been gradually reduced or abolished mainly in developed countries due to the spread of free trade agreements (FTAs) and customs unions.

On the other hand, the "neoprotectionism" movement, which uses nontariff measures as an alternative means of protecting domestic industry, has expanded all over the world since the late 2000s. Such alternative means include not only technical measures such as trade remedy measures, sanitary and phytosanitary (SPS) measures, and technical barriers to trade (TBTs) but also diversified types such as trade-related investment measures, government procurement, and rules of origin. In addition, the scope of protection measures has recently been expanding.

Nontariff measures related to the steel trade mainly consist of trade remedy measures. Trade remedy measures are trade policy tools that allow governments to take remedial action against imports that are causing material injury to a domestic industry. These trade remedies include antidumping duties (ADs), countervailing duties (CVDs), and safeguards (SGs).

The most commonly used are antidumping measures to counteract unfairly low prices. The World Trade Agreement (WTO) on Antidumping states that goods are "dumped" when companies export them at prices lower than those at which they sell in their home market. Dumping is not illegal per se, but it becomes illegal as soon as it results in injury to local businesses in the importing country. Countervailing tariffs are measures to counteract subsidies by national authorities that unfairly enable their companies to export at a lower price. A safeguard action is an "emergency action." An emergency "safeguard" action may be taken where a surge of imports causes or threatens to cause serious material injury to a domestic industry. These trade remedy measures are based on the principles of the WTO Agreement. That is, the WTO identifies three main types of import restraints as trade remedies. These measures do not counteract an unfair practice but allow countries to suspend import surges temporarily to grant local industries time to adjust to increased foreign competition on national markets. In addition to trade remedy measures, there are complicated certification systems such as Indonesia's Indonesian National Standard (SNI) and India's Bureau of India Standards (BIS). Moreover, TBTs, such as complicated processes to arrange trade and amendments to an industrial standard, are used as barriers to exports.[16]

These trade remedy measures are widely known to be consistent with the WTO rules on curbing unfair trade practices. However, if each country determines that "Standards and Conformity Assessment Systems," such as the technical regulations of another country, will hinder its own exports, each country petitions the TBT committee to rectify the matter as a "specific trade concern" (STC). In particular, the number of STC cases has increased significantly, mainly in emerging countries, due to the mandatory implementation of TBT agreements in developing countries since 2005.[17]

By country, not only developed countries such as the United States and those in the EU but also emerging countries such as India, Indonesia, and Thailand have been strengthening their trade remedy measures to protect their domestic industries. ASEAN economies, which are the largest export destinations of KJC, have strengthened their import restriction measures to protect their domestic industries since the 2010s. Furthermore, from the political economy perspective, the iron and steel industry is easily subject to trade frictions because it is a material industry that supports a country's industry. Additionally, in many countries, this industry has an oligopolistic structure.

WTO statistics indicate that antidumping measures have been widely used to protect domestic industries in recent years. Starting in the 2010s, many countries began to use trade remedies as a means to protect their steel industry, and since then, trade remedy measures have been rapidly

[16] POSRI (2019b, pp. 8–9).

[17] The number of STC cases increased from 17 in 2000 to 77 in 2018. Since the TBT committee usually meets three times per year, it is possible to regularly check the correction status of measures in partner countries.

Table 7 Trade remedy measures by industries (1995–2018)

	Base metal (%)	*Plastic products (%)*	*Chemical products (%)*	*Others (%)*
ADs	31	13	20	36
CVDs	44	11	10	34

Source Compiled by the author from Korea International Trade Association (KITA) and WTO data

increasing all over the world. The number of trade remedy measures initiated from 1995 to 2018 *amounted to* 6,613, of which 2,094 measures were related to steel and metal (base metal), accounting for 60% of the total (Table 7).

Examining the number of trade remedy measures initiated, we see that as of 2018, ADs were the most common, accounting for 87% of all trade relief measures (345) at 300 cases, followed by CVDs at 34 cases and SGs at 11 cases. By country, China was the largest at 23.7%, followed by the ROK at 7.3% and India at 5.1%.

In particular, the implementation of the United States' aggressive enforcement of U.S. trade laws was the origin of import restrictions and trade frictions related to the steel industry; notably, the United States is the largest importer of steel products worldwide. The following measures were cited: a restriction on imports of steel and aluminum for national security reasons based on Section 232 of the Trade Expansion Act of 1962; the implementation of SG measures against imports based on Section 201 of the Trade Act; and trade remedy measures. Since then, the EU and Canada have also introduced measures similar to those of the United States as a means of retaliating against unilateral measures imposed by the United States.[18]

Regarding the ROK's iron and steel industry, which has the highest export dependency among the three KJC countries, the details are as follows.[19] As of 2019, the number of trade remedy measures targeting the ROK amounted to 207 cases (up 13 cases compared with previous years), and the number of measures initiated was 36 cases, while 171 cases were in force. Regarding measures, the proportion of antidumping measures

[18] For example, the EU conducted *14 market investigations* into import restrictions over the course of one year, including an implementation of SG measures for steel products in January 2019.

[19] KITA (antidumping.kita.net), retrieved on October 15, 2019.

was the highest at approximately 75% (152), followed by SGs at approximately 22% (46) (up 12 units compared with previous years) and CVDs at 5% (9). By product, steel and metals sectors accounted for the highest proportion of 50.2% (86) out of 171 cases under regulation, followed by chemicals at 19.3% (33), plastics and rubber at 11.7% (20), and textiles at 6.4% (11). In addition, there are 36 products under investigation. By item, there are 10 cases for steel and metals, 7 cases for chemicals, 6 cases for plastics and rubber, 2 cases for textiles and clothing, and 11 cases for other items.

Regarding countries, in 2019, the ROK was a target of trade remedy measures by 27 trading partners. The United States accounted for the largest number of measures at 40 cases (59.8%), followed by India at 32, China at 17 cases, Canada at 13 cases, and Indonesia at 11 cases. Moreover, the number of trade remedy measures targeting the ROK by emerging countries such as India, Indonesia, and Thailand, where imports from the ROK have consistently increased, is gradually increasing.

Regarding antidumping measures targeting the steel sector, which has the highest number of trade remedy measures, the three KJC countries have rarely used antidumping measures to target each other. Between 1995 and 2017, the number of antidumping measures initiated by the three KJC countries to target each other and in force amounted to only 300 cases, accounting for 8% of the total number (3,604 cases) of ADs worldwide.

Moreover, the number of antidumping measures initiated to target the steel and metals sector and in force amounted to only 31 cases, and the chemicals sector has been the most frequent target. Since the 2010s, the number of antidumping measures by China and Japan associated with the steel industry and targeting the ROK amounted to only one case for the steel industry.

Moreover, in the iron and steel industry of KJC, as expected, protectionism by major export partners, such as ASEAN, the United States, and the EU, is increasingly strengthened, the competition for survival will become even more intense, and dependency on the intraregional market will rise.

4.2 Overcapacity and Steel Exports

The first step is the definition of overcapacity. This paper considers overcapacity to be the difference between production capacity and demand

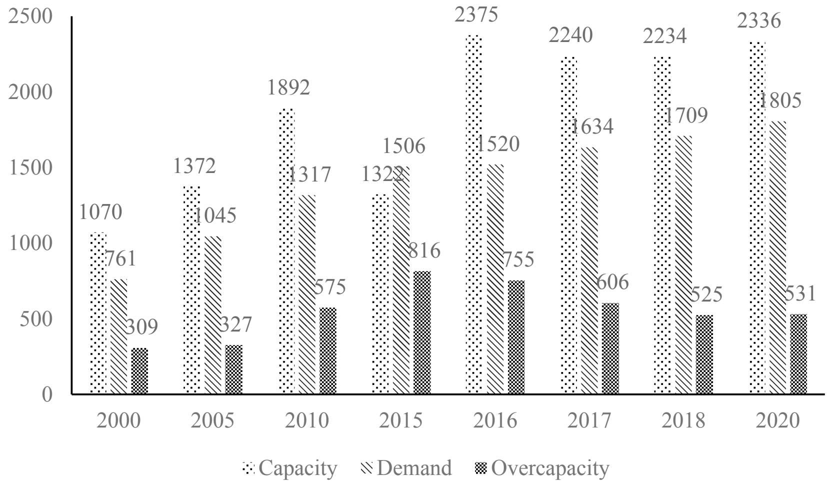

Fig. 1 Trend of global steel overcapacity (unit: million tons) (*Source* Compiled by the author based on the database from OECD [2000–2020] and World Steel Association [1980–2020])

(OECD 2000–2020). This paper calculates the volume of overcapacity in the world and in each country by subtracting the demand volume from the existing production capacity.[20] The OECD committee treats only the worldwide situation of overcapacity. In the worldwide base, neglecting inventory fluctuation, demand equals production. Therefore, the OECD definition is in line with our definition of overcapacity as the difference between capacity and production. The second issue is the promotional factor of overcapacity. In general, overcapacity can be generated as a result of an increase in capacity induced by capital investment or along with shrinking demand. The former is better suited to the current situation in the global iron and steel industry because production capacity has increased enormously since the 2000s (Fig. 1). Brun (2016) indicated that there are two kinds of overcapacity. The first is "cyclical overcapacity," which is caused by the variability of demand, including cyclical demand in one economy or uneven changes among economies. The

[20] Brun considers unutilized production capacity as a simple indicator of overcapacity (Brun 2016).

second is "structural overcapacity," which is caused by overinvestment due to nonprice factors. According to Brun, nonprice factors are over-investment induced by governmental behavior, exit barriers, investment barriers, etc. However, we should pay attention to not only the process by which overinvestment leads to overcapacity but also the process by which production capacity falls into overcapacity as a result of the competition for survival. The market distortion caused by governmental intervention is the main cause of overcapacity in many countries. Specifically, governmental intervention in many countries includes state ownership involvement in corporate decision making, direct support through low-interest loans and grants, indirect support through the low-priced sale of energy, administrative bailouts to stop the shutdowns of low-performing factories, and debt refinancing (Brun 2016; Kawabata 2017).

According to the OECD (2019), the occurrence of overcapacity is the result of a capacity that exceeds demand. The increment in global capacity from 2000 to 2013 was 1.23 billion tons. Although harmonized statistics are not available, the increment in crude steel production capacity in China in the same period was 957 million tons. In fact, when the Chinese government implemented an economic stimulus package to support the economy during the global financial crisis in 2008, Chinese steelmakers rapidly increased their capital investment due to the expectation of increased domestic demand. A total of 70–80% of the increment in capacity was attributable to China, even considering any possible errors. If China had been the only investor in production capacity, excess capacity of 200 million tons or more would have occurred in 2013. Based on this calculation, the rapid expansion of production capacity in China was a major cause of the increase in overcapacity worldwide. Figure 1 shows the trend of global crude steelmaking capacity and crude steel production. The global production capacity of steel is surveyed by the OECD on a continuous basis. According to this survey (as of 2019), the total crude steel production capacity reached 2.234 billion tons in 2018, compared to 1.070 billion tons in 2000. In the same period, crude steel production increased to 1.89 billion tons from 849 million tons, according to a survey by World Steel Association. That is, the growth in production capacity was larger than that in production records. As a result, the capacity utilization rate showed a downward trend in the 60–80% range. The total overcapacity was 309 million tons in 2000, after which it contracted temporarily but increased again after the world financial crisis, peaking at 820 million tons in 2015 and declining yet again and reaching 525 million tons in 2018.

By country, China, which is the largest producer, accounted for 35.8% (188 MT) of the world's overcapacity (525 MT). Japan, which is the second largest producer, accounted for 12.0% (63 MT), and the ROK, which is the fifth largest producer, accounted for 6.5% (34 MT). In other words, the world's top 5 producers accounted for more than 60% of the world's overcapacity. Based on this calculation, the rapid increase in production capacity in China was a major cause of the growth in global overcapacity. However, this does not mean that all existing overcapacity is in China. That is, it is also necessary to consider whether the expansion of equipment in China was based on competitive advantage (Table 8).

The next point is the relation between overcapacity and steel exports. Under the severe trade environment such as the intensifying trade frictions and the strengthening protectionism, it is necessary to investigate whether overcapacity simply stops operations or deliberately operates to export low value-added products. Brun (2016) indicated that a firm with

Table 8 Crude steel production capacity and operating conditions by country (2018) (unit: million tons)

	Crude steel production capacity (1)	*Crude steel production (2)*	*Apparent consumption (3)*	*Overcapacity (1)–(3)*	*Capacity utilization rate (%)*
World	2,234	1,809	1,709	525	81.0
China	1,023	928	835	188	90.7
India	128	107	97	31	83.6
Japan	128	104	65	63	81.3
United States	113	87	100	13	77.0
ROK	88	73	54	34	83.0
Russia	85	72	41	44	84.7
Turkey	49	37	31	18	75.5
Brazil	51	35	21	30	68.6

Source Compiled by the author based on the database from OECD (2000–2020) and World Steel Association (1980–2020) overcapacity has an incentive to export products with low prices to maintain a steady rate of capacity utilization and to recover fixed costs.[21] This means that massive overcapacity promotes the export of low value-added steel products. However, there is not a sufficient theoretical basis for the claim that overcapacity directly leads to an export drive. For example, it is possible that overcapacity leads to a decrease in capacity utilization. Moreover, it should be noted that exports from countries with overcapacity do not necessarily mean a dumping export drive to maintain capacity utilization.

Regarding Northeast Asia, this region is the center of production, consumption, and overcapacity in the global iron and steel industry, with China situated at the center.[22] As of 2018, China accounted for approximately 50% of crude steel consumption and more than 50% of crude steel production worldwide. The Chinese iron and steel industry is not extremely export oriented, with a net export share of only 7.4%, but in physical terms, China's net exports of crude steel are huge, and they are overwhelmingly the largest worldwide.

The capacity utilization rate of the Chinese iron and steel industry is not particularly low compared to that of other countries. The scale of China's overcapacity and exports is overwhelmingly the largest in the world. Moreover, China's export items are biased toward low value-added products, and the unit price of many Chinese export products is lower than that of products from Japan and the ROK (Sect. 3.3). This finding means that there may be a link between overcapacity and large-scale exports in the Chinese iron and steel industry. As described above, it is possible that overcapacity leads to a decrease in capacity utilization. Moreover, massive overcapacity promotes the lowering of steel prices and leads to a decline in steel company profits. In short, the excess production capacity in the global steel industry is a major cause of deterioration in the profitability of steel manufacturers, and it worsens the supply–demand relationship due to excessive exports. However, even in Japan and the ROK, overcapacity exists to a significant extent compared with the production capacity of each economy. It is necessary for the regions and

[21] Brun quotes the example of past trade frictions as a basis (Brun 2016, pp. 21–23).

[22] According to the OECD (2019), many steel companies in China are installing new EAF facilities, and through the end of 2018, a total of 5.2 mmt of EAF's capacity in China had started operations.

products in which overcapacity promotes low-priced exports to be specified. For this purpose, it is necessary to utilize the results of qualitative case analysis on the nature of production facilities and trade.

5 Concluding Remarks and Future Agenda

Based on the analysis of this article, the following conclusion is drawn. In addition, we search for the future direction of the intraregional division of labor to overcome the current difficult business environment and future challenges.

Analysis has shown that the iron and steel industries of the Republic of Korea (ROK), Japan, and China (KJC) have developed through "competition and cooperation" with each other, but various development patterns and supply–demand structures have been created among these countries. Therefore, intraindustry trade and the intraregional division of labor have been formed and developed in Northeast Asia. In particular, since the 2010s, intraregional specialization has intensified, accompanied by the rapid development of the technological development capability of the ROK and China. Currently, the three countries have become dominant players, and they lead the development of the global iron and steel industry.

The Japanese and Korean iron and steel industries have an export-oriented production structure, and the scales of overcapacity and exports of Japan and the ROK are smaller than those of China. The high international competitiveness of both countries is caused by economies of scale due to large-scale capital investment, a high technological development capability, and the optimization of the global value chain. Meanwhile, as the main factor in the international competitiveness of China, many small and medium-sized steel manufacturers have enhanced the productivity of low-priced products by specializing in specific production processes and specific products.

However, the steel industry of KJC has been facing a severe trade and competition issues, such as increasing protectionism and trade frictions, a slowdown in global demand and overcapacity. The neoprotectionism related to the steel trade has spread not only to developed countries but also to developing countries. Furthermore, the double shock of protectionism and COVID-19 has severely damaged the manufacturing industry and the world economy.

Under the current difficult business environment surrounding the iron and steel industry of KJC, it is expected that the growth momentum of the iron and steel industry will be weakened and that the competition for survival will become more intense in both domestic and overseas markets.

In the following, we explore the challenges for the further growth and survival of the iron and steel industry of KJC.

First, it is important to strengthen the technological development capability for the construction of a new business model that will become the pillar of future growth. As the iron and steel industry is a mature industry, it is necessary to develop new materials and environmentally friendly production processes to survive as a global dominant player in the future. For this purpose, it is necessary to rebuild a strategic cooperation system and the intraregional division of labor structure beyond the boundaries of the steel industry, including BF manufacturers and electric furnace manufacturers in Northeast Asia.

The second challenge is how to address the growing neoprotectionism and trade frictions. As mentioned above, the three KJC countries are large exporters, and China is one of the main countries targeted by major trade remedy measures. Neoprotectionism and U.S.-China trade frictions have a great influence on the division of labor in Northeast Asia because the United States and China are the cornerstones of the industry's global supply chain. Moreover, while the double shock of protectionism and COVID-19 has begun to affect the global value chain, including the collapse of the industry's global supply chains, the movement of the reshoring and nearshoring of overseas production bases has begun.

The three KJC countries should make efforts to maintain trade liberalization based on the rules of capitalism and to strengthen their strategic alliance to prevent the spread of protectionism. For this purpose, it is necessary to enforce mega FTAs early, such as the Regional Comprehensive Economic Partnership (RCEP), while actively utilizing the FTA already signed in the East Asia region.[23] In short, international cooperation is needed during and after the crisis.

Third, how should we address overcapacity due to the slowdown in global demand and new capital investment? Most of the overcapacity in the Northeast Asian steel industry centers on China. However, even in

[23] The RCEP is a proposed FTA in the Asia–Pacific region between the ten ASEAN member states and five of ASEAN's FTA partners: Australia, China, Japan, New Zealand, and the ROK.

the ROK and Japan, overcapacity exists to a significant extent compared with the production capacity of each economy. Overcapacity is unlikely to easily diminish. In addition, the recession in the manufacturing industry due to COVID-19 is expected to continue. However, it is difficult for most steelmakers to drastically cut output because BFs are designed to run constantly, and reducing production to zero is usually a last resort. The three countries should strengthen the intraindustry trade and specialization system: there should be vertical and horizontal intraindustry trade, depending on the degree of the unit price and product differentiation of the traded goods.

Finally, to make the analysis in this paper more convincing, the competitiveness of the iron and steel industry in each economy and the relationship between overcapacity and exports must be clarified more concretely. In particular, the relationship between overcapacity and international trade frictions is an urgent topic. Regarding this topic, the main issue is the impact of government assistance and subsidies, which are a major cause of trade frictions. It is important to consider whether overcapacity is caused by government assistance and market competition, such as intense entry and high withdrawal barriers, or both. These issues represent the future agenda.

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