THE ECONOMIC EFFECTS OF ECONOMIC COOPERATION OF KOREA, CHINA, AND JAPAN

PARK, Young Ji*
KIM, Kabsung
HARRINGTON Jr., James W.

Abstract

Today's world economy is changing on a daily basis with extensions in the economic cooperation of various countries. With the deepening of the so-called block economy, as in the case of Korea where reliance on other countries is high, any form of a weakened foreign trade might result in the decline in competitive power and retardation in economy growth of participating country states. The purpose of this study is to examine each stage of the industrial development of Korea, China, and Japan, as well as to establish the specialization strategy of industry from this economic cooperation perspective. Thereafter, the effects of the Korea-China-Japan economic cooperation are evaluated and analyzed. The analyses of this study are largely divided into two parts. First, the analysis of input-output model among the three countries is conducted in order to establish the specialization strategy of industry, stressing industries that have higher production inducement coefficients. Second, after evaluating each production inducement coefficient and by applying real values to final demand by country and industry (i.e., in both cases of "no cooperation" and "economic cooperation"), we compare the figures of each scenario and analyze which case is more economically efficient.

Key words: Korea-China-Japan economic cooperation, input-output model, economic effect, specialization

JEL codes: O53

1. Introduction

The trend of today's world economy is toward globalization and regionalism. As a consequence of regionalism since the late 20th century, the world economy has been divided into three axes: European Union (EU), North American Free Trade Agreement (NAFTA), and the East Asian economic region. From a global perspective, the two major axes of regional cooperation (EU and NAFTA) have achieved block economies on a higher plane; they occupy 40% of the world's trade volume, thereby allowing them to control a large amount of world trade. Incidentally, unlike the countries involved in EU and NAFTA, the East Asian bloc is rather placed at a disadvantaged position. Specifically, economic cooperation has not yet been accomplished because of a string of historical and political relationships among its countries.

With economic volume and potential not any less than EU and NAFTA, the Korea-China-Japan economic region has the possibility to rise as the third axis of the world

* Young Ji Park, Graduate student of Urban Planning and Development, Dept. of Urban Planning & Engineering, Yonsei University, 262 Seongsan-dor, Seodaemun, Seoul 120-749, Korea, e-mail:jen21c@empas.com; Kabsung Kim, Associate Professor of Urban Planning and Development, Dept. of Urban Planning & Engineering, Yonsei University 262 Seongsan-ro, Seodaemun, Seoul 120-749, Korea, e-mail:kabsung@yonsei.ac.kr; James W. Harrington, Jr., Professor of Geography, University of Washington, 36 Gerberding Box 351271, Seattle, WA 98195-1271, USA, e-mail: jwh@uw.edu

economy by cooperating through economic integration. It is expected that the strong growth of China, steady growth of Korea, and economic recovery of Japan can extend the economic powers of the three countries and allow Northeast Asia to become the most dynamic economic region of the world. The level of industrial technology of Korea is between that of Japan and that of China. In addition, as it is being pursued by a rapidly growing China, Korea currently faces a critical situation—a seeming nutcracker phenomenon—between Japan and China. In the unavoidable change in the world economy, only active preparation through pre-research would enable the aforementioned regional bloc to triumph over economic wars in the future.

In this context, this study examines the present state of industrial growths in Korea, China, and Japan. It also analyzes the effects of economic cooperation in Northeast Asia, assuming the situation of economic cooperation among the three aforementioned countries would persist.

This research is divided into three parts. First, the research reviews literature on the meanings, background, and economic effects of economic cooperation of Korea, China, and Japan. Second, the research examines input-output linkages among the three countries by analyzing input-output model and explores the competitive and advantageous industries by comparing levels of production inducement coefficient. Finally, in each case of "no cooperation" and "economic cooperation," this research analyzes the effects on economic growth of each country and the economy of Northeast Asia.

2. Literature Review

Several researchers from East Asian countries have paid special attention to the close geographical location of Korea, China, and Japan. With this physical feature, there are currently many precedent studies estimating the economic growth of East Asia through economic cooperation of Korea, Japan, and China; these analyze the economic effects of the cooperation on each country by using qualitative and quantitative methods. Kim (2000) asserts on highlighting the experiences of EU and NAFTA's economic cooperation when considering the political and economic distinctiveness of East Asia. He also maintains that a special model be designed to apply to the geographical feature of East Asia.

By using actual data on past events related to existing free trade agreements (FTAs), Lee et al. (2004) studied how the FTAs among Korea, China, and Japan contribute to the economic growth of each country. They also developed a methodology to explore the trade creation effect of the three countries. Lee et al. (2004) expect that the FTAs of the three countries would promote growth for each state, with the effect on Korea the largest. In another research, Lee & Wang (2004) analyzed the relationship of trade structure with economic growth by focusing on the change of trade structure; the dynamic panel model has been used for this purpose. They also analyzed the effects of changes in the trade structure across Korea, Japan, and China by contracting the FTA of each country's economic growth. They concluded that FTA contracts have a positive effect on the three countries' economic growth.

Yuichi & Nagendra (2005) have studied the economic interdependency of eight East Asian countries using the Asian input-output table with respect to total intermediate input goods. They found that the economic interdependency in East Asia had been

growing, but there were also differences in dependency structures at both country and industry levels.

3. Analysis of Industrial Structures of Korea, China, and Japan

Powered by high-rapid growth for about 30 years, Korea, China, and Japan have maintained stronger economic growth compared with other countries in the world, occupying about 20% of the world economy. Japan achieved rapid growth in the 1960s. Then, newly industrializing countries, including Korea, continued to growth in the 1970s and 1980s. China has the highest economic growth rate worldwide in 2000s.

In addition, in year 2000, Japan has occupied about 15% of the world economy with respect to economic size, achieving twice the economic growth rate compared with that of other countries. Having been referred to as "the miracle on the Han River," Korea has growing rapidly over the past 20 years, given the abundant labor and government-driven support to its capital-intensive industry. Since year 2000, following the economic growth of Japan, Korea leaped from a capital-intensive to a technology-intensive industry. China's population is 1.26 billion. Its GDP rose over 1,080 billion in year 2000. Expectedly, China—with its market in full potential—has entered the global top 10 in terms of economic size. It could potentially reach the 7% growth rate mark annually, which is much more than that of US (3%).

From the perspective of GDP per capita, the gap between China and Japan in year 2000 is quite big at $853 versus $35,000, respectively. Despite this gap, Korea, Japan, and China have functioned as the export markets for each other's economic growth. Under such trade relations, the export volume among the three countries has grown drastically from 7.7% in 1990 to 14.1% in year 2000; meanwhile, import volume has increased from 7.6% to 11.5%. While the weight of EU or NAFTA in the world's economy is stagnating if not decreasing, Northeast Asia has increased over the years, strongly indicating that the three countries have to search for ways to make their ongoing trade relations influence economic growth more positively through efficient economic cooperation.

The input-output analysis for Korea, China, and Japan was studied using data on the forward and backward linkage effect of the three countries (i.e., see the tabular data on "Analysis of Industrial Interdependency among Japan, China and Korea: Application of International Input-Output," Korea Institute for International Economic Policy, 2002. Forward and backward linkage effects were calculated using the tabular transaction data on the "Asian International Input-Output (2000)" published by the Institute of Developing Economies under the Japan External Trade Organization (2006).

Table 1. Industry Index

1	Agriculture, livestock, forestry and fishery	6	Light industries	11	Electronics and electronic products	16	Construction
2	Crude oil and gas	7	Chemical products	12	Transport equipment	17	Wholesale and transport
3	Mining	8	Ceramic	13	Precision equipment	18	Services
4	Food and beverage	9	Metal products	14	Manufacturing products		
5	Textile	10	Machinery	15	Electricity, gas and water supply		

By using the international input-output table and Leontief inverse matrix (the basic model of I/Oanalysis) and by analyzing both forward and backward linkage effects of Korea, Japan, and China at the one's home vs. that of other countries we identified the industry that manifests the highest competitive advantage over the others (i.e., intra- and inter-country).

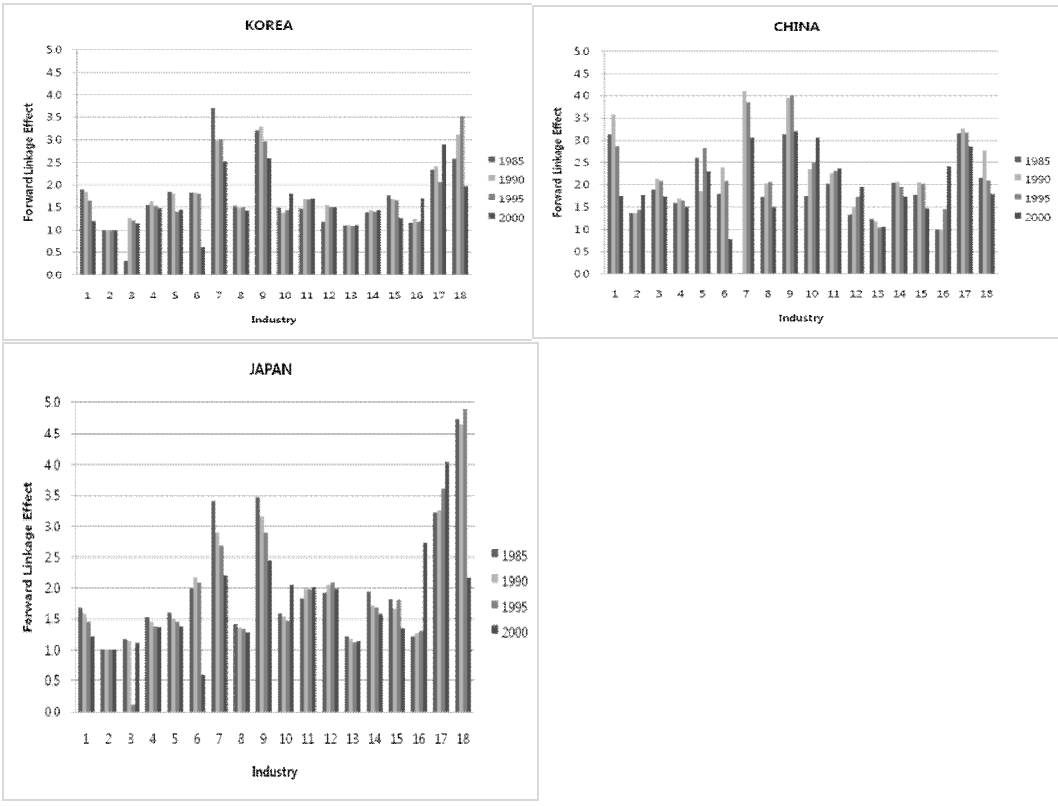

Figure 1. Forward Linkage Effect at one's home Level

The result of analysis of forward linkage effect on Korea, Japan, and China in years 1985, 1990, 1995, and 2000 shows that the industries, which have increasing multipliers in China, are machinery, electronics, transport equipment, and construction. Based on findings, chemical and metal products also achieved the higher effects compared with the other industries. The industries with competitive advantage had been the wholesale and transport industries in 1985 and the chemical industry in 1990, 1995, and 2000. In the case of Japan, the forward linkage effects on most industries decreased slightly over time except for machinery, construction, and wholesale and transport. Moreover, the effects of wholesale and transport and the service industries seemed to be higher than those for others. As shown in Figure 1, the industry with competitive advantage in 1985, 1990, and 1995 had been the service industry, and this has exhibited an unsurpassed forward linkage effect over the others. In year 2000, however, the forward linkage effect of the service industry decreased dramatically, putting wholesale and transport at the forefront. In Korea, the effects of machinery, wholesale and transport, and service industries increased whereas those of the chemical and metal industries decreased. This analysis shows that

chemical products, metal products, and services have higher effects than those for others. The most competitive industry in 1985 has been the chemical industry; metal products in 1990; the service industry in 1995; and wholesale and transport in 2000.

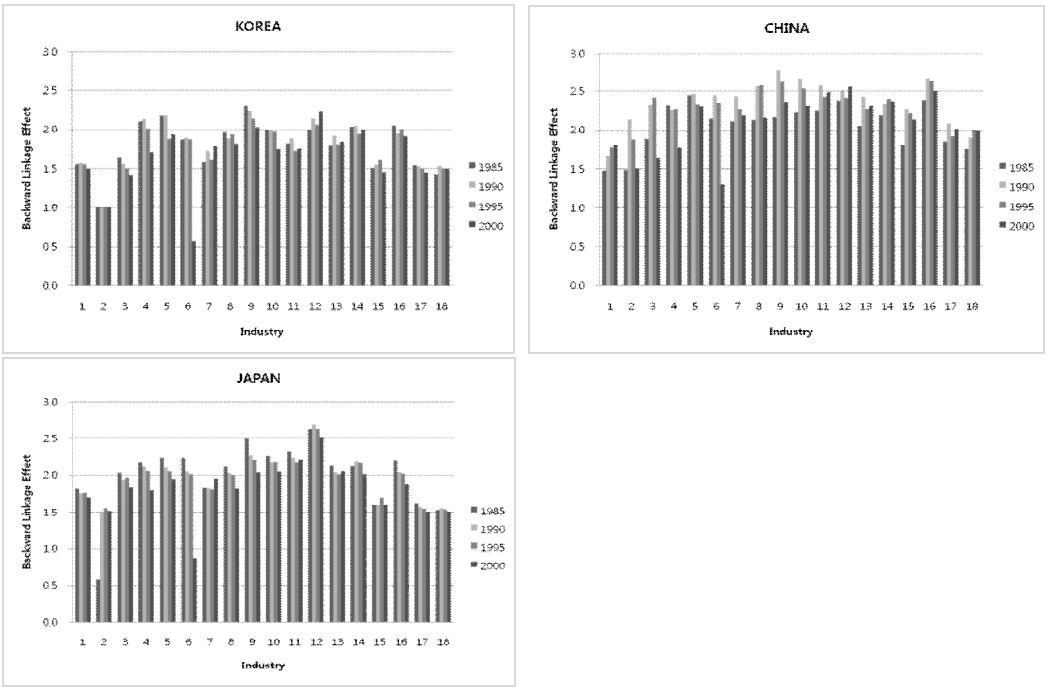

Figure 2. Backward Linkage Effect on one's Home

The result of the analysis on backward linkage effects shows that the overall industry in China attained similar effects, especially for metal products, machinery, and construction. Therefore, it is important to determine the transition across the competitive industries from 1985 to 2000. Every year in China, industries on textile, metal, construction, and transport equipment have obtained the highest backward linkage effect. Hence, the obvious growths of these industries have affected the production of other industries supplied with these intermediate goods. In the case of Japan, similar to the forward linkage, the effects decreased over time except for the effects of chemical products. In addition, the effects of metal product, machinery, and transport equipment presented higher backward linkage effects compared with others. The industry with the highest effects in 1985–2000 corresponds to transport equipment. In Korea, the backward linkage effects of metal products, transport equipment, and construction had been higher than that for the other industries. Most industries have exhibited rising and declining effects. Prior year 2000, the most competitive industry has been the metal industry. Beginning year 2000, the backward linkage effect of transport equipment has been the most prominent. All three countries have strong backward linkage effects on metal products in one's own home. This indicates that the three countries have high self-production ability and independent product systems.

The following segments present the study on the types of industries in each country that exhibit the comparative advantage. The inter-industry effects on the other countries at the country level were analyzed. Figure 3 shows the types of industries at which each

country has stronger effects on others. For this purpose, the analysis of forward and backward linkage effect between Korea and Japan was first conducted.

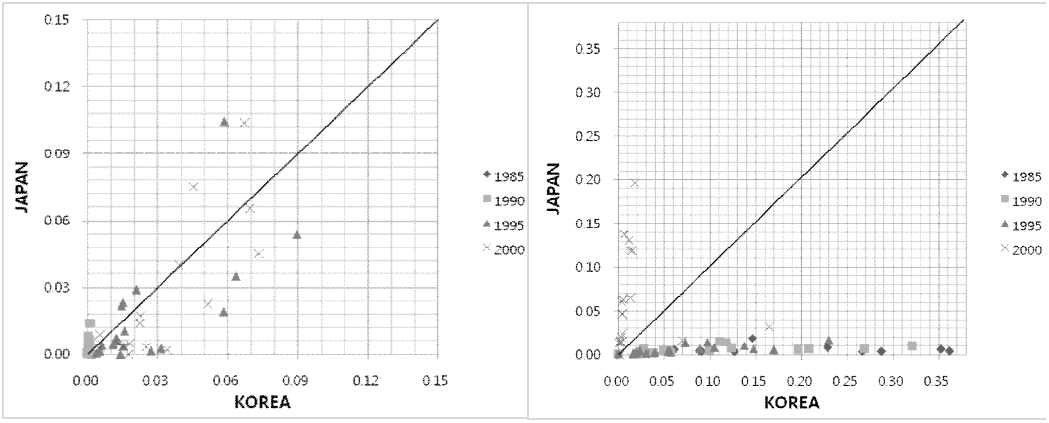

Figure 3. Forward (L) and Backward (R) Linkage Effect between Korea and Japan

In Figure 3, the x-axis denotes the forward and backward linkage effects of Japan on Korea while the y-axis displays the vice versa. Accordingly, we could distinguish easily the industries that have comparative advantages. A spot over the diagonal line denotes an industry in Korea manifesting an advantage; a spot below the diagonal line denotes an industry in Japan manifesting an advantage. In Figure 3, all spots are concentrated near the x-axis. Therefore, it can be deduced that the forward and backward effects of all industries in Japan on Korea are much bigger compared with those in Korea on Japan. This indicates that the output of Japan affects the production of Korea significantly. Moreover, the demand for intermediate goods in Japan is likely to affect the products of Korea. In comparison with this forward linkage effect analysis between Korea and Japan, the backward linkage effect is a bit different. Prior 1995, the spots are almost concentrated near the x-axis, tending to decrease over time. In year 2000, the effects of Japan on Korea became almost zero, and the effects of Korea on Japan have increased. Therefore, the rate of dependence of Japan on Korean imports has decreased, whereas that of Korea on Japanese imports increased. Accordingly, the demand for intermediate goods in Korea has likely affected Japanese products since year 2000.

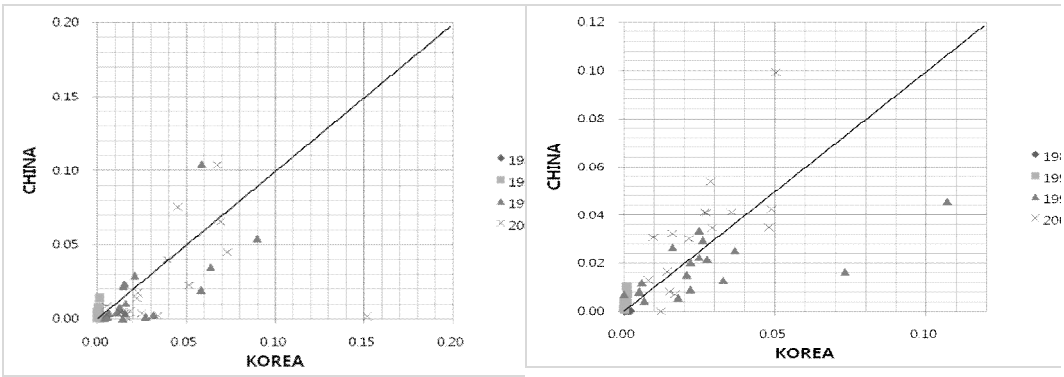

Figure 4. Forward (L) and Backward (R) Linkage Effect between Korea and China

The input-output data has been limited to 1995 only because there have been no diplomatic relations and trade between Korea and China in the past. In year 2000 in China, industries with significantly large forward effects on Korea are textile, metal product, wholesale and transport, and construction. Those that have large effects on China in Korea are chemical products, electronics and electronic products, and other light industries. In terms of backward linkage effects, Figure 4 shows that China is affected by textile, chemical, metal products, electronics, and other manufacturing and other light industries of Korea.

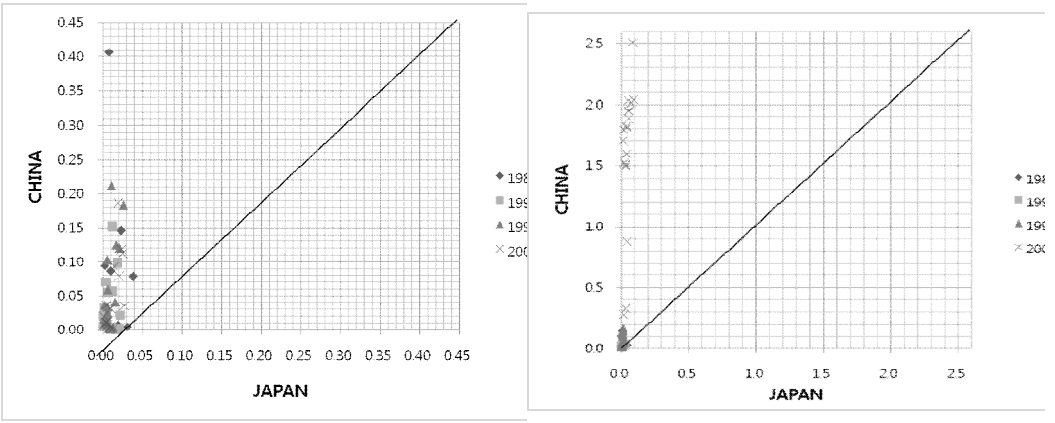

Figure 5. Forward (L) and Backward (R) Linkage Effect between China and Japan

Additionally, machinery and manufacturing industries in China have high demand on intermediate goods from Korea. China has a stronger forward linkage effect in textile while Korea has a stronger backward linkage effect in textile. In other words, textile production in China affects the production in Korea, and textile production in Korea needs the intermediate goods produced in China. In consonance, with increasing numerical values, the inter-industrial interdependency between China and Korea has also increased.

The analysis on forward and backward linkage effects between China and Japan is illustrated in Figure 5. The x-axis denotes the forward and backward linkage effects of China on Japan while the y-axis denotes the effects of Japan on China.

As shown in Figure 5, most spots are near the y-axis; therefore, in analyzing the inter-industry comparative advantages with forward and backward linkage effects, we could infer that the effects of Japan on China are much higher than those for China on Japan. Accordingly, the growth of output from metal, electronics, and electronic product industries in Japan has affected Chinese products. Then, the production activities of agriculture, forestry, and fishery, as well as crude oil and gas, in China affect Japan. Backward linkage effects are also shown in Figure 5, with the effects of China on Japan seemingly insignificant. The effects of Japan on China are quite strong for textile, electronics and electronic products, transport equipment, and precision equipment. Consequently, these industries in Japan are dependent upon the intermediate goods produced in China. In year 2000, the effects increased dramatically more than ever. Hence, we can conclude that the rate of dependence of Japan on Chinese imports has intensified.

Table 2. Industries with High Effects of Korea, China, and Japan

Industry	Korea	China	Japan
Agriculture, livestock, forestry, and fishery			
Crude oil and gas		○	
Mining		○	
Food and beverage	○	○	
Textile	○		
Light industries			
Chemical products	◎	△	○
Ceramic			
Metal products	◎	△	◎
Machinery	○	△	○
Electronics and electronic products		◎	◎
Transport equipment	◎	△	◎
Precision equipment		○	◎
Manufacturing products	△	○	
Electricity / Gas and water supply			
Construction		△	△
Wholesale and transport	△		△
Service	○		

◎ Advantage in one's home country + advantage over the other countries

○ Advantage over the other countries. △ Advantage at one's home country

4. Analysis on the Economic Effects of Economic Cooperation of Korea, China, and Japan

Using the production inducement coefficients of year 2000, which had been used previously to analyze the input-output linkage of Korea, China, and Japan, we calculated the degree of specialization of industry by applying the location quotient (LQ) index. We also analyzed the specialized industries of each country. The calculated index presented in this paper has been set as standard to divide the various fields of industry across countries, assuming that an economic cooperation exists; this index was calculated using Equation 1.

$$LQ_i = \frac{E_i^r / E^r}{E_i^n / E^n} \quad \text{(Equation 1)}$$

E_i^r: Production inducement coefficient of r industry in i country

E^r: Average of production inducement coefficient of r industry in the three countries

E_i^n: Average of production inducement coefficient of all industries in i country

E^n: Average of production inducement coefficient of all industries in the three countries

Table 3 shows the results of the specialization index calculation corresponding to the relative concentration of each industry. If the specialization index of a certain industry in a certain country were bigger than 1, the degree of specialization of the industry is high. The shadow-dropped parts of the table denote specialized industries with indices bigger than 1. As shown Table 3, the fields of specialized industries of China and Japan are distinctly divided while those of Korea overlap with China and Japan. This result implies that unless Korea specializes and re-structuralizes its key industries, in consideration of the potential economic cooperation with China or with Japan, the future of the industrial development of Korea would be somewhat hazy.

The highlighted parts with bold fonts in Table 3 denote the major country with the highest specialization index in terms of industry. Based on the presented result, the key industries of Korea are food and beverage, chemical products, ceramic, metal products, precision equipment, electricity-gas-water supply, and services. China has attained the highest specialization indices in agriculture–livestock–forestry–fishery, crude oil–gas, mining, light industries, textile, machinery, and electronics–electronic products. The key industries of Japan are transport equipment, manufacturing, construction, and wholesale–transport. Subsequent analysis focuses on the assumption that economic cooperation has been implemented through perfect division of fields of industry, as described above.

Table 3. Calculation Results of the Specialization Index

Industry	Korea	China	Japan
Agriculture, livestock, forestry, and fishery	0.976844	**1.109720**	0.895208
Crude oil and gas	0.888981	**1.248284**	0.816328
Mining	0.975578	**1.149743**	0.850433
Food and beverage	**1.141283**	0.923620	0.958801
Textile	0.951288	**1.196457**	0.818979
Light industries	1.044039	**1.062505**	0.888108
Chemical products	**1.088062**	1.049142	0.863294
Ceramic	**1.139790**	0.950139	0.929730
Metal products	**1.054501**	1.035085	0.910033
Machinery	0.875788	**1.178747**	0.908158
Electronics and electronic products	0.934164	**1.039722**	1.014459
Transport equipment	0.926996	0.954845	**1.118398**
Precision equipment	**1.122244**	0.854405	1.055592
Manufacturing	1.015532	0.969022	**1.021384**
Electricity / Gas and water supply	**1.043298**	0.960098	1.006302
Construction	0.831691	0.940553	**1.221718**
Wholesale and transport	0.991441	0.779148	**1.261247**
Service	**1.114195**	0.810457	1.113366

We analyzed the economic effects of economic cooperation with production inducement coefficients (Leontief inverse matrix) calculated from the tabular data on international input-output of Korea, China, and Japan for year 2000. Production inducement coefficient refers to the unit of total output induced directly or indirectly by the impact of one unit of final demand. In this study, we summed up production

inducement coefficient by country and by industry; calculated the effects of each country and each industry on all three countries; and simulated economic effects by applying the basic input-output model containing the Leontief inverse matrix. In other words, from the basic input-output model ($X=(1-A)^{-1}Y$), we can easily set the numerical value of $(1-A)^{-1}$ (i.e., production inducement coefficient by country and industry) and assume that that final demand (Y) of each industry in each country is uniform. Therefore, we can express the total output of the three countries using Equation 2.

$$X = \sum (E_i^r \times Y_i^r)$$

X: Total output of the three countries
E_i^r: Production inducement coefficient of industry i in country r
Y_i^r: Final demand of industry i in country r

Let Korea, China, and Japan secure economic cooperation. We then assume perfect division of fields of industry and simulate three kinds of scenario by using the production ratio of the key industry of the relevant country on behalf of the three countries. First, the basic model explaining the case of "no action" is established in order to compare with the case of "economic cooperation." By multiplying the final demand of the relevant industry in the relevant country by production inducement coefficients for year 2000, the basic model can be expressed as

- Basic model

$$X = (E_i^C \times Y_i^C) + (E_i^K \times Y_i^K) + (E_i^J \times Y_i^J)$$ (Equation 3) C: China, K: Korea, J: Japan

Scenarios of economic cooperation can then be established, with the three cases of each production ratio of key industry for the relevant country fixed at 100%, 50%, and 30%. The production ratio of the relevant industry can be expressed by applying different production ratios to each final demand (Y_i^r,) of each country. In other words, if the country in charge of key industry i produces 100% of the whole final demand of the three countries, total output can be calculated by multiplying the sum of the final demands of the three countries $(Y_i^C + Y_i^K + Y_i^J)$, by each relevant production inducement coefficient. After rearranging for final demand of each country (Y_i^C, Y_i^K, and Y_i^J), we compare the coefficients of each country with the production inducement coefficients of the basic model in the case of "no economic cooperation." Assuming that the final demand of each country is uniform in the case of "economic cooperation" and knowing that final demand is positive, we could then explain the increase of coefficient as the economic effect of economic cooperation.

Let us also take this example: If Korea is in charge of a% of production of the key industry i on behalf of the three countries, the final demand of Korea can be expressed as

$$\left(\frac{a}{100}Y_i^C + Y_i^K + \frac{a}{100}Y_i^J\right).$$

The total outputs of the other countries can then be evaluated by multiplying the final demand of each country at the rate of $\left(1-\frac{a}{100}\right)$ (i.e., the rest of the production) by the production inducement coefficient of each country.

- Korea produces 100% of total production
-

$$X = E_i^K\left(Y_i^C + Y_i^K + Y_i^J\right) \quad \text{(Equation 4)}$$

- Korea produces a% of total production

$$X = \left[E_i^C \times \left(1-\frac{a}{100}\right)Y_i^C\right] + \left[E_i^K \times \left(\frac{a}{100}Y_i^C + Y_i^K + \frac{a}{100}Y_i^J\right)\right] + \left[E_i^J \times \left(1-\frac{a}{100}\right)Y_i^J\right]$$

(Equation 5)

After deducting coefficients multiplied by the final demand of each country and each industry, we then apply numerical values of final demand for each country and each industry to Y_i^C, Y_i^K, and Y_i^J, and . Next, we analyze how the total output of each industry could change by scenario and how the sum of the total output of Korea, China, and Japan differs by scenario. This analysis would enable us to see the overall economic effects on all three countries in Northeast Asia. We also use the data of final demand of Korea, China, and Japan for year 2000. The data are then converted to the currency of each country (in 1 million dollars) by using the average exchange rate for year 2000. Due to limitations in data, information on mining and light industries has been excluded.

We have established the basic model to explain the case of "no economic cooperation" and the simulation models of the three cases that apply each production ratio of the key industry of the relevant country (i.e., 100%, 50%, and 30%.) After applying the relevant ratio of final demand to Equations 4 and 5, and rearranging each final demand (Y_i^C, Y_i^K, and Y_i^J), we compared coefficients multiplied by final demands of each industry of each country with those presented by the basic model. Then, we applied the numerical value of final demand of each country and each industry to Y_i^C, Y_i^K, and Y_i^J, and . Subsequently, we analyzed the total output of the three countries by scenario.

Table 4 shows the industries that have positive effects on all countries. Based on results, economic cooperation for these industries stimulates production in all three countries. In accordance with the result of analysis of specialization index, the country in charge of the key industry is shadow-dropped in Table 4. Ten of the 18 industries have positive effects on all countries (agriculture–livestock–forestry–fishery, crude oil–gas, mining, textile, light industries, machinery, electronics–electronic products, transport equipment, construction, and wholesale–transport).

Table 5 itemizes the industries with positive effects on two countries and negative effect on the remaining country. The result includes food–beverage, chemical products, ceramic, manufacturing, and services. It specifically includes key Korean industries with the highest specialization index in the three countries. Based on results, the country with the higher production inducement coefficient (as opposed to that with the highest specialization index) is affected negatively by economic cooperation. Whether the total output of all of three countries increases or not depends on the final demands of the other two countries, except the country of the key industry.

Table 4. Industries with Positive Effect on all Three Countries

Industry	Scenario	Y_i^C (CHI)	Y_i^K (KOR)	Y_i^J (JPN)	Industry	Scenario	Y_i^C (CHI)	Y_i^K (KOR)	Y_i^J (JPN)
Agriculture	BASE	1.7694	1.2220	1.2300	Machinery	BASE	3.1217	1.8993	2.4525
	100%	1.7694	1.7694	1.7694		100%	3.1217	3.1217	3.1217
	50–50	1.7694	1.4957	1.4997		50–50	3.1217	2.5105	2.7871
	30–70	1.7694	1.3862	1.3918		30–70	3.1217	2.2660	2.6533
Crude oil and gas	BASE	1.797214	1.0001	1.0077	Electronics–electronic products	BASE	3.4901	1.8553	2.8325
	100%	1.7972	1.7972	1.7972		100%	3.4901	3.4901	3.4901
	50–50	1.7972	1.3986	1.4025		50–50	3.4901	2.6727	3.1613
	30–70	1.7972	1.2392	1.2446		30–70	3.4901	2.3458	3.0298
Mining	BASE	1.7686	1.1661	1.1176	Transport equipment	BASE	1.9651	1.5077	2.0572
	100%	1.768652	1.7686	1.7686		100%	2.0572	2.0572	2.0572
	50–50	1.7686	1.4673	1.4431		50–50	2.0111	1.7824	2.0572
	30–70	1.7686	1.3468	1.3129		30–70	1.9927	1.6725	2.0572
Textile	BASE	2.3998	1.5051	1.4244	Construction	BASE	2.4898	1.7268	2.9337
	100%	2.3998	2.3998	2.3998		100%	2.9337	2.9337	2.9337
	50–50	2.399858	1.9525	1.912130		50–50	2.7117	2.3302	2.9337
	30–70	2.3998	1.7735	1.7170		30–70	2.6229	2.0889	2.9337
Light Industries	BASE	0.8265	0.6477	0.6111	Wholesale transport	BASE	2.9215	2.9499	4.2672
	100%	0.8265	0.8265	0.8265		100%	4.2672	4.2672	4.2672
	50–50	0.8265	0.7371	0.7188		50–50	3.5944	3.6086	4.2672
	30–70	0.8265	0.7013	0.6757		30–70	3.3252	3.3451	4.2672

Table 5. Industries with Positive Effect on Some Countries

Industry	Scenario	Y_i^C (CHI)	Y_i^K (KOR)	Y_i^J (JPN)
Food and beverage	BASE	1.534416	1.489137	1.379173
	100%	1.489137	1.489137	1.489137
	50%–50%	1.511776	1.489137	1.434155
	30%–70%	1.520832	1.489137	1.487843
Chemical products	BASE	3.156185	2.645979	2.551326
	100%	2.645979	2.645979	2.645979
	50%–50%	2.901082	2.645979	2.598653
	30%–70%	3.003123	2.645979	2.579722
Ceramic	BASE	1.522818	1.436035	1.309695
	100%	1.436035	1.436035	1.436035
	50%–50%	1.479426	1.436035	1.372865
	30%–70%	1.496783	1.436035	1.347597
Manufacturing	BASE	1.758218	1.456108	1.664483
	100%	1.664483	1.664483	1.664483
	50%–50%	1.711350	1.560296	1.664483
	30%–70%	1.730097	1.518621	1.664483
Services	BASE	1.807719	1.977891	2.191644
	100%	1.977891	1.977891	1.977891
	50%–50%	1.892805	1.977891	2.084768
	30%–70%	1.858771	1.977891	2.127518

Table 6 lists the case of negative effect on the total output of Korea, China, and Japan. The result includes metal products, precision equipment, and electricity–gas–water supply; these industries have been established as key Korean industries with the highest specialization indices. Incidentally, Korea has the lowest production inducement coefficients of the three countries despite its highest specialization indices. However, if Korea selects key industries for economic cooperation and promotes them by efficiently investing on limited resources, it can attain representative productive capacity in East Asia. Nevertheless, economic cooperation from these industries can induce a positive economic effect on all three countries.

Table 6. Industries with Negative Effect on all Three Countries

Industry	Scenario	V_i^C (CHI)	V_i^K (KOR)	V_i^J (JPN)
Metal products	BASE	3.291010	2.677852	2.742709
	100%	2.677852	2.677852	2.677852
	50%–50%	2.984431	2.677852	2.710280
	30%–70%	3.107063	2.677852	2.723252
Precision equipment	BASE	1.213016	1.105584	1.151574
	100%	1.105584	1.105584	1.105584
	50%–50%	1.159300	1.105584	1.128579
	30%–70%	1.180786	1.105584	1.137777
Electricity, gas, and water supply	BASE	1.480808	1.272501	1.361817
	100%	1.272501	1.272501	1.272501
	50%–50%	1.376654	1.272501	1.317159
	30%–70%	1.418316	1.272501	1.335022

Table 7 Result of Positive Effects of Economic Cooperation (unit: mln USD)

Industry	Scenario	Total Output	Industry	Scenario	Total Output	Industry	Scenario	Total Output
Agri culture	BASE	4,277,514	Chemical Products	BASE	11,108,431	Transport Equipment	BASE	48,635,768
	100%	6,028,650		100%	11,503,382		100%	48,656,903
	50–50	5,153,082		50–50	11,305,906		50–50	48,646,335
	30–70	4,802,854		30–70	11,226,916		30–70	48,642,109
Crude oil and gas	BASE	2,913,251	Ceramic	BASE	814,645	Construction	BASE	225,138,455
	100%	5,188,332		100%	877,862		100%	225,249,115
	50–50	4,050,791		50–50	846,253		50–50	225,193,785
	30–70	3,595,775		30–70	833,610		30–70	225,171,653
Food and beverage	BASE	39,917,728	Machinery	BASE	54,371,107	Wholesale transport	BASE	382,144,734
	100%	43,075,599		100%	69,210,704		100%	382,320,859
	50–50	41,496,664		50–50	61,790,906		50–50	382,232,797
	30–70	43,042,478		30–70	58,822,986		30–70	382,197,572
Textile	BASE	5,206,034	Electronics–electronic products	BASE	97,780,345			
	100%	8,686,094		100%	120,551,206			
	50–50	6,946,064		50–50	109,165,776			
	30–70	6,250,052		30–70	104,611,603			

We analyzed previously the total output of Korea, China, and Japan. Next, we apply directly the real values of final demand in year 2000 to Y_i^C, Y_i^K, and Y_i^J ; subsequently, we evaluate how the total outputs of each industry and all three countries change by scenario.

As shown by the results presented in Table 7, the total outputs of the 11 industries (agriculture, crude oil–gas, food–beverage, textile, chemical products, ceramic, machinery, electronics–electronic products, transport equipment, construction, and wholesale–transport) increase under the "economic cooperation" scenario. In contrast, the result of the other five industries (manufacturing, service, metal products, precision equipment, and electricity–gas–water supply) shows a slight decline of total outputs (Table 8).

Table 8 Result of Negative Effects of Economic Cooperation (unit: mln USD)

Industry	Scenario	Total Output
Manufacturing	BASE	10,748,086.1
	100%	10,747,067.7
	50%–50%	10,747,576.9
	30%–70%	10,747,780.6
Service	BASE	619,535,791.8
	100%	559,240,782.2
	50%–50%	589,388,287.0
	30%–70%	601,447,288.9
Metal Products	BASE	3,624,459.9
	100%	3,536,395.8
	50%–50%	3,580,427.9
	30%–70%	3,598,040.7
Precision Equipment	BASE	3,576,769.1
	100%	3,433,972.8
	50%–50%	3,505,370.9
	30%–70%	3,533,930.2
Electricity, gas, and water supply	BASE	13,622,163.8
	100%	12,728,217.5
	50%–50%	13,175,190.6
	30%–70%	13,353,979.9

Table 9 Comparison of Total Output

Scenario	Total output (mln USD)	Increasing rate to the basic model (%)
BASE	832,465,803.1	-
100%	837,183,908.5	0.567
50%–50%	834,824,855.8	0.283
30%–70%	836,036,658.2	0.429

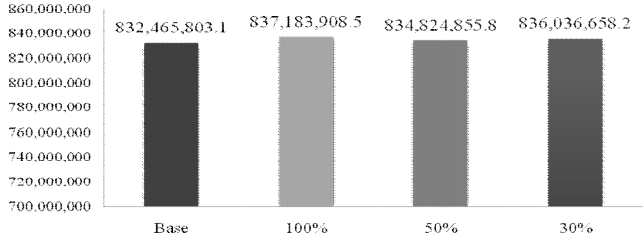

Figure 6. Comparison of Total Output

We have analyzed in this paper the economic effect of economic cooperation of Korea, China, and Japan by comparing production inducement coefficients of each industry of each country and the coefficients for the case of "economic cooperation," which are induced by modulating the ratio of final demand of each country and by rearranging it accordingly. Based on results, 15 of the 18 industries have positive effects on three scenarios of "economic cooperation."

Additionally, by applying real values of final demand of each country to $\mathbf{Y}_f^r$, we have proven that the total output of all three countries increases generally in any scenario of economic cooperation. It has been shown by the result that economic cooperation has positive effects on about 70% of the industries, as well as on the overall economy of Korea, China, and Japan.

5. Conclusion

In this paper, we analyze the multipliers of the input-output model for the three countries; explored the advantageous industries within one's home country and that for others; and presented trends in specialization. This paper also analyzes degree of specialization by applying the LQ and key industries of each country. Finally, by applying real values for the final demand of Korea, China, and Japan, we evaluate the real effects of economic cooperation numerically. Assuming perfect division of fields of industry, this study has evaluated and compared the economic effects in both cases of "no action" and "economy cooperation" by constructing the Northeast Asian economic community through simulation.

Based on the analysis of production inducement coefficient, the vector of industrial linkage effects and the stronger industries have strong linkage effects on the other two countries. Japan has been leading in technique-intensive industries, such as precision equipment and transport equipment. China has its competitive power in labor-intensive industries, such as in textiles and metal products. Korea—having been placed at the intermediate channel between Japanese and Chinese industries—has its competitive ability in electronics, light industries, and manufacturing. An analysis of the key industries of each country through the specialization index shows that Korea can maximize its the intermediate channel role between the labor intensive industry of China and technology-intensive industry of Japan, which is similar to the result obtained from the input-output analysis. Subsequent analyses proved further the economic effects, and these have shown that even if the effects differ according to industry, economic cooperation has positive effects on more than 70% of the industries. The sum of the total output of Korea, China, and Japan increases under the "economic cooperation" scenario. Considering China's high-rapid growth and improvement in knowledge-based industry, we can therefore conclude that a crisis in Korea might soon occur. Unless Korea can lead Japan with respect to technical improvements, Korea has to exert itself for flinging off China's chase. Additionally, if there would be any delays in the formation of the Northeast Asian economic community (e.g., political scenarios), Korea cannot completely exclude the possibility of succumbing to the economic powers of Japan and China.

The results of the analyses prove the necessity of economic cooperation. By cooperating economically, most especially with the formation of the Northeast Asian economic community, Korea, China, and Japan could improve significantly their

interdependent relations and establish more efficiently their network. By infusing interdependent relationship through horizontal or vertical divisions in the industrial structure of East Asia, such an economic cooperation could be realized more efficiently, thereafter enhancing the economic position of East Asia globally.

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