The Economic Impact of the Establishment of the China-Japan-South Korea Free Trade Area and Impact on the Communication Industry
-Base on GTAP Model Analysis-

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한중일 자유무역지대 설립의 경제적 영향과 통신 산업에 대한 영향
-GTAP 모형 분석을 바탕으로-

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Abstract In recent years, the world's free trade system has been severely damaged by a series of protectionist measures in the United States and anti-globalization practices such as Brexit. Against this background, RCEP, the world's largest trade agreement, was officially signed on November 15, 2021. The RCEP provided a good working basis for the establishment of a Korea, China, and Japan free trade zone. First, this paper describes the current status of Korea-China-Japan trade cooperation and the current status of the trilateral telecommunication industry. Second, this paper simulates the changes in the overall economy of China, Japan, and Korea when tariffs are reduced to 0%, 5%, and 10%, respectively, after the establishment of a free trade zone using the 8th edition GTAP database. Then, using the simulated data changes and using the 2019 data as a benchmark, we calculated the changes in the RCA index for the three countries' telecommunications industries for the three tax rates. In the end, it is concluded that the economies of the three countries will grow to different levels in many ways when the Korea, China, and Japan free trade zone is established. Japan's telecommunications industry will not be significantly affected, Korea will grow significantly with higher tax rates and China will grow significantly with lower tax rates.

Key Words : China-Japan-South Korea free trade area, communication industry, RCA index, GTAP, economic impact

요 약 최근 몇 년간 미국의 일련의 보호무역주의 조치와 브렉시트(Brexit) 등 반세계화 행태로 세계의 자유무역체제가 큰 타격을 받았다. 이러한 배경에서 세계 최대 무역 협정인 RCEP가 2021년 11월 15일에 공식 서명되었다. RCEP는 한중일 자유무역지대 구축을 위한 좋은 작업 기반을 제공했다. 첫째, 본고는 한중일 무역협력 현황과 3국 통신 산업의 현황을 기술한다. 둘째, 본 논문은 제8판 GTAP 데이터베이스를 이용하여 자유무역지역 설정 이후 관세가 각각 0%, 5%, 10%로 인하될 때 중국, 일본, 한국의 경제 전반의 변화를 시뮬레이션하였다. 그런 다음 시뮬레이션된 데이터 변경 사항을 사용하고 2019년 데이터를 벤치마크로 사용하여 3개 세율에 따른 3국 통신 산업의 RCA 지수의 변경 사항을 계산했다. 결국 한중일 자유무역지대가 수립되면 3국의 경제는 다방면에서 서로 다른 수준으로 성장할 것이라는 결론이 나온다. 일본의 통신 산업은 큰 영향을 받지 않을 것이며 한국은 높은 세율로 크게 성장할 것이고 중국은 낮은 세율로 크게 성장할 것이다.

주제어 : 한중일 자유무역지대, 통신 산업, RCA인덱스, GTAP, 경제적 영향

1. Introduction

In recent years, the U.S. government has taken a series of protectionist measures to protect its own industries, and Britain's Brexit has set off a wave of anti-globalization around the world, seriously impacting the free trade system, which has affected China, Japan and South Korea(CJK). In addition, the RCEP was formally signed on November 15, 2021, marking the formation of the world's largest free trade area. On the basis of describing the current situation of trade between CJK and their communication industry, this paper uses the GTAP model to simulate the establishment of free trade area among the three countries, and analyzes the impact on the economy of them under the hypothetical policy of gradually eliminating tariff and non-tariff barriers. Especially for the communication industry, whether it will be impacted or contribute to its own development is within the scope of this paper.

In order to analyze the impact, this paper uses the global trade analysis model (GTAP) which has been widely used. The GTAP model is a multi-country computable general equilibrium model developed by Purdue University in the United States. Since 1993, the GTAP model has been widely accepted and applied to the simulation of agricultural, tax, trade and energy policies. The GTAP-8 database used in this paper contains data on all 57 GTAP commodities in 129 countries and regions, as well as the reference years 2004 and 2007. In the simulation, all non-tariff barriers are eliminated, and under the policy of tariff reduction to 0, 5% and 10%, the economic effects of CJK as well as the impact on the communication industry are analyzed.

2. Literature Review

Since the proposal of CJK free trade area was put forward, many scholars have done quite in-depth research. They generally believe that the establishment of the CJK free trade areahas a very positive impact on the economic development of the three countries.

Li Zhongmin and Tang Zhong(2006) analyzed the impact of the possible free trade area in East Asia on China's agricultural products trade by using the GTAP 6th version database, and believed that the best plan for China was to strive for the establishment of a free trade area between CJK, and to prevent trade liberalization among ASEAN, Japan and South Korea.

South Korean scholars Hyung Rae Park, Yoo Sik Jang(2010) using computable general equilibrium model analyzes the possible measures for the free trade deal with South Korea and Japan's impact on trade liberalization. Their analysis suggests there would be potential gains from signing free trade agreements with South Korea and Japan. In all cases, free trade agreements are expected to have positive real productive and trade-creating effects on the economies of both countries. However, because of the low level of bilateral trade, the impact isrelatively small. The best policy option, they argue, is to pursue multilateral free trade.

In general, most of the existing studies focus on the overall economic effect and impact of the establishment of the CJK free trade area on the three countries. In addition to using the GTAP 8th version model to simulate the over all economic effect and influence of the establishment of the CJK free trade area on the three countries, this paper also analyzes the influence on the communication industry, which is of great significance to China's industrial upgrading and transformation.

3. Current situation of trade and communication industry

3.1 Trade integration(intensity) index

The trade integration(intensity) index is a relatively comprehensive index used to measure the interdependence of two countries in trade. The higher the number, the closer the trade links between the two countries. The calculation formula is as follows:

$$T_{ab} = \frac{X_{ab}/X_a}{M_b/M_w}$$

Tab represents the trade integration index between country a and country b, Xab represents the export volume of country a to country b, and Xa represents the total export volume of country a. Mb represents the total amount of imports of country b; MW represents the world's total imports. If Tab>1, it means that country a and b are closely related to each other in terms of trade. If Tab<1, it means that country a and b are loosely related in terms of trade.

Table 1. China's trade intensity index with Japan and South Korea

Year	China-Japan	Japan-China	China-Korea
2001	3.32	2.19	2.26
2002	3.13	2.32	2.17
2003	2.94	2.49	2.08
2004	2.77	2.48	2.08
2005	2.44	2.43	1.98
2006	2.14	2.46	1.92
2007	2.00	2.52	1.94
2008	1.89	2.63	2.05
2009	2.01	2.58	1.79
2010	1.85	2.35	1.63
2011	1.81	2.30	1.57
2012	1.68	2.07	1.55
2013	1.65	1.98	1.51
2014	1.57	2.03	1.55
2015	1.63	1.98	1.72
2016	1.61	1.76	1.74
2017	1.58	1.81	1.66
2018	1.54	1.78	1.59
2019	1.48	1.72	1.65

Source: UN Comtrade Database

As can be seen from Table 1, from 2001 to 2019, although the trade integration index between CJK has been declining, on the whole, both the index of China with Japan and South Korea and index of Japan and South Korea with China have greatly exceeded the critical value 1. Therefore, if the free trade area can be established, it will better promote the trade links among the three countries, and the rebound and rise of the trade integration index of the three countries and stimulate the economic development of them.

3.2 Revealed Comparative Advantage Index

The revealed comparative advantage (RCA) index indicates whether acountry is in the process of extending the products in which it has a trade potential, as opposed to situations in which the number of products that can be competitively exported is static. It can also provide useful information about potential trade prospects with new partners. Countries with similar RCA profiles are unlikely to have high bilateral trade intensities unless intra-industry trade is involved. The calculation formula is as follows:

$$RCA_{ij} = \frac{X_{ij}/X}{X_{wj}/X_{wt}}$$

Xij and Xwj are the values of country i's exportsof product j and world exports of product j and where Xit and Xwt refer to the country's total exports and world total exports. A value ofless than unity implies that the country has a revealed comparative disadvantage in the product. Similarly, if the index exceeds unity, the country is said to have a revealed comparative advantage in the product. Revealed comparative advantage of the value range is divided into three stages, respectively is RCA>2.5, 2.5≥RCA≥1.25, 1.25≥RCA≥0.8 and RCA<0.8. These four ranges

respectively represent the four degrees of great competitive advantage, relatively large competitive advantage, moderate competitive advantage and less obvious competitive advantage for the export of j products in country i. The following is the RCA index calculation results of products from CJK.

From the table it can be seen that the RCA index of Hides and Skins and Footwear products from China has shown a downward trend, but it is still above 2 and 2.5, so it still has a great and relatively large international competitive advantage. The RCA index of Mach and Elec and Capital Goods rose from below 1.25 to above 1.25, indicating that these two categories of products have a relatively large competitive advantage in the international market. Consumer Goods, on the other hand, dropped below 1.25. While the RAC index of other products in China is almost below 0.8, especially the Fuels product's RCA index once dropped to below 0.1. This shows that the international competitiveness of these products in China is not obvious.

By 2018, the largest competitive advantage of Japan is transportation product. Due to its small land area, Japan's government attaches great importance to the development and protection of resources, so its exports to primary products are less, and it does not have a comparative advantage in primary products. On the contrary, as a developed country, Japan has a strong comparative advantage incapital and technology-intensive industries, especially in transportation equipment industry.

By 2018, Korea's products with RCA index above 1.25 are Mach and Elec, Capital Goods and Plastic or Rubber, which have a relatively large competitive advantage in the international market. Like Japan, South Korea has few comparative advantages in primary products, which is also related to its small size and limited natural resources.

To sum up, the comparative advantages of CJK in primary products are notobvious, but

Table 2. China's RCA Index

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Capital goods	1.47	1.5	1.57	1.66	1.7	1.72	1.66	1.55	1.47	1.59	1.6
Consumer goods	1.28	1.26	1.23	1.18	1.13	1.1	1.07	1.06	1.11	1.03	1.04
Intermediate goods	0.76	0.61	0.63	0.68	0.68	0.68	0.72	0.66	0.67	0.64	0.65
Raw materials	0.13	0.12	0.11	0.1	0.09	0.09	0.09	0.11	0.13	0.11	0.1
Animal	0.35	0.33	0.33	0.36	0.33	0.31	0.3	0.28	0.3	0.27	0.27
Chemicals	0.48	0.4	0.45	0.51	0.49	0.49	0.5	0.48	0.49	0.49	0.54
Food Products	0.33	0.3	0.31	0.32	0.34	0.31	0.3	0.28	0.3	0.28	0.3
Footwear	4.4	4.04	4.05	4.05	3.92	3.7	3.35	2.97	2.89	2.66	2.63
Fuels	0.08	0.07	0.07	0.05	0.04	0.05	0.05	0.07	0.09	0.08	0.08
Hides & Skins	3.32	3.15	2.95	2.87	2.76	2.56	2.35	2.14	2.16	2.07	2.08
Mach & Elec	1.83	1.85	1.9	2.02	2.08	2.1	2.03	1.9	1.81	1.94	1.96
Metals	1.06	0.86	0.86	0.92	0.95	0.99	1.08	1.05	1.11	0.98	0.95
Minerals	0.25	0.17	0.15	0.13	0.13	0.12	0.12	0.14	0.14	0.12	0.12
Miscellaneous	1.5	1.4	1.36	1.38	1.35	1.27	1.27	1.25	1.26	1.38	1.4
Plastic or Rubber	0.77	0.74	0.72	0.77	0.81	0.83	0.84	0.79	0.83	0.81	0.85
Stone & Glass	0.76	0.72	0.65	0.66	0.7	0.63	0.66	0.5	0.48	0.47	0.51
Textiles & Clothing	2.86	2.78	2.71	2.72	2.67	2.6	2.45	2.22	2.23	2.1	2.1
Transportation	0.26	0.27	0.32	0.32	0.32	0.31	0.3	0.28	0.28	0.28	0.32
Vegetable	0.25	0.25	0.25	0.25	0.24	0.24	0.22	0.22	0.24	0.2	0.23
Wood	0.68	0.64	0.65	0.68	0.71	0.69	0.69	0.66	0.71	0.65	0.64

Source: World Integrated Trade Solution

Table 3. Japan's RCA Index

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Capital goods	1.73	1.68	1.68	1.78	1.75	1.68	1.66	1.52	1.5	1.52	1.54
Consumer goods	0.9	0.79	0.8	0.78	0.81	0.85	0.83	0.86	0.87	0.86	0.88
Intermediate goods	0.94	1.08	1.04	1.05	1.03	1.06	1.06	0.98	0.94	0.98	0.97
Raw materials	0.07	0.09	0.08	0.08	0.09	0.09	0.09	0.11	0.12	0.11	0.09
Animal	0.11	0.12	0.13	0.11	0.11	0.12	0.12	0.14	0.14	0.1	0.12
Chemicals	0.83	0.87	0.86	0.9	0.89	0.97	0.94	0.86	0.84	0.87	0.93
Food Products	0.1	0.1	0.11	0.11	0.12	0.1	0.12	0.13	0.14	0.15	0.17
Footwear	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Fuels	0.12	0.11	0.1	0.11	0.09	0.13	0.12	0.15	0.14	0.12	0.11
Hides & Skins	0.09	0.09	0.08	0.1	0.08	0.08	0.08	0.07	0.08	0.08	0.07
Mach & Elec	1.68	1.59	1.59	1.69	1.62	1.55	1.53	1.41	1.39	1.4	1.42
Metals	1.1	1.36	1.3	1.3	1.41	1.48	1.42	1.35	1.24	1.21	1.2
Minerals	0.14	0.12	0.09	0.09	0.1	0.1	0.11	0.14	0.13	0.12	0.13
Miscellaneous	0.98	0.95	1.02	1.14	1.23	1.16	1.19	1.12	1.13	1.26	1.32
Plastic or Rubber	1.19	1.33	1.32	1.33	1.37	1.36	1.32	1.26	1.21	1.2	1.19
Stone & Glass	0.66	0.71	0.71	0.8	0.63	0.55	0.6	0.57	0.63	0.76	0.66
Textiles & Clothing	0.28	0.28	0.27	0.3	0.31	0.31	0.31	0.29	0.29	0.29	0.27
Transportation	2.47	2.34	2.3	2.22	2.37	2.42	2.3	2.21	2.15	2.18	2.23
Vegetable	0.03	0.03	0.03	0.06	0.03	0.03	0.04	0.04	0.04	0.04	0.05
Wood	0.25	0.27	0.29	0.29	0.3	0.32	0.33	0.35	0.35	0.37	0.36

Source: World Integrated Trade Solution

Table 4. Korea's RCA Index

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Capital goods	1.78	1.77	1.78	1.73	1.71	1.76	1.67	1.66	1.62	1.66	1.65
Consumer goods	0.76	0.67	0.69	0.78	0.81	0.76	0.76	0.71	0.69	0.67	0.68
Intermediate goods	1.11	1.14	1.12	1.15	1.13	1.12	1.2	1.03	1.05	1.08	1.14
Raw materials	0.05	0.07	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.05	0.05
Animal	0.17	0.17	0.16	0.17	0.17	0.15	0.12	0.12	0.14	0.11	0.1
Chemicals	0.68	0.6	0.62	0.71	0.73	0.76	0.74	0.7	0.78	0.79	0.93
Food Products	0.16	0.18	0.18	0.19	0.23	0.21	0.22	0.24	0.26	0.28	0.31
Footwear	0.16	0.14	0.12	0.11	0.11	0.11	0.09	0.09	0.1	0.09	0.08
Fuels	0.47	0.45	0.44	0.54	0.53	0.5	0.52	0.54	0.55	0.5	0.51
Hides & Skins	0.45	0.43	0.39	0.39	0.45	0.5	0.44	0.42	0.38	0.31	0.26
Mach & Elec	1.78	1.74	1.71	1.67	1.69	1.76	1.69	1.68	1.67	1.69	1.75
Metals	1.15	1.26	1.2	1.27	1.29	1.24	1.24	1.25	1.23	1.24	1.21
Minerals	0.13	0.1	0.1	0.1	0.1	0.09	0.1	0.1	0.08	0.07	0.1
Miscellaneous	0.89	0.92	0.99	1.01	1.01	0.89	0.87	0.88	0.8	0.78	0.73
Plastic or Rubber	1.62	1.62	1.59	1.6	1.65	1.69	1.66	1.57	1.58	1.53	1.55
Stone & Glass	0.35	0.42	0.35	0.37	0.36	0.33	0.72	0.26	0.28	0.31	0.27
Textiles & Clothing	0.74	0.68	0.68	0.67	0.68	0.66	0.62	0.57	0.57	0.51	0.44
Transportation	1.35	1.43	1.47	1.54	1.48	1.48	1.38	1.32	1.24	1.35	1.14
Vegetable	0.04	0.05	0.05	0.05	0.05	0.04	0.05	0.04	0.05	0.04	0.04
Wood	0.28	0.29	0.3	0.29	0.3	0.31	0.29	0.27	0.29	0.26	0.24

Source: World Integrated Trade Solution

compared with the other two countries, China's comparative advantages in primary products are slightly stronger. In addition, China also has a strong comparative advantage in labor-intensive manufactured products, and South Korea's comparative advantage in labor-intensive manufactured products is inferior to China's. While Japan has a strong comparative advantage in capitaland technology-intensive finished products, China and South Korea are also constantly strengthening the development of this product category.

4. GTAP Model Analysis

GTAP (The Global Trade Analysis Project) was established in 1992 by a team led by Professor Hertel from Purdue University in the United States. Its main purpose is to deal with quantitative analysis of the international economy at a lower cost. The GTAP model is a multi-region and multi-sector CGE model and is one of the most widely used CGE models. The GTAP model is a good economic analysis tool for analyzing changes in international trade policies. Almost all industries in the economic field are covered in the main program design of the GTAP model.

4.1 Simulation Design

This paper uses GTAP 8th version database, which includes 129 countries and regions, 57 sectors and 5 factors of production. This paper mainly studies the impact of tariff changeon the overall economy and communication industry of CJK after the establishment of the free trade area, according to the tariff reduction plan in the trade agreement.

This paper divides the 129 countries and regions in the GTAP databaseinto 10 categories as shown in the table.

Table 5. National Classification of GTAP Simulation

	Code	Countries and Regions Included
1	CHN	China
2	HKG	China Hong Kong
3	TWN	China Taiwan
4	JPN	Japan
5	KOR	South Korea
6	USA	United States of America
7	IND	India
8	RUS	Russia
9	EU	Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom,
10	REST OF WORLD	Rest of World

For the department classification in the GTAP database, the default classification method in GTAPAGG is adopted in most cases, and the original communication in transportation and communication is only listed as adepartment separately. In this way, the department categories set in this paper will be increased from the original 10 to 11. They are grains and crops, livestock and meat products, mining and extraction, processed food, textiles and clothing, light manufacturing, heavy manufacturing, utilities and construction, transport, communication, other services.

The most important purpose of signing free trade agreements among countries is to eliminate trade barriers among member countries in the free trade area. And trade barriers are divided into tariff and non-tariff trade barriers. This paper mainly studies the impact of tariffs on member countries in the free trade area, so non-tariff barriers are not included in the consideration. This paper sets up three scenarios, namely, the tariff of all import and export commodities between China, Japan and South Korea is reduced to 10%, 5% and 0 respectively, so as to analyze the impact of different tariff reductions on the economies especially the communication industry of the three countries.

4.2 Simulation Results

4.2.1 The Overall Economic Impact

According to the simulation results in the table, when the tariff between CJK is reduced to 0, the GDP of each country has a small increase. But GDP will fall as tariffs rise, most notably in South Korea. The terms of trade of Japan and South Korea improve only under 0 tariff, while the terms of trade of CJK under other tax rates and China under 0 tariff rate have deteriorated. Each country's exports, imports and welfare fall as taxes rise, as does GDP. The tariff change has the biggest impact on South Korea's imports and exports.

4.2.2 Impact on the Communication Industry

Since this paper focuses on the impact of the establishment of free trade area on the communication industry, the simulation results of other industries are not listed in detail. The simulation results are summarized in the following table.

Table 6. Changes in Exports of The Communication Industry and Total Exports

	0 tax rates		5% tax rates		10% tax rates	
	Exports (%)	Total Exports (%)	Exports (%)	Total Exports (%)	Exports (%)	Total Exports (%)
China	−0.40	2.16	−1.86	−0.46	−3.32	−3.07
Japan	−3.81	1.85	−5.53	−0.62	−6.84	−3.09
Korea	−4.48	2.92	−2.16	−1.09	0.17	−5.09
World	−6.38	4.5	−8.63	−2.05	−10.84	−8.60

Source: run GTAP results

Table 7. Changes in the RCA Index of the Communication Industry

	0 tax rates	5% tax rates	10% tax rates	2019
China	3.23	3.14	3.03	2.97
Japan	0.15	0.14	0.14	0.14
Korea	1.13	1.16	1.18	1.09

It can be seen from the table that the RCA index of the communication industry of CJK has increased compared with 2019, regardless of the tax rate. This shows that the establishment of the CJK free trade area will enhance the competitive advantages of the communication industry ofthe three countries. Among them, China's RCA index rose the most under the 0 tax rate, and South Korea's RCA index rose the most under the 10% tax rate. Japan's RCA index rose only slightly at 0 and barely budged at other rates. To sum up, the establishment of the CJK free trade area has played a role in enhancing the competitive advantages of the communication industry of the three countries. But the effect on Japan was negligible. China's communication industry benefits most under 0 tariff, while South Korea's benefits most under 10% tariff.

5. Conclusion

By using the GTAP model to simulatethe changes in GDP, terms of trade, welfare level, import and export of the three countries after the establishment of the free trade area, we can further see the impact of the establishment of the free trade area and the changes in tariffs on the economies of the three countries. In general, the establishment of the free trade area is more beneficial to Japan's economic growth, terms oftrade, social welfare, etc., followed by South Korea. While China's GDP has increased, but the growth rate is not large, and China will have some disadvantages in terms of trade. But China has a slight advantage over Japan and South Korea in its trade balance. From the perspective of communication industry alone, the establishment of free trade area has little impact on the competitive advantage of Japan's communication industry. The lower the tariffis, the greater the increase of the competitive advantage of China's communication industry, while the higher the tariff is, the greater the increase of the competitive advantage of South

Korea's communication industry. In other words, the higher the tariff among the three countries, the better itis for South Korea's communication industry, while the lower the tariff, the better it is for China's communication industry. but the less impact it has on Japan. But it has little impact on Japan.

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