Research and Prospect of China, Japan and South Korea Trade Under RCEP Background via Gravity Model

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Abstract. China, Japan and South Korea are the most important economies in Asia. Trade liberalization among the three countries can bring regional economic synergy and rapid development. After the signing of the RCEP agreement in November 2020, China, Japan and South Korea entered a closer stage of trade cooperation, but there still exist space for further development. The paper selects the relevant trade panel data between the three countries from 2001 to 2020, and uses the trade gravity model to regress on the basis of preliminary analysis of bilateral trade between the three countries, and puts forward some suggestions on the relevant conclusions. The study found that: trade between China, Japan and South Korea developed rapidly before 2008, after the financial crisis has continued to shock, growth is not obvious. In the past 20 years, trade between China and South Korea has grown faster than that between China and Japan. Among the factors affecting trade, China's per capita national income has the greatest impact. The trade deficit between China and Japan and South Korea is still increasing, and China needs to further accelerate core technology research and development to enhance international competitiveness in the domain of high-end products.

Keywords: Gravity Model · Trade Research · RCEP

1 Introduction

As the most powerful economic countries in Asia, China, Japan and the ROK have witnessed a steady increase in multilateral trade volume and economic cooperation, which have provided a better impetus for the development of the three countries. Under the background of economic globalization and regional economic integration, many FTA have established to promote the prosperity of transnational trade. The idea of China-Japan-ROK FTA was proposed at the summit of their leaders in 2002. Today, after several rounds of negotiations and consultations, some progress has been made. However, due to the interference of political, diplomatic and other factors, it still takes time to reach the formal agreement [3]. If China, Japan and the ROK can agree on a free trade agreement, it will become the world's third largest economic and trade zone after the NAFTA and the EFTA.

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After 31 rounds of formal negotiations, on November 15, 2020, China officially signed the Regional Comprehensive Economic Partnership (RCEP) with 15 countries in the Asia-Pacific region, which means that the economic and trade cooperation in the Asia-Pacific region has taken another historic step. Under such framework, China, Japan and South Korea have completed the approval process of each country, which means that the implementation of RCEP has been implemented among the three countries [4]. In 2019, China, Japan and South Korea accounted for 81.5% of the total GDP and 69% of the total population of RCEP participating countries. RCEP can also bring more opportunities for development and cooperation to the three countries and lay a good foundation for further regional economic integration.

2 Literature Review

Trade gravity model can effectively and reasonably evaluate trade efficiency in practical application. Li Chunding constructed a large-scale trade model system of global general equilibrium by using CES production function, and predicted that the implementation of RCEP will increase China's welfare level and foreign trade by 1.116% and 8.549% respectively [2]. The establishment of China-Japan-ROK FTA can increase China's welfare by an average of 0.232%, and foreign trade by an average of 5.356%. The establishment of FTA will greatly improve the benefits of all countries. Wan Hongxian used ESI and G-L indexes to analyze the trade competitiveness and complementarity of the statistical data of RCEP countries from 2005 to 2019, and on this basis constructed an expanded trade gravity model [6].

Stochastic frontier gravity model has been recognized by many scholars and widely used in domestic and foreign research. Wang Liang and Wu Binyuan used stochastic frontier gravity model to estimate the degree of trade inefficiencies in the Silk Road Economic Belt, and found that countries such as Iran, Ukraine and Russia had higher levels of trade inefficiencies [8]. In addition, improving the level of Internet infrastructure was conducive to improving bilateral trade efficiency in countries along the Silk Road Economic Belt. Peng Jizeng introduced the stochastic frontier trade gravity model into more levels of research [5]. Starting from the Hofstede cultural dimension theory, he used the stochastic frontier trade gravity model to empirically analyze the impact of cultural distance on China's import and export trade efficiency, and found that cultural distance had a negative impact on trade efficiency, and the effect on import trade efficiency was more obvious.

3 Model Settings and Data Sources

3.1 Construction of Stochastic Frontier Gravity Model

The stochastic frontier production function was first proposed by Greene W and used to measure the technical efficiency of enterprise production. In this model, the stochastic disturbance term is decomposed into two parts: the random error term and the non-negative technical inefficiency term, and the non-negative technical efficiency term is highlighted [1]. The specific formula is shown in Eq. (1).

$$T_{ijt} = \alpha_i + \beta x_{ijt} + \nu_{ijt} - u_{ijt}, u_{ijt} \geq 0 \quad (1)$$

$$v_{ijt} \sim N\left[0, \sigma_v^2\right], u_{ijt} \sim N\left[\mu_{ijt_t}\sigma_{ijt}^2\right]$$

Among them, T_{ijt} represents the trade volume of country i to country j in year t, x represents the natural factors that affect the trade volume, such as economic scale, geographical distance, α is the intercept term, ν is the residual, u is the non-negative trade inefficiencies composed of human factors, such as government governance ability, financial deepening level, etc. Wang H. J. modified the traditional stochastic frontier gravity model and proposed the hypothesis that the inefficiency term u obeys semi-normal distribution or truncated normal distribution, considering the heterogeneity of the inefficiency term of individual effect [7]. Since different countries have great differences in economic goals, policy formulation, and economic development level, we choose the heterogeneous stochastic frontier gravity model with technical inefficiency subject to semi-normal distribution for econometric analysis. The distribution characteristics are assumed as follows:

$$v_{ijt} \sim N\left[0, \sigma_v^2\right], u_{ijt} \sim N\left[0, \sigma_{ijt}^2\right]$$

$$\sigma_{ijt}^2 = \exp\left(\sigma_0 + z_{ijt}\gamma\right) \tag{2}$$

Among them, z_{ijt} is the exogenous variable affecting the non-efficiency term, γ is the corresponding coefficient.

3.2 Model Setting and Variable Description

The paper constructs a stochastic frontier gravity model to estimate bilateral trade efficiency based on Eq. (1). The specific formula is as follows:

$$\begin{aligned} \ln Y_{ijt} = {} & \alpha_j + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} \\ & + \beta_3 \ln PGDP_{it} + \beta_4 \ln PGDP_{jt} + \beta_5 \ln DIST_{ij} \\ & + \beta_6 \text{ Crisis}_t + v_{ijt} - u_{ijt} \end{aligned} \tag{3}$$

Subscript i represents China, j represents the trading partner, and t represents time. Equation (3) is the stochastic frontier gravity equation of export trade volume, and the explained variable Y_{ijt} is the export trade volume of i country to j country in t period. The explanatory variables are as follows: GDP_{it} and GDP_{jt} respectively represent the gross domestic product of China and trade partner countries in the t year, which are used to measure the economic scale of China and trade partner countries. Generally speaking, the larger the economic scale of a country, the greater the export potential and import demand; $PGNI_{it}$ and $PGNI_{jt}$ respectively indicate that per capita GDP of China and trade partner countries in the third year, and the impact of income level on a country's demand structure is crucial. Zhang Huiqing believes that per capita GDP can be used as a complementary indicator of factor endowment conditions, and the higher the value is, the higher the degree of trade complementarity between the two countries is [9]. The author uses per capita GDP to measure the income levels of both trade partners; $DIST_{ij}$ denotes the geographical distance between China and the trading partner j, which is measured by the linear distance between the capital of the two sides of the trade. The greater the geographical distance, the transaction cost will inevitably increase. It is expected that $DIST_{ij}$ is negatively correlated with trade volume. $Crisis_t$ is a financial crisis variable, reflecting the impact of the global financial crisis on bilateral trade. The author set $Crisis_t = 0$ for all years before 2008, $Crisis_t = 1$ for all years after 2008.

3.3 Data Sources

The time span of the paper is from China's accession to WTO in 2001 to 2020, bilateral trade data is from the UNComtrade database; GDP and per capita GDP of each country are from the World Bank database; the geographical distance is measured by the linear distance between the capitals of both sides of the trade, in kilometres, organized by the CEPII database. Some missing data are obtained by multiple interpolation of time series and other channels.

4 Empirical Analysis

4.1 China-Japan-ROK Bilateral Trade Situation

Firstly, a preliminary analysis is made on the import and export of trade between China, Japan and the ROK. In this phase of analysis, the year-on-year growth rates of exports and total trade between the two countries are used (Fig. 1).

Since China's accession to the WTO in 2001 and before the global financial crisis in 2008, trade between China and Japan has been growing steadily with growth rates above 10%, reaching 31.1% and 25.7% in 2003 and 2004, respectively. In 2001, the first year of China's accession to the WTO, Japan's exports to China exceeded China's exports to Japan for the first time, and the trend continued later, reflecting, to some extent, China's growing demand for foreign imports. China's imports to Japan fell from \$150.6bn in 2008 to \$139.38bn in 2009, while exports to Japan fell from \$1161.33bn

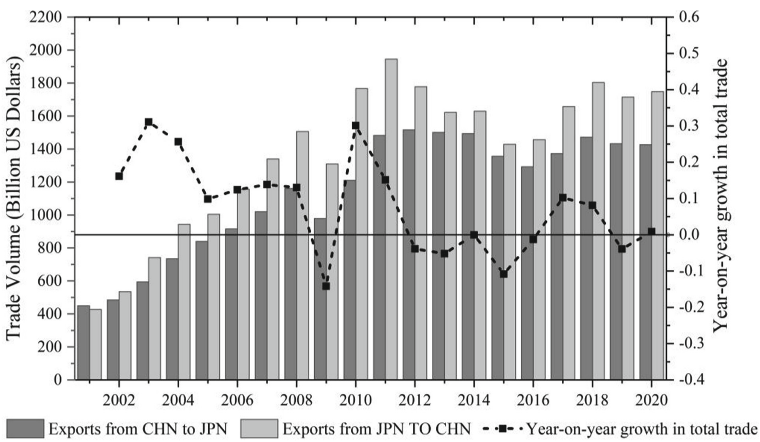

Fig. 1. Sino-Japanese trade situation in 2001–2020

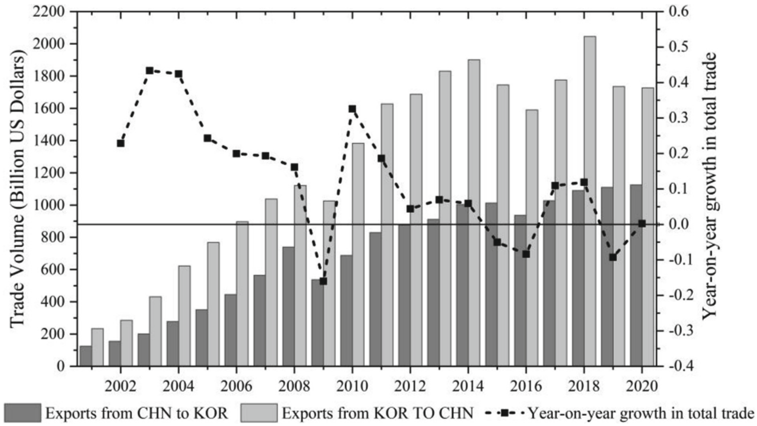

Fig. 2. Sino-Korea trade situation in 2001–2020

in 2008 to $979.11bn, a total decline of 14.2%. In 2010, there is a relatively obvious warming trend, basically restored to the level of trade before the financial crisis. Since 2012, Sino-Japanese trade has experienced a stable period of up to eight years. From the perspective of time series, the absolute trade volume is almost unchanged, but the Sino-Japanese trade deficit has experienced a 'U' type change of first decreasing and then increasing, and the end level is lower than the initial level, which shows that China's exports to Japan have been relatively weak in recent years (Fig. 2).

Trade between China and South Korea has grown rapidly in recent 20 years, with bilateral trade increasing from $35.896 billion in 2001 to $285.260 billion in 2020, nearly 7.9 times in absolute terms. From 2001 to 2008, China-ROK trade maintained a stable and rapid growth. As a result, the trade between China and South Korea recovered rapidly in 2008. From 2011 to 2020, the trade between China and South Korea showed a fluctuating growth trend, slowing growth and relatively stable. With the steady growth of total trade between China and South Korea, we note that the trade deficit between the two countries is also increasing, even in 2018, South Korea's exports to China reached twice the import (Fig. 3).

Trade between Japan and South Korea has been relatively stable in the past 20 years, showing an inverted 'U' trend, reaching a peak in 2011, with bilateral trade reaching $107.999 billion. From the perspective of the absolute value level, the overall base fluctuates and rises. Affected by the global economic trend, the fluctuation turning point is basically equivalent to the economic cycle. In terms of the import and export trade volume of the two countries, Japan has always been a net exporter of South Korea, and the trade deficit first increases and then decreases during the study period.

In general, the trade between China, Japan and South Korea has entered a bottleneck period under the current trade conditions. In the past five years, whether from the perspective of trade volume or growth, it is basically flat with the initial level, and some even have a more obvious negative growth. From the perspective of time series, before the 2008 financial crisis, the trade development among the three countries maintained rapid growth. In the post-financial crisis era, there were many uncertainties in the international

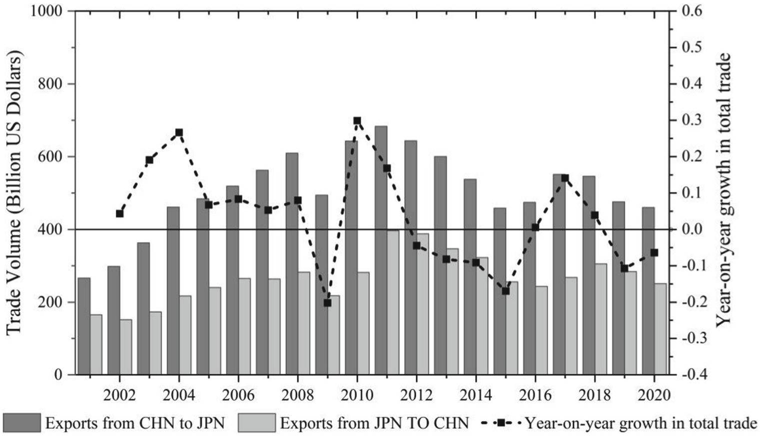

Fig. 3. Japanese-Korea trade situation in 2001–2020

Table 1. Descriptive statistics of variables

VAR	mean	sd	min	max
T	2,243	888.1	359.0	3,428
GDP1	72,208	46,515	13,394	147,084
GDP2	30,760	19,578	5,477	62,032
PGNI1	5,155	3,298	1,010	10,530
PGNI2	32,258	10,099	11,950	49,480
DIST	1,527	578.5	955.7	2,098
CRISIS	0.650	0.483	0	1

economy, and the trade growth also became weak. Therefore, it is particularly important to build a new trade system and implement a new development strategy under the current situation of sluggish trade development between China, Japan and South Korea.

4.2 Analysis of Trade Development Potential

In empirical research, natural logarithms are taken for variables such as GDP, per capita GDP, geographical distance and bilateral trade volume; in order to solve the problem of outliers, all variables are unilaterally truncated in the 5% confidence interval to ensure the accuracy of the estimation results. In this paper, China and Japan, South Korea are selected for trade analysis, so China is set to 1, GDP1 and PGNI1 represent China's GDP and per capita income, GDP2 and PGNI2 represent Japan and South Korea. Table 1 descriptive statistical analysis of each variable.

Table 2 regression results were obtained through the regression analysis of the Eq. (3) by Stata 16.

Table 2. Regression measurement results

VAR	Coef,	t
lnGDP1	0.051***	(3.54)
lnGDP2	0.024	(1.52)
lnPGNI1	0.613***	(3.08)
lnPGNI2	0.045***	(3.17)
lnDIST	−0.985**	(−2.50)
lnCRISIS	372.827**	(2.72)
Constant	772.186*	(1.85)
Observations	40	
R-squared	0.946	
F test	0	
F	176.8	

Robust t-statistics in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

From the regression results we can see that GDP1, lnPGNI1, lnPGNI2 are significant at 1% level, lnDIST and lnCRISIS are significant at 5% level. R-squared value is 0.946, the overall fitting is good. Among them, China's per capita gross domestic product (lnPGNIi) has the greatest contribution to the scale of export trade, and its elastic coefficient is 0.613, which is significantly positive, indicating that the growth of China's export trade to Japan and South Korea is more dependent on the increase of China's per capita national income. The greater the per capita GNI, the more effective it can stimulate bilateral trade. In addition, although both China and the host country's per capita GDP were significantly positive at the 1% level, China's per capita income level coefficient (0.613) was significantly greater than that of Japan and South Korea (0.045), indicating that China's economic development contributed more to the expansion of regional economic trade. Secondly, China's GDP and Japan and South Korea's GDP impact are significantly positive, 0.051 and 0.024, respectively, due to China's large-scale economy is still relatively rapid development stage, so China's GDP impact is about twice the total of Japan and South Korea. The variable of geographical distance is significantly negative at the level of 5%, indicating that with the increase of geographical distance, it is not conducive to the development of trade between China and Japan and South Korea, which is in line with theoretical expectations. China and Japan and South Korea are still highly similar in the manufacturing structure, especially concentrated in labor-intensive industries, and have not yet opened the gap with these countries. Moreover, China's economic scale relies on large-scale processing and manufacturing of intermediate products with medium and low technology, which is at the low end of the value chain and has low product profits, weakening its export competitiveness to a certain extent.

5 Conclusions and Recommendations

5.1 Promoting the Innovation of Industrial and Supply Chain and Breaking Technical Barriers

Among the factors that affect the trade between China, Japan and South Korea, the positive impact of per capita GDP is greater. China, Japan and South Korea should actively promote the innovation and upgrading of industrial chain and supply chain, and tap new economic growth points to achieve comprehensive cooperation with China, Japan and South Korea at the middle and high levels of industry. And the trade deficit between China and Japan and South Korea continues to expand, the deficit between China and South Korea reached twice the total in 2018. This will also indicate that the domestic industry depends on the import of high-end products and makes the domestic technology development slow. Reflecting on China's export-oriented economic model in these years, many industries lack core technology. Which is under the asymmetric globalization with developed countries that they believe in comparative advantages and free trade, despise independent innovation and other policies that lead to China's deepening in importing high-end products with high added value and exporting low-end products with low added value. The game between China and developed countries is the control of core technology and the competitiveness and innovative ability. To offset the industrial and supply chain shortage, China needs to form new advantages in this field, which would provide a broader market and a strong traction in the trade between China, Japan and South Korea.

5.2 Guiding Transformation of Service-Oriented Export and Stabilizing Digital Economy

Increase the proportion of capital and technology-intensive intermediate exports, in order to reduce the negative impact of distance factors on bilateral trade, improve trade efficiency and promote the upgrading of industrial structure. China has entered the era of digital economy, China, Japan and South Korea should actively boost regional cooperation to eliminate trade barriers. The rapidity, high permeability and increasing marginal effect of digital economy are bound to break through the traditional geographical boundaries between countries, make countries in the region closely linked to reduce the impact of external adverse economic factors, and spur new growth in bilateral trade. China, Japan and South Korea have carried out the layout in the field of digital economy. There are great business opportunities among the three countries. In recent years, Sino-US trade disputes have brought many unsafe factors to China's foreign exchange reserves. Increasing investment in mobile payment and blockchain technology, piloting digital RMB and implementing digital currency can reduce the impact of US dollar dominance. Under the new development pattern, China should seize the opportunity of a new round of scientific and technological wave, promote the digital economy to a high level and multi-field, introduce laws and regulations matching with data trading as soon as possible to clarify the bottom line of data supervision, guide the data trading mechanism to improve the trading rules, and encourage the Internet industry to dock with traditional enterprises to promote the digital transformation and innovation development of the real economy.

5.3 Accelerating the Trade Integration and Enhancing the Comprehensive Competitiveness of Foreign Trade

Although RCEP has become the world's largest free trade agreement, its role in promoting a more capital-intensive China-Japan-South Korea triangle remains limited. In addition, India, another important emerging economy in Asia, joined the RCEP, which will greatly reduce the influence of the agreement in Asia. Therefore, on the basis of RCEP, China, Japan and South Korea can take this opportunity to further promote multilateral trade liberalization and accelerate the coordinated development of regional economy.

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