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ANALYSIS OF ECONOMIC EFFECTS OF THE ESTABLISHMENT OF THE BRICS FREE TRADE ZONE —BASED ON THE GTAP-E MODEL

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Abstract

The international regional economic integration is developing to a broader and higher standard. The BRICS countries have been cooperating for a long time. As the representatives of the emerging economies of the world, the establishment of a free trade zone by the BRICS can not only promote economic and trade growth among the BRICS members, but also help the developing countries to speak in the new round of international economic and trade rules reshaping. Based on the above background, this paper uses the GTAP-E model to simulate the economic effects of the BRICS free trade area with the zero tariff and exception sectors scenarios to simulate the expected economic effects of the BRICS free trade area. The construction of the BRICS free trade zone has brought different impacts on different industries of member countries, and the overall optimization and adjustment in the direction of their respective comparative advantages. Resource integration in the industrial sector can increase productivity in BRICS countries.

Keywords

BRICS countries; GTAP-E model; free trade zone; effect

1. Introduction

Since the 21st century, the world economy has been continuously adjusted to the international situation, and a broader and higher level of international regional economic integration organization has become a long-term trend of world economic development. The dominance of the new round of international trade rules has also become the object of competition among countries. The BRICS countries are also actively involved in the process of building a free trade zone, but the free trade zone construction of the members started late, and needs to be further improved. In the new round of globalization, the high-standard international economic and trade rules represented by the developed countries have a tendency to expand in scope. As developing countries, the BRICS countries cannot meet the high requirements of the new economic and trade rules in many aspects, and the possibility of being marginalized in international trade increases, so members hope to build strategic foreign economic and trade relations from a long-term perspective based on their own status.

1.1 Introduction of BRICS countries

The BRICS countries are the representatives of global emerging economies, with 40% of the world's population and about 20% of GDP. They have developed well in recent years and have made unique contributions to promoting global economic stability and development. According to the data published by the International Monetary Fund (IMF), the nominal GDP of China, India, Brazil, Russia, and South Africa ranked second, seventh, ninth, twelfth, and thirty-second in the world in 2018, which shows their influence in the world. Under the background of the new round of reshaping of international economic and trade rules, further tapping the trade potential of the BRICS countries and strengthening the practical cooperation relationship within the BRICS countries are of great significance to the economic growth of the BRICS countries and safeguarding the interests of developing countries.

As representatives of the global emerging economies, the BRICS countries have always maintained stable growth and made important contributions to the promotion of world economic growth, especially after the 2008 financial crisis. Although the economic growth rate of the BRICS countries has slowed down in recent years, the economic growth rates of Brazil, Russia, and South Africa have been lower than the world average since 2014, but

China and India have maintained a GDP growth rate of about 7%. The overall economic scale of the country is still considerable. In 2019, Brazil, Russia, India, China, and South Africa exports of goods were $222.64 billion, $418.8 billion, $324.16 billion, $2499.03 billion, and $86.1 billion. In 2019, the BRIC countries exported goods worth approximately 3.46 trillion U.S. dollars. In 2020, the GDPs of Brazil, Russia, India, and China were $1363.77 billion, $1464.08 billion, $2592.58 billion, and $14860.78 billion. In summary, the economic and trade development potential of the BRICS countries needs to be further tapped. The ever-increasing economic strength and the vigorous development of trade in goods and services have also laid the economic foundation for the construction of the BRICS free trade zone.

1.2 Introduction of research significance

The theoretical significance of this article is to enrich the relevant research content of the BRIC countries on the construction of free trade zones, and to conduct forward-looking research on the non-started BRIC free trade zones at the theoretical level. At present, WTO multilateral trade negotiations are stagnant, and international regional economic integration has become a major trend in world economic development. Russia and India in the BRIC countries are on the "Belt and Road" governance line. Brazil and South Africa are important markets in South America and Africa, respectively. The establishment of a BRIC free trade area is of great significance to the member states to enhance their strength and integrate into the world. Existing studies have relatively few discussions on the construction of the BRIC free trade zone. This article focuses on the GTAP-E model to further explore the expected economic effects of the BRIC white trade zone from a quantitative perspective, enriching the relevant theoretical research on the construction of the free trade zone.

The practical significance of this article focuses on the fact that this article can provide guidance for BRICS cooperation in the future. At present, the BRICS countries are rapidly emerging, but there is no collective cooperation mechanism among the BRICS countries, and there are certain problems in the economic and trade cooperation of the BRICS countries, which are reflected in the large gap in the scale of foreign trade between countries, the lack of close trade relations, and the economic and trade relations between the countries Unbalanced cooperation, etc. This article will use the GTAP-E model to simulate the expected economic effects of the establishment of the BRICS free trade zone, and analyze the changes in the GDP, welfare level, trade scale, and industrial sectors. Based on the analysis results, this article puts forward relevant policy expectations and recommendations in a targeted manner.

This article takes the BRICS countries as the research object, analyzes the opportunities and challenges faced by the BRICS countries in the establishment of free trade zones by combing through relevant documents on economic and trade relations, cooperation mechanisms, and building free trade zones in the BRICS countries, and then constructs a GTAP-E model to challenge the BRICS. The economic effects of the National Free Trade Zone are simulated in advance. Use simulation results to examine the impact of the BRICS Free Trade Zone on the GDP, trade, and output of the BRICS member countries and other countries in the world.

The content of the article is divided into five sections. The rest of the paper is organized as follows. In Section II, I will do a literature review, systematically collating relevant literature on BRICS cooperation, and summarizing the research viewpoints on the BRICS economic and trade relations cooperation mechanism and the establishment of the BRICS free trade zone. Section III is an introduction to the methodology, which will systematically explain data sources and application models, and will conduct scenario simulations to reflect more realistic trade conditions.

Section IV is an empirical study. Through the construction of two scenarios of zero tariff and retention of tariffs in special sectors, the GTAP-E model is used to simulate and analyze the expected economic effects of the BRICS Free Trade Area after the completion, which mainly includes economic indicators and the change of departmental output. Section V is the conclusion, based on the previous research results, the research conclusion drawn aiming to provide data analysis for the establishment of the free trade zone.

2. Literature review

In the context of the slow progress of the WTO's multilateral trading system due to the hindrance of the Doha Round of negotiations, regional trade agreements have become the mainstream choice for countries to seek their own development and increase their influence. In order to consolidate their leading positions in the international economic and trade fields, developed countries such as the United States and Europe have adopted high-standard international economic and trade rules by advancing the construction of free trade zones, thereby gaining leadership in the new round of reshaping of international economic and trade rules. Trans-Pacific Partnership Agreement (TPP), Trans-Atlantic Trade and Investment Partnership Agreement (TTIP), International Trade in Services Agreement (TISA), Enlarged Alliance Comprehensive Economic and Trade Agreement (CETA), Japan-EU Mega Economic Cooperation Agreement (EPA) These are the results of developed economies reshaping the international economic and trade rules of the 21st century. The BRICS countries have a common foundation of interests and need to obtain more economic development opportunities and the right to dialogue with developed countries

through cooperation.

Since the concept of the BRICS countries was first proposed in 2001, they have gradually developed into a cooperation mechanism with a pragmatic trend. At present, they still lack a substantive economic cooperation basis to strengthen their relations. The establishment of a free trade zone for the BRICS countries is one of the important ways to carry out pragmatic cooperation, and it is also a goal for further consideration by the BRICS countries in strengthening open cooperation. The establishment of the BRICS Free Trade Zone will not only promote the growth of trade and investment among BRICS countries, but also help enhance the voice of developing countries in global economic affairs. Therefore, considering the establishment of a free trade zone in the BRICS countries is of great significance to the in-depth and long-term cooperation of the BRICS countries, and can be used as an idea for the future. Based on the analysis of the opportunities and challenges faced by the BRICS Free Trade Area, this paper uses the GTAP-E model to simulate the expected economic effects of the BRICS Free Trade Area beforehand.

Li Chunding (2013) believes that China and other BRICS countries have significant mutual trade complementarity, and the difference in the industrial structure determines that the BRICS countries have greater potential for trade. Zhang Xiaomei and Wang Chun (2017) From the national level and industry We explored the trade competitiveness and complementarity of BRICS countries at different levels, and the results showed that there is general trade complementarity between BRICS countries at the national and industrial levels. Although there is also certain trade competition, the industrial division of labor with complementary advantages constitutes a pattern. Establish the foundation of the BRICS free trade zone. Kocourck (2015) studied the structural changes in the economies of the BRICS countries in the past two decades, and analyzed the comparative advantages and disadvantages of the five countries and their long-term changes. Production of more complex products is constantly changing. Javeria Maryam and Umer Jeelanie Banday et al. (2018) investigated the trade profile of the BRICS countries at the global level and within the group. The research results show that Brazil and Russia have comparative advantages in natural resource products. India and China have comparative advantages in manufacturing and processing products: the export similarity index shows that India and China compete in the EU market. The author proposes that the BRICS countries should strengthen cooperation and promote the transformation of product structure to promote internal trade and obtain trade benefits. Wenjing Yin (2014) analyzed the characteristics of agricultural product trade in BRICS countries from multiple aspects. Research shows that BRICS countries export different agricultural products in the same market, so there is no real competition in the agricultural product market. Compared with other BRIC countries, China and India have higher similarities in agricultural trade.

The existing literature research methods focus on the GTAP-E model, and simulate the economic effects of establishing the BRIC free trade area through scenario assumptions. Liu Wenge and Wang Wenxiao (2014) used the GTAP model to simulate and analyze the economic effects of the BRIC countries after the establishment of the free trade zone based on the feasibility analysis of the establishment of the BRICS free trade zone. The overall economic level, trade scale, welfare, etc. have been improved, which is in the long-term interests of the BRIC countries, but it will also have an impact on the comparatively disadvantaged industries of the countries. Zhou Yuancheng (2015) based on the GTAP-E general equilibrium simulation. The results show that the establishment of the BRICS free trade zone has positive effects on the social welfare level, GDP, and import and export scales of all countries. He believes that China should promote the BRICS free trade zone in stages. strategy. Wang Shaomei and Qu Delong (2015) conducted an analysis of the economic effects of the BRICS free trade zone in GTAP. The results of the analysis concluded that the establishment of the BRICS free trade zone will increase overall welfare, and increase the scale of trade. The domestic industry sectors have benefited the most from India and Brazil. Li Dandan(2018) discussed the expected economic effects of the establishment of free trade zones in the BRIC countries from the perspective of global value chains. The status in the value chain is different, so there is extensive trade complementarity between each other, comprehensively reducing tariffs, removing technical trade barriers, and retaining exceptions. The GTAP-E simulation results show that the establishment of a free trade zone will contribute to the growth and welfare of the BRICS countries GDP. The improvement of trade conditions and the improvement of trade conditions have a significant positive effect, but we must also pay attention to supporting industries that lack competitive advantages and improving the technical content of products.

3. Methodology

The establishment of a free trade zone in the BRICS countries is both necessary and facing challenges. The BRICS countries have internal development needs and opportunities for external efforts to strive for common interests, but the challenges are difficult to coordinate and solve in a short period of time. However, in the long run, building a free trade zone is a pragmatic way of cooperation for the BRICS countries to further deepen the BRICS partnership. Then the expected economic effects brought about by the BRICS Free Trade Zone and the potential impact on the macroeconomic and industrial sectors of the BRICS and other economies in the world are issues that this article needs to explore. This article will use the GTAP-E model to simulate the expected economic effects of the BRICS

Free Trade Zone after its completion.

The full name of the GTAP model is the Global Trade Analysis Project (Global Trade Analysis Project). It is a multi-country and multi-sector general equilibrium model (Computable General Equilibrium, CGE) designed and developed by Thomas W. Hertel, a professor at Purdue University in the United States. The GTAP-E model is based on a new comparative static model designed by classical economic theory. The model assumes that the market is completely competitive, the return to scale of production remains unchanged, producers minimize production costs, consumers maximize utility, and the market for all products and input factors is clear. In the GTAP-E model framework, firstly establish a sub-model that can describe the production, consumption, government expenditure, and other behaviors of each country (or region) in detail, and then connect the sub-models into a multi-country and multi-sector through the relationship of international commodity trade "General equilibrium model". At present, the GTAP-E model has been widely used in the quantitative analysis of trade policies, which can effectively evaluate the impact of the trade policy on the macroeconomics, industrial sector production, and social welfare levels of various countries. The data in this article will be GTAP 10.0 database based on 2014.

4. GTAP-E Simulation Analysis

This part will introduce the classification of countries and departments, and the specific division of the two scenarios, and will show the results of estimation and corresponding analysis.

4.1 Total processing of regions and departments

The GTAP 10.0 database selected in this article is based on 2014, and includes 141 countries or regions, and 65 product sectors. Because this article studies the expected economic effects of the BRICS Free Trade Area, 141 countries or regions are divided into 10 major countries and regions, specifically, Brazil, Russia, India, China, South Africa, the United States, the United Kingdom, and the 27 EU countries, Japan, South Korea and other countries in the world. At the same time, according to the commodity classification system of HS code and the industrial characteristics of BRICS countries, 65 industry sectors in the database are integrated into 5 main product groups, as shown in Table 1.

Code	Sector	Detailed product composition
1	Agriculture	Paddy rice, Wheat, Cereal grains nec, Vegetables, fruit, nuts, Oil seeds, Sugar cane, sugar beet, Plant-based fibers, Crops nec, Bovine cattle, sheep and goats, horses, Animal products nec, Raw milk, Wool, silk-worm cocoons, Forestry, Fishing
2	Processed food	Bovine meat products, Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar, Food products nec, Beverages and tobacco products
3	Manufacturing	Textiles, Wearing apparel, Leather products, Wood products, Metal products, Motor vehicles and parts, Transport equipment nec, Electronic equipment, Machinery and equipment nec, Manufactures nec
4	Energy intensive	Coal, Oil, Gas, Minerals nec, Paper products, publishing, Petroleum, coal products, Chemical, rubber, plastic products, Mineral products nec, Ferrous metals, Metals nec
5	Services	Electricity, Gas manufacture, distribution, Water, Construction, Trade, Transport nec, Water transport, Air transport, Communication, Financial services nec, Insurance, Business services nec, Recreational and other services, Public Administration, Defense, Education, Health, Dwellings

Table 1: Product Departments Grouping

4.2 Policy simulation scenarios

After the BRICS free trade agreement is reached, the members will significantly reduce tariffs. The BRICS countries are all developing countries, in which similar economic development levels and industrial structures make the BRICS countries have competition. Therefore, it is unrealistic to completely abolish tariffs, so zero tariffs are only used as a simulation scenario under ideal conditions. According to the tariff status of imported products in various countries and the competitiveness of various industries in the BRICS countries announced on the WTO website, this article reserves the exceptions for each of the BRICS countries. They are Brazilian agricultural products, Russian manufacturing, Indian agricultural products, Chinese mineral products, and South African processed food and manufacturing industries, in which the tariff policies are different. The specific program settings are as follows:

Scenario 1: Brazil, Russia, India, China, and South Africa completely cancel their import tariffs on trade in goods with each other, that is, tariffs are reduced to 0.

Scenario 2: Brazil, Russia, India, China, and South Africa each retain sensitive industries. Import tariffs on sensitive industries will be reduced by 50%, and import tariffs on trade of other goods except for sensitive industries will be completely canceled.

4.3 Analysis of simulation results

4.3.1 Macroeconomic effects (GDP, welfare, trade scale, terms of trade)

	GDP growth rate (%)		Welfare changes (million)		Terms of trade (%)	
	Scenario 1	**Scenario 2**	**Scenario 1**	**Scenario 2**	**Scenario 1**	**Scenario 2**
BRA	0.53	0.28	1,765.55	3277.8	0.45	0.29
RUS	-0.18	-0.28	3,133.86	1673.5	-0.06	0.1
IND	-0.2	-0.47	2,521.65	-1573.34	-0.25	-0.37
CHN	0.47	0.51	7,070.89	16719.87	0.37	0.39
SAF	0.53	0.6	1,086.26	1110.94	0.42	0.47
USA	-0.07	-0.11	-1,511.12	-2654.17	-0.06	-0.09
UK	-0.09	-0.12	-390.16	-622.95	-0.04	-0.05
EU-27	-0.11	-0.08	-2,519.30	-1296.79	-0.04	-0.07
JPK	-0.05	-0.13	-629.57	-3627.43	-0.06	-0.08
Rest of World	-0.12	-0.14	-3,268.50	-5765.28	-0.07	-0.08

Table 2 : Changes in macroeconomic indicators after the establishment of the BRICS Free Trade Zone

It can be seen from Table 2 that the establishment of the BRICS free trade zone will bring positive effects to the overall economic development of the BRICS countries, especially China, Brazil and South Africa will benefit the most, while other economies outside the BRICS countries will be negatively affected to a certain extent. In terms of economic growth, the GDP of the BRICS countries has grown significantly in Brazil, China, and South Africa. Under the ideal state of completely abolishing tariffs, the growth rates are 0.53%, 0.47%, and 0.53%, respectively, and the growth rates are respectively when the exception industries are retained. 0.28%, 0.51%, and 0.60%. On the contrary, India and Russia's GDP fell, especially when the exception industries are retained, Russia and India's GDP fell by 0.28% and 0.47%, even more than other non-BRICS economies. Outside the region, the other non-BRICS countries in the world will suffer an even greater impact when the exception industries are retained, at about 12%. This differential change is mainly related to the economic and trade development status of the BRICS countries. In terms of social welfare, the EV of social welfare in Brazil, China, and South Africa has all increased significantly. China's growth is particularly significant, nearly three times the total growth of other BRICS countries, which is about 16.72 billion US dollars. India has the least growth in social welfare, respectively, which is US$2.52 billion under the completely tariff-free scenario and US$1.57 billion decrease under the scenario of retaining some tariffs on sensitive industries. At the same time, the data also shows that while implementing the policy of retaining some tariffs on sensitive industries, Russia and India still need to bear the negative impact of reduced social welfare, and other economies outside the region, especially the 27 EU countries, will therefore reduce their own potential losses. Therefore, no matter what, the construction of a free trade zone will bring welfare growth effects to some member countries. In terms of trade, similar to GDP growth, Russia, China, Brazil, and South Africa have improved, while the terms of trade of India have deteriorated, which have dropped by about 0.37%, far exceeding the negative impact of other economies outside the region. Other economies outside the region have been affected to varying degrees, and the terms of trade have deteriorated to varying degrees, especially when the exception industries are retained. The terms of trade usually reflect the economic benefits of a country's foreign trade by using the ratio of the periodical export price index to the import price index, which is generally affected by factors such as import and export commodity demand, market organization, industrial structure, and exchange rate. Russia has long been over-reliant on the resource industry, especially the energy industry. Mineral products, including fossil fuels and mineral oil, are the main export products from Russia. According to the National Report of the Ministry of Commerce, the export value of Russian mineral products in 2018 was 241.96 billion U.S. dollars, accounting for 62.7% of the total export products of Russia. After the establishment of the BRICS free trade zone, the output scale of Russia's resource industries has further increased, and the pricing power of international bulk commodities is controlled by developed countries, which puts developing countries in a passive position in the production and consumption of oil and other bulk commodities. In addition, Fluctuations in the exchange rate of the U.S. dollar will also have an impact on the market value of commodities. Therefore, the deterioration of Russia terms of trade is due to a single industrial structure with primary products as an important export commodity, while the deterioration of India terms of trade is due to multiple industrial sectors including agriculture, resource industries, and processing industries, and the financial sector. The other member states of the brick have created competition.

	Changes in imports (%)		Changes in exports (%)		Trade balance (million)	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
BRA	3.59	4.02	1.63	2.63	24,230.95	24,369.86
RUS	2.37	1.9	1.61	1.07	106,070.53	142,579.44
IND	2.7	3.4	2.81	2.96	-59,161.80	-58,949.94
CHN	1.31	1.19	1.13	0.86	345,838.75	508,763.75

SAF	4.33	3.58	2.48	2.03	-5,398.76	-4,848.37
USA	-0.16	-0.25	-0.14	-0.03	-828,907.25	-605,774.62
UK	-0.13	-0.16	-0.1	-0.05	-116,880.88	-141,532.12
EU-27	-0.14	-0.18	-0.12	-0.09	-4,081.00	-4,865.00
JPK	-0.14	-0.17	-0.08	-0.1	120,767.62	120,420.50
Rest of World	-0.15	-0.19	-0.12	-0.11	417,522.25	417,299.50

Table 3: Trade changes after the establishment of the BRICS Free Trade Zone

Table 3 presents the changes in the scale of trade between the BRICS countries and other economies in the two scenarios. Due to the trade creation effect and the trade transfer effect, the establishment of the BRICS free trade area has a significant role in promoting the import and export trade of member countries. The import and export trade of countries outside the zone has been negatively affected to varying degrees. In the second scenario where certain exception industries are retained, the import scale of Brazil, India, and South Africa has increased by 4.02%, 3.40%, and 3.58% respectively, of which the exports of Brazil, India, and South Africa have also grown at an amazing rate, increasing by 2.63%, 2.96%, and 2.03% respectively. From the perspective of trade balance, the sharp reduction of tariff barriers has significantly increased the import trade of the BRIC countries, and the growth rate of exports is generally higher than that of imports, except for India and South Africa. rate. Therefore, in both scenarios, the BRIC countries, except India and South Africa, are in a state of trade surplus. In particular, China, as the world's largest exporting economy, has a trade surplus that is 4.93 times the total trade surplus of the other two countries. But it is also worth noting that although Russia and China can still maintain export surplus when the exception industries are retained, their export and import levels have been weakened to a certain extent compared to the complete abolition of import tariffs. This also further proves that industrial protection tariffs are more in line with the actual interests of all BRICS countries and more in line with reality.

4.3.2 Industrial sector impact

In order to examine the impact of the establishment of the BRICS Free Trade Zone on the industrial sectors of various countries, this chapter selects the simulation results of scenario 2 where the tariffs of the exception sectors are retained for analysis, and strives to make the results closer to reality.

	BRA	RUS	IND	CHN	SAF	USA	UK	EU-27	JPK	Rest of World
Agriculture	3.32	0.76	1.70	1.97	3.51	(0.15)	(0.14)	(0.16)	(0.02)	(0.26)
Processed food	3.70	6.45	6.91	1.61	2.59	(0.14)	(0.13)	(0.16)	(0.14)	(0.22)
Manufacturing	9.85	2.67	10.46	1.31	4.16	(0.36)	(0.19)	(0.18)	(0.34)	(0.19)
Coal	(0.01)	(0.13)	(0.48)	1.34	1.90	(0.15)	(0.13)	(0.16)	(0.07)	(0.19)
Oil	0.59	0.09	(0.17)	0.43	0.38	(0.13)	(0.12)	(0.11)	(0.05)	(0.10)
Gas	0.66	0.18	(0.72)	0.59	2.02	(0.12)	(0.13)	(0.16)	(0.07)	(0.18)
Oil Products	0.11	0.12	(0.33)	0.51	0.81	(0.11)	(0.11)	(0.12)	(0.07)	(0.14)
Electricity	0.76	(0.01)	(0.40)	0.95	2.00	(0.11)	(0.12)	(0.15)	(0.12)	(0.23)
Energy intensive	3.70	2.09	4.20	1.37	3.39	(0.16)	(0.14)	(0.16)	(0.13)	(0.19)
Services	0.73	0.10	(0.21)	0.94	1.67	(0.21)	(0.17)	(0.17)	(0.14)	(0.21)

Table 4: Changes in imports by industry (%)

First, we will analyze the changes in the total imports of various countries in different sectors after retaining some industrial tariffs. According to Table 4, we can see that in terms of imports, the scale of imports of various industrial sectors in the BRICS countries, especially in 5 main sectors, which are agriculture, processed food, manufacturing, energy-intensive, and services sectors, has shown an increasing trend, while the scale of imports of various industrial sectors in non-BRICS countries has decreased. Among them, for the agricultural sector, Brazil and South Africa have seen significant growth, with a growth rate of 3.3%-3.5%, similar to the manufacturing sector; the processed food industry is dominated by Russia and India, and growth rate of India is 2-3 times that of other countries; the processed industry in Brazil, India, and South Africa has also been developed because of trade in the free trade zone; the growth rate of energy-intensive industries is relatively higher between India and Brazil, 4.20% and 3.70% respectively; the growth rate of the service industry sector has benefited less but more balanced than other sectors. There are advantages to different industries among members in the free trade zone. On the one hand, they are affected by the country's policies on the protection of sensitive industries. On the other hand, it is also related to the original industrial structure of the BRICS countries and the initial development level of each industry. At the same time, it should be noted that in terms of major energy sources such as coal, oil, and gas, the BRIC countries generally increased their imports due to price advantages. Only India has reduced related energy imports. On the one hand, the Indian energy structure is relatively single, and on the other hand, Indian energy imports are at a relatively low level, and import demand does not respond strongly to price advantages. However, all the industries sectors get loss to varying degrees among the non-BRICS countries.

	BRA	RUS	IND	CHN	SAF	USA	UK	EU-27	JPK	Rest of World
Agriculture	3.28	1.66	1.34	1.84	5.93	(0.17)	(0.11)	(0.09)	(0.36)	(0.19)
Processed food	10.50	6.67	2.21	(2.33)	(0.63)	(0.14)	(0.23)	(0.28)	(0.30)	(0.55)
Manufacturing	3.37	4.98	6.97	1.12	0.36	(0.06)	(0.15)	(0.17)	(0.09)	(0.08)
Coal	(1.05)	0.50	0.17	(2.33)	(2.52)	(0.01)	0.01	0.01	(0.13)	0.40
Oil	(1.07)	(0.10)	0.22	(1.55)	(1.77)	0.06	0.02	0.02	(0.09)	0.02
Gas	(3.89)	(0.30)	0.42	(4.86)	(8.18)	(0.25)	(0.20)	(0.11)	(0.42)	(0.01)
Oil Products	(0.45)	(0.09)	0.90	(0.51)	(0.46)	(0.06)	(0.07)	(0.11)	0.07	(0.02)
Electricity	(1.49)	0.11	0.38	(1.62)	(2.89)	0.12	0.13	(0.03)	0.19	0.13
Energy intensive	0.83	4.03	4.15	3.18	4.58	(0.18)	(0.26)	(0.30)	(0.18)	(0.57)
Services	(1.32)	0.31	0.40	(1.55)	(2.41)	0.17	0.16	0.19	0.19	0.25

Table 5 Changes in exports by industry (%)

At the same time, the total export volume of various countries in different sectors will also change. According to Table 5, we can see that in terms of exports, after the establishment of the free trade zone, most of the export scale of the BRICS countries' industry has increased. Combined with the expectation of establishing a free trade zone, the industries with the highest export growth rates in different countries are not the same. Brazil exports in agriculture and food processing industries have grown significantly, especially the food processing industry growth rate as high as 10.50%. Russia has a significant advantage in the food processing industry and handicraft industry, with a growth rate of about 5%-6.7%. Indian major industrial sectors have achieved export growth, especially energy-intensive industries, and major energy exports relying on price advantages to grow, and the growth of handicraft exports surpassed other BRIC countries at 6.97%. The concentration of energy-intensive industries in China has reduced the export of major energy sources, but energy-intensive industries have increased due to the increase in product exports, and the export of food processing industries has decreased due to the lack of price advantages. South African agricultural and energy-intensive industries' export growth is the first among the BRIC countries. The export advantages of the service industry are reflected in Russia and India. Except for the food processing industry in South Africa, most of the growth in exports of these BRIC countries has benefited from industrial protection policies and the price advantages of different industries in each country. The food processing industry in South Africa may have reduced potential losses to a certain extent due to industrial protection policies. The advantages of other countries outside the BRICS Free Trade Zone are more reflected in the export of major energy sources, such as oil from the United States, electricity from the United Kingdom, Japan, and South Korea, coal from other countries, and exports of service industries from all non-BRICS countries. Although the tariffs on service exports of the BRICS countries have been completely abolished, the exports of service products in the BRICS countries have all received an impact, and the exports of service products in economies outside the BRICS free trade zone have increased.

From the perspective of the changes in the import and export of the industrial sectors of the BRICS countries, the establishment of the BRICS free trade zone has a strong trade creation effect and trade transfer effect. On the whole, the scale of import and export of most industries in the BRIC countries has shown an upward trend after the establishment of the free trade zone, while the scale of imports and exports of all industries in other economies outside the zone has declined to a different extent. In addition, the establishment of the BRIC free trade zone has made the BRICS countries have achieved more specialized products on the basis of their respective comparative advantages, thereby improving production efficiency.

	BRA	RUS	IND	CHN	SAF	USA	UK	EU-27	JPK	Rest of World
Agriculture	1.05	(0.07)	(0.14)	(0.14)	0.97	(0.01)	0.01	0.01	0.02	(0.02)
Processed food	1.24	(0.37)	(0.24)	-	(0.26)	(0.01)	(0.02)	(0.05)	(0.02)	(0.07)
Manufacturing	(1.98)	(1.11)	0.09	0.11	(2.20)	0.08	0.04	-	0.08	0.13
Coal	(0.60)	0.46	(0.14)	(0.12)	(0.98)	0.01	0.01	0.02	(0.03)	0.03
Oil	(0.16)	0.05	0.07	(0.34)	(0.54)	0.02	0.04	0.04	0.01	0.06
Gas	(0.68)	0.13	(0.30)	(0.72)	(1.31)	(0.02)	-	(0.11)	0.03	0.05
Oil Products	0.12	0.12	(0.08)	0.22	0.44	(0.02)	(0.02)	0.02	(0.05)	(0.02)
Electricity	(0.12)	0.13	(0.22)	0.07	0.11	-	(0.01)	(0.02)	0.01	(0.03)
Energy intensive	(0.63)	0.71	(0.88)	0.14	1.17	0.03	(0.05)	0.02	(0.11)	(0.15)
Services	0.11	0.06	0.14	(0.01)	0.07	(0.01)	-	0.01	(0.01)	-

Table 6 Changes in output by industry (%)

The establishment of the BRICS free trade zone will have a certain impact on the output of various sectors of these countries. Tables 6 shows that after the significant reduction in tariffs, the market mechanism will re-allocate the production resources in the region, so that each production sector will optimize and adjust in the direction of giving full play to their respective comparative advantages, thereby improving their production efficiency. We have implemented a tariff reduction policy for agricultural products in Brazil, manufacturing industries in Russia,

agricultural products in India, mineral products in China, and processed food and manufacturing industries in South Africa. Although these exceptional sectors have also been affected to varying degrees and reduced total output, the policy of halving tariffs has protected these industries, thereby reducing the losses in these industries. From the perspective of the agricultural sector, the agricultural output in Brazil is relatively developed, and their competitiveness of agricultural products is extremely strong compared to all the other countries. The output of its agricultural sector is showing positive growth. Brazil also has an advantage in the competition of the food processing industry. In the non-agricultural sector, China's manufacturing industry has the fastest growth. South Africa has abundant metal mineral resources, and its energy-intensive industries have significant comparative advantages among the five BRIC countries. India is good at exporting service products compared to all the other countries in the world. It can be seen that, due to the implementation of industrial protection policies, the BRICS countries have industries with relative competitive advantages, and at the same time, the potential losses of industries without comparable advantages are reduced. The implementation of protection policies is not only feasible, but also brings more benefits and fewer losses to the BRICS countries.

5. Conclusion

This article uses the GTAP model to analyze the expected economic effects of the establishment of the BRICS free trade zone, including macroeconomic effects and changes in sector output. Based on the above empirical analysis results, the following conclusions are drawn:

First. The BRIC countries have the economic foundation to establish a free trade zone. After the establishment of the free trade zone, the overall economic level of the BRIC countries will be improved. In both cases, the GDP of the BRICS countries has grown significantly in Brazil, China, and South Africa. Outside the region, the EU and other countries in the world will suffer an even greater impact when they are completely free of tariffs and retain some tariffs, at about 10%. The social welfare level of all member states has been effectively improved, which shows that further deepening the economic and trade cooperation of the BRICS countries is a beneficial measure for the members as a whole. In addition, the macroeconomic effect of the complete removal of tariff barriers is slightly higher than that of retaining special industries.

Second, reducing tariff barriers can promote the growth of the import and export trade of the BRICS countries, and the establishment of free trade zones can fully explore the trade potential of the BRICS countries. In both the zero-tariff and the retention of special sectors, the import and export values of the BRICS countries have increased significantly. At the same time, the establishment of the BRICS Free Trade Area has also improved the terms of trade between China, Brazil, and South Africa, but the terms of trade between Russia and India have slightly deteriorated. The terms of trade are usually used to reflect the economic benefits of a country's foreign trade. The main reason for the deterioration of Russia's terms of trade is a single industrial structure with primary products as the main export commodities. India is due to multiple industrial sectors and other BRICS member states. The impact of fierce competition on the demand and prices of various industrial sectors has changed India's trade conditions.

Third, the establishment of the BRICS free trade zone has brought different impacts on different industries of each member country. The resource integration of industrial sectors can improve the production efficiency of the BRICS countries. At the same time, a substantial reduction in tariff barriers will also have an impact on the relatively disadvantaged industries of the BRIC countries, and reduce the output of these industries. Therefore, the construction of the BRICS Free Trade Zone has further deepened the division of labor among the BRICS countries, generally providing Brazil with agricultural products, Russia and India with mineral resources, China and India with light industrial products, and South Africa with metal products, etc. However, developing countries are restricted by the level of economic development and it is difficult to form a complete industrial chain. In the long run, the upgrading of the industrial structure of the BRICS countries is a BRICS free trade zone. An important guarantee for in-depth development.

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