

# Study on the Systematic Dynamic Simulation of High-Quality Development of Foreign Trade and Jiangsu Economic Growth

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**Abstract**— In recent years, China's foreign trade has been facing a complex situation at home and abroad. Although Jiangsu's foreign trade is on a steady growth trend, there are still many problems. It is imperative to further explore the high-quality development of foreign trade to promote Jiangsu's economic growth. Combined with the background of foreign trade at home and abroad, the system dynamics model of high-quality foreign trade and Jiangsu economic growth is established around the three factors: economic development, supply and demand, and input. Then simulates and analyses it. According to the results, the path of high quality development of Jiangsu's foreign trade is proposed to promote it healthy development.

**Keywords**— High-quality of foreign trade; Economic growth; System dynamics; Path research.

## I. INTRODUCTION

The current international and domestic environment is facing a complex and changeable situation. Regional differentiation and business differentiation caused by industrial divergence among countries are becoming more and more serious. Global inflation situation is not optimistic. The game between major countries, especially the intensification of trade friction between China and the United States. The impact of the COVID-19 pandemic has led to the global economic recession, the instability and uncertainty of the world economic development gradually deepened. At the present stage, China's demographic dividend is disappearing, the population aging is prominent, the economic development is facing the problem of limited labor input, the foreign exchange reserves are too high, which affect the independence of monetary policy and aggravate the pressure of inflation, leading to the imbalance of the structure of economic growth. As a coastal province in the east of China, Jiangsu has a superior geographical position, high per capita consumption level, developed economy and rapid technological development level. Its foreign trade occupies an important position in the country's foreign trade. The steady economic development of Jiangsu in recent decades cannot be separated from the high quality development of foreign trade. However, there are still many unstable and uncertain factors in the development of Jiangsu foreign trade. Therefore, it is of great practical significance to further enhance the high quality development level of foreign trade and promote the economic growth of Jiangsu. By constructing a system dynamic model of high quality foreign trade and economic growth of Jiangsu, the dynamic simulation of high quality development of foreign trade promoting Jiangsu's economic growth is carried out, then the high quality development path of foreign trade in Jiangsu is proposed.

## II. SYSTEM DYNAMICS MODEL CONSTRUCTION

### *Subsystem analysis*

The key to analyze the problem using system dynamics is to formulate the causal relationship between related variables. The main factors affecting the high-quality development of Jiangsu foreign trade are economic development, supply and demand, and input. Therefore, it is divided into three interrelated subsystems, namely, economic development subsystem, supply and demand subsystem, and input subsystem. Economic development subsystem is represented by Jiangsu GDP. In the supply and demand subsystem, supply is measured by export volume, commodity structure and trade mode as the main factors, which represented by high-tech products and general trade. And import volume as the demand index. The input subsystem is divided into foreign capital input, R&D fund input and R&D personnel input.

### *Model building*

Based on the relevant data of Jiangsu foreign trade from 2014 to 2021, the system dynamics model was constructed. The simulation time span of different schemes is set from 2022 to 2035 with a time interval of 1 year to analyze the simulation results of the dynamic mechanism of high-quality development of Jiangsu foreign trade. The data are from Jiangsu Statistical Yearbook, China Statistical Yearbook over the years. The system dynamics model is shown in Figure 1.

### *Model testing*

#### *1. Intuitive test*

The intuitive test refers to judge whether the index selection of the model is reasonable, whether the causal relationship is correct, and whether the choice of the equation is reasonable through the relevant theoretical data. The data sources of this paper are reliable. The system construction refers to the academic viewpoint, and makes an objective analysis and detailed demonstration in the modeling process. The "Check

Model" test in Vensim software is also passed, so the model intuition test is passed.

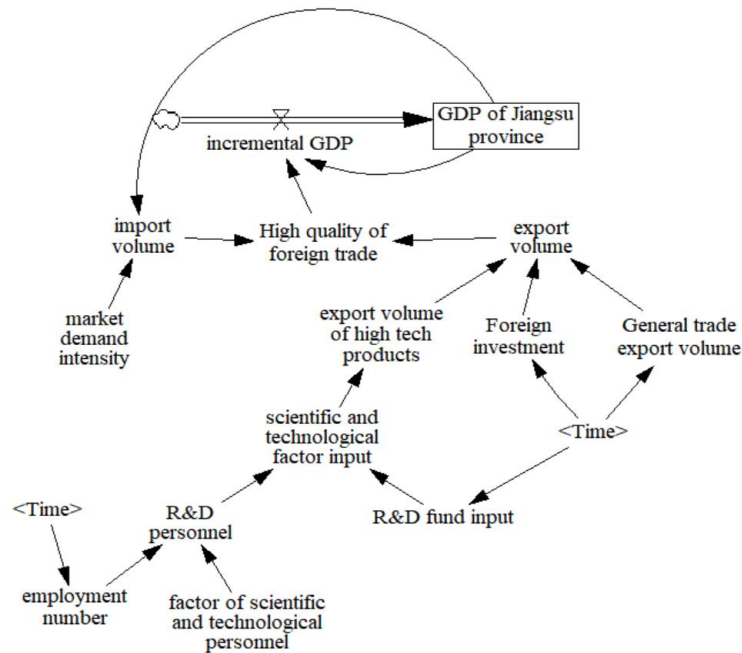


Figure 1. Flowchart of system dynamics of the high quality of foreign trade and the economic growth in Jiangsu province.

TABLE 1. Comparison of the simulation results with the actual values.

Year	2014	2015	2016	2017	2018	2019	2020	2021
Actual value	6.48	7.13	7.34	8.59	9.32	9.87	10.28	11.64
Predicted value	6.44	7.41	8.02	8.55	9.25	10.02	10.75	11.27
Error	0.006	0.039	0.093	0.005	0.008	0.015	0.046	0.032

## 2. Validity test

The validity test means that the smaller the error between the simulated value and the actual value of the model, the better the model can reflect the research problem. Generally, the error between the simulated and the actual value of the model is required to be controlled within 10%."GDP of Jiangsu Province" is selected as the test variable. The simulated values and the real values are shown in Table 1. The errors are within 10%, indicating that the model is valid and can be simulated.

## III. MODEL SIMULATION AND ANALYSIS

### A. Simulation scheme design

The high quality of foreign trade and the economic growth of Jiangsu are a system in which each dynamic element is interconnected and mutually checked. It can change the constants in the model to observe the operation of the whole system. It also can provide data reference for analyzing the operation of the dynamic system and provide a path for the high-quality development of Jiangsu's foreign trade. The market demand intensity is an important indicators to measure import. Only when the market demand is high, the relevant enterprises will increase the import of products. The scientific and technological personnel factor is also important to the output of science and technology products. When the coefficient of scientific and technological personnel factor is

large, more people are engaged in R&D activities in the employed population, which will bring more benefits to the high-tech industry. As a result, it promotes the development of high-tech industry, and then promotes the growth of export volume and makes the foreign trade develop with high quality. Therefore, in this paper, the model is analyzed by changing the intensity of the domestic market demand and the factor of scientific and technological personnel. According to the relevant literature and the current situation of Jiangsu's foreign trade, the following four schemes are designed:

(1) This scheme is the baseline scheme, which sets parameters to predict the export volume, import volume and the GDP of Jiangsu Province from 2022 to 2035 according to its foreign trade development.

(2) This scheme is a single factor change scheme. On the basis of the baseline scheme, the market demand intensity is increased by 0.08, and the export volume, import volume and GDP of Jiangsu province from 2022 to 2035 are predicted.

(3) This scheme is a single factor change scheme. On the basis of the baseline scheme, the factor of scientific and technological personnel is increased by 0.02, and the export volume, import volume and GDP of Jiangsu province from 2022 to 2035 are predicted.

(4) This scheme is a combination scheme. On the basis of the baseline scheme, the market demand intensity is increased by 0.08, the factor of scientific and technological personnel is

increased by 0.02, and export volume, import volume and GDP of Jiangsu province from 2022 to 2035 are predicted.

**B. Analysis of simulation result**

According to the scheme design, Figures 2 to 5 below show the simulation prediction results of export volume, import volume, export volume of high-tech products and GDP of Jiangsu Province under the four scheme designs.

It can be seen from the single factor change scheme that the market demand intensity has an impact on the import volume but has little impact on the export volume. When the intensity of market demand increases, it will promote the increase of import volume and the high quality development of foreign trade, and then increase the GDP of Jiangsu Province. The scientific and technological personnel factor has an impact on export volume, import volume and GDP. The improvement of scientific and technological personnel factor means the increase of personnel engaged in the field of science and technology, promotes the innovation and development of science and technology industry, drives the export of high-tech products, enhances the export volume and the quality of foreign trade, and then brings effect to the GDP of Jiangsu Province.

Comparing the two single-factor schemes, it is found that the impact brought by the scientific and technological personnel factor on foreign trade is greater than the impact brought by the intensity of market demand. The increase of scientific and technological personnel factor leads to the increase of scientific and technological factor input, which reflects the impact of foreign trade from the supply side and the effect of the optimization of commodity structure on the high-quality development of foreign trade. The impact of market demand intensity on foreign trade is weak. With the great development of social economy and the improvement of people's consumption level, they pursuit of higher quality products, so as to promote the transformation and upgrading of foreign trade structure and meet the domestic market demand. It can be seen from the combination scheme that the simultaneous increase of market demand intensity and scientific and technological personnel factor is more likely to have an impact on the high-quality development of foreign trade. Therefore, unilateral factors have certain limitations and should promote the multi-level and multi-faceted development of foreign trade.

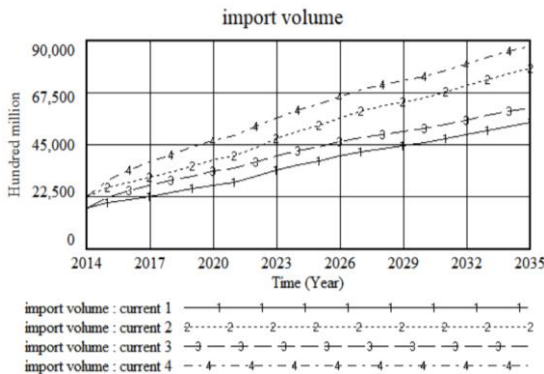


Figure 2. Simulation result of export volume.

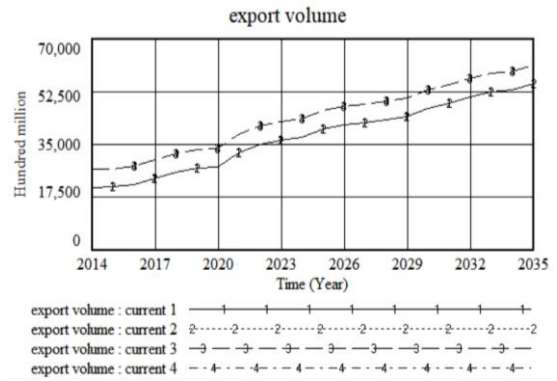


Figure 3. Simulation result of import volume.

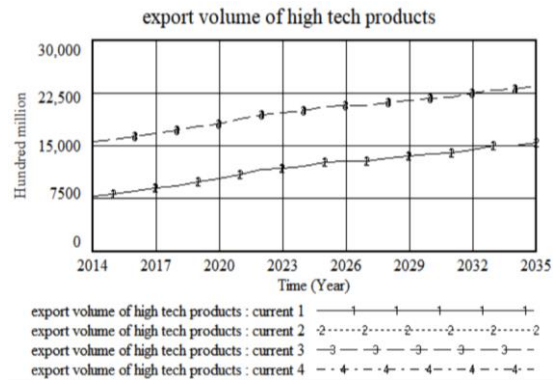


Figure 4. Simulation result of export volume of high-tech products

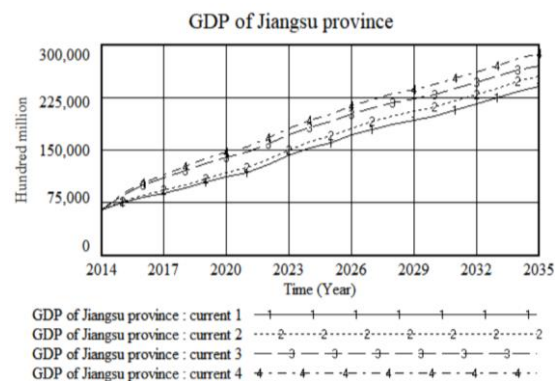


Figure 5. Simulation result of GDP of Jiangsu province.

**IV. JIANGSU FOREIGN TRADE HIGH-QUALITY DEVELOPMENT PATH EXPLORATION**

**A. Promote supply-side structural reform, emancipate and developing productive forces**

Although Jiangsu's foreign trade development is among the top three in China, there are still problems such as insufficient supply in the middle and high end and excess capacity in the low end. Therefore, the high-quality development of foreign trade should be promoted through supply-side structural reform and focusing on the emancipation and development of productive forces. The specific measures are: firstly, in production, Jiangsu should correct the distortion of factor allocation, expand the effective supply, improve the total factor productivity, and improve the adaptability and flexibility of the supply structure to the change of demand. Secondly, in the factor input, Jiangsu should vigorously

eliminate the ineffective supply and promote the reduction of excess capacity. Thirdly, scientific and technological innovation should be emphasized to promote the optimization of traditional industrial structure, and increase the investment in the research and development of core technology products. Fourthly, Jiangsu should vigorously reduce the cost of the real economy and the institutional transaction.

*B. Improve the ability of scientific and technological innovation, increase the competitive advantage of products*

The key to the high-quality development of foreign trade is innovation ability. In recent years, R&D activities in Jiangsu have been at the forefront of the country, but there are still problems such as weak innovation ability and fewer large enterprises. For the government, it should increase the investment in high-tech industries, introduce high-end talents and create a good innovation atmosphere and environment for enterprises. It also should protect intellectual property rights and improve relevant systems, laws and regulations. For enterprises, they should always pay attention to the trend of technological innovation in the world, actively introduce foreign cutting-edge technology, attach importance to the investment and research of science and technology, and enhance the ability of independent innovation. In the meanwhile, enterprises strengthen the construction of talent team, manage and train technical personnel, provide good welfare treatment, and use various incentive measures to stimulate the enthusiasm of employees. Besides, the cooperation of technological innovation should be strengthened among enterprises to drive the steady development of other enterprises and the whole industry.

*C. Improve the international logistics industry, establish a modern logistics system*

Jiangsu should further improve the international logistics, expand the international logistics service network, and improve the competitiveness of enterprises. One is to promote the improvement of the international logistics industry, accelerate the establishment of logistics branches by enterprises with global supply chain operation capabilities in Jiangsu, and use enterprise investment and acquisition, strategic cooperation and other measures to integrate transportation resources and improve the landed logistics level. The other is to improve the modern logistics system. The traditional logistics system has disadvantages such as long transportation time and complex operation, while the modern logistics system integrates information, transportation, storage, inventory and other logistics activities, supported by modern science and technology and advanced scientific theories, which can reduce transportation costs and provide better services for consumers.

*D. Reduce the dependence on foreign trade, adjust and optimize the trade market*

Jiangsu has high foreign trade with the United States, Japan, Europe and other developed regions and countries, and depends heavily on their trade, which is not conducive to the high-quality development of Jiangsu's foreign trade. Due to the advantage of geographical location, foreign trade with Japan and South Korea has promoted the export volume of Jiangsu in

recent years. However, because of various reasons such as epidemic and political situation, it is bound to affect the development of Jiangsu's foreign trade. Therefore, it is necessary to optimize and improve the structure of Jiangsu's foreign trade and reduce the dependence on some developed countries and regions. Jiangsu should increase the trade with the third world countries and optimize the country structure of Jiangsu's foreign trade. Although the third world countries are underdeveloped, there is still a large demand for primary products, manufactured products and other commodities. Increasing trade cooperation with them can not only promote the development of foreign trade, but also accelerate the formation of friendly cooperative relations with the third world countries.

*E. Attach importance to the provincial regional economy, coordinate the balanced development of regions*

The development of regions in Jiangsu province is extremely unbalanced. The foreign trade of southern Jiangsu accounts for three quarters of the whole province's foreign trade, and the development of central and northern Jiangsu is relatively slow. Jiangsu should pay attention to the balanced development of the region, give play to the advanced innovative technology of southern Jiangsu, promote the ability of cluster development, and explore the late-comer advantages of northern Jiangsu and central Jiangsu. Southern Jiangsu should increase the production of high-tech products, improve the added value of commodities, and increase the competitiveness of the industry. Northern Jiangsu and central Jiangsu should take advantage of their own location, low cost and policy advantages to optimize the industrial structure, increase the development of the tertiary industry and promote industrial upgrading. Also, the governments should improve the investment environment, attract foreign investment and strengthen the construction of infrastructure

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