Research on the Foreign Trade Efficiency and Influencing Factors of the Yangtze River Delta under High-quality Development

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Abstract. It has become the consensus of my country's foreign trade development to promote the high-quality development of trade and accelerate the building of a strong trade country. The Yangtze River Delta is an important intersection of the “Belt and Road” and the Yangtze River Economic Belt. With its superior location environment, the Yangtze River Delta has become a leading force driving the overall high-quality development of China's economy and trade. This paper discusses the status quo of foreign trade in the Yangtze River Delta from the perspective of high-quality development, constructs a foreign trade efficiency evaluation system based on the DEA model, measures the efficiency of foreign trade in the Yangtze River Delta, uses the Tobit model to analyze its foreign trade efficiency factors, and finally proposes strategies for improving foreign trade efficiency. And the high-quality development path of regional trade, providing reference for decision-making for my country to coordinate the high-quality development of trade in the Yangtze River Delta and even across the country.

1. Research background and significance
International trade is particularly important for the development of a country or region, and is an important path for improving social welfare and economic growth [1]. With the acceleration of the globalization process, trade exchanges between countries have become closer. In 2018, global merchandise exports totaled US$19.475 trillion, imports totaled approximately US$19.87 trillion, and global trade volume increased by 3.0% month-on-month. However, after the international financial crisis, the domestic and international situation has changed, and the supporting conditions for the rapid development of my country’s foreign trade have changed. With the continuous increase in the volume of trade, the increasing types of trade, and the increasing domestic dependence on export growth, high-quality trade development has become the goal of trade development pursued by our country.

The Yangtze River Delta is one of the regions with the most active economy, the most international competitiveness and development potential in China, and it has an important core position in my country's national economic and social development. However, in recent years, with the continuous expansion and development of trade, my country’s foreign trade development has faced many risks and challenges. The weak international market demand and the increasing downward pressure on the domestic economy have largely restricted the healthy development of trade [2]. Therefore, the evaluation
of foreign trade efficiency under the background of high-quality development will promote the transition of the Yangtze River Delta economy to high-quality development.

2. Calculation and Analysis of the Foreign Trade Efficiency in the Yangtze River Delta

2.1. Data Envelopment Analysis

The data envelopment analysis method (Data Envelopment Analysis, DEA) research ideas can be divided into three steps, one is to map the actual input and output data of each decision making unit (DMU) to the space, and the other is based on different orientations. Determine the minimum input or maximum output production frontier, and finally calculate the distance from the production capacity represented by the sample point to the optimal production frontier, and use this as a basis to evaluate the comprehensive technical efficiency of the sample point [3].

DEA explicitly considers the use of multiple input and multiple output indicators that do not need to be converted into the same currency unit. Achenes [4] first publicly proposed a data envelopment analysis method based on constant returns to scale in 1978, and named it the CCR (Constant Returns to Scale) model. In 1984, Banker and Charles [5] and other scholars proposed the BCC model to make up for the shortcomings of the CCR model, explores the efficiency problem under variable returns to scale. The BCC model is as follows:

\[
\begin{align*}
\min \theta \\
\text{s.t. } & \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{ik} \\
& \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{rk} \\
& \sum_{j=1}^{n} \lambda_j = 1 \\
& \lambda \geq 0 \\
& i = 1,2, ..., m; r = 1,2, ..., q; j = 1,2, ..., n
\end{align*}
\]

2.2. Index selection and data sources

Taking into account the limited number of DMUs in this article and the objectivity, representativeness, and easy accessibility of the indicators, after repeated demonstrations and trial and error, the indicator selection method of scholars such as Xia Yun [6] and Li Dan [7] is used to divide the indicator system into the input indicators and output indicators shown in Table 1.

| First-level index | Second-level index |
|-------------------|--------------------|
| **Investment indicators** | **Output indicators** |
| Economic development level | Regional GDP per capita |
| Human capital | Employment of the whole society |
| Trade opening level | Foreign trade dependence |
| Trade competitive advantage | Trade competitive advantage index |

The data used in this article are mainly from the "China Statistical Yearbook" and "China Labor Statistics Yearbook". Some indicators of input use per capita and proportional data, which helps to eliminate the interference factors caused by the number of permanent residents and the employment of the whole society, so that the data can better reflect the level of regional investment.

2.3. Trade efficiency calculation results and analysis

This paper uses the BCC-DEA model to analyze the comprehensive efficiency of foreign trade in the three provinces and one city in the Yangtze River Delta. The efficiency value equal to 1 is the effective
sign of DEA. The lower the efficiency value. Table 2 shows the comprehensive efficiency of foreign trade in three provinces and one city in the Yangtze River Delta from 2008 to 2017.

### Table 2. The efficiency of foreign trade in the Yangtze River Delta from 2008 to 2017.

| Year | Shanghai | Jiangsu | Zhejiang | Anhui | Mean |
|------|----------|---------|----------|-------|------|
| 2008 | 1        | 1       | 1        | 0.709 | 1.236 |
| 2009 | 1        | 0.977   | 1        | 0.773 | 1.250 |
| 2010 | 1        | 0.926   | 1        | 0.493 | 1.140 |
| 2011 | 1        | 0.88    | 1        | 0.528 | 1.136 |
| 2012 | 1        | 0.901   | 1        | 0.836 | 1.246 |
| 2013 | 1        | 0.858   | 1        | 0.69  | 1.183 |
| 2014 | 1        | 0.816   | 1        | 0.722 | 1.179 |
| 2015 | 1        | 0.82    | 1        | 0.788 | 1.203 |
| 2016 | 1        | 0.813   | 1        | 0.777 | 1.197 |
| 2017 | 1        | 0.864   | 1        | 0.693 | 1.186 |
| Mean | 1        | 0.886   | 1        | 0.701 | 1.196 |

It can be concluded from Table 2 that the comprehensive efficiency values of Shanghai and Zhejiang from 2008 to 2017 are both 1, which is valid for DEA. In terms of time scale, the efficiency values in 2008-2009, 2012 and 2015 all exceeded 1.2, which is closely related to the high efficiency of Jiangsu and Anhui. After 2013, the average efficiency of the three provinces and one city fluctuated around 1.18, and then as of 2017 comprehensive trade the average efficiency remains high and stable. From the perspective of spatial span, the Yangtze River Delta has always been in the forefront of the foreign trade efficiency of the Yangtze River Economic Belt, especially Shanghai and Zhejiang. With their superior geographical location and strong economic foundation, they have become the forefront of the Yangtze River Delta's foreign trade. Anhui's geographical disadvantages and the siphon effect of big cities made it relatively backward, but at the same time, due to the radiation effect of Shanghai, Jiangsu, and Zhejiang, its overall performance was relatively stable during the ten years from 2008 to 2017.

3. Influencing factors of foreign trade efficiency based on Tobit model

3.1. Tobit model

The Tobit model is a kind of regression model, also called the dependent variable restricted model [8]. Unlike traditional regression models, the dependent variable in Tobit is a range of restricted upper or lower limits. The general form of the Tobit model is

\[ Y_{it} = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n + \varepsilon_i \]  

(2)

Among them, the efficiency value of the ith area of Yit in year t, Xn is the explanatory variable, βn is the regression coefficient, when n=0, β0 is the intercept term, and εi is the error term [9]. In this paper, the measured values of foreign trade efficiency of the three provinces and one city in the Yangtze River Delta are all between (0, 1), and the dependent variables are limited, so the Tobit model is more reasonable.

3.2. Regression results and analysis

In the Tobit regression, the foreign trade efficiency of the Yangtze River Delta was taken as the research object, and the following six subdivision indicators were selected from the four aspects of industrial structure, investment status, education level of employees, and infrastructure. The specific indicators are shown in Table 3.
Table 3. Index system of factors affecting the efficiency of foreign trade in the Yangtze River Delta.

| First-level index                  | Second-level index                  |
|-----------------------------------|-------------------------------------|
| Industrial structure              | Proportion of tertiary industry     |
| Investment status                 | Fixed asset investment              |
| Education level of employees      | Proportion of employees with college degree and above |
| Infrastructure                    | Cargo turnover                      |
|                                   | Number of Internet access ports     |

Table 4. Regression results of factors affecting the efficiency of foreign trade in the Yangtze River Delta.

| Explanatory variables              | Coefficient | Standard error | t     | P>t    |
|-----------------------------------|-------------|----------------|-------|-------|
| Proportion of tertiary industry   | 0.113       | 0.319          | 0.350 | 0.725 |
| Fixed asset investment            | -0.717      | 0.167          | -4.300** 0.000 |
| Foreign investment                | 0.108       | 0.043          | 2.510 | 0.014 |
| Proportion of employees with college degree and above | -0.014 | 0.004 | -3.420** 0.001 |
| Cargo turnover                    | 0.133       | 0.056          | 2.360** 0.020 |
| Number of Internet access ports   | 0.510       | 0.139          | 3.660** 0.000 |
| Constant term                     | 1.567       | 0.364          | 4.310 | 0.000 |

Note: ** means significant at the 5% level

Through the above regression results:

1. The industrial structure is positively correlated with the efficiency of foreign trade. Although not significant, it also shows that the higher the proportion of the tertiary industry, the higher the degree of rationalization of the industrial structure and the higher the level of export products, the more efficient the development of foreign trade.

2. Fixed asset investment is negatively correlated with the efficiency of foreign trade, indicating that fixed asset investment optimizes the domestic investment environment, improves production conditions, stimulates the national demand for domestic products, increases the level of consumer goods self-sufficiency, shrinks import demand, and foreign trade The efficiency is reduced.

3. The proportion of employees with a college degree or above is negatively correlated with the efficiency of foreign trade, and it has passed the significance test, indicating that high-level labor has increased the input cost, making the efficiency of foreign trade lower.

4. In terms of infrastructure, the level of access to transportation and information has a significant role in promoting the efficiency of foreign trade. The greater the cargo turnover, the better the regional transportation network and the higher the efficiency of foreign trade. The number of Internet access ports reflects the degree of development of the regional network. Efficient information sending and receiving can ensure the timeliness and efficiency of foreign trade cooperation to a greater extent.

4. Main conclusions and countermeasures

4.1. Main research conclusion

1. Judging from the results of the DEA evaluation, the Yangtze River Delta's foreign trade efficiency has always remained high and stable. Regionally, the Yangtze River Delta has always been in the forefront of the foreign trade efficiency of the Yangtze River Economic Belt, especially Shanghai and
Zhejiang. With their superior geographical location and strong economic foundation, they have become the forefront of the Yangtze River Delta's foreign trade.

(2) From the regression results of the restricted Tobit panel, the proportion of tertiary industry, foreign investment, cargo turnover, and the number of Internet access ports have a positive impact on the overall efficiency of the Yangtze River Delta's foreign trade. Fixed asset investment and employee education level has a significant negative impact on overall efficiency. The proportion of tertiary industry and foreign investment have the greatest influence on the overall efficiency of foreign trade, indicating that the industrial structure and investment environment have a greater impact on the level of regional foreign trade. The education level of employees with a college degree or above has a significant negative impact on the efficiency of foreign trade in the Yangtze River Delta, indicating that the current production level uses a higher-quality labor force to affect the increase in input costs and reduce efficiency.

4.2. Suggestions

4.2.1. Strengthen regional cooperation and give play to the agglomeration effect of foreign trade. All provinces should actively explore local excellent resources, and use geographical advantages, industrial advantages, and talent advantages to build key foreign trade industries with provincial characteristics. Strengthen the integration and interaction between industrial clusters to avoid homogeneous industry and low-level competition.

4.2.2. Optimize industry and investment structure and create a healthy foreign trade investment environment. Reasonably plan the scale of fixed asset investment and investment fields, enhance the vitality of fixed assets, and enable fixed assets to be invested in reproduction; ensure the orderliness of foreign direct investment, guide foreign direct investment to extend to high-tech and technological innovation fields; realize the transformation and upgrading of industrial structure in order to optimize the structure of export commodities [10], reduce resource misallocation, and promote the improvement of the efficiency of foreign trade.

4.2.3. Promote infrastructure construction and improve foreign trade infrastructure conditions. First, we must improve the transportation network, strengthen the inter-provincial port cooperation mechanism, improve the efficiency of sea and land transport, and reduce the cost of iceberg transportation. Second, it is necessary to improve the information network, give full play to the role of the Internet in product design, production, sales, and after-sales links, promote the construction of new infrastructure, and ensure the endogenous power of high-quality trade development.

Acknowledgement

Fund Project: Jiangsu Social Science Fund Project "Sino-US Trade Friction Impact Mechanism and Countermeasure Research on the Conversion of Jiangsu's New and Old Kinetic Energy" Project NO: 19EYB004

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