Research on the Contribution of Regional Import and Export Influential Factors Based on RBF Neural Network

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Abstract. Since the reform and opening up, the proportion of imports and exports in all provinces in China has increased to a great extent, and the total import and export volume is an important condition for reflecting the economic level of a region, and it is also one of the important influencing factors affecting economic growth. In the context of economic development, by analyzing what are the factors affecting import and export, the contribution of import and export to economic growth and the reasons for promoting economic development can be analyzed. Based on this, this paper selects Zhejiang Province as the research object, uses the data from 1990 to 2020, and uses the RBF neural network algorithm to analyze this series of data. In this paper, multiple secondary indicators are selected from the five perspectives of population, industrial structure, economic development level, currency, and science and technology, and RBF training is carried out, and it is found that when the model parameter is 19, the model accuracy converges and the algorithm reaches the optimal value. According to the algorithm results, we conclude that the methods to increase the total import and export volume of the region include implementing an expansionary fiscal policy and increasing the total budget expenditure; Increase research and development funding, such as university research funding and talent subsidies; Increase industrial output value, such as providing assistance and subsidies to industrial enterprises for export orientation.

Keywords: RBF neural network, Zhejiang Province, Regional Import, Influential Factors.

1. Introduction

Since the reform and opening up, the proportion of imports and exports in China's provinces has increased. In order to clarify the factors that affect imports and exports, so as to further analyze the contribution of imports and exports to economic growth and the reasons for promoting economic development, and analyze the current status of imports and exports in China's provinces, there are Help to break the economic stagnation, and help strengthen the construction of various factors in the economic field. In the concept of economics, import and export refers to a series of transactions between different countries or regions, such as commodities, services, technologies, and labor services. From the level of import and export, we can analyze the scale and level of my country's foreign economic and trade at the present stage, as well as the structure and growth preference of export commodities, so exploring import and export is an indispensable part [1].

Many existing studies have analyzed the factors affecting import and export. For example, Wang [2]used the GARCH model to construct an incomplete import and export model based on exchange rate volatility and FDI, and analyzed exchange rate volatility in the long and short term. Impact on China's import and export trade.Tu Rui [3] used the asymmetric regression conditional heteroscedasticity (EGARCH) model to analyze the correlation of import and export trade structure and its changes, and pointed out that under the export-oriented strategy, foreign investment stimulates exports while promoting imports. In the context of the deepening of economic globalization, China joined the World Trade Organization (WTO) in November 2001, which is a major development node for China's import and export trade. Generally speaking, my country's trade growth is faster than GDP growth, which makes the import and export trade economy particularly important in our country.

In previous studies on trade analysis, Vanek proposed to extend the two-factor model to a multi-factor model, so that the impact of multiple factors on trade structure, scale and level can be considered in trade analysis [4]. Zhao [5] used the input-output model, based on the LMDI method, and analyzed carbon emissions as an important driving force in import and export trade, taking the flow direction and total amount of embodied carbon as the main body. Through comparative research methods, Dani Rodrik believes that promoting the improvement of specialization level and improving technical content and efficiency from different angles are the key to improving China's trade structure and import and export [6]. Since 2020, due to the special environmental background of the new crown epidemic, the global economic system has been severely impacted. Huang, etc. [7] based on the vector autoregressive model and system analysis method, expressed the import and export impact of the new crown epidemic from different categories of commodities, analyzed the structure of import and export trade under this background, and proposed policies for industrial transfer and upgrading suggest.

In the research of some scholars in China, most of the literature focuses on considering the factors affecting the import and export trade of a certain province, or the effect of a specific single factor on import and export, and less consideration is given to other comprehensive influencing factors. However, various external factors such as reform and opening up, China's accession to the WTO[8], the financial crisis, the deepening of the global economy's dependence on interconnection, and the current environment of the new crown epidemic are all affecting the import and export trade of China's provinces. Trade structure, China's domestic GDP, population growth, and investment volume all affect the import and export of each province. In the multivariate and complex background, we need to analyze the factors that affect the import and export of each province to improve the import and export trade structure. The research purpose and innovation of this paper is here. Therefore, we propose to use RBF neural network method for analysis. We will study the factors that affect the import and export of various provinces in China based on the RBF neural network under the contribution score. Our research direction is how to maintain stable growth through the influence of import and export factors in the context of economic development. We will take the regional import and export status of each province as the research object and analyze its factors in depth. The marginal contribution of this paper lies in broadly summarizing the commonality of factors affecting import and export in various provinces and regions in China, and to some extent making up for the lack of sample analysis of a single province.

2. Construction of regional import and export impact index system

2.1. Population

The total floating population in each province of China is large. The large population base has brought demographic dividends, which is a major factor for the significant growth of imports and exports. With the continuous improvement of the socialist market economic system, China's various provinces have increasingly close economic exchanges with the outside world, and the population flow between provinces, cities, counties and towns is very frequent, and the basic flow of population has driven the increase in labor demand in the surrounding area., to promote structural adjustment, thereby improving the growth of imports and exports. The rapid economic growth of China's eastern provinces has attracted a large number of people from other regions. The floating population can change the distribution of the population industrial structure, make the population industrial structure continuously coordinate with the economic industrial structure, and then promote the continuous optimization of the industrial structure [9]. In the process of economic growth, the flow of production factors first causes the transformation of the economic industrial structure, and then leads to the transformation of the population industrial structure. Sufficient reserves of labor force, increasing market demand for labor force, and promoting the integration and upgrading of economic institutions have enabled China's provinces and regions to develop an all-round, high-quality import and export economy.

2.2. Industrial Structure

Generally speaking, the proportion of labor-intensive products in total exports is the highest, which is also related to China's long-term development mode. Whether it is capital-technology-intensive or labor-intensive products, they all remain relatively high. growth rate, but there will also be local flattening. Regional import and export trade is extremely affected by the international environment and international situation. On the whole, among the three industries in China, the focus of the industry is gradually developing towards the secondary industry and the tertiary industry, but the secondary industry and the tertiary industry are equal, especially since my country's accession to the WTO in 2001, the secondary industry and the tertiary industry have The added value of the tertiary industry began to grow rapidly. Since 2014, the growth of the tertiary industry has begun to outpace that of the secondary industry, indicating that provinces have attached more importance to the tertiary industry. The industrial structure of each province is becoming more and more mature. With the development of foreign trade and economic growth, the industrial structure of each province is further optimized. Sometimes there are large fluctuations in the proportion of the secondary industry and the tertiary industry, due to the influence of factors such as international and domestic environments and government policies[10].

2.3. Economic Development Level

In the early stage, due to the influence of national economic development and the constraints of a highly centralized and unified system, the trade form of China's export-oriented economy in provinces and regions was relatively simple, and the scale of imports and exports was small. After China joined the World Trade Organization (WTO) in 2001, in line with the national policy of opening up to the outside world since 1978, the provinces made full use of the relevant measures to adjust the national foreign trade policy, based on the provincial conditions, maximized the economic advantages, and constantly adapted to the new situation of opening up to the outside world. The continuous and rapid development of foreign trade, the rapid expansion of the total volume of import and export trade, the proportion of the total national trade volume has been continuously increased, and the ranking of trade volume has been steadily improved. An important engine for upgrade optimization. Foreign trade has become an important force to promote my country's economic growth. The quantitative indicators of China's economic growth are very impressive. At this stage, China's economic development level will pursue high-quality comprehensive development and build an all-round import and export market system, including regional coordination and sharing, reasonable and efficient resource allocation, and optimization and adjustment of import and export structures.

The impact of import and export trade on China's GDP growth is significant. In the long run, there are two main sources of economic growth, one is the increase in factor supply, and the other is the increase in total factor productivity. The effect of foreign trade on economic growth depends entirely on whether it can promote the increase of factor inputs and the improvement of total factor productivity. Regional import and export has improved China's technological progress, industrial structure optimization, economies of scale and institutional innovation, among which technological progress is the key. Trade policy choices are endogenous to our understanding of this core issue. With the rapid development of import and export trade in various provinces, the export-oriented degree of economic development has also increased year by year. The increase in dependence on foreign trade shows to a certain extent that the economic construction of China's provinces has become quite dependent on global import and export exchanges. The growth of the national economy is inseparable from the development of import and export trade.

2.4. Currency and Exchange Rates

The rise and fall of the RMB exchange rate will affect the fluctuation range of import and export trade. When the external environment is healthy, that is, when the global economy is developing stably, China's regional import and export trade also maintains a relatively high level of growth; when the external environment changes, that is, the global economic crisis or economic fluctuations in a

specific period, the RMB exchange rate is under huge impact and pressure, which is also It will have an impact on the structure of regional import and export trade. From a macro perspective, China has carried out several exchange rate reforms, and the fluctuation of the RMB exchange rate directly affects the flow of capital and the direction of import and export trade. At the same time, the adjustment of tariffs is also one of the influencing factors. Generally speaking, reducing import tariffs is conducive to expanding imports, but it does not necessarily promote export trade. The imbalance and instability of the import and export trade structure will also intensify the inflationary pressure on the country's economic structure. Tariffs have a dynamic two-way impact on import and export trade.

2.5. technology

The adjustment of economic structure is accelerating, the contribution of scientific and technological innovation to economic growth is becoming more and more prominent, and technology import and export has gradually become an important industry for China's foreign economic development. Small and medium-sized enterprises in China are actively participating in world technology transfer activities; technology transfer targeting high-tech is increasing; intellectual property rights have become an effective means of strengthening technology import and export trade and competition. All provinces in my country are gradually enhancing market awareness, planning market development, cultivating market elements, and making market mechanisms play a greater role. In terms of promoting technological innovation, the basic role of market allocation of scientific and technological resources is very obvious. Enterprises in various provinces of China have also continuously increased their investment in science and technology, which has greatly promoted the upgrading of the modern economic structure. Under the influence of high economic growth, China's high-tech industrial chain has gradually matured and scaled, multi-industry open development, cooperative innovation, technology crossover and upgrading. The import and export trade of scientific and technological products is highly irreplaceable and has strong market competitiveness, which will help promote the development resilience of import and export trade.

To sum up, the regional import and export impact index system constructed in this paper is shown in table I:

Table 1. Index System Table

Level 1 indicators	Secondary indicators/Unit
Population	Total population (10000 persons)
	CPI (based on 1985)
Industrial structure	Proportion of primary industry
	Proportion of secondary industry
	Proportion of tertiary industry
	Industrial proportion
	National money and quasi money supply M2 (100 million yuan)
Economic development level	Total net export value (USD 10000)
	Provincial GDP (100 million yuan)
	GDP per capita (yuan)
	Exchange rate of RMB against USD
	National tariff (100 million yuan)
	Central foreign exchange reserves (100 million US dollars)
Currency	Total freight volume (10,000 tons)
	Total cargo turnover (100 million tons/ha)
	Actual utilized foreign capital (10000 US dollars)
	Total general budget revenue (100 million yuan)
	Total general budget expenditure (100 million yuan)
Technology	Research and experimental development expenditure (100 million yuan)

3. RBF Method

RBF neural network was developed in the late 20th century. Scientists such as Broom head, Lowe, Moody and Darken successively applied RBF to neural network design and proposed a structure of RBF neural network [11]. The structure of the RBF neural network is similar to that of a multilateralyer feed-forward network, which is a three-layer feed-forward neural network with a single hidden layer. The schematic diagram of the RBF neural network is shown in Fig.1. The hidden lay composed of signal source nodes in that input layer is a single neuron layer, but the numb of neurons can be determined according to the needs of the described problem, and the action response of the output layer to the input. The transformation from the input layer space to the hidden layer space is nonlinear, while the transformation from the hidden layer space to the output layer space is linear. The transformation function of hidden layer neurons is RBF, which is a non-negative nonlinear function with locally distributed central radial symmetric attenuation.

It has the best approximation performance, the training method is fast and easy, and there is no local optimal problem.

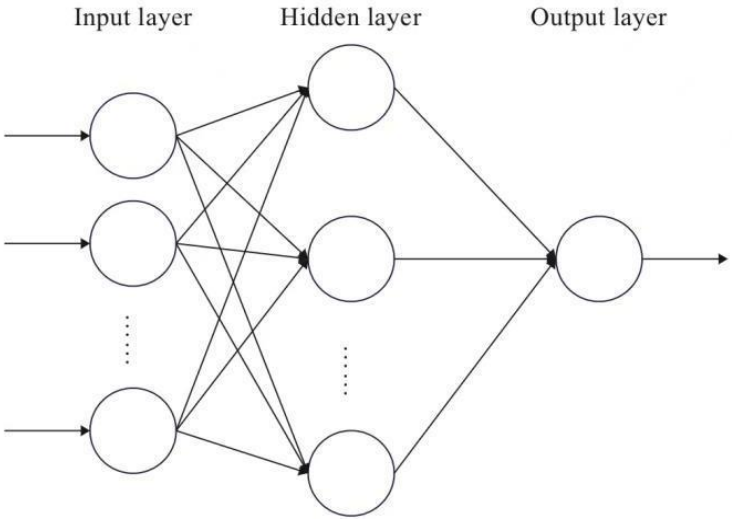

Figure 1. RBF diagram

The activation function of Step1 RBFN can be defined by formula (1), i.e.

$$R(x_p - c_i) = exp(-\frac{1}{2\sigma^2}\|x_p - c_i\|^2) \quad (1)$$

Where: is the Euclidean norm; Is the center of the Gaussian function; Is the variance of the Gaussian function.$\|x_p - c_i\| c\sigma$

The output of the Step2 neural network can be calculated by Equation (2), i.e.

$$y_i = \sum_{i=1}^{h} w_{ij} exp(-\frac{1}{2\sigma^2}\|x_p - c_i\|^2) \quad (2)$$

Where: is the P-th input sample; Is the center of the network hidden layer node; Is the weight from the hidden layer to the output layer; I = 1, 2,..., h is the number of nodes in the hidden layer; Is the j-th actual output.$x_p = (x^p{}_1, x^p{}_2, \ldots\ldots, x^p{}_m)^T c_i w_{ij} y_i$

Step3 sets D as the expected output value of the sample, and the variance σ of the function can be calculated by Equation (3), i.e.

$$\sigma = \frac{1}{P}\sum_{j}^{m} \quad (\|d_j - y_i c_i\|^2) \quad (3)$$

Step4 To evaluate the prediction results, the average absolute percentage error (MAPE) was used for evaluation. MAPE represents the difference between the actual total imports and exports and the average absolute error of the forecast total imports and exports. MAPE is represented by formula (4), i.e.

$$MAPE = \frac{1}{N}\sum_{i=1}^{N} \left|\frac{I_f^i - I_a^i}{I_a^i}\right| * 100\% \quad (4)$$

4. Setting of inspection indicators

The purpose of hypothesis testing is to judge whether there is a significant difference between the original hypothetical population and the present actual population. Hypothesis testing is a one-and-one statistical method that uses the actual data of samples to test whether the assumptions made in advance about certain quantitative characteristics of the population are credible[12].

$$\boldsymbol{R^2 = 1 - \frac{SS_{residual}}{SS_{total}}} \quad (5)$$

R^2For goodness of fit, it indicates the degree to which each explanatory variable explains the variable to be explained. The larger the proportion, the better. The more accurate the model, the more significant the regression effect. Between 0~1, the closer to 1, the better the regression fitting effect. The larger is the result that the explanatory variable can explain the impact of regional import and export, mainly used to reflect the degree of the fitting.R^2

$$MAPE = \frac{1}{N}\sum_{i=1}^{N} \left|\frac{I_f^i - I_a^i}{I_a^i}\right| * 100\% \quad (6)$$

MAPE is the average absolute percentage error, which is a relative measure that determines the MAD scale as a unit of percentage rather than as a unit of the variable. Average absolute percentage error is a measure of relative error, which uses absolute values to prevent positive and negative errors from canceling each other out. You can use relative errors to compare the accuracy of various time series model predictions.

5. Empirical analysis

5.1. Selection of research subjects and data collection

Zhejiang Province is located in China's Yangtze River Delta region, bordering the Pacific Ocean to the east, Shanghai and Jiangsu to the north, and Fujian to the south; it is not only a strong economic province in China, but also an important member of the Asia-Pacific economic circle, with a developed light industry in its territory, a GDP per capital of 110,000 yuan in 2021, much higher than the per capital level in China, strong consumption power, and a unique advantage in import and export trade; during the past three decades, the total GDP has maintained steady growth, and Total imports and exports have been climbing, and the economy has a high degree of external dependence; in the trade data from January to July 2022, Zhejiang Province ranked second in the country in total export trade (200.31 billion yuan), and has a pivotal position in China's foreign trade sector.

Based on this, this paper selects Zhejiang Province as the research object, collects its data during the past thirty-one years (1990-2020), the data comes from China Statistical Yearbook and Zhejiang Province Statistical Yearbook, and analyzes this series of data based on the RBF neural network algorithm. The descriptive statistical analysis of indicators is shown in Table II.

Table 2. Descriptive statistics

Indicator / Unit	Minimum value	Maximum value	Average value	Middle value
X1 / $ million	277,342.00	2,334,029,008.00	360,260,836.58	10739123
X2 / billion	904.69	64,613.34	21,408.50	13028.33
X3 / %	3.3	24.9	9.06	6.8
X4 / %	40.9	54.7	50.14	51.6
X5 / %	30	55.8	40.81	40.1
X6 / %	35.1	49.3	44.3	45.6
X7 / Yuan	2,143.00	100,620.00	37,763.26	26277
X8 / 10,000 people	4,234.91	5,069.00	4,625.42	4602.11
X9	169.4	555.6	391.51	384.6
X10 / million tons	33,474.00	299,919.00	133,938.19	126192
X11 / million tons	400.65	12,391.21	4,824.61	3416.9
X12 / $ million	16,235.00	1,621,326.26	921,326.26	1087685
X12 / billion	101.59	12,421.49	3,883.45	2115.36
X13 / billion	80.23	10,082.01	2,773.19	1265.53
X14 / billion	2.04	1,858.59	444.82	163.29
X15 / Yuan	478.32	861.87	717.28	689.85
X16 / billion	159.01	2,997.85	1,398.12	1066.17
X17 / $ billion	110.93	38,430.18	14,858.58	8188.72
X18 / billion	15,293.40	1,219,342.00	619,342.00	298755.7

5.2. RBF training

In this study, based on SPSS.24 software, samples from 1990 to 2010 were selected as training data and samples from 2011 to 2020 were used as test data, and then the mean absolute percentage error (MAPE) and R2 were used to measure the prediction accuracy and model performance of the established RBF neural network model. Where the smaller MAPE indicates higher prediction accuracy and R2 is between 0 and 1, the closer to 1 indicates higher prediction accuracy.

Table 3. Test indicators

Number of neurons in hidden layers	R^2	MAPE
1	0.99743	172.65%
2	0.99851	128.89%
4	0.99956	27.86%
5	0.99520	181.77%
6	0.99754	22.02%
7	0.99822	18.32%
8	0.99988	18.32%
9	0.99986	17.12%
10	0.99250	97.36%
11	0.99889	12.52%
12	0.99988	12.81%
13	0.99940	11.60%
14	0.99970	8.38%
15	0.99881	123.40%
16	0.99996	8.00%
17	0.99988	8.51%
18	0.99857	27.70%
19	0.99999	6.48%
20	0.98629	15.20%
21	0.99962	62.27%
22	0.99932	45.61%
23	0.99937	18.81%
24	0.99993	30.49%
25	0.99995	63.68%

The initial parameters were selected as 1 and calculated continuously with 1 as the interval and their prediction accuracy was calculated the results obtained are shown in the table III.

Based on the above training, this paper finds that when the model parameter is 19, R^2 reaches the maximum value of 0.999986 and MAPE is the smallest at 6.48%, at which time the model accuracy converges the algorithm reaches the optimal value.

5.3. Contribution analysis

Based on the calculation of the above test index, we selected the results when the number of hidden neurons is 19 and calculated the contribution analysis, which is shown in Fig.2:

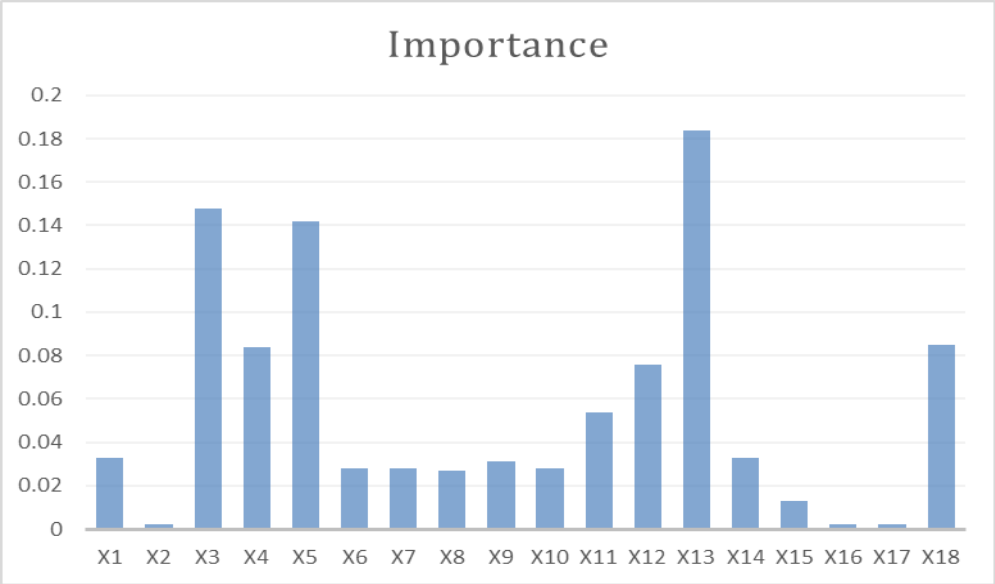

Figure 2. Importance of independent variables

Using the RBF neural network algorithm to analyze the regional import and export influencing factors, we mainly find that (1) the industrial output value reflected by X3 and X5, the total general budget expenditure reflected by X13, the research and development expenditure reflected by X14 and the money supply reflected by X18 has a considerable influence on the total import and export, with X13 having the largest contribution of 0.184; (2) the agricultural output value represented by X2 then has a very small impact on the total value of exports and imports; (3) the output value of services represented by X4, the consumption capacity and consumption level represented by X6, X8 and X9, and the freight capacity represented by X9 and X10 have a moderate degree of impact on the total value of exports and imports.

For the total general budget expenditure, which has the largest contribution, the government should increase the total budget expenditure based on economic laws and economic situation, adopt the expansionary fiscal policy, expand government expenditure and implement fiscal deficit, which is exactly in line with the Keynesian idea of stimulating economic development. In contrast for X14 (research and development experimental funding) and X3 and X5 (industrial output), which have the second highest contribution rate. Therefore, the government should increase research funding for universities and give certain subsidies to research talents, and encourage enterprises to invest and innovate, and provide certain policy underwriting for enterprises with R&D capability, and provide certain subsidies and assistance for export-oriented industrial enterprises. As for the agricultural output value, which has a very small contribution, on the one hand, the agricultural output value of Zhejiang Province itself is low, accounting for a small ratio of the total industry, on the other hand, it has a large population and strong internal consumption capacity, and agricultural products are mostly used for internal digestion, while in recent years, due to external factors such as trade wars and the suspension of freight transportation brought about by the new crown epidemic, the total import and export of agricultural products is also at a low level, which ultimately leads to a low contribution of

agricultural output value, and The government should guide the cultivation structure of local agriculture, increase the independence of local agricultural production and reduce the external dependence of agriculture.

6. Conclusion

Total import and export is an important condition to reflect the economic level of a region, in order to explore what are the influencing factors affecting import and export, and the degree of impact, we select Zhejiang Province, a province with representative and research value, we use RBF model and use contribution analysis to analyze, the data is Zhejiang Province 1990-2020 31 years of data. Using MAPE and this indicator to evaluate the accuracy of the model, the following conclusions were drawn through the study:

(1) The main influencing factors of total import and export volume are general budget total expenditure, industrial output value, research and development expenditure, and money supply; Secondary influencing factors include the output value of the service industry, residents' consumption capacity and consumption level, and freight capacity; Other factors have a small impact on total imports and exports.

(2) According to the algorithm results, if you want to increase the total import and export volume of a country or region, you can adopt the following ways: implement an expansionary fiscal policy and increase the total budget expenditure; Increase research and development funding, such as university research funding and talent subsidies; Increase industrial output value, such as providing assistance and subsidies to industrial enterprises for export orientation.

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