

Research on the Forecasting of China's Import and Export Trade Situation--Based on VAR Analysis and ARIMA Model

Ziwei Tang

School of Mathematics and Statistics, Chongqing Technology and Business University, Chongqing, 19 Xuefu Road, 400067, China

Abstract: In the era of post-epidemic economic crisis, research on whether China's international trade can maintain the original momentum of development. This paper adopts a combination of quantitative and qualitative analysis, the construction of two sets of vector autoregressive model, not only on the structure of China's import and export trade characterization, but also the use of time-series model on China's import and export trade trends in the 4-year forecasting study. Through the overall analysis, it puts forward highly targeted suggestions for the in-depth reform and development of China's import and export trade situation as well as industrial structure adjustment.

Keywords: var model, arima model, granger causality analysis, forecasting

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I. Introduction

Foreign trade is an important part of national economic development, in order to fully understand the development of China's foreign trade, first of all, the total amount of China's import and export in recent years based on the analysis of the conclusion of the countermeasures proposed in the development of foreign trade. On issues related to the development of international trade, especially the structural and trend research on the development of China's international trade, the existing research results are mostly analyzed from the perspectives of energy consumption, international trade pattern, system setting, etc., and there are fewer empirical quantitative analyses carried out from the perspective of input and output. The former analytical method is utilized to designate international trade policies from the macro level, while the latter analytical method facilitates the structural analysis of international trade. Only after the structural determination, the designated macro policies can be more effective. Based on this, this study decides to take the input-output perspective as the research perspective, and through empirical analysis, not only to determine the deep internal structure of China's international trade, but also to utilize the time series model to forecast the potential of China's foreign trade in the coming period of time.

II. Literature review

Economic globalization has posed a great challenge to the global economic system, and its impact has exceeded people's expectations; the world has essentially entered an economic crisis. Unlike the economic and financial crises experienced by people in the past, this time it is an economic crisis caused by the crisis in the financial market resulting from the extension of economic globalization, which is not a simple crisis of the collapse of the stock market, the monopolization of the capital chain and the massive surplus of products, but rather a contagious economic crisis stemming from the imbalance in foreign trade related to imports and exports that has been extended to the financial sphere. How should we respond to the challenges posed by economic globalization? It requires the whole country to respond with a positive attitude. We are required to adhere to the development strategy of opening up to the outside world and actively participate in international economic cooperation, so as to seize the opportunities and meet the challenges brought by economic globalization. At the same time, we also need to clearly understand the huge risks brought by economic globalization, adhere to the principle of independence and autonomy, enhance the ability to resist financial and economic risks, and effectively safeguard China's economic security and strengthen our own country. Cui Xiaoyu (2021)^[1] The impact of financial risk on China's foreign trade enterprises and countermeasures research are studied from the background of economic globalization. Wu Xin, Wang Wenjing (2016)^[2] Research on whether China's international trade can maintain the original momentum of development in the era of post epidemic economic crisis. The research adopts the combination of quantitative analysis and qualitative analysis, through the construction of two sets of vector autoregressive models, not only to characterize the structure of China's import and export trade, but also to predict the trend of China's import and export trade. Through the overall analysis, it

puts forward highly targeted suggestions for the in-depth development of China's international trade and industrial structure adjustment.

III. Macro analysis of China's import and export trade

First of all, China's import and export trade is analyzed in general, mainly based on the macro level. The analysis is based on the total import and export data of China in the past 18 years, and the analyzed data comes from the statistical yearbooks of China in the past years. In order to ensure the objectivity of the analysis as much as possible, the import and export data are unified in US dollars as a unit for summary statistics. Through macro-analysis, the following chart is obtained (see Figure 1 and Figure 2). As can be seen from Figure 1, China's total import and export trade is basically a sustained growth, with two brief periods of negative growth, respectively 2008-2010 and 2014-2016. The main reason for the first negative growth was the U.S. subprime crisis. From the perspective of the growth trend, before China resumed its WTO membership, the growth was relatively slow; after the subprime crisis adjustment period, the growth momentum was relatively strong. The second negative growth was mainly due to the Russian economic crisis in 2014. In particular, the increase in exports, for example, is still in a period of strong development, with no trend of slowing growth; imports, for example, are currently in a period of growth, but the growth trend has slowed down.

From the point of view of the trade gap between imports and exports, China is in a state of trade surplus as a whole, and the total amount is significantly higher than the total amount of imports. In terms of changes in the surplus, the macroeconomic situation is characterized by a gradual strengthening of the surplus. Trade surplus from the earliest tiny surplus, expanded to today's surplus reached 900 billion U.S. dollars. The size of the surplus has gone through two stages of change, before China has not resumed its WTO membership, the size of the trade surplus is relatively small; after China's resumption of its WTO membership, the trade surplus has gradually expanded as a whole (excluding some years affected by the U.S. subprime mortgage crisis and the Russian economic crisis). In terms of the characteristics of trade surplus changes, the current trend of trade surplus growth is the highest in the same period in history. What exactly are the macro factors that play a decisive role in China's import and export trade, which leads to the pattern of change as above? The answer will be given through the following VAR analysis.

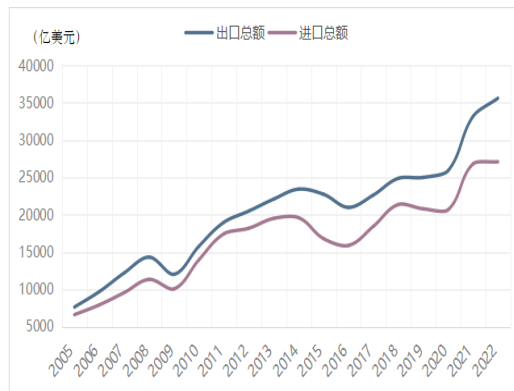


Fig. 1 China's annual import and export trade development

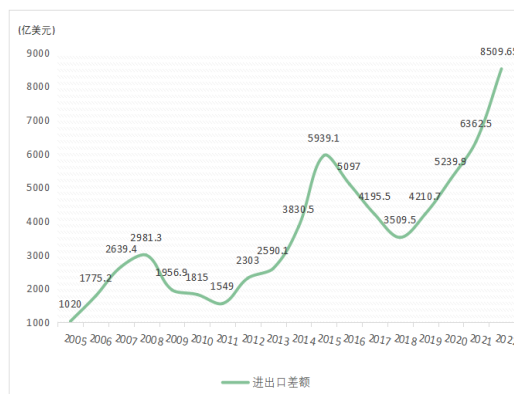


Fig. 2 Development of China's annual import and export trade balance

IV. Empirical analysis

4.1 Indicator data determination

As to how to conduct structural analysis, it is mainly from the input-output perspective. Considering the accessibility and objectivity of international trade data, input-output indicators should be based on officially released indicators. Based on this, for the output indicators, China's total export trade and China's total import trade are taken as the output indicators of international trade. In order to balance the comparability of trade indicators, the exchange rate indicator represented by the US dollar is added as a balancing indicator. Using this indicator, the data of all monetary unit indicators are converted uniformly into data in US dollars. Among the input indicators, the focus was considered to be determined from the factor input indicators. For the input indicators, the core is developed from the perspectives of energy inputs, freight inputs, and labor inputs. Specifically, total employment, cargo turnover, and total energy production are used as specific input indicators.

4.2 Correlation test

Let the total amount of China's foreign import and export trade be y , the total number of people employed be x_1 , the turnover of goods be x_2 , and the total amount of energy production be x_3 , and take the logarithms of the variables be $\ln y$, $\ln x_1$, $\ln x_2$, and $\ln x_3$, respectively, in order to carry out the linear regression analysis. By using SPSS to analyze the simple correlation between the four variables, the results of the correlation test are shown in Table 1.

Table 1 Correlation analysis

evance	rel	ln x1	ln x2	ln x3	ln nx4	l nx5	l nx6	l
	$\ln y$	0.954***	0.956***	0.612***	0.612**	0.612*	0.612**	0
P-value		0.000	0.000	0.007	0.012	0.059	0.041	0

From the simple correlation coefficients in Table 1, it can be seen that there is a significant correlation between the explained variables and each of the explanatory variables, and that the total amount of inter-provincial foreign import and export trade is positively correlated with all the six variables, with a strong correlation.

4.3 Smoothness test

ADF test is based on the extension of Dickey-Fuller unit root test, used to determine whether there is a unit root in the time series data, so as to determine whether the data is smooth or not. ADF test is often used in the field of financial economics, macroeconomics and other fields, used to determine the smoothness of the time series data, such as stock prices, economic indicators, etc. In this paper, we adopt the ADF unit root test to test the smoothness of time series data (with constant term but with trend term). In this paper, we adopt the ADF unit root test to test the smoothness of time series data (including the constant term but not the trend term), which is realized by Eviews.12.0 software to get the test results, and the test results are shown in Table 2 below:

Table 2 Results of the Stability Test

ariant	v	ADF value	Critical values at each level of significance			P-value	Test results
			1%	5%	10%		
ny	l	-1.980	-3.886	-3.052	-2.666	0.2	uneven
lny	Δ	-3.878	-3.920	-3.065	-2.673	0.0	smoothl
nx1	l	1.4442	-3.920	-3.065	-2.673	0.9	uneven
lnx1	Δ	-2.537	-3.959	-3.081	-2.681	0.0	smoothl
nx2	L	-0.754	-3.886	-3.052	-2.666	0.8	uneven
lnx2	Δ	-3.994	-3.920	-3.065	-2.673	0.0	smoothl
nx3	L	-0.501	-3.920	-3.065	-2.673	0.8	uneven
lnx3	Δ	-3.086	-3.920	-3.065	-2.673	0.0	smoothl
nx4	l	-2.954	-3.920	-3.065	-2.673	0.7	uneven
	Δ	-3.994	-3.920	-3.065	-2.673	0.0	smoothl

lnx4		85	35	59	46	087	y
nx5	I	-1.268	-3.675	-3.052	-2.666	0.3	uneven
lnx5	Δ	-3.832	-3.886	-3.216	-2.666	0.0	smoothl
nx6	I	-0.501	-3.920	-3.065	-2.673	0.8	uneven
lnx6	Δ	-3.086	-3.920	-3.065	-2.673	0.0	smoothl
lnx6		68	35	59	46	252	y

According to the above table, it can be seen from the test results that the absolute value of ADF of all time series variables is less than the 5% critical value level, i.e., the original series is not smooth at the 5% level of significance. After the first order differencing of the above variables, the values of all the variables can be rejected the original hypothesis at the 5% level, so that the difference series of the original series are all smooth series at the 5% level of significance. Thus it can be concluded that all the above time series are first order single integer series i.e. I(1).

4.4 Causal analysis

As determined above, input and output indicators, whether there is a statistical correlation between input indicators and output indicators? For this doubt, Granger-Casuality analysis is used to determine (for causal analysis, in the empirical analysis, drawing on scholars Song Gashan (2015)^[3], Wu Xin (2016)^[4], Ruan Hang et al. (2023)^[7]et al. These results provide very many empirical suggestions on how to conduct effective causal empirical analysis). The indicator data used in the whole analysis are from our national database, and the sample time range is from 2005 to 2022. The monetary unit data in the sample data are treated with the above mentioned balancing. The input factors affecting the total export trade of our country and affecting the total import trade of our country were determined and the deterministic results are as follows (see Table 3). From Table 3, two main features can be found, the first is that not all input factors have a causal relationship with output factors, and the second is that for a single input factor, its causal relationship with output factors is not unique. In the first case, the inapplicability of the input indicators was established. For the second type of scenario, the most appropriate structure must be determined through an optimal lag analysis. Suitable lags better characterize the dynamics of the model without causing too much loss of degrees of freedom. The lag order is generally determined by the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SC)^[9]. In this paper, the LR test, AIC information criterion, SC criterion, final prediction error, and Hannan-Quinn information criterion are used to determine the optimal number of lags of VAR, and the results are shown in Table 4 By analyzing the optimal lags, the following results are obtained (see Table 4).

Table 3 Causal analysis test results

		AIUR	AIRI	PCWC	GT	C	TE	EP	T
M	TE	1-step	1-step	5-step	1-step	tep	2-s	-step	2
		0.3776	3.5324	3.8425	3.7299	3482	12.	0.8852	1
		0.0681	0.0812	0.2193	0.0739	015	0.0	.0025	0
M	TI	5-step	5-step	1-step	1-step	tep	1-s	-step	2
		39.734	13.8409	4.4998	3.9172	007	3.8	.9634	4
		0.0247	0.0687	0.0522	0.0678	716	0.0	.0291	0

Note: The first row of the analyzed indicator data represents the lag in which causality exists (causality in this context refers only to causality in which input factors influence output factors, and does not include causality in which output factors influence input factors). The second row of the analyzed data represents the F-statistic in the causality analysis, and the third row of the analyzed data represents the probability of non-existence of causality. Also this econometric analysis was done using the econometric analysis software Eviews 12.0, below.

Table 4 VAR model lag results

	ogL	L	R	L	PE	F	IC	A	SC	Q	H	hy		
& TEM	AIUR	06.9936	1	.876117	5	64E-10	3.	6.16561	-1	5.76152	-1	6.31522	-1	2
TEM	GT &	02.0977	1	.947049	1	62E-09	2.	4.16887	-1	3.73429	-1	4.2582	-1	2
TEM	TEC &	33.1363	1	.696893	1	70E-10	1.	7.01947	-1	6.38041	-1	7.07862	-1	2
TIM	AIRI &	11.0583	1	.931614	5	59e-10	6.	5.54743	-1	5.11285	-1	5.63675	-1	2
& TIM	PCWC	04.4593	1	.420084	0	99E-09	3.	3.91681	-1	3.3084	-1	4.04186	-1	2

From the results of the above analysis, it can be seen that the optimal lags are unique for input and output factors with multiple causality. Therefore, using the existence and uniqueness of lagged causality, VAR model construction and analysis can be carried out.

As far as China's export trade is concerned, among the six VAR models identified, the impulse response decomposition and variance decomposition of total energy consumption, for example, yield the following graph (see Figures 3 and 4). It can be seen that the impulse response of China's total energy consumption on the impact of China's exports is relatively strong, which is completely opposite to Figure 4. However, it should be noted that the variance decomposition of total energy consumption on exports is over-represented. It can be determined that China's exports are mainly dependent on energy consumption to realize, and this dependence and the intensity of dependence is gradually strengthened, rather than gradually weakened. This reflects that China's export trade is still in the middle and lower end of the industrial chain, the industrial added value is not high, and energy dependence and labor dependence is strong. This structural feature is also reflected in exports and cargo turnover. This shows that China's export products are mainly products in physical form rather than conceptual products in design form. Compared with foreign developed countries, it adopts the international trade strategy of separating design and realization - the design of export products is completed in the country, and the realization of export products is completed abroad. It is clearer that China's international trade is still at the lower end of the industrial chain, and this situation is being further strengthened.

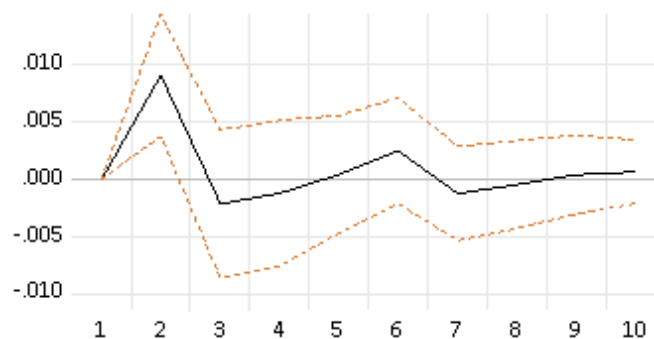


Fig. 3 Impulse response diagram

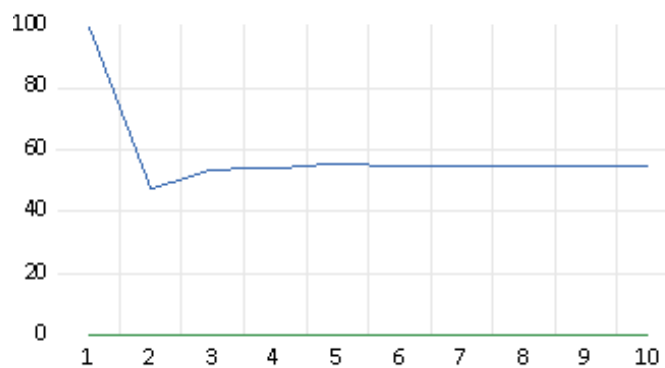


Fig. 4 Variance plot

V. Time series forecasting

Since the VAR model is not applicable to out-of-sample period forecasting, ARIMA time series is used for forecasting. Taking total imports as an example, the relevant charts are shown below:

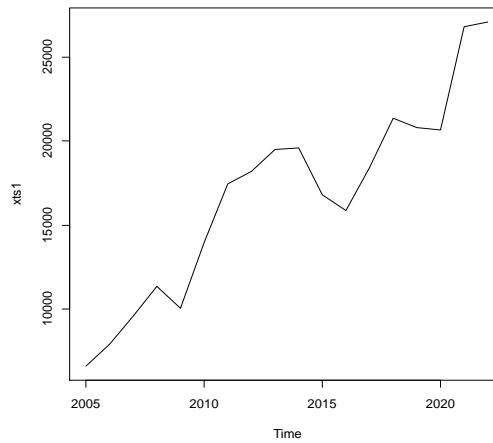


Fig. 5 Timing diagram of inlet sequence

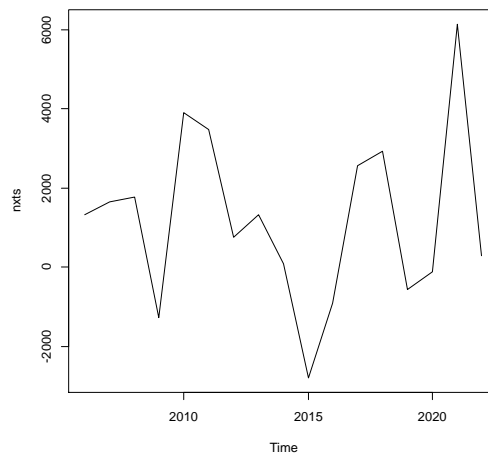


Fig. 6 First order difference diagram of inlet sequence

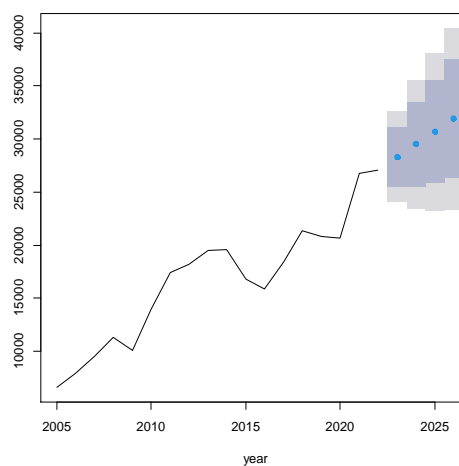


Fig. 7 Forecast of total imports

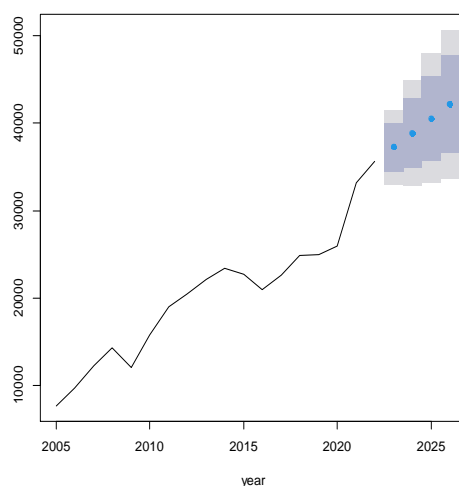


Fig. 8 Forecast of total exports

Table 5 Projected data for total imports

Year	Y	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2023	2	28301.4	25510.5	31092.3	24033.08	32569.72
2024	2	29507.06	25560.13	33453.99	23470.75	35543.37
2025	2	30712.72	25878.74	35546.71	23319.78	38105.66
2026	2	31918.38	26336.58	37500.19	23381.75	40455.02

Table 6 Projected data for total exports

Year	Yea	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2023	202	37251.62	34457.26	40045.98	32978.02	41525.22
2024	202	38897.85	34946.03	42849.67	32854.06	44941.63
2025	202	40544.08	35704.11	45384.05	33141.98	47946.17
2026	202	42190.31	36601.59	47779.02	33643.10	50737.51

VI.conclusions and recommendations

1. Potential analysis

Combining the results of the existing VAR analysis and adhering to the principles of maintaining moderate growth in the income of China's urban and rural residents, and a relatively large year-on-year decrease in energy consumption and energy production, as well as an appropriate reduction in freight turnover, the potential for China's import and export trade is determined. The reason for setting these principles is, firstly, the principle of considering the dividends of reform and sharing by all people, secondly, the results of energy consumption must be consistent with the low-carbon development requirements of the 2023 Global Energy Internet Conference in Beijing, and thirdly, the inherent requirements of ecological civilization development and sustainable development of our country must be adhered to, and based on the above realities, the above principles have been put forward.

With the rapid development of China's economic level, China has jumped to the second largest economy in the world after the United States. The economies of China and the United States are interdependent and competitive, and the relationship is complex and delicate. The United States, as China's major exporting country, has taken some measures to increase tariffs on Chinese exports in order to reduce its trade surplus and weaken the price advantage of Chinese exports to the United States. At the same time, in order to ensure its own high-tech advantage, the United States has also reduced or restricted the export of some high-tech products. These measures have had a negative impact on the trade of both sides.

Since the outbreak of the new crown epidemic, China's foreign trade cooperation has been affected by the flow of people, logistics, and domestic and foreign preventive and control measures. Yiwu, Zhejiang Province, for example, as an international trade city known as the "world's supermarket", is the wind vane of

China's foreign trade and even the global market. Before the epidemic, Yiwu resident foreign businessmen about 15,000 people, each year to Yiwu procurement of foreign businessmen more than 500,000 times. Obstructed by the global epidemic, the number of resident foreign businessmen in Yiwu was reduced by half at the lowest point. With the relaxation of the epidemic policy, businesses around the world began to redirect their focus to the economy. To make up for nearly three years of business losses, exporters and manufacturers from all over China rushed out of the country one after another, scrambling to make contact with foreign customers. However, the prolonged isolation of the domestic epidemic has accelerated foreign customers' search for alternative suppliers. Coupled with the fact that some low-end production chains have been shifted as the domestic industry upgrades, foreign reliance on China has begun to dwindle. As overseas market share shrinks, competition between Chinese exporters and others is becoming more intense.

As far as China's export trade is concerned, it is certain that China's exports are mainly dependent on energy consumption, and this dependence and the intensity of such dependence are gradually strengthening rather than gradually weakening. This reflects that China's export trade is still in the middle and lower end of the industrial chain, with low value-added industries and strong energy and labor dependence. This structural feature is also reflected in exports and cargo turnover. This shows that China's export products are mainly products in physical form rather than conceptual products in design form. Compared with foreign developed countries, it adopts the international trade strategy of separating design and realization - the design of export products is completed in the country, and the realization of export products is completed abroad. More clearly China's international trade is still in the lower end of the industrial chain, and this situation is being further strengthened!

Compared with exports, China's import trade has fewer influential factors, only five, but the way of influence is quite different from exports. Taking the cargo turnover as the object of analysis, it is found that the dependence intensity of China's imported goods on freight transportation shows a continuous enhancement. Combined with the impact of energy consumption on import trade, it can be found that the intensity of energy consumption dependence on China's imports is also characterized by a gradual strengthening. This reflects that the share of primary products in our imported goods is higher. The input direction of imported products is industrial raw materials for export enterprises, which plays a key role in the specific formation of our international trade products. In contrast to the rural income in the export trade, in the import trade, the average annual rural income plays a very strong role in influencing imports and has a relatively large share of influence on imports. This suggests that not only are our exporting firms predominantly rural laborers, but also that the remuneration they can offer to rural laborers is very limited. With the gradual increase in the cost of production and the cost of living, the remuneration provided by export enterprises will gradually decline, which will lead to a continuous decrease in the profitability of their export trade, thus further affecting the feasibility of their international trade. This is also fully reflected in the ultra-high dependence of China's import and export trade on employment.

Through the above analysis, there is a clearer understanding of China's international trade, mainly the structural characteristics of import and export trade.

2. Recommendations

First, international trade is a process of mutual achievement. Political friction between two countries can easily lead to trade disputes, thereby affecting the country's imports and exports. Therefore, it is necessary to take appropriate measures to neutralize the impact of trade disputes. First, countries should actively negotiate with each other and express their demands openly and honestly to minimize the probability of trade disputes; second, in the face of the U.S.'s tough attitude, China should try to find other countries as new trade partners, so as to mitigate the economic losses caused by the U.S. as China's largest exporter; lastly, the national government should improve its ability to predict the potential risks of the trade disputes and strengthen its awareness of the potential risks of the trade disputes. Finally, national government departments should improve their ability to predict potential risks in the aftermath of trade disputes and strengthen their monitoring of global markets.

Second, the liberalization of China's epidemic control policy has facilitated the entry and exit of traders from all countries. Although the three-year-long epidemic control has caused China to miss out on some of its long-term or potential foreign customer base, it has not hindered the development of Chinese goods. China can promote international trade cooperation by organizing or participating in various international exhibitions to expand the avenues for international enterprises to interact and communicate with each other.

Third, compared with trade in goods, China's trade in services is generally less competitive globally. Compared with other countries' trade in services, China's trade in services has developed for a relatively short period of time and lacks more mature experience. For this reason, vigorously cultivating talents related to trade in services is an effective way to improve China's national influence and competitiveness in trade in services. At the same time, it should improve the treatment of foreign students returning to China from all aspects, introduce excellent talents, accumulate excellent experience abroad, and form a set of China's own service trade

development strategy. In addition, China can give full play to its advantages in infrastructure construction technology and actively export such technical services to other countries. China can directly take advantage of the policy of the "Belt and Road" initiative to carry out similar services trade with the countries along the route, so as to realize mutual benefit and win-win situation. In addition, the construction of reasonable trade barriers can help to protect the development of China's internal service industry while restricting imports through the setting of reasonable tariffs, thus avoiding the impact of foreign imported services on domestic services.

References

- [1]. Cui Xiaoyu. Research on the Impact of Financial Risks on China's Foreign Trade Enterprises and Countermeasures under the Background of Economic Globalization[J]. Modern Marketing (Academy Edition),2021(07):88-89.DOI:10.19932/j.cnki.22-1256/F.2021.07.088.
- [2]. WU Xin,WANG Wenjing. Research on the forecasting of China's import and export trade potential - based on VAR analysis method[J]. Economic Research Reference,2016(33):34-39.DOI:10.16110/j.cnki.issn2095-3151.2016.33.009.
- [3]. SONG Jashan,DANG Jintang,HUANG Ting. A study on the deviation between the virtual economy and the real economy of the United States based on cointegration theory and Granger test[J]. Science and Technology Progress and Countermeasures,2015,32(15):49-53.
- [4]. WU Xin,WANG Wenjing. Research on the forecasting of China's import and export trade potential - based on VAR analysis method[J]. Economic Research Reference,2016(33):34-39.DOI:10.16110/j.cnki.issn2095-3151.2016.33.009.
- [5]. Hu Shiman. Analysis of the current situation of China's import and export trade and countermeasures[J]. Modernization of Shopping Malls,2023(24):5-7.DOI:10.14013/j.cnki.scxdh.2023.24.051.
- [6]. ZHANG Yu,YANG Tieli,ZHAO Xin. Sports financial investment, sports development and economic growth--an empirical study based on time series data in China[J]. Journal of Beijing Sport University,2015,38(06):12-17.DOI:10.19582/j.cnki.11-3785/g8.2015.06.003.
- [7]. Ruan Hang,Zheng Yimei,Pei Bozun et al. A study on the extreme Granger causality between China's import and export trade and FDI[J/OL]. Systems Engineering:1-15[2023-12-23].<http://kns.cnki.net/kcms/detail/43.1115.n.20230628.1142.002.html>.
- [8]. ZHANG Wen,WANG Jia,XU Xiaoqin. Analysis of income distribution effects on the evolution of urban-rural employment structure in less developed regions--an empirical study based on Jiangxi Province[J]. Northwest Population,2015,36(05):31-36.DOI:10.15884/j.cnki.issn.1007-0672.2015.05.006.
- [9]. An Juanjuan,Deng Qian. Research on the impact of industrial upgrading on economic growth in Dongguan based on VAR model[J]. Value Engineering,2023,42(29):39-41.
- [10]. He Yinjuan.An empirical study on the impact of higher education on regional economic growth in Jiangxi province under VAR model[J]. Industrial Innovation Research,2023(20):170-172.
- [11]. Chen Xiongbing,Zhang Zongcheng. Reconsideration of Granger causality test[J]. Research on Quantitative and Technical Economics,2008(01):154-160.
- [12]. LI Mengyi,KONG Yinghao. Natural gas price forecasting based on time series modeling[J]. Oil, Gas and New Energy,2023,35(01):61-66.