Literature Review in International Trade Forecasting Based in Machine Learning Method

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Abstract. In recent years, with the intricacy of international politics and economic situation and the anti-globalization trend, China's trade with world is facing many serious challenges. There are more factors that effects China export and import. Because of that, high-precision forecasting for international trade is beneficial for nation's government, guild and export and import enterprise that need a judgement or decision for future. To better promote future research, the paper reviews the paper written by experts from world in trade forecasting field, classifies and summarizes their opinion according in their adopting machine learning method.

1 Introduction

After China's accession to the World Trade Organization in 2002, its economic potential has been further released. World Bank data show that China's GDP reached 17.3 trillion (US dollars) in 2021, and its exports of goods and services reached 3.5 trillion. The average growth rate of China's GDP in the past two decades is 8.7%, surpassing Germany, Japan, France and other developed countries, China now has become the world's second largest economy and the world's largest exporter. With the continuous expansion of the scale of the foreign economy, the domestic supply chain and industrial chain of China's foreign trade industries tend to be complete, and the number of related enterprises on the chain has increased dramatically. From 2012 to 2021, the ratio of dependence on foreign trade of China's economy has been maintained at more than 20%, which is an important part of the national economy.

2 International trade forecasting

2.1 Current situation of China's international trade

Since China's accession to the World Trade Organization, China's economy has begun to integrate into the world. Stable and rapid growth has made it the focus of the world's attention, and has played an increasingly important role in the stability and growth of the world economy, which has further stabilized China's position in the development of foreign trade. From 2002 to 2022, China's total trade exports showed a rising trend, reaching 3.36 trillion dollars in 2021, breaking the 3 trillion dollar barrier.

In addition to the rapid growth of the total volume, China's foreign trade also shows the following characteristics: First, the structure of import and export commodities has been further optimized, and mechanical and electrical products and high-tech products are the main points of trade growth. Second, the export of processing trade and general trade grew basically at the same time, and the import growth was uneven. Third, foreign-invested enterprises, collective and private enterprises have become the main force to promote export growth.

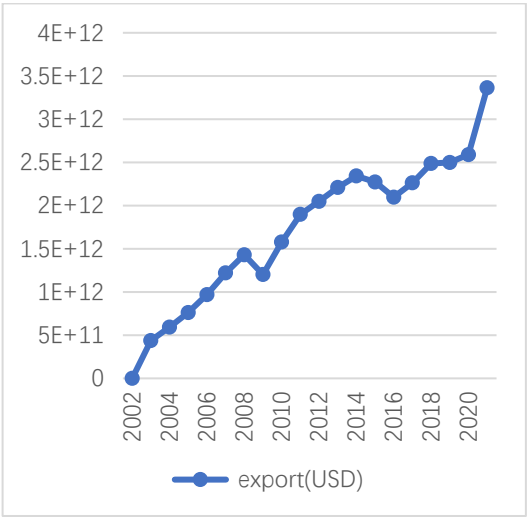

Fig. 1. 2002-2021 The gross volume of China export
Source: World Bank Open Data.

2.2 Risks faced by China's foreign trade

In the context of economic globalization, China's foreign trade enterprises occupy an important position in the global economic chain. A large part of China's national economy has been integrated into the international

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economic system. Under such circumstances, any change in the international economic situation will profoundly affect the development of China's foreign trade enterprises. The main risks faced by enterprises include exchange rate risk, price risk and policy risk.

Exchange rate risk refers to the possibility that economic entities may suffer economic losses or gain gains due to exchange rate changes in the economic activities of holding or using foreign exchange, including foreign exchange trading risk, transaction settlement risk and pricing risk.

The price risk mainly comes from the price fluctuation in the international market and the change of transportation costs. Because the implementation period of international trade contracts is long, and the price in the international market fluctuates at any time, this will bring some difficulties to the price management of enterprises.

2.3 Significance of international trade forecast

In today's world economic integration, the importance of international trade is growing. Especially for countries like China that rely on external demand, the fluctuation of international trade will have an important impact on the international competitiveness and employment of enterprises,. From a macro perspective, China's foreign trade has been maintained at a high level. Foreign trade has directly or indirectly driven 180 million people in employment, accounting for more than 20% of the national employment. It has a huge impact on the national economy and is related to domestic employment and social stability. From a micro perspective, there are a large number of foreign trade related enterprises. If each enterprise wants to survive in the fierce competition, it must predict the import and export situation and more accurately match the international market demand. Therefore, forecasting the export situation and controlling foreign trade risks have become a common problem faced by the government and the government. Among them, forecasting the trade volume of foreign trade is one of the necessary conditions and bases for controlling foreign trade risks. Therefore, it is of great significance to forecast international trade.

At present, for the prediction of international trade, the methods used and the results obtained by some international economic forecasting institutions are generally recognized. The International Monetary Fund (IMF) relies on the investigation and judgment of national and regional experts to propose forecast data, which is submitted to the research department to establish the benchmark situation, so as to achieve the prediction of the main macroeconomic variables of the world economy, including finance, trade, output, price level, etc. The forecasting process of the OECD combines expert opinions and large-scale structural models. First, regional country experts and subject experts propose preliminary forecasts for each country, and then use the Interlink world economic model developed by the OECD to test consistency, focusing on the consistency of cross-border financial and trade links. In addition, the European Commission, the Economic and Social Council of the United Nations and other institutions also forecast and analyze the world economy and trade every year.

From the perspective of prediction methods, compared with institutional prediction, the academic community has a variety of prediction methods and models in this field. These models include regression models[1] based on statistical methods, ARIMA models[2 3,4] based on time series methods and S-ARIMA[5,6,7]models with seasonal factors. They use methods that are widely used in medicine, finance and other fields, and are more innovative and pioneering.

3 Machine Learning

Machine learning is the core of artificial intelligence. It aims to simulate and realize human behavior with computers, so as to acquire new knowledge and reorganize existing knowledge architecture to improve its performance. At present, machine learning has made an important breakthrough in the processing and analysis of massive data, and has been widely used in computer, medical, media, finance, management and other fields. Among them, compared with traditional prediction methods, machine learning methods are more explanatory, and have more advantages in prediction accuracy. Many scholars have also proved this conclusion through experiments. Using machine learning methods to predict foreign trade data has the characteristics of good algorithm effect, strong applicability and easy processing of big data, which brings new solutions. At present, machine learning models widely used in the field of trade economy include grey prediction model, parallel vector machine model and deep learning model.

4 Machine learning method literature review

4.1 Grey wave prediction model (GM)

According to the grey theory, the behavior of a system is seemingly disordered and obscure, but the law must be regularly included in it. Therefore, grey prediction is a method to predict the system with uncertain factors. The generated data is obtained by processing the known sequence data through accumulation, subtraction, mean value and grade ratio, and is brought into the grey prediction model (GM) formula, The predicted value of time series data is obtained.

The grey wave prediction model is an effective tool to deal with the prediction problem of small samples, which is very suitable for the prediction problem of international trade volume, which has a single data index and a small amount of data. In addition, the calculation of the model is relatively simple and accurate compared with other nonlinear models, so many scholars use this model to forecast international trade.

C.Wang[8] and others studied the grey modeling method of import and export trade forecast in 2002, and X.Zhu[9] studied the application of GM model in international trade forecast with the import and export data between China

and Mongolia in 2007. C.Yang and C.Liu[10] constructed GM (1,1) model after translation and transformation of China's import and export data from 2001 to 2013, which further improved the accuracy of the model and made the grey prediction model more suitable for forecasting trade volume. K.Ying[11] and others also used this model to forecast China's overall trade volume. These scholars made predictions on the macro level.

In addition, there are also some scholars studying from the single industry level, such as Yang Jun, who applied the grey prediction model to the prediction and analysis of China's soybean imports in 2006. Later, Y.Ren[12] and H.Zhao[13] will also adopt this model to forecast the import and export volume of Chinese soybeans, and use the forecast data to analyze the relationship between market supply and demand. H.Xiang[14] also used the grey prediction model to predict the honey output and export in China.

4.2 Support Vector machine

Support vector machine (SVM) is a machine learning method proposed by Cortes and Vapnik in 1995 based on statistical theory to solve the problem of small sample and nonlinear data regression. It can achieve a better fitting effect on multi-dimensional data through nonlinear changes and kernel functions.

Zhao 'an Han[15] et al. used the support vector machine model to predict and analyze China's foreign trade imports and exports, and found that the nonlinear prediction results of the support vector machine model were well matched with the actual value of China's foreign trade exports. The prediction error of the support vector machine model was controlled within 10%, showing a good prediction effect. T.Chen[16] and Y.Zheng[17] respectively used this model to study the export of Chongqing motorcycles and Sino Japanese trade. The results show that the SVM method has good modeling and generalization capabilities for non-stationary small sample import and export time series data. Another scholar, S.Bai[18] proposed a trade forecasting method based on PSO optimized mixed correlation vector machine (RVM) model in 2014, using the indicators affecting import and export trade as input data, and verified the accuracy of this method by taking Shenzhen's import and export as an example.

4.3 Deep learning

Deep learning is a popular research direction in the field of machine learning. It is a relatively complex machine learning algorithm. It can process a large number of multidimensional data samples and explore the internal laws of samples with the help of high-performance computers. With its excellent performance in processing nonlinear data, deep learning algorithms have made many achievements in image processing, speech recognition and other aspects, promoting the development of related disciplines. At present, there is little research on the deep learning model in the field of international trade, which mainly focuses on forecasting applications. It can be roughly divided into three main branches: artificial neural network (ANN), recurrent neural network (RNN) and convolutional neural network (CNN).

Based on the artificial neural network, Lei Xu[19] predicted the financial risk of international trade enterprises with the method of back feed neural network (BP) algorithm and time series model, which has good accuracy and error control. Z.Tian[20], with the help of an adaptive neuro fuzzy inference system and a neural network algorithm, established a Sino Russian trade forecasting model with Sino Russian relations, Russian foreign trade and China's foreign trade as inputs. J.Huang[21] combines genetic algorithm and BP neural network, and introduces Guangdong export trade volume data to establish a prediction model, which not only gives play to the excellent generalization ability of neural network, but also improves the convergence speed of the model. S.Zhu and M.Lai[22] set up a time delayed BP neural network model (TDBPNN), used Bayesian regularization method to improve the generalization ability of BP neural network, and applied the model to the prediction of China's import and export trade. The results show that the improved TDBPNN model has good generalization ability, and accurately fits the historical value and trend of import and export trade development.

Scholars have also developed many new forecasting methods based on the algorithm of recurrent neural network, such as M.Shen[23] and other foreign trade forecasting methods that rely on long-term and short-term memory neural ne tworks. The empirical results show that this method can properly model the time information about the uncertain trend of foreign trade data. J.Yi[24] decomposes the high-frequency data in the trade time series data with the help of wavelet transform to build a Gated Cycle Unit (GRU) model, which overcomes the possible risk of over fitting of the deep learning method in small sample data. Y.Deng[25] also used the short-term memory model in his research on the import and export volume of China-ASEAN, and combined this model with ARIMA model to improve the prediction accuracy.

5 Conclusions

From the perspective of machine learning methods, the grey prediction model is favored by most scholars because of its simple structure and small amount of data required. Therefore, the number of documents using this model for empirical analysis accounts for a large part of the total number of relevant documents. However, methods such as support vector machine and neural network have high requirements on the modeling level of researchers, so only a few scholars have explored this aspect. From the perspective of model accuracy, the deep learning model shows a better prediction effect, which can better reflect the nonlinear law in the import and export trade volume time series, and is more consistent with the actual trend

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