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SHANGHAI MARITIME UNIVERSITY
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The formation mechanism of China's export container freight rate

By

LIU YUCHAO

China

A dissertation submitted to the World Maritime University in partial fulfillment of the
requirements for the award of the degree of

MASTER OF SCIENCE

INTERNATIONAL TRANSPORT AND LOGISTICS

2021

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DECLARATION

I certify that all the material in this research paper that is not my own work has been identified and that no material is included for which a degree has previously been conferred on me.

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ABSTRACT

Title of research paper: **The formation mechanism of China's export container freight rate**

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The smoothness of container freight rate not only affects whether the capacity supply of container ship is stable, but also affects the income level of enterprises related to container shipping, as well as the cost and price of international trade based on maritime transport, which has a profound impact on the globalization of trade. Since China's accession to the WTO, China is playing an increasingly important role in international trade, and the demand for container shipping capacity has gradually increased, directly promoting the increase in the freight rate rates of container shipping. However, the fluctuation of the market price of container ship transportation, as well as the uncertainty caused by the particularity of container ship transportation services, have brought difficulties to the country's macro-control, increased the cost of international trade, and adversely affected the stable operation of container ship companies. Therefore, to understand the law of tariff changes of China's export container ships, fundamentally grasp the mechanism of the formation of container ship freight rate rates, accurately grasp the specific type of container ship freight rate rate formation reasons. It is of positive significance for the state to formulate effective macro-control policies, stabilize the freight rate and logistics cost of container ships, and promote the steady development of international trade.

This paper mainly through the past domestic and foreign container ship freight rate research data collection, identification and collation, to arrive at the container ship freight rate rate formation process of various factors, links of the relationship and mechanism of action, grasp the main situation and progress of the study. From the perspective of western economics, this paper analyzes the pricing power and price formation process of various types of container ship capacity, studies and analyzes

the pricing power of different types of ship capacity, distinguishes the process of container ship capacity price formation under different market conditions, and grasps the main factors of container ship capacity price formation.

This paper uses a combination of qualitative and quantitative analysis of the factors affecting container ship freight rate rates, makes theoretical and empirical analysis of the problem of China's container ship freight rate rate mechanism, and finds out the factors affecting the freight rate rates of container ships on the basis of detailed analysis of the factors affecting the supply and demand of China's export container ships, and constructs a causal relationship between the factors that form the freight rate rates of container ships. The process system analysis of container ship freight rate rates is carried out, and then the container ship transport market is studied by using this model, and then the regression equation model of China's export container ship freight rate rates is constructed by establishing econometric model, which is carefully analyzed according to the influence factors in the model and the corresponding countermeasures to solve the freight rate problem of China's export container ships.

KEYWORDS: container ship freight rate, formation mechanism, China's export, econometrics, regression model

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Chapter 1 Introduction

1.1 Research background

As a large international import and export country, international trade is an important link of China's socio-economic development. With the establishment of China's export-oriented economic model, the stability of container shipping freight rate rates plays an important role in stabilizing China's leading position in international trade.

The freight rate of container ships, like other freight rate freight rates, consists of three parts: the value of the transport material consumed in transport, the value created by the necessary labour of the transporter and the value created by the residual labour of the transporter. At the same time, the freight rate of container ships is also affected by the supply and demand of capacity. The smoothness of container freight rate not only affects the capacity supply of container ship transportation, but also affects the income level of enterprises related to container ship transportation, as well as the cost and price of international trade based on maritime transport, which has a profound impact on the globalization of trade.

Since China's accession to the WTO, China's economy has continued to develop rapidly, the import and export volume in international trade has increased significantly, and the demand for container ship transportation has been gradually increasing, which has directly promoted the rise in the price of container ship transportation. However, due to the outbreak of the global financial crisis, the fluctuation of international crude oil prices, the storageability of container ship transport capacity and other factors have led to a great instability in the balance of supply and demand in the container shipping market, but also make China's container ship freight rates after the 2008 financial crisis has again occurred huge fluctuations. Therefore, the main influencing factors in the process of container ship freight rate formation are studied, and the main link of container ship freight rate formation is fundamentally grasped. It is of positive significance for the state to formulate an effective policy for container ship transportation industry, stabilize the freight rate of container ship and promote the smooth operation of social economy.

The change of container ship freight rate is subject to many factors, all the factors that affect the capacity supply and capacity demand may cause the change of container ship freight rate. China's export container ship transport capacity demand fluctuates greatly, the derivation of container ship transport demand leads to international trade for container ship capacity supply has an irreplaceable adjustment role.

At present, with the development of global economic integration, the container ship transportation market and shipbuilding, second-hand ships, international trade, finance, global economy and other markets have an interrelation role, domestic and foreign scholars to study their relationship, mainly divided into two categories: one is the container ship transport market and ship transport market, second-hand ship transport market and other container ship transport industry related market correlation, one is the container ship transport market and international trade, manufacturing and other external related markets.

In the study of the correlation between the container ship transport market and its associated markets, Zhang and others studied the relationship between the container ship transport freight rate market, the new ship transport market, the second-hand ship transport market and the container ship transport stock market before, during and after the financial crisis. Gu et al. explore the relevance of international container ship transport to the domestic container ship transport market. Jiang Bao used the VAR model to explore the correlation between container shipping freight rate rates and export trade on the Maritime Silk Road in the study of the correlation between the container ship transport market and the external industry-related market. The study found a one-way causal relationship between China's export container freight rate index CCFI and manufacturing PMI. Using the GJR-GARCH-DECO model and the volatility spill factor method, Maitra Debasish and others studied the correlation between oil prices and container shipping stocks and found that the volatility correlation between the two increased during the 2007-2009 financial crisis and the 2010-2012 European debt crisis. Wang Qiong and other VAR model-based CCFI and international crude oil prices, container ship capacity, China's import and

export trade relationship. This paper hopes to examine the above points and make a more in-depth analysis of the price of transportation of my container ships.

1.2 Purpose and significance of the study

By studying the formation mechanism of container freight rate and analyzing the relationship between the factors affecting container ship freight rate, it will help China to formulate macroeconomic policies on container ship transport industry.

From the practical significance, the main purpose of carrying out research according to the characteristics of container ship transportation market is to deeply understand its operation law, reveal and demonstrate the internal relationship between the overall trend of container freight rate and local characteristics of economic operation, and predict its development trend while scientifically simulating the mechanism of price formation of China's export container ship transportation market. By analyzing the correlation coefficient between the price of China's export container ship transport market and the import and export volume of international trade, the reasons for the price fluctuations in China's export container ship transport market are analyzed, and the relevant policies and measures are helped to formulate relevant policies and measures to promote the steady development of the container ship transport market. From the theoretical research point of view, on the basis of the previous use of system dynamics methods for macroeconomic simulation, this study will establish econometric models that facilitate the simulation of policy regulation and control;

1.3 Research ideas and methods

1.3.1 Research Ideas

This study will be based on the basic ideas of system theory and the basic economic law of the container ship transportation market, using qualitative analysis and quantitative calculation of the combination of methods. First, the system mechanics method is used to break down China's export container ship transportation market

into interconnected subsystems, qualitatively analyze its influencing factors and mutual causal feedback, and then establish a system dynamic causal feedback map according to requirements and operability principles, understand the formation mechanism of both sides, then establish econometric model, analyze the existing problems, analyze the sensitivity factors, and finally adjust the adjustable variables in the model, and make policy simulation experiments in order to make policy recommendations.

1.3.2 Research methods

(1) System dynamics

System dynamics is a kind of complexity for all kinds of economic systems and based on the knowledge of system structure, automatic control and information transmission, which absorbs the knowledge of systems theory, control theory, information theory computer simulation technology, management science and decision-making theory, and is a quantitative method to study complex social systems. The research object of this paper is that the container ship transportation economic system is a complex social and economic system, there is information feedback and delay between the supply and demand of capacity, and the change of a certain quantity in the social and economic system will lead to the change of the state of the system.

System dynamics uses quantitative and experimental methods to study the characteristics of information feedback in socio-economic behavior, and simulation methods to study the role of policy and the effect of delay in system behavior on the dynamic behavior of the system. System dynamics can use the conceptual model of feedback structure, with the help of computer, to study the characteristics of the change of state of the system due to the change of policy, find out the role point of the policy in the system, test the sensitivity of the system to the policy, study the possibility and timing of improving the system structure, try to eliminate the problems in the real system by changing the policy and system structure, and guide the social and economic system to the desired goal. Therefore, it is appropriate to use

systematic dynamics to study the problem of container ship transportation market.

(2) According to the forecast model and forecast method

The system dynamics model needs some data as known data input, the relevant indicators must be predicted, the variables must be predicted before the model must be established, and the parameters in the model must be estimated using observable historical data. The model describes the dynamic characteristics of data changes, and the model can be used to link the present with the statistical characteristics of the past and extrapolate the observable historical data. The basic prediction methods used in this study are regression analysis prediction:

Regression analysis prediction is a causality prediction method, which is a method of making prediction by analyzing the degree of causality and mutual influence between things. Regression analysis is based on data, and the actual data is fitted with mathematical analytical models or relational patterns to reflect the potential regularity of the data. Regression model is an analytical approach that reflects the causal relationship between explanatory variables and interpreted variables, which is influenced by internal and external factors, and usually can only provide a rough trend of development with regression model prediction.

1.3.3 Research content

The main research content of this paper is to construct a system dynamic model suitable for the container ship transportation market, and to carry out empirical research, based on the scientific prediction of future container ship freight rates, early warning analysis, and then to carry out policy simulation research. The content of the paper can be summarized in two aspects:

(1) Study on the formation mechanism of the price formation mechanism of China's export container ship transportation market

Starting from qualitative analysis of the internal and external factors affecting the container ship transportation market, find out the various factors affecting the freight rate of container ships, and construct a causal feedback chart to fully understand the interaction between the various subjects of the market.

(2) Establish econometric models for empirical research

The theoretical model is formatted, that is, the relationship between variables with causal feedback relationship is clarified in the form of mathematical equations, the initial value of variables is determined, and then the computer simulation is carried out to compare the simulation results with historical data to test the feasibility of the model.

On the basis of model analysis, we fully understand the impact of container ship freight rate fluctuations, analyze the causes of fluctuations, and simulate government management departments to formulate relevant policies and measures by changing the mathematical parameters and variable initial values of the system dynamics model.

Chapter 2 A Review of Literature

The freight rate of container ship has always been the core problem in the research of container ship transportation. Because the capacity demand of container ship transportation is derived and has more influencing factors, the price of container ship transportation fluctuates frequently and sometimes very sharply. However, container ship transportation, as an important link in the field of modern international logistics, requires container freight rates to remain relatively stable. Therefore, to ensure the relative stability of container freight rates, we need to study the market's self-regulation ability under the premise of government policy influence. In the past, the relevant price research also mainly revolves around the market regulation under government policy.

2.1 Research on the freight rate of container ships

This paper selects China's container ship freight rate as the starting point of research, and focuses on analyzing the formation mechanism of China's export container ship transport market price. The focus of the study on China's container ship transport pricing mechanism is mainly based on the following reasons: First, price is the core of the market economy, and the change of container ship freight rate directly affects

the vital interests of various economic subjects and the fluctuations of the global economy. Since China's accession to the World Trade Organization, with the advance of economic globalization, the adjustment of container ship freight rates has been gradually moved towards market regulation by the government in the past, and the price of container ship transportation has changed more and more frequently. The result of the change in the freight rate of container ships has changed the distribution of benefits between cargo owners, carriers and the government, and the imbalance in the distribution of benefits has often become the motivation for new reform measures. In addition, container ship transportation as a basic international logistics link, its price fluctuations in the national economy have an important impact on many variables, such as container ship transport capacity, residents, especially urban residents income, GDP level and so on. The important role of container ship freight rate fluctuation in the steady development of social economy can not be ignored by any government that has the status of a great power in international trade.

Secondly, the pricing mechanism of container ship transportation not only determines the characteristics of price changes, but also has an important influence on the expected and capacity supply behavior of shipowners. Under government pricing, the price level is relatively fixed and can reflect the government's intention, but the efficiency of resource allocation is not high, and market pricing can achieve the effective allocation of resources, but the volatility is not conducive to the stability of the container ship transport market. More importantly, the influence of pricing mechanism is not limited to market exchange, empirical research shows that it has an important impact on shipowner's earnings expectation and capacity supply behavior. Under different pricing mechanisms, there are great differences in the response of shipowners to price changes, and the behavior of shipowners will eventually affect the volatility of the entire container ship transport market.

Thirdly, The imperfection of container ship pricing mechanism is a major problem to be dealt with in the development of container transportation market in China. In the development of China's economy, for the container ship transport economic development started late, mastering the container ship transport tariff pricing power

still faces many challenges. Among them, the imperfection of the pricing mechanism of container freight rate is a key factor. Against the background that the government's complete monopoly pricing has long existed and the price of China's export container ships is facing full marketization, China is striving to seek pricing power in the international container ship transportation market. Although the container throughput of Chinese ports has been in a far-leading position in the global container throughput, it is still necessary to further study and improve the pricing mechanism of the container market to grasp the voice in the process of international container ship transportation pricing.

As can be seen from the law of supply and demand, the freight rate of container ships is determined by the supply of capacity and demand, and the research on the market price of container transportation at home and abroad is mainly carried out from the theoretical and empirical levels.

In economic theory, the relationship between the supply of capacity and price of container ship transportation is mainly reflected in the setting of supply function. Smith (1928) and Bean (1929) were the first to derive the supply function. Since then, the research mainly widens the range of variables in the supply function, introduces the person's expectation mode, risk preference, system and other factors into the supply function, thus enhancing the explanatory power of the function. The most important results are reflected in the study of producer expectations: Muth(1961) presents a childish price expectation model that assumes that producers do not have a learning process and simply uses the previous year's market price to make decisions; Nerlove(1,956) assumes a learning process in production, resulting in an adaptive price expectation model(Adaptive Model), which assumes that producers can correct their judgments on price expectations based on past experience; Rational price expectations, etc., are based on a broader range of information, assuming that producers rationally use all the information available to maximize utility. As China's export container ship transport market belongs to the oligopoly market, many scholars have studied the response of cargo owners' capacity demand to market prices. In the reaction of cargo owners to market prices, according

to Xu Mei(2010), the response of Chinese cargo owners to changes in the market price of container ships is quite small, and the effect of changes in container ship freight rates on capacity demand is no greater than that caused by changes in raw material prices.

In the supply of China's export container ship transport market, some studies including the study of Zhao Buorong&Zhu Pengzhou (2015) show that there is a huge gap between the total capacity of China's export container ship transport and the supply of container ship transport market, the main reason for this gap is the shipowner's initiative to reduce the capacity supply behavior. With the continuous improvement of the basic theory of microeconomics, the research including the study of Bernacki Dariusz on the demand of container ship capacity in western countries is mainly based on empirical research, and many economists use survey statistics to construct and test consumption functions. In recent years, some domestic research including the study of Shan fusheng on the demand for container ship capacity analysis is becoming more and more detailed. Some books and articles including the study of Xing Yuwei divide the total demand of container ship capacity into the demand of offshore routes and the demand of ocean-going routes, and analyze the changing trend of China's export container ship capacity demand through the statistics of previous years, and try to summarize the laws.

The market price of goods is determined when the market supply and demand are balanced, but for the container ship transport market, one of the striking problems in the supply and demand balance mechanism is the "cobweb fluctuation". The "cobweb model" was proposed by Tinbergen et al. and has been expanded and refined by many economists. Traditional cobweb models suggest that the supply of the t -period is determined by the price of the $t-1$ period. Some western economists believe that it is a simple practice to study the spontaneous fluctuations in the market of container ship transport products using traditional cobweb models, because when the production cycle repeats and the price changes one cycle after another, it is unrealistic to assume that the producer keeps the expected price at the previous level forever, because the producer will gradually revise their expected price from their

own experience, bringing the expected price closer to the normal price, thus proposing a cobweb model that introduces the expected price and the normal price. The expected price for period t is the price determined after the producer compares the actual price of the $t-1$ period with the expected price for the same period and adjusts the expected price for the $t-1$ period. Using cobweb theory to examine the specific situation of the container transportation market in the Chinese market will find that the trend of divergent cobweb fluctuations or the trend of spontaneous fluctuation of unstable equilibrium can not achieve stable equilibrium by the spontaneous action of market mechanism, and must be achieved with the help of government regulation. Other studies have specifically examined the different fluctuations in different container ship types, and so on. But these conclusions are only preliminary.

The general law of container ship transportation market can be derived from the basic theory of international trade in international economics. When a country's economy moves from closure to opening up, it has an impact on the production and prices of domestic related products as early as Adam Smith and David. Ricardtu's writings are covered. Since then Heckcher and Olin have developed classical trade theory, pointing out that the difference of factor endowments among countries is the basis of comparative advantage and the reason for the formation of international trade. Since China's accession to the World Trade Organization, it has rapidly emerged as a world factory by virtue of international trade, and the volume of import and export trade has started to grow significantly, and the international logistics services with derived needs, represented by container ship transportation, have also developed rapidly. But soon a key issue in international trade, the different trade policies of different countries, led to the emergence of international trade friction. As Lockwood Erin (2021) said, this is mainly reflected in the unequal political economy problems of countries in the world. With the process of China's accession to the WTO, the analysis of the impact of China's accession to the WTO on the field of container ship transportation is emerging, some studies including the study of Wei jiafu (2001) have discussed the long-term and short-term impact of China's export

container ship transportation, and some studies have discussed the impact of China's export container ship transportation industry from the perspective of trade protection policies such as price protection and market integration.

2.2 Study on policy behaviour in the field of container ship transport

The government's basic concept of container ship transportation market is based on the smooth flow of international logistics is a kind of trade guarantee. The history of container ship transportation Market economic development shows that the market alone can not guarantee a stable container freight rate in the special period of major trade policies and financial crisis, we must rely on the guidance and regulation of the government to ensure that the price of container ship transportation is maintained at a price level that can promote the healthy development of the industry. The Chinese government guides the container ship transport market through state-owned enterprises and a series of container ship freight rate indices. The role of the government in the container ship transport market has also been a problem in the economics of container ship transportation research including the study of Zhu Mo&Zhangqiang (2015). There is a lot of research on the regulation and control of the container ship transportation market by the Chinese government, which has a certain background: before the reform and opening up, the Chinese government monopolized the whole industry through state-owned enterprises. After the reform and opening up, the Chinese government opened up the container ship transportation market to the world, forming a loose oligopoly market. Due to the rapid growth of container throughput in Chinese ports, the total throughput has been far ahead of the world, ranking first in the world, and many scholars have made in-depth analysis of the pricing power of container ship transportation from the perspective of policy formulation and theoretical research. For example, The research including the study of Chen Jinhai, Yu Siqing&Ren Ye on government regulation and policy measures mainly focuses on the pricing power of container ship transportation.

Policy research on improving China's export container ship transportation market.

There is a general consensus in the current research that the future direction of development should be based on marketization. With the Chinese government's policy objective of building Shanghai into an international container ship transportation center, the Shanghai Container Ship Transport Exchange has launched a series of container ship freight rate indices since its official establishment. Discussions about how to develop, improve and regulate China's export container shipping market are beginning to deepen, rather than just discussing the big goal of marketization. At present, the leading idea is to establish and improve the container ship transport financial derivatives market, through the Shanghai Shipping Exchange issued a series of container ship freight rate index to guide and regulate the container ship transport market. Combined with previous studies, we will find that these studies rarely analyze the price of China's export container ship transport market from the perspective of pricing mechanism. The internal mechanism of the formation, as well as the pricing mechanism and the deep-seated reasons for the change. Ignoring the comparative analysis of different pricing mechanisms, it is difficult to understand the importance of China's export container ship transportation market to grasp the international pricing discourse. Therefore, this paper focuses on the transportation pricing mechanism of China's export container ships, analyzes the reasons for the formation of oligopoly pricing, market pricing, the internal mechanism of price formation under different pricing mechanisms, and the dynamics of the change of pricing mechanism. In particular, we should elaborate on the role of futures pricing in stabilizing China's export container ship transportation market from a theoretical and empirical point of view. In addition, this paper will also discuss the container freight rate decision mechanism closely related to the public policy issues of container ship transport. China's container ship transportation pricing mechanism has undergone an evolution from comprehensive government control pricing to market-oriented pricing. At different stages of economic development, it should be seen whether a pricing mechanism is reasonable to see whether it can achieve the corresponding container ship transport policy objectives. With the change of macroeconomic environment, capacity supply capacity of container ship

transportation and other factors, the original container ship transportation pricing mechanism can not adapt to the requirements of the policy objectives under the current actual development of China's economy, and finally causes the replacement of the pricing mechanism of the transportation of new and old container ships. Although marketization is the future direction, the spot market alone still can not solve a series of deep-seated problems caused by the demand derivation and non-storage of container ship capacity. For example, in the only primary market, shipowners lack more accurate expectations, easy to lead to the blindness of expanding capacity, thereby aggravating the instability of the container ship transport market, and the inherent instability of the container ship primary market is China's export container ship transport market to further develop the problem. In order to stabilize the market price of container ship transportation, it is necessary to introduce the market of financial derivatives of container ship transportation to match the primary market. Container ship transport Financial derivatives through a series of unique institutional arrangements can effectively make up for the shortcomings of the primary market, can form a long-term equilibrium price, stabilize the shipowner's earnings expectations and capacity supply behavior, avoid market risks, reduce fluctuations in the container ship transport market. Actively exerting the function of financial derivatives market can provide a new perspective to solve the problem of long-term large price fluctuations in container ship transportation market.

2.3 Problems facing China's export container ship transportation market

Because the container ship transport market is affected by international trade and maritime emergencies, there are many uncertainties, and the ship's construction cycle is long, easy to fluctuate, less alternative, and less easy to store capacity. Under the condition of market economy, although the market mechanism can play an effective role in the allocation of container ship transportation capacity resources, but also has its Achilles heel, because market regulation is an after-the-fact adjustment, from container ship freight rate formation, market feedback to container ship capacity supply link, there is a time difference, coupled with the shipowner's micro-decision

inevitably with a certain degree of passivity and blindness, which may increase the market container ship freight rate fluctuations, so that the contradiction between supply and demand intensified. As the capacity of container ship transportation is completely regulated by the market, once the supply and demand relationship is out of balance, the price fluctuation of container ship transportation is too high, on one hand, it will hit the owner's earnings expectations, resulting in a decline in the supply of container ship transport capacity. On the other hand, the rapid rise in the price of container ship transportation will promote the chain reaction of international trade prices and affect the steady development of China's import and export trade. Therefore, it is necessary to establish a long-term and effective price stability mechanism to ensure the comprehensive balance of the total supply and demand of container ship transportation.

Chapter 3 China's export container transport market analysis

3.1 China Export Container Ship Transport Market Freight rate system

The freight rate system of China's export container ship transportation is a relatively single system, dominated by market prices. The price of the invisible container ship transport market is represented by the freight rates set by some large container ship companies doing business in China. Since China's accession to the WTO, China's container ship freight rates have followed a tortuous path with the vigorous development of international trade and the strong impact of the world financial crisis. Looking back at the 48-year history of China's export container ship transportation market, the change in container ship freight rates is roughly divided into three phases:

China opened international container transport by sea in 1973 and Shanghai to Yokohama, Osaka and Kobe by cargo ship in September 1973. Since 1973, when Tianjin took off its first international container, after the beginning of the 1970s and the steady development of the 1980s, China has a modern container fleet and built a number of container-specific deep-water berths. By the 1990s, China's international

container transportation was beginning to attract worldwide attention. At this stage, China's export container ship transport market is mainly controlled by state-owned enterprises, container ship freight rates are also indirectly set by the government according to the needs of economic development. At this stage, China's export container ship transport market is to some extent biased towards being completely monopolized. With the rapid development of China's economy, China's export container ship transportation market has also entered a high-speed development stage,^{2,001} China's accession to the World Trade Organization, China's Shanghai, Hong Kong, Shenzhen Port has developed into the world's first container port, third and fourth place; During the same period, international container shipping companies began to enter the Chinese market on a large scale, and various Chinese and foreign ownership of small and medium-sized container shipping companies also appeared in the Chinese market. China's export container ship transport market has entered a phase of explosive growth, China's export container ship transport market capacity continues to expand, while freight rate rates are also rising. At this stage, China's export container ship transport market has the trend towards a fully competitive market. It was not until the financial crisis of 2008 that the level of international trade began to slow and the container shipping market suffered a major setback. Due to the disorderly expansion and investment of a large amount of capacity in the market before, the market oversupply after the outbreak of the crisis, freight rate rates fell rapidly. Subsequently, large container shipping companies began to gradually reduce capacity, a large number of small and medium-sized container shipping companies out of the market. Since then, China's export container ship transport market has officially moved into the era of oligopoly. In the first half of 2019, due to the slowdown in world economic growth and the overall deterioration of the global trading environment, Canada-China trade frictions continued to escalate, with some of China's exports being hit hard and China's export container shipping market also being hit. Export overdrafts in 2018 due to trade frictions also contributed significantly to the slowdown in demand for 2019. Against the backdrop of weak demand, continued trade frictions between China and the

United States and new rules of the "sulfur restriction order" implemented by the International Maritime Organization in 2020 have had many adverse effects on the market. But after the outbreak of a new global crown outbreak, china's export container ship transportation market became active again because the outbreak in China was effectively controlled at the earliest.

3.2 Volatility characteristics of China's export container ship transport

For the vast majority of markets, price fluctuations are a very common phenomenon, as the shipping industry container ship transport market is no exception. Because the expansion of the capacity of the container ship transportation market is restricted by the international trade and shipbuilding cycle, the price volatility of the container ship transport market is often more obvious than that of other markets. This section mainly examines the fluctuation of container ship freight rate after China's accession to WTO and analyzes the characteristics of container ship freight rate fluctuation.

Normal container ship freight rate fluctuations are mainly reflected in quarterly fluctuations. China's container shipping market is mainly divided into North America East-West route market, South America East-West route market, Africa East-West route market, Southeast Asia route market, Australia, New Zealand and South-West Pacific island route market, Northern Indian Ocean route market, Mediterranean route market, West and West Nordic route market. Therefore, in the following analysis will be specifically examined these routes by the market price. As mentioned earlier, this paper mainly examines the changes in the price of China's export container ship transport market after China's accession to the World Trade Organization.

The study on the characteristics of freight rate fluctuations in container ship transport often breaks down the tariff sequence into four aspects: long-term trend, cyclical fluctuation, seasonal fluctuation and irregular fluctuation. Long-term trend refers to the basic level and overall direction of the development of container ship transport tariff time series over a considerable period of time, although the actual value of the freight rate sequence tends to deviate from its long-term trend, up or down at a given

time, but in the long run, the sum of positive and negative deviations is zero. Periodic cycle refers to the periodic up and down fluctuations of the tariff sequence over a long period of time, each cycle includes four stages of peak, drop, trough and rise, which represents the cycle fluctuation process in which the tariff falls from the peak to the trough, then rises to the peak, and then falls to the trough. Seasonal fluctuations refer to seasonal fluctuations in the freight rate rates of container ships that are subject to seasonal changes within one year due to seasonal climate and production. The difference between seasonal fluctuation and periodic cycle fluctuation is that the seasonal fluctuation period is less than one year, the occurrence time of the peak trough is relatively fixed, and the periodic cycle fluctuation period is greater than one year, the length is uncertain, and the peak trough appears period is also uncertain. Irregular fluctuation refers to the price of freight rate caused by a number of uncertain micro-factors, such as oil prices, exchange rate fluctuations, such as the frequency of these small factors occur more frequently, the impact is small, basically in a purely random way, or sudden time, such as strikes, military conflicts, natural disasters, etc. , they produce fluctuations are basically irregular fluctuations.

3.3 Definition and composition of the market price of China's export container ships

China's current container freight rate system is a relatively single system. International market prices dominate the entire China export container ship transport market freight rate system. Before analyzing the price warning of China's export container ship transport market, it is necessary to define the definition and composition of the concept of price.

The emergence of container liner transportation has promoted the rapid development of "door-to-door" transportation, which has extended the sea transport service to the whole process of transportation. The whole process of container multimodal transport is divided into five sections: inland transportation stage of receiving and originating, loading and unloading port of loading and unloading, and sea

transportation stage. The cost structure and sharing of container transport are complex because the form of consignment of goods transported by container liners (whole and LCL), handover terms, whether or not inland transport are included, etc. However, in general, the basic composition of container liner freight rate rates can include sea transportation costs, inland transportation costs, various types of loading and unloading costs, packing costs, yard operation costs, etc

3.4 Analysis of the factors influencing the freight rate of China's export container ships

3.4.1 Supply demand factors

The imbalance in China's export container shipping market is the determining factor of the long-term trend of freight rate fluctuations. The supply of container ship transportation market refers to the capacity of ships available in the container ship transportation market for a certain period of time, mainly influenced by direct or indirect factors such as market structure, freight rate level and transportation cost. The demand of container ship transportation market refers to the quantity of transport services demanded by shippers in the container ship transport market for a certain period of time, which is generally measured by the volume of containerized goods trade, mainly influenced by the world economic development, freight rate level, international political and economic events, natural disaster events and other factors. "It can be seen from the theory of price equilibrium that when the market supply is less than demand, the increase in freight rate rates will promote the increase in supply, and conversely, when the market supply exceeds demand, the fall in freight rate rates will lead to a decrease in supply." Since the 21st century, the integration of global economy and international trade has led to the increase of containerized goods trade volume and the increase of container freight rate in China. And because of the characteristics of the market structure, China's export container ship transport market entry and exit barriers are high, in a short period of time it is difficult to rapidly and substantially reduce capacity, freight rate rates to rise sharply again, will depend on

the Chinese market container goods trade demand. Therefore, from a long-term macro perspective, the price fluctuations in the container transport market in China are determined by market supply and demand, that is, by the capacity of container ships in the market and the volume of containerized goods traded in the Chinese market.

3.4.2 Transport cost factors

Transportation cost is the most direct and basic factor affecting the fluctuation of freight rate rates of China's export container ships, and it is the most important component of freight rate rates. Container ship transportation costs mainly include fixed investment, voyage operating costs, management costs, financial costs, etc. , which account for more than 90% of freight rate rates. Therefore, container shipping enterprises pay great attention to the control of transport costs, if the freight rate rate is much higher than the transport cost, then attract more competitors and capacity to the market, which in turn causes the freight rate rate to fall to the broad cost (including the average profit and tax costs) near;

It should be noted that the transportation costs of container ships in the air transport costs accounted for a large proportion of the total cost, and fuel costs in the voyage operating costs of up to about 16%, therefore, fuel costs in China container shipping price fluctuations have a more important impact. Studies have shown that there is a clear correlation between freight rate fluctuations and oil price fluctuations, so container ship freight rate fluctuations are also greatly affected by international oil price fluctuations.

3.4.3 Market structure factors

The structure of container ship transportation market reflects the competition, resource occupation and transaction relationship between shipping companies in the container shipping market, which can be divided into complete competition, monopoly competition, oligopoly and total monopoly market. The development of

container ship transport alliance has further increased the ability of enterprises to control capacity in practice. At present, China's export container ship transport market is close to the oligopoly market, leading container shipping companies can control freight rate rates to a certain extent. The increase of market concentration has brought about the improvement of economies of scale, and to a certain extent, the efficiency of the market. But when the dominant enterprises in the market have full tariff control capability, through alliances and other means, collective reduction of effective capacity supply to increase freight rate rates in order to obtain excess profits, at this time will require government supervision of market freight rate rates.

3.4.4 World economic factors

The world economy mainly affects the fluctuation of international container liner freight rate rates by affecting freight rate demand. The changes in the global economy have caused the increase or decrease of China's international trade in goods, which in turn has affected the price of China's export container ships, so China's container shipping prices are closely related to the development of the world economy. When the world economic prosperity will lead to an increase in international trade, China's container ship cargo volume correspondingly increased, that is, China's export container ship transport market capacity demand increased, resulting in higher freight rate rates. On the contrary, when the world economy is depressed and international trade flows decrease, China's containerized cargo volume decreases accordingly, affecting the decline in freight rate rates. In 2008, for example, the world economy declined as a result of the financial crisis, and the price of China's export container ships fell sharply.

3.4.5 Container Futures Factor

Futures are a powerful tool for market participants to avoid risks, with certain price discovery and hedging functions. At present, CCFI futures adopt a hybrid delivery method of cash delivery and capacity delivery, which has the dual nature of

commodity futures and financial futures. CCFI futures prices can reflect market participants' expectations of market supply and demand and container ship freight rate movements for a certain period of time, and can be hedged by operating in the same quantity and in opposite directions in the CCFI spot market.

Container ship transport spot market information is more scattered, one-sided, the future market supply and demand relationship information reflects insufficient, while the futures market is relatively open, the amount of information is large, can more accurately reflect the market's expectations of future freight rate rates, and thus affect the spot market freight rate fluctuations. If the futures price rises, its spot price will change in the same direction. Therefore, CCFI futures prices can more accurately reflect the future supply and demand relationship of the container ship transport market, and play a guiding role in the operation decision-making of container ship transport enterprises.

3.4.6 Other factors

In addition to supply demand, transportation costs, market structure, the world economy and other major factors, China's export container ship transport market prices are also affected by the world's scientific and technological development, the national container ship transport policy, the new crown epidemic and other major public health emergencies, the International Political Bureau military conflict, natural disasters and other uncertainties. These factors generally affect the volume of trade in goods, the world economy and other forms, and then affect the supply and demand of China's export container ship transport market, causing fluctuations in the price of container ship transport.

In recent years, the rapid development of the level of science and technology, shipbuilding technology progress makes container ships port large-scale trend is very obvious, new ship capacity equipment to improve the speed of navigation become a reality, the development of information technology to improve the efficiency of port aviation management, the application of new technology from different aspects to reduce the transport costs of China's export container ships, and thus affect freight

rate rates.

Container ship transportation market is an important bridge between China and other countries, but also by the government's jurisdiction, so China's export container ship transport market price is also affected by the route of the country's government political system, economic structure, container ship transport policy and other government elements. The government mainly influences the freight rate of container ship by controlling the competitive way and pricing behavior of container ship transport enterprises or organizations in the market through macro-control. Existing container ship transport tariff supervision measures mainly include anti-monopoly law exemption, container ship transport organization agreement filing and freight rate reporting. Countries regulate the competitive behavior of container ship transportation market through different container ship transport policies, thus stabilizing market freight rate rates. Therefore, the price fluctuation analysis of different routes should be combined with the relevant container ship transportation policy analysis of the country or region on the route.

Major emergencies such as international political situation, military conflicts, natural disasters and major public health events will affect the world economic development, affect China's international trade volume, and thus affect China's container shipping market.

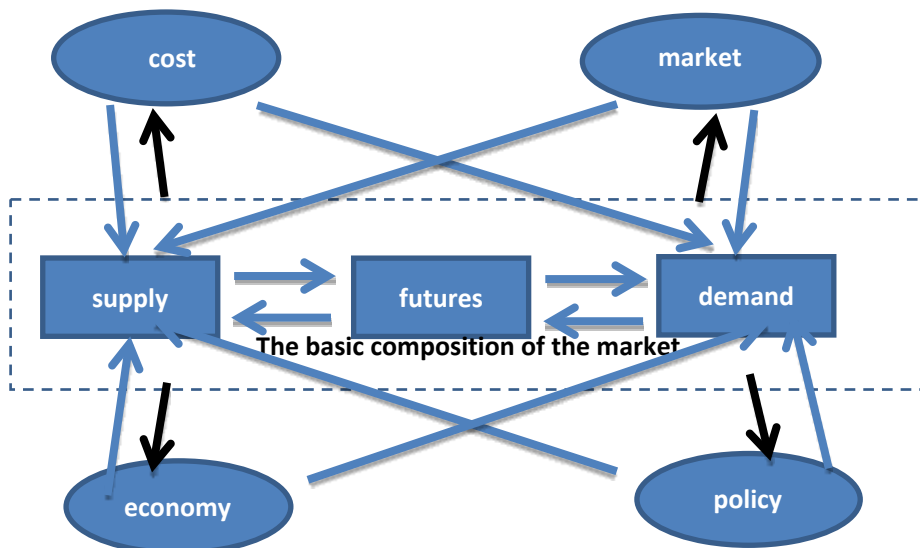
3.5 Causal analysis of China's export container ship transport market

The object of this model is the process of container freight rate formation in China market, in which the model involves more internal and external factors, requires historical data and their mutual influence, and has a large research workload. It is not difficult to find that the subject of research is a complex social and economic system, a wide range of influencing factors, after the study found that China's export container ship transport market can be analyzed from the aspects of supply and demand factors, cost factors, market structure factors, futures factors, macro-political economy and so on.

3.5.1 System description

Based on the system structure and the actual situation of the container ship transportation market, this chapter comprehensively analyzes the price formation mechanism of China's export container ship transportation market, reveals the essential properties of each sub-block and its interaction relationship, and establishes a model for the systematic analysis of China's export container ship transportation market.

A system is usually divided into subsystems to consider. A subsystem is a collection that has an input and output and contains state variable rates or auxiliary variables, and so on. Subsystems, especially when state variables are not included, are also accustomed to being called links. In this paper, capacity supply, capacity demand and CCFI futures are divided into three basic subsystems of the market, and transportation costs, market structure, world economy and national policies are divided into four subsystems of influencing factors. The relationship is shown in the figure:



Structure Description: The three basic components of China's export container ship

transport market freight rate system are: demand subsystem, supply subsystem and futures subsystem. The other four factor subsystems affect the development of China's export container ship transportation market by acting on the supply subsystem and demand subsystem respectively. At the same time, as an important trade link in the world economy, China's export container ship transport market freight rate system is counterproductive to these factors subsystem.

3.5.2 Causal analysis

China's export container ship transport costs mainly include ships and containers and other fixed investment, voyage operating costs, management costs, financial costs. Among them, the shipping costs of container ships in the total cost of the voyage operating costs are a large proportion, and fuel costs in the voyage operating costs of up to about 16%. In the long run, the transportation cost of container ships is the root cause of price fluctuations in China's export container ship transportation market. The market mechanism of oligopoly determines that the capacity supply of China's export container ship transportation is based on large shipping companies, and any large shipping company may have an impact on the market price of China's export container ship transportation, and become an indirect setter of prices. Therefore, the marginal income of large container ship companies is determined by the market price, which in turn is influenced by the large container ship companies. Price is partly an endogenous variable for large container ships. In the short term, the average transportation costs of different container shipping companies may be higher than or below or equal to market prices. But in the long run, the average shipping cost of shipping companies must be lower than the market price. This is because the shipping company is in a loss-making state if the average cost is higher than the market price. Shipping companies in the industry will compete to reduce capacity. At the same time, mergers and reorganizations between shipping companies will follow. Since container ship transportation is a capital-intensive industry that favours economies of scale, some small and medium-sized shipping companies will be the first to exit the container ship transport market in the fierce competition of the

off-season. As a result, in the container ship transportation industry, some large shipping companies will stand out from the competition in the cyclical fluctuations, and long-term existence in China's export container ship transport market. As the size of China's overall foreign trade continues to rise, so will the size of these large container shipping companies. The entire Chinese export container ship transportation market will continue to move closer to the oligopoly market in the long-term development process after each market cycle. In this same market structure, large container shipping companies have the ability to ensure that the industry's average long-term transport costs are lower than the market freight rate. It can be seen that China's export container ship transport market capacity adjustment process, is the large shipping companies continue to strive to reduce the average transport costs under the market freight rates process. Container ship transportation cost is the most important component of China's export container ship price, this paper will also make a detailed quantitative study of how the transport cost of container ship affects freight rate. The supply and demand of container ship capacity in the Chinese market affects the short-term container freight rate in the Chinese market.

3.6 Fluctuations and conduction of freight rate rates of China's export container ships

3.6.1 Freight rate rates fluctuate

Fluctuations in economics refer to the process by which an economic variable moves up and down around a center. Fluctuations in container ship transportation freight rate rates refer to the process by which the container ship transportation industry moves up and down around the market equilibrium price due to a series of factors such as market supply and demand, economic fluctuations and seasonal production. The study on the characteristics of freight rate fluctuations in container ship transport often breaks down the tariff sequence into four aspects: long-term trend, cyclical fluctuation, seasonal fluctuation and irregular fluctuation. The long-term trend

refers to the basic level and overall direction of the development of the container ship transport tariff time series over a considerable period of time, and although the actual value of the freight rate sequence tends to deviate from its long-term trend, up or down at a given time, the sum of positive and negative deviations is zero in the long run. Periodic cycle refers to the periodic up and down fluctuations of the tariff sequence over a long period of time, each cycle includes four stages of peak, drop, trough and rise, representing the cycle fluctuation process in which the freight rate falls from the peak to the trough, then rises to the peak, and then falls to the trough. Seasonal fluctuation refers to the seasonal fluctuation of container ship transportation freight rate in one year due to seasonal climate and production. The difference between seasonal fluctuation and periodic fluctuation is that the seasonal fluctuation cycle is less than one year, the occurrence time of the peak trough is relatively fixed, and the periodic cycle fluctuation period is greater than one year, the length is uncertain, and the peak trough appears period. Irregular fluctuation refers to the price of freight rate caused by a number of uncertain micro-factors, such as oil prices, exchange rate fluctuations, such as the frequency of these small factors occur more frequently, the impact is small, basically in a purely random way, or sudden events, such as strikes, military conflicts, natural disasters, etc., they produce fluctuations are basically irregular fluctuations.

3.6.2 Freight rate conduction

Freight rate conduction is a price effect, which means that when the freight rate rate of container ship transport market fluctuates due to some factor, it will last for a period of time and affect the market price of container ship transport in other regions, or affect the relevant market price in the same region, or even the price of the market in the related industry.

According to the different routes of freight rate transmission, the conduction of container ship transport freight rate can be divided into vertical conduction and horizontal conduction. Vertical conduction of container ship transport freight rate rates refers to the process of price fluctuations conducting each other along different

links in the container ship transport industry chain. The horizontal conduction of container ship transport freight rate rate refers to the conduction of price fluctuations between different markets.

The conduction of container ship tariff fluctuations referred to in this paper is mainly based on horizontal price fluctuation conduction, including self-related volatility conduction, sub-route freight rate rate volatility conduction, spot price volatility conduction. The main research is to study the phenomenon of mutual influence and transmission between freight rate rates in different time periods, between freight rate rates on different routes and between spot market prices, including the conduction direction and conduction path of freight rate conduction.

Chapter 4 Econometric Analysis of China's Export Container Ship Freight rate Fluctuations

Based on the main influencing factors of China's export container ship tariff fluctuations proposed in Chapter III, this chapter constructs an econometric model and makes empirical research to reach the test conclusion. Different container liner transport routes between countries economic and trade exchanges, shipping conditions, etc. are different, route tariff fluctuations are also more frequent, so the study of freight rate fluctuations in sub-routes using frequency higher weekly data. Taking into account the availability and consistency of freight rate data for sub-routes, select weekly data for CCFI's 13 route tariff data from January 1, 2010 to December 31, 2019 as sample data. In order to maintain the completeness of the time series, the weekly data that has not been published for holidays or other reasons is supplemented by linear interpolation. Other international fuel prices and China's container export merchandise trade volume are based on the corresponding same-period data published by the Ministry of Commerce of China. Corresponding to the reference of China's export container ship capacity, the Shanghai Shipping Exchange announced the total capacity of the current market input of major shipping companies.

In econometrics, multidimensional time series data obtained from continuous

observations of cross-sectional individuals at different times are called panel data. The panel data model can reflect the change law and the characteristics of different time and different units in both the time and the section unit, and can effectively reduce the possibility of multiple collinearity of the explanatory variables, better solve the correlation between the ignored variables and the explanatory variables, and better solve the correlation between the ignored variables and the explanatory variables, thus making the parameter estimation results more credible.

4.1 Regression model construction and evaluation

4.1.1 Normal minimum second multiplication regression

Set random variables y with general variables X_1, X_2, \dots . The linear regression model of X_p is

$$Y = B_0 + B_1X_1 + B_2X_2 + \dots + B_pX_p + e$$

Where B_0, B_1, \dots, B_p is an unknown parameter of $P-1$, B_0 is called a regression constant, B_1, B_2, \dots, B_p is called a regression coefficient. Y is the interpreted variable, while B_1, B_2, \dots, X_p is a general variable that can be accurately measured and controlled. Its random error assumes that $E(e) = 0, \text{Var}(e) = 0$

Call $E(Y) = B_0 + B_1X_1 + B_2X_2 + \dots + B_pX_p$ as the theoretical regression equation, and for a practical problem if you get group observation data $(X_{i1}, X_{i2}, X_{ip})_{i=1,2,3,\dots,n}$, the regression equation model can be represented as

$$Y_1 = B_0 + B_1X_{11} + B_2X_{12} + \dots + B_pX_{1p} + e_1$$

$$Y_2 = B_0 + B_1X_{21} + B_2X_{22} + \dots + B_pX_{2p} + e_2$$

.....

$$Y_n = B_0 + B_1X_{n1} + B_2X_{n2} + \dots + B_pX_{np} + e_n$$

Written as a matrix can be expressed as: $Y = XB + e$

$$\text{Among them, } Y = \begin{pmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{pmatrix}, X = \begin{pmatrix} 1 & X_{11} & X_{12} & \dots & X_{1p} \\ 1 & X_{21} & X_{22} & \dots & X_{2p} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & X_{n1} & X_{n2} & \dots & X_{np} \end{pmatrix}, B = \begin{pmatrix} B_1 \\ B_2 \\ \vdots \\ B_n \end{pmatrix}, e = \begin{pmatrix} e_1 \\ e_2 \\ \vdots \\ e_n \end{pmatrix}$$

The minimum dipsembly estimated value of vector B by the least-squares method is

$$B=(X'X)^{-1}X'Y$$

The estimated model is: $Y=B^0+B^1X_1+B^2X_2+\dots+B^pX_p$

4.1.2 Ridge Return

A method of improving the minimum two-multiplier estimate, also known as Ridge estimation. The basic principle is that when there is multiple collinearity between variables, At the time of $|X'X|=0$, we envision giving $|X'X|$ plus a normal number matrix $KI(K>0)$, then $X'X+KI$ will be much less close to singularity than $X'X$ is to singularity. Considering the scale of variables, the data is standardized first, and the standardized sample matrix is recorded as X , and the $B^k=(X'X+KI)^{-1}X'Y$ is defined, and the ridge regression estimate is called B , wherein K is called the ridge parameter. The feature roots of $X'X$ are Z_1, Z_2, \dots, Z_n knows that the characteristic roots of $X'X+KI$ are $Z_1+K, Z_2+K, \dots, Z_n+K$ "If the minimum feature root Z_1 of $X'X$ is close to 0, then Z_1 plus K is closer to 0, so there is reason to expect that B^k is better than B^s ."

Ridge regression has some properties as follows:

- a. B_k is a partial estimate of regression parameter B .
- b. The ridge regression coefficient is a linear combination of the regression coefficient under the general principle of least square one
- c. For any $K>0$, $\|B^k\|$ Not equal to 0, there is always $\|B^k\| < \|B^s\|$
- d. The mean square error of the estimated vector in MSE, where $K > 0$, makes $MSE[B^k] < MSE[B^s]$, which indicates that there is a K -value interval, so that in this interval, the mean square error of the ridge regression estimate is consistently less than the mean square error of the normal minimum dip estimate, so that the B^k is closer to the theoretical value than the B^s .

4.1.3 Regression equation modeling steps

(1) Argument selection. The key element of the modeling process of regression equation lies in the selection of arguments, and it is the primary work of the model to

choose what factors enter the equation.

(2) Build a preliminary regression equation. The arguments and dependent variables selected in the previous step are established according to certain rules, and the regression results are tested to determine whether the influence of the arguments on the dependent variables is statistically significant. For predictive models, the main equations and coefficient tests include:

The item is inspected	The statistic expression	Test the meaning	Check the threshold
F test	$F = \frac{SSR/p}{SSE/(n-p-1)}$	The regression equation is tested	The level of significance α
T-test	$t_j = \frac{B^j}{\sqrt{c_{ij}\alpha}}$	The significance test of the regression coefficient	The level of significance α
Fit excellence check	$R^2 = \frac{\sum_{i=1}^n ei^2}{\sum_{i=1}^n yi^2}$	Regression effect is good or bad	Generally more than 70%.
DW test	$DW = \frac{\sum_{i=1}^n (ei - ei-1)^2}{\sum_{i=1}^n ei^2}$ $= 2(1 - p^{\wedge})$	Sequence self-correlation test	1.5-2.5
VIF test	$VIF = \frac{1}{Toli} = \frac{1}{1 - R2}$	Multi-colinear test	Close to 1

According to the above test items, each of the above equations needs to be tested to determine how the overall performance of the model performs at a given level of significance and whether it is statistically significant. A brief description of each inspection item is as follows:

(a) F test is a test of the overall significance of the regression equation, i.e. depending on whether the argument $X_1, X_3, \dots X_p$ has a significant effect on the random variable

Y as a whole. The test is set to $H_0: B_1=B_2=B_3=\dots=B_n=0$. ($p, n-p-1$) of the F distribution, given the significance of a case, when $F > F_a(p, n-p-1)$, rejects the original assumption H_0 , that at the significance level α , Y to X_1, X_2, \dots there is a significant linear relationship, i.e. the regression equation is significant.

(b) In multilinear regression, the significant regression equation does not mean that each argument has a significant effect on Y, because it is always necessary to re-establish a simpler regression equation by removing the secondary, optional variables from the regression equation and re-establishing the simpler regression equation. At a given significance level α , if the original hypothesis $H_0: B_j = 0$ is rejected at $|t_j| \geq t_{\alpha/2}$, B_j is considered significantly not zero, the argument X_j is significantly linear to Y, and the argument is accepted as not significant for dependent variables.

(c) Fit excellence test. Fitting the excellent degree of R^2 reflects the quality of the regression effect, the economic significance of which is explained as a percentage of the total variation, that is, the fit of the regression equation to the sample observations, the sample decision factor R^2 is easy to approach 1, which implies some false elements. Therefore, the corrected R^2 is introduced as the criterion for the regression fitting effect significance test

(d) DW test. DW is used to verify that random perturbation items have first-order self-related sequence-related issues. If the error term of a regression equation cannot satisfy the assumption that there is a sequence correlation between the error terms, and the minimum secondary regression hypothesis is not satisfied, the estimation coefficient t statistic is inaccurate and meaningless. It is therefore necessary to test sequence-related issues against the DW value, using a criterion of 0.005 significance level of d_u of approximately 1.5 and $4-d_u$ of approximately 2.5, if $1.5 \leq DW \leq 2.5$, the model is considered to satisfy the assumption.

(e) Multi-colinear test. An important assumption of multilinear least square regression is that the column vectors in matrix X, which are made up of argument sample data, are linearly independent. If this hypothesis is not satisfied, it is said that there is multiple colinearity between the regression model arguments, which will

result in the model's regression parameter estimates are very unstable, and the variance of the regression coefficient will accelerate with the increase of multiple colinear strength, resulting in a reasonable economic explanation of the positive and negative signs of the regression coefficient.

(3) Regression equation model improvement. According to the test of the previous step, we will find various problems in the model, among which the problems that have the greatest influence on the model are both sequence autocorrelation and multicollinearity, while the problem of multicollinearity in economic sequence is a more common phenomenon. The model needs to be adjusted on the basis of the above test on the basis of the model judgment. For the problem that the Chinese equation coefficient of the model is not significant, the equation fitting effect is not good, and the overall significance of the equation is not strong, it is mainly solved by changing and adjusting the arguments entering the model, and the optimal model is selected through multiple experiments. When there is sequence autocorrelation in the model, consider adding variables that might be missing or ways to change the form of functions. When there is multiple colinearity of the arguments in the equation, resulting in the model's minimum two-multiplier result is extremely bad, not in line with the real economic situation of the phenomenon, the model adopted the treatment method for the Ridge regression method to obtain the argument coefficient instead of the minimum secondary regression of the argument coefficient coefficient.

(4) Test the significance of the Ridge regression coefficient. The regression equation argument coefficient estimated according to the Ridge regression method also needs to be tested statistically to determine whether it is statistically significant, and only by testing the equation by significance can it become a predictive equation. The test of the multi-regression equation obtained by the Ridge regression method is basically the same as that of the multi-regression equation obtained by the least-squares method.

(5) To find the predicted value. According to the tested ridge regression equation established in the previous step, the expected or predicted value of the argument can be replaced by the ridge regression equation, and the forecast value of the relevant fiscal revenue can be obtained.

4.1.4 Model Evaluation

Regression model is a kind of causal analysis model, according to the number of regression model variables are divided into multiple regression and monism regression, in the complexity of the equation can be divided into simple regression and the econometric model of the inter-cubic equation system. The main application in this model is the simple multi-regression model. Causal analysis model is a prediction model that combines economic principles with statistical methods, compared with the above-mentioned time series analysis, causal analysis can provide forecasters and policy makers with more relevant economic factors at the same time and the impact these changes may have on fiscal revenue. In general, causal analysis requires more time, resources, and expenditure than simple time series predictions, but it provides a structural forecasting model. This model can be presented as a mathematical expression. In addition, one of the greatest advantages of causal analysis is that it provides policymakers with an understanding of the economic principles of the process system through the revenue forecasting process and the forecasting method (Rdedikc, C.q2004). Although many of the literature mentions the desire for local governments to use causal analysis more for forecasting, only 21.7percent of the 531 cities surveyed by CIMA 1999 used economic forecasting.

4.2 The establishment of econometric models

There is a high correlation between the market price of China's export container ship transport and international trade. Thus, changes in China-related international trade, especially China's export trade volume, will directly affect changes in the price of China's export container ship transport market. In addition, other important factors that continue to fluctuate will also be taken into account in the following

models as an important part of quantitative analysis after modeling. China's export container freight rate index is used as the freight rate index. The total capacity of container ship market is the market supply. China's export trade volume as demand. WTI oil price index is used as transportation cost index. The interest rate in the interest rate hedging generally carried out by container shipping companies will be used as the index of China's shipping derivatives.

Generally speaking, the factors affecting the total market price index of container ship transport include the futures price index, the international fuel price index, the total capacity of all shipping companies in the market in the current period, etc.

$$P=f(Y, Y-1, I, I-1, E, E-1, F, F-1)$$

Among them, P is the previous period China Export Container Ship Freight rate Index, Y is the total capacity of all shipping companies in the market in the previous period, Y₋₁ is the total capacity of all shipping companies in the market in the current period, I is the previous interest rate, I₋₁ is the current interest rate, E is the previous international crude oil price index, E₋₁ For the current international crude oil price index, F is the previous period of China's exports of goods ,F₋₁ is the current period of China's exports of goods .

In this paper, China's export container ship transport market price total index as a dependent variable, to the market all shipping companies in the current and previous period of the total capacity of investment, current and current futures price index, current and current international fuel price index as an argument to analyze their impact on the market price of container ship transport. This article uses backward culling in spss regression analysis, i.e. selecting all arguments to enter the model and then deleting one argument at a time to minimize the F value in the variance analysis, depending on the condition, until the regression equation no longer contains ineligible arguments. The judgment condition of the selection of the thesis is that the F probability is used as the basis for introducing variable culling variables.

Entry:0.05, which means that a variable is introduced into the equation when its SigT value is less than or equal to 0.005;

Model	serial	Enter variables in	The variables that	The backward
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number	the model	the model rejects	culling method
1	China Export Container Ship Freight rate Index, total capacity of current inputs by all shipping companies in the market, total capacity of current investment by all shipping companies in the market, current interest rate, current interest rate, current international crude oil price index, current international crude oil price index, current China's export volume of goods, china's export value of goods in the current period		Enter all
2		The total capacity of all shipping	Backward culling (using the F

		companies in the market for the current period	probability as the basis for introducing variables or proposing variables.) Entry:0.05 means that when a variable's SigT value is less than or equal to 0 At 05, the variable is introduced into the equation Removal:0.10 When the SigT value of a variable is greater than or equal to 0.01, the variable is removed from the regression equation.)
3		China's exports of goods in the current period	ditto
4		Current interest rate	ditto
		Current International Crude Oil Price Index	ditto

Model 1, argument: China's export container ship freight rate index, the total capacity of all shipping companies in the market in the current period, the total capacity of all shipping companies in the market, the current interest rate, the current interest rate, the current international crude oil price index, the current international crude oil price index, the current period of China's goods exports, the previous period of China's exports of goods

Model 2, argument: China Export Container Ship Freight rate Index, total capacity of all shipping companies in the market, current interest rate, current interest rate, current international crude oil price index, current international crude oil price index, current China's export volume of goods, China's export value of goods in the previous period

Model 3, argument: China's export container ship freight rate index, the total capacity of all shipping companies in the market in the previous period, current interest rate, current interest rate, current international crude oil price index, the current international crude oil price index, the previous period of China's exports of goods

Model 4, argument: China's export container ship freight rate index, the total capacity of all shipping companies in the market in the previous period, the previous interest rate, the previous period of the international crude oil price index, the previous period of China's exports of goods

According to the criteria of variable rejection, the paper can give the sequence of variable rejection, and the results show that the order of variable rejection is: the total capacity of all shipping companies in the market in the current period - China's exports of goods in the current period - current interest rate - current international crude oil price index.

For the change of the influence degree of the original equation, the paper uses the backward culling method, it can be found that the variable in the equation is significantly improved for the equation interpretation level, the following is the coefficient result of regression analysis:

SUMMARY							
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OUTPUT								
Regression statistics								
Multiple R	0.9728							
	94							
R Square	0.8619							
	44							
Adjusted R Square	0.8536							
	64							
standard error	82.011							
	11							
Observations	120							
analysis of variance								
	Df	SS	MS	F	Significance F			
regression	4	24756	61890	92.01	6.46E-35			
analysis		40	9.9	997				
residuals	115	77346	6725.					
		9.5	822					
total	119	32491						
		09						
	Coefficients	standard error	t Stat	P-value	Lower 95%	Upper 95%	Lower limit 95.0%	Upper limit 95.0%
Intercept	405.92	0.390	0.103	0.917	-7.328	8.139	-7.328	8.139

	57	4433	965	378		856		856
I Variable 1	-5498.1	0.237	-2.317	0.022	-1.01979	-7.98	-1.019	-7.983
	4	2673	28	258		332	79	32
E Variable 2	5.6286	0.358	1.516	2.27	4.918432	6.338	4.918	6.338
	73	561	9794	E-30		913	432	913
Y Variable 3	0.0560	0.163	0.034	0.972	-3.1879	3.299	-3.187	3.299
	4	7683	219	762		976	9	976
F Variable 4	0.0264	0.030	0.871	0.385	-0.03369	0.086	-0.033	0.086
	49	363	097	516		593	69	593

4.3 Application of the model

Through the price model of China's export container ship transportation market, it can be seen that among the main factors influencing the price of container ship transportation, the factor of interest rate in the previous month is negative, indicating that the price index of China's export container ship transportation in the previous period is inversely changing with the previous interest rate, which basically reflects this negative correlation. As interest rates rise, the price of transportation for China's export container ships falls, and when interest rates are low, the price of transport for China's export container ships rises. This shows that interest rates not only affect the current China's export container ship freight rates, but more importantly affect the next phase of China's export container ship freight rates, interest rates on the price of the impact of a significant lag.

The model study results of China's export container ship freight rate show that: China's export container ship freight rate is greatly affected by the total capacity supply of container ships in the international market during the same period, so when the shipping company formulates the container ship capacity supply plan for China's export market, it must predict the next period of China's export container freight rate trend, if the next phase of China's export container ship freight rate is low, the shipping company should formulate a timely capacity reduction plan, on the

contrary, should develop a reasonable capacity improvement plan.

Oil prices, China's export trade volume and so on have a direct impact on China's export container ship freight rates, and indirectly affect the further development of the Chinese market in the international trade status, so the Chinese government should consider measures to maintain the stability of China's export container transport market: China's export container shipping market, shipping companies to hedge the interest rate level. The current general interest rate for the shipping industry generally uses the benchmark U.S. interest rate, an important reason is that this interest rate directly affects the trading of shipping derivatives. Therefore, if China wants to stabilize the level of interest rates hedged by the shipping industry, it needs to develop a shipping derivatives trading market based on China's benchmark interest rate. China should promote the influence of its oil futures in global oil trading and contribute to macro-control and stabilization of oil prices. Stable oil prices will in turn stabilize the price of China's export container shipping market.

Chapter 5 Summary and Recommendations

5.1 Conclusions of this article

From the day container ship transport goes into commercial operation, the problem of fluctuations in the price of container ship transport has arisen. With the globalization of international trade, countries all over the world are beginning to face the problem of how to stabilize the freight rate of container ships. However, with the different times and the actual situation of different countries, container ship freight rates fluctuate. As an important country in the field of international trade, China is directly faced with the problem of how to stabilize the fluctuation of the freight rate rates of its export container ships. This paper selects the freight rate of China's export container ships as the starting point of the study, and tries to explore the mechanism of the formation of China's export container ship freight rates. The reason for choosing the mechanism of freight rate of export container ships as the research content, first of all, is that the export container ship transport service is generally

aimed at China's domestic manufacturing industry, and China's manufacturing industry is closely related to some major problems in the current Chinese economy. Secondly, different price formation mechanism determines the efficiency of price to resource allocation is different, and more importantly, the freight rate formation mechanism not only affects the cost problem in international trade, but also affects the future development of the global economy. By reviewing the evolution of the freight rate system of export container ships since China's accession to the WTO, this paper analyzes the characteristics of the freight rate mechanism under different market conditions, and tries to explore the fluctuation law of the price formation mechanism, thus providing a theoretical basis for the perfection of the price formation mechanism for China's export container ship transportation. This paper combines qualitative and quantitative analysis to make theoretical and empirical analysis of this problem at the macro and micro levels.

The work done in full text and the conclusions formed can be summarized in the following aspects: (1) The system introduces the composition and evolution of China's export container ship freight rate system, describes the change trajectory of container ship freight rate since China's accession to the WTO, and analyzes the cyclical characteristics of container ship freight rate. (2) A detailed analysis of the formation mechanism of container ship freight rates: The article analyzes the factors that affect market prices under the conditions of oligopoly, and carries out measurement tests, which show that China's export trade volume, international crude oil prices, shipping market hedging interest rates, market input container ship total capacity, etc. have a significant impact on China's export container ship transport market prices. By reviewing the evolution of the mechanism of the formation mechanism of China's export container ship freight rate rate, this paper discusses the key factors that determine the fluctuation of China's export container ship freight rate rate (3) And concludes that the freight rate of China's export container ship is greatly influenced by the total capacity supply of container ships in the international market during the same period, so the shipping company is formulating China's Export market container ship capacity supply planning, we must predict the next phase of

China's export container ship freight rate trends, if the next phase of China's export container ship freight rates are low, shipping companies should make timely capacity reduction plan, on the contrary, should develop a reasonable capacity improvement program. Oil prices, China's export trade volume and so on have a direct impact on China's export container ship freight rates, and indirectly affect the further development of the Chinese market in the international trade status, so the Chinese government should consider measures to maintain the stability of China's export container transport market: China's export container shipping market, shipping companies to hedge the interest rate level. The current general interest rate for the shipping industry generally uses the benchmark U.S. interest rate, an important reason is that this interest rate directly affects the trading of shipping derivatives. Therefore, if China wants to stabilize the level of interest rates hedged by the shipping industry, it needs to develop a market for shipping derivatives based on China's benchmark interest rate. China should promote the influence of its oil futures in global oil trading and help to macro-control and stabilize oil prices. Stable oil prices will in turn stabilize the price of China's export container shipping market.

5.2 Deficiencies and directions for improvement

Due to time and other reasons, this paper is still not deep enough to study the formation mechanism of China's export container ship freight rates, freight rate rate fluctuation model needs to be further revised and supplemented, while container ship freight rate pre-replacement involves a wide range, data collection is difficult, the vast majority can only rely on the data provided by the national statistical department, some indicators because the information is not used, so that the model of this paper has yet to be perfected. Taken together, this paper mainly has the following shortcomings:

1. Some factors affecting the freight rate of container ships are difficult to quantify, such as policy factors, maritime emergencies, etc., their role is not well reflected in the model, reducing the accuracy of the model.
2. The sequence of available statistical data events is too short, China's relevant

market mechanism formed late, the relevant system records are relatively lacking.

3. China's relevant statistical data indicators are often adjusted, and the statistical caliber between different departments is not uniform, which makes modeling analysis difficult, some of the more important indicators because the data did not enter the model variables, some data are not made public, some data collection is more difficult.

4. The impact of China's import container ship transportation market is not taken into account in the mechanism of China's export container freight rate formation, which is also the next step to study the direction of improvement.

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