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Research on the international linkage of Chinese oil tanker transport market based on the theory of new economic geospatial

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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.

The contents of this research paper reflect my own personal views and are not necessarily endorsed by the University.

(Signature):……

(Date): ……

Supervised by

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ABSTRACT

Title of research paper: **Research on the international linkage of Chinese oil tanker transport market based on the theory of new economic geospatial**

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The petroleum industry is a resource-based sector, whose formation and development is closely bound up with the exploration and utilization of petroleum resource. What's more, it is inextricably related to the oil tanker transportation market. In 2021, Saudi Arabia announced an additional and voluntary oil production cut in February and March, which was supported by OPEC's second largest oil country Iraq. Such an announcement led to a tighter source market , and a decline in the VLCC freight rate. As geopolitical tensions ease, the freight rate has been affected by a weak market and the decline in demand. In the oil tanker transportation market, geopolitics always makes headlines, but the oil supply fills the declining demand caused by the COVID-19 epidemic. The storage of floating oil has also increased, mainly because oil production does not match the demand for it, and that the tightened transport capacity in the market drives the freight rate up. Oil, as one non-renewable natural resource, has a strong geographic advantage. Though spatial disparity results in spatial difference of economic activities, it is not a fundamental factor. This paper, therefore, analyzes the applicability, cause, pattern, connotation and influence of the "Central - Peripheral" theory in the international oil tanker transportation market of a new era, showing that affected by COVID-19, the center-peripheral pattern in the oil market will change.

KEYWORDS: Core-Peripheral Model, New Economic Geography Theory, Tanker Transport Market, Industrial Agglomeration, Scale Economy ,VAR

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LIST OF ABBREVIATIONS

CP	Core and Periphery Theory
DWT	Deadweight Tonnage
OPEC	Organization of the Petroleum Exporting
FFA	Forward Freight Agreement
OECD	Organization for Economic Co-operation and Development
BDTI	Baltic Dirty Tanker Index
CTFI	China Import Crude Oil Tanker Freight Index

1 Introduction

1.1 Research Background

Petroleum is an important commodity. It is not only a fuel for powering automobiles, airplanes, ships and other vehicles, but also a source of synthetic polymers and organic chemicals for other industrial sectors. Its downstream products and price fluctuations are closely linked with people's life. With the rapid development of the world economy, people's demand for oil shows a rising trend. However, oil is not distributed evenly around the world, and there is generally a long distance between the place of production and the place of consumption. Thus, people have to turn to different freight transport modes such as ship, rail and pipelines. Shipping, as an important means of transportation, is regarded as " the carrier of world trade".

Since 2020, the price of oil transportation has fallen dramatically due to the uncontrollable nature of the epidemic, and the agreement between OPEC and non-OPEC producers to cut production. Oil freight is in a unilaterally price-falling situation: in the Baltic crude oil freight index, the time-charter equivalent (TCE) rates for very large crude carriers (VLCC) closed at 10,323 US dollars a day on February 10 , down 83.67% from a month ago. It is then followed by the declines in the rates of the Suez and Aframax tankers, which, on the same day, closed at $29,936 per day and $17,677 per day respectively, falling 57.90 percent and 67.75 percent from a month ago. In the year of 2020, the Baltic Crude Oil Transport Index rose and fell by 70.82 percent.

In terms of crude oil vessels, Saudi Arabia this year unexpectedly announced that it would voluntarily reduce oil production in February and March, which was supported by Iraq, OPEC's second-largest oil producer. This further tightened market supply and the VLCC freight rate dropped accordingly. As geopolitical tensions ease, freight rates have felt the full impact of a weak market and a decrease in demand. In the oil tanker transportation market, geopolitics has always dominated the headlines, with oil supplies making up for a sharp drop in demand caused by the outbreak of COVID-19. Floating oil storage has also increased, mainly due to the mismatch between oil production and oil demand, and the fact that the tighter supply of capacity in the market has further increased freight rates. Oil, as a non-renewable natural resource, has a superior regional advantage. The spatial difference, though, accounts for the spatial difference of economic activities, it is not the fundamental cause.

China's demand for energy, especially oil, is growing. BP's Statistical Review of World Energy 2020 reveals that China's oil consumption from 2005 to 2019 has risen from 3.28 × 108t to 6.34 × 108t, an increase of 7.8% year-on-year and that the degree of dependence on foreign is as high as 70.8%. China, the United States and India are the top three oil consuming countries in the world, which means that there is a great demand for oil tanker transportation in China. China is almost the incremental purchaser for each commodity, playing a core role in the global supply chain. Therefore, its anti-epidemic measures in the context of COVID-19 have affected not only the world economy and trade, but also the maritime industry. The oil tanker transport market cannot be spared the impact of the epidemic when bulk carriers, carriers and even LNG have been hit seriously. Especially in the oil tanker transportation market, the epidemic has aggravated the impact of geopolitics on the oil transportation market. Hence, in a fiercely-competed market, how to make use of the spatial difference of oil to make domestic tanker transport enterprises secure their own interests and obtain more profits is the significance of this study.

1.2 Research Purpose

This paper first analyzes the status of international oil tanker transportation market in detail. Based upon the features of oil tankers, the author makes a detailed analysis of the factors affecting the demand, supply as well as freight rate of oil tanker transportation market, and then reviews and predicts the market in a qualitative way. The third chapter introduces the main model adopted in the article, the center-peripheral model. In this part, the author first compounds its connotation and the feasibility of its application in the international oil tanker transportation market, and then carries out a theoretical investigation of the international linkage of China 's tanker transportation market. The fourth chapter mainly analyzes the causes and effects of the international linkage of China's oil tanker transportation market under the coronavirus COVID-19 pandemic. In the fifth chapter, the author, after sensing the external environmental factors that affect market, proposes the strategies that China's tanker transport enterprises can adopt so as to minimize profit maximization and risks, in addition to obeying tariff feedback regulation, and puts forward the corresponding implementation plans for shipping enterprises to seize the opportunity to expand their market.

The main analytical methods used in the article are as follows:

1. The combination of quantitative and qualitative methods. Based on the review of previous market performance and the forecast of certain authoritative institutions, this paper conducts a qualitative analysis of market development, and establishes relevant mathematical models for analysis.

2. The method of comparison. By comparing the shipping market models established by domestic and foreign scholars, the central-peripheral model is selected for this study.

3. Simulate the process of companies' countermeasures to the market, and propose more practical and feasible recommendations to resolve the existing problems of

relevant enterprises.

1.3 Methodology

This paper firstly makes a detailed analysis of the international oil tanker transportation market. After summarizing the characteristics of oil tanker transportation, it compounds the factors that affect the demand, supply and freight rates of oil tanker transportation market in detail, reviews and qualitatively predicts the market outlook. The fourth chapter introduces the main model used in this paper, that is, the core-periphery model under the new economic geospatial theory. Its connotation and feasible application in the international oil tanker transportation market are illustrated. By reviewing domestic and foreign literatures about the theory of "core-periphery", this paper argues that the structure of "core-periphery" also exists in the international oil transportation market, and it has an impact on the international linkage of oil transportation market through spillover effect and policy effect. Then VAR model is established and its co-integration is tested for quantitative analysis of the international linkage of China's oil tanker transport market. The Baltic freight index of VLCC tanker from January 2020 to June 2021 and China import crude oil tanker freight index are selected for the VAR model to analyze how these two variables influence each other.

Based on the understanding of the external environment of oil tanker transportation market, the fifth chapter proposes the strategies that Chinese oil tanker enterprises can adopt in order to maximize their profits and minimize the risks, and puts forward corresponding proposals for shipping enterprises to seize the opportunities and expand their market.

1.4 Dissertation Structure

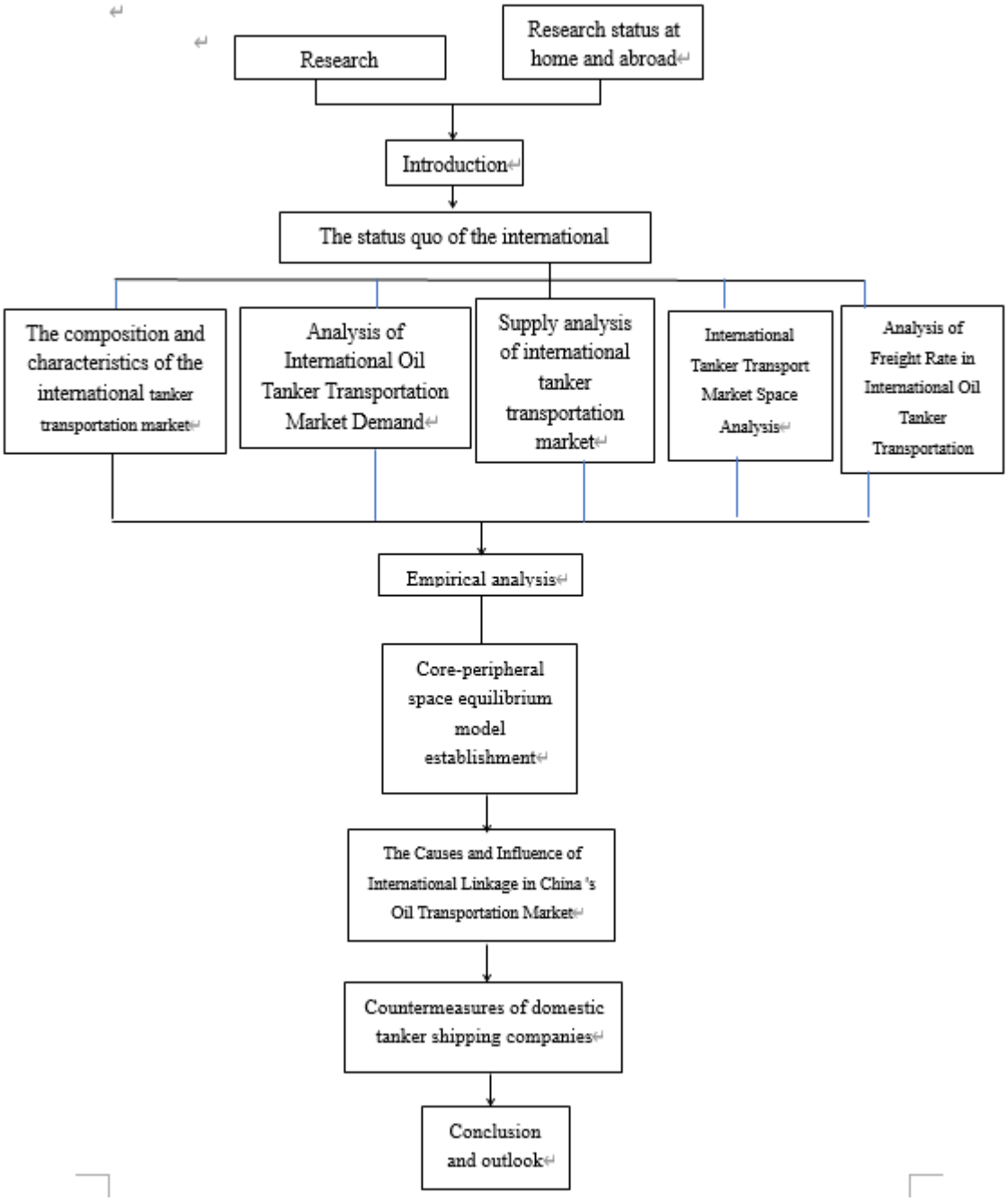

Figure 1 Dissertation Structure

2 Literature Review

2.1 New Economic Geography Theory

Space is central to economic life. New economic geography is a new development in space economics, and focuses on the acquired conditions. Premised on its control over the first natural advantage, new economic geography holds that the concentration of economic activities is an endogenous process, and has nothing to do with the natural advantages. Such a theory, for the first time, successfully explains why regions with the same initial conditions do not achieve the same level of economic development. The contributions of scholars such as Krugman have helped space economics to develop from the margin to the center of economics, thus making new economic geography theory an important tool for space economists to carry out their researches. New economic geography concentrates on how transportation costs, increasing returns to scale, as well as the interaction between supply and demand influence and determine the spatial location of economic activities.

Krugman (1993) pointed out that the “first” advantage of owning natural resource cannot explain why regions endowed with the same or similar natural resource develop quite differently. Therefore, although the spatial difference caused by the "first" advantage is an important reason for the spatial difference of economic activities, it is not the fundamental cause. The problem to be solved for new economic geography is how the endogenous force of the economic system affects and determines the spatial distribution of economic activities while controlling the "first" advantage. Fujita（2010） believes what distinguishes New Economic Geography from other disciplines are as

follows: First, it is the general equilibrium model of spatial economy, which makes its method different from traditional location theory and economic geography; secondly, the increasing returns to scale of production and the inseparability of individual firms have led to the emergence of a market structure characterized by monopolistic competition, which prevents the formation of “backyard capitalism”, in which each family or small group produces their own commodities; thirdly, there is iceberg transport cost, so it is significant to select the location; finally, the production factors analyzed by the model and the location selection of consumers actually display the process of agglomeration.

2.2 Core-Peripheral Model

The "Core-Peripheral" theory was proposed by Argentine economist Prebisch in May 1949. Early center-peripheral theories were most used to analyze the trade issues in developed countries and underdeveloped countries from the perspective of international trade or international economic division of labor. On the basis of Prebisch's "core-peripheral" theory, Friedman et al (1964) made improvements and pointed out the changing trend of "peripheral-center" structure in different economic development phases, that is, after taking the long-term evolution trend of regional imbalance into consideration, they divided the spatial structure of economic system into two parts: the center and the periphery, which constitute a dual spatial structure.

By the 1990s, economists such as Krugman (1991) embedded the space structural into the Dixit-Stiglitz (D-S) Model. On the premise of monopolistic competition and increasing returns to scale, they used standard mathematical method to construct the "core-periphery" model (CP model), focusing on the analysis of how transportation costs, increasing returns to scale and labor mobility influencing the selection and variation of the space location, and believing that the space location is the result of the balance between the gathering force and the dispersing force.

To better interpret the unbalanced development of space economy, some scholars have developed the original center - peripheral model (CP model) of new economic geography. Baldwin's (2006) Capital Creation Model (CC Model) introduced two variables of capital formation and capital depreciation to replace the factor flowing in CP model. He reviewed Krugman 's collective model from the perspective of firm heterogeneity in trade theory, arguing that the key of industrial rearrangement lies in the loss and creation of capital.

By reviewing of the development of "core-peripheral" theory, it is found that the current "core-peripheral" theory has mainly been improved based upon the theoretical framework laid down by Krugman, which focuses on how an industrial center is formed in different locations. With the deepening of economic globalization, global oil tanker transportation market has begun to form a whole, and there is an uneven "core-peripheral" distribution in various countries, which, to a certain extent, will determine the imbalanced development of oil tanker transport.

2.3 Application in the shipping market

Ji Yujun and Li Zhenyang (2016) incorporated regional location advantage into Krugman's core-periphery model, and concluded that as geographic advantage gets improved, the marine industries will be attracted to form agglomerations in the region, and the wage level of highly skilled labor there will be raised, so that they will choose to work in this region and so will the maritime enterprises that employ such labor force. Zhao Fang and Yuan Chaowen (2017) employed the spatial equilibrium model to explore the micro mechanism behind the development of China's urbanization. By constructing a capital creation model, He Xionglang (2021) found that as trade freedom, industrial product expenditure share and capital discount rate increase, yet the elasticity of substitution and capital depreciation rate decrease, the stability of the symmetric

structure will be reduced while the stability of the center-peripheral structure will be strengthened. The industrial equilibrium of economic geography space is the result of the interaction of agglomeration and dispersion.

It can be seen that the new economic geography theory is of unique significance to analyze regional advantages, market equilibrium as well as industrial agglomeration. However, few studies are carried out on shipping market based upon such a theory. The oil tanker transportation market has its particularity to the shipping market. The international oil tanker transportation market is characterized by non-scheduled shipping and plays a fundamental role in the international shipping market system. Its basic market factors include market demand, market supply and freight rates in economic theory. The oil tanker market is monopolized by cargo owners, so oil tanker companies do not have much power for pricing. Nevertheless, due to the high barriers to enter into the oil tanker market, and the number of shipping companies capable of operating oil tankers is much smaller than that of dry bulk ship owners and container ship owners, these above-mentioned factors must be taken into account during the research process.

3 International Tanker Transport Market Analysis

In 2020, the coronavirus epidemic ravaged the world economy. Influenced by various factors, the international oil price plummeted and the oil transportation market fluctuated violently. Throughput the year, the oil tanker transport market experienced big "ups and downs". In March, a large number of VLCCs were used as floating tanks for offshore oil storage, closing their freight service. At the same time, the epidemic brought both the delivery of new ships and the number of orders down, leading to a sharp rise in tanker freight rates. As COVID-19 epidemic continued to spread around the world and major oil producers began to implement the agreed-upon production cuts in May, freight rates began to fall sharply after the third quarter. The maritime oil trade volume in 2021 is expected to be slightly higher than that of 2020, but it is still difficult to be back to 2019 levels. Oil tanker capacity will continue to grow, and the excess capacity supply remains a problem to be resolved. Considering the impact of the epidemic, the policies of oil producers as well as the speed of destocking, the outlook of the international oil tanker transport market is discouraging.

3.1 Composition and characteristics of international tanker transportation market

3.1.1 Composition of the international tanker transportation market

Shipping market is a comprehensive concept, which is formed by all kinds of interrelated markets and different market elements. The international oil tanker transport, according to the convention, belongs to the tramp transport market and is a basic in the international shipping market system. The basic market of international oil tanker transportation market includes market demand, market supply and freight rate in economic theory.

Relevant markets refer to all the markets related to the international oil tanker transportation market, such as new shipbuilding market, ship buying and selling market, ship recycling market, maritime labor market, ship repair market, shipping capital market, shipping information market and so on. This paper mainly introduces the new shipbuilding market, the ship trading market and the ship recycling market.

1. New shipbuilding market

New shipbuilding market emerges from the trade relationship between shipowners and shipyards for building new ships. It is the main source of ship supply in the basic international shipping market. As shipbuilding takes a certain period of time, the increase or decrease of ship-building orders in new shipbuilding market is usually delayed after the shipping market.

The COVID-19 epidemic led to a slump in investment in new shipbuilding, with the number of new oil tanker orders falling to a record low in 2020. However, there was new VLCC ordering with 41 ships and 12.337 million DWT, higher than that in 2019, mainly due to a large number of orders completed at the end of the year. According to Clarksons, a shipping consultancy, the deliveries of new oil tankers in 2020 fell to their lowest level since 2005 and were only 50 per cent from its peak in 2010. Nevertheless, the deliveries of new ships in 2020 were 85 percent from that of 2019 level, demonstrating the strong resilience of shipbuilding industry and its supporting supply chain in responding to the epidemic, and indicating that the challenges in shipbuilding industry's operations and logistics caused by the epidemic have been basically solved.

The combination of continued declines in new ship orders and in new ship deliveries have driven tanker hand-held orders at the end of 2020 falling to their lowest level since 1998. Global hand-held orders for crude oil vessels account for about 8% of the global tanker fleet, among which 74 VLCC vessels were ordered by the end of 2020, accounting for only 8.9 percent of the VLCC fleet capacity.

2. Ship trading market

The ship trading market, also known as the second-hand ship market, focuses on the trading relationship between the demander and the supplier whose main purpose of business is to trade the second-hand ships. The ship trading market does not bring about changes in the total supply of the shipping market, but improves the usage of ships among different ship owners. Compared with new ships, second-hand ship is characterized by

its low cost of capital and fast market adaptation.

3. Demolition market

Demolition market refers to the trade relationship between shipowners and ship recycling industry, which aims at dismantling old ships. Demolition is an important way to reduce the supply of ships and relieve the pressure of excess capacity in shipping market. The basic market and relevant market of the international oil tanker transportation market mutually restrict, promote and rely on each other, boosting the international shipping economy by the interaction of such factors as price, supply & demand, competition and service.

In 2020, the ship recycling market, affected by both the freight market and the COVID-19, displayed a depressing picture, with ship volume far lower than the historical level. Specifically, there was only 2 VLCC ships for recycling, down 50 percent compared with that in 2019.

3.1.2 Characteristics of the International Tanker Transportation Market

The oil tanker transportation industry grows with offshore oil trade, boasting a history of about one century. It has become a mature sector recognized as standardized, highly specialized, full of information, open and transparent.

1. Monopolizing market with high professionalism

From the development and operation of oil tanker transportation industry, it can be seen that there are not only risks facing this sector, but also strong professional skills needed. For example, when oil is transported, it is necessary to observe technical safety requirements and to timely deal with the problem of leakage and pollution that may occur during the transportation. All these situations require an oil tanker fleet with excellent professional knowledge. Besides, the high professionalism of oil tanker transportation industry can be seen from the division of labor between the oil tanker transportation industry and the container shipping industry. Moreover, every international oil tanker

shipping company in this sector has its own professional qualities in terms of its fleet management, operation standards, prime customers as well as navigation routes.

In international oil tanker transportation market, tanker fleet can be divided into two categories in terms of their operation mode: one is the tanker fleet affiliated to an oil company while the other is an independent tanker fleet. It can be seen from the development of international oil tanker transportation market in recent years that the tanker fleet independent of oil companies has gradually become the backbone of this market. However, oil companies still dominate the whole market due to oil scarcity, highly-risky oil transportation and high degree of professionalism. The number of customers who need to charter vessels is small in the market, and most of them belong to certain oil companies and merchants. This has led to a monopoly for the buyers in the market. In recent years, independent oil tanker fleets have stepped up the pace to cooperate and merge, growing up as several professional and large-scale independent fleets in the world.

2. Influenced by geopolitics in the context of COVID-19

Global politics and trade policy play a key role in the development of tanker transportation market. According to BP's Statistical Review of World Energy in 2020, more than 33 percent of global oil is produced in Middle Eastern countries. The Organization of Petroleum Exporting Countries (OPEC) is mainly made up of Middle Eastern countries, especially Saudi Arabia, which plays a balancing role in the oil market with its huge crude oil production and storage capacity. On March 6, 2020, OPEC negotiated with Russia, a non-OPEC ally, to cut crude oil production. The main reason for both sides to reach such an agreement is their concern over the growing trend of the US shale oil trade. They agreed to cooperate with each other, cutting oil production by May 2020 so as to stop the slump in oil prices. However, the widespread impact of COVID-19 has weakened oil market demand, with BDTI index falling sharply from March 2020 to April 2021 (see Figure 2) and even turning negative in January 2021. Therefore, it is inevitable for oil price and tanker freight index to plunge in such cases.

Due to the uncontrolled outbreak of COVID-19 worldwide, many countries turn to geopolitical means to get out of the predicament of slumping oil price and BDTI index. Iran, for example, a country heavily dependent on its oil, has managed to export oil indirectly through countries such as China, notwithstanding US sanctions, However, it had to sell at a price below the international exchange rate in order to ensure sufficient market share and to cover its losses.

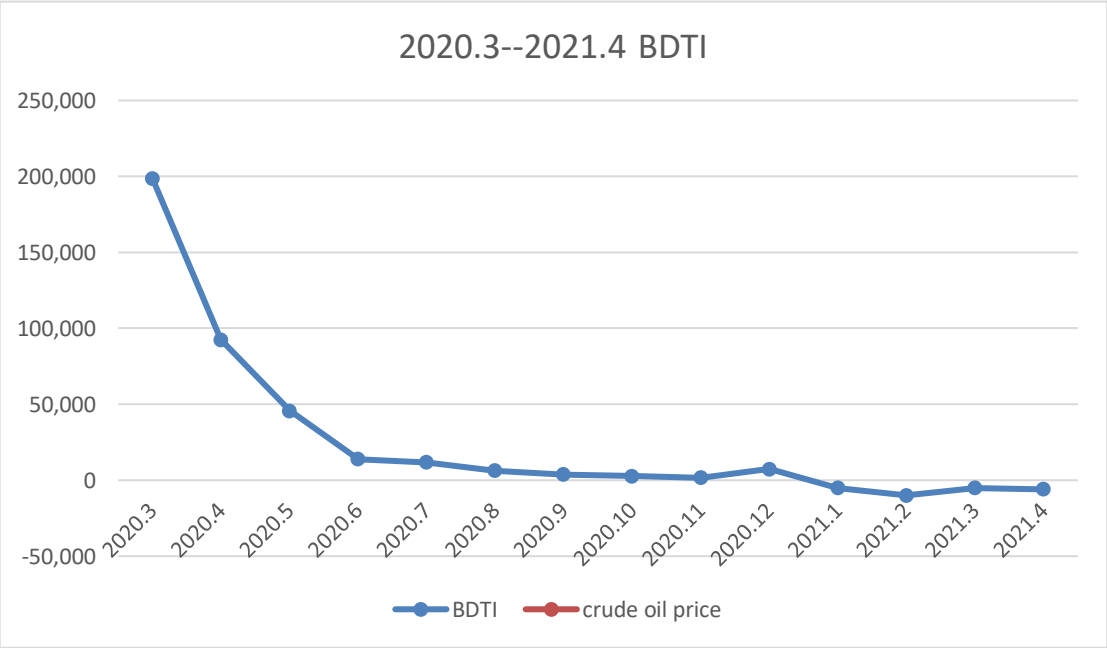

Figure 2 2020.3--2021.4 BDTI

3. Characterized by regularity and periodicity

According to the business cycle theory, the world economy presents an alternating trend of economic expansion and economic recession. The theory of short-term fluctuations states that small fluctuations will occur in the economic activities every three to five years. For example, from 1953 to 1982, the volume of world trade exports peaked for six times, with fluctuations occurring every five years on average.

The oil tanker transportation market is an economic system with many economic features. The invisible hand of market ensures a cyclical economy to a certain extent. Similarly, the oil tanker transportation industry shows the characteristics of periodicity. Observing

the data of past few years (see Figure 3), it can be found that the oil tanker market has experienced four strong volatility cycles from 2008 to 2021, a decade from now.

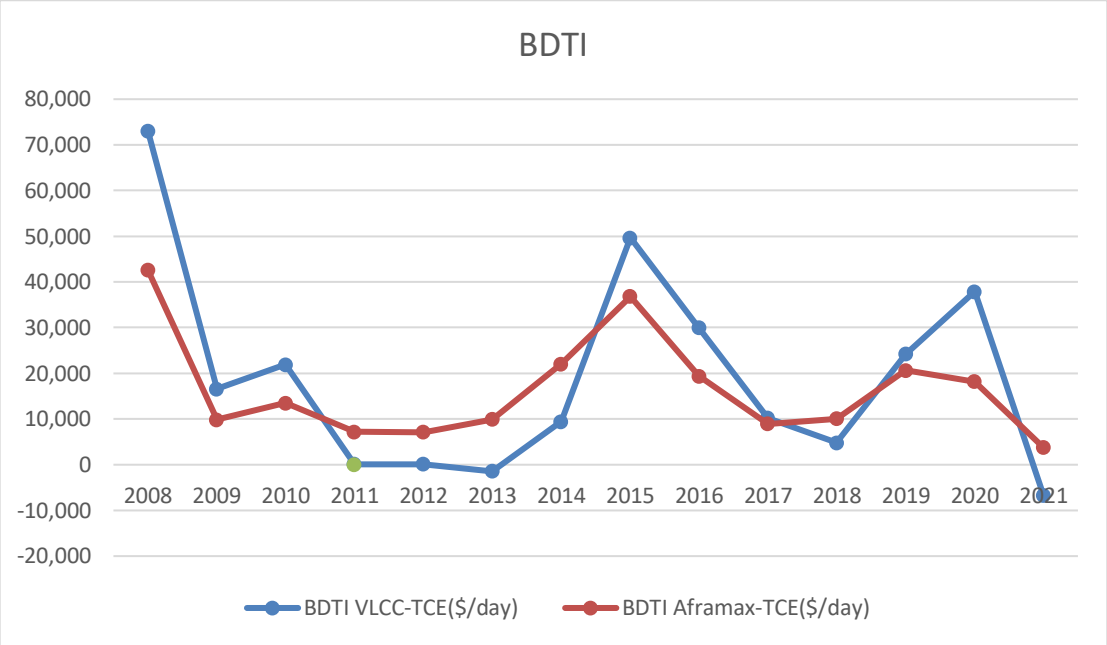

Figure 3 2008--2021 BDTI

3.2 Supply Analysis of International Oil Tanker Transportation Market

3.2.1 Factors affecting oil tanker supply in international oil tanker transformation market

The supply of oil tanker depends on a series of factors, such as the current state of shipping capacity, the number of newly-delivered and newly-dismantled ships, the freight rate and so on.

1. Current state of shipping capacity

Current shipping capacity refers to the capacity of vessels left over from the prior period of forecast phase, including oil tankers that are in use or sit idle. Impacted by supply & demand, or the profitability of a company, some ships may be idle when the market is not promising, yet re-enter the transport market as long as the market picks

up. The current state of shipping capacity is a basic condition for forecasting the market fluctuations, accounting for the vast majority of the total number of ships in the future market. Yet, idle ships and the uncertainty caused by their usage will have an impact on the forecast of capacity supply.

2. Newly delivered ships

New delivery ships refer to the number of ships that will enter the tanker market during the forecast period, and this part of ships is the fundamental reason for the increase of ship capacity. Due to the long time required to build a ship, it usually takes one or even three to five years for the ship to be completed. The specific time is usually determined by the quantity of orders placed by the shipyard. The rise and fall of the shipbuilding market was determined by the quality of the tanker transportation market at that time. Therefore, there is a certain connection between the new ship delivery and the new shipbuilding market.

3. Quantity of dismantled ships

The volume of dismantled ships is the main driving force for the decline in oil tanker capacity, and an important factor influencing the rise and fall of ship dismantling market. When retired ships cannot be used any more, the shipowners will dismantle them, which, on one hand, reduces waste and conserves resources, and on the other hand, protects the crew and cargo from the threat posed by those old ships .

4. Freight rate and expected freight rate

In an economic system, the price can stimulate the supply. So can freight rate exert a huge impact on the supply of transportation capacity in the shipping market. Freight rate decides whether a ship should sit idle or be put into use. Meanwhile, the forecast of future freight rate is an important factor for shipowners to decide whether to order a new ship or dismantle a retired one.

5. Other factors

Apart from the above factors, there are other causes such as policies that will also affect shipping capacity in a certain period of time. For example, China in recent years has proposed the policy of "national oil and national transportation" and strongly supported domestic oil tanker transportation enterprises, which led to a huge increase in China's crude oil ship-building within a short period of time.

3.2.2 The review of capacity supply in international oil transportation market

1. Review of newly-delivered ships capacity

The number of newly delivered crude oil ships in the past decade is shown in the figure 4 below. As can be seen from the figure, the number of new ships delivered from 2010 to 2020 shows an overall downward trend, and it closely coincides with the change of deadweight tonnage (DWT). The decline in oil tanker deliveries is partly because it takes time to build new ships, typically several years after orders are placed. On the other hand, the COVID-19 has led to a sharp decline in the demand for new ships from both shipowners and investors.

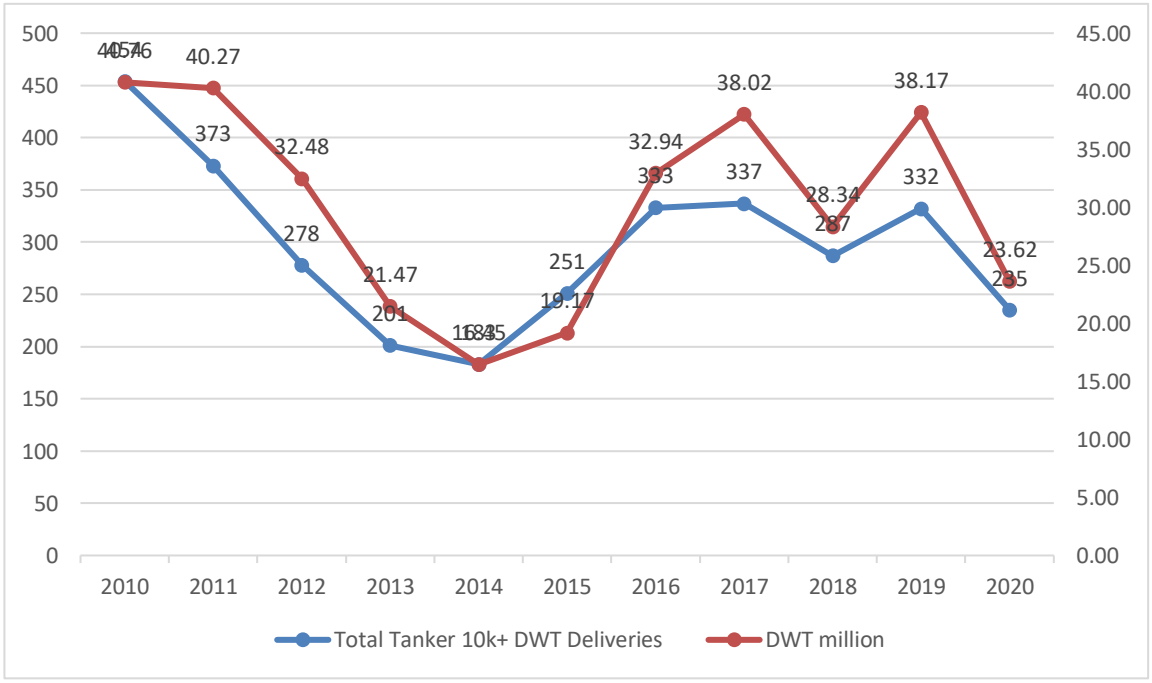

Figure 4 2010--2020 Tanker 10k+ DWT Deliveries and DWT million

2. Review of the capacity in ship demolition market

The continued outbreak of coronavirus in the United States, Europe and other countries and regions have reduced the demand for oil tanker transportation. Therefore, the demand for oil tankers remains low because of the restrictions on the amount of oil shipped. Besides, due to low freight rate, the tonnage of oil tankers that were sent to be dismantled has already reached the total level of 2019 and 2020 in the first four months of 2021 (see Figure 5).

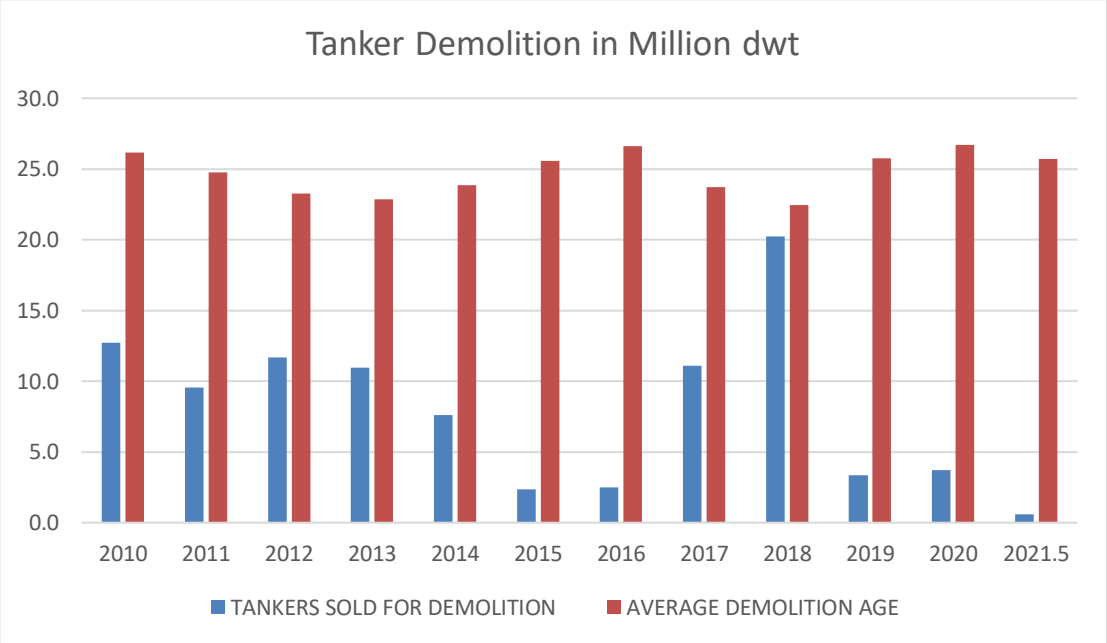

Figure 5 2010—2021.4 Tanker Demolition in Million DWT

3. Review of capacity in oil tanker market

Table 1 Total Tanker Fleet Development Quantity & DWT(million)

Year	**2008**	**2009**	**2010**	**2011**	**2012**
Quantity	1589	1591	1655	1683	1771
DWT	270.44	274.37	290.91	299.48	319.89

Growth（%）	1.4	6.0	2.9	6.8	4.7
Year	**2013**	**2014**	**2015**	**2016**	**2017**
Quantity	1831	1843	1824	1843	1932
DWT	335.06	340.38	341.69	348.10	368.24
Growth（%）	1.6	0.4	1.9	5.8	5.0
Year	**2018**	**2019**	**2020**	**2021**	
Quantity	2012	2009	2116	2180	
DWT	386.57	388.87	414.32	428.36	
Growth （%）	0.6	6.5	3.3	1.6	

Source: Clarkson

As can be seen from the above table, the deadweight tonnage of tanker fleet has been rising gradually in the past decade, displaying a relatively average growth rate, whereas the rising rate has been slower and slower in recent years. As shown in the table, by the end of this year, there will be 5,652 oil tanker ships in the world carrying more than 10,000 tons, with about 549.8 million deadweight tons. As for different types of ship, it shows that large oil tankers in the future will dominate the market, which can be proved by both the existing capacity and the number of orders. Large oil tanker is the main type for oil tanker transportation, but they also account for the majority of idle tankers in the market.

3.3 Demand Analysis of International Oil Tanker Transportation Market

3.3.1 Factors influencing demand in international oil tanker transportation market

1. World economic outlook

The demand for oil tanker transportation results from world's demand for petroleum products, which witnesses the production of petroleum and relevant products changed into the circulation field. Given that the demand for oil tanker transportation is mainly derived from international oil trade, it will be greatly affected by the world economic

conditions and oil trade. The influence of world economy on the demand of the international oil tanker transportation market is mainly reflected in the periodic fluctuation of world economy, the regularity of long-term economic trend, regional collectivization, economic impact, knowledge economy and so on.

2. Maritime transportation distance and crude oil transportation channels

The oil supplier is also an important factor affecting oil tanker transport market. In the 1960s, the proportion of oil produced in the Middle East increased greatly in global oil trade market, and the average transportation distance of crude oil in the world was extended, leading to a surge in demand for oil tankers. Since the 1970s, the imports of global crude oil have declined, so did the proportion of oil from the Middle East. Meantime, the average distance of crude oil was shortened to nautical miles, which explained the decline in demand for oil tankers. This phenomenon is known as the law of oil tanker demand multiplier in the shipping industry. Later on, Norwegian economists have found that the average distance of trade will be shortened as freight rates rise, which entails decreasing demand for shipping measured in tons of nautical miles. Northwestern Europe has increased their imports of crude oil from North Sea fields and West Africa, reducing the imports from the Middle East. The construction of Russian oil pipelines has also helped European Union countries and China to import more crude oil from Russia, lowering the volume of shipping. Due to different cost caused by distance, people will use different transport routes or turn to pipeline transport, thus affecting the demand for different types of ships in offshore oil transportation market.

3. Politics and wars around the world

Global politics and wars have seriously damaged the demand for international oil tanker transportation. A lot of oil-producing countries use oil for diplomatic benefit, while some large oil-consuming countries turn to wars to punish those oil exporters. Local wars happened in oil producing areas will immediately decrease their oil production and exports, thus battering the oil market and then the oil tanker market.

For example, Middle Eastern countries used oil as a political weapon, and adopted measures such as the embargo against the United States and price restriction to drive oil prices sharply higher in a short period of time. Tanker rates soared during the two Gulf wars. The increase in freight rates eventually led to a change in demand for international oil tankers.

4. Energy policy, science and technology

Oil is a kind of strategic energy, but it also pollutes the environment. From the perspective of sustainable development and harmony between man and nature, it is necessary for the renewable energy to replace oil in the future. Many countries have put forward policies to support the development of green energy, and have implemented strategic plans for oil storage and energy conservation. On the other hand, the development of science and technology will contribute to the replacement of new energy to petroleum products in the future. These above-mentioned factors will eventually lead to changes in oil demand, and thus affect the oil tanker transportation market.

To sum up, the factors influencing the demand for oil tankers market are as follows: world economy, trade volume of crude oil, freight rate, politics, war, policy and so on.

3.3.2 Review of demand in international oil tanker transportation market

From 1960 to now, the market demand trend of international oil tanker transportation has experienced three periods of fluctuations.

1. From 1960 to 1986

From 1960 to 1986, there was a complete cycle of fluctuations in the demand market. In the 1960s, the volume of oil trade in the Middle East soared, and the average oil transportation distance rose from 4,500 kilometers to more than 7,000 kilometers. All

these boosted the growth of the demand for international oil tanker transportation, resulting in a peak in 1978. However, in the late 1970s, the output of new oil fields increased sharply. For instance, the new North Sea oil field, which was put into use in 1975, rapidly increased its production to 5.5Mbpq, which brought the average transportation distance down to 4,450 km, and decreased the market demand for oil tankers, hitting a record low in 1986.

2. From 1986 to 2008

In 1986, international oil price fell sharply, leading to a huge growth in oil exports from Middle East, and the tonnage of oil transportation began to rise, all of which raised the demand for international oil tanker transportation. Besides, the rapid economic development also boosted world demand for oil. In the late 1990s, most countries and regions in the world increased their imports of crude oil. The rising trend continued until the outbreak of global financial crisis in 2008. Then, the economic recession brought oil demand down.

3. From 2008 to 2021

The outbreak of financial crisis in 2008 lead to a global economic downturn, which gradually reduced oil transportation demand. The Iranian nuclear crisis in 2012 further influenced the oil transportation market, and from then on, geopolitical crisis frequently broke out. In 2020, the COVID-19 spread around the world, which resulted in a sharp decline in international oil demand. The global oil industry is now in a passive period with low demand and obvious oversupply.

3.4 Analysis of Freight Rates in International Oil Tanker Transportation Market

3.4.1 Factors influencing freight rates in international oil tanker transportation

market

1. Poor balance between supply and demand

The balance between supply capacity of oil tankers and transportation demand is a fundamental factor influencing the oil tanker market rate. In the case of excess capacity, the change of freight rate is basically synchronous with the imbance between supply and demand in oil tanker market, that is, when the gap between supply and demand reduces, the freight rate will fall, thus bringing down the supply of vessels. In the meantime, the decline in supply in turn compensates for the imbalance between supply and demand decreases. On the contrary, when the gap between supply and demand enlarges, freight rates will rise, stimulating market supply. In the oil tanker market, freight rates are very sensitive to the balance between supply and demand.

2. Seasonal changes of supply and demand in oil tanker market

The offshore oil tanker transportation market has to experience peak season and off season in a year, usually with demand rising in winter and falling in summer. Freight rate is the barometer, reflecting the change of supply and demand in the oil tanker transportation market. Therefore, it has obvious seasonal variation characteristics. In addition, the supply of oil tankers is so rigid that it is difficult to be transferred to other markets, so the short-term supply in the crude oil shipping market is less elastic.

3. Crude Oil Prices

In shipping market, freight rate, as a source of cost, will affect the price of goods. However, things turn out differently in the crude oil market. Fan Zhicheng(2011) established an econometric model to explore the relationship between crude oil price and freight rate. Through Granger causality analysis, he found that the change in crude oil price could explain the freight rate fluctuations, but not vise versa.

4. Other factors

Other factors such as national policies or settlement method also affect freight rates. Some nations, in order to protect their own energy, only allow state-owned enterprises to transport their crude oil and set protective tariffs. Whether the settlement is set in a spot market or in a futures market also influences the current freight rates. What's more, the settlement currency cannot be ignored. For example, the oil trade is generally settled in US dollars, which indicates that the price of oil tanker transportation will be increased if the US dollar depreciates.

3.4.2 Review of freight rates in the international oil tanker transportation market

Since the Baltic Exchange published the freight index, oil tanker freight rates are mostly set based on the Baltic Exchange Dirty Tanker Index (BDTI). Starting from 1998, the fluctuations of freight rates in crude oil market can be divided into four periods.

1. From 1998 to 2002, the oil tanker market experienced a cycle of fluctuations. At first, the growth of oil transportation demand brought with it a promising market and increasing freight rates, peaking in 2000. When the world economy began to slump in 2001, the demand for oil dropped and freight rates began to fall all the way until the second half of 2002, when market conditions began to improve at the end of 2002

2. From 2003 to the end of 2006, freight rates in crude oil market went through extreme highs and lows with almost four cycles of fluctuations, displaying obvious seasonal fluctuation features.

3. Before financial crisis broke out from 2007 to 2008, the freight rates in the market were in a high level. Some experts concluded that the growth rate of market capacity supply was less than that of the prior period, which brought about a prosperous tanker shipping market.

4. From 2008 to now, the changes of freight rates baffle people. Oil tankers made a lot of profits in 2015, and later on reached peaks in Q3 of 2019 and Q2 of 2020. Nevertheless, generally speaking, it is not a continued period of rise.

4 Analysis of International Linkage of Chinese Oil Tanker Transportation Market Based on Core−Periphery Model

4.1 The Interpretation of Core – Periphery Theory

The core-periphery model goes like: in a given economic entity with only agriculture and manufacturing sectors, two similarly-developed areas will gradually change into different forms when a series of assumptions are met, that is, one area with small advantages will continue to accumulate until it becomes an industrial center, while the other region will gradually become peripheral, eventually forming the "manufacturing-centered and peripheral agriculture" model. Prebisch(1962) believes that in the context of traditional division of labor, the world economy was divided into two categories: large industrial centers and peripheral areas that provide food and materials for industrial areas, which is represented by the British, a renowned industrial center, and its colonies in the pre-war period, and manifested by a ladder divisional structure between developed countries and developing countries after the war.

In such a model, countries at the center mainly produce and export industrial products, whereas peripheral countries are responsible for producing and export primary products. Prebisch (1962) argues that the trade conditions of primary products are in a disadvantage compared with that of industrial products, concluding that the interests of the central countries and peripheral countries are unequal in international division of labor and international trade.

In sum, the "core-peripheral" theory contains three main concepts: first, the "core-periphery" system is a dynamically related and unified one; Second, there exist

differences in production structure between central and peripheral countries. Third, the status of central countries and that of peripheral countries is asymmetric and unequal, which is a key concept and can be explained by the origin and development of "core-periphery" structure. Since the establishment of international trade system, peripheral countries have lagged behind due to the starting point for development is not the same for central countries and peripheral countries. The subsequent long-term deterioration of primary trade conditions has further increased the inequality between these two types of countries. The "core-periphery" system itself and its structure and development rules determine that the peripheral countries will always be placed in a disadvantaged position. Peripheral countries' demand for advanced industrial products and services mainly depends on central countries, but their means of production is used to offer service to central countries, so the economic and trade development of central countries has a great impact on the periphery. On the contrary, due to that peripheral countries are mainly engaged in low-technology manufacturing and trade such as the processing of primary product, which can be easily replaced with other producers, the economic fluctuations of peripheral countries have little impact on central countries.

4.2 International Oil Tanker Transportation Market under the "Core - Periphery" Model

4.2.1 The connotation of "center - periphery" structure in international oil tanker transportation market

Agglomeration can boost economic growth with economic activities being geographically concentrated, so that the development of external areas can be promoted. The concentration can help to realize the economies of scale and drive economic growth through the mechanisms of sharing, matching, and learning. However, the economic concentration is enlarging the gap between central countries and peripheral countries. Krugamn (1991) believes that the space heterogeneity, which refers to the difference of various areas in endowment, historical culture, policy environment and etc., is not only a basic element for regional division of labor, but also the cause of industrial agglomeration. The geographic concentration of industries leads to spatial asymmetry of economic activities, which, in turn, further promotes industrial geographic concentration. Ultimately, a system of relatively developed

"central areas" and relatively backward "peripheral areas" is formed.

The petroleum industry is a resource-based sector, whose formation and development is based on the exploration and utilization of petroleum resources. On the other hand, the oil tanker transportation market is formed with the development of petroleum industry and shipping industry, having a strong geographic advantage. At the national level, the distribution of global oil reserves is significantly concentrated (see figure 6), with Venezuela (17.52%), Saudi Arabia (17.16%), Canada (9.97%), Iran (8.97%) and Iraq (8.36%) reaching the top five. From the perspective of demand side, the average daily world oil consumption has been increasing year by year from 2012 to 2019. In 2019, there were 98.27 million barrels of oil consumed per day in the world, 3 million barrels more than oil production. Overall, demand exceeds supply in the global oil market. However, since the outbreak of COVID-19, the demand for oil has dropped sharply, while the freight rates of oil tankers have soared in a short period of time. Currently, the world's major oil consumers are the United States, China, India, Japan, Saudi Arabia and Russia. Therefore, from the point view of supply and demand, the United States, Russia and OPEC + are in the central position of oil transportation market.

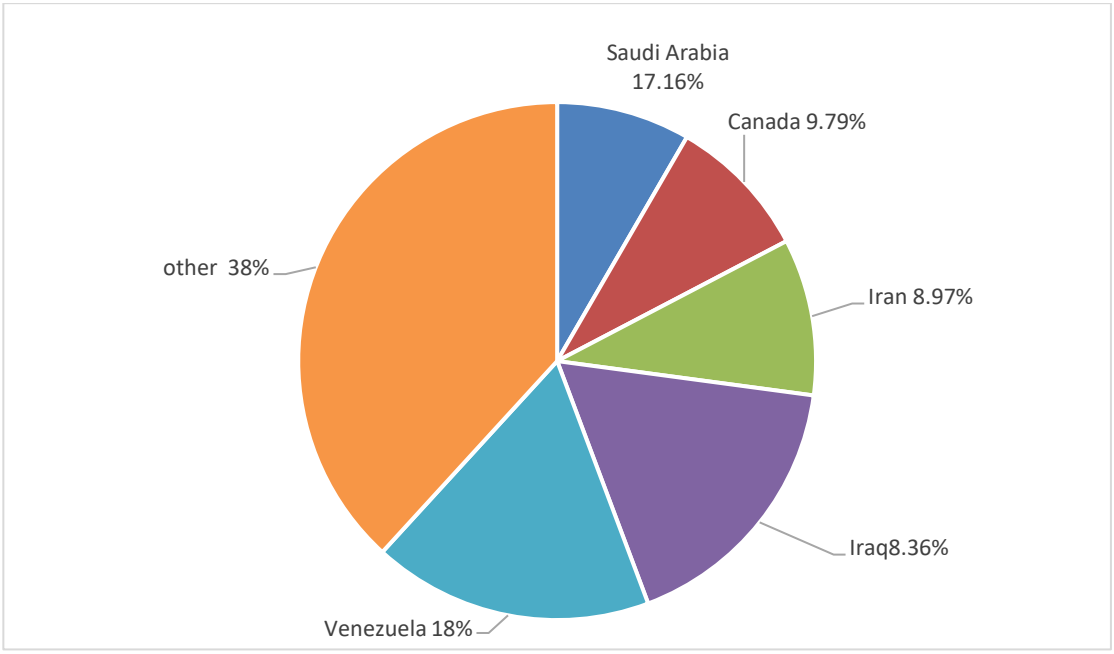

Figure 6 Distribution of major world oil producing countries

4.2.2 The origin of "core - periphery" structure in international oil tanker

transportation market

The geographical advantages of different countries will directly affect the spatial distribution of oil industry and oil tanker transportation industry, which will finally lead to the differentiation of transportation market. Therefore, it is a necessary to explore the relationship among the geographic advantages of countries, the agglomeration of petroleum industry as well as the differentiation of tanker transportation market. Among these three factors, the relationship between geographic advantages and petroleum industry agglomeration is relatively important, for the impact of the former on the latter is a basis for the interconnection of all these three components.

As the epidemic continues to spread around the world, global economy has been hit hard, and the international crude oil market is no exception. Since the beginning of 2020, oil demand in the international market has fallen sharply, and oil prices continued to slide. Impacted by the extreme imbalance between supply and demand, the oil market has been severely damaged, bringing pains for market participants.

Factors that help the formation of "core - periphery" structure include economies od scale, geographic locations as well as institutional support. Among them, economies of scale is a key factor. It will be impossible to generate economic agglomeration and diffusion and to eventually form the spatially connected center-periphery structure if there is a lack of economies of scale.

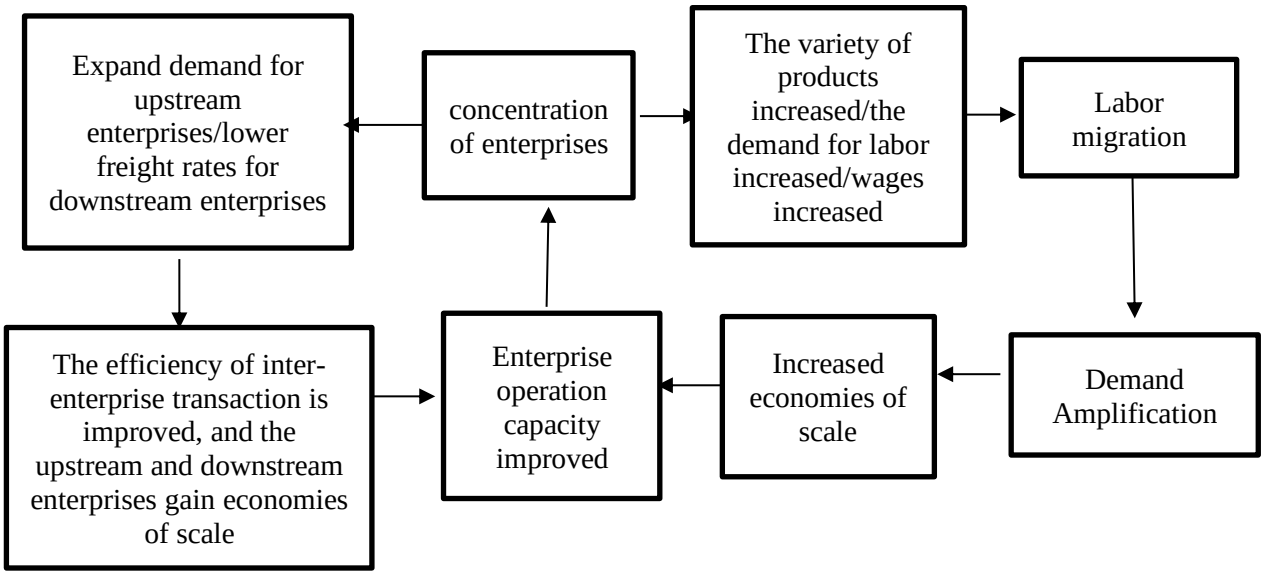

Figure 7 Krugman's process mechanism for industrial clusters

As can be seen from Krugman's process mechanism of industrial clusters (see Figure 7), the improvement of economies of scale will reduce the freight rates for downstream enterprises and expand the demand for upstream enterprises. In oil tanker transportation market, larger economies of scale will lower the fixed and marginal cost of production for oil manufacturers, so that the oil processing industry will be concentrated in the region, thus leading to the differentiation of oil economic development. The agglomeration of petroleum processing industry will further improve the wages of the workers in this sector, which will in turn reinforce the agglomeration of petroleum processors in this region and form a "core-periphery" pattern. Moreover, the reduction of transportation costs, the enlarged scale of petroleum processors, as well as the increase of consumption will reinforce the agglomeration of petroleum processing industry with regional advantages.

4.2.3 The applicability of "core-periphery" theory in international oil tanker transportation market

The "core- periphery" theory can be applied into the world economic system. Prebisch (1959) holds that the "core-periphery" system is a unified and dynamic one with integrity. Nowadays, with the acceleration of economic globalization, its characteristics of integrity will be more prominent. However, different nations, when facing economic globalization, do not always have strong power. Those who

are less developed are more likely to be swallowed by the tide of economic globalization, and are finally placed at the "peripheral" position for a long period of time. The development of shipping industry is also closely related to economy. The ships in the market every day were ordered a long time ago. Shipowners, brokers and traders are in a price negotiation every day for future trade. Once there is a problem in trade, it will be immediately reflected in the negotiation table, which shows the relationship between supply and demand. The shipping industry responds to economic development faster than the stock market. In other words, it predicts the future trade economy.

In oil tanker transportation market, the strong geographical advantages of oil make it more likely to form the "core-periphery" pattern. Natural resources are the foundation for human development. During the course of history, many countries have achieved rapid development and become worldwide economies by means of developing natural resources trade. Saudi Arabia, for example, has secured its place in the world oil market with its rich oil reserves. However, it is also found that on the one hand, the position of "central" or "peripheral" countries is not unchangeable and the "central" ones may go into reverse and that on the other hand, the early world trade for any country starts from natural resource products, which is in the "periphery" of world trading system. Even Japan, a country lack of natural resources, is no exception. Despite Japan’s scarcity of resources, it greatly improved its per capita national income through the export of primary products in early times. This paper holds that the natural resource endowment of a country may be neither a necessary condition nor a sufficient condition for its economic growth in the context of economic globalization and international division of labor. Therefore, in the oil tanker transportation market, though oil production to a certain extent has driven the formation of "core-periphery" model, it cannot be ignored that factors such as the system, economies of scale , human capital, material capital and technical progress have all promoted the evolution of this pattern.

4.2.4 The status quo of "core - periphery" structure in international oil tanker

transportation market

The "core-periphery" structure of international oil tanker transportation market is formed under severe competition, which is not immutable but dynamic and changing. The traditional oil tanker transportation market will not adapt to new rules when the emergence of a scientific and technological revolution has changed the status quo of world oil trade. In such a case, the new system will eventually replace the old one, and the "core - periphery" structure will present new features. On one hand, the status of central or peripheral countries may be reversed, with the peripheral countries upgraded to central due to their economic growth and regional integration, and the central countries falling into peripheral countries, such as the US shale oil. On the other hand, the number and status of clusters will change as a core can either be a single country or regional allies, such as OPEC.

Figure 8 Map distribution of major oil producing and consuming countries

Figure 9 Map distribution of major oil producing and consuming countries

Petroleum is not distributed evenly around the world, mainly concentrated in Saudi Arabia, Russia and the United States (see Figure 8), forming a relatively stable pattern of three pillars. In recent years, the oil producers in the world are becoming increasingly diversified. Specifically, the number of medium-sized oil producing countries has increased sharply, and the output scale of medium and small oil producers indicates a gradual rising trend. The world oil consumption is highly concentrated in the United States, China, Japan and Russia. The spatial distribution of world oil consumption extends from the east and west, with the center located in the middle of the world, and gradually shifts to the eastern hemisphere and the northern hemisphere in low latitude. Overall, the world oil production does not match its consumption. Influenced by the mismatch of oil production and consumption, the oil in the world generally presents a distribution pattern from the middle of the world to the east and west.

4.2.5 The impact of COVID-19 on the world oil market

Affected by the COVID-19 epidemic, global oil demand and the crack fell sharply, which resulted in the production cut of major refineries and even a complete shutdown. Soon after the epidemic, global refining capacity fell by about 12 million barrels per

day by the end of April 2020. Due to the decreased demand in downstream production, global oil demand was cut by 24 million barrels per day, which was equivalent to reducing 24 percent of global oil consumption in the current period. In 2020, global oil consumption is down 9 percent from 2019. That supply exceeds demand will inevitably lead to a rapid decline in international oil prices. On April 20, 2020, the NYMEX WTI 2005 futures contract (first line) plunged $ 55.9 to close at -$37.63 per barrel (settlement price), turning negative for the first time since oil futures landed on the NYMEX in 1982. It fell about 306 percent, with the lowest point in the market being -40.32 US dollars per barrel.

As China firstly recovers from the epidemic in 2021, U.S. Energy Information Administration predicts that the oil needs from China, the Middle East and other non-OECD member countries will recover to 2020 levels by 2021. By the end of the first quarter of 2021, world oil demand will remain lower than that of pre-epidemic era, and the daily consumption will be between 92 million to 9500 million barrels. However, despite a slowdown in the recovery of demand , there is expected to be a supply gap in the second half of the year due to production cuts of OPEC + nations.

When the epidemic initially broke out, the decline in oil demand in effect promoted the development of oil tanker market, further boosting the demand for floating oil. The reason is that the refining capacity was reduced, and the onshore oil reserves reached the limit. However, the demand for floating oil in 2020 did not remain high. From May to October of 2020, crude oil tanker demand has gone through a rapid decline with the volume dropping to the lowest level since 2016. Figure 9 shows the demand and supply of oil tanker vessels and the cargo miles since 2020. During this period, the tonnage of global crude oil tankers fell by 11 percent month-on-month to nearly 900 billion tons, down 11 percent from a year ago. This indicates that global oil demand will continue to reduce as the demand for floating oil slows down in the context of COVID-19. When there is a lack of demand in the market, the oil tanker rent will collapse quickly.

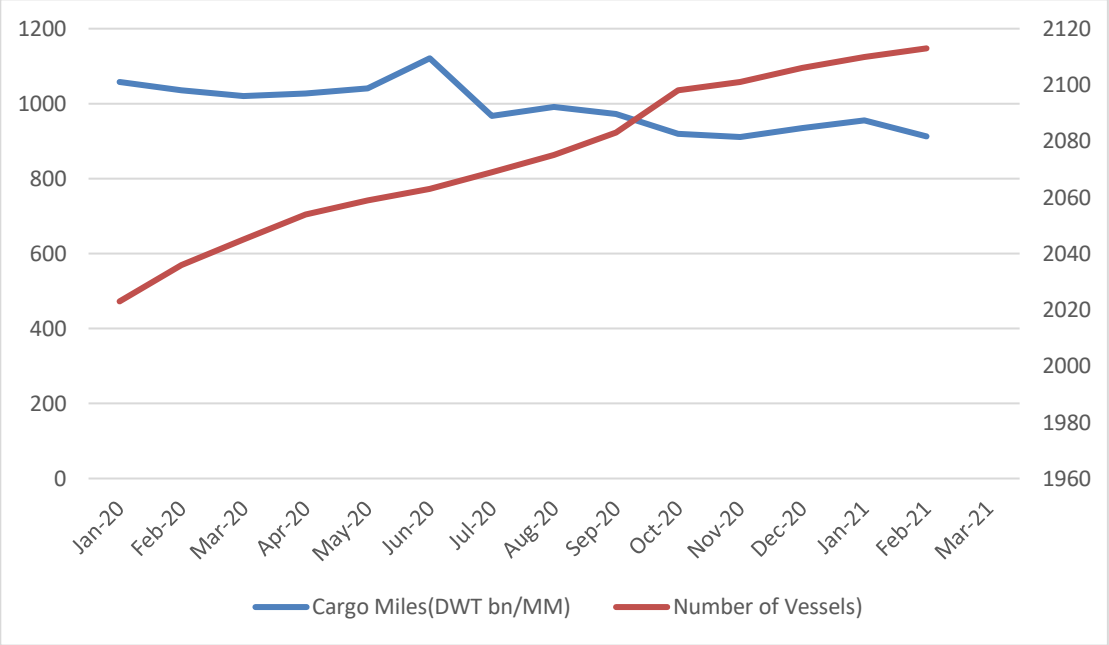

Figure 9 Crude tanker supply vs demand

As is known to all, the world's major crude oil producers mainly concentrated in the Middle East Gulf region, North Africa, West Africa, the North Sea, Siberia, Central Asia, China, Malaysia, Caribbean region and North America region. In terms of the exported volume of offshore crude oil, the Middle East Gulf, North Africa, West Africa, Caribbean Sea, the Near East and Southeast Asia are six top regions. Northwest Europe, the United States and Japan mainly need to import crude oil from other countries. In terms of the imported volume of offshore crude oil, the order is as follows: Northwest Europe, North America, China, Japan, Russia, the Mediterranean Sea and South America. The four oil routes in the world are Persian Gulf-Western Europe & North America route, Persian Gulf-Japan route, Persian Gulf-Western Europe route as well as Mexico-Japan route.

In addition, there are some short-distanced maritime routes for oil shipping, such as the West Africa-North & South America routes, North Africa-Western Europe route, the Black Sea-Mediterranean route, Persian Gulf-Australia & New Zealand route, Alaska-US East Coast route, Mexico-Caribbean route, China - Japan route and so on. It is clear that the world's crude oil is mainly transported from the Middle East to Northwest Europe, North America, Japan, etc. However, the oil demand of Northwest

Europe, North America and Japan has dropped significantly because of the outbreak of COVID-19. Moreover, due to the popularity of shale oil in the United States, the supply of oil has exceeded the demand. China's demand for oil imports remains strong despite the COVID-19 pandemic. In fact, low international oil prices are more beneficial for China, for it is one of the largest importers of petroleum in the world. Without the coronavirus, China would have gained more economic advantages in the price war than ever before. To conclude, in the context of COVID-19, the "core-periphery" pattern in the international oil tanker transportation market has been gradually changed into a "core-subcenter-periphery" model.

4.3 Influence of the International Linkage of China ‘s Oil Tanker Transportation Market in the Context of COVID-19

4.3.1 Overflow effect of the international linkage of China's oil tanker transportation market

International trade is an important part of international economic communication, accounting for more than half of the GDP of major economies from 2010 to 2021. For economies that rely heavily on oil, the demand for maritime transport is closely related to the world economy at the time. The supply of oil in the international oil tanker transport market is mainly in the hands of large shippers, which leads to a buyer-monopolized market with the shippers having a greater say in the market than shipping enterprises. The derived characteristics of shipping industry decides that the demand for oil is also closely related to the world economy. Though international trade has brought closer economic ties among countries and driven the growth of trade, it also leads to economic crisis through the linkage mechanism that affects both the economy and market. The difference in economic scale of the core and peripheral countries proves a strong "core-periphery" structure of global economy, which further indicates that the central countries plays a key role in the social and economic development of the whole region. In such a case, the central economies have a strong power over the peripheral economies, which often choose to attach themselves to the central economies so as gain more economic benefits.

The socio-economic connection between the central and peripheral countries is extremely close, so is the trade. China's export-oriented economic model determines its import and export will play a key role in the national economy. Figure 10 shows the total volume of China's crude oil imports and exports from 2010 to 2020. As can be seen from the figure, China's imports and exports display an upward trend apart from the year of 2009 when there was negative growth due to the financial crisis, which indicates that China's status in international trade is becoming increasingly significant. The activity of oil tanker transportation market is also affected by international trade. With a deeply-interdependent global economy, the linkage among markets will be strengthened. The volume of trade in the following figure fully shows that China and the central countries are in a close trade relationship, which will affect the oil transport market of countries and regions concerned. The economic downturn of central countries will lower the demand for importing oil, which is a blow for China's industrial economy, and brings a slump in the oil transport market. Moreover, the relationship of trade will inevitably lead to different levels of market linkage.

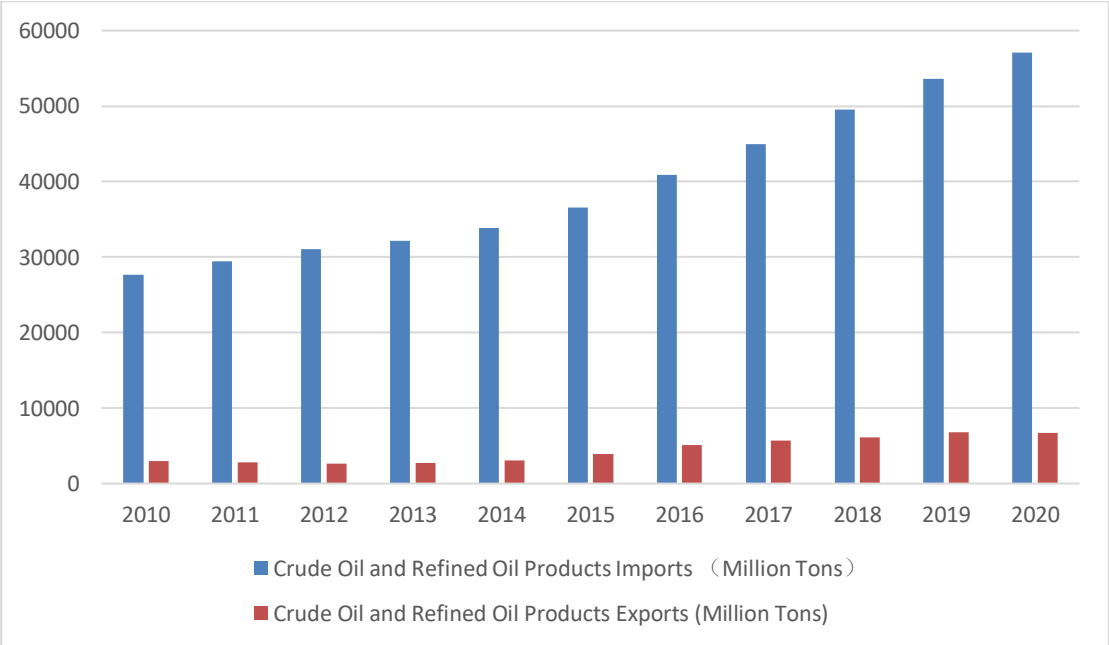

Figure 10 Imports and Exports of Crude Oil and Refined Oil Product

The decline in oil demand after the epidemic broke out in fact has boosted oil tanker market, with people's demand for floating oil increasing. In China, oil reserves are a part of national strategies, and the elasticity of consumption in this sector is relatively

low. As can be seen from the figure, China’s oil imports and exports from January 2020 to January 2021 were relatively stable, compared with a sharp drop in global oil demand resulted by the epidemic. The increase in global floating oil reserves has led to rising orders for oil tankers, which can be represented by the oil transport market performance of China, South Korea and other countries. Most shipyards are filled with ships such as oil tankers and containers.

4.3.2 Policy effects of the international linkage of China's oil tanker transportation market

The international economic policies and maritime transport policies issued by the regulatory authorities will have a positive impact on the linkage of international oil transport market. As domestic oil transportation market is directly involved in the competition of the international market, there is a significant linkage between China's oil transportation market and the international oil transportation market. One instance is that after the coronavirus broke out and OPEC agreed to cut oil output, the freight rates of oil tanker shipped to China has risen or fallen in lockstep with those of international oil tanker transportation. Against the background of China’s increasing open economy and trade, the following part examines the linkage mechanism of international oil tanker transportation market from the two aspects: foreign exchange controls and trade controls.

4.3.2.1 Foreign exchange controls and cross-border capital flow

China's tanker fleet is headed by CCOSC and China Merchants Energy, which have 54 VLCCs and 51 VLCCs respectively, ranking second and third in the world, second only to Tankers International that is operated under the "joint venture" model. The total number of VLCCs owned by these two state-owned enterprises accounts for about 12.7% of the total VLCCs in the world, but it is far enough from the huge demand for oil transportation in China. In addition, considering market gains and many other factors, the two state-owned companies have to transport a considerable part of foreign cargo. According to the annual reports of these two companies, the proportion of domestic

cargo carried by them in recent years account for only 60 percent, which further increases the demand for oil transportation capacity in China. In other words, China's oil companies need to increase their transportation capacity from foreign shipowners so as to meet domestic demand for oil transportation, which forms the cross-border capital flow. In VLCCs sector, the VLCCs were chartered 2,266 times in 2020, down 7 percent from 2019. Among them, China International United Petroleum & Chemicals Co., Ltd. (UNIPEC) is the leading company, chartering more ships than the 12 VLCC charterers combined.

After the People's Bank of China announced the implementation of a managed floating system of the RMB exchange rate in relation to a basket of currencies, China’s exchange rate mechanism is becoming market-oriented. Developed economies represented by G7 are in the center of international economic system, whose currencies remain central to the international monetary system. Central currencies, as the main foreign exchange reserve assets possessed by peripheral economies, can effectively intervene in the foreign exchange markets by putting pressure on the peripheral economies. In international foreign exchange market, the exchange rates of peripheral developing economies such as China are extremely vulnerable due to the large and irregular fluctuations of the US dollars and other major international currencies, which will leads to instability of the global currency exchange rate, thus triggering a global crisis. China's oil tanker transportation market needs a large amount of foreign capacity, which is highly susceptible to foreign exchange markets. Therefore, exchange rate reforms will have a positive impact on the oil transportation market linkage.

4.3.2.2 Released trade controls

Trade freedom is an indicator to measure the convenience of trade among different countries: the less the barriers to the flow of goods between trade parties, the more goods can be traded across borders at lower cost, thus there is more freedom for trade. Therefore, the implementation of China's free trade policy will gradually enhance the linkage of China's capital market with other economies, and China’s oil tanker transportation market will be closely connected with the world as a result of the enhancement of trade freedom. At present, as trade barriers are gradually removed and

capital programs are on the rise, China's oil tanker transportation market has become an inseparable part of the world's shipping market. Trade integration is regarded as a catalyst that has effectively accelerated the cross-border flow of capital elements around the world. Among them, multinational enterprises can expand their regional scope of asset allocation to the whole world, so as to make full use of their idle capital. Developing countries, by contrast, can rely on the international oil tanker transportation market to ease the pressure of inadequate domestic capacity.

4.4 Conclusion

This paper holds that:

1. In a globalized economy, a country's natural resource endowment may be neither a necessary nor a sufficient condition for its economic growth. Therefore, in the oil tanker transportation market, though the oil output promotes the formation of "core-periphery" pattern to a certain extent, other factors such as the system, economies of scale, human capital, material capital as well as technological progress also stimulates the continuous transformation of the this pattern. In particular, economies of scale have a great impact on the agglomeration of oil tanker transportation industry. For example, the establishment of oil free trade zone attracts the upstream and downstream enterprises to cluster, and the industry clusters is conducive to the transformation of China's status in the international oil tanker transportation market.

2. In the context of COVID-19, the "core-periphery" pattern of international oil tanker transportation market is quietly changing, and presents a model of "core-subcenter-periphery", which is mainly reflected in China's strong demand for petroleum and oil transportation.

3.During the epidemic, the influence of geopolitics on the international oil tanker transportation market is intensified, and the linkage of international oil tanker market is strengthened. China's oil companies need to borrow a large amount of shipping capacity from foreign shipowners in order to meet domestic demand for oil transportation, it is, therefore, significant for China to adopt policies to ensure the

safety of its oil transportation.

5. An empirical analysis on the international linkage of China's oil transportation market

5.7 Data collection and processing

Eviews (Econometrics Views) is a software package for Econometrics. It analyzes the time series data by Econometrics methods and techniques on the quantitative laws of social and economic relations and economic activities. This paper collects the VLCC Baltic Dirty Tanker Index and China Import Crude Oil Tanker Freight Index from January 2019 to June 2021, with data from Clarkson and Shanghai Shipping Exchange. (See Appendix for data)

5.2 Stationary test

The unit root test of China Import Crude Oil Freight Index (CTFI) is carried out, and the results are as follows:

Table 2 Unit root test of CTFI

Null Hypothesis: CTFI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.309453	0.1758
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

As can be seen from Table 2, the P value of unit root test of CTFI at the significance level of 1% is 0.1758, which is greater than 0.05, indicating that CTFI has not passed the significance test. Next, the first-order unit root test of CTFI is carried out, and the obtained results are shown in Table 3:

Table 3 First-order unit root test of CTFI

Null Hypothesis: D(CTFI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.619419	0.0001
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

As shown in Table 3, the p value of the first-order unit root test of CTFI is 0.0001, which is less than 0.05, indicating that it has passed the significance test. This variable is a first-order stationary time series.

The unit root test of BDTI is carried out, and the results are as follows:

Table 4 Unit root test of BDTI

Null Hypothesis: BDTI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.329534	0.1700
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

As can be seen from Table 4, the P value of unit root test of BDTI at the significance level of 1% is 0.1700, greater than 0.05, indicating that it has not passed the significance test. The first-order unit root is tested, and the results are shown in the table below:

Table 5 First-order unit root test of BDTI

Null Hypothesis: D(BDTI) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.739940	0.0001
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

*MacKinnon (1996) one-sided p-values.

As can be seen from Table 5, the P value of the first-order unit root test of BDTI is 0.0001, which is less than 0.05, indicating that it has passed the significance test. This variable is a first-order stationary time series. This shows that BDTI and CTFI are both first-order stationary time series.

5.3 Granger causality

Table 6 Granger Causality of CTFI & BDTI

Pairwise Granger Causality Tests
Date: 07/04/21 Time: 15:25
Sample: 2019M01 2021M06
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
CTFI does not Granger Cause BDTI	28	6.48328	0.0058
BDTI does not Granger Cause CTFI		11.2016	0.0004

Table 7 Test of causality

Assumption	F-Statistic	P	Accept or reject
CIFI does not Granger Cause BDTI	6.48328	0.0058	Reject
BDTI does not Granger Cause CIFI	11.2016	0.0004	Reject

It can be seen from Table 6 and Table 7 that there is a two-way Granger causality relationship between CIFI and BDTI, and a VAR model can be established by roughly judging these two variables.

5.4 The determination of the lag order

Make the model with lag period of 2, then make the AIC value of each order, and finally find out the appropriate order according to the minimum AIC value.

Table 8 The determination of the lag order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-319.4610	NA	6.78e+10	30.61534	30.71482	30.63693
1	-308.1442	19.40029	3.39e+10	29.91850	30.21693	29.98326
2	-293.7571	21.92314	1.28e+10	28.92925	29.42664	29.03720
3	-286.9865	9.027591	1.02e+10	28.66538	29.36173	28.81650
4	-277.4101	10.94442	6.38e+09	28.13429	29.02960	28.32860
5	-274.2149	3.043021	7.71e+09	28.21094	29.30521	28.44843
6	-273.5375	0.516089	1.28e+10	28.52739	29.82060	28.80805
7	-271.1535	1.362288	2.03e+10	28.68129	30.17346	29.00513
8	-238.8091	12.32168*	2.33e+09	25.98182	27.67295	26.34884
9	-208.0670	5.855637	5.53e+08*	23.43496*	25.32504*	23.84515*

As can be seen from Table 8, when the lag order is 9, the AIC value is the minimum, so the most appropriate order to determine the VAR model is 9.

5.5 Establishing VAR Model

5.5.1 Introduction of VAR Model

VAR model is a simultaneous form of autoregressive model, so it is called vector autoregressive model. Suppose there is a relationship between y1 and y2, if you build two autoregressive models

$$y_{1,t} = f(y_{1,t-1}, y_{1,t-2}, \dots)$$

$$y_{2,t} = f(y_{2,t-1}, y_{2,t-2}, \dots)$$

The relationship between two variables cannot be captured. If you use the simultaneous form, you can establish a relationship between the two variables. The structure of the VAR model is related to two parameters. One is the number of included variables N, the other is the maximum lag order k.

$$\begin{cases} y_{1,t} = \mu_{11,1} y_{1,t-1} + \pi_{12,1} y_{2,t-1} + u_1 \\ y_{2,t} = \mu_2 + \pi_{21,1} y_{1,t-1} + \pi_{22,1} y_{2,t-1} + u_2 \end{cases} \quad (5\text{-}1)$$

Import the data of two independent variables into the VAR model (as shown in Table 9) :

Table 9 Vector autoregression estimates of BDTI & CTFI

Vector Autoregression Estimates
Date: 07/04/21 Time: 17:33
Sample (adjusted): 2019M10 2021M06
Included observations: 21 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	BDTI	CTFI
BDTI(-1)	-0.277151	-2.451657
	(0.40282)	(0.88260)
	[-0.68803]	[-2.77777]
BDTI(-2)	0.153305	3.023038
	(0.40296)	(0.88291)
	[0.38044]	[3.42394]
BDTI(-3)	0.629506	2.093862
	(0.57420)	(1.25809)
	[1.09632]	[1.66431]
BDTI(-4)	-1.661833	-1.407274
	(0.78351)	(1.71670)
	[-2.12101]	[-0.81975]
BDTI(-5)	-0.989218	-1.178076
	(0.81818)	(1.79266)
	[-1.20905]	[-0.65717]
BDTI(-6)	1.283231	2.516969
	(0.76932)	(1.68562)
	[1.66800]	[1.49320]
BDTI(-7)	0.256566	-1.583270
	(0.60460)	(1.32469)
	[0.42436]	[-1.19520]
BDTI(-8)	1.482188	3.678198
	(0.77719)	(1.70285)
	[1.90712]	[2.16003]
BDTI(-9)	-0.341212	-0.298066
	(0.37722)	(0.82649)
	[-0.90456]	[-0.36064]
CTFI(-1)	0.458719	0.976205
	(0.19844)	(0.43478)
	[2.31168]	[2.24529]
CTFI(-2)	0.280399	0.335012
	(0.15973)	(0.34997)
	[1.75548]	[0.95726]
CTFI(-3)	-0.377132	-0.882803
	(0.16376)	(0.35881)
	[-2.30293]	[-2.46037]
CTFI(-4)	-0.302124	-0.705249
	(0.21830)	(0.47831)
	[-1.38398]	[-1.47447]
CTFI(-5)	0.339823	0.290111
	(0.14728)	(0.32269)
	[2.30739]	[0.89905]
CTFI(-6)	-0.014392	-0.427251
	(0.18026)	(0.39496)
	[-0.07984]	[-1.08175]
CTFI(-7)	0.029067	0.364711
	(0.19025)	(0.41685)
	[0.15278]	[0.87493]
CTFI(-8)	-0.484696	-0.586105
	(0.12392)	(0.27152)
	[-3.91128]	[-2.15861]
CTFI(-9)	-0.158239	-0.332643
	(0.11426)	(0.25034)
	[-1.38495]	[-1.32876]
C	653.3500	-811.0418
	(446.804)	(978.965)
	[1.46228]	[-0.82847]
R-squared	0.988928	0.994600
Adj. R-squared	0.889285	0.945998
Sum sq. resids	24442.06	117337.9
S.E. equation	110.5488	242.2167
F-statistic	9.924655	20.46431
Log likelihood	-103.9229	-120.3948
Akaike AIC	11.70694	13.27569
Schwarz SC	12.65198	14.22074
Mean dependent	761.4762	1298.280
S.D. dependent	332.2389	1042.317

Determinant resid covariance (dof adj.)	1.53E+08
Determinant resid covariance	1383538.
Log likelihood	-208.0670
Akaike information criterion	23.43496
Schwarz criterion	25.32504
Number of coefficients	38

As can be seen from Table 9, the goodness of fit of the VAR(9) model reached 98.8928, close to 1, indicating that the fitting effect was good.

5.5.2 Model stability

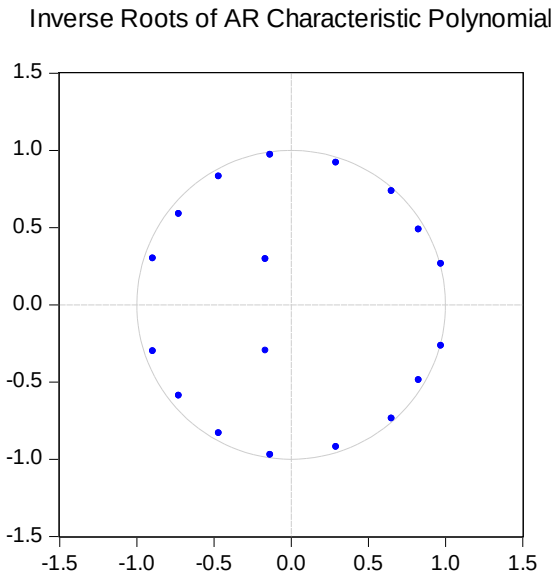

Figure 12 Inverse Roots of AR Characteristic Polynomial

Figure 11 shows that all the points fall within the unit circle, so the lag period of 9 of the VAR model is relatively stable. Meanwhile, the maximum lag order is determined to be 9, and the constant term is taken as the exogenous variable. The obtained parameter results are as follows:

Table 10 Inverse roots of AR characteristic Polynomial

Root	Modulus
0.971721 + 0.265048i	1.007220
0.971721 - 0.265048i	1.007220
0.651008 + 0.735511i	0.982236
0.651008 - 0.735511i	0.982236
-0.134540 + 0.971239i	0.980513
-0.134540 - 0.971239i	0.980513
0.292168 + 0.921019i	0.966250
0.292168 - 0.921019i	0.966250
0.827215 - 0.487656i	0.960257
0.827215 + 0.487656i	0.960257
-0.469045 - 0.831558i	0.954721
-0.469045 + 0.831558i	0.954721
-0.896055 + 0.300403i	0.945070
-0.896055 - 0.300403i	0.945070
-0.727054 + 0.588635i	0.935467
-0.727054 - 0.588635i	0.935467
-0.165891 + 0.295669i	0.339028
-0.165891 - 0.295669i	0.339028

In Table 12, the left side represents the imaginary part of the root, and the right side represents the real part of the root. The real part and imaginary part are all less than 1, which proves the stability of the model is good again.

5.5.3 Pulse Diagram

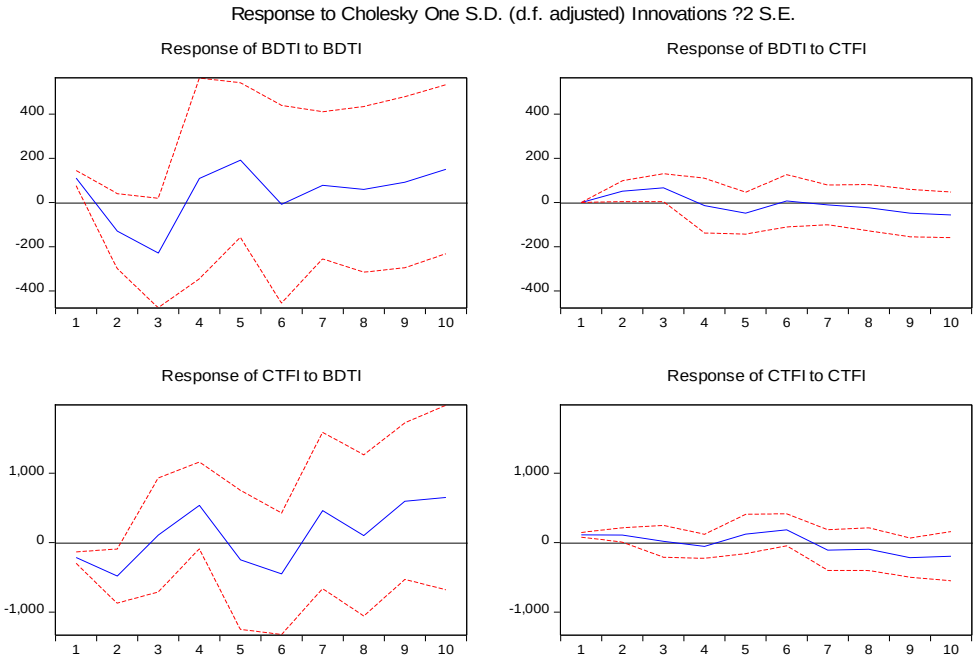

Figure 11 Response to Cholesky One S.D Innovations

In the figure of response of BDTI to CTFI, the impact of BDTI on CTFI in the first three phases showed an upward trend and played a promoting role, and then decreased to the fifth phase, and then showed a slow upward trend and fluctuated around zero in the future, indicating that BDTI played a promoting role on CTFI in the early stage before the occurrence of COVID-11, and then acted as a blocking role on CTFI. Then it is a stimulative effect, and finally it tends to level off; In the figure of response of CTFI to BDTI, CTFI obstructs BDTI in the early stage before the COVID-17 outbreak. From the second phase to the fourth phase, CTFI plays a sharp impact on BDTI, plays a role of promotion, and then plays a role of obstruction, and then gradually increases.

5.5.4 Variance decomposition

Variance decomposition in VAR is used to analyze the contribution degree of structural impact affecting endogenous variables.

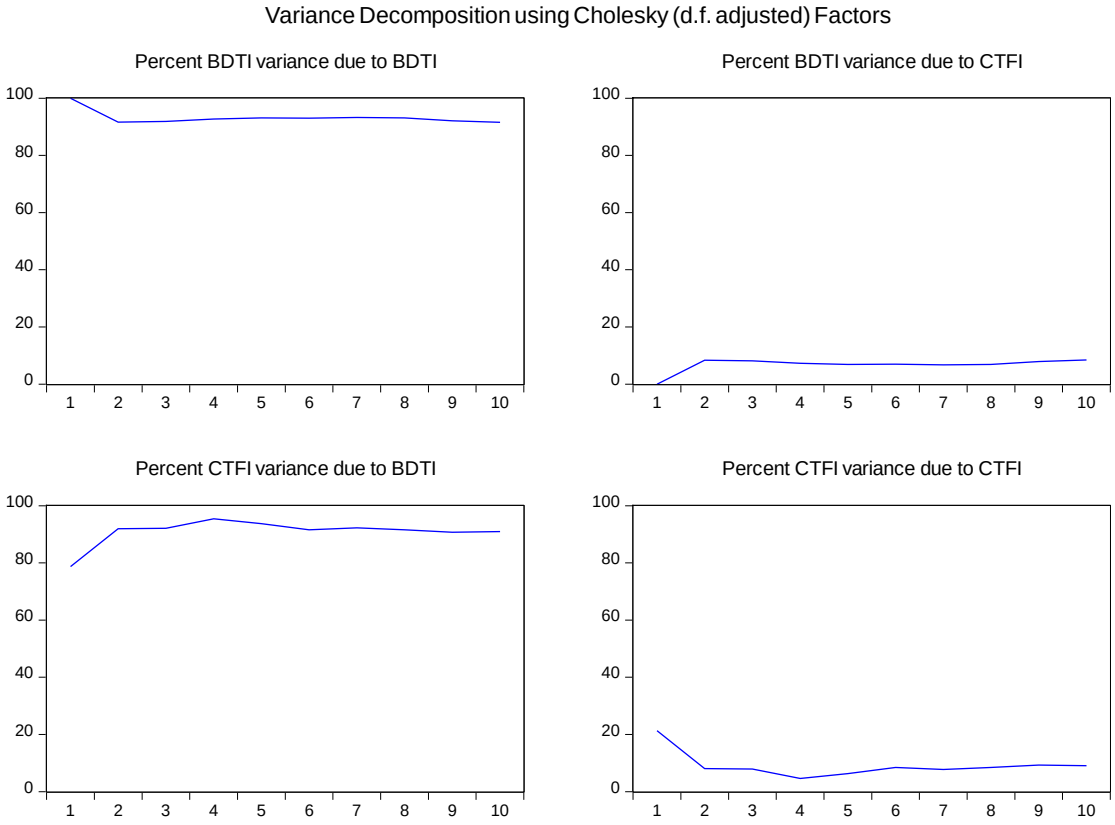

Figure 12 Variance Decomposition using Cholesky Factors

Table 11 Variance Decomposition of BDTI & CTFI

Variance Decomposition of BDTI:			
Period	S.E.	BDTI	CTFI
1	110.5488	100.0000	0.000000
2	177.6123	91.67451	8.325495
3	296.7634	91.89759	8.102410
4	316.6279	92.68866	7.311336
5	373.5746	93.08930	6.910705
6	373.7293	93.05323	6.946770
7	381.9200	93.26916	6.730844
8	387.2284	93.10021	6.899795
9	400.9504	92.13749	7.862511
10	431.9022	91.54257	8.457432
Variance Decomposition of CTFI:			
Period	S.E.	BDTI	CTFI
1	242.2167	78.72579	21.27421
2	549.3249	91.92207	8.077934
3	560.4531	92.13362	7.866384
4	777.1137	95.42599	4.574013
5	825.0460	93.72597	6.274030
6	957.6863	91.59146	8.408537
7	1068.192	92.23234	7.767661
8	1077.352	91.58030	8.419698
9	1250.602	90.74998	9.250021
10	1422.818	90.94101	9.058993
Cholesky Ordering: BDTI CTFI			

In the figure of Percent BDTI variance due to CTFI, the contribution rate of BDTI to CTFI gradually increases from zero to 8.457435 and tends to be stable. In the figure of Percent CTFI variance due to BDTI, the contribution rate of CTFI to BDTI gradually increases from 78.72579, reaches the maximum in the fourth period, and then gradually decreases to about 90 and tends to be stable.

5.6 Conclusion

Through the establishment of VAR model and Granger causality test, the data of BDTI and CTFI from January 2019 to June 2020 were analyzed, and the results showed that there was a significant interaction between the two, and BDTI promoted CTFI in the early stage before the occurrence of COVID-19, and finally leveled off. CTFI hindered BDTI in the early stage, and then gradually increased.

This proves that there is an interactive relationship between the international Baltic Dirty Oil Tanker Index and Crude Oil Tanker Freight Index, and after the outbreak

of COVID-19, the international linkage of China's oil transport market is enhanced, and the influence of CTFI on BDTI is increased.

6. China Potion Shipping Enterprise Strategy

6.1 The current shipping cycle position of shipping enterprise

In the future, the trend of oversupply of crude oil transportation market still exists, and the world is still in the process of oil destocking. If the shipping cycle is divided according to the economic theory, the current market is experiencing the cycle from 2008 to now, and it is in a declining stage or a trough, that is, a market depression. From a smaller cycle point of view, the market is now in a small cycle of rising period, the short-term market conditions have improved. In addition, due to the impact of COVID-19, China benefits from the low oil price in the international market, and the domestic demand for oil transportation increases. In the short term, the tanker transportation situation is improving.

There is no better test of a business than a downturn in the economic cycle. Intensifying competition in the existing market will result in the survival of the fittest. After a steep decline in corporate profits in the recession process, many companies were eliminated; Companies that remain in the market can adjust their development plans during this downturn, find their shortcomings before, and choose to expand their scale to meet the next peak, or reduce layoffs to improve their viability in the existing market.

6.2 Shipping Enterprise Fleet Adjustment Strategy

The strategy of adjusting fleet size of international tanker transportation enterprises is put forward in view of the influence effect of international linkage of Chinese oil transportation market. Enterprises can decide how to adjust the fleet structure in the future by combining their own existing capacity and stable supply of goods. The

reasonable structure of the fleet can not only keep the transport capacity of the enterprise relatively stable, but also enable the enterprise to obtain huge economic benefits. Specific method has purchase second - hand ship or new ship, hire ship to wait.

6.2.1 Buy ships

Before the COVID-19 epidemic, due to the depressed shipping market, some companies began to sell ships in order to reduce losses. The price of selling ships in the market fell and fell again. There was a preferential period for new tanker building prices, and the cost of buying used ships or order new ships would be very low for tanker transportation companies. However, after the COVID-19 outbreak, the cost of oil tankers increased due to the increased demand for oil floating storage. According to Clarkson's statistics, as of May 14, 2021, 119 new orders have been signed globally in April 2021, and the price of new tanker ships has increased from month to month for all types of tanker ships and individuals. In this case, or the enterprise liquidity is not sufficient, then it is not recommended to blindly order a new boat or buy a second-hand boat. If new ships are to be ordered, it is recommended to increase the tonnage per ship ordered to reduce future unit operating costs.

6.2.2 Charter ships

The capital of shipbuilding and ship purchase is relatively large, and the delivery time of newly built ships is also uncertain, which has a lag for structural adjustment. Therefore, if you want to adjust the fleet structure in a short period of time, the simplest way is to lease ships as the company's control capacity. The advantages of chartering ship are as follows: First, the fixed ship hire can reduce the impact of inflation and facilitate the calculation of costs for enterprises; Second, less capital investment, higher rate of return, in the case of maintaining the normal operation of the enterprise, increase the cash flow of the enterprise; Third, the leasing method is flexible. The financial leasing method can be adopted or the ship can be chartered separately, and the procedures are simple, the timeliness is strong, and the transaction realization time

is short. Fourthly, it is convenient to enter and exit the market. Enterprises can not only avoid the trouble of single ship operation, but also improve their ability to respond to market changes.

The trend of the transport market still depends mainly on supply and demand as well as the driving of market atmosphere. The main purpose of chartering ships is to use information asymmetry to negotiate prices with shipowners. As an oil enterprise, it seems simple to exercise the decision-making power on the basis of full understanding of its own pallets, but it is difficult to implement it in practice, because the scale of an oil enterprise is usually relatively large and the division of labor is clear, which requires the oil enterprise to establish a sound communication mechanism and better control the whole from a macro perspective. Tanker lease ship companies choose this way to expand business scale, need to be aware of the problem is to grasp its own fleet and proportional relationship of the rented fleet, and correct selection of charter and lease, can according to its own supply contract and enterprise development planning is to choose light rent or period, long-term leases or short-term lease.

6.3 Market rate hedging strategy

Operating risk of tanker transportation is very high. In order to counter operating risk and gain maximum profit in the case of market weakness, many shipping companies adopt the strategy of maintaining freight rate. The expected freight rates can be regulated by the tanker transportation enterprises themselves, and the strategy of maintaining freight rates is one of the control means. The main methods are signing forward freight agreements (FFA) and buying and selling freight options, both of which are freight derivatives.

6.3.1 Forward freight agreement

The forward freight agreement is a kind of hedging tool, which can hedge the transaction risk of the tanker transportation enterprise in the spot market. In addition, the tanker transportation company can also use the agreement to carry out pure futures speculation in the futures market to seek greater profits. A lot of market information

will be displayed in the forward freight agreement. The price of futures to a large extent shows the judgment of the development of the future market by shipowners, major shippers and charterers, as well as the positioning of the target market by these participants. Through the analysis of the known forward freight agreement, the tanker transportation company can fully understand the business trend of the peers in the industry, and judge the development trend of the future market.

The measures taken by tanker transportation enterprises to counter market risks by applying forward freight agreements are mainly as follows:

(1) In the future, when the market situation is rising and the rental cost may increase, the enterprise can buy a time lease airline contract or a specific airline contract;

(2) In the case of future market decline and possible reduction of rent and freight, the enterprise can sell the corresponding route contracts;

(3) According to the prices of ships in the spot market and the futures market, the shipowner can decide whether to charter the ships in the spot market or buy the futures market contract, or whether to charter the ships in the spot market or sell the futures contract.

6.3.2 Forward freight option

Freight options are developed from forward freight agreements. Freight options, like options trading in other commodities, use margin to control risk. Compared with the forward freight agreement, the rights and obligations of the seller and seller of the freight option are not equal. The seller has the right to decide whether the contract is executed or not, while the seller can only act according to the requirements of the buyer.

Tanker freight transport enterprise application options to against the risk of shipping market freight rate fluctuation method is: assuming a tanker transportation company buy a options, when the future market, the market is advancing, no matter how high rate rise, tanker transport enterprise loss is only the option of margin, without the need for like forward freight agreement contract to the seller pay the difference; However,

if the market price drops in the future, the seller will have to pay the difference to the tanker shipping company. In this way, the tanker transportation company can choose not to execute the contract when the market price rises, control its loss to the margin amount, and obtain greater profits through the spot market to charter ships. And when the market falls, they can enforce contracts to guarantee their own freight costs.

However, the risks and benefits of using freight option hedging are not symmetrical. If the tanker transportation company is the seller, it will bear great risks. Therefore, many companies have gone bankrupt due to improper operation. Tanker transportation companies should consider carefully when applying this method.

6.4 Enterprise Alliance Strategy

Enterprise alliance and cooperative management is a win-win mode to fight the crisis and develop together, which is also popular in the shipping industry. It is another method to adjust the transport capacity and expected freight rate. As far as shipping industry is concerned, there are mainly two kinds of alliance strategies to choose: one is to establish joint ventures between shipping companies, such as liner trade unions; the other is to establish joint ventures between ship owners and large cargo owners. Under the situation that the tanker transportation is obviously oversupplied and the market competition is fierce, it is the choice of many enterprises to adopt alliance strategy actively.

6.4.1 Alliance between Ship Company

For each tanker owners, with different oil companies to form different "alliance", and the whole oil transportation system is also changing in the interaction of various factors, and the oil companies should also adapt to the requirement of oil transport system, with the owner of "coordination" and "no synergy", seeking for their own development strategy.

This kind of joint operation between shipping companies has the following advantages:

First, create economies of scale. In a capacity pool or joint operation, the large size of

the fleet can obtain larger orders, and the synergies of the same type of ship can reduce the empty space distance of the ship. Sharing human and material resources among shipowners can also reduce operating costs.

Second, the supply of goods is relatively stable. Many of the pools have good relationships with oil companies and work locations around the world, which allows pool members to have access to more information, expand their business scope, and ensure a relatively stable supply of goods.

Third, higher profits than the market can be achieved. In the joint operation of the company will generally have senior management personnel, more advanced risk management tools. Their explorations of the market allow them to discover the most profitable markets and exploit the fleets they control to make a profit. For example, in a period of time, the western market income of a ship type is higher than the eastern market, but for the combination of the two markets, the actual income of the shipowner is higher than that of the two markets alone.

Fourth, to promote the joint tanker company faster development. For smaller oil tanker transportation enterprises, they can obtain financial support from the joint venture to solve the problem of capital turnover. For the tanker transport enterprises with weak talents, they can communicate with the first-class companies in the transport capacity pool to improve their talent quality. The alliance's organisers are paid a commission to manage the fleet.

6.4.2 Alliance between shipowners and shippers

The alliance cooperation between shipowners and shippers is common in the shipping market. For example, in the dry bulk cargo market, South Korean shipowners have signed a long-term transportation contract with Korea Electric Power, and China Shipping and Guohua Electric Power have jointly invested to establish a joint venture company. These can be extended tanker transport market, tanker transport enterprises to provide reference. According to the close degree of cooperation between the two parties, the alliance between shipowner and shipowner can be roughly divided into the

following categories: contractual agreement, joint venture, equity participation, etc. The alliance is vertical, an alliance of upstream and downstream in the value chain. The advantages of this form of alliance are as follows:

1. Stable supply. Tanker companies can sign long-term and large transport contracts with shippers, such as COA contracts. In this way, in a period of time, the tanker transportation company will not appear idle ship problem, to ensure the stable income of the enterprise.

2. Reduce transaction costs. The alliance between shipowner and shipper can reduce the transaction cost between different transaction links such as bargaining or resolving conflicts.

3. Complementary resources. The risk-sharing and profit-sharing relationship between shipowners and shippers can achieve better economic results than their respective operations. The two sides can learn from each other's strengths and weaknesses in their own fields to achieve a win-win goal. And this resource complementation can also improve the shipowner and the shipowner's own competitive advantage.

4. Enhanced financing capacity. The long-term transportation agreement signed by ship-owners and shippers can be used as the guarantee voucher for tanker transportation enterprises to obtain bank loans, thus making it easier for tanker transportation enterprises to obtain funds and equipment support from banks or other financing companies, and playing a positive role in promoting the future development of enterprises.

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Appendix A: Monthly data of BDTI and CTFI

Date	BDTI VLCC	CTFI
Jan-2019	1009	795.34
Feb-2019	795	1017.84
Mar-2019	774	968.95
Apr-2019	640	674.1
May-2019	635	648.27
Jun-2019	634	813.92
Jul-2019	679	728.38
Aug-2019	620	948.56
Sep-2019	651	1001.66
Oct-2019	998	1691.56
Nov-2019	1029	1592.15
Dec-2019	1252	1972.72
Jan-2020	1503	2361.38
Feb-2020	850	1734.7
Mar-2020	796	4053.03
Apr-2020	1406	3873.12
May-2020	1105	1105.54
Jun-2020	698	1087.2
Jul-2020	464	805.69
Aug-2020	506	658.45
Sep-2020	466	560.09
Oct-2020	432	857.93
Nov-2020	406	554.85
Dec-2020	455	557.41
Jan-2021	543	542.42
Feb-2021	515	503.42
Mar-2021	668	531.63
Apr-2021	699	542.2
May-2021	602	579.09
Jun-2021	598	1099.3