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## Research on risk control of ship financial leasing

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**World Maritime University**

Shanghai, China

# **Research on Risk Control of Ship Financial Leasing**

By

**XU JUNYI**

**China**

A research paper submitted to the World Maritime University in partial

Fulfilment of the requirements for the award of the degree of

**MASTER OF SCIENCE**

**International Transport and Logistics**

2018

## **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.

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## **Abstract**

On the basis of the introduction and summary of the existing main ship financing problems, this thesis focused on the study of ship financial leasing and its risk control. Since risk control problem has become the bottleneck of the development of ship financial leasing, this thesis referred to the risk management theory that is widely acknowledged and academic research results and aimed to apply them to practice. VaR model method was adopted in this research to quantify the special credit risk: freight rate risks. The result of the application indicated that VaR model was a good one to quantify the freight rate risk. And the control of credit risk needs to be enhanced. The conclusion was drawn that besides making qualitative analysis to financial leasing risk, leasers were also suggested to strengthen the risk control by using quantitative analysis to make the risk more concrete and the control more effective. Hope this study may provide reference for the further development especially the risk control of ship financial leasing in China.

Key words: ship financial leasing, risk control, VaR model

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# **1 Introduction**

## **1.1 Background and Purpose of the Research**

### **1.1.1 Research Background**

Maritime industry is one of the key industries of global economic and trade development. Since the global financial crisis took place in 2008, the shipping market has suffered great depression and till now the market is not well recovered.

Maritime industry is characterized by intensive capital, high technology, high risk but low return. The first two characteristics are mainly reflected on the initial ship investment. Ship building and ship financing are two important factors affecting the development of this industry. In order to develop maritime industry, it is necessary to enlarge the fleet size. In order to enlarge the fleet size, it is significant to have plenty capital to support. However, for a long time, ship financing has mainly depended on government grants or bank loans. Nowadays, fewer banks are willing to lending money to shipping enterprises because of the last two characteristics of maritime industry: high risk but low return. Therefore, financial leasing, as an important financial instrument should be fully utilized to strengthen shipping industry. Financial leasing companies provide shipping enterprises with the opportunity to expand their business but also they don't have to take too much burden on debt and liquidity, which is a good way to solve the dilemma.

In the past few years, financial leasing has developed rapidly in China. Till March of 2017, there have been about one third of financial leasing companies that conducted ship financial leasing business. However, despite Chinese government encourage developing ship financial leasing which has been widely adopted in many countries with developed shipping industries, ship financial leasing in China still faces many problems. For Chinese financial leasing companies, this mode was introduced into China only for about 30 years. There are still a few shipping enterprises get ships through bank loan. The way of ship financial leasing is not widely applied. Furthermore, the financial leasing system is not perfect, and the understanding and prevention of various risk factors are not mature enough. Meanwhile, the shipping industry is affected by a lot of factors: the large demand for capital, the complex operation and the high risk, which are all great tests for the immature ship financial leasing companies. Ship financing business involves a large amount of money and the duration is long. Since a large part of ship financial

leasing companies don't have enough experience, they are generally vulnerable to risks. The risks are various including market risk, interest risk and foreign exchange risk, credit risks and so on. Some are non-systematic risks and others are systematic risks. Once the risk of the leasing project takes place, it will have huge impact on the operation of the financial leasing company. The common result is losing profit while the serious result is bankruptcy.

Therefore, if ship financial leasing companies still stick to the past experience and using traditional qualitative methods of analyzing risks, it is very likely to fail in the rapidly changing market. To realize the healthy and sustainable development of ship financial leasing companies, it is of great necessity to attach importance to the risk control of ship financial leasing business.

### **1.1.2 Research Purpose**

As mentioned above, the main problems of China's ship financial leasing are that ship financial leasing is not widely adopted by Chinese shipping enterprises and Chinese ship financing leasing companies lack experience to deal with risks that may happen in the business. Therefore, one of the purposes of the research is to enrich the financing channels of ships in China. It is of great significance to change the financing mode which has been dominated by loans for a long time. Another purpose of the research is to help solve the difficulty in ship financing and develop ship financial leasing in China. The third purpose of the research is to give advice to ship financial leasing companies such as making measurement on risk elements when conducting leasing programs and enhance the risk management of these companies.

## **1.2 Literature review**

### **1.2.1 Researches on ship financial leasing**

Maritime industry is one of the key industries of global economic and trade development. This industry is characterized by intensive capital, high technology, high risk but low return. Ship financing is an important factor affecting the development of maritime industry. If ship financial leasing can develop properly, it will bring a lot of benefits not only to shipping enterprises, but also to shipping industry. Therefore, there are many researches on ship financing and financial leasing at home and abroad.



Liu Fenglian and Mo Yanxia (2004) considered that that modern financial leasing combined finance, trade and technology update was of great importance for related parties and macroeconomic adjustment. So it is indispensable for a mature capital market and it is necessary to learn the successful experience of others and combine our financial situation with the development of modern financial leasing. Wang Gang (2006) combined the qualitative analysis and quantitative techniques, made an in-depth research on the transportation project of investment decision, financing decision and risk issues and made a comparison model of various financing mode. Ma Wenyao (2006) analyzed the issues about maritime policy and financing channels that China's ship financial leasing was facing. Also, he put forward some suggestions on improving the laws and regulations of China's ship financial leasing and actively exploring the international ship leasing service market. Xu Xiangjuan (2007) thought that financial analysis and economic analysis should be used to compare various financing methods or investment schemes from the perspective of investment. Liu Xiaodong (2007) compared the influence of loan and financial leasing on ship financing decision based on NPV and made a conclusion that the financing lease mode is superior to the loan mode. Huang Chunxu (2014) compared three typical modes of ship financing in foreign countries. These modes are KG Fund in Germany, Singapore Maritime Trust Fund and British tax leasing. He compared the funding target, way of financing, number of ships in operation and constrains on the ship's nationality. Yang Conghui (2015) introduced the KG mode applied in German ship financing. KG is the abbreviation of the German word "Kommanditgesellschaft", meaning limited partnership. KG Fund consists of debt which takes over 60%-70% of the fund, typically sourced from large German shipping banks and equity which takes over 30%-40% of the fund, typically sourced from German investor base. Trevor Law (2017) introduced the benefits of KG financing, including allowing the original owner to retrieve equity against long term charter, flexibility with regard to fleet composition, no interest or FX rate risk based on fixed charter and so on. Guo Hanbing (2016) analyzed the financial leasing business, the commercial factoring business and its development in our country. He also analyzed the meaning and influence of the free trade zone to the whole financial leasing industry and takes the ship financing leasing as an example to analyzed specific measures for financial leasing companies to operate commercial factoring business.

There are still some existing problems. Jiang Yuanyuan (2013) considered that small and medium sized shipping companies themselves have many problems. Small business operation, limited capital, backward ship operating technology, aging ships, weak operation ability and lacking knowledge of shipping market are all the reasons for the difficulty of ship financing. From Zhang Xianghui's (2014) point of view, the development of domestic ship financial leasing industry faces the following problems. The first is that the independent third-party leasing companies who serve small and medium-sized enterprises are weak. The second is the insufficient way of ship financing. The financial leasing products are highly similar to the traditional mortgage loans of Banks. Last but not least, the cost of financing has been an obstacle the development of ship business in domestic leasing companies. Dai Yun (2014) pointed out that the overcapacity caused the depression in the shipping market, which leads to the difficulty of ship financing. Another problem was that the fierce competition among shipping companies increased the risk of ship financial leasing since the low freight policy taken by many small and medium sized ship companies. In addition, the state's policy support for ship financial leasing need to be improved.

### **1.2.2 Domestic research on risk management of ship financial leasing**

In recent years, the researches mainly focused on qualitative analysis rather than the specific, practical and comprehensive risk management evaluation and application model of the ship financial leasing.

Yang Rongbo and Du Lifu (2004) stated that the lessor and lessee both faced the commercial risk, interest risk and foreign exchange risk generated by ship financial leasing but can be prevented by related financial instruments. While certain interest safeguard mechanism is needed to deal with credit risk.

Tan Wei (2008) applied VaR model to make risk analysis on dry bulk shipping market. From the perspective of banks, Ding Jing (2008) listed the risk elements in logistics industry and proposed the measures that domestic banks can take to prevent the financial leasing risks. Xue Hanbing (2008) made a discussion about the risk and risk control of ship financial leasing. Du Qingyun (2011) researched on the issue of preventing the risk of ship financial leasing from the legal perspective. Based on the current legal framework to achieve the goal of protecting lessors' interests, Wang Jianwei (2011) analyzed the risks and related prevention measures. Xie Yanyun (2013)

discussed the protection for the interests of the lessors and tried to explore for the perfection of ship financing lease law system in China in order to fully protect the interests of the lessor. Zhai Xiaolong (2014) considered that ship financing is a high cost and high risk business. During the ship financial leasing, non-systematic risks and systematic risks are likely to happen. Therefore financial leasing companies should make effective assessment of risk elements. Qian Kejin (2017) made a qualitative analysis on the risk existing in domestic ship financial leasing.

Ding Jie (2013) classifies the ship financial leasing risks into internal risks and external risks. The internal risks such as financial risk mean that shipping companies have internal control problem. They are vulnerable to external shocks therefore damage the lessor's interests. In terms of the external risks, take FX risk as an example, if the rent of the ship is paid in RMB and the freight is paid in USD, the shipping company will suffer losses as the RMB appreciates against the US dollar. Fei Feng (2016) mentioned the credit risk from the side of lessee. Since the ship is daily operated by lessee, so to some extent, the lessor does not own the right of control, which makes it possible that the lessee can do something with the ship without the lessor's knowing. Liu Junli (2015) pointed out that China's financial leasing institutions lack scientific risk management mechanism, comprehensive risk control awareness and advanced risk control technology. Meanwhile, the financial institutions engaged in ship finance leasing do not have the professional knowledge for the shipping industry, which makes the financing leasing program face the higher special risks in shipping area.

### **1.2.3 Foreign research on risk management of ship financial leasing**

In 1994, Shawn D. Halladay and Sudhir P. Amembal analyzed the potential risks in leasing and gave suggestions on preventing risks in the book "Lease Securitization". Peter K. Nevitt and Frank J. Fabozzi (2000) particularly emphasized the importance of credit risk in financial leasing. In their book "Equipment Leasing", they carefully introduced how to make assessment on credit risks when completing a financial leasing program, including qualifications of the lessee at an early stage of the leasing program, timely attention paid to the lessee in the middle of the leasing program, as well as the exit mechanism carried out at the end of leasing program. Chris Boobyer (2009) explained the significance of comprehensive risk analysis and discussed the current analyzing technology. He pointed out that during the whole procedure of business operation, scientific and sustained supervision and attention should be paid to the lessee,

which means a variety of risks should be taken into consideration during the business operation.

Compared to domestic researches, foreign researchers have already made analysis and estimations on risks of ship financial leasing through complete quantitative model. For example, early in 1952, Markowitz introduced the concept of expectation and variance in statistical research of the portfolio. Return on assets is put forward to measure expected earnings expectations, with the standard deviation of asset returns to measure the risk. In addition, Creditmetrics, the product of risk management produced by J.P. Morgan Chase & Co, was used to quantify the risk in 1997, which is also one of the quantitative models that widely applied in risk management nowadays. Based on the financial statements of a financial institution, Jonathan Bolin (2001) not only narrates the process of credit risk control in detail, but also puts forward the famous model: CAMELS Model. The basic elements include capital adequacy, asset quality, management, earnings, liquidity and sensitivity of market risk. This model reveals risk through qualitative and quantitative analysis.

In conclusion, Due to the fact that western countries started financial leasing earlier; the construction of financial system is more mature, their researches on risk control of ship financial leasing are more about using multiple indicators and models to make assessment or measurement on ship financial leasing risks. However, the start of financial leasing in China was relatively slower; the construction of financial market is not perfect, and the research on the risk management of ship financial leasing is not as good as the foreign system. The research on ship financial leasing still stays in the legal contract and the qualitative elaboration, and does not apply some advanced risk control methods in the ship financial leasing. Therefore, it is of great necessity to refer to some mature risk control methods and learn lessons from the application of risk control in other fields to help solve the bottleneck of further development of ship financial leasing, provide new financing channels for shipping industry and promote the development of the whole industry.

### **1.3 Research methodology**

The dissertation will attach importance to the research of ship financial leasing based on the analysis of current situation of the ship finance. Besides analyzing the existing problem of ship financial leasing in China, emphasis will be laid on the credit risk control

of ship financial leasing. The dissertation will apply the current risk management research achievement to practice, expecting to provide references for small and medium sized ship financial leasing companies.

Qualitative and quantitative analysis was used in this paper to measure the credit risk and then took related measures to prevent such risk. The qualitative method was due diligence. The quantitative method was VaR model.

#### **1.4 Research contents**

Based on the introduction of the ship financing, the research will lay emphasis on ship financial leasing, especially the risk of ship financial leasing, which is the key issue of the development of ship financial leasing. By applying risk measurement method to one case, I hope that this research can provide reference for the development of Chinese ship financial leasing.

The first chapter is the introduction about the research background, research purpose, research methodology and research idea. Besides, there is also the literature review about ship financing and ship financial leasing, both from home and abroad.

The second chapter is the theory study. It includes the related concepts and features of ship finance. There is also the introduction of ship financial leasing and several modes of ship financial leasing.

The third chapter is the risk analysis of ship financial leasing, including analyzing the current situation and problems of ship financial leasing, classification of ship financial leasing risks and the influences.

The fourth chapter is the credit risk assessment and control of ship financial leasing. Some common methods of risk assessment of ship financial leasing, including qualitative analysis methods and quantitative analysis methods were first introduced. Then this chapter focuses on the credit risk control of ship financial leasing. The credit risk can be classified into general credit risk and special credit risk: freight rate risk. Due diligence is used to assess general credit risk of ship financial leasing and VaR model is applied to measure the freight rate risk.

The last chapter is the conclusion and suggestion.

## 1.5 Research route

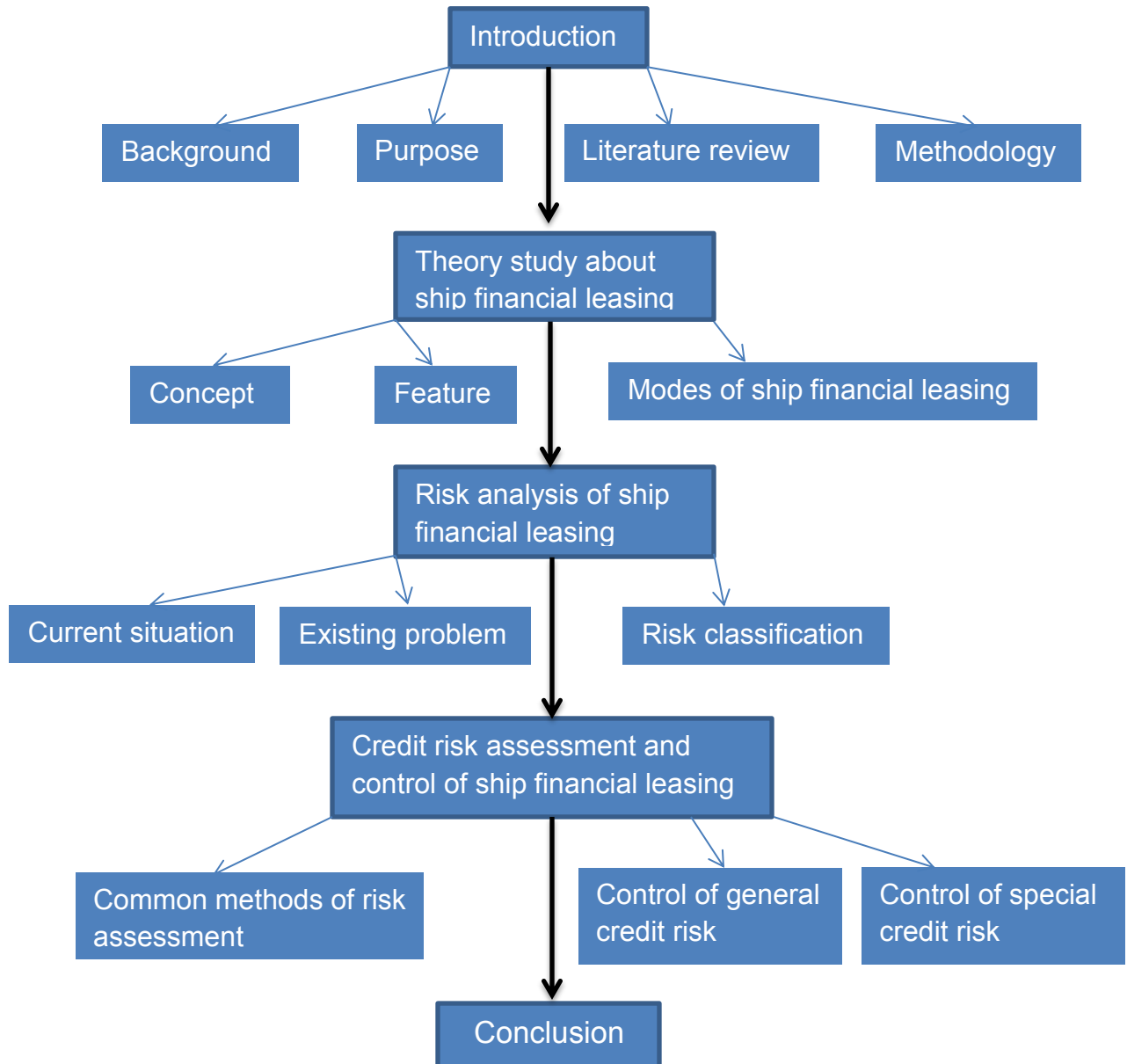


Fig.1 Flowchart of the research

## **2. Overview of ship financial leasing**

### **2.1 Ship finance**

Nowadays, the shipping industry is characterized by capital intensive and high risk. Ship financing has gradually become a common way for shipping companies to choose new ships or buy used ones. This not only can alleviate the huge financial pressure, but also can achieve the purpose of improving ship capacity, expanding fleet size and increasing benefits in a short period of time.

#### **2.1.1 Concept of ship finance**

Ship financing is a kind of financial service which is based on the assets of the ship and is intended to provide financing for ship owners to make, sell, lease and operate the ship. Because shipping enterprises have the characteristics of intensive capital and big risk, on one hand, if shipping companies want to expand the scale of the fleet development of shipping capacity and enhance their competitiveness, they have to vigorously develop ship financing channels and raise a lot of shipping development funds. On the other hand, compared with other industries, various kinds of financial institutions at home and abroad seem to be extremely cautious of the investment activities of shipping companies. When making investment decisions, besides strictly inspecting enterprise credit level, such as enterprise's assets and liabilities, cash flow, profit and enterprise credit history, etc., guarantee or mortgage are also needed to provide, which makes the ship shipping enterprise financing relatively difficult.

#### **2.1.2 Feature of ship finance**

Ship financing has the following features:

Huge demand of capital and difficult to raise fund: Due to the large amount of funds required for ship financing, the long investment recovery period, and the relatively high risk of changes in the environment during the cycle, financial institutions and other investors have no confidence in the credit of ship owners, especially the small and medium sized ones, resulting in big difficulties in raising funds.

Various financing methods and difficult to make decision: For most shipping companies, funds are usually raised in the form of a combination of one or more of commercial bank loans, bonds, government loans, listing financing, and ship financing leases. Because different financing methods have certain advantages and disadvantages, the decision-

making needs to balance and consider the different financing conditions in combination with the characteristics of the ship owners themselves, which brings a certain degree of difficulty to the decision-making of vessel financing.

Relatively high risks: The shipping industry is a high-cost and high-risk industry. Ship financing, as a fundamental and important part of shipping companies' operations, is affected not only by the political economy but also by changes in shipping markets, financial markets, and shipbuilding markets. Therefore, the risks are bigger.

## **2.2 Ship financial leasing**

In the wave of global financial deregulation and liberalization, there are countless examples supporting the combination of real estate industry and capital. As a typical representative in the field of international trade, ship financial leasing has developed rapidly in international trade and shipping with its unique advantages. China's shipbuilding scale is already the third largest in the world, and it has great demand and broad market prospects for the new form of financing operators for ship financial leasing.

### **2.2.1 Concept and feature of ship financial leasing**

Ship financial lease refers to the lessor according to the requirements of the lessee for ship subject matter parameters and the selection of shipbuilding enterprises, pay for the rent to the lessee to use, and will ship the lessee in installments within an operating leasing company rent a financing mode. However, the lessor has the ownership of the ship during the lease term. The expiry of the lease rental is successfully fully paid and the lessee shall, in accordance with the regulations on ship financial lease contract situation after performing their obligations. The ownership of the lease item belongs to the lessee.

In the process of the ship financial leasing, the materials, crew, and fuel required by the ship need to be configured by the renter himself, and the ship management activities also require the lessee to engage in the ship's own management. Because of the fact that it is a financing lease, ship financing leases generally have a long period of time, which is more than ten years. In the aspect of cost sharing, the operating cost of the ship is paid by the lessee and the ship construction and purchase costs are paid by the lessor, and other issues related to the rent need to be carried out in accordance with the ship financial leasing contract.



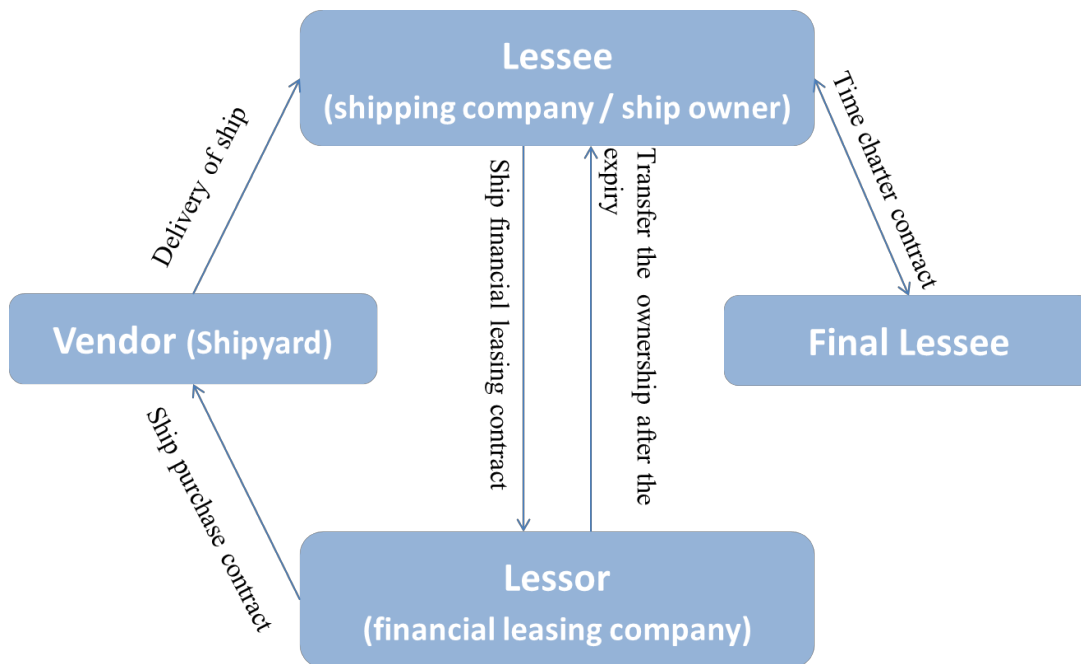


Fig.2 process of ship financial leasing

## 2.2.2 Modes of ship financial leasing in foreign countries

### (1) KG Mode in Germany

Germany started implementing the KG ship financing system in 1969. This is a tax incentive that encourages investors, especially individual investors, to invest in ships. KG is the abbreviation of the German word “Kommanditgesellschaft”, meaning a limited liability partnership. In the German legal system, it mainly means that a number of partners (shareholders) form a partnership company under a joint firm to conduct a business operation. At present, many international companies are using the KG model. This German-style financing model allows shipping companies to develop their business at a 100% financing rate without any impact on the balance sheet.

Usually, the traditional ship financing method is that the ship owner borrows money from the bank by mortgage, and the funds needed to purchase the ship are generally greater than the loan amount. Therefore, the ship owner needs to raise a part of the funds when purchasing the ship. However, in the KG model, third parties provide funds for the purchase of ships, so owners can use only a small amount of their own funds to rent ships.

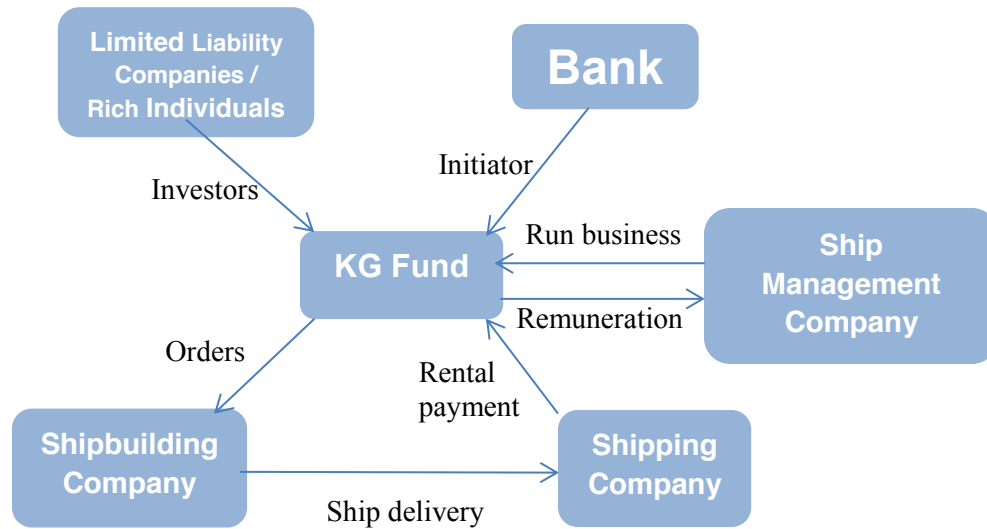


Fig.3 KG mode in Germany

## (2) Singapore Maritime Trust

In the ship financial leasing, the most representative operation mode is Singapore Maritime Trust Fund. The operation mode of the Maritime Trust Fund is that it only requires one sponsor to initiate the establishment of the Maritime Trust Fund. Its sources of funding mainly include two aspects: on the one hand, the sponsors own funds and IPO funds, and on the other hand, bank credit. The Singapore government implements extremely generous tax incentives for this financing model. Including the permanent tax exemption for the income obtained through the leasing method for the ships purchased by the Marine Maritime Trust Fund, and the implementation of the tax concession for the management of the maritime trust fund of the marine trust fund by 10% for ten years, and exemption for income tax for the relevant party's income for investing in marine financial trust funds.

Compared with other ship financing modes, the Singapore Maritime Trust Fund model can greatly promote the development of financing industry, attract more talented people, and deploy funds in this field more efficiently. At the same time, through this fund platform, an information system for the entire shipping industry can be established. Information on employees and major customers in the field will be included, and through the processing of big data and other electronic information technologies, the unique needs of the supply and demand sides will be better met to lay the foundation for further competition and cooperation in this field.

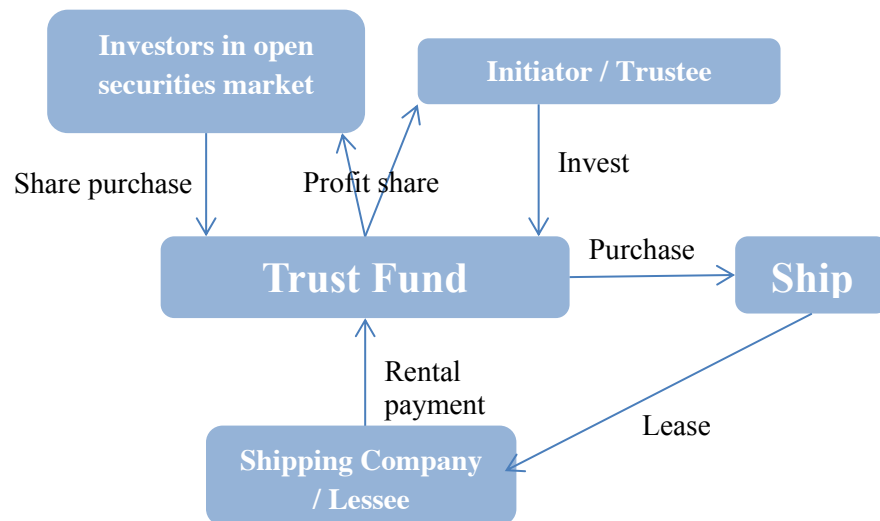


Fig.4 Singapore Maritime Trust

### (3) UK tax lease

The UK tax lease is a lease method that uses the provisions of the UK tax law on tax reductions to reduce financing costs. The lessor, which must be a British company shall finance the purchase of the vessel, lease it to the lessee, which must also be a British company, and the lessee shall pay the rent to the lessor. Since British law requires ships to depreciate at 25% of the book value of the previous year, in the first few years, the rent must be less than depreciation, and the lessor's book loss can be used to offset some of its profits and reduce taxes. The lessor returns this portion of the income to the lessee, who can also reduce the cost of financing. Tax leases in various countries have the largest income from UK tax leases, but also with the characteristics of strict requirements, complex structures, and high costs.

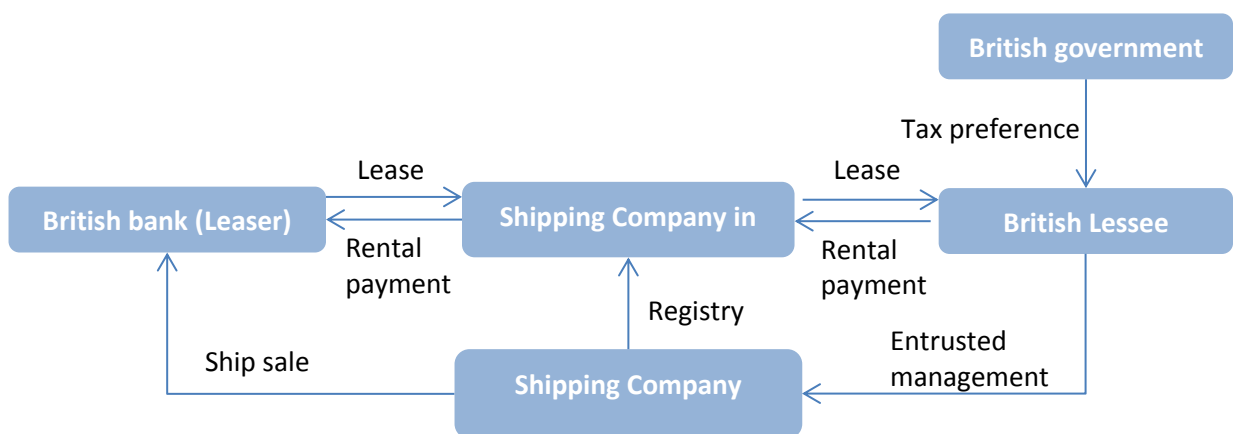


Fig.5 UK tax lease

The following table is the comparison among these three modes of ship financial leasing.

<b>Comparison</b>	<b>German KG Fund</b>	<b>Singapore Maritime Trust Fund</b>	<b>UK Tax Lease</b>
<b>Sources of Fund</b>	Individual investors with high income	Investors in public security market	British banks
<b>Financing Method</b>	Selling fund share until sold out	Issuing fund that can be transferred in the secondary market	Selling ships to banks and signing chartering agreement
<b>Number of Vessels Operated</b>	Only one ship	No restriction	Only one ship
<b>Restriction of Shipping Companies' Nationality</b>	German KG company, no restriction on lessee	Singapore as the registration place of leased ships	British leaser and lessee

Table.1 Difference among three modes of ship financial leasing

### **3. Risk analysis of ship financial leasing**

Although ship financial leasing has been introduced into China for nearly many years, risk control problem has still been the bottleneck of the development of ship financial leasing. Therefore, current situation and existing problems should be clearly recognized, then to identify the risk, measure the risk and finally prevent the risk.

#### **3.1 Current situation and existing problems of ship financial leasing**

##### **3.1.1 Financial leasing institutions' lack of industrial experience and professionals**

Currently, most ship financial leasing practitioners are financial professionals, not operators of shipping or shipping. Financial leasing is a product of the combination of the traditional physical industry and the financial industry. It has a high level of complexity and comprehensiveness. It has requirements for relevant knowledge in the areas of shipping, trade, finance, investment, management, finance, and law, which actually requires the talents familiar with these areas. But at present, compound talents who know both professional knowledge and good management skills are relatively lacking. The lack of such knowledge is reflected in the lack of relevant knowledge and, more importantly, the lack of relevant industry experience. Therefore, they can only analyze each ship financing project from the bank's point of view, and they often lack professional predictability for the shipping market. This will lead them to judge that the basis is too dependent on the market status. The consequence is that the ship is purchased only when the ship's price is high, and it is extremely conservative when the market is low. This will not only increase risk but also lose opportunities. The lack of experience in the shipping industry has also led to the weak ability of financial leasing institutions to prevent fluctuations in the shipping market and ship technology.

##### **3.1.2 Imperfect policy environment and insufficient support**

Countries with relatively successful development of international financial leasing have issued corresponding tilt policies for the development of domestic financial leasing. The government policies that promote the development of the financial leasing industry are mainly fiscal and tax policies. Ship financial leasing companies in developed countries usually enjoy very favorable taxation policies. However, China lacks preferential taxation policies for ship financing and leasing institutions, which to a certain extent inhibited the development of ship finance leasing industry. Now it is based on the construction of an international shipping center. With the financial center's policy support, some preferential

tax policies have also been introduced for ship financial leasing. For example, the income from the financial leasing companies registered in Shanghai engaged in international shipping-related ship finance leasing business will be exempted from business tax, and these measures will be more effective. It is conducive to the development of financial leasing.

On the other hand, China's support for the financing of ships in terms of fiscal policy is also somewhat insufficient, and there is no national finance investment in leasing industry projects. Since the source of China's ship finance leasing companies is mainly bank loans, the financial support for China's bank credit policies is not sufficient and it has not been tilted to the ship finance leasing industry. This has caused the financial strength of China's ship financial leasing companies to be weak.

### **3.1.3 Incomplete law system for financial leasing**

China has not yet introduced special laws regulating the financial leasing industry. At present, the laws and regulations on financial leasing are relatively fragmented and cannot cover all the contents involved in the financial leasing business, and they lack the overall control and control. Therefore, it has greater limitations in legal effectiveness. Since there are still legal gaps in some aspects of financial leasing business, certain specific issues in the practice of financial leasing business cannot be resolved. At the same time, for ship financial leasing, as the subject matter, the characteristics of ship further increase the complexity of the leasing business and makes the existing law weaker. Lack of legal uniform standards not only increases the risk of the company, but also limits the development of the industry.

### **3.1.4 Small and medium sized financial leasing companies being lacking of capital**

The lack of capital of financial leasing companies is one of the main reasons for the slow development of ship finance leasing business before, because ship finance leasing companies want to expand their business scale on the premise that they have sufficient capital. Judging from its registered capital, China's financial leasing companies are mostly small and medium-sized enterprises, but they generally find it difficult to get financed. Because funds basically only flow to large ship owners. The distorted fund allocation system has increased the loss of efficiency for both financial institutions and ship owners. From the perspective of future development, due to the consideration of

risk control, the preference of banks for large ship owners will not change, and the pattern of centralized financial resources will also be difficult to change in the short term.

## **3.2 Classification of ship financial leasing risks**

### **3.2.1 External Risks:**

#### **3.2.1.1 Market risks:**

The market risks mainly include interest rate risk, exchange rate risk and freight rate risk.

①Interest rate risk refers to the possibility that the financial leasing institution of the vessel may suffer losses in the financial leasing business of the ship.

On the one hand, the rent for ship leasing companies of ship financial leasing companies is based on interest rates. To a certain extent, it is similar to a commercial bank loan and can be regarded as an interest rate product. If in the ship financial leasing business, the rent specified in the lease contract is calculated on the basis of a fixed interest rate, if the market interest rate increases, the intrinsic price of the ship that has been leased out will be relatively reduced, thus giving the lessor the ship's financing. Institutions bring losses; conversely, if interest rates fall, the value of the vessels that have already been rented will rise relatively.

On the other hand, in the international ship financial leasing, the leveraged leasing model is usually used. Therefore, in addition to self-financing, the lessor often needs to borrow medium- and long-term funds from a third party. Therefore, the lender will face greater interest rate risk. If the rent is fixed and interest rates change frequently, it will surely result in the loss of the interests of one party. Therefore, in financing loans, ship financial leasing agencies should try to match the loan term with the lease term of the ship and make the interest rate calculation method as consistent as possible. If the lease is a fixed average interest rate, then the loan interest rate should also be negotiated to the average interest rate. It can reduce the interest rate risk borne by the project.

②Exchange rate risk in ship financial lease refers to the possibility that the financial leasing institution of the ship may suffer losses due to the uncertainty of exchange rate fluctuations in the business of using foreign exchange.

In recent years, the international financial market has been turbulent and ups and downs. If foreign exchange settlement is used in the leasing business, it is likely that the change in foreign exchange will affect actual income and even bring losses. The exchange rate risk in ship financial leasing business mainly manifests itself in two parts: First, during the process from the signing of a sales contract or construction contract to the completion of a ship charter contract, the actual expenditure cost or income of the ship may be changed due to exchange rate changes. The second is the risk of exchange rate changes leading to increased costs in the process of raising funds. Of course, due to the longer duration of the vessel's financial leasing, the first risk is much higher than the second risk. In the ship financing and leasing business, the financial leasing institutions use the following types of foreign exchange: the lessee is a shipping company doing international seaborne trade transportation, and the lessee will require the rental in the leasing contract to be settled in U.S. dollars; the shipbuilder designated by the lessee is in foreign shipyards, the shipyard will require that the ship's payment in the ship construction contract be paid in foreign currency; the second-hand ship that the lessee chooses to purchase, whose owner is a foreign shipping company, will require the purchase of the ship to be paid in foreign exchange; the ship financial leasing institution borrows foreign exchange from the bank loan. At present, the vast majority of countries in the world generally adopt a floating exchange rate system. The exchange rate changes from time to time and fluctuates continuously. Therefore, when a ship owner encounters the above situations, he must bear certain exchange rate risks in the ship financial leasing business. In particular, when a vessel financial leasing institution pays two different currencies for payment of its payment and income, it will face a higher exchange rate risk. Therefore, financial leasing institutions prefer to use the same currency for settlement throughout the entire financial leasing process to reduce exchange rate risks.

#### 3.2.1.2 Policy risk

The policy risk is mainly the risk that the country adjusts to an industry. Policy risks include macroeconomic policy risk, shipping industry policy risk, financing policy risk and so on.

The development of shipping industry depends on the economy development. Macroeconomic policy is an external factor for the development of the shipping industry.



Loose economic policy will create favorable conditions for the development of shipping industry, and carried out relevant industrial policy support will also create opportunities for the industry development, on the other hand will restrict the development of shipping industry.

National government departments may take measures to impose macro-control and policy restrictions on the shipping industry and the shipbuilding industry, which will have a significant impact on the individual businesses in the shipping industry and the shipbuilding industry, and thus pose risks to the vessel's financial leasing.

Financing policy risk is the risk caused by the country's adjustment to the overall financing environment. For example, a country that relaxes its financing environment may prompt shipping companies to switch to other financing channels for financing, which in turn triggers corresponding financing risks.

#### 3.2.1.3 Risks of force majeure

Force majeure risk refers to the risk of damage or destruction caused by natural disasters such as typhoons, earthquakes, floods, or volcanic eruptions during the lease period of the vessel. Or political incidents, such as wars, riots, etc., may cause the ship owner to suffer loss without normal operation or damage. Force majeure brings unexpected characteristics to the risks. It is difficult to predict in advance, and once it happens, the harm will be great. At the same time, the leasing of the ship is not subject to the actual control of the lessor, so the lessor should pay more attention to this risk.

### **3.2.2 Internal Risks:**

#### 3.2.2.1 General credit risks:

The general credit risk refers to the risk that each party to the financial lease will bear because of the other party's inability to perform all or part of the performance. With the economic and social development, credit has been given unprecedented attention, especially in the areas of huge financing such as ship trading, ship chartering, and credit loans. The ups and downs of the shipping market and the diminishing power of lessors and lessees, may directly or indirectly lead to violations. Usually, credit risk can be divided into lessor's credit risk and lessee's credit risk.

The lessor's credit risk is mainly reflected in the loss caused to the lessee due to the breach of contract by the ship financial leasing company. For example, the lender has a funding problem, causing the shipyard to refuse or postpone the delivery of the ship. Or the lease contract and the ship are to be cancelled without justification during the lease period. These will let the lessee suffer default losses in economic and other aspects. However, this type of risk is generally small, with few types and easy to predict. And by specifying the relevant breach of contract in the lease contract, lessee's risk can be avoided to a greater extent.

The lessee's credit risk happens much more frequently. There are usually the following types.

First, due to the economic downturn in the shipping market or poor management of its own operations, when the market declines, there is a sharp drop in profits or even a loss. As a result, the lessees have a tight cash flow and cannot pay rental. Ultimately, they have to breach the contract and require the early termination of the lease contract or the cancellation of the contract, even refusing to pay rental. Such risks are particularly acute during a recession or a general downturn in the shipping market.

Second, the lessee fails to insure the ship in accordance with the contract. Ship financial leasing takes the form of bareboat charter and shall be insured by the lessee against bareboat charter. If the lessee did not take out ship insurance in accordance with the ship owner's consent or agreed method, or are insured but failure due to any reason attributable to the lessee insurance, once the ship's loss or damage, the lessor will suffer the risk that the financing principal and interest can't be recovered.

Third, the lessee has not been able to dispose of the vessel without the consent of the lessor, such as sublease of the bareboat vessel, sale of the vessel to a third party, removal of the vessel, etc.

Last but not least, when the reason why the ship was damaged or lost cannot be attributed to the parties clearly, the lessee often requires the lessor to take the risk and refuses to pay rental because the lessor owns the ship. At this time, if the lessee and the lessor have no insurance or a third party responsible for this, then the lessor will suffer more serious losses.

#### 3.2.2.2 Special credit risk

There is another special credit risk in ship financial leasing: the credit risk caused by freight rate fluctuation. Freight rate risk is the fluctuation of freight rates which is on one hand caused by the pressure from the market competition and on the other hand affected by shipping cost, such as shipbuilding costs and fuel costs. However, the most fundamental reason for the fluctuation of freight rates is the change in the relationship between the volume and capacity of the market during a certain period of time. Therefore, when the ship owner conducts the ship financial leasing business, it is necessary to understand and grasp the default risk caused by the fluctuation of the shipping price of the shipping market. Such risks are not lessees' subjective intention but importance needs to be attached.

### 3.2.2.3 Risks of third party responsibility

During management of ship, the lessee may default to a third person, infringement, or the violation of administrative law and administrative responsibility, so that indirectly put the lessor at great risk. On the basis of these maritime claims, a third party or administrative authority may apply to the court to arrest the ship, and the lessee shall be obliged to provide a guarantee to release the vessel. However, with a large amount of maritime liability, the lessee is generally unable or unwilling to provide a huge guarantee that the ship will be forced to sell once unsecured. Therefore, when the lessee does not provide the guarantee to release the vessel, the ship actually puts the lessor in the position of the person who takes the responsibility, and ultimately the lessor has to pay the large amount of compensation. Although the lessor has the right of recourse against the lessee, the realization of the right of recourse is questionable. In practice, the ship's existing liabilities and oil pollution liability often involve the lessor involved in the great risk. However, the risk of third party liability is often difficult to control by the lessor. Therefore, such risks need special attention.

## **4. Credit risk assessment and control of ship financial leasing**

There were various risks in ship financial leasing as I mentioned in the previous chapter. In this chapter, I first introduced some common methods of risk assessment. Then I focused on the credit risk control, both of the general credit risk and the special credit risk. Due diligence was used to assess the general credit risk and VaR method was applied to measure the special credit risk: freight rate. At the end of the chapter, I gave some advice to ship financial leasing companies on preventing credit risks.

### **4.1 Common methods of risk assessment**

After identifying various risks, it is necessary to make risk assessment. A good risk assessment can help ship financial leasing companies control the risks better.

#### **4.1.1 Qualitative analysis methods**

##### **4.1.1.1 Expert Opinions**

Expert Opinions, also called Delphi, is now used extensively in domestic and international risk analysis research. It is an anonymous letter of inquiry method. To overcome the shortcomings of expert meetings that are susceptible to psychological factors, it uses anonymous rounds of enquiries to solicit expert opinions. After each round of expert opinions are aggregated by statistical methods, feedback materials are sent. For each expert, for their analysis and judgment, put forward a new argument. If the experts reach a unified opinion, the investigation will be ended. This method is characterized by the advantages of anonymity, feedback and repetitive statistics, so it is often used in risk management.

##### **4.1.1.2 Brainstorming**

Brainstorming was first proposed by American creative scientist A. F. Osbron in 1939. It has been widely used at home and abroad in recent years. Through the exchange of experts, intelligence collisions in the mind, creating a new spark of intelligence. It can be carried out in one group, or it can be completed by a single person and then centralized. The issue under discussion should be simple. If it involves a wide range of factors and contains too many factors, it should be analyzed and resolved in advance and this approach should be adopted.

##### **4.1.1.3 Decision Tree**

Decision tree analysis is one of the important methods for risk-based decision making. This method uses the graphical representation of the decision analysis process to express the level and stage of the entire decision and the corresponding decision-making basis. It has features such as clear gradation and convenient calculation, so it is widely used in decision-making activities. The key to this approach is to build a decision tree. It consists of squares, circles, knots, lines, and presents a tree-shaped structure.

#### 4.1.1.4 Flow Chart

Flow Chart is also called business process analysis, meaning that first, the business process of the company is made into a series of flow charts according to its logical relationship. Then, each step of the flow chart is analyzed and investigated one by one, and the potential risks that may occur in the business are discovered. The insufficiency and defects in the business operation can be found through the analysis of the flow chart.

### 4.1.2 Quantitative analysis methods

#### 4.1.2.1 Value at Risk

The VaR method calculates the various risks in the ship financial leasing project. The VaR method was initially used by financial institutions to measure capital risks in different financial markets. It then developed rapidly and was widely recognized within the financial industry. VaR, also known as value at risk, refers to the maximum possible loss of an investment at a certain confidence level for a certain period of time in the future under normal market fluctuations. It is a benchmark for integrating financial risks such as market risk, interest rate risk and exchange rate risk. VaR is a risk-oriented approach compared to traditional financial risk measurement methods. In the actual calculation, VaR is divided into absolute and relative two kinds. The VaR values in this paper are relative VaR values. At present, the calculation methods of VaR mainly include historical simulation method, Monte Carlo simulation method, variance and covariance methods, etc.

In fact, in VaR experiments many of the sample is found not completely subject to normal distribution. In order to make VaR model more realistic and applicable, to make calculation results more accurate, researchers gradually research and introduce models such as ARCH model and GARCH model. These models are the extension and the

thorough elaboration of the VaR model. In practice they have proved to be models that better measure the risks of financial markets.

#### 4.1.2.2 Multiple regression analysis

The multiple regression analysis method is based on the correlation between phenomena and establishes a regression model of multiple independent variables. When the structural relationship among variables of the year does not change significantly in the future, the future value of the predicted object is obtained from the predicted value of the independent variables.

#### 4.1.2.3 Analytic Hierarchy Process

The so-called AHP (Analytic Hierarchy Process) refers to a complex multi-objective decision-making problem as a system, which decomposes the target into multiple objectives or criteria, and then decomposes it into several levels of multiple indicators (or criteria, constraints). Through the qualitative metric fuzzy quantification method, the hierarchical single-order (weight) and total sorting are calculated, which is used as a systematic method for the target (multi-indicator) and multi-project optimization decision-making.

The characteristics of the AHP are based on the in-depth analysis of the nature, influencing factors, and internal relationships of complex decision-making problems, using less quantitative information to mathematicalize the decision-making thinking process, thus achieving multiple goals and multiple criteria or complex decision-making problems without structural features provide easy decision-making methods. It is especially suitable for occasions where it is difficult to directly and accurately measure the result of the decision.

#### 4.1.2.4 Principal Component Analysis

Principal Component Analysis (PCA), a multivariate statistical analysis method that converts multiple variables through linear transformation to select fewer important variables, also known as principal component analysis. In the actual project, in order to analyze the problem comprehensively, many variables (or factors) related to this are often put forward, because each variable reflects some information of this topic in varying degrees. Principal component analysis was first introduced by K Pearson on

non-random variables. After that, H. Hotelling extended this method to the case of random vectors. The amount of information is usually measured by the sum or variance of dispersions

## **4.2 Control of general credit risks**

### **4.2.1 General credit risk assessment**

For most ship financial leasing companies, their biggest concern is rent arrears, while rent arrear is the main reflection of credit risk. Therefore, due diligence is especially important as a precautionary measure for companies to control credit risks of financial leasing before lease.

The due diligence report mainly includes the basic information of the project, the analysis of the industry, the lessee's information and the project feasibility and other important matters. The basic information of the project contained the structure of the transaction and the analysis of the use of funds and its rationality. As for the industry analysis, market supply and demand and industry policy should be taken into account. The most important part of due diligence report is the analysis of the lessee. In this part, there includes the general information of the lessee such as the company and equity structure, also included the lessee's position in industry and its main business. In addition, the ship financial leasing company needs to make an evaluation of the lessee's financial situation. Basic data such as annual audit report, financial report, bank statement, tax bill and big contract are required to calculate the financial ratios such as asset-liability ratio, liquidity ratio, net profit ratio and so on. Other important matters could be the insurance or legal facts or could be the main risk points and corresponding preventive measures.

The following graph can summarize the procedure of due diligence.

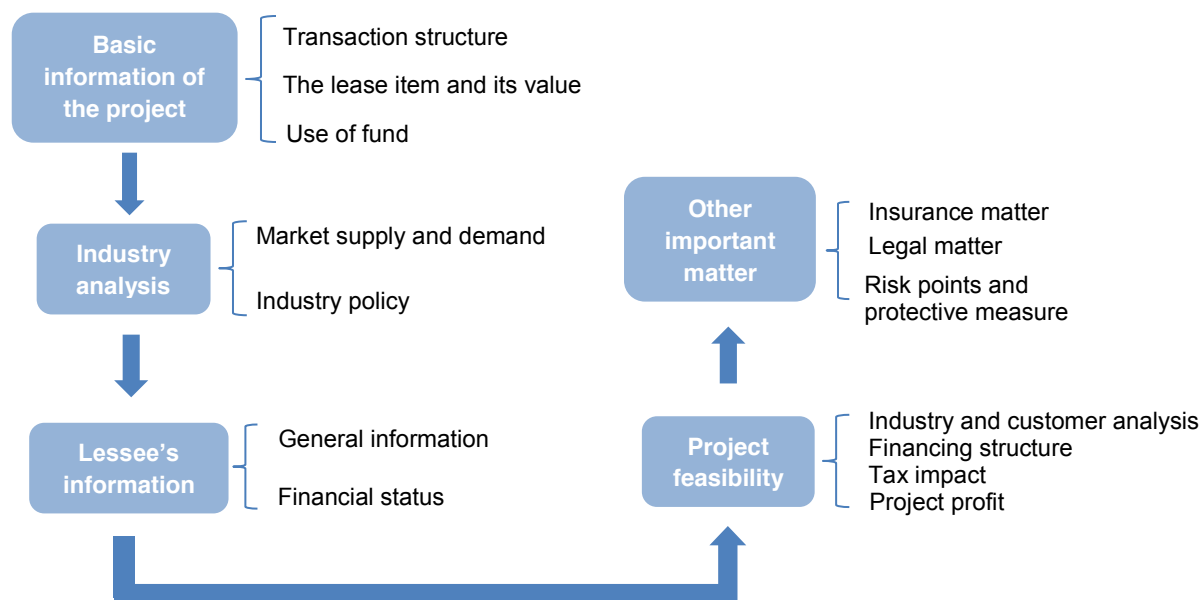


Fig.6 Procedure of due diligence

Generally speaking, after completing the due diligence, the leaser will have a clear outlook of the lessee. The due diligence report can give reference to help the leaser assess risks as well as minimize the potential risks of the case.

#### 4.2.3 Prevention of general credit risk

General credit risk also should be prevented. For leasers, they can take various measures to prevent credit risks. First of all, make a credit investigation of the lessee before signing a financial leasing contract. Meanwhile, make a dynamic assessment and prediction of the shipping market. Furthermore, make a clear stipulation in the contract about the risk of liability for breach of a contract. Guarantee or insurance can also be an option. Leaser can require lessee to provide guarantee or pay the insurance cost for lessee in advance and deduct from the rental afterwards. For lessees, credit risk can be avoided to a large extent by clarifying the relevant clauses of contract breach in case the situation really happened.

In addition, timely investigation needs to be made to control the risk especially for shipping market risk. Before starting the project, it is essential for the leaser to analyze the development trend of the shipping market. After the start of the project, the financial situation of the lessee shall be monitored, and the lessee shall be kept informed of the situation of the lessee. Meanwhile, the shipping market shall be closely monitored to



reduce the credit risk of the shipping market. It is also very important to strive for the inclusion of protection clauses in the contract. Improving relevant institutional mechanisms such as creating credit rating system, risk warning mechanism and risk compensation reserve system can all reduce credit risk from a long-term perspective.

### **4.3 Control of special credit risk arisen from fluctuation of freight rate**

#### **4.3.1 Selection of analytical methods**

Since many financial leasing companies lack quantitative analysis when assessing risks, a proper quantitative analytical method becomes a necessity. Then, VaR method was recommended to measure risks.

VaR methods and relevant models were gradually adopted by major financial institutions, companies and financial regulators around the world since 1990s because VaR method has two main advantages. One is that VaR method can measure the complex asset portfolio composed of different risk factors, different financial instruments and the overall risks faced by different business sectors, so it is more widely applicable. The other advantage is that VaR method not only provides a general risk measurement and its occurrence probability, but also provides the comparability of the risk measurement, which is more likely to be understood, accepted and adopted by top management. Since the ship financial leasing company essentially belongs to the financial institutions, this paper will use the mainstream risk measurement method in current financial sector: VaR method to make risk measurement in the case of a financial leasing company in the next chapter.

#### **4.3.2 Freight rate risk measurement**

In most cases, like what has been mentioned before, due diligence was a good way to control credit risk. After completing the due diligence, the leaser had a clear outlook of the lessee. The due diligence report can give reference to help the leaser assess risks as well as minimize the potential risks of the case. However, the risks were still abstract that they were usually controlled only by experience. If the risks could be measured, then they would become more concrete and they would be better controlled.

##### **4.3.2.1 Collection and processing of sample data**

I selected the Intra-Asia Container Freight Rate Index from Clarkson. The data were from January of 2004 to March of 2018, 170 samples altogether. The following graph is downloaded from Clarkson.

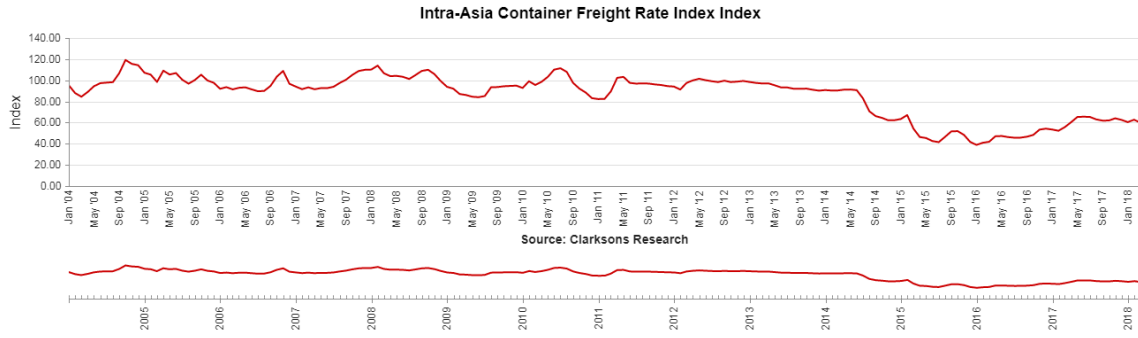


Fig.7 Intra-Asia container freight rate index

Generally speaking, the two methods commonly used in investment returns are simple return on investment and logarithmic return on investment. Many scholars at home and abroad adopt the logarithmic method because of its practicability and applicability, which means that this method linearizes the curve trend of the sequence and eliminates the linear trend by difference, also reduces the difficulty of derivation. Therefore, this paper adopts logarithmic return rate method.

Since the freight rate was so fluctuating, in order to make the data more stable, natural pair processing was performed on the container freight rate data sequence to form a logarithmic sequence as  $\ln P_t$  and perform first-order differential on  $\ln P_t$  to obtain  $R_t$ .

$$R_t = \ln P_t - \ln P_{t-1} = \ln \frac{P_t}{P_{t-1}}$$

Then, use Eviews to get the fluctuation graph of the logarithmic return rate sequence of this index:

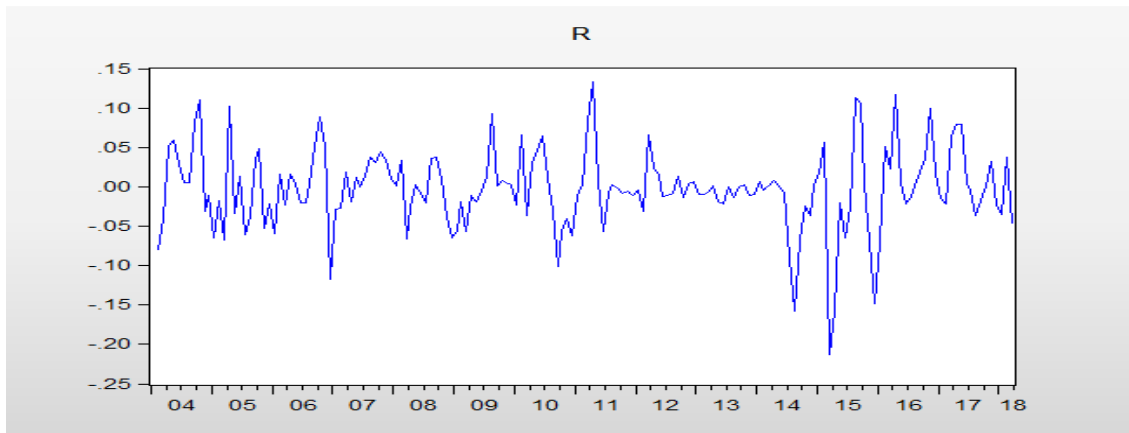


Fig.8 Intra-Asia container freight rate index log returns fluctuation graph

As can be seen from the graph of the logarithmic rate of return sequence fluctuation of the sample, the logarithmic rate of return basically oscillates up and down around the value of 0 throughout the sampling period. Therefore, the fluctuation of the yield sequence can be regarded as a relatively stable time series. In addition, there is a period of violent fluctuation in a specified period of time, while the other period is relatively stable. This fluctuation diagram indicates that there is a certain aggregation phenomenon in the fluctuation of sample sequence.

#### 4.3.2.2 Data analysis and testing

##### (1) Descriptive statistical analysis of time series sample

In many financial studies, rates of return are assumed to follow a normal distribution. After a lot of practical research, it is found that most of the returns are not normally distributed. Therefore, in this paper, the Jarque Bera value test method is firstly adopted to test the normality of the sample time series. Skewness and Kurtosis are two important parameters in JB test. Skewness is a statistic of the asymmetries surrounding the mean distribution of time series data, while kurtosis is a statistic that measures the peak and flatness of time series distribution. JB, skewness and kurtosis were three main indicators in normality test. The calculation formulas were as followed:

$$S = \frac{1}{N} \sum_{i=1}^n \left( \frac{y_i - \bar{y}}{\hat{\sigma}} \right)^3$$

$$K = \frac{1}{N} \sum_{i=1}^n \left( \frac{y_i - \bar{y}}{\hat{\sigma}} \right)^4$$

$$JB = \frac{N - n}{6} \left( S^2 + \frac{1}{4} (K - 3)^2 \right)$$

$y_i$  was the sample observations.  $\bar{y}$  was the average of observations.  $\hat{\sigma}$  was the estimated standard deviation.  $N$  was the sample size.  $n$  was the number of estimated coefficients used to generate the sample sequence.  $S$  was the skewness and  $K$  was the kurtosis.

The test results are obtained by comparing the above values with the standard form of normal sequence.

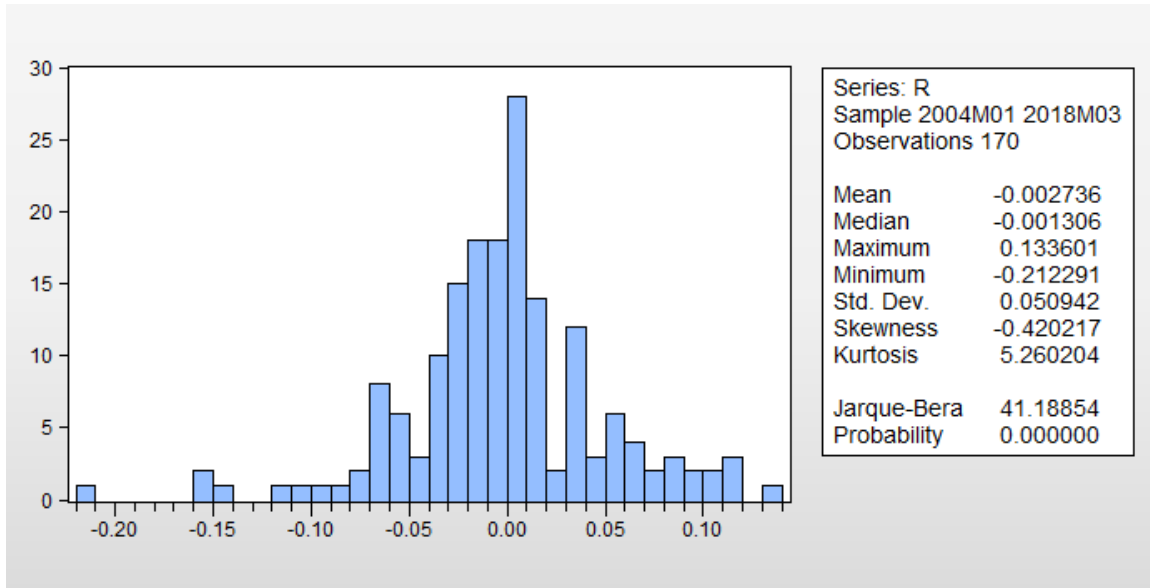


Fig.9 Logarithmic return series of normality test picture

Sample Series	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
R	-0.002736	0.050942	-0.420217	5.260204	41.18854	0

Table.2 Statistical table of normality test results

Generally speaking, if the skewness is positive, this means the number of days that are below average rate of return are bigger than the number of days that are above average rate of return and vice versa if the skewness is negative. Usually, we regard the normal distribution standard (skewness is 0, kurtosis is 3) as the benchmark. Therefore, if the kurtosis is bigger than three and the JB value is significant, the sequence was defined to follow a Leptokurtic Distribution or a Fat tailed Distribution.

As shown in the table above, the following conclusions can be drawn: through Eviews software, the skewness of logarithmic rate of return sequence in the sample was -0.420217, which was a right skewness. The kurtosis of the sequence was 5.260204, which was greater than the normal distribution. JB value was 41.18854, which was very significant.

From the above results, the logarithm rate of return sequence did not completely obey the standard normal distribution, but with the phenomenon of Leptokurtic Distribution or Fat tailed Distribution. Therefore, GARCH model was introduced to estimate the VaR value dynamically, in order to effectively overcome the time-varying characteristics of sample data. Since the sequence distribution of samples was close to normal distribution,

this paper will still conduct in-depth research on the basis of normal distribution GARCH model. After the completion of the normality test, the stationarity test and data autocorrelation test will be conducted for the logarithmic rate of return sequence.

## (2) Stationarity test

According to the characteristics of GARCH model, the time series stability of sample data is an essential condition for studying the fluctuation characteristics of financial time series by using GARCH model. Therefore, this section will use the ADF test method which is commonly used in practical research to test whether the time series of sample data has unit root.

The following results are obtained by ADF test using Eviews software:

Null Hypothesis: R has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=13)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-8.961750	0.0000
Test critical values:	1% level		-3.469214	
	5% level		-2.878515	
	10% level		-2.575899	
*Mackinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(R)				
Method: Least Squares				
Date: 06/20/18 Time: 02:04				
Sample (adjusted): 2004M03 2018M03				
Included observations: 169 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
R(-1)	-0.644882	0.071959	-8.961750	0.0000
C	-0.001401	0.003662	-0.382567	0.7025
R-squared	0.324742	Mean dependent var		0.000192
Adjusted R-squared	0.320699	S.D. dependent var		0.057685
S.E. of regression	0.047544	Akaike info criterion		-3.242566
Sum squared resid	0.377489	Schwarz criterion		-3.205526
Log likelihood	275.9969	Hannan-Quinn criter.		-3.227535
F-statistic	80.31297	Durbin-Watson stat		1.892759
Prob(F-statistic)	0.000000			

Fig.10 ADF test result

From the result, we can see that the t statistic of ADF test was -8.961750, less than the values of the confidence intervals of 1% Level, 5% Level and 10% Level respectively. And also, the probability was 0, which means the time series of sample return rate was stable and there was no unit root.

### (3) Autocorrelation test

Use EVIEWS software to test sequence correlation and get the residual sequence of autocorrelation coefficient (AC) and partial autocorrelation coefficient (PAC), Q-statistics and the probability, as shown in the figure below.

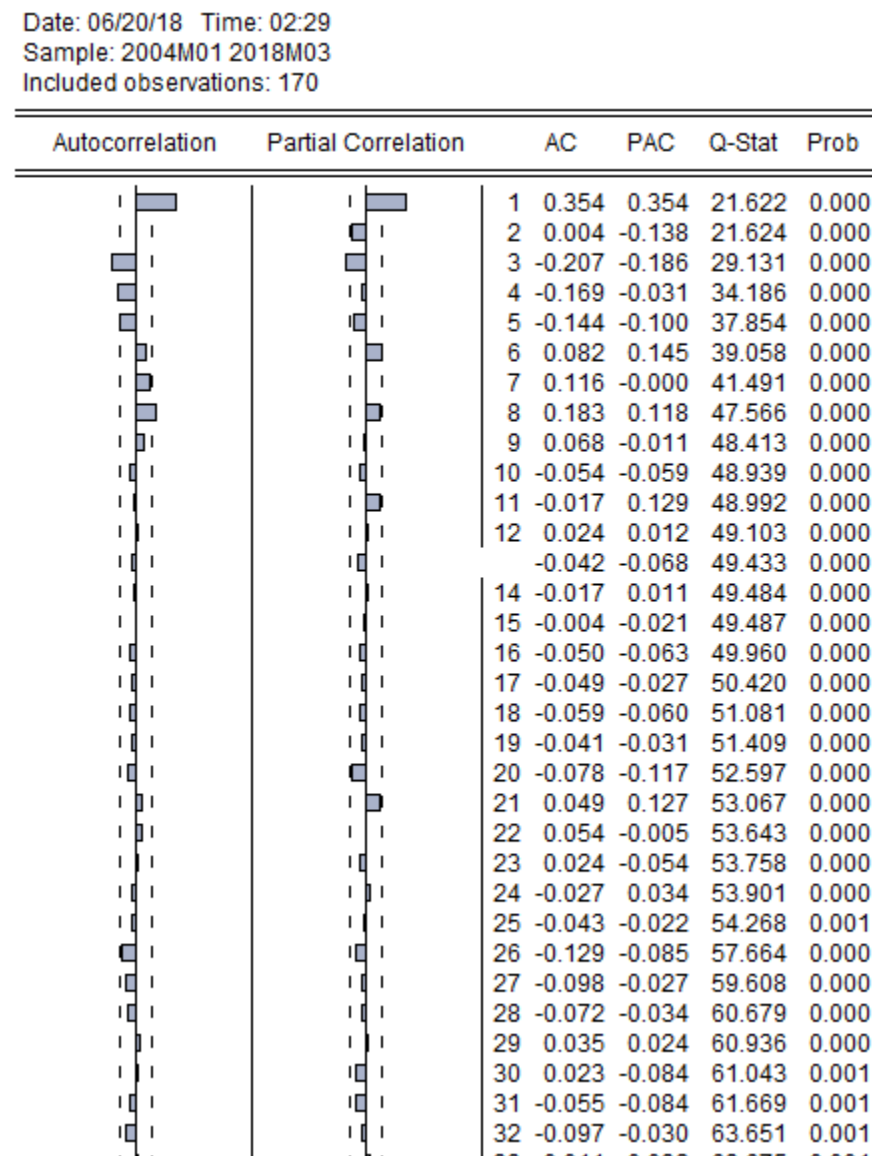


Fig.11 Autocorrelation test results

From the test results, it can be seen that neither of autocorrelation coefficient and partial autocorrelation coefficient was zero. The Q-statistical value was relatively significant and probability was zero, indicating that the sequence has obvious autocorrelation.

#### 4.3.2.3 Establishment and calculation of VaR-GARCH model

According to the above test results and the applicability of the model, the GARCH (1, 1) model was selected to be established for the characteristics of the logarithmic return rate sequence of Intra-Asia container freight rate index. The simulation results are shown below:

Dependent Variable: R  
Method: ML - ARCH (Marquardt) - Normal distribution  
Date: 06/20/18 Time: 02:46  
Sample (adjusted): 2004M02 2018M03  
Included observations: 170 after adjustments  
Convergence achieved after 11 iterations  
Presample variance: backcast (parameter = 0.7)  
GARCH = C(1) + C(2)\*RESID(-1)^2 + C(3)\*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	0.000906	0.000182	4.968590	0.0000
RESID(-1)^2	0.822633	0.164936	4.987600	0.0000
GARCH(-1)	0.074711	0.082833	0.901939	0.3671
R-squared	-0.002901	Mean dependent var	-0.002736	
Adjusted R-squared	0.002998	S.D. dependent var	0.050942	
S.E. of regression	0.050866	Akaike info criterion	-3.271768	
Sum squared resid	0.439845	Schwarz criterion	-3.216431	
Log likelihood	281.1003	Hannan-Quinn criter.	-3.249313	
Durbin-Watson stat	1.270983			

Fig.12 GARCH (1, 1) model of Intra Asia container freight rate Index log return series

From the result, we can see that the coefficient of RESID was 0.822633 and the coefficient of GARCH was 0.074711. The sum of these two values was less than one, which means that under the assumption of normal distribution, the GARCH model can accurately fit the time series. Therefore, the expression of this model is:

$$\text{GARCH} = 0.000906 + 0.822633 \cdot \text{RESID}(-1)^2 + 0.074711 \cdot \text{GARCH}(-1)$$

$$\sigma_t = 0.000906 + 0.822633 \varepsilon_{t-1}^2 + 0.074711 \sigma_{t-1}$$

After that was the calculation of VaR model.

The GARCH conditional variance sequence can be generated by EViews software. Then, by squaring the conditional variance sequence, the conditional standard deviation sequence was obtained. The graph was shown below:

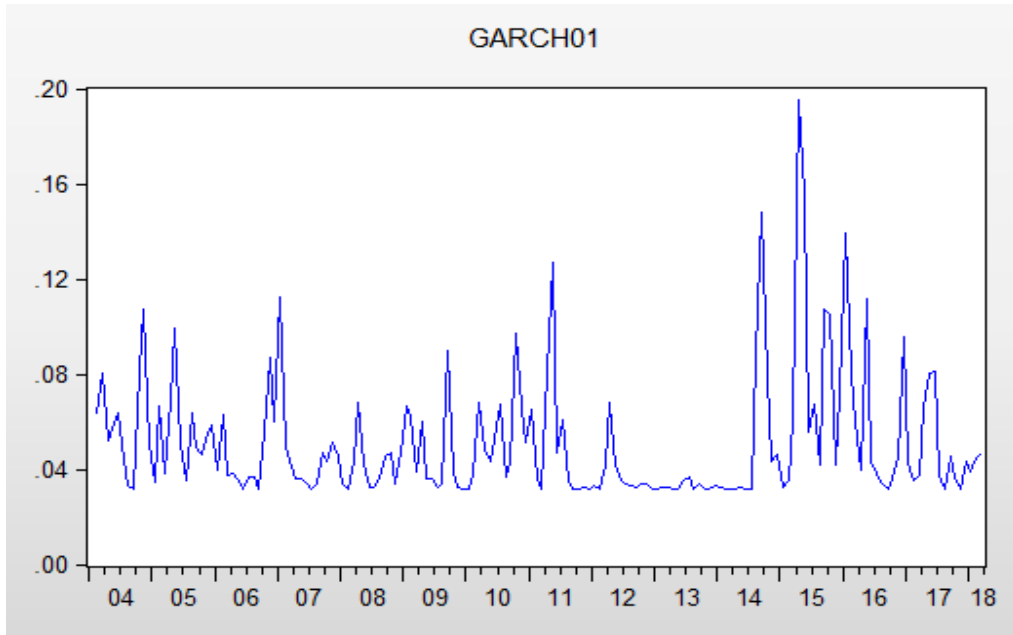


Fig.13 GARCH conditional standard deviation sequence

According to the confidence level commonly used in statistics, the critical values of 90%, 95% and 99% were obtained as  $Z_\alpha$  by referring to the corresponding table. After that, the value of VaR can be obtained.

$$VaR_t = Z_\alpha \sigma_t$$

The confidence level and the corresponding critical value of the normal distribution commonly used in our daily life are shown in the following table:

C	90%	95%	99%
$Z_\alpha$	1.65	1.96	2.33

Table.3 The confidence level of normal distribution corresponds to the critical value

The following table was the calculation results by using excel:



	VaR (90%)	VaR (95%)	VaR (99%)
MEAN	0.083908	0.099672	0.118488
MEDIAN	0.068256	0.08108	0.096386
MIN	0.051683	0.061393	0.072983
MAX	0.322719	0.383351	0.455718
Std Dev.	0.043805	0.052035	0.061857

Table.4 Calculation result of VaR

#### 4.3.2.4 Summary

After data collection and data processing, we obtained the return rate sequence of Intra-Asia Container Freight Rate Index. Through the normality test, the return rate sequence is not subject to normal distribution. After that, the stability test of ADF was conducted, and the conclusion of its stability was obtained. Through the autocorrelation test, the return rate sequence was proved to be autocorrelation. The results of these above tests all illustrated that the return rate sequence of Intra-Asia Container Freight Rate Index fit the GARCH model very well.

Actually, many researches have made the risk measurement on interest risk and exchange rate risk by using VaR-GARCH model. The result showed that these two external risks of ship financial leasing that fluctuate over time can also be well adapted to VaR-GARCH model.

#### 4.3.3 Prevention of freight rate risks

The main credit risk comes from the volatility of shipping market. The freight rate risk analyzed above was a special type of credit risks. Several measures can be taken to prevent such risks.

For both leaser and lessee, they should have awareness of freight rate risks and keep track of shipping market trends therefore be prepared for possible volatility in small sized container ship freight rates. In addition, they should pay close attention to the dynamic of shipping market, predict the price trend through reasonable methods, and use derivatives tools to avoid risks. Risk quantification model such as VaR model used in previous content can also be used when analyzing freight rate risks.

## **5. Conclusion and suggestion**

### **5.1 Conclusion**

The process of financial leasing is complex, not only because it involves a huge amount of money, but also it contains a wide range of risks. Only by having sufficient expertise, strong financial strength and good reputation can it be supported by financial institutions and the country in order to make a difference in this area. With the gradual standardization of shipping companies, shipbuilding companies, and financial institutions, a series of problems have been solved, coupled with the huge potential of the domestic ship financing market, we believe that in the near future, China's shipbuilding investment and financing industry will rise in the world.

### **5.2 Suggestions for Chinese ship financial leasing companies**

This paper takes the risk of ship financial leasing as the research object to discuss the concept of ship financing lease, analyzes China's macro development environment, current status and existing problems, the risks it faces, and how to effectively avoid risks. The combination of theory with practice and the combination of qualitative and quantitative methods has led to more in-depth discussions and comparative analysis. In a comprehensive view, the current status of China's ship financial leasing is still far from the world's developed countries in both experience and professional standards. Problems such as financial leasing institutions' lack of industrial experience and professionals, imperfect policy environment and insufficient support, incomplete law system for financial leasing and small and medium sized financial leasing companies being lacking of capital are impeding the development of Chinese ship financial leasing companies.

I put forward some suggestions for reference:

#### **(1) Build a professional talent team**

As I mentioned before, ship financial leasing business involves shipping, finance, shipbuilding, law, brokerage and many other aspects. It has higher requirements for professional skills and overall quality of employees. However, such talents are still relatively lacking. In view of the current situation, on the one hand, it is necessary to strengthen business training and cooperation among employees, build a comprehensive and multi-layered talent team covering ship financial leasing, and prevent various risks

that may arise in the ship financial leasing business to the maximum extent. On the other hand, the implementation of school-enterprise cooperation, financial leasing companies and colleges and universities jointly cultivate high-quality, market-oriented, professional shipping finance professionals to build a training system for China's shipping finance talents.

## (2) Strengthen governmental support and introduced preferential policies

As policy makers and organizers of financing, the relevant government departments should encourage financial institutions such as banks to increase their loan and financial subsidy policies for shipping and shipbuilding companies. The State shall grant certain preferential conditions such as tax deductions and subsidies in order to encourage domestic shipping companies to build ships in the country and vigorously develop China's shipbuilding industry. At the same time, the state or industry associations can provide guarantee for the domestic and foreign orders that shipbuilding companies have contracted to obtain sufficient loans from financial institutions such as banks to ensure the smoothness of the entire shipbuilding and delivery process.

## (3) Modify and improve relevant legal systems

The relevant laws such as the "Maritime Law" can be amended and special chapters on "financial leasing contracts" can be added to clarify the rights and obligations of tripartite entities in ship financial leasing thus filling the legal gaps in priority, liens and wrecks in the process of ship financial leasing as well as in responsibility identification to eliminate the legal conflicts in existing laws and regulations.

In addition, registration and announcement system for ships under financial leasing can be added to establish the principles for the separation of ship ownership registration and ship financial leasing registration, limit the transfer of ownership of ships and the registration of changes and registration of mortgage rights in financial leasing meanwhile limit the cancellation of the registration of ship financial leasing. Through the above restrictions, the relationship between ownership and possession in the process of financing leasing can be regulated, and the legal risks brought about by unauthorized disposition can be circumvented.

## 4 Establish market risk early warning mechanism and hedging mechanism

The ship financial leasing market is exposed to a large market environment and is influenced and changed by various external factors. Although financial leasing companies have identified and assessed various existing risks in the early stage of each financial leasing project contract, the external market is changing rapidly, and potential market risks are still likely to occur, bringing corresponding losses to financial leasing companies. Therefore, in order to effectively compensate for possible risk losses, appropriate control measures and hedging mechanisms should be adopted. Close attention should be paid to the scientific research on macroeconomic trends at home and abroad. Ship financial leasing companies should fully consider the volatility and periodicity of the market, on the basis of scientifically predicting changes in the market, optimize asset allocation and formulate reasonable development strategies and business scale.

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