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WORLD MARITIME UNIVERSITY

Shanghai, China



**Research in Credit Risk of Shipping Enterprises Based on
the KMV Model**

By

Yannan Wu

China

A research paper submitted to the World Maritime University in partial Fulfillment of
the requirements for the award of the degree of

MASTER OF SCIENCE

In

INTERNATIONAL TRANSPORT AND LOGISTICS

2014

DECLARATION

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

The contents of this dissertation reflect my own personal views, and not necessarily endorsed by the University.

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Abstract

Title of Dissertation: Research in Credit Risk of Shipping Enterprises Based on the KMV Model

Degree: Master of Science in International Transport and Logistics

From 2008 to 2009, the international shipping market met ‘Waterloo’, and in the following four years, the shipping market is experiencing a winter with no deadlines. Low freight and serious excess capacity, cause the shipping market's overall business go from bad to worse. The downturn of Shipping market also restricts the development of shipping in the finance markets, with shipping real economy as the carrier, shipping financing is forced into the embarrassed situation, European commercial Banks stop lending or reduce credit, in recent years, there are no new shares issuing into the stock market in which the two delisting and repeatedly to ST happened, and the shipping industry in 2013 has been classified to high-risk category by the international credit rating agencies, all above have great influences on the shipping financing of enterprises in China. while at the same time, the good news of shipping bonds issued in Asian bond market stimulate the shipping enterprises in our country, which intend to join in the bond force causing the subscribe of the bond.

But due to the low maturity of the bond market, the imperfection of credit rating system in China, and the investors’ lack of knowledge in credit risk, our country shipping bond market swung from the right orbit. Bonds price issued by the harbor-shipping enterprise shocks all the way, even though there is no real default happens, the drop in prices also caused a certain loss to bondholders, rational investors and speculators in the market take cautious attitude on the future development of harbor-shipping enterprise bonds. At the same time, the government cannot promote enterprises to actively adjust the management pattern with picking up the tab, which to some extent greatly restricted the development of our country's shipping finance, shipping bond market. So how to measure the credit risk objectively and how to prevent various risks in shipping bonds is the biggest problems which

faces the bond market's development. At present, related domestic research discuss about the present situation of the domestic and foreign shipping bond financing, put forward the corresponding policy recommendations. No one have not used the method of quantitative analysis to measure the credit risk in shipping financing.

In this paper, based on credit risk measurement model domestic and abroad, firstly we compare all kinds of models' applicability in shipping bond market, decide to choose the KMV model based on GARCH model for empirical research and analysis. Then with the combination of particularity in national conditions and the nature of the enterprise bond issuance, we do the appropriate correction for this model. Finally, we select the typical four enterprises bonds issued by harbor-shipping enterprise for empirical research, do the conclusion and analyze research limitations.

Due to the bonds issued by shipping companies concentrated after the 2012 years, we lacks of domestic related theory research and credit risk quantitative analysis in the literature. In this article we only analyze for four port and central state-owned enterprises, and the sample size is small, empirical research has one-sidedness and limitations, so we put forward the corresponding suggestion in the future development of shipping in the bond market of our country.

KEYWORDS: Shipping Finance, Shipping Bond, Credit Risk, KMV model

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LIST OF ABBREVIATIONS

BDI	Baltic Dry Index
EDF	Expected Default Frequency
LGD	Loss Given Default
CBRC	China Banking Regulatory Commission
SPV	Special Purpose Vehicle
ICBC	Industrial and Commercial Bank of China
COSCO	China Ocean Shipping (Group) Company
HSBC	Hong Kong and Shanghai Banking Corporation
DD	Default Distance
NYK	Nippon Yusen Kaisha Line Ltd
DPT	Default Point

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Chapter 1 Introduction

1.1 Research Background

Maritime, the most import transportation in international logistics which take the 90% of all the imports and exports especially in China. As the crucial part of all the net, shipping market connects the financial industry and the shipping industry together.

Since ancient times, maritime transportation appearing in the world take the role of demand derived from the trade, in a way, the modern international trade will affect the demand of shipping market, and the supply will go with the demand of transport capacity at the same time. In the July of 2008s, the Baltic Dry Index (BDI) reaches the top of the history ever, followed by the increasing the freight and the charter hire. To meet the potential demand, many shipping companies put new building vessels on the agenda which need a huge investment. It is a fact that most companies have no ability to input enough into manufacturing market since its capital intensive characteristic. Considering the economy principle, shipping companies have to borrow money from the financial institution. While in the next half year, the BDI fall down to the bottom at 764.(12-12-2008) the shipping market also has been attacked by the fluctuation which put all the shipping companies into a despairing condition.

As we all know that the traditional finance product follow the Operating Cycle principle, it says, when it is in the high market, the ship financing is relatively easy operated, while in a low market, the shipping companies won't be served by the financial institution. So the traditional won't solve the shipping enterprise's financing problems under the global financial crisis, and innovative financing products, the shipping private equity, following the Operating Conversion Period principle which raise the social capital and financial capital to purchase the ship in the low market, conversely, it will exit investment once meet the high point in order to get the high profit.

European Banks have been the main global shipping companies' mortgagee, while recently the European Sovereign Debt Crisis urges the financial institution to tighten the line of credit. Other industry fund, FSL and KG, sinking into the risk of business distress, the capital market is closed now, and it seems that the diversification of the capital is the future of the shipping finance. Current European traditional bank loan markets showed weak trend, global shipping company must raise money from private equity and corporate-bond market to expand their new business and stay afloat. It is available of the Chinese shipping industry to solve the financing problems in the low market.

1.2 Recent Research

To solve the financial problem in the low market, scholars have done a large amount of research in models and real cases. As an important role in finance product, private equity help the enterprise overcome adversity, while in China, there are barriers of issuing it to the investors. So value whether the private equity can be applied to the shipping market, we shall take the overseas cases and similar industries in China into our consideration.

Firstly, many Chinese and abroad scholars have done enough research in the shipping market and the shipping finance market. To help the readers have the further understanding on shipping finance, Anonymous, issue the annual report about shipping finance from 2008 to 2012. Wang Donghua¹ made the research on the relationships among the freight rate, shipping market. Guo Xiaohe and Qu Linchi² insisted that there are mainly two ways, government loans and commercial bank loans, of leasing in China, also made introduction in their thesis.

1 Wang Donghua, Ocean shipping deregulation restructures the liner shipping industry [J] Maritime Policy & Management.2014, 1:97-111.

2 GUO X, QU L. Analysis of Present Situation of Financing in China's Shipbuilding [J]. Journal of Jiangsu University of Science and Technology (Social Science Edition), 2008, 3: 10-13.

Secondly, in the research on the credit risk model, many foreign scholars offer the conduction and application. KMV is a model which KMV company³ using Merton option pricing theory to develop a prediction model of default, and it is calculated through the company's stock price fluctuations loan EDF. The EDF can be used to calculate default losses LGD. The research of Song Zhu⁴, which was based on normal distribution assumption, studying the M&A type of private equity fund portfolio risk and the calculation method of regulatory capital. And Grenadier, Steven R⁵. made the further discussion based on the discriminant analysis method and expected default rates in credit risk, also in the same area, Huang Weiwei⁶ did research on the application of KMV in the listed companies.

1.3 Existing problems

However, problem and weakness still exist.

Application of credit risk model is too simple to finish the overall analysis. In many reports, the Value at Risk is more widely used than the KMV.

Lin Yuan⁷ researched in application of the pension fund investment risk control based on VaR. Fan Yun⁸ made the further exploration in credit debt behavior. It is a fact that asset in shipping market concentrate in these big shipping companies, so simple VaR can't satisfy the need of shipping finance, to the listed companies, if they eager to issue the private equity, the EDF is more suitable.

3 Dwyer.D, Woo, Analyzing The Subprime Market Fallout Using EDF Credit Measures. Moodys' KMV Corporation. 2007

4 Song Zhu. Credit Rating in China's Bond Market: Evidence from Short-Term Financing Bonds [J]. Modern Economy, 2013, 04:157-181.

5 Grenadier, Steven R. Leasing and credit risk [J]. Journal of Financial Economics, 1996, (42):312-333.

6 Huang Weiwei, Research on credit risk of the listed company based on KMV, Shanghai University of Finance and Economics master degree research paper, China Academic Journal Electronic Publishing House. 2012

7 Lin Yuan, Application of VaR in pension fund investment risk control,[D] Southwestern University of Finance and Economics master degree research paper, China Academic Journal Electronic Publishing House. 2003.

8 Fan Yun. Research on the risk management of private real estate equity investment funds, Southwestern University of Finance and Economics doctor degree research paper, China Academic Journal Electronic Publishing House. 2011

Some research dissertations on resource allocation are too theoretical to omit the practical meaning after application into real case.

Most scholars only do the exploration of the credit risk model itself, especially the doctor degree research thesis, how to set up the models, how many variables shall be selected to take into consideration, and how to make further exploration in the same area. These dissertations lack application in real cases, without the data, we can't check the final impacts in specific number. After the models being introduced into real cases, the effect in social and economic sphere can gain more expansion.

Articles of decision making on resource allocation at shipping market is not enough, economists prefer to make the exploration in other areas.

As we all know, in a long time, there are fluctuations in the shipping market, but these changes can't be the important factors to the whole market. In 2008, the shipping market met the top and bottom in a half year, it induced in many years, shipping market couldn't cover quickly. Firstly in China, the government loans and commercial bank loans occupy the most shares in the shipping finance market, scholars haven't done research about private equity in recent years. Secondly, there are some policy barriers which make the economists stop the research in private equity.

1.4 Research Purpose and Methodology

1.4.1 Research Purpose

The main purpose of the dissertation is to value whether the listed shipping companies have the potential possibility to put the private equity on sale. In general, we often use the financial risk measurement model to measure the potential risk in private fund, and the risk will affect the investors' behavior in financial market. To finish the assessment, we shall firstly analyze all the share prices of all the shipping companies in the recent years. Secondly, we will use the financial model to calculate

the credit risk of all the listed shipping companies with a series of variables. Thirdly, we shall take the existing value of credit risks in the similar companies as standard to compare with that in the shipping companies. Finally, according to the result we have, we will give some suggestions in dealing with the private equity releasing in shipping finance market.

1.4.2 Research Methodology

The financial and data models will be applied to the dissertation. The financial models are used to calculate the potential credit risk in the share market which is in public market, and the share prices in recent years will affect the assessment of credit risk. To deal with so complicated data, we often use data model to do the data fitting which will help us realize the relationship in the stock volatility. Because of the large amount of data, simple calculation won't satisfy the thesis, some tools, Matlab, will be used in the data handling. Qualitative and quantitative analysis will be applied to the comparison so that in the final chapter, we can do some conclusion in the possibility of private equity of the listed shipping companies.

Chapter 2 Current Condition in Shipping Finance

2.1 Analysis of the Shipping Market

The global shipping market is at the bottom in the history, from low to break through to the crucial breakthrough, seeking and recovery of heavy. Now the financial crisis has not yet been completely faded, the global economy and industrial structure have been in a period of economic adjustment, major developed economies face with the debt crisis, at the same time government, debt risks rise, unemployment remains keep a high proportion, especially the economy in the western is hard to run out from the recession. The emerging Asia, China, India and Brazil, faces a deteriorating external export environment, economic growth falls down from the peak. With manufacturing entity regression, foreign capital retracement and the multinational companies procure nearby, demand of marine transportation keeps slow development, all the global market's recover is hard to foresee in the next economy period.

1) Dry Bulk Market

In 2013, the global shipping industry starts at the low point, the trend of international dry bulk transportation looks like a curve which started deeply and ended highly. At the beginning of 2013, affected by emerging economies growth falling down, all the global demand of commodities met a recession, and the strategy, 'low inventories', in iron enterprises affected the trend of continuous growth in demand of iron ore, the transportation volume of steel and iron cannot maintain expected level. While in the second quarter, because of the summer heat surge in electricity consumption, coal and other energy lead to the peak in demand of dry bulk market. In the second half year, the growth rate is relatively higher. Since the second half, the Australian mining giant deal the big contract and the advantage in price of Port Hedland induces the dry bulk market price going up which was the highest in the

recent 3 years. And China's coastal dry bulk market is also in the same curve with the obvious seasonal characteristics and amplitude.

When hovering at the deep point, the Baltic Dry Index forge two fluctuations which started deeply and ended highly. In June, the BDI reached 1000 and in the end of month it closed at 1179. After a series of wave, the BDI went up from 1139 to 2113 in one month, the amount of increase is nearly 1000, even though there is a fluctuation in September, it still was over the 2000 and the average increase kept over 54%. As we all know that the fourth quarter is a traditional busy season in the dry bulk market, and the BDI also increase steadily till the 2013 ends. Especially in 12th September, it arrived at 2337 which has been the highest point since 2010.

2) Container Transport Market

Since financial crisis year, container transport has been regarded as the hardest hit area in the three main shipping market. According to the China Container Freight Index, the first 12 months of the year of comprehensive index has been hovering between 1026 points to 1143 points. On the whole, because the international trade recovers step by step, the demand of container is larger than that in 2012, while since the ship delivery period is coming, capacity growth is over than the volume growth, and the gap between them is more serious with the time goes by. It is obvious that the container transport market will have to stay in a recovery period for a long time to come.

To survive in this low market, many liner companies continue slowing down the vessel speed and shipping capacity, and improve the space utilization. Till 2nd December, there are 211 idle container ships with the capacity of 67,2000TEU, which occupies 3.9% of all the current container capacity. In the second half year, with the overall gradual increase in demand of the main line, for example, Asia-Europe, Asia-America, most liner companies seize the opportunity to cover the loss, on one hand, they keep the high utilization, and on the other hand, the ship owner put up the price of the main lines successfully. But when the Ultra Large Container Ships are put into

the market, the vessel with container capacity which is less than 10,000TEU has been replaced to the secondary route, then the gap between the demand and the supply will expand to more routes. Because Europe-Mediterranean, North America, the Persian Gulf route and other ocean routes are in the abyss, the price goes down continually. In the end of 2013, the overall container transport market has no power capable of saving a desperate situation with demand squeezing.

3) Tanker Market

As a kind of important strategic resources, oil and oil tankers transport has always been the focus of international economic, political, and military competition. In 2013, international oil prices continue rising which following the trend of 2012, it maintain a high level at the beginning, while in the 2nd season, accompanied with the decrease in the demand growth forecasted by the international institution, the crude oil price falls down. Even though China and India keep large demand of imported crude oil, the tanker market still hovers at the low point with consideration of excess tanker capacity and poor performance in American imported oil market. So as we all know that the product oil transportation market airlines freight also keep fluctuating between falling and rebounding modestly.

2.2 Shipping Finance and Shipping Financing

2.2.1 Overview in Shipping Finance Market

Shipping finance usually refers to the serious of service happens in shipping companies which contains the process of financing, custody, currency exchange, settlement, accommodation and other economic activities. Shipping finance has been considered as an important part of international financial markets, and also have a major impact on the development of shipping market.

As a traditional industry which is influenced heavily by the policy and economy situation, shipping industry have the characteristic of huge investment, high risk and long-recovery cycle, it is obvious that normal company cannot offer so giant capital support, it ought to be under the financial operation which keep the shipping market runs efficiently. In general, the shipping finance is divided into following four parts, shipping financing, shipping insurance, fund settlement and shipping price derivatives.

Shipping financing is a kind of economy service which is used in new shipping building and the construction of fleet. Shipping insurance, refers to protect all the cargo on carriage and the shipowners' vessels from any incurred loss. Fund settlement, refers to financial institutions in the international and domestic market for shipping companies to provide the corresponding funds operations. Shipping price derivatives is a kind of price tools, which is closely related to shipper and shipping company itself in order to avoid market volatility and loss. In brief, the emergence of shipping finance is determined by the characteristics of shipping industry itself.

After hundreds of years of rapid development, four major factors of shipping finance business sector has been basically formed. In many developed shipping countries, there have been derived several professional institutions and companies which specialize in shipping financial related businesses and services. Shipping finance operators mainly includes shipping companies, ports, shipyards, banks, insurance companies, securities companies, commodities and derivatives business sellers, financial leasing companies and other financial services institutions. The development of shipping finance cannot survive without the construction of shipping center and financial center. From a global perspective, the famous international shipping financial centers, such as Hong Kong, Singapore, London, Tokyo, New York, is also the important shipping center and financial center in this region or country. At the same time, the local development of shipping finance induce the flourishing of the finance industry in the same region, government statistic shows that there are hundreds of billions of dollars of shipping financial transactions happening in one

year, including loans of \$300 billion, roughly \$70 billion about shipping leasing trade, about \$15 billion in equity and bond financing, \$150 billion in shipping freight derivatives product, \$25 billion of shipping insurance. While more than 80% of the deals are monopolized by the related shipping financial service institution in London, Hamburger and New York. With the movement of shipping industry transferring to the emerging markets, Singapore, Tokyo, Hong Kong and Shanghai will highlight all the more important global position.

Shanghai take the dual role of China's economic center and shipping center, which will achieve innovation and development in the competition with other international shipping finance centers. Along with economic globalization, financial globalization and international industrial upgrading and structural adjustment, our country's shipping industry will enter a more open and competitive international shipping financial markets, it also offers a huge space for development of shipping industry in our country, however on the whole, there are a lot of the disparity between development of shipping finance in our country and internationally recognized shipping finance center, especially no stronger competitiveness in the field of shipping finance related policy and the law in mainland China (Shanghai), relatively backward in professional shipping financial services development which does not rich in enough relevantly shipping financial services products. And mainland lacks the talent in shipping finance which is left behind by other international shipping financial center. In general, there are merely little amount of shipping companies, port companies and shipyard taking action in the capital transaction market, the rest still stay in more traditional financing deal phase, overall Chinese shipping industry do not optimize resource allocation function effectively in the capital market.

In the next several years, to construct the basic international shipping financial center, Chinese government will give shipping financial related enterprises and institutions enough policy support, and develop the shipping financial services and a variety of financing approach, it will create the opportunity for the flourishing of China's shipping finance. Recently, the constitution of Shanghai Free Trade Zone and

establishment of Shanghai-Ningbo-Zhoushan International Shipping Center circle will offer the best practicing opportunity for the Chinese shipping finance testing. However, it is well-known that shipping financing is the key step of all the development in shipping industry. Only by given enough investment, our shipping market will have a new beginning in the next economy cycle.

2.2.2 Shipping Financing Market

Ship finance is the important influencing factors to promote the evolution of shipping industry and ship manufacturing, being the most important factor in shipping finance, it will determine the basic direction of ‘two centers’ in Shanghai, and proper financing mode also determine the financing effect and affect the development of the enterprise. After hundreds years of exploration, shipping financing is divided into following four important ways,

1) Bank Loan

The trend of economic globalization leads to the flourishing of international trade, and the growth of the trade force the demand of large scale, unitization and the high speed. Shipowner will input a large amount of money to improve the performance of the ship, and the biggest stakeholder, bank will offer enough money for the shipowner to purchase a new ship, also the bank loan is regarded as the main ways to do the shipping financing, it occupies 60%-80% of total financing market. Then shipowner will repay the principal and interest with the help of daily operating income, considering the huge need in large ship manufacturing and long-time repayment period, shipping loan usually is conducted by a series of banks group. Syndicated loans is a traditional financing way which come from bilateral loans, it is led by a bank or several Banks, participated by several banks, drafted by all the member banks, then issue the loans to the shipowner with the common loan contract in a same interest rate, at the same time, they will share the loan risk by the loan proportion. In 2013, Shanghai Import and Export Bank take full use of a policy-oriented financial

reverse economic cycle regulation function, issued loans amounted to 10.05 billion RMB in shipbuilding industry only, the total amount takes as much as 2.7 times with the last year.

In the past twenty years, the shipping industry has faced with the most serious crisis . Most Banks reduced the loan amount of shipping industry, and in the case of bank credit policy tighten, ship financing have to be separated in two extreme situation, the big owner and the traditional owner fully enjoy the benefits came from the current liquidity, nevertheless the ordinary owners have no ways to search for the potential ship financing ways. Currently because of the poor economy situation and the negative market forecast, a large amount of default happens, owners cannot repay the principle and interest to the lending banks, which also is treated as the main cause of the attitude the bank industry hold in shipping financing. In China, the current credit situation has attracted the attention of the China Banking Regulatory Commission (CBRC), the CBRC divide the loan of shipping industry into the loan limit class list, and also most banks have adjusted the credit line of shipping companies.

2) Shipping Fund

The restrict in shipping loans makes the small and medium-sized owners transfer their attention from the traditional bank loan to the fund operations. Before 2008, there exist several relatively mature shipping industry fund in some regions or countries whose shipping finance market is in the developed phase. Compared with the traditional shipping financing which the owners add the rest of the bank loan, the basic operation of all the shipping fund is that company investors usually put a small amount of their own money, then attract a certain number of investors to put a large amount money in the their plan by public or private ways in the capital market, at last they will establish a kind of shipping industry fund to purchase the new ship, and the operating income will issue bonus to the investors after paying the operating cost, principle and interest. In these shipping industry fund, the investors have no eager to

manage the fund, they only wish to gain the bonus in the end of each year by the rational financial operation, in fact, the owner is the real manager in this contract who want to gain more operating profit by rational economical operation. It seems that the shipping fund can be seen as the an important intermediate link among all the shipping financing chain which provide related policy and law security for the capital management, operation and investment. From a global perspective, Germany KG Fund, Singapore Maritime Trust Fund and Islamic fund is considered to be a kind of mature shipping industry fund which operate efficiently and managed rationally.

But from some recent analysis in the industry development reports, it shows that the trend of fund closures is more and more serious in the Germany KG Fund. According to the report of the Deutsche Fund Research Institutions, in 2012, there are no less than 150 KG fund announcing they have broken up in the sake of the income cannot meet the operating cost and financial cost, and only in the first half of the 2013, this number may be bigger than 200. It is a more terrible fact that this kind of bankrupt has been transferred from the single ship funds area to the multi-ship one. It is reported in Lloyd's Daily that EEH has been the first one of the KG funds which is established since 2009, and this fund company is also the third multi-ship one following the collapse of the Appen Capital and Embdena Fund in 2013. Located in Hamburg, in April, HCI Capital company announced that from 2009, there are about 41 of all its 271 KG ships cannot cover the loss, and in 2013, the number has reached about 10, this situation is extremely serious. Chinese shipping industry funds occurred at the low point of shipping market, overall shipping industry hope this financial tool will make vigorous efforts to turn the situation, but the aim of the shipping fund is not only simply solve the shipping financing problems but also make profit in the market. Even though the risk in the poor market is low, in the meantime the ability to attract the public and private investment comparatively is reduced, indeed the effect cannot match the one which Chinese shipping industry hoped.

3) ship financing leasing

Ship financing leasing refers to the leasing company purchase the vessel from the shipyard directly with the order of the shipowners who have the specific demand in the performance of vessel and the option of shipyard. After contracting with the appointed shipyard, the ship leasing company will lease it to the owner, and the real right to use belongs to the owner who will pay the installment of rent in a long period. During this ship leasing term, the ship ownership is occupied by the ship leasing company, when the leasing term ends, the ownership will be taken over to the owner after they pay all the principle, interest and finish all the duties in their ship financing leasing contract. The common leasing modes include direct financial leasing and Leaseback Leasing. Now the modern financing leasing in shipping companies have not just been limited in shipbuilding itself, it has been expanded to the wharf construction, port facilities and other more fields.

At present, shipping finance lease become the second way following the bank loan financing. The statistics shows that in 2009, among all the domestic shipping financing channels, the four major shipping financing bank commit about \$25 billion, shipping companies issued about \$2.8 billion bonds, and ship leasing commitment amounts to \$4 billion. After 2012, the KG funds management face the edge of bankruptcy, the ship financing leasing keeps a relatively strong momentum entering the field of shipping financing. With the consideration of the low price in the new-building market and second-hand market presently, the ship price nearly equals to the real value of the ship itself, which virtually reduced the risks in shipping financing leasing. The leasing companies shall make full use of their own professional ability and the advantage in capital to maintain mass production in the weak market, and keep the new building ship orders, smooth industry cyclical fluctuations, support national shipbuilding and shipping industries in various ways, stimulate the development of the shipping industry, then lease these vessels to the urgent need companies in a proper rent return. All these actions will forge the multilateral cooperation and win-win situation. In domestic leasing company, the China Minsheng Leasing and the ICBC Leasing occupies over 50% in the field of the ship financing

leasing. By the end of 2011, the number of ships belongs to the ICBC Leasing is about 160 with 3 million tons, and the number in Minsheng Leasing is 130 with 4.8million tons. It is a fact that the two leasing companies take the relatively lead role in the diversification of service models.

Compared with the foreign mature leasing companies, Chinese ones do not have the weakness in ordering ships since the shipbuilding center is located in China, nevertheless, from the perspective of the capital origins, overseas dollar financing costs is far lower than the domestic RMB financing costs, and there are many barriers for the domestic companies to encircle money. At present, the domestic financing leasing companies cannot be allowed to set up SPV (special purpose Vehicle) companies outside. It means that by setting up SPV to reasonably avoid the relatively high tax and foreign exchange control which are normal way to the international is still illegal in China. As we all know that in most developed shipping countries, it is legal to set up SPV overseas, which will be an important factor affecting the development and competence of ship financing leasing in our country.

4) Stock and Bond financing

Usually public offering stock market is one of important ways in listed shipping company direct financing. During the period of Financial Crisis and the global shipping industry downturn in 2008, the credit crunch of traditional bank loan has made many owners decide to launch financing in the stock market and bond market. While it is the same that only will the big shipping companies or the listed shipping companies do the enough shipping financing to invest in the basic construction of shipping industry. From the shipping block's perspective as on a whole, the performance of most stock runs smoothly, issued prices operate below inquiry range mostly, and in most phase, stock prices are running below the issued price range. At the beginning of 2014, almost three listed shipping companies turn the loss into the benefit, which will stimulate the market enthusiasm.

Now in bond market, the big shipping company or crack issuing bonds to do financing is treated as the main role which instead of the traditional bank credit loan. And the most serious problems to the port and shipping enterprises is adding the financial liquidity in the short and medium term, while the financing leasing and trust fund aims to run the program itself, the capital is used in amplifying the transportation capacity by buying new vessels, and it lacks of offering enough aid for solving the problem about the liquidity within the enterprise. On the contrary, the advantages of bond financing not only has the low financing cost, but also can be applied to supplement the enterprise's liquidity capital, especially benefit the port and shipping enterprises. With the help of government policy and the prosperity in the bond market, a large amount of high-class port, shipping enterprises and shipbuilding enterprises issue their own corporate bonds. In 2012, there has been 27 port shipping enterprises and shipbuilding enterprises issuing five kinds of shipping bonds for financing with the total amount of 104.22 billion RMB, the cardinal number is much larger than the same phase in past years, at the same time the domestic enterprise have tried to issue the bond overseas, for example, the Far East Horizon, Rongsheng Heavy Industry, the COSCO and other listed companies. Except the public bond market, in June of 2013, the new starting about the private bonds in medium-sized and small enterprises offer an effective and ideal financing way for the small shipping companies without the ability to issue bonds in public, and in private bond market, it is clear that the main issuers are centralized in the big or listed port and shipping enterprises. For instance, in 12th November of 2013, the Sinotrans have issued a three-year fixed rate bonds with the total amount of 2 billion RMB, which contains 10% sold to the public investors issued online and the rest was sold to the institutional investors offline in the private market.

So only by direct financing tools, for example, stock and bond, will the China shipping market survive.

Chapter 3 Shipping Bond and Its Risk

3.1 Shipping Bond

Bond is a kind of financial contract offers which is used in raising funds directly from the society and the public issued by the government, financial institutions, industrial and commercial enterprises, it is on the sale of all the potential investors. Before offering the contracts, the issuers have stipulated the contract interest rate and repayment period, and in accordance with the terms of the contract the issuers will pay principal and interest to the investors, generally these bond contract offers can be seen as a kind of creditor's rights debt obligations between two parties. The nature of bonds is the certification of debt or creditor, which is recognized in legislation and actually can be seen as a lending relationship between investors and issuers. In the bond market, Bond issuers is the debtor, investors (buyers) is creditors, its issuing model always can be divided into two ways, private bonds and public bonds.

This dissertation does the example research in shipping bond which is issued publicly by the listed shipping companies, it has the fixed interest rate, the fixed redemption period, and also can be circulated in the public shipping bonds market. When immersed in the weak shipping market, the bond financing becomes the one of the important channels in the direct shipping financing.

3.1.1 Overview of the Foreign Shipping Bond Market

Before 2010, there were barely shipping companies issuing such these financial products with low rate of return on investment. As the world economy and trade environment were much better, the bank loan is the basic financing ways to many enterprises, and the bond financing is merely one of the supplementary forms in the direct financing. However, since the beginning of 2011, a large amount of shipping companies have keened on issuing the shipping bonds for financing, the main reason of changing in the financing model is that all the global economy, the demand and

volume of marine transportation are in the poor situation, and the whole shipping finance market is blocked in a continuous declining tendency, bank loan by which the port and shipping enterprises do the financing is more and more difficult. The two-year down made the companies change their devices from the traditional one to the emerging shipping bonds market, and considering the low issue price and relatively high liquidity of shipping bond in the international market, 'low input, high yield' shipping bonds will be an appropriate choice for more speculators to invest.

1) Purpose of issuing bond

Issuing shipping bond is mainly aimed at raising enough money in covering the short-term debt and enhancing the daily liquidity to ease the present enterprise operating pressure, while to the well-operated shipping enterprises, the purpose of issuing bonds is to invest in new programs. For example, in 2010, the Maersk Group issued 500 million euros bond which not only is used in broadening diversification of financing channels, but also can be put into more project investment, this was different from the traditional purpose improving the enterprises' own cash liquidity.

2) Patterns of issuing bond

Only the Asian market has issued varieties of shipping bonds, contains the medium-term notes, perpetual bonds, multiple currency bonds and other forms, the issuing corporate bonds are recognized as an efficient tool of make benefit. For example, the Neptune Orient Lines posted on issuing corporate bonds to greatly improve the company's cash reserves, from the end of 2011 to the September in 2012, its cash reserves increased from \$227.6 million to \$708.6 million, it is also happened in Marine Development Group listed in Singapore that in 2012 corporate bond yields surged 130% compared with the same period in 2011, and the net profit reached \$28.1 million.

3) Area of issuing market

From the perspective of issue market area, in recent years, the location of shipping bonds issuing company mainly concentrated in Asia and in European market there was only Maersk releasing the shipping bonds in 2010. Most traditional European banks suspend their related business of shipping enterprise loan, which affect the ability in issuing bonds of European shipping enterprises directly. Compared with the European investment bank, the issue situation in Asian shipping industry is relatively optimistic, it is a fact that each enterprise issuing bonds is supported actively by a number of banks or banks groups. For instance, the Neptune Orient Lines Bond is mainly composed by HSBC, the OCBC and the SCB, cooperated by the DBS. And the plan of issuing HMM corporate bond is supported by a large of financial institutions including Daishin Securities, the KDB, the Korea Investments and Securities and the Hyundai Securities.

4) Overview of issuing foreign shipping bond market

In the Asian market, in addition to mainland China, the port and shipping enterprises South Korea, Japan, Taiwan, Singapore and Malaysia and other countries or regions have issued the shipping bond with total amount over than \$22 billion in recent three years, only in 2011, the number has reached \$7.99 billion which is increased by 90% than that in 2010.

(1)South Korea market

In 2011, the STX, the Hanjin Shipping, the HMM and the SK issues bonds of \$1.9 billion together, and in the next year, the HMM and the STX issue the total amount nearly 500 million shipping bonds, especially in the second half year of 2012, the HMM issued a five-year shipping bond about \$285 million, at the same time, the STX issued a total of \$178 million corporate bond which is allowed to be converted into stock in South Korea market.

(2)Japan market

In 2011, the NYK and Mitsui issued bonds of \$1.1 billion, and the NYK took about \$716 million, and in the June of the next year, the NYK issued \$500 million corporate bond including a five-year bond of \$250 million, a six-year bond and a ten-year \$125 million shipping bond.

In the September of 2013, the NYK have successfully raised nearly 40 billion yen (\$400 million) from the bond market. In this shipping bond contract offer, it issued two transactions, each one took 20 billion yen, one is a five-year contract and another is a seven-year bond. Bond maturity dates are set to the September of 2018 and the September of 2020, at the maturity date, all the principle and the rest interest will be repay to the previous investors and the coupon rate is mere 0.572% and 0.939%, both of the two shipping bonds have the evaluation of A+ rating by the Japan credit rating agencies.

(3)Southeast Asian market

In 2011, the Neptune Orient Lines and the Swiber has issued \$357 million bonds, the MISC has issued the amount of \$422 million bond, on the average, each port or shipping enterprise has issued \$400 million in one year, in 2012, it is the third time that the Neptune Orient Lines issues shipping corporate bond which is a total amount of \$245 million in a seven-year contract with the interest rate about 4.4%. This shipping enterprise has issued three times shipping bond in one year, the past two times issue nearly \$1.5 billion of medium-term notes. And in the May of the same year, Singapore Marine development group issued \$500 million worthy of multiple currency bonds by the guarantee of the Singapore Exchange Ltd, in September, it issued \$100 million of perpetual bonds which can be achieved indefinitely interest on schedule without the limitation of maturity date, while the group had the right to repurchase all these shipping bonds in the third year.

In the November of 2013, Rickmers Maritime announced that they would launch a plan about the medium-term notes currency with the total cost of 300 million Singapore Yuan, the DBS and the HSBC joined the thesis plan to be joint coordination and dealers, the Qatar Islamic bank SAQ set up the \$300 million four-year shipping bonds in Malaysia, including 30% came from the private equity, and 70% is invested by the Islamic bank, all the money is used in acquisition of ships.

(4)European market

In recent years, the European crack shipowner restricted by the European Banks policy barely issue corporate shipping bonds in the international bond market, only has Maersk issued the corporate bond with amount of \$1.953 billion and \$1.433 billion in Luxembourg stock exchange in 2010 and 2012 respectively.

3.1.2 Domestic Shipping Bond Market

The COSCO and the China Shipping, the most two important shipping companies, which has always relied on bank loans to maintain operation of shipping business and new business investment, while in the consideration of the poor market resulting in a loss of income and the increase of maintenance cost, their last three year's operation suffers the long-time loss. In the sake of potential operating risk, a large number of commercial Banks stop credit loan and relative business of shipping companies, at the same time, induced by the current Asia shipping financing trend, powerful crack owner turned to the bond market to search for more innovative and more free financing channels in the domestic and international market, the listed companies issue bonds to raise financing in the public, medium-sized and small shipping companies do the preparation of solving the current liquidity problem by the high yield of private equity funds.

1) 2014

China Shipping (Group) Corporation issued a five-year \$500 million long-term bond which is the direct financing breakthrough in the overseas dollar debt markets,

the bond issued is widely accepted and recognized by the international investors, the number subscribed is as 4.5 times much as the number issued in planning, and the number of investors amounted to 195. The international rating agency, Moody's, class this kind of shipping bond into the credit rating 'A1' whose depth and breadth of the distribution in the investors are much better than the similar shipping corporate bonds. Issuing dollar bonds further broaden the channels of financing in the international capital market, at the same time, this transaction reduces the cost of financing and avoid the potential interest rate risk. It is a fact that the dollar shipping corporate bond will offer a powerful financial guarantee against shipping market volatility in the shipping economy cycle.

2) 2013

In March, China Shipping (Group) Corporation sold \$161 million in the short-term financing bonds, and issued the worthy of 2 billion RMB short-term bonds with bond period of 180 days, all the financing will be put into the project in optimizing financial structure. In the accordance with assessment by the China Lianhe Credit Rating Company, the current credit rating of the China Shipping Group is AAA, the underwriter of this shipping bond is the China Merchants Bank and the China Construction Bank. In November, the Sinotrans won regulatory approval in installments under total 4 billion RMB corporate bonds by the China Securities Regulatory Commission, and its first issue three-year fixed rate bonds about 2 billion RMB in the same month is divided into two ways, 10% of the all is sold to the public investors issued online and the remaining 20% is sold to institutional investors offline, according to the rating by professional rating agency, the credit rating of the main body of company is AAA. In December, the wholly owned subsidiary of the Zhoushan Marine co. LTD made confirmation that they would make the preparation in the issuance of private bonds with the record amount of almost 30 million RMB, this private bond was on the consignment sale of the Uni-Power Group co. LTD.

3) 2012

In July, due to the recession in the first half year of the global shipping industry , actively coping with the international economy and shipping market fluctuations and strengthening the guarantee of capital funds, the listed China Shipping Development Company hold by the China Shipping applied to the CSRC for 5 billion Yuan bond issuance, the first phase of 2.5 billion RMB (including respective three-year 1 billion bond and ten-year 1.5 billion bond), the second phase of the 2.5 billion RMB (including respective seven-year 1.5 billion bond and ten-year 1 billion bond). In November, the COSCO successfully issued \$1 billion of 10-year bonds whose issuance will be used to cover the cost of the company's overseas subsidiaries and associated companies, this issued shipping bonds also optimized the debt structure of the COSCO, the credit rating of these bonds is A1 rated by the Moody's which won the favor in the capital market, the total subscribe amount is 11 billion dollar which takes as 11 times much as the issued amount. As the sole global coordinator, the bank of China international also launch this important corporate shipping bond with the HSBC regarded as joint book-runners and co-lead agent.

4) 2011

In February, China Shipping development Company issued the six-year convertible equity bond up to 3.95 billion RMB, only in the Chinese market for sale of the bond which aimed to provide enough financing in the shipbuilding. In order to further improve the company debt structure and broaden the financing channels, in March, the Shanghai Port Group announced that the group will issue the aging corporate shipping bond with the total amount under 8 billion RMB in the period no more than 6 years, and in the end of March, would issue the first phase of the size with no more than \$5 billion bonds, the issuance of bonds to raise funds will be used in covering the debts of the company, optimizing the structure of corporate debt and supplementing the liquidity, after issuing completely, the long-term debt financing ratio increased and the debt structure will be partly improved at the same time. In June, the

Guangdong Shipping Group issued 600 million RMB three-year medium-term notes whose lead underwriters are both of the Bank of Communication and the National Commercial Bank. In August, China Shipping (Group) Corporation issued 4 billion RMB seven-year medium-term notes whose lead underwriters is the Bank of China, without any guarantee, in accordance with the assessment of the Uni-Power Group co. LTD, the credit rating of this shipping medium-term notes is AAA and the main body of the company itself is also the same level. In this issue bonds, raising funds is mainly used to meet the long-term working capital requirement of subsidiary of the China Shipping Development and the China Shipping Industry.

So considering all the events above show that China port shipping enterprises following the Asian bond market have developed their bond financing to support their business in the low market, and the development of the shipping bonds is still in the bud.

3.2 Credit Risk in Shipping Bond

3.2.1 Definition of Risks

There existing different kinds of views in the definition of credit risk, the traditional view is that the bond credit risk is the default risk which is due to the securities issuers cannot repay debts on time and it will bring the potential loss to the investors. Credit risk in the traditional views only contains the probability of the loss in default events which is consistent with the narrow sense of the credit risk.

Along with the development of the financial derivatives market and the risk management technology, modern risk environment has changed, the traditional definition cannot fully reflect the nature of the modern risk. Some incidents always happen which will affect the credit rating of issuers, for instance, the debtor's credit rating falls and the decline in profitability, all these issues will bring the risk to the investors. So the bond credit risk in the modern views not only contains the default risk, but also including the loss probability induced by the changes in the market

value of the debt which is led to the changes in the credit rating and compliance capabilities of issuers and their the counterparty. In this sense, the default is a kind of extreme possibility, and the assessment of credit risk mainly depends on the financial status and risk status of the counterparty's.

Based on the definition of credit risk in the modern view, this dissertation argues that credit risk of the issuing corporate bond in the shipping listed companies mainly divided into two types, one is default happening which the issuers cannot repay the principle and interest on schedule, another is the risk whose credit rating of the listed shipping companies decline resulting in credit spreads arising and beating the bond prices down.

3.2.2 Classification of Credit Risk

From the perspective of the financial industry, the bond risk mainly is divided into flow risk, market risk, moral risk and credit risk, etc. Liquidity risk refers to the risk of which investors are forced to hold the bond maturity risk in the sake of inconvenience in bonds transfer dealing. Market risk is the risk which is led to the market interest rate, stock price, exchange rate risk and other risks caused by changes in macroeconomic factors such as uncertainty, all of these is the main causes in affecting the actual yield of the corporate bonds. Moral hazard is result from individual opportunism, and it is the action to promote one's own utilities to the maximum at the cost of others' benefits, the issuers may conceal some key point of the transaction which will make risk against the actions of the others. Credit risk is a risk that the issuers cannot repay debt on schedule, their credit rating falls result in defaulting or the bond prices decrease.

In these several kinds of risk, the credit risk is the most serious risk of the listed shipping companies in bond issuance, so this dissertation focuses on the value and research of the credit risk in shipping company corporate bonds.

3.3 Formation Mechanism in the Bond Credit Risk of Shipping Listed Companies

3.3.1 Information Asymmetry Theory

In the 1970, George Akerlof, Joseph Stiglitz and Michael Spence jointly proposed the Asymmetric Information Theory, they found that in the market, transaction information is asymmetric between the two contrary sides. Depending on the amount of information held by both parties, the situation of the information is divided into information symmetry and information asymmetry, there also two meanings in the information asymmetry, one is, there are obvious prevailing party and the underdog in the transaction in the sake of the imbalance between the two parties, four example, in the bond transaction, the issuers know more about their own financial position and solvency. Another is, both parties fully understand their own information position, even though the underdog doesn't have enough sufficient information, they will foresee the market risk and revenue of the shipping bond according to the distribution of the relevant information, for example, the investors will decide whether hold the shipping bond or not by the probability of repayment in bond issuance which can be assessed with the credit rating of the listed port and shipping companies.

The credit risk in the listed shipping countries mainly came from the two ways, one is that even though the Chinese listed companies have reported the annual and semi-annual financial statement about the state of business in one year, the financial reports still have certain composition of false information due to reasons, such as audit, policies, laws and regulations and this hiding information of the listed shipping companies has increased the difficulty in realizing the subject issuers. Another is that the industry losses will have influence on the bond market with the credit ability of enterprise issuance continue weakening and the three state-owned enterprises in shipping industry are on the suspended or lead to delisting and massive stock drops. Facing with the both poor markets in the shipping and financing industry, a large amount of shipping companies have to thickening their profit by the sale of assets or

restructuring methods. In China, the shipping bond issuers in the public bond market are always state-owned enterprises which have the relatively high credit rating and the partly secured credit promotion, the industry loss has the limited effect on the bond market. While the gap between the supply and demand is still obvious, the recovery phase of shipping industry is far from coming, continuous loss result in the financial pressures' rising, and the high quality assets have been sold also reduce strong cashability of enterprises themselves, the enterprises' own real debt paying ability is weaken accompany with the falling of the credit rating of enterprise bond issuers partly. Nevertheless all these changes in credit rating cannot be reflected at the period of subscription, all of these factors enlarge the information asymmetry between both parties.

3.3.2 Break Windows Law

Wilson and Kelling firstly put forward the "broken Windows" theory, if someone breaks a window without timely maintenance which can be seen as a declared effect to others, more and more people will be suggested to break more windows, and finally it will lead to the emergence of the disorder situation.

"Broken Windows" theory can be used to analyze the future development of the shipping bond market in our country, the listed companies has issued the shipping bond is the enterprise owned by the central and local government, if an enterprise breaks the contract without corresponding punishment and the loss is covered by the government, there will be more shipping bond issuers suggested to refuse to pay maturity debt by the 'free-rider' thought, and with the consideration of the weakness in shipping industry, in future, the credit risk of the shipping bond market will be sharply increased, and fewer and fewer investors invest the bond market of other industries rather than holding the shipping bond, it will be obstacles to the development of our shipping bond market.

To study shipping bond credit risk, we shall understand the game occurred between the government and the enterprises, on one hand, the government realized the high risk and possible default outcomes of shipping bonds, in order to achieve economic growth and offer enough economic support for enterprise operation as much as possible, the government will take a tolerance on the default problem of shipping companies with assuming liability to gain the effect about economic growth and social stability, and put off the time dealing with the default, in fact it has nothing to do with the credit risk solution. On the other hand, when game playing with the government, in response to the policy, some issuers who do not have the ability to issue the shipping bonds will undertake the risk of default to gain the policy support from the government, and at the same time, they know the repayment items in the contract are non-binding. Once the repayment problems happen, will they pass all these to the central and local governments who ultimately pay the bills in reality.

In order to closely monitor the credit risk in the shipping bond market, the government shall change the game mode, actively deal with the effect of ‘broken window’, and severely punish enterprises getting out of the line. All the actions above will reduce shipping bond market credit risk, further expand the size of the market, decrease the financing cost of the enterprise which has the real financing need, so as to realize the balance between the economic growth and the good social credit.

All the cause above will help us to find out the appropriate ways to avoid the potential credit risk in china shipping bond market.

Chapter 4 Sketch of Credit Risk Measurement Models

4.1 Development of Credit Risk Measurement

The development of the credit risk measurement model probably experienced three following stages,

Before the 70s in last century, most of the financial institutions evaluated the loan enterprises through the Specialist System, judge and analyze whether the risk can be accepted relying on the organization of expert experience and the historical data analysis. As to the financial statement and state of business, the policy effect, the economic situation and other factors, the financial situation will decide whether lend to the company or not. In this period, the representatives of the credit risk research methods mainly include, the 5c, the 5w or the 5p, the LAPP, the Five Categories Classification System, etc.

During the period from 70s to 80s, most financial institutions insisted that the previous Specialist System was so subjective and one-sided that it may affect the judgment in default probability of loan enterprises. At the same time, the Credit Scoring Model based on financial index have emerged in the sights of financial institutions. In this period, the representatives of the credit risk research methods mainly include, the Linear Probability Model, the Logit Model, the Probit Model, the Altman Model, the ZETA Model, etc.

Since the 1990s, some famous commercial Banks and financial institutions have introduced the credit risk measurement model combing the modern financial theory with mathematical tools. This kind of credit risk measurement model basically takes the default probability and expected loss as the core index. At the same time, the Basel Committee published the Basel II advocating the IRB, the Basel II established a complete set of international capital-adequacy rules based on weighted model which is used in the evaluation of the risk, both on and off the balance-sheet, effectively curb

the international risk associated with debt crisis. And then the big commercial Banks pay more attention to make quantitative analysis on the loan enterprises, also makes the credit risk under control, still be able to maintain the assets quality in the later financial crisis. In this period, the representatives of the credit risk research methods mainly include, the KMV Model, the CreditMetrics Model, the Credit Portfolio View, the CreditRisk + model and so on.

4.1.1 Traditional Credit Risk Measurement Model

1) Specialist System

The Specialist System is one of the most ancient credit analysis method, which is an effective credit risk analysis and management system formed in the long-term credit activities by the commercial Banks. The Specialist System includes, the 5c, the 5w or the 5p, the LAPP, the Five Categories Classification System, etc. One of the most commonly used is 5c, refers to commercial Banks analyze and grade in accordance with a series of loan enterprise characteristics, the morality and prestige (Charter), the qualification and ability (Capacity), the capital (Capital), the security (Collateral) and the present operation conditions and business cycle (Cycle Conditions), then give the different weights of each factor by the expert's subjective judgment. At last the banks will have a score comprehensively reflecting the borrower's credit quality which is treated as the basis of credit decision. And the LAPP assesses the credit risk based on the Liquidity, the Activity, the Profitability and the Potentialities. the Five Categories Classification System is the method which is used in classification of the existing assets' credit quality, the FCCS judge the asset quality with qualitative and quantitative analysis method centralized in the repayment probability, by this way, assets can be divided into five main kinds, the normal and the focus, the subprime, the suspicious and the loss.

The Specialist System is the core essence of direct credit risk method, now widely accepted and adopted by most countries, but this method is very simple, strongly

influenced by subjective factors with higher demand. It is a fact that the Specialist System is a kind of subjective judgment based on the long experience rather than a method of analysis.

2) Z-Value Model and ZETA model

The basic principle of the Z-Value Model is selecting an overall set of financial ratio indicators which can reflect the borrower's financial condition and servicing ability, classifying the previous loan cases into the defaulting group and the non-defaulting one, designing a Z-Value Model which can distinguish the loan credit with the selected financial ratio index at the most extent to evaluate borrowers' credit risk and credit situation and judge the expected default probability of the loan enterprises.

The ZETA model can better predict the probability of bankruptcy, this model takes the changes of the financial reporting standards and accounting practice into consideration, and also makes a correction in statistical discrimination technology based on five kinds of financial variables. It is obvious that the longer time of the enterprise bankruptcy prediction the more accuracy in the final model prediction.

Both of Z-value model and ZETA model are the multivariate linear resolution model based on financial data, they can be used to measure the credit rating about the default and bankruptcy of the debtors in a certain period and can early warn about the debtor business prospects, and thus both models have strong operability, adaptability and strong ability of prediction.

4.1.2 Modern Credit Risk Measurement Model

The biggest difference between the modern credit risk measurement model and the traditional one is that the former model describes the credit risk extent and probability of incidence in the complex mathematical model, and tries to offer the accurate assessment. At the same time, the modern credit risk measurement models draw the lessons from many classical economic thought and the scientific methods in other

fields, such as the Option Pricing Theory, the Interest Rate Expectations Theory, the Actuarial Method in insurance, the VAR method used to measure the market risk and the Neural Network Theory, etc.

1) CreditMetrics Model

CreditMetrics model do the research in the relation among the bonds, the loan company, the financial institutions based on Merton's Option Pricing Theory, The owner's equity can be regarded as a call option, and the claim may be regarded as the creditors' right to sell an option, default is equivalent to the company owner to exercise the option. Especially, according to the BS model, we can make the quantification and analysis of the portfolio credit risk by connecting credit rating of the loan company with the expected value of risky assets. The Credit Metrics model has become one of the most international typical internal risk management models.

2) KMV model

KMV model is a kind of credit monitor model which can be used in predicting the probability of default in the listed shipping companies, it is a kind of credit risk measurement model developed by famous risk management company, KMV. The KMV model is based on the Black and Scholes option pricing theory, through the Merton following research on the theory of corporate debt, with the aid of the relative data, such as the asset prices, the volatility of the asset, equity prices and the volatility of equity, make the judgment about expected default probability of some enterprises. With the comparison in other credit analysis model which refer financial data to make credit rating, the KMV Company has established a huge amount of credit risk measurement history database, now the Moodys' release the latest default data, regularly update the database at any time which has achieved a perfect prediction effect. In this article, we will emphatically expound the principle and calculation process of KMV model in the following chapters.

4.2 Basic Framework of KMV Model

4.2.1 KMV Model

In 1997, the founder of KMV, Mcquown and Vasicek did the research and improved the BSM model which is combined with the improved Option Pricing Formula for calculating the default distance, this theory is applied to analysis the evaluation of enterprise credit risk. It takes into account the corporate debt levels, stock price and its floating, compared with recent models which only rely on the company's financial data of evaluation, KMV model is more accurate.

The Black - Scholes Option Pricing Theory and the Merton Company Debt Pricing Theory is the theoretical foundation of the KMV mode's building, when a company or enterprise market value dropped below the book value of the debt, it will lose solvency which lead to default. This model is a credit risk measurement method which adopts the perspective of the enterprise stock market price changes to analyze the enterprise condition and the company's assets is viewed as the underlying assets. The structure of the model consists of two theories: one is that the company's owners' equity is a call option, the liability is a put option, another one is that there is a relationship between company's stock value volatility and the company's assets value change. Assuming that the value of the company follows Geometric Brownian Motion which gives the estimate of company's assets value and volatility, then defines the default distance, finally gives the expected default probability. This method considers that when the value of the company dropped to a certain level, the enterprise will broke the contract. With the expected value and the default point of company in the future, we can determine the probability and the level of when to default.

4.2.2 KMV Model Assumptions

Compared with other credit risk models, the KMV model is a dynamic model, do the company's credit risk rating mainly through the financial market data and disclose

information in financial statement. It transfers the share price information into the credit information of listed companies. KMV model is sensitive to the change of the listed company's assets with comparing the industry market information at the same time, which also has stronger ability to predict.

1) Assumptions in common

Due to the KMV is developed on the basis of the BSM model, all models shall build under certain assumptions. So Black, Scholes and Merton have four assumptions in the model:

(1) No friction, no transaction costs, no short-selling restrictions in this financial transactions;

(2) The benchmark interest rate is risk-free, which is under the assumption of continuous compounding, assuming that there are no changes in interest rates before the execution day;

(3) The underlying security trading is continuous and divisible which can be traded in any ratio.

(4) The underlying stock price follows the ITO Process Change Process,

$$ds = \mu dt + \sigma dw$$

And in this motion, S is the price of the underlying securities, the constant, μ and σ mean instantaneous expected return and standard deviation of the underlying securities separately, dw is a standard wiener process.

2) Assumptions in KMV only

Researching in KMV model itself, KMV Company made the following assumptions in establishment:

(1) No consideration in the change of credit rating in the evaluated enterprise or industry, only assess the credit assets risk which has a direct relationship with the enterprise asset value.

(2) The model assumes that the credit rating transition probability is a stable Markov Process, the enterprise market value or the stock price obeys the random Brown Movement;

(3) The capital structure of listed companies consists the following: the owner's equity, the short-term debt, the long-term debt and the convertible bonds which can be converted to the preferred stock. When calculated, all the elements above have their own fixed coefficients.

(4) Assume that the default point is D which is views as the default line, when it reaches the DP line, the company will default. On the contrary, the borrowing firm will not default.

4.2.3 KMV Model Calculation Principle

First of all, through the Black-Scholes Option Pricing Formula, according to the enterprise current assets price, volatility of the asset value, risk-free rate, compound interest under the continuous benchmark interest rate calculation model and the value of the debt. All of these will be deduced from the stock market present price volatility and stock value;

Secondly, according to the company's assets income statement, we can calculate the Default Point ($DEP = \text{enterprise short-term debt which under 1 year} + 1/2 \text{ of long-term debt}$), then calculate the borrowing enterprise Default Distance.

Finally, through the mapping relationship between the distance to Default (DD) and the Expected Default Frequency, calculate actual Default probability of the borrowing enterprise.

Chapter 5 Empirical Research

5.1 Sample Selection

5.1.1 Parameter Selection and Calculation Methods

1) Risk-free interest rate

In this thesis, we collect information of 2011, 2012, 2013, these three years market data can be used in measuring bond default probability and risk compensation, and the arithmetic interest rate in 2011, 2012, 2013 central bank announced interest rate which is in one year is views as the risk-free rate. And risk-free interest rate in 2011 is 3.125%, in 2012 is 3.375%, 3.25% in 2013.

2) Calculation of shipping listed companies' equity value

Only two listed shipping companies which is selected in our thesis have accomplished the reform of non-tradable shares, the rest, the COSCO and Sinotrans Development still has non-tradable shares, so we need to classify the equity value when calculated. On one hand, to the Shanghai Port and China Shipping Group, we use trading day the day's closing price and product to determine the company's total equity value, on the other hand, the COSCO and the Sinotrans Development, we use non-tradable shares and tradable shares together to define the equity value, calculating formula is that the closing price multiply by the product of the total shares outstanding plus the net assets per share multiply by the total amount of product, so the price is the company's equity value we need.

3) Determination of σ_e and u_v , u_e

In the model, the value of stocks and corporate assets are assumed that following geometric Brownian motion, the method to determine the geometric Brownian motion is that recording the stock value data in a longer period of time $[0, t]$. This period of

time consists of a series of equal subinterval time Δt , the number is n . We can know every time the value of the shares in the end, at t_i , the stock value is E_i , and the total number of sample is $n + 1$.

Firstly, do the calculation, $U_i = \ln(E_{i+1}) - \ln(E_i)$

Secondly, do the calculation of average U_i and variance S^2 :

$$U = n^{-1} \sum_{i=1}^n U_i$$

$$S^2 = (n - 1)^{-1} \sum_{i=1}^n (U_i - U)^2$$

Thirdly, solve equation;

$$U = \left(u - \frac{\sigma^2}{2} \right) \Delta t, S^2 = \sigma^2 \Delta t$$

At last, we can have the u_e .

According the steps above, we can have u_v when we know time series of the company's assets value.

4) Determination of the asset value V_a and its volatility σ_a

We can accompany with Black & Schole Option Pricing Formula to deduce the relationship between asset value V_a and stock value V_e . According to the Black & Schole Option Pricing Formula, the relationship is:

$$E_t = V_t N(d_1) - L e^{-rT} N(d_2)$$

$$d_1 = \frac{\ln\left(\frac{V_0}{L}\right) + \left(r + \frac{\sigma_v^2}{2}\right) T}{\sigma_v \sqrt{T}},$$

$$d_2 = d_1 - \sigma_v \sqrt{T}$$

Here also need to establish an equation to work out the company's assets value and the asset volatility. In the assumption of the model, the changes of the company asset value can be expressed by the Geometric Brownian Motion:

$$\frac{dV}{V} = u_v d_t + \sigma_v dW_t$$

W is a standard Brownian Motion Process, so you can deduce the second equation of Merton model:

$$\sigma_E = \frac{N(d_1)V}{E} \sigma_v$$

We can draw the equations as follows, we will use the mathematical software Matlab to solve this set of implicit equation:

$$V_E = V_A \times N\left(\frac{\ln(V_A/D) + (R + 0.5\sigma_{VA}^2 \times T)}{\sigma_a \sqrt{t}}\right) - K \times e^{-n}$$

$$\times N\left(\frac{\ln(V_A/D) + (R - 0.5\sigma_A^2 \times T)}{\sigma_a \sqrt{t}}\right)$$

$$\sigma_e = N\left(\frac{\ln(V_A/D) + (R + 0.5\sigma_{VA}^2 \times T)}{\sigma_a \sqrt{t}}\right) V \times \sigma_a / E$$

Combining the company's equity value and the value of equity volatility, we can work out the company's total assets value and volatility of the company's total asset value.

5) Debt

When we calculate the company's assets value, we need to compute the value of equity and the value of the company's debts at the same time. D means the total debts of the corporation at the end of the company. But considering the differences in redemption period of all these bonds calculation, this time shall reflect comprehensively the company's overall debt repayment time. In this thesis,

considering with special reasons, some individual companies will be adopted the interim report, there will be a detailed explanation in the rear.

6) Default Point

To determine the default boundaries, in a lot of literature thoughts, long-term liabilities have buffer effect on the enterprise bankruptcy, so in the model, boundaries of default is not equal to the debt value, but a certain ratio. The default limit is set to half of the short-term liabilities plus long-term liabilities by KMV Company. In order to better study the application of Merton Model in market evaluation of listed companies in our country, Zhang Ling (2004) compare and study the application of KMV Model in our country, and determine boundaries of default analysis equals to short-term debt plus 0.75 long-term liabilities, which is more is more aligned with the reality in our country. In this thesis, we will refer to the former study, the default limit is set to short-term liabilities plus half of long-term liabilities.

Probability of default in the Merton model is:

$$EDF = P\left(\frac{\ln(V_0/DPT) + (\mu_A - \sigma_A^2/2)T}{\sigma_A\sqrt{T}} \leq \varepsilon\right), \varepsilon \sim N(0,1)$$

5.1.2 Sample Selection

In this thesis, our aim is to value the default probability of bonds which are issued by the listed companies from 2011 to 2013, in the selection of these bonds, we will chose these which are issued by the listed companies, and the sample data of during the period is complete. In this thesis, all the sample data came from big market intelligence software, and the listed company financial statement.

Considering the stock market data is from 2011 to 2013, so we will choose the free-risk interest rate in the same period to calculate the change in a company's assets value, in 2011, the rate is 3.125%, it is 3.375% and 3.25% in 2007 and 2008 separately.

Table 5-1 Free-risk Interest Rate from 2011 to 2013

Year	2011	2012	2013
Free-risk interest rate	3.125%	3.375%	3.25%

Because the design system of bond layered in our country is not perfect, unable to form similar system as the priority repay hierarchy in the European and American countries, so in our study, the research in company debt only is divided into two parts, long-term debt and short-term debt, while not doing the prioritization of repay bank loans and debt financing.

Table 5-2 Overview of China Shipping Development Convertible Bond

Name	The convertible bond of China Shipping Development co., LTD in 2011
Issuing Scale	3 .95billion RMB
Period	6 years
Value date	August 1stin 2011
Issuing way	Public market
Type	Unsecured Bond
Face amount	100 RMB
Bond interest rate	0.5%, 0.7%, 0.9%, 1.3%, 1.6%, 2.0%
Repayment	Simple interest, a fixed annual coupon and mature at par
Secure methods	Unsecured
Purpose	Pay the 19 tankers and dry bulk vessels
Rating organization	Shanghai Brilliance Credit Rating & Investors Service Co. , Ltd.
Credit rating	AAA
Register location	China Securities Depository and Clearing Co. , Ltd. Shanghai Branch
Transfer platform	Shanghai Stock Exchange

Assuming that the corporation turnover remains the same after issuing bonds, and the issuing scale only affect the long-time debt, and the corresponding financial.

Table 5-3 Financial Data before and after

Comparison	Before	After
Industry	Transportation and logistics	Transportation and logistics
Main business	Port and relevant logistics	Port and relevant logistics
Turnover	114.0941974152	114.0941974152
Total debt	87.95156814	127.4515681
short-term debt	16.62809871	16.62809871
Long-term debt	71.32346943	110.8234694
V_e (billion)	326. 15610747	326. 15610747

5.1.3 Calculation Steps

1) Calculation of the listed company asset value and asset value volatility

In order to calculate the stock volatility more accurately, we will adopt the methods in the chapter 3, then the method need enough length of data in calculation, in order to increase the precision of the model calculation, we will use the stock price as much as possible in each year to calculate the volatility in stock price, and the more data will be better in fitting of share price volatility, less errors at the same time.

Based on the stock price per day of the Shanghai Port Group (stock code: 600018) from 4th January in 2011 to the end of December in 2013, in total, there are 720 sessions days with opening and closing prices, which can used in $U_E = \ln \left(\frac{P_t}{P_{t-1}} \right)$ to calculate on the stock daily return of the Shanghai Port Group.

We define the session's day is 720, according to $\sigma_e = U_e \times \sqrt{242}$, we can have the annual volatility of the stock prices.

Combining these following two equations, put the V_E, σ_E, R, T and D known in the equation set, and then do the iterative analysis by the Matlab, we can have the enterprise value V_A and its volatility σ_a at the same time:

$$V_E = V_A N(d_1) - e^{-rT} D N(d_2)$$

$$\sigma_E = \frac{V_A}{V_E} N(d_1) \sigma_A$$

$$d_1 = \frac{\ln(V_A/D) + (r + \sigma_A^2/2)T}{\sigma_A \sqrt{T}}, d_2 = d_1 - \sigma_A \sqrt{T}$$

2) Calculation of the default point

According to the international calculation method of KMV model and Yu Xinjiang's the discussion of the default point, with China's current market situation, we make the default point, $DPT = CL + 1/2 LL$, it is concluded that there exists difference in default point of the Shanghai Port Group respectively before and after the issuance.

3) Calculate the default distance DD and expected default frequency EDF

According to the average growth rate g in three years, we can estimate the company the total expected asset value $E(V_a)$ in six years.

According to the default distance calculation formula $DD = \frac{E(V_A) - DPT}{\sigma_A}$ and the known $E(V_a)$, DPT 和 σ_A , we can calculate differences in default point of the Shanghai Port Group respectively before and after the issuance.

According to the expected default probability formula $EDF = \frac{\ln(V_0/DPT) + (\mu_A - \sigma_A^2/2)T}{\sigma_A \sqrt{T}}$ and known DPT 、 σ_A 、 V_0 、 μ_A 和 T , we can calculate the different EDF before and after issuance.

5.2 Empirical Calculation and Data Analysis

5.2.1 Empirical Results

Through the calculation above, issuing the "China Shipping Development Convertible Bond", the corresponding data and the results of the China Shipping shown in the table below:

Table 5-4 Calculation of the China Shipping Development

Comparison	Before	After
The stock market value	32615610747	32615610747
Period	6	6
Free-risk interest rate	3.25%	3.25%
Volatility of stock	0.306155	0.306155
Total debt	87.95156814	127.4515681
Short-term debt	16.62809871	16.62809871
Long-term debt	71.32346943	110.8234694
Default point	52. 2898	72. 0398
Total asset value	369. 17	385. 39
Volatility of asset value	0.2728	0.2615
Default distance DD	3.1459	3.1096
Expected default frequency EDF	0.00082782	0.00093666

By the same calculation steps, we can conclude the situations of the rest three listed shipping central bonds.

In 2012 Sinotrans Development Bond:

Table 5-5 Calculation of the Sinotrans Development Bond

Comparison	Before	After
The stock market value	7017977155	7017977155
Period	3	3
Free-risk interest rate	3.25%	3.25%
Volatility of stock	0.3934795388	0.3934795388
Total debt	85.7522	115.7522
Short-term debt	61.363	61.363
Long-term debt	24.3892	54.3892
Default point	27879250	1027879250
Total asset value	704330000	795030000
Volatility of asset value	0.4	0.3544
Default distance DD	2.4903	2.4571
Expected default frequency	0.00064	0.0007

The 2011 COSCO Bond:

Table 5-6 Calculation of COSCO

Comparison	Before	After
The stock market value	64025389349	64025389349
Period	10	10
Free-risk interest rate	3.25%	3.25%
Volatility of stock	0.2987750658	0.2987750658
Total debt	85.7522	115.7522
Short-term debt	61.363	61.363
Long-term debt	24.3892	54.3892
Default point	25059000000	28170280000
Total asset value	81621000000	83743000000
Volatility of asset value	0.2733	0.2673
Default distance DD	2.5355	2.483
Expected default frequency EDF	0.0056	0.0065

Now we can have the conclusion in the differences of EDF before and after issuance:

Table 5-7 Conclusion of Calculation

Name	Before	After
Sinotrans Development	0.064%	0.07%
China Shipping Development	0.082%	0.093%
COSCO	0.56%	0.65%

The credit rating methods of the standard & poor's and the Moody's are shown below:

Table 5-8 Comparison of Result

EDF (%)	standard & poor's	Moody's
0.02~0.04	≥AA	≥Aa2
0.04~0.10	AA/A	A1
0.10~0.19	A/BBB+	Baa1
0.19~0.40	BBB/BBB+	Baa3
0.40~0.72	BBB-/BB	Ba1
0.72~1.01	BB/BB-	Ba3
1.01~1.43	BB-/B+	B1

EDF (%)	standard & poor's	Moody's
1.43~2.02	B+/B	B2
2.02~3.45	B/B-	B2

5.2.2 Analysis in Credit Risk

In general, the trend of change in EDF are consistent in four samples, the COSCO with the highest total liabilities has the highest EDF, and the Shanghai Port which has the lowest asset liability ratio also has the highest credit rating, as we all know that, the higher asset liability ratio, the higher risk of financial and industry as a whole, and the lower asset liability ratio, the lower risk. So the calculation results are shown that COSCO has the highest probability of default, it has much to do with its large amount of long-term liabilities short-term liabilities, in addition, the share price volatility of COSCO is higher in three years, the risk is bigger, too.

At the same time, we can find that the credit rating reported by the credit rating organization is obvious higher than the real calculation, except other subjective reasons, it may relate to the imperfection of the Chinese credit rating agencies, namely, in order to promote the subscription of bonds, the credit rating organizations usually increase the bond credit rating, and investors subscribe the enterprise bonds based on credit rating at first, while they cannot forecast the change in credit, and the changes in volatility will lead to the change in its credit risk, so after one or two year, the credit risk will increase , the probability of default will also arise.

In KMV model, the financial information is very important, which has a buffer effect on the changes in the market asset value, so the KMV model is more robust and comprehensive on measurement, and by calculation in the real-time expected default frequency can be used in determination of the change in credit risk.

Chapter 6 Conclusion and Suggestion

6.1 Conclusion

In this thesis based on the study of international and domestic shipping financing, we combine the shipping financing market situation with the analysis of the industry itself development, try to apply the popular shipping bonds in other Asia countries to the Chinese shipping market. To explore the feasibility of shipping bond market in China, we will discuss the credit risks of shipping bonds in a comprehensive and objective perspective. In combination with China's national conditions and the target data, we choose the sensitive KMV model based on option pricing theory to do the credit risks measurement in our country shipping bond market. In this dissertation, with the daily volatility of listed companies and the distribution of annualized volatility, we establish the corresponding regression model. Then we analyze the current situation of the domestic and international shipping listed companies which have issued the bonds, at the end of the thesis, we select four government enterprise which have the better credit to analyze the credit changes after issuance, and the results show that when the corporate debt is high, after issuing long-term bonds, the credit risk of issuer will have a large growth, and by the consideration of our credit rating agencies, the company's credit rating will be arisen in some degree. In current shipping market, the central state-owned enterprises and listed companies should transfer the financing thought from the equity financing to the bond financing, and for the credit risk of listed shipping enterprises, we shall maintain long-term care.

6.2 Suggestion

6.2.1 Construct the Default Database with Chinese Characteristics

Due to the risk judgment of Chinese investors is relatively weak, the impulse phenomenon of subscription often happens, so the market balance is more dependent

on the rating agencies. As the core of bond market supervision, credit rating system, has a positive effect on preventing the risk of default and reducing asymmetric information of transaction parties, which is the foundation in good market operation. However, the present enterprise credit rating system is mainly aimed at the listed companies and state-owned enterprises with larger scale and strong profitability, are not suitable for other small and medium-sized enterprises. Meanwhile, our rating industry development still in the early period, so the lack of perfect enterprise credit rating system and high risk in shipping bonds may be a will be threat to the authority of our country's credit rating. Therefore our country should establish suitable for shipping industry of credit rating system with the consideration that the situation and the development characteristics of shipping companies in our country.

Firstly, an independent credit rating industry regulations on both listed companies and medium-sized or below enterprise. Secondly, with the macro economic cycle, assets and liabilities, cash flow, profitability indicators and other factors, we shall establish shipping industry rating database. Thirdly, according to the enterprise scale, credit and nature, we shall establish different rating system.

6.2.2 Development of Credit Risk Transfer and Hedge Products

The biggest risk to the bonds is that the issuers are unable to pay the debt, because of the high risk in shipping bond and the characteristics overseas, many institutional investors are restricted by regulators cannot invest the bond, the investors who hold the shipping bond don't have effective tools in the hedge of the potential risks in bonds investment. Introducing relevant derivatives can active the secondary market and enlarge the scale of shipping enterprise bonds market, which offer bondholders the opportunity to hedge risk. Drawing lessons from international experience, it is suggested that based on the different size of the risk, firstly launch credit default swaps (CDS) with high credit rating mark or mortgage debt obligations (CDOS) to hedge or transfer the credit risk of the bond in the early stage. And when the market

develops into a certain stage, we will introduce hedging tools which has the low credit rating mark.

6.2.3 Establish Credit Risk Measurement Method

1. A Complete Credit Risk Measurement Method

In order to control and prevent shipping debt default risk, our country should establish shipping corporate default risk measurement and risk control mechanism. Setting up a default risk measurement method can be considered into the following three types:

(1)Construct the default risk measurement model. Although the qualitative and quantitative measurement method such as Z, Logistic, KMV model, Credit Risk and Credit Metrics is being seen as international measurement model now, these models generally originate from Europe, the United States and other developed bond markets, it is poor fit to the unlisted or small and medium enterprises in China, so we need drawing lessons from foreign existing research and constructing our country shipping debt default Risk measure model in accompany with the situation of our country and the shipping industry operating conditions.

(2)Build industry default database. According to the financial ratios and industry index, such as balance sheet, cash flow, management level and the method of the economic cycle influence, we shall establish shipping enterprise customer default database, to support the data basis for rating and credit risk measurement.

(3) We shall build the early shipping corporate default risk warning system, track bond default risk dynamically, and try to set up the corresponding default risk level line, which can provide the dynamic bond risk data reference to the bond issuers, underwriters and investors.

2. A Complete Credit Risk Control Mechanism

To build the Shipping corporate default risk control mechanism, it is suggested that we shall consider the following three ways:

(1) Introduce the corresponding laws and regulations to define the power and responsibility of shipping bond issuers.

(2) Establish strict information disclosure system, adopt the ways that requiring the different issuer disclosures separately, strengthening the joint and several liability of the underwriters and other intermediary agencies and exchanging regular reporting the latest to regulators of market, which can improve the transparency in market supervision.

(3) Adopt the credit guarantee measures, reduce the degree of loss in default.

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