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Research on the fluctuation ship price in new-building market

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RESEARCH OF THE FLUCTUATION SHIP PRICE IN NEW-BUILDING MARKET

By

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

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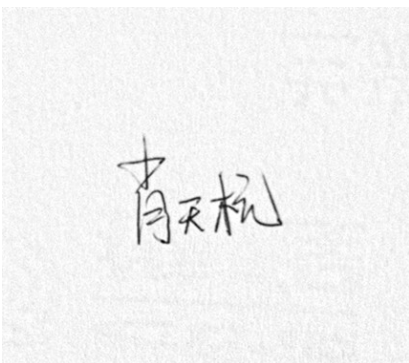# Declaration

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

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

2012-06-09

Supervised by

Professor SHI XIN

World Maritime University

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Abstracts

Title of Research paper:	**RESEARCH OF THE FLUCTUATION SHIP PRICE IN NEW-BUILDING MARKET**
Degree:	**M.Sc.**

The content of this paper is the new-building ship price fluctuating mechanism. The research contains two main sections: analyzing the factors affecting the new-building ship price, how those factors influence the new-building ship price and then establish a fuzzy linear regression model to predict the new-building bulk ship price.

This research firstly shows the analysis of the new-building ship price fluctuating mechanism. By observing the new-building ship price's fluctuation, this paper finds the important factors what influence the new-building ship price and how those factors influence the new-building ship price. By observing the fluctuation of the new-building ship price, this paper finds the factors what influences the new-building ship price and those factors' action system. Then based on the above analysis, this paper builds the new-building ship price predict model. This research presents the new-building ship price predict model of the bulk carriers. This paper builds the predict model to make sure that the analysis of the above is correct.

Through analyzing the new-building ship price's structure and transforming disciplinarian, on the one hand, the research can enrich the research of the fluctuating mechanism of the new-building ship price, on the other hand, the research can make a direct sustain for the shipbuilding industry. The shipyard can get the most profit shipbuilding order in the most suitable time, with the best price, in the most suitable gathering manner.

KEYWORDS: New-building ship price, bulk new-building ship price, Fluctuation factors, New-building market

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List of Abbreviations

BDI   Baltic Dry Index

DWT   Dead Weight Tonnage

FLR   Fuzzy Linear Regression

GDP   Gross Domestic Product

IMF   The International Monetary Fund

IMO   International Maritime Organization

TEU   Twenty-Foot Equivalent Unit

UNCTAD   United Nations Conference on Trade and Development

VLCC   Very Large Crude Carrier

WTO   World Trade Organization

Chapter 1 Introduction

1.1 Background

Under the situation that the world ship-building center is moving to the east, China is devoting all their effort to develop the ship-building industry. When trying to increase the numbers of built ships，we also need to do some further analysis on the new-building market to help the ship yard develop in the world ship-building market. The new-building ship price is a very important object to be analyzed in this progress. In this market, with the trend of lager ships, the technology content of ships keeps increasing, as a result, the new-building ship price grows higher and higher.

However, the financial crisis in the year 2009 changed the law of the market. Now we should not consider the fluctuation of the new-building ship price only with the demand and supply theory of the market. Ship is a kind of good with high value, even 1 percent change on the price may lead to the profit or loss of the shipyard and the ship-owner.

Because nearly all the income of the shipyard comes from the new building contracts, the change of the new-building ship price will finally affect the loss or profit of the shipyard. If the shipyard wants to make the proper price of the order, the fluctuation

of the new-building ship price in the new-building market must be analyzed.

This research will firstly analyze the content of the new-building ship price and its trend of change, which can not only rich the analysis of the mechanism of the fluctuation of the new-building ship price, but also can make the proper judge to the trend of the new-building ship price. Base on this, the shipyard can improve their way of taking the orders of the ships strategically and gain the best profit in the best time.

1.2 Research Purpose and Methodology

The fluctuation mechanism of the new-building market means the forming progress and the system behind the volatility of the new-building ship price. In this research, the factors affecting the new-building ship price during the operation of the ship-building market and the process which will be finally formed under the impact of these factors will be discussed and analyzed.

Based on this, a prediction model of the new-building bulk ship price will be established to check the above analysis.

1.3 Literature Review

1.3.1 Recent research of new-building market

The current research about new-building market mainly put emphasis on the price of the new ships. Some researched have discussed the possible factors affect the price of the new-building ships with qualitative analysis, others mainly so some prediction

about the future price of the ships with quantitative analysis. The former kind of literature appears more frequently in China and the latter ones usually belong to foreign countries.

1.3.1.1 Qualitative Analysis

The researches on the factors affecting the new-building market are mainly based on the supply and demand theory of market. For example, we can find such basic analysis from *Yang Shangling, Lin Bin, 2006, Several new understandings towards price fluctuation of new ships, MARINE EQUIPMENT/MATERIALS & MARKETING, Vol.3, 2006.* The author firstly analyzes the price of productions from the relationship between the demand and supply. He analyzes from the features of the new-building ships and raises the point of view that the analysis of the fluctuation of the new-building ship price should not only be focused on the demand and supply. This research draws the point of views that the fluctuation of the new-building ship price was mainly affected by the subjective and objective factors. The author also thinks that ships are secondary consumer goods. Meanwhile, the psychological factors of the buyers should also be taken into the consideration when analyzing the fluctuation of the new-building ship price. The demand and supply are basic factors in the two dimensions. We shall add some restrains in the third dimension. But unfortunately the author does not mention the factors which should be taken into the third dimension.

Besides the basic market factors, some author also raised some unique point of views from other field, such as *Ming Jie and Ding Rui, 2008, Analysis for factors affecting the relation of supply to demand in current ship market, Marine Technology, Vol.5, 2008.* This article mainly discussed the factors affecting the current demand and

supply in the new-building market from both the demand of the ships and the supply of the ships. The mentality of the ship owners, the economic power of the ship owners, the renewing of the requirement of the ship owners, the building technology and ability, the number of the order, the change of the cost of building ships and many other factors are all considered.

The author also considers some factors which are in different fields. He thinks that in the year 2006, 2007 and 2008, the ship-building industry was prosperous, which also led to the lack of the land of the ship companies. With the working out of the new international industry standard, the competition of the human resource is more and more fierce. The economic consequence which was incurred by the financial storm in 2009 is still not very clear, so it is hard to judge the final trend of the international trade. Thus also affects the shipping market and the fluctuation is getting severe. As a result the world economy and the increase of the international trade all slow down their path under such situation.

In terms of the world trade and economy, some researchers also take the exchange rate into consideration. We can find this in *Zhu Rujing, Zhang Rui, 2008, How Should the Shipbuilding Industry face the Yen Appreciation, SHIP ECONOMY & TRADE,Vol.4, 2008.* In this article, the author firstly discusses the direct impact of yen appreciation. The yen appreciation has led to huge economic loss of the signed contracts. As a result, the competing power of the new-building ship price was getting weak, and the number of export ships decreased. Besides, the number of orders decreased and the building capacity was surplus which brought great losses to the shipyard.

There are also some other kinds of factors affecting the new-building ship price. In the book *"Marine Finance— Vessel Investment and Financing"*, *Lv Jing, 2011, China Communications Press* (ISBN: 9787114038952), the author regards the factors impacting the new-building ship price are:

(a) The own problems of the ships, which includes the different ship types and the navigation zone of the ship.

(b) Ship yard. Different shipyards may need different cost to build a ship, which leads to the difference of each ship. In conclusion, the main factors are the condition of the shipyard, the supplier of the equipment, the working days, the labor costs and the interest goal of the shipyard.

(c) Trade negotiation factors. During the negotiation of some key factors in the building contract between the ship owner and the shipyard, a lot of factors may be involved such as the delivery date, delivery place, the loan of building the ship and the way of payment.

(d) Ship insurance。Besides, the author thinks that the change in the foreign exchange market is also an important factor which may impact the new-building ship price.

1.3.1.2 Quantitative Analysis

There are also some researchers in China who have done the quantitative analysis about the price of the new ship in many different ways. For example, we can see from *Li ShengJiang, 2007, Applying ARMA models to forecast the price index of ships, SHIP ENGINEERING, Vol. 29(6), 2007*. In this article, the author introduced a

model ARMA to predict the price of the new ships. None of present market forecast methods about the price index of ships take itself long-term tendency into consideration．　Therefore，the ARMA model is introduced to get the mole accurate price anticipation under fully considering the development tendency of time sequence．

Besides, the article *Yang Shangling, 2006, Research of the New-building ship price Fluctuating Mechanism, Marine Equipment, Vol.3, 2006* analyzed the basic factors affecting the new-building ship price, and the author build a model to predict the new-building ship price in order to check whether the factors are really connected to the new-building ship price of the new-building market. He build a function and suppose each of the factors as a variable which is coefficient with the new-building ship price.

In the article *Dong Xiaoyong, Chen Jiayuan,2003, Researches on ship investment decisions and assessment models, Shipping Management, Vol.3,2003,* the author use the recent price of a certain type of ship, the load displacement tonnage of the same type of ship and the light displacement tonnage to get the function to calculate the price of the new ship.

1.3.2 Existing problems

1.3.2.1 The current researches are not systematic

However, problems still exists in this area. The biggest problem is that none of the researchers can get a comprehensive conclusion or methods to analysis the factors affecting the price of the new-building ship systematically. Some of the authors only

list the possible factors which may affect the price of the ship, but they had never proved them. Some of the researchers also raise the point of view that the fluctuation of the 5 price of the new-building market cannot be analyzed only from one or two aspect.

1.3.2.2 No specified new-building ship price prediction model

In one hand, The Chinese researchers prefer to use some existing math models to predict the new-building ship price directly, but the fact is that the new-building market is very complicated. Many potential factors can also affect the new-building ship price such as the speculative psychology of the buyers. The existing models only use the new-building ship price index to predict the price. In the other hand, the researchers in foreign countries would like to "play edge ball". They often introduce some models which were used in the financial area. Such models are too specified in the financial area to be used in the new-building market. Other authoritative organizations such as Clarkson only offer a result of prediction weekly or monthly. In a world, there is no model which is specified for the new-building market.

In my research of the fluctuation of the new-building market, I will try to avoid and solve the above problems. Because of the limitation of my knowledge, some of the existing problems may still to be solved after my research, but I will go on further study and keep attention on this topic in order to try my best to improve such research in this area.

Chapter 2 Analysis of New-building Ship Prices Fluctuation Mechanism

2.1 The Fluctuated Situation of the Whole Shipping Market

Shipping market is very sensitive. It will be affected by many different factors and all the derivatives of this market will be subject to its fluctuation. The new-building market is also an important part of the whole chain of shipping industry.

From Figure 2-1 we can see that, the prices of new ship had gone down, rose, fell, and increased, which showed a W-cycle trend from 1980 to 2005. The process also assumes that there are several major fluctuations existed in the prices of new ship. But it is still hovering at a high state.

The several major fluctuations have their own characteristics. What they have in common is the annual capacity growth rate of demand for new ship lower than the growth rate of shipyard built capacity.

However, they have a lot of difference in the point of external influence factors. The table shows the new-building ship prices index for the calendar year. The data comes from Clarkson data (Set January 1988 as the base 100).
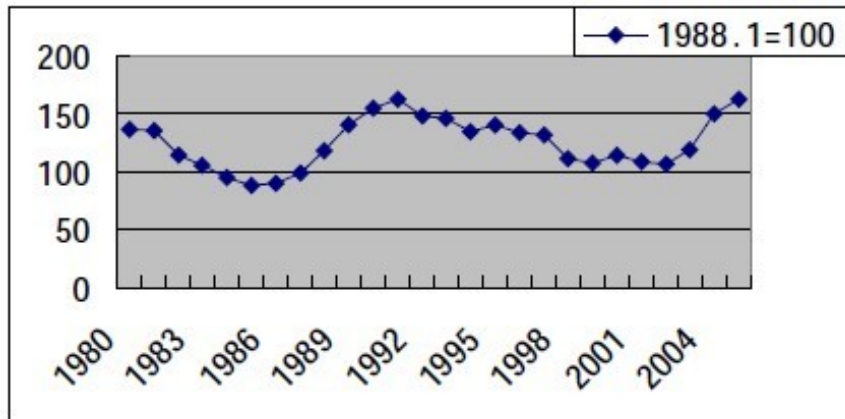
Figure 2. 1:   New-building ship prices index for the calendar year from 1988 to 2004
Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)
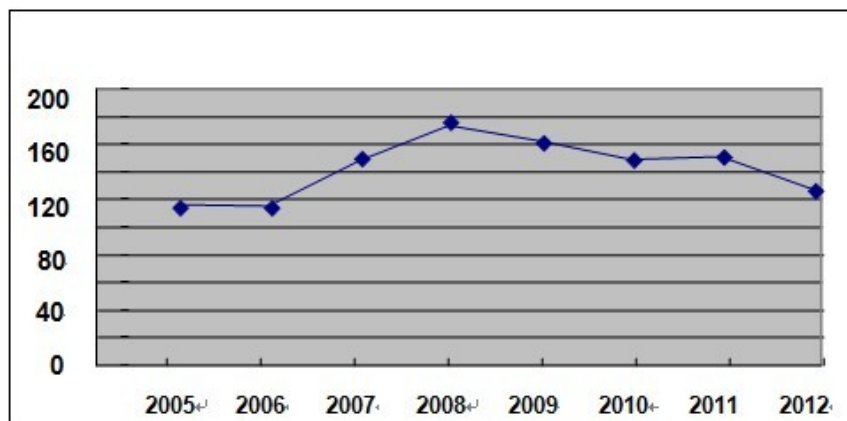
Figure 2. 2: Bulk carrier new building price index from 2005 to 2012

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

(1) Down stage of new-building ship prices: 1980-1985

The demand for new ship had increased slowly after the two oil crises in 1973 and 1979. As a result, hundreds of shipyard had closed in European countries and Japan due to the demand is on the decline. The world GDP growth rate had plummeted to 0.6 percent in 1982 from 2.5 percent in 1980. The cold world shipping activities appeared. Since then the world economy had made a significant growth, but it still didn't reach a better level. And then, marine transport cargo inevitably was affected

because people's consumption level and the demand for consumer goods reduced. Therefore, the ship owner become not optimistic about the expectations of shipping market (During the period, the dramatically increased amount of demolishing ships could be good to explain the phenomenon. The ship owners chose scrapping to save all kinds of losses for the operating ship is not on). The shipping market oversupplied because the ships supply of shipping market was rising as new-building ship orders had being completed in previous years. Hence, the ship owners did not want to make more order of new ship. At that time, the orders which shipyard received sharply reduced while the production capacity increased. Each shipyard had to reduce the new-building ship prices in order to get orders. It led to a decline of new-building ship prices.

(2) Slow rising stage of new-building ship prices: 1986-1991

The world economy began to recover growth. The world economy trade was to make a rapid growth. The shipping market began to flourish and shipping fees bounded back. A lot of food imports from 1987 to 1989 and amounts of iron ore transportation in 1988 led to a high demand for bulk carriers. Thus, ship owner was bullish on the shipping market. The enthusiasm of ship order increased. But the world shipbuilding capacity did not change too much due to the influence of a few years ago. There was a greater growth of new-building ship order during this period. The supply was shortly inadequate to meet the demand in shipbuilding market. New-building ship price index set a record by reaching 162 points in 1991.

(3) Down stage of new-building ship prices: 1992-1999

During this period, the price index of new ship in a certain period of time had a small

rise. During the 1994-1995, China had imported large quantities of grain and other raw materials. It promoted the demand for bulk carriers was stronger in the short term. Ship owner was active with shipbuilding. So the new-building ship price rose from 134 points to 140 points in 1993. But overall the new-building ship price which fell from 161 points in 1991 to rare 107 points in 1999 was downward trend because of an excess of shipbuilding capacity. Although the growth rate of the world economy was still large, the world shipping volume growth rate remained hovering at a low state. With the impact of the Asian financial crisis, the world shipping volume even appeared the negative growth -0.01 percent in 1998 mainly because it led the world economy growth which was no longer primary products such as raw materials but high-tech products such as electronics, automotive. The demand for shipping of latter ones was relatively less than the former ones. At that time, new ship demand was on the decrease in the shipping industry while shipyard building capacity had continued to increase. The enthusiasm of the new ship decreased.

The ship owner decided to make new ship mainly because the fleet updated. The exchange rate of South Korean currency *won* and the Japan currency yen against the U.S. dollar achieved 1402:1 and 130:1 respectively. *Won* devaluation fell significantly against dollar. Each shipyard in South Korean suffered serious losses. Overall, the demand situation for world shipping market was very optimistic. The order quantity increased. On one hand, low prices stimulated the purchase desire of ship owners; on the other hand, some countries was to actively develop and update their own shipping fleet in order to adapt to the future development of the shipping industry. As a result, the world shipping market was experiencing a quite busy and strange periods: the demand increased while the new-building ship price decreased sharply. The most important reason was that the South Korean shipyards provided a very low price quotation and signed a contract. South Korean shipyards built new

ships in lower prices that continued to drop the international shipping price to a new low using the favorable situation of *won* depreciation in order to resolve the difficulties by itself that was the shortage of foreign exchange as well as the quantity of orders could not meet the huge production capacity.

(4) Rising stage of new-building ship prices: 2000 - now

The world economy was growing rapidly. World shipping began to be active. Shipping fees was on a marked increase. The national currency *won* and yen exchange rate against the U.S. dollar began to raise in the world shipbuilding powerful nation- South Korea and Japan. The motivation of new ship customized was high for ship owners. The new ship order index hit record high of 178 points. Though shipyard building capacity increased, it couldn't meet the demand of ship owners in a short term. The slipway was full and tight. New-building ship prices were on a marked increase.

The shipping market turned positive trend after 2000. It encouraged the ship owners to build new ship by assault in 2000 and 2001, resulting in excessive growth of the world fleet in 2001 and 2002. Data displayed that the tanker fleet grew by 2.8 percent and the bulk carrier fleet increased by 2.1 percent in 2002 (4.6 percent in 2001 touched record high). All of this enabled ship owners to have more concerns when considering the new ship-built, so the demand reduced.

After the "9·11" incident, the main reason for the decline in growth of trade was that the world economy was affected to some extent and cost increased while economic activity reduced. From then on, the costs of insurance, transportation and security related to international trade increased significantly, customs inspections become

more rigorous. All of this led to an increase in trade costs. The expectation of shipping for ship owners was not very high. The motivation of new ship customized was very low. All of this led that a downward trend in new-building ship price continued to 2002.

Under the fair condition of the world economy as a whole after 2002, the shipping market prospects were good with the depreciation of dollar. The single-hull oil tankers under way were on the trend of withdrawal from the oil shipping market in advance due to the higher ship safety requirements for ship owner, ship inspection and IMO. These had prompted the ship owner optimistic about the shipping industry and actively made new ship. At the same time, the new-building ship price increased naturally because of slipway tension. Since 2005, the world economy remained essentially the medium pace of development.

The world shipping industry had been influenced by the impact of China's macroeconomic regulation and control, the level of three cargo ships freight appeared phased decrease, the motivation of new ship customized was low for ship owners. But they were active in ordering new ships because there were 90 million dwt single-hull oil tankers should to be washed out and updated before 2010. The prices of a variety of raw material rose obviously. The delivery date of new ship had long been routed in 2008 because of the increasing appreciation of currencies of major shipbuilding countries in Asia and more new ship order that multinational shipyard(especially South Korean shipyard) had held. The price of ship would be stability basically and even rise with the influence of slipway tension and so on. The tendency of the world economic development had been better in 2006. "China factor" continued to play a role in keeping the prices of steel and marine accessory products on hovering historically high levels. For example, the mainframe price was about

$100 per horsepower a few years ago. Now it had doubled. The price of the host which was about 40 thousand horsepower VLCC had reached about 8 million U.S. dollars. The price of the large container ship host which sped up 25/26 (about 100 thousand horsepower) was close to $20 million. According to the above analysis, the reason why the new-building ship price fluctuated could be:

(1) 1980 to 1985 (from prosperity to depression)

During the five years, the new-building ship index kept dropping from 136 to 88. The reason for this is that the world economy went into thee sustained depression in the 80s. During the year 1979 to 1980, the second oil crisis occurred. Thus the market need less ships because of over capacity but the ship yard kept building the new ships with signed orders.

(2) 1986 to 1991 (from depression to resuscitation)

During these five years the ship index kept raising. That was because the world economy was recovering. Besides, the world shipping turnover capacity and fleets kept increasing, and the building productivity of the ship yards reduced.

(3) 1992 to 1999 (from stationary to depression)

The new-building ship price index increased from 1992 to 1994 and then decreased from 1994 to 1996 till 107 in 1999. During these years, the world economy developed steadily and slowly, the demand and supply was in balance, but then the supply was over the demand because of the expanding of Korean ship-building industry. In the year 1998 and 1999, the world faced the financial crisis. The shipping market was in depression and the demand of the capacity decreased.

(4) 2000 to 2001 (from recovery to depression)

The ship index began to rise up but dropped again at the end of the year 2000 and drop to the bottom. That was because the Asian financial crisis ended basically but the following event of September 11th affected the world economy.

(5) 2002 to 2004 (from recovery to prosperity)

The ship index kept increasing; the world economy recovered; the shipping market kept warming and the foreign trade volume of China kept increasing. Besides, the price of steel increased; some policies will facilitate the demolishing of old and obsolete vessels; the currencies of some Asian countries had the tendency of appreciation.

(6) 2004 to2007

The world economy developed in 2004 but from 2005 the world oil price kept increasing which affected the world economy. However in the year 2004, the world maritime trade growth rate is about 49 percent. Then from 2006 to 2007, although the fuel price kept increasing and the bank in main economic entities raised the interest rate, the shipping market developed slowly and in the first quarter of the year 2007, the new ship volume made the record of 39 million TEU, the year-on-year growth is 38.5 percent.

(7) 2008 to 2011 (From depression to recovery)

The financial crisis at the end of 2008 hit the world economy as well as the shipping

market seriously. Many ship owners abandoned their new ships but many new orders were still in built in the shipyards because of the long cycle of ship-building. The new building TEU in 2006 may not be absorbed until 2010. In the year 2010, because many countries took the rescue measures to save the economy, such as the Chinese government release 4000 billion *yuan* into the market, the world economy warmed again and the world trade growth rate reached 13.8 percent, which is the highest since 1990.

In conclusion, the main factors affecting the new-building ship price are the world economy and financial condition, the shipping market, ship-building market, the cost of building ships, the emergent affairs and the government policy, etc.

2.2 The Factors Affecting the New-building Ship Price

Generally speaking, the factors affecting the new-building ship price include the direct factors and indirect factors. Direct influencing factors include the future shipping market demand for new ships and demand for new ships by ship owners' updating fleet etc. Indirect influencing factors refer to factors influencing the demand for new ships by affecting on the direct influencing factors, such as the world economy, the world's shipping capacity, the government policy and so on.

The direct factors affect the direct demand for new ships with a relatively simple and obvious process, and have a positive correlation with changes in the prices of the new ships. For example, since 2003, with the development of China's economic, the strong demand for various raw materials, which contributed to the further improvement of the world shipping market, prompted the world shipping market demand for new ships to further increase, thus affecting the prices of new ships and

pushing the prices of the new ship to a high level. Although the indirect factors do not have a direct impact on the new-building ship prices, they can affect other factors to influence the demand for new ships and then affect the prices of new ships. Development of world economy, or more precisely the fluctuations of world economy, certainly has an impact on the world shipping market. The actual situation of the last century proves this point. While the shipping market is an international market, national policies is one of the factors that have to be considered with their great impact. Macroeconomic regulation and control (monetary policies, etc.), as well as the tariff policy etc. by the government, affect the macro-economy and national import and export, thereby affecting world seaborne turnover and finally influencing the prices of new ships.

There is an example in China. In 2006, when the Chinese government's regulating of the overheated economy began to work out, the steelmaking movement ended and the imports of raw materials situation changed with poor port logistics in many large ports. It showed that Chinese government's initiatives on the import of raw materials had a direct impact on the changes in the world shipping market, thereby affecting the ship owner's enthusiasm in new ship orders, and finally affecting the prices of new ships.

However, impact of demand factors and supply factors on the prices are not independent, but simultaneously. They work together to achieve balance between supply and demand the formation of equilibrium prices.

According to the law of value theory, new-building ship price fluctuations in the world shipping market are not only reasonable, but also have a meaning of its existence. Analysis from the appearance was found that price fluctuations could be

decomposed into the following situation: cyclical fluctuations, seasonal fluctuations, irregular and sporadic fluctuations, non-rational and long-term trends. New-building ship price fluctuation was basically affected by the ship market fluctuations as a whole. Cyclical fluctuations: the new-building ship price fluctuations were basically synchronous with the volatility of the shipping market. In fact, the shipping price was an important indicator to measure the rise and fall of the ship market. Seasonal fluctuations: seasonal fluctuations generally occurred only in the shipping market. Seasonal fluctuations of the prices of new ships were not obvious. Irregular and sporadic fluctuations: these fluctuations were often difficult to predict, such as the oil crisis, the Suez Canal shutting down and so on. These events had a major impact on the shipping market, and directly decided the new-building ship price fluctuations. Irrational fluctuations: the prices were decided through negotiations between buyers and sellers.

These factors were in a state of uncertainty at any moment, so the new ships prices were always fluctuant. Price formation is based on value, but value is not almost the only factor taken into account for the last actual formation and realization of price. In the process of price formation, price is the realization form of the value sports. It not only reflects the production conditions of value which are constrained by the value and various factors that impact value changes, but also images the realization conditions of value which are subject to market factors. It not only reflects the production and realization conditions of value, but also images the distribution of value. It not only reflects the impact of social and economic conditions, but also images the economic policy in the country. In addition, the price formation is also affected by the historical, realities, and even psychological factors. Thus, there are many impact factors instead of a single during the process of price formation. The price formation of ships and general goods are both in common, but it also has

individuality. Shipbuilding cost plays an important role in determining the new-building ship price change, but it is absolutely not the only factor.

Based on the above discussion, the main factors we consider in this research which affect the new-building ship price are as following:

(1) World economy

(2) World trade and world shipping industry

(3) The demand and supply in the shipping market

(4) The Costs of Building Ships

(5) Profit

(6) State Revenue

(7) International Finance, Exchange Rate and Interest Rate

(8) The Competition In the Ship-building Market

(9) The different level of ship conductions

(10) The order behavior of the ship owner

(11) Public Policy

(12) International Covenant

(13) Anthropogenic interference

(14) Emergencies

2.3 How the Factors Affecting the New-building Ship Price

Since we have analyzed the fluctuated situation of the shipping market and generate the main factors affecting the new-building ship price, here we will analyze how such factors leave the impacts on the new-building ship price.

(1) World economy

First of all, the change of new ships prices depends on the level of economic development. This relationship is passed through the shipping market. And the delivery period is normally about a year. When the shipping market is thriving, or tends to thrive, the ship owner would invest in ordering new ship. At this time, even if the new-building ship price has been rising, the ship owner would be actively make new ship to gain more revenue in the shipping market .For instance, the world economic growth was high up to 5 percent in 2004, which become the relatively rapid growth year in nearly 30 years; both the developed and developing countries had shown a good economy growth, especially Chinese economic growth rate was still high up to 9.4 percent. Driven by the rapid economic development in the world, the global trade was highly active, and the trade volume growth of 9.1 percent was substantial.

The prominent feature of the world economy was strong growth in 2004. The growth rate was up to 5 percent which was the highest record in the past 30 years. Economic in most parts of the world and national is recovering evidently. Economic performance was generally better than last year. So the world economy was in a periodic high point. Among them, the economic growth rate of the three major economies (U.S., Japan and the EU) generally improved in the developed countries. With the impact of oil prices increase, although the growth rate had slowed in the third quarter, the annual growth rate of the U.S., Japan and Europe was respectively 4.4 percent, 3.5 percent and 2.4 percent. The economies of East Asia as a whole In developing countries would continue to be the region where the economic growth was the highest in global. China's economy had maintained a high-speed growth of 9.4 percent, India's economic growth rate was 6.2 percent, Russia's economy was on

sustained growth for 6 years. Meanwhile, the world shipping industry also fired up as the economic recovery (development) of the major trading powers in the world. Ship owners began to order new ship in order to earn more profits in the future while shipyard building capacity could not meet the huge demand in a short term meet. So it appeared a shortage in the shipbuilding market. And the new-building ship price increased. The new-building ship price index reached 109 points in 2004 which was far beyond 85 points in 2003.

The ship market is the "function" of the world economy. The impact of world economy on the new-building ship price can be analyzed from two aspects. On the one hand, from the aspect of raw materials in the form of world economic growth, prices will increase, the national workers' wages and working hours, fees will be substantial growth, shipbuilding cost increases, thereby causing new-building ship prices rise. On the other hand, from the aspect of the impact on the ship owners, world economic development enhances their desire to buy ship. It will increase demand for new ship that a good momentum of the world economy development, world trade increase and the world shipping rising, which promotes the new price to a certain extent.

(2) World trade and world shipping industry

According to statistics released by the WTO, world trade growth was 4.5 percent in 2003, 7.5 percent in 2004. UNCTAD 2004 World Trade and Development Report noted that the global commodity production and trade in general returned to growth following the 2003.Global trade appeared to accelerate growth in 2004. The growth rate reached a high level in the late 1990s. At present, 90 percent of global trade was finished by sea. Due to the substantial growth in world trade, the global shipping

increase reached 7.5 percent in 2004, more than 7.0 percent in 2003, far higher than the average annual growth rate of 9 percent in the 1990s. It can be seen from the figure that the global shipping growth was accelerating since 2001, rising from 0.5 percent in 2001 to 7.5 percent in 2004. In 2003 and 2004, the global shipping growth rate had reached the fastest during the past 15 years. Global trade and shipping had been on a substantial increase due to two reasons.

Firstly, China continued to low tariff rates and reduce non-tariff carries since entered into WTO three years ago, coupled with sustained and rapid economic growth, which led to substantial increase of the oil, iron ore and other raw materials and equipment in imports. Meanwhile, the international competitiveness of Chinese industrial significantly improved, and industrial manufactures in exports were substantial growth. In the first 11 months of 2004, China's total foreign trade volume reached $ 1.038 trillion, year-on-year rose of 7.7 percent. Total volume of imports and exports jumped over 500 billion U.S. dollars mark respectively. The cumulative trade surplus was 20.48 billion U.S. dollars. The annual import and export volume reached 1.1 trillion U.S. dollars, ranking third in the world, a year-on–year increase of more than 2500 billion dollars. This growth rate was rare in the history of international trade development. China had become a reality trading power from the so-called potential one.

Secondly, the expanded demand of domestic consumer was driven by the strong growth of the U.S. economy, leading to consumption demand far beyond the production capacity of the United States and the import volume growth. According to statistics, the U.S. consumption of total imports in 2004 was up to over 1 trillion U.S. dollars.
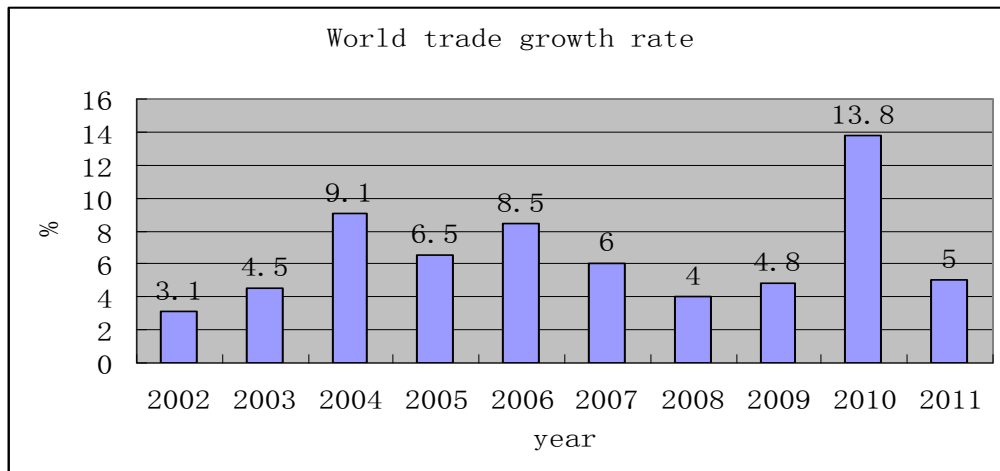
Figure 2. 3: The world trade growth rate from 2002 to 2011

Source: The International Monetary Fund (IMF)

(3) The demand and supply in the shipping market

The relation between the demand and supply of the ship-building market and the shipping market has a great impact on the fluctuation of the new-building ship price. This can be explained partially by the Marshallian Demand Curve. The effect of the demand and supply of the ships on the new-building ship price actually is the impact of the world economy, which means that the nature of the change in the demand of the new ship is caused by the change of the world economy and the shipping market. When analyzing the impact on the new-building ship price by the change of demand and supply, we should differentiate the enthusiasm of needs and the quantity of demand. The demand and supply in the shipping market always support the new-building ship price. The development tendency of them is more and more similar. Here we can use the quantitative analysis to see the impact of the main factors on the new-building bulk ship price.

Table2. 1: The relationship between the world shipping turnover capacity, world fleets and the new-building bulk ship price

	World shipping turnover capacity	World bulk fleet	New-building bulk Price Index	World ship-building abilities
1998	100	100	100	100
1999	102	99	103	113
2000	111	100	113	119
2001	114	103	110	125
2002	123	108	105	134
2003	127	111	117	144
2004	136	113	156	155
2005	150	120	184	188
2006	155	130	183	195
2007	162	138	233	231
2008	164	147	275	256
2009	161	158	256	294
2010	173	172	237	300

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

The correlation coefficient relationship can be known by using the analytic method of index[1] to get the indexes of the world shipyards building ability, the exchange rate, and demand and supply in the shipping market and the growth of world GDP as the base. Through calculation we can get the degree of correlation of these three factors after 1998 is 0.93 and 0.92, by which we can get the conclusion that there is a rather strong relationship between the world fleet and the new-building ship price. Establish the regression equation between these two factors:

$$Y = -161.0618 + 1.4066817X_1 + 1.104726X_2$$
$$R = 0.9$$

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[1] Here we change the data of the all the factors in 1988 to 100 by ratio.

X_1: The world shipping turnover capacity [2]

X_2: The world fleet

Y: The new-building ship price

The sign before the regression coefficient of the variables represents the positive and negative effects of the variable to the new-building ship price. The plus sign means the variable has positive effect on the increase of the new-building ship price; the minus sign is the opposite. From the Table we can see that the world shipping turnover capacity has the negative effect on the increase of the new-building ship price, but the world fleet is the opposite. Besides, in the shipping market, the ship owners make the profit by taking the tariff. When the freight rate is high, the ship owner can make great profits. Only if the ship owners make a certain degree of profit, they can borrow the loan from banks and book new ships from the shipyards.

If the shipping market is warm, the freight rate will increase and the ship owners will make great profit. Then based on the good overview of the shipping market and the increasing freight rate, the ship owner may begin to take building new ships into consideration, and the loan can be paid in several future years. Then the ship owners may gain a lot of profit which lead to the stimulation of the ship owners of purchasing new ships. Simultaneously, the new-building ship price will increase because of the lack of new ship berths.

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[2] The world shipping turnover capacity hereby means the world shipping capacity.

Table2. 2: The relationship between the new-building ship price and the freight rate

	New-building bulk ship price	Freight rate
1998	100	100
1999	103	88
2000	113	107
2001	110	58
2002	105	116
2003	117	318
2004	156	307
2005	184	160
2006	183	293
2007	233	610
2008	275	52
2009	256	200
2010	237	118

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

Build the regression equation between the new-building bulk ship price and the freight rate of the bulk carrier and calculate with the Excel:

$$Y = 146.1075 + 0.107907x_1$$
$$R = 0.258$$

Y : The new-building ship price

x_1 : Freight rate

We can see that the freight rate has the positive effect on the increase of the new-building ship price. On one hand the shipping market can affect the new-building ship price, on the other hand, only if the shipping market is combined with the supply of the ship building market, it can bring more effective impact on the new-building ship price.

As a result, we establish the regression equation of these three factors:

$$Y = 124.4947 + 0.6129X_1 + 1.60899X_2 - 2.70258X_3$$
$$R = 0.97$$

Y : The new-building ship price

X_1 : The world shipping turnover capacity

X_2 : World shipyards building ability [3]

X_3 : The world fleet

We can see that when these three factors affect the new-building ship price at the same time, the world shipping turnover capacity will facilitate the increasing of the new-building ship price but the other two have the opposite effects. However in different time of periods the degree of effects of these three factors on the new-building ship price is different. For example, during the year 1987 to 1991, the new-building ship price fluctuated together with the demand of the new ship in the market, but in the year 1992, the situation changed. At that time the demand volume increased a lot but the new-building ship price reduced. The reason is that the over increasing productivity prevented the development of the market. As a result the price was not like the expectation.

In further analysis of impact on the new-building ship price by the shipping and new-building markets, we will introduce the concept of transportation efficiency. Transportation efficiency is the actual shipping turnover volume which has been reached by the fleet. unit is TEU per year.

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[3] World shipyards building ability hereby means the delivered orders of new-building ships

$$K(N) = WST(N)/FL(N) \qquad \textcircled{1}$$

$K(N)$：The transportation efficiency in the n year

$WST(N)$: The world shipping turnover volume

$FL(N)$: The tonnage of world fleet

The transportation efficiency represents the relationship between demand and supply in the shipping market. If K increases, it means that the utility of the fleet increases, the volume of laid-up fleet decreases and the freight rate increases. K is the important evidence of the ship owner's booking new ships and demolishing old ships.

In fact, the increase of the volume K cannot totally facilitate the ship owners to buy new ships. Only if the mean value of K in the former years is high, the ship owner can gain enough profit to get the confidence and reputation in borrowing the bank loan to book new ships. So the real factor which matter a lot is the average transportation efficiency KC:

$$KC(N) = \left[K(N) + K(N-1) + K(N-2) + K(N-3) \right]/4 \qquad \textcircled{2}$$

The new booking orders are the volume of the contracts of new-building ships signed by the ship owners and the ship yards. The main aim of the ship owners to book new ships is to renew the fleet or expand the present fleet scale. The new booking orders are the induce quantities of the shipping turnover capacity. When the shipping turnover capacity and the transportation efficiency increase, the ship owner can make great profit. Besides, the shipping market is prosperous, and the ship owners will try to gather funds to book new ships. The warming of shipping market, especially the increasing of the average transportation efficiency are the main factors to stimulate

the increasing of new-building orders. The building ability of the ship yards can be regarded as the supply of the market. Thus the condition of the demand and supply of the ship-building market is:

$$X(N) = KC(N)/S(N) \qquad\qquad ③$$

$X(N)$: The condition of the demand and supply of the shipping market

$S(N)$: The World shipyards building ability

Table2. 3: the relation ship between the demand of the shipping market, the supply of the ship-building market and the new-building ship price.

	Demand of the shipping market	Supply of the ship-building market	New-building bulk price index
1998	100	100	100
1999	50	113	103
2000	150	119	113
2001	47	125	110
2002	50	134	105
2003	225	144	117
2004	125	155	156
2005	250	188	184
2006	185	195	183
2007	450	231	233
2008	350	256	275
2009	50	294	256
2010	150	300	237

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

Establishing the regression equation of these three factors:

$$Y = 0.6177 + 0.113264x_1 + 0.8147796x_2$$
$$R = 0.97$$

Y : The new-building ship price

x_1 : The demand of the ship-building market [4]

x_2 : The supply of the ship-building market [5]

From the above we can get the conclusion that the shipping industry has a great impact on the new-building ship price, which also means that the ship market is the buyer's market.

(4) Profit

Profit is the d-value of the income from the sales of the production, operating organizations or individuals and the costs. After paying the income tax, the profit will be kept by the organizations or individuals. The ship yards can benefit from the building of the ships for the ship owners. The volume of the profit concerns closely the inner and external condition of the enterprise. The inner condition is the guiding ideology of the business operation, the technique and the level of administration as well as the management and scheduling of the production plan, the labor productivity and the material supply

External factors are the demand of the vessel market, the change of economic environment, the currency and the exchange rate. The main profit of the new-building ship price is the d-value of the new-building ship price and the ship-building costs which reflects the effect of the economic activity of each manufacturing or current department. The manufacture of the products must be beneficial, which is the necessary premise of the survival of the enterprise, the

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[4] The demand of the ship-building market means the volume of the new orders of bulk carriers.
[5] The supply of the ship-building market here by means the shipyards' building ability.

expanding of production, the improving of the level of production technique, the enhance of the competition of the enterprise, the perfecting of the working condition and the stimulation of the stuff's enthusiasm. The enterprise should price the production reasonably and properly according to its competition in the market in order to win out against the competitors.

(5) State Revenue

Vessel market is an international market. Therefore, the taxes affect the new-building ship price are the business tax, value-added tax, export rebates and import and export tariff, etc. These taxes have great impact on the costs of ship-building. Many policies in the foreign countries protect the ship-building industry. In recent years, the export rebates in China slumped, which reject obstruct the development of the ship-building industry. Besides, when building the national ships, the government should take the same policies as building the foreign ships in order to solve the problem of the national ships being built by the nation. Currently, building ships in China will not gain the export rebates, so many ships have been built in foreign countries, which result that the local ship yards build a lot of foreign ships but many Chinese ships are built in foreign ship yards.

(6) International Finance, Exchange Rate and Interest Rate

The change of the exchange rate and the interest rate of the bank together with the confidence and enthusiasm of the world finance on the ship–building industry and the shipping market have a great impact on the ship market. The of exchange rate means that during the world economy and trade, the change of the exchange rate may lead to the loss of the counter parties. In the export trade of ships, the risk of the

change of the exchange rate is bigger than that of export trade. The reason for this is that the building cycle of ships is very long, as well as the time of receive the foreign exchange. If the ship-owners take the way of delay payment, the time of receive the exchange will be extended to eight to ten years after the delivery of ships. The longer the time, the deeper the degree of unpredictability will be.

The loss caused by the change of the exchange rate is not only reflected on the depreciation of the receiving exchange, but also can be seen during the process of building the ships when the importing of some equipments and materials is needed.

When considering the fluctuation of the exchange rate, the ship yards in China need to take two main aspects into consideration: The *yuan* is mainly exchanged to the currencies of the west countries. The exchange rate of the export ships also should be considered. For example, some ship yards may choose the purchase method with the larger ratio of payment in the early period in order to reduce the impact of the fluctuation of the interest rate and exchange rate on the new-building ship price. Thus they can decrease the loan of the working capital and the risk of the increase of the interest rate of the *yuan*. Besides, they can decrease the risk brought by the appreciation of the *yuan*. When facing the increasing of the interest rate of the *yuan*, cutting down the loan of the *yuan* can reduce some degree of losses. Apparently, increasing the ratio of early progress payment is a very effective way to reduce the risk of change of the interest rate and exchange rate of the *yuan*.

Building the export ships will need the currency translation. The fluctuation of the translation will lead to the difference between the budget and the settlement of the contracts. The ship yards will decrease the new-building ship price when the state currency devalues and increase the new-building ship price when the currency

appreciates in order to reduce the risk. However, this method will affect the competitiveness of the ship yards. The change of the exchange rate will only affect the profit of the relating ship-building enterprises and the ship-owners, which leads to the change of the number of the new orders. The ship-building industry will also face some risks in short term, but the whole market won't be affected in a long-term. The change of the exchange rate and interest rate will finally be reflected on the new-building ship price.

(7) The Competition In the Ship-building Market

The competition and monopoly in the technique and business are the inevitable phenomenon as well as the world ship-building market. The monopoly and competition directly lead to the survival of the fittest from the competitors. For the ship-building market, the consequence of the competition in the market is that the ship yards with low level of the technique and competition will go bankrupt or change the line of production or they can only survive by build the ships with low additional value.

The world vessel market is the market with low concentration of oligopoly. The world vessel market is now over capacity. Meanwhile, the degree of concentration of the ship buyers market is high, which lead to the fierce competition of the market and the difficulty in cooperation between the ship-building enterprises. Thus, the price competition between the enterprises is non-cooperative price game.
In the world vessel market, there are a large number of oligarchs, but only one will win the bidding of the ship-owners.

If the degree of the knowing the business activities of the competitors decreases, the enterprises will take high risks when raising the price, because the enterprises may lose the orders and find it difficult to raise price in the next tender. The vessel market has been over capacity for a long time, so the ship yards may pursue probability of gaining the orders instead of the potential high profit. Hence, generally, if the external environment does not change much, the new-building ship price will be steady on a lower level.

The economic benefit and competition to a great degree determine the status of the ship-building enterprises in the market structure. Meanwhile, the degree of concentration of the ship-building market reflects the degree of monopoly of some ship yards. The concentration of the market means the concentration ratio of certain industries or market. It is usually showed by the market share of the medium enterprise in the market which can reflect the degree of the monopoly in the market. The higher the degree of the market concentration is, the higher the degree of the market monopoly. Ship-building enterprises need to face not only the bargaining environment with the ship-owners, but also the competition with the world ship-building groups and other ship yards. They need to make sure that whether the price they made is reasonable.。

(8) The different level of ship conductions

The improvement of shipyard construction level can make it provide the new ships to the ship owner at a shorter time and higher quality. At the same time, shipyard can get more new ship order by lower its price; however, the difference price of the new ship is resulted from the different price. Product differentiation means the difference production of the same type made by different companies, which lead to the different choices of the consumers and the incomplete competition of the market. The more

difference of the production the more right a company can get to price the market and the easier a differentiation can appear in a market. The difference of the production reflects in:

(a)The difference of the consumers' recognition; This is brought by some characteristics of the production such as quality, packing, function, etc. like food, and subjective impression of the buyer like the bias to different brand of the productions.

(b) The price of one brand production have a constraint to the other once the two are the substitutes, which means the number of their cross elasticity of demand is positive, what is more, is large. The characteristics of the ship production can be description by some indexes, but different provider of the ships doesn't make different in some of the indexes such as location. The main function of the ship is its transportation; therefore, its location is not important for the buyer. Whether the relevant information of the shipyard can be get for the ship owner is seemed indifference. Because the number of the buyer and seller of the ships in the market is small and stabile, the buyer can get enough information of the market. On the other hand, products for sale are finished by inviting public bidding, and by this way buyer can get enough information of the seller.

The differences of the same type of the ships built by the different companies are:

(a) The techniques designation and construction; the trades of the ship products are dealt on the order of the products and the seller make the ships by the contract.

(b) The ships type; the quality of high-tech and high added value complex ships are obvious while the common ships are not.

(c) The leading time; some companies can deliver the goods on time for its high level of designation and production, while the others cannot for the limitation of their lower product tech, which lead to the late delivery and price of new ships. So for the same type of common ships there is little production difference. High-tech ships have an obvious difference which leads to the different price of new ships.

(9) The order behavior of the ship owner

Ship owners have their expectations towards the new-building ship price through the analysis to the macro-economy and shipment industry. The expectation of all the ship owners can change the relationship between supply and demand in the ship market, furthermore the price of the new ship. The expected fluctuation will strengthen the supply and demand and expectation of ship owners. The motivation of ship owners are including:

(a) The ship team need the new ship for the old has been used for long enough.

(b) When the ship owner forecast the market of the shipment will be better, he will make the new or the second-hand ship order to expand his ship team, so that he can make a profit in the future shipment market (for example, the increase of the new ship because of the transportation of new goods, or the new transportation routes.

(c) The ship owner will make new ships order because he forecast the ship market will be better and buy the ship at the present price and sell later can make a profit at a higher price. For another we can analyze the buyer behavior from the usefulness and differentiation of products. The more "surplus value" a ship can make for the owner, the higher demand of the ship can be needed by the owner, and the price of

the new ship will go up. The ship owner will buy the high quality and reasonable price ships in the market. The decision depends on the ship owner if the price of a company's ship is high and the quality is better than the others'. When the construction quality of the ship is stable, the number of the order a company can get depend on its price and that of the competitors'. When the price is closer, whose quality is higher than the others' who can get more orders. However when there is a huge price gap between the companies, the one whose quality is lower can get more order.

The duality and contradiction made the purchase decision analysis complex, and the common way is to contribute the "unreasonable affection" to "psychological price phenomenon".

For example, in the ship market, there is an acceptable interval of the new-building ship price in the ship owner. Because of the present high price shipyard has enough order and doesn't eager to accept new order, and at the same time the delivery price is high enough for the ship owner to increase his income; therefore, ship owner can accept a higher price. This can partly explain why the consumers will buy the goods positively when the price is climbing. There are always some consumers would like to buy the goods at a price higher than its list price. This also means the price of the products is lower than the "perceived value". The gap between the highest price and the actual price is called consumer surplus: the surplus of the highest price a consumer would like to pay and the actual price is the profit the consumer get from the deal, and its forum is the good's use value minus its deal value. There are two behaviors in the ship market:

(a) Opportunistically building ships.

(b) Urgent high price. The order forecasts the new-building ship price will climb in the future will make lots of ships. A good example of this is in 1983 the world ship market is desolate, but some Japanese ship teams thought believed the market will be better soon, and then they made 125 ships which were 4 million and 70 thousands ton, and this made the new-building ship price appeared "platformperiod" and no longer dropped, and this behavior made San Guang who were in those team broke in 1985. According to the update and expanding, the ship owners have their detailed plan. They hope they can get the ship at the appropriate time when the price is appropriate and lower than the evaluation price of the new ship. But when the ship owner needs a ship urgently, the "urgent high price" appears. For the ship maker shorten the construction period is one of the most important part of its competitiveness.

(10) Public Policy

Shipbuilding market has a strong relationship with public policy. Shipbuilding is a technology, capital, labor-intensive industry. In order to arrange the national labor force, enforce the industrial distribution, as well as some military and political considerations, countries actively provide a variety of positive measures to encourage their ship owners to make new ships in their domestic shipyard, even if supply exceeds demand in the shipbuilding market. Kinds of subsidies in some shipbuilding counties are such examples before the shipbuilding subsidies haven't been canceled. This phenomenon distorted the fundamental role of market to a certain extent. Pricing should compare the two forces, government force and the market force. In the ordinary consumer goods, the market economy takes a dominant position.

However, the government force plays a stronger role when related to national security or protection. Ship is the product living in the strategic position of the State. In considering the prices of new ships, the role of government should not be ignored. Japanese shipbuilding industry development depends largely on government's support by implementation of industrial policy on the shipbuilding industry. Their main measures include direct administrative intervention and administrative leadership, as well as finance, taxation, financial measures. Through measures such as the planned shipbuilding and deferred payment loans, Japanese shipbuilding industry provides the shipbuilding industry with indirect financial assistance actually.

The Japanese government also provides financial subsidy such as buyer's Credit with interest rate lower than 4 percent and 5 percent to 30 percent new-building ship price subsidies at different times. During 1990 and 1992, the development fund which the Japanese government allocated to the shipbuilding enterprises exceeded more than 10 billion U.S. dollars annually. Tax rate was 3 percent when the shipyard profit margin was 5 percent and 1.6 percent when profit margin was 3 percent. Besides, the government provides huge loans to domestic and foreign shipping industry to stimulate demand for ships, with implementation of industrial protection through tariff barriers and other measures. Since the 1960s, the Korean government listed the shipbuilding industry as one of the national key development projects, and put forward the slogan "Better Shipbuilding for Stronger Nation" with strong supports in the industrial policy.

In the 1980s, South Korean shipyards gained a large number of orders by providing prices 10 percent to 25 percent lower than the price in Japan and Western Europe shipyard, which made the Korean shipbuilding worldwide market share escalated from 5.5 percent to 20 percent to 25 percent, become the second largest shipbuilding

country in the world, and Finally boarded the ship throne. The seller loans, credit guarantees and favorable tax provide by the shipbuilding government have good effects on raise of the new-building ship prices. It is noted that by providing seller loans increase the new-building ship price by about 5 percent (reference 2). Actually, this is done by loss of soft loan interest rate in exchange for the increase of shipyard operating rates and employment rates.

(11) International Covenant

International Convention impacts the costs of new ship construction, thereby affecting the prices of new ships, which is demonstrated in the previous chapter.

(12) Anthropogenic interference

When the shipbuilding industry continued depression, the shipbuilding enterprises of the shipbuilding country (region) will jointly put forward various forms of industry protection measures to improve the boat price and reduce the shipyard started, in order to protect their own interests. When shipbuilding profits dropped significantly, such cooperation is particularly prominent. When the shipbuilding industry is booming, the various protection measures will be removed early or later and enterprises consciously start co-expansion of shipbuilding equipment. In late 1980s, Japanese and Korean shipyards suffered heavy economic losses after a long period of price competition. After repeated consultations between the two sides, the new-building ship price recovered.

(13) Emergencies

Worldwide emergencies affect the new-building ship prices, according to the experience existing in the shipping market. During 1967 and 1975, the close of the Suez Canal forced the shipping industry to customize a large number of VLCC which could pass the Cape of Good Hope. The new-building ship prices soared to a very high level with such large orders received by the world shipbuilding industry. In the earlier half of the 1960s and 1970s, the world shipping and shipbuilding industry entered a golden era. In 1973, the total transport capacity of the shipping industry reached 39.22 kilotons. Nautical miles/dwt, and the orders for new ships reached 129.6 million dwt (73.6 million gross tons).

In 1974, orders for new ships of the world shipyards reached 242.32 million dwt. During this period, the shipbuilding and shipping industry made strong earnings. After the first oil crisis, the global economy has been seriously affected. The shipping market became weaker with the ocean turnover, transport efficiency, orders for new ships and shipbuilding profits felling into the trough. The war is politics with bloodshed while politics is a bloodless war. The ebb and flow of politics during the peacetime also impacts the new-building ship price. For example, the impact of 9 • 11 events on the new-building ship price is obvious.

The prices of new ships consist of the cost and the profit, with the cost accounting for about 94 percent and being the key influencing factor of the new ships. In factors constituting the cost, the host, steel and labor costs affects the prices of new ships greatly, especially the price of the steel impacts the new-building ship price largely at present. Therefore, when we analyze the fluctuations in the prices of new ships, the price of steel is one of the factors necessary to consider.

Take South Korean shipbuilding industry for example, the trends of the prices of new ships and shipbuilding costs can be seen from the following figure. During 1997 and 1998, the trends of these two indices were broadly consistent. In 1999, the differences appeared that the prices were still the original levels with the costs rising. The differences became more apparent during 1999, 2000 and 2001. Compared with 1997, in 2002 the index differences between them reached 13 with a continuing expanding trend. Therefore, consideration of the shipbuilding cost factors is relatively simple and not enough to analyze of the new-building ship prices. Through the above analysis, in addition to shipbuilding costs, the factors that affecting the prices of new ships also include the following outside influencing factors: the world economy, the shipping market supply and demand, shipbuilding market supply and demand conditions, international finance, human intervention, and emergencies.

As the various factors affecting the prices of new ships on different aspects, the strength of their impact on the prices of new ships are not the same. The following statistical correlation analysis method is used to analyze the relevance of each factor with the new-building ship price. For some of the factors, such as national public policy and emergencies, their impact can be assessed only when they occur. These factors impacted the new-building ship price through their influence on other quantizable factors in the past years. This research only analyzes those quantizable factors, including the world economic growth rate, the shipping market supply and demand, the shipbuilding market supply and demand, major shipbuilding country's exchange rate (*won* for example).

Table2. 4: The relationship between the new-building ship price and other factors

	World GDP growth rate	Demand of the ship market	Supply of the new-building ship market	Exchange rate of main ship-building countries	New-building ship price
1998	100	100	100	100	100
1999	150	50	113	108	103
2000	240	150	119	96	113
2001	135	47.5	125	103	110
2002	100	50	134	107	105
2003	135	225	144	101	117
2004	205	125	155	99	156
2005	175	250	188	92	184
2006	200	185	195	81	183
2007	200	450	231	79	233
2008	70	350	256	75	275
2009	-115	50	294	107	256
2010	210	150	300	96	237

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

After analyzing the data in Table 2.4, we get the Correlation coefficient of other factors to the new-building ship price as the following which is calculated by the Excel:

Table2. 5: Correlation coefficient of other factors to the new-building ship price

	World GDP growth rate	Demand of the shipping market	Supply of the ship-building market	Exchange rate of *won*
δ	-0.29	0.54	0.95	-0.6

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

As can be seen from the Table 2.5, factors with their relevance level of the price of new ships in decreasing order are shipbuilding country's exchange rate, the shipbuilding market supply and demand conditions, the shipping market supply and demand conditions, as well as world economic growth rate (this is the fundamental

factor). Production costs and the exchange rate have become major factors affecting the new-building ship prices in recent years. Certainly, during some specific period of time, the importance of these affecting factors will have some changes on their impact of the new-building ship prices, but mostly the case.

This is mainly due to the expensive single ship with shipbuilding costs accounting for about 95 percent and the steel taking a large proportion in the shipbuilding costs. In addition, as South Korea and Japan take the leading position in the world shipbuilding market, *won* or Japanese yen exchange rate fluctuations will lead to the shipyards of South Korea or Japan to take measures to adjust the prices of new ships, which results in great impact on the new-building ship prices within the whole ship market.

The Asian financial crisis is such an example. Although in recent years, the discipline of supply and demand in the ship market has a slightly smaller impact comparing with other factors, still plays an important role in it. The shipping market supply and demand conditions affect the changes in the prices of new ships through the shipbuilding market supply and demand. This is consistent with our analysis. Other factors might show stronger impact in a certain period, but their relevant strength with the new-building ship prices are generally the case in the past 16 years. Even if the growth rate of world GDP has increased, the price of new ships is still possible at low levels if the level of world economic development is very low. That is because it is the international level of economic development in promoting the growth of prices of new ships, rather than the world GDP growth rate. World GDP growth is only in one way showing the economy's growing, and does not indicate the level of economic development. However, the analysis of the data in the tables is relatively simple. Without consideration of the impact of historical unexpected

events and human factors, their relevance with the price for new ships will change, which is the main content of the next chapter to be analyzed.

2.4 Conclusion

In the chapter 2 we find out the main feathers and reasons of the fluctuation of the new-building bulk ship price by analyzing the condition of the new-building ship price fluctuation from 1988 to 2010. These factors affect the new-building ship price by affecting the demand and supply of the new-building market. The factors include: the world economy, world trade, shipping market, new new-building market, international conventions, emergencies, government policies, deliberate human interference and the costs of building ships. By the quantitative analysis of the relationship between the quantifiable factors and the new-building bulk ship price, we can get the conclusion that, the impact weight of these factors is from high to low: costs of building ships, the exchange rate of main new-building countries, the demand and supply of the new-building market, the demand and supply of the shipping market, the growth of the world economy.

Chapter 3 Prediction of the New-Building Bulk Ship Price

3.1 The Mathematic Model

3.1.1 The theoretic basic of the model

Regression analysis is an applied science which describes the way to deal with the data. The linear program is on of the most popular ways used n mathematical statistics, which will solve the relationship between the variables in the systems and predict them by using the simulation model to analyze the observed data.

Usual linear program only puts emphasis on the measurement error and the uncertainty caused by the random factors. The parameter is regarded as distinct. However in physical problems, there is fuzziness between the dependent and independent variables. When people's judgment is affected by the external factors, fuzziness must be taken into consideration.

In the 80s when the "house price evaluation model" was raised, the fuzziness had been taken into consideration because of the condition of the materials. Besides, such method has been used in the prediction of the exchange rate.

In China, this method has also been improved and applied. In general regression model, the difference between observed value and estimated value is regarded as observation difference. But in FLR, such difference has been regarded as the uncertainty of the system structure. Such difference is defined as the fuzziness of the parameters of the system.

In this research, the new-building bulk ship price we will predict is the price of the new bulk carriers, so in the following contents in Chapter 3, the "new-building bulk ship price" means the new ship price of the bulk carriers.

The new-building bulk ship price is the result of the negotiation between the ship owners and shipyards, so the factors affecting the new-building bulk ship price are to some degree inevitably subjective. In this research, the sensitivity between the new-building bulk ship price and each factor is analyzed.

There are many factors affecting the new ship price. According to the analysis in the previous chapters, the main factors affecting the new-building bulk ship price are the demand of the shipping market, the supply of the ship-building market and the exchange rate of main ship-building countries. The variation and the interaction of these factors are to some degree uncertain and irrational. There is no way to gain an exact predicted price by any prediction. Besides, the prediction of a variation range is more acceptable than a certain point. The fuzzy regression model shows the fuzziness between the independent variable we input and the dependent variable the model outputs. As a result, the fuzzy linear regression model is proper to deal with the problem of price prediction.

3.1.2 The Choose of the Variable

In this research, we choose the one small group of variables in which are irrelevant and with most part of information of the original sample.

For example, if w want to observe the relationship of $X_1, X_2, ..., X_M$, we will analyze their liability:

$$X = \begin{vmatrix} x_{11} & x_{12} & ... & x_{1M} \\ x_{21} & x_{22} & ... & x_{2M} \\ ... & ... & ... & ... \\ x_{n1} & x_{n2} & ... & x_{nM} \end{vmatrix}$$

X is also called the observation matrix. If we want to simplify the M variables, we can try to find a new group of variables $Y_1, Y_2, ..., Y_M$, by which the original variables can show linearity. $Y_1, Y_2, ..., Y_M$ should have the features as the following:

(1) $Y_1, Y_2, ..., Y_M$ should be independent on each other. Besides, the sum of their variance and the variance of $X_1, X_2, ..., X_M$ should be equal. The variation of $Y_1, Y_2, ..., Y_M$ should be diminishing from big to small.

(2) In order that $Y_1, Y_2, ..., Y_M$ is convenient for us to calculate and analyze, their length should be 1. It means that the $X_1, X_2, ..., X_M$ expand a linear space Ω, and any element in the space can be signified by $X_1, X_2, ..., X_M$ as:

$$\zeta = a_1 X_1 + a_2 X_2 + ... + a_M X_M$$

Then we find a vector with the biggest variation in the Ω and normalize it:

$$X = \left(X_1, X_2, ..., X_N \right)', a' = \left(a_1, a_2, a_3, ..., a_N \right)$$

If the covariance matrix represented by $V(X) = V$, $V(a'X) = a'Va$ represents the variation of $a'X$, and a should meet the need that $a'a = 1$. In fact this is aim at calculating the max eigenvalue λ_1 of the matrix V, and the a_1 is relevant eigenvector of λ_1. By this way we can get $\lambda_1 \geq \lambda_2 \geq \lambda_3 \geq ... \geq \lambda_M \succ 0$ and relevant eigenvector $a_1, a_2, ..., a_M$. Now we can define the principle component:

$Y_1 = a'_1 X$ the first principle component

$Y_2 = a'_2 X$ the second principle component

…

$Y_M = a'_M X$ the M principle component

From the above we can get see that the variance of the covariance is centralized on the diagonal line by orthogonal transformation and the diagonal elements are in descending order. Apparently, $Y_1, Y_2, ..., Y_M$ and $X_1, X_2, ..., X_M$ all carry the information of the problems need to be analyzed, and $Y_1, Y_2, ..., Y_M$ simplify the information. There are irrelevant, which means the information they carry are not repeated. Besides, Y_1 carries most of information and Y_2 carries less than Y_1, and

by such analogy. If the initial variable is normally distributed, the new variables are independent from each other. If the first n $Y_1, Y_2, ..., Y_n$ carries 85 percent of the information of $X_1, X_2, ..., X_M$, then we can simplify this problem:

Set $S = \lambda_1 + \lambda_2 + \lambda_3 + ... + \lambda_M$

S is the sum of the variances, so the first vector Y_1 occupies λ_1 / S of the total variation, and the first and second vectors occupies $\lambda_1 + \lambda_2 / S$ of the total variation and by such analogy. Thus we can do statistic analysis on $Y_1, Y_2, ..., Y_n$ so that to simplify the problem. This research will combine the principle components analysis and regression analysis to solve the problems.

Based on the above theory, generally the regression equation can be:

$$y = X\beta + \varepsilon \qquad\qquad (1)$$

$$y = (y_1, ..., y_p)^T \quad, \quad \varepsilon = (\varepsilon_1, ..., \varepsilon_P)^t \quad, \quad \beta = (\beta_1, ..., \beta_p)^T$$

$$X = \left| 1, x_{ij} \right| \quad, \quad i = 1, ..., p ; \quad J = 0, ..., n$$

The β can be calculated by the function:

$$\beta = (X^T X)^{-1} X^T y \qquad\qquad (2)$$

Generally the fuzzy regression analysis model is:

$$Y = A_0 + A_1 X_1 + ... + A_n X_n = A(x) \tag{3}$$

Y is the model output dependent variable, $X_i (i = 1,...,n)$ is the model output independent variable. $A_i (i = 1,...,n)$ is the model parameter. $A_i (i = 1,...,n)$ is often represented by the symmetrical triangle fuzzy number $A_i = a_i c_i$ with the central value of $a_i \in R$ and the width of $c_i (c_i \geq 0) \in R$ as:

$$\mu_{A_i}(x) = 1 - \left| \frac{a_i - c_i}{c_i} \right| , \quad a_i - c_i \leq a_i \leq a_i + c_i \tag{4}$$

According to the Extension Principle of the Fuzzy Theory, (4) can be represented as:

$$Y(x_i) = (a_0, c_0) + (a_1, c_1)x_{j1} + ... + (a_n, c_n)x_{jn} = (a^T x_j, c^T |x_j|) \tag{5}$$

$a^T x_j$ is the central value of the fuzzy output: $a^T x_j = a_0 + a_1 x_{j1} + ... + a_n x_{jn}$

$c^T |x_j|$ is the range internal of the fuzzy output: $c^T |x_j| = c_0 + c_1 x_{j1} + ... + c_n x_{jn}$

The membership function of $Y(x_i)$ can be represented as:

$$\mu_{Y_i}(y) = 1 - \left| \frac{y - x^T a}{c^T |x|} \right|, x \neq 0 ;$$

If $x = 0, y = 0$ then $\mu_{Y_i}(y) = 1$; if $x = 0, y \neq 0$, $\mu_{Y_i}(y) = 0$.

If two fuzzy numbers $A_1 = (a_1, c_1)_L$ $A_2 = (a_2, c_2)_L$ has the internal as $0 \le h \le 1$, then their relationship is:

$$[A_1]_h \ge [A_2]_h = \begin{array}{c} a_1 + |L^{-1}(h)|c_1 \ge a_2 + |L^{-1}(h)|c_2 \\ a_1 - |L^{-1}(h)|c_1 \le a_2 - |L^{-1}(h)|c_2 \end{array}, \quad [A]_h = \{x, \mu_A(x) \ge h\}$$

$$Y = f(x_1,...,x_{11}) y \in [Y]_h = \begin{array}{c} a^T x + |L^{-1}(h)|c^T|x| \le y \\ a^T x - |L^{-1}(h)|c^T|x| \le y \end{array}, \quad |L^{-1}(h)| = 1 - h$$

Hence the $[Y]_h$ on the level set h is:

$$[Y]_h = \left[a^T x - (1-h)c^T|x|, a^T x + (1-h)c^T|x| \right]$$

If $(x_j, y_j) = (1, x_{j1},..., x_{jn}, y_j), j = 1,..., p$, then the coefficient of the regression model $A_i = (a_i, c_i)_L, i = 0,..., n$ can be calculated by the following function:

$$\min J = \sum_{J=1}^{p} c^T|x_j|$$

s.t $a^T x + (1-h)c^T|x| \le y$

$\quad a^T x - (1-h)c^T|x| \le y, j = 1,..., p$ (6)

$\quad c_i \ge 0, i = 0,..., n$

In the FLR model, the fitting degree of the fuzzy output and actual observed value must be measured. We can use the H level set. If all the observed data y_i shall at least belong to the estimated fuzzy set Y_i on the H level set，then:

$$\mu_Y(y_i) \geq H \qquad (i = 1,2,...,N) \tag{7}$$

If we expand the formula, then we get:

$$a^T x_i + (1 - h_i)c^T |x_i| \geq y_i$$

$$a^T x_i - (1 - h_i)c^T |x_i| \geq y_i, i = 1,...,p \tag{8}$$

$$c_j \geq 0, j = 0,...,n$$

$$0 \leq H \leq 1; i = 1,2,...,N$$

In the years that considered in this research, the new-building bulk ship price fluctuated illogically because of some emergencies. In this research, we will not take such emergencies such as war into consideration. In order to archive this, we will take the following steps:

(1) Solve the min squares regression coefficient

$$\beta = (x^T x)^{-1} x^T y \tag{9}$$

(2) The standard deviation of the model σ

$$\sigma = \sqrt{\frac{\sum_{i=1}^{P}(y_i - y_i')^2}{p - n - 1}} \tag{10}$$

In the formula, the y_i is the j th actual value. y_i' is the relevant predicted value.

$y_i' = \beta x$, n is the independent variable input number. p is the simple size.

(3) If $y_i' - t\sigma \leq y_i \leq y_i' + t\sigma, i = 1,..., p$ then the data at the year of i is the data chosen by the model. If not, then the data belongs to difference group which will be treated as a singularity.

In the FLR model which is extracted because of the actual problem, the bigger the fuzzy central value, the bigger the relevant fuzzy with.

The constraints are as the following:

$$\max\left\{\frac{c_0}{|a_0|}, \frac{c_1}{|a_1|},..., \frac{c_n}{|a_n|}\right\} \leq \delta \tag{11}$$

3.1.3 The Establishing of the Mathematic Model

Based on the above analysis, we will take the following measures to solve the problem:

(1) Calculate the central value of the fuzzy parameters a by using the min squares regression. The formula is as the following:

$$a = \left(X^T X\right)^{-1} X^T y \tag{12}$$

(2) Calculate the fuzzy width c with the linear programming formula:

$$\min_{a,c} J = \sum_{J=1}^{p} c^T |x_i|$$

$$\max\left\{\frac{c_0}{|a_0|}, \frac{c_1}{|a_1|}, ..., \frac{c_n}{|a_n|}\right\} \leq \delta$$

$$\text{s.t} \quad a^T x_i + c^T |x| \geq y_i \tag{13}$$

$$a^T x_i - c^T |x| \leq y_i$$

$$c_j \geq 0, j = 0, ..., n$$

3.2 The Resource of the Data Used in the Model

According to the analysis in the chapter 3, hereby we set the factors which mainly affect the new-building bulk ship price as the independent variables, and the new-building bulk ship price as the dependent variable:

$$Y = f(x_1, x_2, x_3, x_4)$$

Y : The new-building bulk ship price

x_1: The demand and supply in the ship-building market, including the ship-building ability and the volume of the new orders.

x_2: The demand and supply in the shipping market, including the shipping turnover capacity and the world fleet scale.

x_3: The costs of building ships

x_4: The exchange rate of the currencies in main ship-building countries.

Because of the difference of the order magnitude of these factors, here we turn them into indexes as the following form:

Table3. 1: The change of the index of the factors in the ship-building market from 1998 to 2012

	World GDP growth rate	Demand of the shipping market	Supply of the new-building ship market	Exchange rate of main ship-building countries	New-building ship price
1998	100	100	100	100	100
1999	150	50	113	108	103
2000	240	150	119	96	113
2001	135	48	125	103	110
2002	100	50	134	107	105
2003	135	225	144	101	117
2004	205	125	155	99	156
2005	175	250	188	92	184
2006	200	185	195	81	183
2007	200	450	231	79	233
2008	70	350	256	75	275
2009	-115	50	294	107	256
2010	210	150	300	96	237
2011	-	163	310	92	224
2012	-	146	317	98	202

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

We can calculate the value of a and c of the relevant factors affecting the new-building bulk ship price based on the factors in the factors group from 1990 to 2003 with the formula (12) and (13), and we can get the following form:

Table3. 2: a and c of the factor group from 1990 to 2010

Factor Coefficient	Constant term	Supply of ship-building market	Demand of shipping market	*Won* exchange rate
a	139.991	0.7938	0.02258	-1.25885
c	0	0.0055	0	0

$\delta = 0.05$

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

Calculated with the Excel, the fuzzy regression model of the price is:

$$Y = 139.991 + (0.7938)x_1 + (0.02258)x_2 + (-1.25885)x_3 \qquad (14)$$

x_1 : Supply of ship-building market;

x_2 : Demand of shipping market;

x_3 : Korean *won* exchange rate

3.3 Results of the Model

3.3.1 Proof of the Model

Based on the data in 3.2, we can get the "prediction" of the new-building bulk ship price in from 1988 to 2012. Here we calculate the price index of the new-building bulk ship price and compare them with the actual data to prove the practicability of the model. Here the data of 2012 is only for the upper half year.

Table3. 3: Proof of the mathematic model, interval and central value

	New-building bulk ship price index	Central Value (Predicted)	Upper (Predicted)	Lower (Predicted)
1998	100	96	104	88
1999	103	95	103	87
2000	113	116	124	108
2001	110	110	118	102
2002	105	113	121	105
2003	117	132	140	124
2004	156	141	149	133
2005	184	179	187	171
2006	183	197	205	189
2007	233	234	242	226

2008	275	257	265	249
2009	256	240	248	232
2010	237	261	269	253
2011	224	231	239	223
2012	202	203	211	195

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

From the results we can see that the predicted price is very near to the actual price. Besides, from the result we can get the fluctuation range of the new-building bulk ship price in 2011 and 2012: (223,239) and (195,211). Thus we can see that in the condition that each factor is steady, because of the carrying out the "Common Standard" in April 2006, the new-building bulk ship price of 2006 will rise by around 5 percent, which will change from 183 to 197. With the carrying out the "New Coat Standard" in 2007, the new-building bulk ship price index will increase by around 10 points from 233 to 234.

The result shows that the mathematic model is practicable, the range of the prediction is around 10 percent and we can see from Table 3.3 that besides some certain years which the special affairs took place such as the year 2007, the results approximate the real data.

3.3.2 Prediction

After proving the practicability of the mathematic model, we can use the model to predict the new-building ship price index of 2013 and 2014 by using function (14). In the Table 3.4, the data of demand of the shipping market, the supply of the new-building ship market, and the exchange rate of *won* are all predicted value.

Table 3. 4: The prediction of the new-building ship price index of 2013 and 2014

	Demand of the shipping market (predicted)	Supply of the new-building bulk ship market (predicted)	Exchange rate of won (predicted)	Upper value of the ship price	New-building ship price index (predicted)	Lower value of the ship price
2013	144	293	101	259	249	239
2014	140	286	105	248	238	228

Source: Own calculation based on fleet statistics from Clarkson Shipping Intelligence Network (2012)

3.4 Chapter Conclusion

From Table 3.4 we can see the predicted new-building bulk ship price index of 2013 and 2014. The price index is 249 in 2013 and 238 in 2014, with the range of (239, 259) and (228, 248).
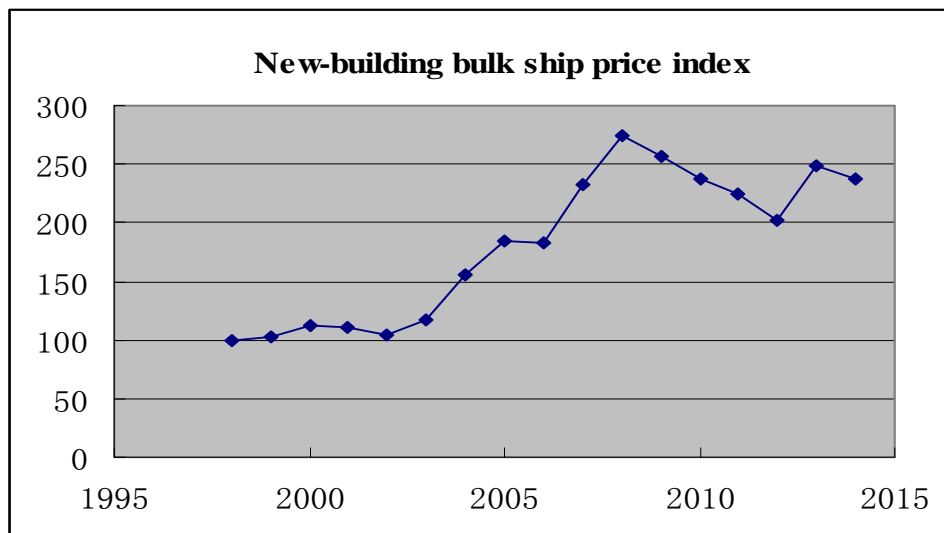

Figure 3. 1: The trend of the new-building bulk ship price index
Source: Own presentation with the data in Table 3.3 and 3.4

From Chart 3.1 we can see that although the new-building bulk ship price still

fluctuates, the general trend of it is increasing. This research raises the point view that, because of the periodicity of building a ship, the ship yards are still full of the orders of the new ships although the new orders in 2012, 2013 and 2014 may decrease. Even if the ship yards stop take the new orders of ships, the orders which have already been existed or built can be expanded to the end of the year 2013. This year, the great volume of the new ship orders will be delivered, thus the world bulk shipping capacity may reach 0.73 billion DWT, with the growth rate of 14.7 percent. Although the volume of the demolishing ships will increase as well, the world shipping capacity will spill over.

From the site of the demand of the shipping market, the demand is still increasing. The data of Seanergy shows that the growth rate of the bulk shipping has increased 7 percent in 2012, and most of the demand comes from China. The five year plan of China will end at the year 2015, the aim of GDP growth rate is 7 percent. Since in 2011 the GDP growth rate had reached 8.9 percent, China is really confident in reaching the goal in 2012. As a result, although the growth rate of the new-building ship price will decrease, the general trend is still upward.

Besides, the model also shows that, except the data in the year which the historical emergencies such as the Asian financial crisis and the war in Libya took place, the new-building bulk ship price has the highest sensibility to the demand and supply in the ship-building and shipping markets. This is accord with the fact that ships are secondary consuming goods.

Chapter 4 Conclusion

This research is based on the analysis of the experts, the law of value, the theory in western economics and the framework of competition in the market. The research analyzes the form of the new-building ship price, the factors affecting the new-building ship price and reveals the effect of each factor on the new-building ship price. Besides, this research chooses the main factors affecting the new-building bulk ship price as the variables and establishes the fuzzy regression prediction model by analyzing the historical data and the theory of the fuzzy regression which predict the new-building bulk ship price and show the verification of the correctness of the theory analysis.

4.1 Main Findings

The fluctuation of the new-building ship price has the features of periodicity, seasonality, irregularity, irrational and it has a trend of increase in a long-term, etc. The fluctuation of the new-building ship price is basically synchronous with the fluctuation of the ship market; the new-building ship price fluctuates with the change of the season; Some unpredictable emergencies left a serious impact on the market and led to the fluctuation of the new-building ship price; the expectation of the market and the speculative psychology of the ship owners have very important effects on the demand of the new ships in the new-building market which also lead to the change of the new-building ship price; The demand of the safety, comfortableness and environment friendliness by the maritime authority are more and more serious, which lead to the increasing of the new-building ship price.

This research shows the main factors affecting the fluctuation of the new-building ship price by analyzing the data from 1980 to 2010: the world economy, world trade, the demand and supply of the shipping market and the ship-building market, the international ship-building conventions, the historical emergencies, the government policies, and the costs of building ships. The costs of building ships are the base of the new-building ship price.

In shot-term, the main factors affecting the new-building ship price are the world ship-building ability, the world shipping turnover capacity, the world fleet scale and the exchange rate of the main ship-building countries such as the Korean *won*, etc. Except the exchange rate, these factors affect the new-building ship price by changing the demand and supply in the ship-building market; in long-term, the main factors affecting the new-building ship price are the raw materials such as steel, the corollary equipments of the vessels, the costs of labor and the international conventions. These factors affect the new-building ship price by changing the costs of building the ships.

In the end of Chapter 2, we summarize the factors affecting the new-building ship price, and finally the factors which had been quantified and used in the mathematic models are:
(1) The demand of the shipping market.
(2) The supply of the new-building market.
(3) The exchange rate of the main ship-building country's currencies.

After choosing the variables, we can establish a fuzzy regression model. This model can be used properly on the prediction of the new-building bulk ship price. In this research, the price of the new-building bulk ship price has been predicted.

From the result we can see that the prediction results approximate the actual data, which also means that the mathematic model is practicable, although there are still many aberrations with it. However, we can get the conclusion from the results of the prediction that, although the growth rate of the new-building ship price will decrease, the general trend is still upward in 2013 and 2014. The delivery of the old orders in 2012 will lead to over-capacity in the

shipping market, as a result the volume of new orders decreases rapidly. However the demand of the shipping especially from China will to some degree help the shipping market live through the spilling capacity.

4.2 Limitations of Research

This research is full of shortages because of the limitation of my knowledge. For example, the analysis on the factors affecting the new-building ship price is not elaborate and incomplete which failed to make a long-term prediction of the new-building bulk ship price.

The utilization of the phrases is still need to be improved. Besides, there a theory of economics paradox in the shipping market that, some people book or not to book the space just before the change of the new-building ship price according to such prediction, but this behavior lead to the change of the new-building ship price which is far different from the prediction, which is also need to be taken in to consideration. The data of the factors such as the exchange rate of the *won in 2013* and *2014* is also predicted one, as a result, the deviation of the results of this model will be larger.

Besides, in this research, some other factors such as the steel price, the supply of the raw materials and any other factors which may appear during the building of the ships have not been taken into the consideration. The reason is that although such factors do exist and may affect the new-building ship price, the weight of the impact they could bring is very little compared with the factors from the shipping market. However, the ignorance of these sporatic factors can still lead to the tolerance of the results of the prediction.

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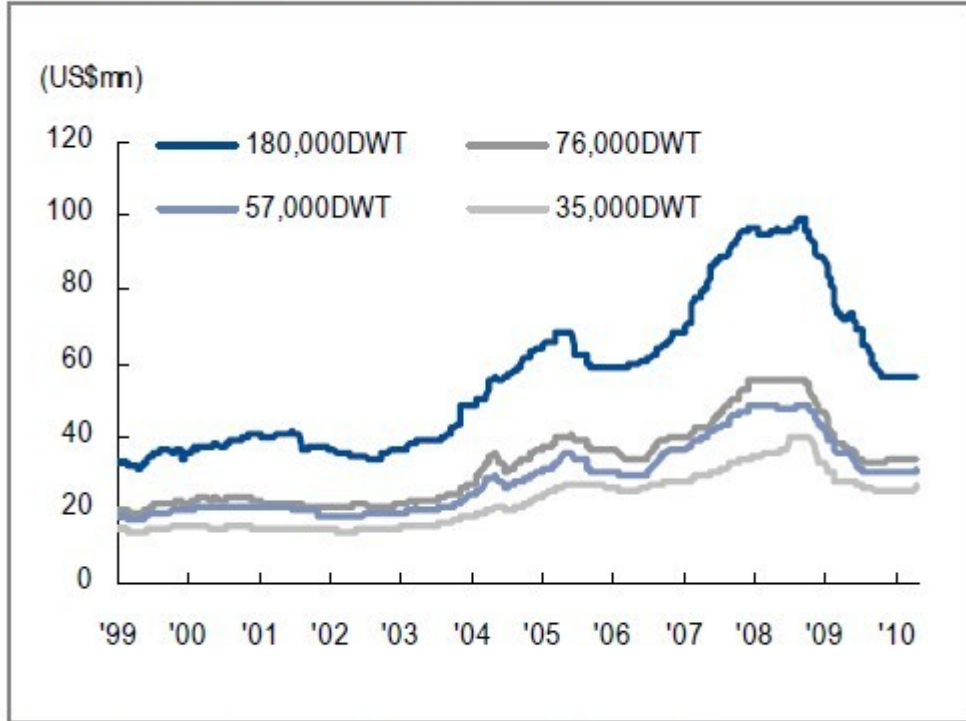
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Appendix I —— Bulk Carrier New-building Prices

Bulk carrier newbuilding prices, by size

Source: Clarkson, Shipping Intelligence Weekly ('10.4.16)

Clarkson Newbuilding price trends   (Units: US$mn, %)

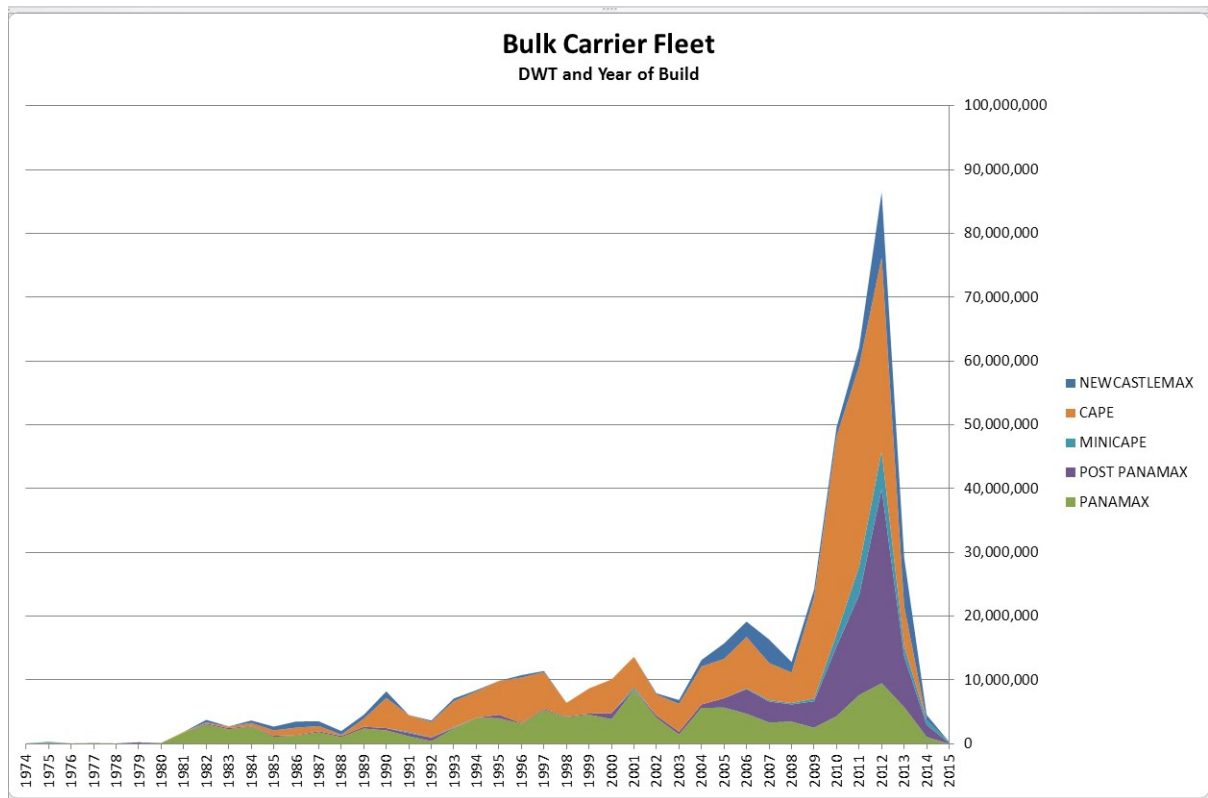|	Tankers				Bulk carriers				Gas vessels		Dry cargo		Clarkson Index
	VLCC 320kDWT	Suezmax 157kDWT	Aframax 115kDWT	MR 51kDWT	Capesize 180kDWT	Panamax 76kDWT	Handymax 57kDWT	Handysize 35kDWT	LPG 82km³	LNG 160km³	Container 3,500TEU	Container 1,100TEU	
2003	77.0	51.5	41.5	31.5	48.0	27.0	24.0	18.0	63.0	155.0	42.5	18.5	119
2004	110.0	71.0	59.0	40.0	64.0	36.0	30.0	23.5	82.5	185.0	53.0	22.5	149
2005	120.0	71.0	58.5	43.0	59.0	36.0	30.5	25.5	90.0	205.0	52.5	23.0	162
2006	129.0	80.5	65.5	47.0	68.0	40.0	36.5	28.0	92.0	220.0	57.0	22.0	168
2007	146.0	90.0	72.5	52.5	97.0	55.0	48.0	34.5	93.0	220.0	63.0	27.5	184
2008	150.0	91.0	75.0	47.5	88.0	46.5	42.0	32.5	92.0	245.0	60.0	25.0	179
2009	101.0	62.5	49.0	35.0	56.0	33.8	30.5	25.0	72.0	211.5	36.0	19.0	138
2009.11	104.0	63.5	49.5	35.5	56.5	33.8	30.5	25.0	74.3	211.5	36.3	19.0	140
12	101.0	62.5	49.0	35.0	56.0	33.8	30.5	25.0	72.0	211.5	36.0	19.0	138
2010.01	99.0	61.5	49.0	34.0	56.0	33.8	30.0	25.0	70.0	211.5	36.0	19.0	136
02	97.0	61.8	50.0	33.5	56.0	34.0	30.0	25.0	69.5	211.5	36.3	19.0	136
'10.03.12	97.0	62.0	50.0	33.5	56.0	34.0	30.0	25.0	69.5	211.5	36.8	19.3	136
'10.03.19	97.0	62.0	50.0	33.5	56.0	34.0	30.0	25.0	69.5	211.5	36.8	19.3	136
'10.03.26	97.0	62.5	51.0	33.5	56.0	34.0	30.3	25.3	69.5	211.5	37.0	19.5	136
'10.04.02	97.0	62.5	51.0	33.5	56.0	34.0	30.3	25.3	69.5	211.5	37.0	19.5	136
'10.04.09	98.0	63.5	52.0	33.5	56.0	34.0	30.5	26.0	69.5	212.0	38.0	20.0	137
'10.04.16	99.0	64.0	52.3	34.0	56.5	34.0	31.0	26.5	70.0	212.5	38.5	20.3	138
Chg 1	58.4	48.8	56.1	30.8	66.2	65.9	69.4	92.0	20.7	41.7	16.7	31.0	32.7
Chg 2	-38.9	-36.0	-36.6	-36.4	-42.9	-38.2	-36.1	-33.8	-27.5	-15.0	-42.5	-26.2	-27.4
'09 low	101.0	62.5	49.0	35.0	56.0	33.0	30.0	25.0	72.0	211.5	36.0	19.0	138
'08 low	146.0	90.0	72.5	47.5	88.0	46.5	42.0	32.5	92.0	220.0	60.0	25.0	179

Note: Annual and monthly newbuilding prices based on year-end and month-end data. Newbuilding prices in bold. April 2 figures not announced due to Easter holidays
　　Chg 1: compared to recent seven-year low
　　Chg 2: compared to recent seven-year high
Source: Clarkson, Shipping Intelligence Weekly (Apr 16, 2010), Woori I&S Research Center

Appendix Ⅱ—— Bulk Carrier Fleet

Bulk Carrier Fleet
DWT and Year of Build

Source: Antipodean Mariner http://antipodeanmariner.blogspot.com/2012/01/bulk-carrier-fleet-growth.html