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AN ECONOMETRIC ANALYSIS OF SHIPBUILDING MARKET IN CHINA

By

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Abstract

This thesis mainly focuses on the situation of Chinese shipbuilding industry. We have done this by looking at factors affecting volume of orderbooks, contracting and deliveries of the Chinese shipbuilding over last ten years.

Firstly, the thesis gives a general overview of factors may influence the supply and demand of shipbuilding. These factors are Chinese industry growth rates, exchange rates, interest rates, prices of second-hand ships, shipyards capacity, prices of steel plate, government policies, labor productivity, international trade, credit availability, shipping earning and market expectations. From these variables we have, we make a selection for further use in our regression analysis. We have not dropped the qualitative variables, but explain them alongside the quantitative analysis create a good overall picture and understanding the Chinese shipbuilding industry.

Methodologically, we use regression analysis as the workhorse tool. Three adjusted regression models are set up and run; the first with volume of orderbooks as dependent variable, the second with contracting and the third with deliveries as dependent variables respectively. We find that the most significant factors affecting the shipbuilding industry in China are exchange rates and government policies. Government policies and three indicators are proven to be highly positive correlated while exchange rates have negative effects on deliveries and positive effects on orderbooks and contracting. Other factors, such as interest rates and earnings, etc are significantly affecting shipbuilding with various degrees.

Qualitatively, in order to analyze the current situations of Chinese shipyards' capacity, regional comparisons of top shipyards with Japan and South Korea are presented. We find that China is playing a leading role in bulker, tanker and containerships construction while most ship yards are small or medium-sized and are very young yards established only in the last three decades. The market share of high-tech ships are mainly held by Japan and South Korea, who produce in larger scale shipyards that have also been established earlier than their Chinese counterparts.

Finally, we look forward the next five years, based on three different likely scenarios. The first scenario is assumed with sluggish recovery of world economy, second with fast recovery of economy and third with the same economy situations but without government supports. In general, orderbooks will decrease with 0.5% annually, contracting will increase around 2% growth annually in best predictions and below 0.9% increase in worst predictions. Besides, deliveries will keep increase with

average 12.6% increase in best outcomes but 12% increase in worst outcomes. Furthermore, Chinese government policies are proved to be more significant in affecting Chinese shipbuilding than world economy by comparing three scenarios. In the last part, we made final conclusions.

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Chapter 1 Introduction

1.1 General Introduction

In the 15th Century, Qing Dynasty built the largest ship in the world which was used to trade with western countries. At that time, this appearance and equipments of this grand ship was very impressive to all over the world. However, due to political reasons, Chinese shipbuilding industry was blocked for hundreds years until the last thirty years of 20th Century. Comparing with shipbuilding technology in western countries, China has been falling behind for hundreds of years. Chinese modern shipbuilding industry started from the middle of 19th century. In the 1980s, the world market share of Chinese shipbuilding volume only occupied lower than 2%. Chinese government realized that developing shipbuilding would bring huge economics and social profits and then supported this industry with billions of dollars and rights of state control. During the past several decades, Chinese shipbuilding industry proved to be surprising as China has come back the rank list of major shipbuilding countries. In 2005, the official announced that China decided to increase supports to shipbuilding industry. The long term result of these supports is to play the leading role among shipbuilding nations in terms of tonnage in ten years later.

In 2010, China has already been the largest shipbuilding country in terms of tonnage in the world. The size of orderbooks reached 65.6 million tons, which increased by 55% comparing with the size of 2009. The aim of being the largest shipbuilding nation was achieved 5 years earlier than expected plan. There are certainly some exclusive factors accelerating this process. Analyzing the correlations among determinants of shipbuilding and the volume of order book contracting and deliveries is necessary to figure out the causes behind the rapid development of shipbuilding market in China.

1.2 Research Question

The main research question of this paper is: **What are the main supply and demand factors that have affected the development of the Chinese shipbuilding market and what can we say about their future potential?**

In this thesis, this main research question is answered by looking at the following sub-parts:

- What have been the historical developments and what is the current state of play for the shipbuilding market in China?

- What are the supply and demand determinants that have had the biggest influence on the development of the Chinese shipbuilding market?
- What are the main challenges and weaknesses the Chinese shipbuilding market is facing?
- Based on the three sub-questions above, what can we say about potential developments for the Chinese shipbuilding market in the future?

We will focus on a market analysis from 1999 to 2010, related monthly data will be collected. We will employ them in a regression analysis to look at importance of factors and use this time-series model to look forward.

1.3 Structure

This thesis paper will consist of seven chapters. In Chapter 2, explanations about twelve variables that affect supply and demand of shipbuilding will be given. The reasons of choosing these variables will also be presented. The twelve variables can be divided into quantitative and qualitative ones. As for quantitative variables, we aim to include domestic economic growth, ships earnings, international trade volume, exchange rates, LIBOR interest rates, number of top shipyards, price of steel plate and price of second-hand ships. Government policies, as a dominant factor in affecting the development of Chinese shipbuilding, will also be elaborated upon in chapter 2. Chapter 3 covers methodology and data issues. The methodological approach looks at which factors matter for the development of the Chinese shipbuilding industry. In this thesis, we will use regression analysis to identify important factors, and causal chain analysis to look at qualitative aspects. Also in this chapter, we look at data issues. Monthly data of last 11 years will be collected from Clarkson, Chinese data bases, periodicals and journals, etc. What's more, due to the fact that shipbuilding is a complex industry, variables listed above may be linked to each other, which will also be investigated. Chapter 4 will present the results and interpretations of regression analysis. Which factors affect the shipbuilding market more and which ones less? In chapter 5, we present the methodology–regression analysis to make predictions for the Chinese shipbuilding sector in the future and explain the results of the forward-looking exercise. Chapter 6 concludes and presents recommendations for further research.

Chapter 2 Variables for Supply and Demand of Chinese Shipbuilding Market

2.1 General Introduction and Expectations

Shipbuilding industry involves nearly 200 sectors related to national economy. There are too many determinants which can affect the supply and demand of shipbuilding. In essence, there is no single driving force behind the determination of shipbuilding and factors are having effect integrated. Moreover, the demand analysis is based on global market while the supply analysis is based on Chinese shipbuilding market. In terms of literature review, existed literatures about this global industry are easy to find. However, English sources of Chinese shipbuilding, especially in modern shipbuilding period, are limited due to the confidentiality. Thus in this sector, we will present more literature reviews of the whole industry instead of Chinese market. Through taking over review of the global industry analysis, drawing similar summary of Chinese shipbuilding industry is acceptable. In the thesis, according to literature reviews, we choose major related variables to explain.

Table 2-1 Variables division

Variables affecting both supply and demand	
• Government initiatives • Ships earnings of freight rates • Exchange rates	
Variables affecting supply (Chinese market)	**Variables affecting demand (global market)**
• LIBOR interest rates • Price of steel plate • Capacity and number of top shipyards • Labor costs and productivity	• Volume of international trade • Price of second-hand ships • Domestic economic growth • Market expectations • Credit availability

Source: own compilation based on various sources.

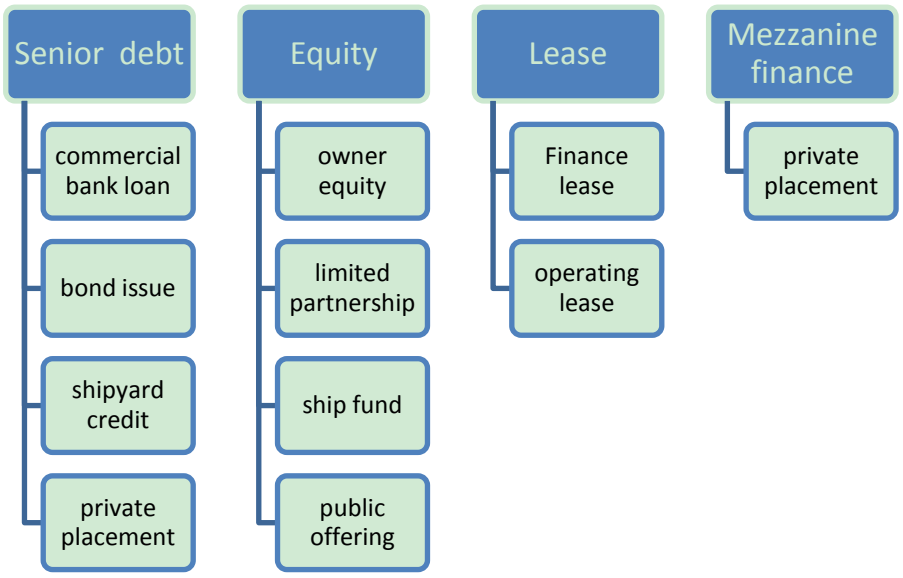
As the division presented above, variables including government initiatives, ships earnings and exchange rate have affects both on supply and demand sides. The reasons will be given in the following sections. Except these three, there are four different variables of supply side and another five variables of demand side will be explained.

2.2 Supply Variables

2.2.1 LIBOR interest rates

Shipbuilding is a capital-intensive industry which requires a huge amount of investment and a very long recoupment period. So ship owners and shipping companies have difficulties in covering all the shipbuilding costs with their funds in the hands. In order to expand and develop the fleets, looking for a way of newbuilding financing is vital for borrowers.

Figure 2-1 Four options for shipbuilding financing



Source: own adaptation from The Export-Import Bank of China (2008)

The figure above shows us the four main options for financing merchant ships. Traditionally, the most important and common source of debt finance for ships and shipping companies is the term loan. Therefore, in this thesis, we will focus on the bank loans. In Stopford's book, he summaries that, for commercial bank loans, there are five key aspects should be considered when negotiation processing between borrowers and bankers (Stopford, 1997, 211-212).

The first one is tenor: the term of the loan. The loan may be provided for anything from 3 to 15 years, relying on situations.

The second one is interest rates: Most financing by commercial banks is done on a floating rate basis. Commercial banks generally lend at a spread over the rate at which they borrow, the spread is related to LIBOR interest rate. Typical spreads

rang from 0.5 per cent to 2.0 per cent, according to the standing of the borrower, maturity, etc.

Fee as the third key aspect where a standby period or an extensive drawdown period is involved, the bank will customarily charge the borrower a commitment fee about 0.5 per cent per annum on the unused portion of the commitment. In certain circumstances, a management fee or arrangement fee of up to 1 per cent is charged as a front-end payment, to cover the costs of processing and administering a complex transaction or where syndication is involved.

The forth one is covenants refer to the security conditions imposed by the lender setting out the conditions that owner must satisfy and the rights of the bank if he defaults.

The last one is collateral means the assets and founds to which the bank has legal access if the borrow defaults.

Due to the facts that the concrete agreements of financing newbuildings differ from each shipyard in terms of ship types and banks , to get related data of five key aspects is not feasible. Besides that, competitiveness among banks and shipyards, to some extent, determines the confidentiality. Because of the limitations of data, among these five aspects, the data of interest rate is the only one that can be obtained easily so we'd better to contain it as one of the variables of influencing shipbuilding industry. As a matter of a fact, interest rates vary from state-owned banks to commercial banks and many Chinese shipyards even borrow money from overseas banks, which decides that we'd better consider the LIBOR interest rate as one of the variables. Sean Fairley and Ruud Legters from DVB bank presented that the LIBOR is fixed on a daily basis by the British Bankers' Association and derived from a filtered average of the world's most creditworthy banks' interbank deposit rates(Fairley and Legters, 2011, MEL STF course). In our view it is more acceptable to look at the LIBOR interest rates than to consider the interest rate from Chinese banks.

If the LIBOR increases, undoubtedly, that results in the increased costs of commercial bank loans for shipping companies. For capital-intensive industry like shipbuilding, increasing interest rate will definitely influence the orders of new ships. In this thesis, we will just look at the LIBOR interest rate for further research.

2.2.2 Price of steel plate

In the process of shipbuilding, steel consumption usually cost over 20% of material cost and cover 35% of the total building cost. The table below display the cost

structures estimations of various ships.

Table 2-2 Cost structure estimation

	Bulk carrier (177000 tons)		**VLCC (297000 tons)**		**Tanker (105000 tons)**		**Bulk carrier (53000 tons)**	
The price of ship (RMB ten thousand)	53040	100%	73044	100%	40710	100%	22377	100%
Outsourcing cost	29212	23%	46762	64%	25192	62%	13093	59%
Among: steel	12302	26%	22762	31%	10736	26%	4941	22%
Corollary equipment	13910	26%	18500	25%	11256	28%	6652	30%
Coating	3000	6%	5500	8%	3200	8%	1500	7%
Other cost	1465	3%	2488	3%	1280	3%	819	4%

Note: with the condition that the steel price is RMB 5589.
Source: own adaptation from Ping An Securities (2008)

In reality, steel plate, section steel and welded pipe are the main steel products in shipbuilding. Because steel plate is used for constructing hull and consumed most, we will consider the price of steel plate as the factor of cost analysis. Since the shipbuilding contract is fixed and long-term, the price of steel plate should be agreed about couple months earlier before the delivery (Ye, 2008). That is to say, the change of steel plate price during the period of shipbuilding will definitely influence the whole costs and even number of new orders. In Ye's study, along with the growing of steel price, the cost propositions of all the ship listed in the table above increased. In the public report from China Association of The National Shipbuilding Industry (CANSI), the cost of shipbuilding will increase by 3.5% if the steel price increases by 10%. In the beginning of 2010, the average price of boat deck was RMB 4600 per ton while it increased by 8.7% and reached about RMB 5000 per ton. The main reason arousing the boat deck price is that price of raw materials goes up (Man, 2011). China, as the main steel consumption country, imports over 50% of the world iron ore and coking coal due to domestic demands. The huge demands, to some extent, lead the price of raw materials goes up with limited supply.

2.2.3 Capacity and number of top shipyards

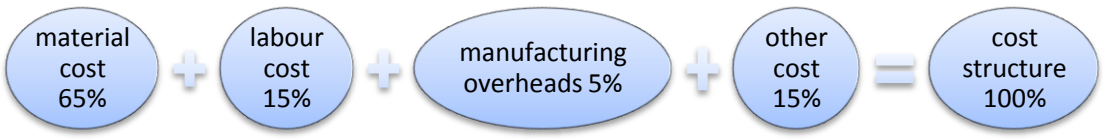
Shipyards are the unique and most important physical facilities which decide how many and how large capacity of ships can be built. Until now there are over 350 shipyards suited for building various ships in the world. On the one hand,

shipbuilding capacity is by and large fixed, that is constrained by physical facilities, such as dry dock, slipway and floating dock. On the other hand, there could be other constraints also affecting the output of shipyards. Skilled workers, available capital, efficient organization and knowhow can improve the productivity of processing, shortening the delivery period (Worldyards, 2010). All these factors contribute to the capacity of shipbuilding. In this thesis, we will not analyze factors mentioned above one by one due to the limited data but show the number of top shipyards in terms of different sorts of ships. Besides that, the number of ships built , average age and size of ships will also included to illustrate the current situation of Chinese shipyards. That is because, in our view, the number of top shipyards as an aggregate factor, is sufficient to present the ability of a nation's shipbuilding.

2.2.4 Labor costs and productivity

Shipbuilding is a labor-intensive, technology-intensive and capital-intensive industry involves complicated production process the level of efficiency and costs varies considerably from one yard to another. The costs of constructing a ship determine the final price of a ship, to a great extent, determine the profits of a shipyard. According to what Stopford summaries in his book, in reality, there are six factors needed to consider when talking about the price competitiveness of a shipyard. Apart from material costs, labor costs, as one of the determining factors, accounting for 15-30 per cent of the costs of a ship, have a major impact on price competitiveness. For Chinese shipbuilding, low labor cost is the primary advantage when competing with Korean and Japanese labor costs, especially for dry bulk carrier sector which requires relatively low-technical skills. The figure below shows us the cost structure of constructing a ship.

Figure 2-2 Shipbuilding cost structure



Source: own compilation according to the book of Maritime economics (1997) and report of Ping An Securities (2008)

However there is an inevitable rule that a nation's fast growth is always along with the increase of labor cost. For instance, the labor cost of Korea in 1980s was only 5% of that of United States. With rapid expansion of Korean economy, labor cost in

2009 has already accounted for 50 % of that of United States (Man, 2011). In the past several decades, labor cost is a key factor boosting the Chinese shipbuilding to reach the dominant role.. After the economy crisis in 2008, the trend of increasing wage tends to be obvious though the labor cost in China is accounting for 10% of Japan and Korean shipbuilding labor cost. The advantage of low labor cost will be weaken gradually even though Chinese shipbuilding can still enjoy the benefits of low labor cost in the short term.

The output of shipyards is also dependent upon the labor productivity. Building a vessel requires highly complex managerial skills in terms of planning and control. Apart from the sizes of facilities, efficiency of labor determines the time of building a ship. Stopford in his book states that labor productivity is measured with manhours per unit output and data related to labor productivity and cost competitiveness is subjective due to practical difficulties (Stopford, 1997, 481-482). He also gives a very general comparison among shipbuilding countries in 1980s.

2.2.5 Government initiatives

In the past several centuries, the importance of government initiatives has been certified too many times. Taking an over review of the shipbuilding cycle, examples below can show us this point.

From the beginning of 19th century, Britain produced over 80% of the world total gross tonnage and owned half the world fleet. This dominant position can be explained with the massive controlled trade flows and routes by the Empire. However, by 1990, the market shares of Britain shipping and shipbuilding fell to below 2%. Except the development of integrated production technology in Korea and Japan, the diminished political supports played indispensible roles in the decline. During the post-war era, the US government provided construction subsidies to the US merchant shipbuilders to offset the difference between the construction in US and foreign yards. At different times the level of subsidy varied from 30% to 50% of the cost of construction. A similar pattern can be found in other countries in 1970s, the highest shipbuilding productivity of any shipbuilding country was also accompanied by the highest level of subsidies (Stopford, 1997). The successes of Japanese and Korean shipbuilding have been the direct outcomes of gaining preferential financing and close government supervision. In Zhendong Lu's thesis in 2005, he also illustrated other countries' government interventions, such as the examples of mediaeval Venice, German, UK, Sweden and France. The table below presents various assistances in favor of the shipbuilding industry in different countries.

Table 2-3 Assistances in favor of shipbuilding

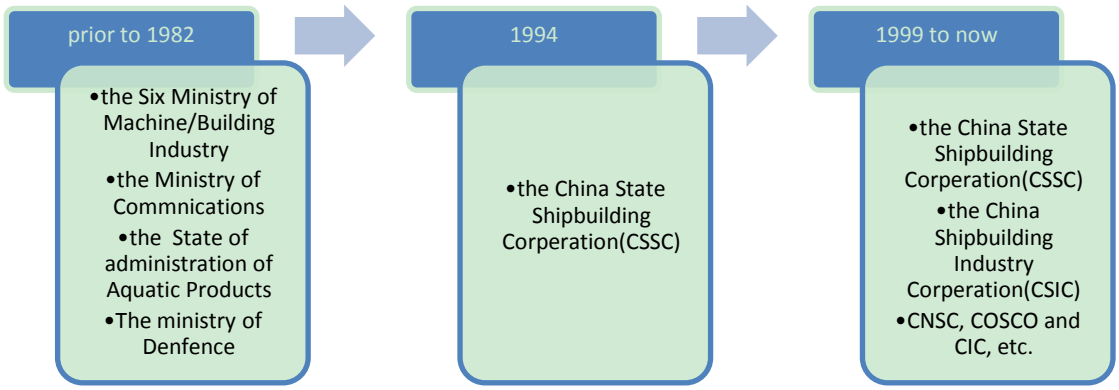
Obvious to subtle supports from governments
1. Market protection: Jones Act, USA
2. Favorable tax treatment: Tax break offered to domestic ship owner, German
3. Export credit assistance: OECD countries, China offering favorable financial term to ship owners.
4. Investment in performance improvement & research: USA, Japan

Source: Compiled by Zhendong Lu (2005) from various sources

Taking an overview of Chinese shipbuilding history, government is always playing an indispensible and significant role in boosting this strategic industry. Just like other countries, China regards shipbuilding as a catalyst for the advancement of iron and steel, electronic, and manufacturing industries and intends to upgrade Chinese national capability, strength technological capability and drive economic development. Policies adopted by Chinese government are the key factor of stimulating and managing thin industry.

For better understanding of Chinese government initiatives, we start by presenting the general structure of shipbuilding industry in China.

Figure 2-3 Development of structure of Chinese shipbuilding



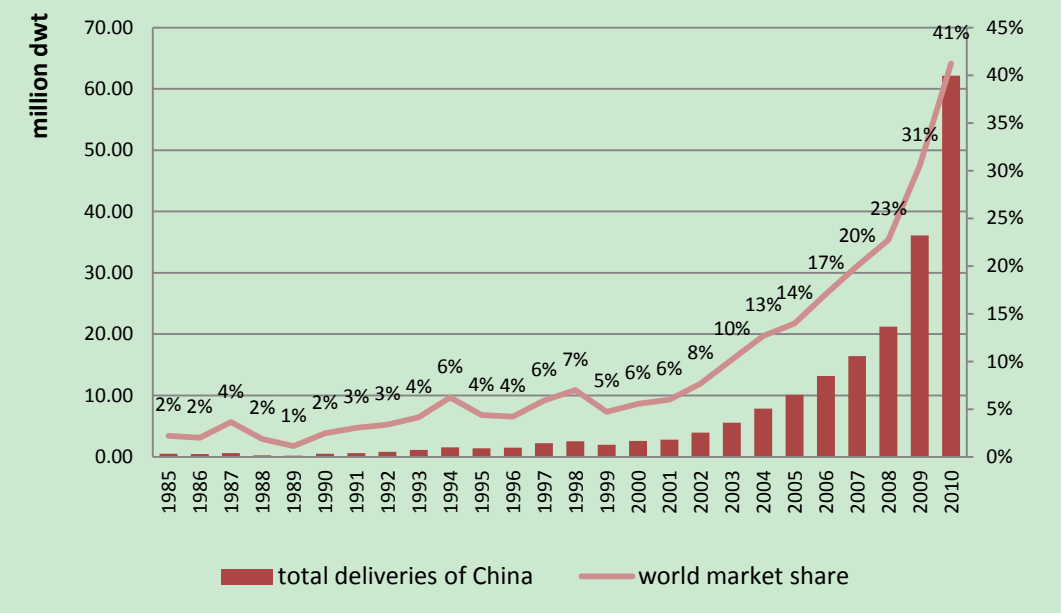
Source: own compilation based on report of Council Working Party on Shipbuilding (2008)

More specifically, before 1994, design and construction of merchant vessels, special vessels related to oil industry and naval vessels were under the supervision of the Six Ministry of Machine Building Industry. Building and repair of smaller and inland waterways ships were under the control of the province of the Ministry of Communications. After 1994, the CSSC works as a new unified corporation under the direct authority of the State Council instead of four organizations. The CSSC

has grouped various shipyards and factories into units for further standard development. In 1999, a new corporation called the CSIC was organized and became another major shipbuilding provider as well as the CSSC. Both are large, State owned enterprise under the direct control of the State Council. Apart from these two big groups, other main domestic shipping companies were established, such as the Changjiang National Shipping Corp, the China Ocean Shipping Company, the China Shipping Industry Company and other shipbuilding industry groups owned by provincial authorities. These shipyards groups are usually supported with enough capital investment, advanced corollary equipments and technologies. At the same time, there are lots of small-sized and private shipyards with limited capital and facilities, government initiatives need to be adopted for managing and supporting.

The figure below shows us the development of Chinese shipbuilding, it is noticeable that market share of Chinese shipbuilding increased steeply after 2000. Except that the booming economic growth of China contributed to this increase, we now analyze it from government initiatives perspective.

Figure 2-4 Total deliveries of Chinese shipbuilding



Source: own compilation, data collected from Clarkson research.

In China, the Five Years Plans are the typically national 5-year economic plans aiming at framing its guide lines for the development of different sectors to ensure long term sustainability and competitiveness. The 11th National 5-year Economic Plan was the first to specifically mention the maritime sector. In 1990s, Xiaoping Deng, the leader and planner of the Reform and Open policy, stated that Chinese

shipbuilding should enter the international market for bigger market share under the circumstance which domestic demands are met. Besides the reconstruction of state-owned enterprise mentioned above, along with the development of shipbuilding, corresponding plans and policies are taken. Table below shows us these national policies and plans when the Chinese shipbuilding started flourishing in global market.

Table 2-4 National plans published in China

Time	National plans
2005.9	Opinions of Accelerating the Equipments Manufacturing Industry
2007.9	The 11th 5-year Program Planning of Shipbuilding Technology Development
2007.9	The Platform of Action of Forming Modern Shipbuilding Mode(2006-2010)
2008	The Revitalization of The Top Ten Industries
2009	Adjustment and Revitalization Plan of Shipbuilding Industry

Source: Own compilation based on various sources.

Under the guidelines applicable to the National Economic Plan, the Chinese State Council and related governmental organizations also introduced various supports to assist Chinese shipbuilding industry competing in international market. General speaking, the principal measures include domestic market protection, R&D investment and financing assistance.

In order to reduce the costs and protect the domestic market, the State Oceanic administration buys vessels built in Chinese shipyards. Further protection is the application of tariffs on imported ships by the Ministry Finance.

As for the R&D investment, since 2001, China has supported the research and development amounting to $ 1.21 million. Advanced production methods and key equipments are imported to improve the proficiency of designing and constructing ship. According to figures, ultra-large crude oil carriers and bulkers made in China has captured nearly half of the total sales of such ship types in the world.

Due to shipbuilding is capital-intensive, financing assistances from government and banks are definitely vital for shipyards. To enhance the possibility of achieving the largest shipbuilders place in the world, major measures are introduced as follows.

Table 2-5 Financing assistances adopted in China

measures	**Explanations and reasons**
Establish Special Economic Zones	Where attract foreign investors, they can receive preferential tax and tariff.

measures	Explanations and reasons
Export tax rebates	Exporting vessels can get the tax rebates for Chinese shipyards to avoid repeated tax collection.
Invest funding reforms	Raise capital from public issues or corporate bond sales are allowed.
Stabilization of material costs	Support the technologies innovation of steel companies to make sure the supply of domestic steel.
Involvement of foreign partners	Joint ventures with foreign partners. The maximum interest hold by foreign investors is limited to 49% of all ventures.
Banks financing	State-owned and private banks are involved in lending and guarantees for shipbuilding. The export credits to borrowers are up to 80% of the value of new building contracts and maximum maturity period is 15 years and the interest rates can be either fixed or floated, plus an unspecified interest rate spread.

Source: own compilation based on various sources.

Except national policies and plans from macro perspective, the provincial governments and related agencies are also trying to develop this industry by expanding capacities of shipyards. JiangSu Province which has the biggest production in ship orders and deliveries among provinces, focuses on four industry shipbuilding chains according to its situations. They are major building chains of tankers, bulkers and containerships, ultra large ships building, marine equipments industry chain and combination of ocean and waterway shipyards. Based on the four chains, provincial government and banks also provide supportive measures to assist the operation of smaller or private shipyards, making sure them to maximize the resources.

There is no doubt that Chinese shipbuilding industry is heavily depending on the supports of governments from contents presented above. In our regression models, government policies will be regarded as a dummy variable to figure out the actual effects on orderbooks, contracting and deliveries.

2.2.6 Ship earnings of freight rates

Ship earnings of freight rates refer to the profits achieved by shipping companies with sea transportation. It is certain that higher freight rates are preferable for shipping companies. In shipping market, freight rate play roles both in demand and supply sides. In this section, we will firstly talk about the relationship between freight rates and supply adjustment.

Table 2-6 The variables in shipping market model

Demand side	Supply side
The world economy	World fleet
Sea borne commodity trade	Fleet productivity

Demand side	Supply side
Average haul	Shipbuilding production
Political events	Scrapping and losses
Transport costs (freight rates)	Freight rates

Source: adapted by Junhui Li according to Haralambides, H. E. (2010). Shipping Economics and Policy (Reader)

There are four stages of supply adjustments below to explain:
The first stage is a perfectly inelastic supply. Carriers don't move and adjust when market is depressed and p to 20% of fleet is laid up. Then even if the freight rates start to increase, the ship owners may be reluctant to bring ships into service. Before taking actions, ship owners will want to see that rise in freight rates is a sustainable trend.

The second stage is elastic but freight rates keep the same. Layups therefore goes down and ships are back in service. Speed is increased to improve the productivity. In a rising market, ship owners will try to postpone maintenance and avoid long-term contract since they don't want to be in a fixed market. Consequently, ship owners prefer to fix vessels in a spot market with short voyages.

Coming to the next stage, supply becomes inelastic as there is nothing that can be done to increase supply. Carriers have monopolistic control- they have leverage in quoting-there is high demand for new ships in shipyards, thereby turning shipyards into bottlenecks as their capacity gets filled, the supply of new buildings is inelastic. Delivery times goes up to 3 to 5 years not because it takes so long to build the vessel but it will take a while for berth to become available.

The fourth stage is that in the long term, the supply becomes elastic. Ships ordered in last stage enter the market and shift supply curve to right. At the same time, new technology will also lower the costs and freight rates.

According to analysis above, we can know that the fluctuations of freight rates determine the orders of new ships and we can also confirm that high earnings of freight rates will stimulate ship owners to invest more in shipbuilding or second-hand ships buying.

2.2.7 Exchange rates

Although currency movements are far removed from the shipyard, they are the single most important factor in determining the cost competitiveness of a shipbuilder (Stopford, 1997, 483-484). Shipbuilding is an international industry which meets demands of global market and is marked in US dollar term, whereas building costs of ships are inevitably marked in local currencies. Thus the exchange

rate is a matter of course. Chinese shipbuilding is a typical export-oriented industry, according to figures, the value of export in three shipbuilding indexes (volume of shipbuilding completion, new orders and hand-held orders) reached more than 50% of total value. At the same time, the shipyards in China are very vulnerable to exchange rate fluctuations comparing with other industries since the order book contracts are agreed dollar wise and the time of loan recovery often last over one year. An example can illustrate this point. We assume the payments of shipbuilding are as follows:

Figure 2-5 Stages of shipbuilding payments

Source: own compilation according to report of Ping An Securities (2008)

There are five stages of contract payments. In each stage ship owner needs to pay 20% of the total costs of shipbuilding agreed with shipyard in contract. Generally speaking, the interval between entering into a contract and coming into operation is over one year.

As a result, the speed of Yuan appreciation will influence the revenue of shipyards directly. If the total value of Chinese shipbuilding orderbooks is RMB86.1 billions in the stage of entering into a contract in 2008 with the exchange rate of $/¥ 7, two years later, when comes to the delivery of ships, the exchange rate falls to $/¥ 6.5, the total value of orderbooks will lost with RMB6.15 billion. However, some specialists also indicate that RMB appreciation will bring the reduction of overseas procurement costs (Liao and Wan, 2010). Different from shipbuilding industries in Japan or Korea, Chinese shipbuilding needs to import 50% corollary equipments from other countries. The cost of corollary equipments accounts for about 20%-30% of total shipbuilding cost. According to the statistics, the decrease of exchange rate from $/¥ 8.23 to $/¥ 7.4 in first half of year 2007 caused the shipbuilding export loss reached RMB 4.5 billion (Zhang, 2007). The appreciation of Yuan will increase the costs of shipbuilding then shipyards in China lost the cost advantage comparing to Japan and Korea, higher price of ships will make demand of new ships decrease. Because of the facts shown above, taking the exchange rate into account is a necessity in our thesis when analyzing the supply of Chinese shipbuilding market.

2.3 Demand Variables

2.3.1 Volume of international trade

Before representing the relationship between international trade and shipbuilding, we need to firstly look at the role of international trade in economic development. In the book of the Wealth of Nations written by Adam Smith, he argued that the central economic force in a capitalist society is the division of labor, and the extent to which this can be practiced depends crucially on the size of market. A business working in a country town without links to the outside world can never achieve high levels of efficiency since its very small market will limit the degree of specialization (Stopford, 1997). Regarding to the transportation of international goods, water carriage which is upon the sea-coast and the banks of navigable rivers can offer a more extensive market opened to every sort of industry at price far below than any other transportation means. What's more, the shipping provides the price, speed, reliability and security required by cargo owners. Undoubtedly, for cargos those are massive volumes and insensitive to time, such as raw materials and manufactures, sea transport is an ideal choice. As stated in professor Haralambides' reader, shipping is both a facilitator to trade-moving goods that otherwise wouldn't be trades - as well as a promoter of trade - low transport costs and economies of scale in shipping have allowed nations that wouldn't be possible 20 years ago (Haralambides, 2010). The number of ships determines how many capacities can be provided to carry seaborne trade. The more volume of international trade, the more demand of shipping and more ships are required by ship owners to meet the demand.

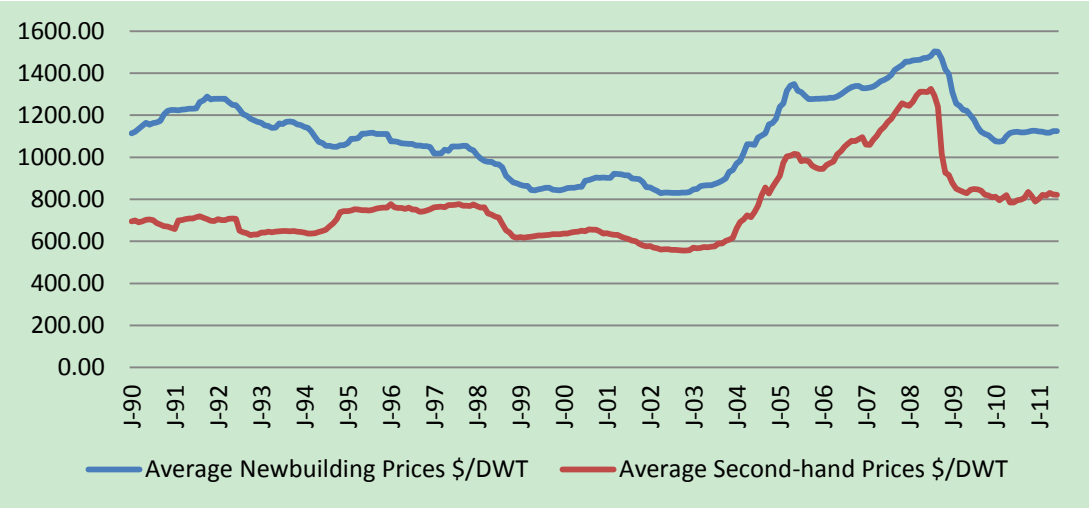
The exports of manufactures and imports of raw materials during last several decades in China propelled the flourishing of shipping trades. For Chinese shipbuilding, most of ships constructed are used for east-west route. This fact highlights that shipbuilding industry in China is correlated with the volume of international trade.

2.3.2 Price of second-hand ships

According to Stopford, the price of new buildings is volatile just as the second-hand ships and both of them are highly correlated. Apart from freight rates, financial liquidity of buyers and expectations, price of second-hand ships is one of the key factors of demand side. A graph of correlation between new and second-hand bulk carriers is drawn and shows that the second-hand prices generally followed the new prices from 1976 and 1993. (Stopford, 1997,110). This is also defined by Haralambides in his reader (Haralambides, 2010, 10). He states that, the price of second-hand ships is not always below the new price. As in a blooming market,

high freight rates attract ship owners to sail more ships on the sea. Some of ships will be resold several times to meet the demand of sea transportation. At the same time, building a new ship will take two or three years, in such period, second-hand price will be higher than the contracting price of new ship. Under this situation, the volume of orders and contracting will also affected. In our thesis, we will consider the second price of all ships as one of the quantitative variables to see its influence on Chinese shipyards' contracting, orderbooks and deliveries. Figure below also illustrate the highly correlation between price of new buildings and price of second-hand.

Figure 2-6 Price trends of new buildings and second-hand



Source: own compilation according to data collected from the Clarkson Research (2011)

2.3.3 Domestic economic growth

The derived nature of demand for transport determines that the volume of transportation depends on the demand of trade, shipping is without exception. As a dominant factor in shipping economy, world fleet supports the circulation of commodities and expands according to economic growth. That is to say, there should be correlations between number of ships and economic growth.

Regarding to the reasons of Chinese shipbuilding booming, rapid domestic economic growth contributes it most. On the one hand, in recent decades, China imports raw materials-i.e coal and iron ore for domestic infrastructure construction and reservation purposes and exports manufactured products mainly to US and far west. Huge demand of international trade results in the active demand of marine transportation. Due to the absolute advantage in cost and safety, there are near 95%

of international trade transported by ships in the world. Along with the huge potential demand of marine transportation, shipyards receive more and more neworders from shipowners and investors. On the other hand, the prosperous Chinese shipbuilding has been the major industry which boosts regional economy advancement. According to the data recorded, the shipbuilding industry in Jiangsu, the biggest shipbuilding province in China, contributes more than 30% of the whole economy growth, reaching around RMB 120 billion in 2010 (An, 2010). Moreover, there are near 97 sectors of 116 national economy sectors related to the shipbuilding industry, especially in engineering and electronics sectors. For ten thousand tons ship construction, more than 3000 people can get related jobs. As a result, choosing the domestic economy growth as one of variables affecting Chinese shipbuilding development is feasible and applicable in this thesis.

2.3.4 Market expectations

In shipbuilding demand function, market expectation will influence the number of new orders placed. It describes the ship owners' reaction to price change. As prices of new ships rise, constraints on finance will weaken the investments in ships, only a few investors who have profitable market chances or need ships urgently would pay a higher price. So the number of orders shrinks. Conversely, lower prices will encourage ship owners to order new ships. The key function facing the ship owners is what level of freight rates will prevail during the years following delivery of vessels. The market expectation introduced in Stopford's book has been included one of the factor affecting demand of shipbuilding. (Stopford, 1997, 473)

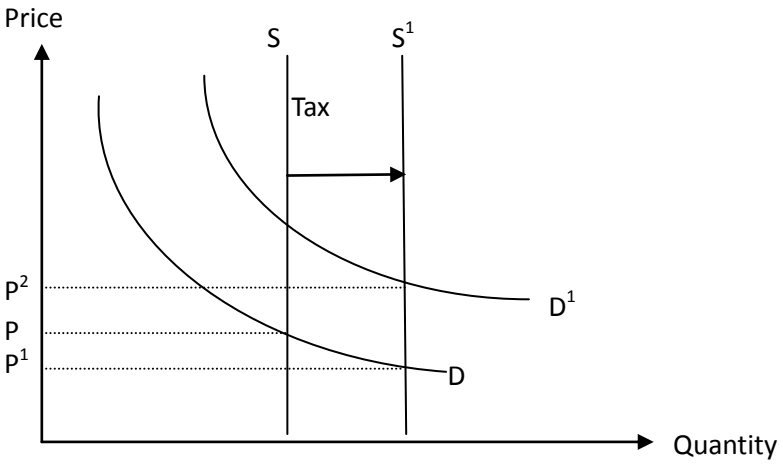
2.3.5 Credit availability

For most of companies, the fund generated from internal revenue is not enough to purchase new ships. This constraint, to some extent, will influence the new orders. According to history records, government has played a very important role in support the shipbuilding by providing available credit, such as financial guarantees and interest rate. The availability of credit can remove help many ship owners which own insufficient capital to enter the market.

2.3.6 Government initiatives

General speaking, regulations and policies adopted by a nation' government will also influence the demand of shipbuilding. The figure below illustrates this point.

Figure 2-7 Supply and demand change with policy support



Source: own compilation (2011)

According the supply and demand theory in Economics, we assume that there is a tax reduction policy in Chinese shipbuilding industry in a flourishing market. The costs of constructing a ship will decrease，leading to increased new ships ordered, the curve of supply moves from S to S^1. As a result, the fleet exists are more than the transported needed. When supply exceeds demand, the price of ships will go down from point P to P^1. Fewer ships are asked for, orders of new buildings are also reducing. If the shipping market continues to be good, demand of seaborne trade increases, fleet in the market cannot meet the demand. In the figure above, the demand curve moves from D to D^1, then price of for new ships and even second-hand ships will increase from P^1 to P^2. This figure might be a little bit general to explain the indirect effects of government initiatives on the demand of shipbuilding.

However, as a matter of fact, during current decades, especially after the crisis in 2008, Chinese government has issued the concrete plan to encourage the development of shipbuilding. For instance, in the Adjustment and Revitalization Plan of Shipbuilding Industry published of 2009, Chinese government encourages the old docks and berths to scrap or update and forces single shell oil tanker to weed out. Consequently, according to experts in Chinese shipbuilding institute, this regulation will stimulate the domestic demand of new ships by scraping old ships and ordering new ships, improving the productivity of ships. The indirect effects on demand of new ships brought about by government initiative will be shown in details in next chapters.

2.3.7 Ship earnings of freight rates

Regarding to freight rates, it is also one of factors affecting the demand of ships

because demand of new ships is activated by the demand of freight market where decisions of ordering new ships is derived by the outlook of future freight rates. Actually, considered be to the most critical indicators among shipping market, freight rates represent the principal source of earnings for shipping companies and determined by the interaction of supply and demand for cargo carrying services. As long as the demand function is concerned, the role of freight rates in generating new ship orders is not hard to understand. In booming market, high freight rates and limited transport capacity drive ship owners or speculators to order more ships thereby increase their profits, the demand of ships goes up. On the other hand, for shipping companies, the high transport costs may decrease the demand for transportation. As a result, ships ordered will exceed the capacity needed. Historically there has been a close relationship between peaks in the freight market and peaks in ordering new ships. But due to the time-lag exists between ordering new ships and taking delivery and the long service life of ships once it has been delivered, current freight rates will only be a partial influence on newbuilding demand (Stopford, 1997).

Many existing studies mainly focus on the dynamic relationship of shipping freight rate market and shipbuilding market. It has been shown that the freight rate is not a stationary as most economic and financial time series, the freight rates are less volatile for smaller size vessels than for larger ones, and the volatilities of freight rates in the spot rates is higher than those in the time-charter rates (Evans and Marlow, 1990; Hsu and Goodwin, 1995; Kavussanos, 1996; Koekebakker, Adland and Sodal, 2006). Besides, the lead-lag relationship between freight rates and shipbuilding markets indicates how far one market reflects information relative to the other and how well the two markets are linked. In the long term, a co-integration and positive correlation exist between freight rates and shipbuilding price, such that the two rates are related to form an equilibrium relationship. Conclusions are drawn that shipbuilding prices are s function of the past history freight rate, rather than the expected future values of the freight rates (Jane Jing Xu, Tsz Leung Yip and Liming Liu, 2007).

As the importance stated above, the freight rates has an impact on the demand of transport and finally the ships ordered. The ship earnings of freight rates will be included as one of the variables in Chinese shipbuilding analysis.

2.3.8 Exchange rates

Hedging exchange rate is one of the key measures to risks for both shipyards and ship owners. For supply side, we have already identified the reasons why appreciation of Yuan results in profits loss of Chinese shipyards.

For demand side, it is true that there are also positive indications that market demands may rebound due to appreciation of currency. If the appreciation of the Euro against the dollar continues, it will give a positive effect on new shipbuilding price and demand (Won, 2010). That because 60% of ship buyers are European companies and shipbuilding contract is usually on a U.S. dollar basis. In terms of competitiveness between Japan and Korea, both are powerful shipbuilding nations. The depreciation or appreciation of local currencies would have an impact on their orders. In the situation which Yen rises comparing with Won's depreciation, Japanese shipyards are worried about that, it is impossible to compete on equal basis. Since on cost, rather than price, both countries are roughly similar. But when converting to dollars, the price of Japanese ships becomes 20 per cent more expensive than Korea yards (Dickie, 2011). Consequently, the price of new ships will affect the buyers' choice to order cheaper ships. Along with the continuing appreciation of Yuan, Chinese shipyards are confronted with the same problem with Japanese shipyards. In this thesis, we will demonstrate it.

2.4 Summary

In this chapter we have discussed the variables of affecting the Chinese shipbuilding industry. Although there are too many factors which can be chosen due to the fact that shipbuilding involves nearly 200 sectors, according to former researches, we pick twelve major variables to explain.

In terms of supply side, firstly building a new ship needs high capital investment and bank loan is the main source of capital. So the higher of LIBOR interest rate may lead to costs of building rise and decrease the orders. Secondly, the factor of steel price is also included in supply side. Higher steel price will increase the costs of shipbuilding, then shrink the demand of new ships. Thirdly, regarding to shipyards, the number of top shipyards determines how many and large ships can be built. Theoretically, more shipyards can produce more vessels. On the demand side, considering the fast development of Chinese economy, we have explained the importance of international trade and domestic economy growth. China imports raw materials in quantity while exports manufacturing products to all over the world. The growing demand of seaborne trade results in more new orders. Moreover, the highly correlation between the second-hand price and new price proven by previous research declares that second-hand price should be contained in this thesis. Both market expectation and availability of credit are factors determining the ship owners whether invest in new ships or not.

There are three variables influencing both supply and demand of new ships. For shipbuilding, it has always been the national economy sector. Government

initiatives adopted regulate and stimulate the development of this industry. Details of Chinese government policies are given in this chapter to explain this significance. Besides that, higher freight rates in a blooming market can encourage ship owners to order more new ships in order to make profits. Four stages about the supply curve movements according to freight rates fluctuations are talked in supply side. The appreciation of Yuan will also bring loss for Chinese shipyards on the dollar-based and installment contract, simultaneously, depreciation of other currency, such as Won and Yen, will lead ship owners move orders from China to Korea or Japan.

In conclusion, these twelve variables presented us their relationship with shipbuilding g industry. In Appendix 1, we state that variables included and excluded according to data limitations. For Chinese shipbuilding, they are generally sufficient to explain the development of shipbuilding industry with quantitative and qualitative methods.

Chapter 3 Methodology

3.1 General Introduction

In practice, any economic phenomenon is typically influenced by various factors. Multiple regression analysis is the most commonly used model to identify how one or more factors are related to a dependent variable or to predict the future value of this dependent variable. The factors believed to be related to this phenomenon should be included to verify their relationships. In our thesis, the ordinary least squares regression will be applied to estimate the coefficients of each independent variable. The type of model will be transformed by taking natural logarithms. The reasons are the same with what Tsolakis states in his paper. On the one hand, taking logarithms may stabilize a non-stationary variance. Also, after transformation, an exponential trend in time series can become linear thus making it easier to analyze. On the other hand, we can interpret coefficients in logarithms as elasticity (Tsolakis, 2003). The only variable that is used directly is the industry growth rates because this variable is already a relative change.

3.2 Variables Definition of Models

In our models, eight quantitative independent variables will be used in model regression and what their affects on volume of orderbooks, contracting and deliveries will be detected. According to literature reviews displayed in last chapter, we expect nine variables to influence Chinese shipbuilding positively or negatively. Each independent variable has the same effects on orderbooks, contracting and deliveries. The exact effects of each one will be seen in the next chapter.

Table 3-1 Expectations of factors effects

Independent variables	Expected affects on dependent variables		
	orderbooks	contracting	deliveries
Growth rates of industrial added value	+	+	+
Import	+	+	+
Export	+	+	+
Exchange rates	+	+	+
LIBOR interest rates	-	-	-
Price of steel plate	-	-	-
Second-hand price	+	+	+
Clarkson Index Earnings	+	+	+
Government policies	+	+	+

Source: own compilation based on own expectations and literature reviews.

3.3 Data Issues

There are totally 1507 monthly data in our model and time ranges from August 1999 to December 2010. The reason of choosing August 1999 as the starting point is that the data of steel plate price has been recorded since that time. Some explanations of data will be given in this section in order to make those models more clearly and understandable. In Appendix 1, Appendix 2 and Appendix 3, explanations of variables and their sources are presented.

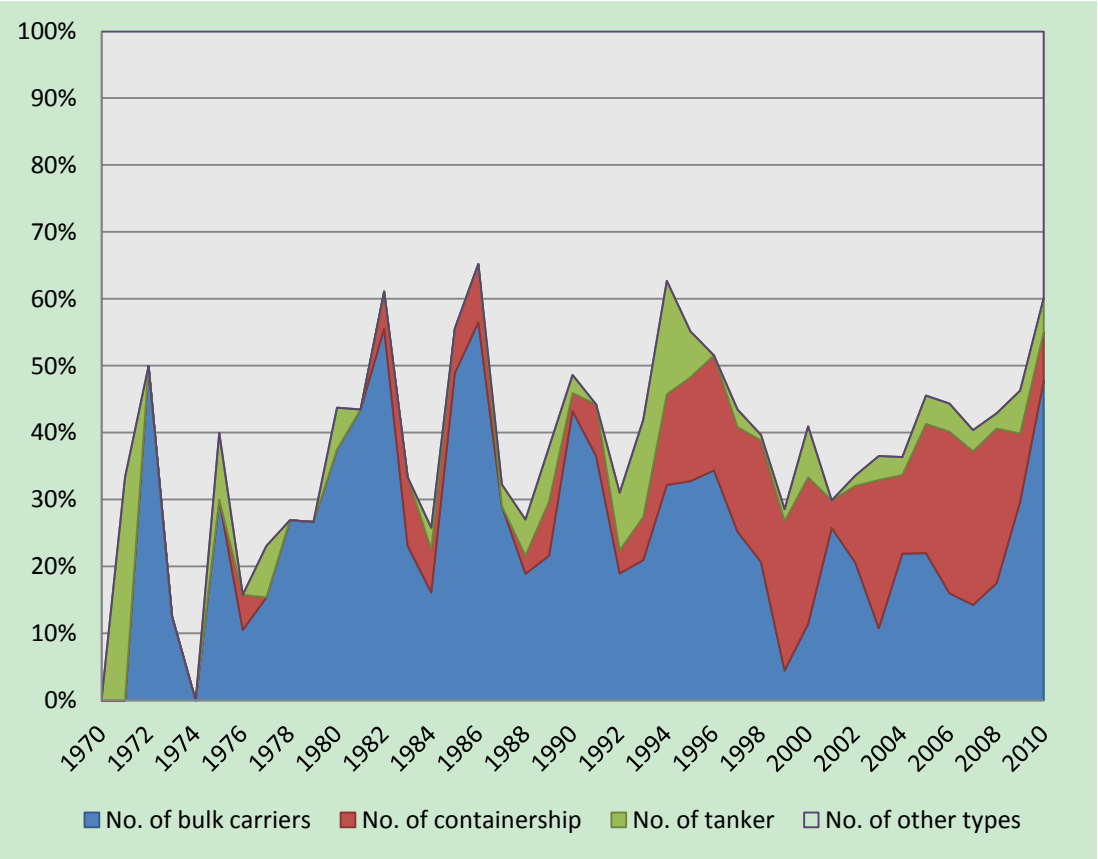
As for government policies, we regard it as a dummy variable. Zero is used to represent that there are no specific government initiatives related to shipbuilding while one is used to state that there are policies published to support development of shipbuilding. Considering the fact that China started to take shipbuilding industry into National Plan in September 2005 and typically National Plan are put into effect in the next January, we assume data before January 2006 are zero whilst data after December 2005 are one.

Among these 12 groups of data, except the data of ship earnings that are recalculated by us, other data are all collected from databases directly. Next we explain the calculations of the Clarkson Index Earnings.

Data recalculations of the Clarkson Index Earnings (CIE)

From Figure 3-1 below we can see that during last 40 years, the total number of bulkers, tankers and containerships has taken nearly more than 50 per cent of all the ships, especially since 1980s, it reached 70 per cent. Even though the total proportion of these three kinds of ships stays flat, the proportion of each type changes a lot. From 1980s to 2000, bulker carriers were built most while containerships and tankers were built particularly few. It is noticeable that the number of bulk carriers started to go down and more tankers and containerships were on orders.

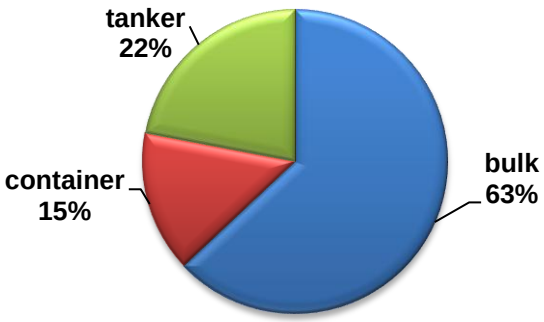
Figure 3-1 Vessels built in Chinese yards



Source: own compilation according to data from Clarkson Research.

In the beginning, we calculate the weights of three kinds of ships by looking at the total gross tonnage built then get proportions below.

Figure 3-2 Weights of tankers, bulkers and containerships in tonnage



Source: own compilation according to data from Clarkson Research.

Later we collect three groups data which are the earning indexes calculated by

Clarkson Research. They present the daily profits of shipping tankers, bulkers and containerships. An example will be given for further understanding. In January of 2000, the Clarkson index bulk earnings, tanker earnings and container earning are 7705, 13774 and10531 dollars per day respectively. According to the weights of Chinese shipbuilding in Figure 3-2, we get the three ships earnings of January per day in the following:

$$CIE = 63\%*\$7705 + 22\%*\$13774 + 15\%*\$10531 = \$9464.08$$

For the rest of data, we deal with them in the same way.

Data Deficiency

When collecting data, we noticed that there is no data related to every January of industry growth rates since the year in 2007, we assumed that both January and February had the same growth rates as was there as less the case before 2007 and we do address an important data group.

3.4 Model Explanation and Specifications

Volume of contracting, volume of orders and volume of deliveries are the main three indicators to measure the supply and demand of shipbuilding in China. As a result, we will carry out three regressions to figure out the relationships among independent and dependent variables.

Firstly, as we have discussed in chapter 2, there are too many factors that affect the shipbuilding volume, in order to avoid the problem of multicollinerity, we conducted the correlation matrix which referring to the Appendix 4 and found that both export and import and highly related to other variables, if running the regression directly, the results might be incorrect. Moreover, theoretically, China imports large amount of raw materials to build ships for exporting. So the more ships China export, the more raw materials are needed to import. As a matter a fact, with our performing, removing both exports and imports improve the strength of models.

Secondly, economic and financial data, such as interest rates and growth rates, are often facing the problems of strong inert time series and time lags. So we may need to consider if all the variables have unit roots and how many lags of each independent variables have. The ADF test has been conducted and results are given in the following table.

Table 3-2 Unit root tests

ADF test results for stationary					
			1st difference		
variable	p-value	stationary	p-value	stationary	lag length
log(orderbook)	0.7267	no	0.0174	yes	
log(contracting)	0.2900	no	0.0000	yes	
log(deliveries)	0.9900	no	0.0000	yes	
industry	0.0029	yes			1
log(exchange)	0.9863	no	0.0037	yes	3
log(libor)	0.8081	no	0.0000	yes	1
log(steel)	0.6066	no	0.0000	yes	1
log(secondhand)	0.6617	no	0.0000	yes	1
log(earnings)	0.1119	no	0.0000	yes	1

Note: reject the null hypothesis that there is a unit root if the p-value is less than the significant level with 1%. The reason why we didn't perform the dependent variables lags is that we will conduct it according to the degree of autocorrelations.

3.4.1 Model of orderbooks

Orderbooks which is also named as hand-held orders, represents the vessels are on order. In reality, the volume of orderbooks is generally much more than that of contracting when ship owners may cancel the contract due to sudden capital shortage or political factors. The equation below shows us the regression model will be estimated.

$$\ln OB = \alpha_0 + \alpha_1 * I_{t-1} + \alpha_2 * \ln Ex_{t-3} + \alpha_3 * \ln L_{t-1} + \alpha_4 * \ln S_{t-1} + \alpha_5 * \ln E_{t-1} + \alpha_6 * \ln Se_{t-1} + \alpha_7 * P + \alpha_{8*} \ln OB_{t-n} \quad (3.1)$$

Where OB=dependent variable, refers to the monthly volume of orderbooks

I= industry growth rates

Ex= exchange rates

L= LIBOR interest rates,

S= price of steel plate,

E= the Clarkson Index earnings

Se= second-hand price

P=Chinese government policy

α_i = coefficient of independent variables

α_0=intercept intercept which means the value of contracting when all the independent variables are zero.

N= the lag length of dependent variables

3.4.2 Model of contracting

The volume of contracting in shipbuilding measures the tonnage which is agreed in building contracts between ship owners and shipyards. In china, this term can be also called new orders. This equation below is used to estimate the relationships of eight factors and volume of contracting.

$$\mathbf{Ln\ C = \beta_0 + \beta_1 * I_{t-1} + \beta_2 * ln\ Ex_{t-3} + \beta_3 * ln\ L_{t-1} + \beta_4 * ln\ S_{t-1} + \beta_5 * ln\ E_{t-1} + \beta_6 * ln\ Se_{t-1} ++ \beta_7 * P + \beta_8 * ln\ C_{t-n}} \quad (3.2)$$

Where C=dependent variable, refers to the monthly volume of contracting

I= industry growth rates

Ex= exchange rates

L= LIBOR interest rates

S= price of steel plate,

E= the Clarkson Index earnings

Se= second-hand price

P=Chinese government policy

β_i= coefficient of independent variables

β_0=intercept intercept which means the value of contracting when all the independent variables are zero.

N= the lag length of dependent variables

3.4.3 Model of deliveries

Typically, the volume of deliveries describes the actual volume of ships completion. It reflects the supply ability of shipyards in practical. The same eight independent factors with last two equations will be used to check their effects on the volume of deliveries.

$$\mathbf{Ln\ D = \rho_0 + \rho_1 * I_{t-1} + \rho_2 * ln\ Ex_{t-3} + \rho_3 * ln\ L_{t-1} + \rho_4 * ln\ S_{t-1} + \rho_5 * ln\ E_{t-1} + \rho_6 * ln\ Se_{t-1} + \rho_7 * P + \rho_8 * ln\ D_{t-n}} \quad (3.3)$$

Where D=dependent variable, refers to the monthly volume of deliveries

I= industry growth rates

Ex= exchange rates

L= LIBOR interest rates

S= price of steel plate,

E= the Clarkson Index earnings

Se= second-hand price

P= Chinese government policy

ρ_i= coefficient of independent variables

ρ_0=intercept intercept which means the value of contracting

when all the independent variables are zero.

N= the lag length of dependent variables

In practice, before we interpret the results of regressions and even for analysis, we conduct tests for heteroscedasticity, autocorrelation and multicollinearity to testify the soundness and reliability of models. After remedying these problems may exist, we will start to interpret the results in next chapters.

Chapter 4 Results and Analysis of Chinese Shipbuilding

In this chapter, combination of qualitative and quantitative analysis will be shown. In the beginning, results of regressions can tell us which factors affect the Chinese shipbuilding more and which ones less. As for qualitative analysis, then regional comparisons with Japan and South Korea in terms of top shipyards describe the current capacities of shipyards in China.

4.1 Quantitative Analysis of Orderbooks, Contracting and Deliveries

Table below summaries the results of regressions and we will interpret them in next sections in order.

Table 4-1 Regression results of orderbooks, contracting and deliveries

Variables	Orderbook	Contracting	Deliveries
Constant	-0.7142*** (0.00)	-12.6712** (0.03)	9.8099*** (0.00)
Ln I_{t-1}	-0.0007 (0.32)	0.0389* (0.07)	0.0105 (0.39)
Ln Ex_{t-3}	0.3635*** (0.00)	5.9300*** (0.01)	-2.9115** (0.02)
Ln L_{t-1}	-0.0031 (0.63)	-0.3534** (0.02)	-0.4303*** (0.00)
Ln S_{t-1}	0.0184 (0.13)	0.0789 (0.83)	0.3959* (0.06)
Ln Se_{t-1}	-0.0413 (0.26)	0.2934 (0.75)	1.0102* (0.06)
Ln E_{t-1}	0.0311*** (0.00)	1.0469*** (0.00)	-0.0386 0.77
P	0.0538*** (0.00)	1.5487*** (0.00)	0.4924*** (0.01)
Ln OB (t-1)	0.9910** (0.00)	-	-
Prob(F-statistic)	0.00	0.00	0.00
R-squared	0.99	0.72	0.86
Durbin-Watson stat	2.05	1.69	1.95
Prob(White Heteroskedasticity Test)	0.60	0.23	0.98

*Note: ***=significant level with 1%*
***=significant level with 5%*
**=significant level with 10%*

Source: own compilation according to regression results.

4.1.1 Factors affecting Chinese orderbooks

From information presented in Table 4-1, there are three independent variables that have significant effect on volume of orderbooks in Chinese shipyards. They are exchange rates, the Clarkson Index earnings and government policies.

To the beginning, exchange rates play the most significant role in volume of orderbooks. If the exchange rates go up by 1%, the volume of shipbuilding will be improved by 0.36%. As the matter of fact, this is accordance with our expectation. The exchange rates and orderbooks are positively correlated in our regression. That is to say, the 1% depreciation of Chinese currency will lead to nearly 0.36% growth of orderbooks. From our perspective, in short time, this positive correlation can be explained that depreciation of Yuan can lead to the price of new buildings comparatively lower if transferring Yuan into dollars. As a result, lower price will attract ship owners, especially speculators to order new vessels.

Next to the government policies, according to our estimation, Chinese government policies influence Chinese shipbuilding market positively. The coefficient with 0.05 is a little larger than that of Clarkson Index Earnings. That indicates that Chinese government policies have more positive effects on orderbooks than earnings of freight rates. The national plan published by Chinese government has guaranteed that shipyards run in a steady economic environment. For instance, Chinese shipyards exporting ships can get the tax rebates, to certain extent, will reduce the costs of shipbuilding. Thus lower price will attract ship owners buy ships from Chinese shipyards. And government also provides technologies support of steel companies to make sure the supply of domestic supply. That is to say, strong supports from Chinese government strengthen the ship owners' belief that ships built in China will be completed and deliveries on time.

The third significant factor positively affecting the orderbooks is the Clarkson Index Earnings. One percentage growth in shipping earnings will lead to the 0.03% growth of orderbooks. This is in line with our expectation. In a booming market, higher freight rates stimulate shipping companies or ship owners to order new ships for bigger profits. As potential transportation demand cannot be met under existed supply, more ships will be on order. The flourishing market in 2007 can illustrate this point. The BDI index which reflects the bulk freight rates even amounted up to 11039 in the November of 2007 expressed the shortage of fleet and over demand. Consequently, higher earnings guaranteed the ship owners to order new vessels.

Factors influencing orderbooks insignificantly are industry growth rates, LIBOR interest rates, price of steel plate and secondhand price. Industry growth rates

present the added value of all the industry production in China. However, the uncertain and unfinished orderbooks in shipbuilding cannot be considered as the production. This explains the weak relation between industry growth rates and orderbooks. And neither steel plate price nor secondhand ship price has significant effects on Chinese shipyards orderbooks.

Besides the independent variables we mentioned above, orderbook of last month is also affecting the orderbook of this month. By adding the one lag variable into model, one growth orderbooks of last month will lead to 0.99% growth orderbooks of this month. This shows us the highly positive relation of two consecutive months. Generally speaking, if no economic crisis happens, the demand for new ships will not change abruptly in a short time. Orderbooks currently represent the market expectations of future shipping situations.

4.1.2 Factors affecting Chinese contracting

Next we turn to the results of contracting regressions. It can be seen that there are five independent variables are affecting the volume of contracting significantly, which contain the Chinese industry growth rates, exchange rates, LIBOR interest rates, the Clarkson Index earnings and government policies. All the effects are in line with our expectations. The industry growth rates, government supportive policies, exchange rates, the Clarkson Index Earnings and play significant roles positively in affecting the change of contracting. Only LIBOR interest rates have negative effects on contracting as we expected.

The most significant positive effects on Chinese contracting is played by the exchange rates. If the exchange rates are increased by 1%, contracting in China shipyards will increase by over 5.9%. From our perspective, this is because when comes to the stage of contracting, nearly 20% of payments should be processed. Ship owners care much about the variations of exchange rates. When Chinese currency depreciates, reduction of shipbuilding costs will leas to lower prices for new ships than other countries' shipyards if their currencies remain unchanged. The more Chinese currency depreciates, cheaper to sign contracts with Chinese shipyards. In this case, both ship owners and shipyards are willing to sign contracts with each other.

Then coming to Chinese government policies, we can see that this variable have the second most significant positive effects on contracting. The adoption of supportive polices can increase the contract volume by about 1.5%. We think the finance assistances from Chinese public and private banks mentioned in Chapter 2 ensure that shipyards can borrow up to 80% of the value of new building contracts

with very long maturity period and unspecific interest rates. Sufficient capital provisions prevented shipyards from capital shortage or even bankrupt. Joint ventures are also welcomed in China but it is regulated that foreign investors can only hold maximum 49% of all ventures. Both capital assistances and protection policy have explained that why Chinese shipbuilding were not affected much by the crisis in 2008.

According to the results, 1% growth in shipping earnings may lead to around 1% increase of contracting volume. This is in line with our expectation that earnings in freight rates and volume of contracting are positively related to each other. Since higher profits encourage ship owners to chase more profits under a good market once they expect the market will continue to be prosperous. Then they will sign the contracts with shipyards to fix terms. So is the effect on orderbooks we explained in last model.

Then the last one has the positive influence on contracting is the industry rates. 1% growth of industry production can cause 0.04% increase of contracting. In our view, this positive relation is not hard to understand. China as the main manufacturing export country, the continuing growth of economy stimulates demand of transportation from other countries. Taking a view for liner shipping, recently far East-West has been the most important and busiest route since the demand for manufacturing products of Asian nations from European countries and North America. In 2010, Shanghai was the biggest port, larger than Singapore with respect to container traffic. The huge potential demand for liner shipping makes ship owners trust liner markets will keep booming in the next few years. Then ordering new containerships can meet the demand for new ships. Another reason of this positive effect, to some extent, can be contributed to the rapid expansion of construction in China in last decade. Over half iron ore Chinese industry needed are depending on the import from Australia and Brazil. The demand for bulk transportation makes ship owners to have contracts with Chinese shipyards whose price are cheaper than Japan or South Korea due to the labor cost advantage

As we expected in Chapter 2, LIBOR interest rates affect contracting volume negatively. One growth of LIBOR interest rates will cause 0.35% decrease on contracting. It is not hard to understand that growth of interest rates can lead to the increase of shipbuilding costs. Then shipyards may increase the price of ships. Thus demand for contracts with Chinese shipyards will reduce.

In terms of other factors which have not significant effects in our regression, there are prices of steel plate and second-hand ships. For second-hand prices, the positive effects can be significant in a very flourishing market where high market expectations and higher second-hand prices stimulate ship owners to order new

ships. But this situation is not often. That is why second-hand prices do not have significant effects in our regression.

4.1.3 Factors affecting Chinese deliveries

Referring to the Table 4-1, exchange rates, LIBOR interest rates, price of steel plate, second-hand prices, government policies are factors which have significant effects on deliveries of Chinese shipbuilding.

Price of second-hand ships has the most positive influence on deliveries. One per cent increase of second-hand price may lead to over 1 % growth of deliveries. Actually deliveries have very strong time lag as constructing a vessel usually requires more than on one year, the current price of second-hand ships have more effects on current orderbooks and contracting instead of future deliveries. The reason why second-hand price and deliveries have positive relation, according to our understanding, is that the growing price of second-hand ships makes ship owners to order new buildings currently, then deliveries two or three years later increased. By looking at the deliveries trend of China, after economy crisis, volume of contracting and orderbooks are always less than the volume of deliveries. Deliveries keep growing since these ships were ordered before the crisis.

The effects of steel prices are opposite to our expectation. Theoretically, higher price of steel plate will increase the cost of shipbuilding, then reducing the demand for ships. As a result deliveries in the future will be reduced. However, based on our estimation, one per cent growth of steel price can cause around 0.4% increase of deliveries. There are two reasons that can be used to explain this positive relation. On the one hand, since the data we collected are the price of Japan steel plate which cannot reflect the prices of steel plate in China in the rounds. On the other hand, Chinese government tries to stabilize the material costs by supporting the technologies innovation of steel companies to make sure the supply of domestic steel. With significant level of 5%, the effects of steel price are not significant on deliveries.

The most significant independent variable which affects the volume of deliveries negatively is the exchange rates according to our regression. One growth of exchange rates may lead to about 2.9% reduction of deliveries. That is to say, the depreciation of Chinese currency influences the deliveries negatively. As a matter of fact, the depreciation of Yuan can typically improve the revenue of shipyards at the last stage of payment under dollar-based market. It is good to exporting ships. However, this regression gives us an opposite effect. In reality, during last tem yeas, Yuan has been appreciating flatly while the deliveries of shipbuilding have been

going up. From our understanding, this increase is attributed to reasons below. This first one is that appreciation of Yuan can reduce the costs of importing equipments from overseas, making sure that shipyards build ships without worries about shortage of money. Sufficient equipments make the whole process of shipbuilding completed smoothly. The second reason can be explained by hedging exchange rates applied by domestic buyers and sellers. As we know, during the period of crisis, Chinese ship owners preferred to buy ships built in China to avoid the risk of exchange rates. Trading with the same currency, to certain extent, can reduce the negative effects on deliveries. Besides, we think domestic demand has also contributed to the increase of shipbuilding completions.

Just as orderbooks and contracting, deliveries are also positively influenced by Chinese government policies. With Figure2-4, we find that deliveries are increasing flatly but going up steeply since 2001. The completions of ships on time attributed to the rapid development of technologies and improved labor productivity. As we stated in Chapter 2, China has spent huge amount of investments on research and development, proficiency of shipbuilding is highly improved. The supporting from government can lead to about 0.5% increase of deliveries.

LIBOR interest rates have negative impact on deliveries as we expected. 1% increase of LIBOR interest rates can make the volume of deliveries decreased by 0.43%. It does make sense as the floating interest rates will increase the costs of building a ship for shipyards. On the other hand, for ship owners, increased capital cost may cause them to reschedule or cancel the order even before the delivery. Ship owners prefer to pay the penal sum than to finish the payments with more money. This can be seen after the crisis.

Factor affecting the deliveries insignificantly are industry growth rates, the Clarkson Index Earnings. That is because both are reflecting the current situations whilst the deliveries are reflecting the demand for ships last two or three years. None of them can affect the current deliveries significantly.

4.1.4 Three regressions comparison

By taking an over view of all the effects of significant variables on orderbooks, contracting and deliveries, we notice that both exchange rates and government policies are significant among the three regression. However, the magnitude(and even in one case the direction of effects and degree of effects vary.

In terms of exchange rates, the changes of contracting are most significantly affected than those of orderbooks and deliveries. Nearly 6% increase can be

achieved if exchange rates increase by 1%. The reasons that can explain this, from our perspective, are the features of contracting. Coming to the stage of contracting, ship owners are ready to fix all the terms of shipbuilding, such as installments, interest rates, price of ships and date of delivery and so on. For foreign buyers, variations of exchange rates are more important than other variables during the payments process. Also for shipyards, they need to hedge the risks of exchange rates especially when they receive the contracts from overseas. Both buyers and seller are caring the changes of exchange rates. Negative effects on deliveries are the second most significant. Because, we think the last payments for shipbuilding make ship owners are still caring about the variations of exchange rates. Differing from contracting and orderbooks, the negative effects may be caused by the hedging measures adopted by buyers and sellers so delivering of ships still go up when Yuan appreciated. As for the effects on orderbooks brought by exchange rates, it is significant but only 0.36% increase can be caused by 1% increase of exchange rates. We think this is because ship owners can cancel the orders by pay much less penal costs than doing so in contracting stage. If the market goes down, canceling orders from shipyards will loss less. The flexibility before signing contracts gives ship owners more active rights. So exchange rates' effects on orderbooks are not so obvious as on contracting and on deliveries.

What's more, orderbooks, contracting and deliveries are positively related to the Chinese government policies according to our estimations. Among them, contracting is affected most significantly, deliveries are affected the second most significant and orderbooks are affected least. Just as we stated in last paragraph, the period of contracting is involved in practical terms. Payments and shipbuilding process will be planned and fixed in contracts. When receiving orders, Chinese government needs to guarantee that the whole process will go on smoothly. For instance, the supply of steel may benefited from the government supporting domestically. While in stage of deliveries, government may encourage the shipyards exporting ships by reducing taxations.

LIBOR interest rates are negatively affecting the Chinese contracting and deliveries. And the effects are a little bit stronger on deliveries than those on contracting. In our opinion, this is maybe caused by the financial assistances provided by Chinese government in order to avoid the risks of interest rates. Due to the attractive financing, ship owners may prefer to sign contract with Chinese shipyards. The effects on contracting are reduced.

As earnings in freight rates are the main profits source for ship owners or shipping companies, higher profits will stimulate them to look forward with high market expectations. As a result, indicators reflecting the demand for new ships – orderbooks and contracting will be affected positively by earnings of shipping freight.

As we discussed before, contracting is involved in more fixed and practical issues so the change of earnings is much higher related to contracting than orderbooks.

Coming to the final conclusions, we can draw that both exchange rates and government policies have significant effects on orderbooks, contracting and deliveries. Chinese government policies are very powerful in supporting the development of shipbuilding especially on contracting. LIBOR interest rates are significant factors for both contracting and deliveries whilst earnings affect both orderbooks and contracting. Furthermore, we can see from this table, generally p-values of F-statistic and R-squares numbers mean that models fit well. The values of Durbin-Watson test tell us no autocorrelations exist. All the p-values of heteroskedasticity test are much larger than significant levels which do not reject the null hypothesis that there is no heteroskedasticity existed. All the tests are indicating our regressions achieved are sound and reliable.

4.2 Qualitative Analysis of Chinese Shipbuilding

Except for understanding the determinants that affect Chinese orderbooks, contracting and deliveries, the capacity of shipyards is also playing very important role in shipbuilding industry. Shipyards are the only places where new ships are built and determining that how many and how large ships can be constructed. It is necessary to see the current situations of shipyards in China. Thus in this section, at first, we will compare Chinese yards with Japan and South Korea by looking at the total deadweight and numbers of ships built since shipyards were built. Then the propositions of Chinese shipyards in world top yards will be presented to learn the capacities of top yards of Chinese shipbuilding for all kinds of ships. With all the information, we believe that research question of weaknesses and challenges Chinese shipbuilding facing can be solved.

4.2.1 Aggregate Comparison with Japan and South Korea

Table 4-2 Aggregate comparisons among three countries in term of total numbers of ships and total DWT

	South Korea		**China**		**Japan**	
Intervals of number	*Frequency*	*Cumulative %*	*Frequency*	*Cumulative %*	*Frequency*	*Cumulative %*
<=10	20	30.77%	192	51.61%	34	14.29%
11～30	13	50.77%	92	76.34%	45	33.19%
31～50	9	64.62%	28	83.87%	33	47.06%
51～100	12	83.08%	26	90.86%	39	63.45%
101～200	3	87.69%	25	97.58%	48	83.61%

	South Korea		China		Japan	
Intervals of number	*Frequency*	*Cumulative %*	*Frequency*	*Cumulative %*	*Frequency*	*Cumulative %*
201～300	1	89.23%	7	99.46%	22	92.86%
301～400	1	90.77%	1	99.73%	9	96.64%
401～500	2	93.85%	0	99.73%	5	98.74%
501～600	0	93.85%	0	99.73%	1	99.16%
601～700	0	93.85%	1	100.00%	2	100.00%
>700	4	100.00%	0	100.00%	0	100.00%
total shipyards	65	1	372	1	238	100.00%
Intervals of DWT	**South Korea**		**China**		**Japan**	
<=1000	2	3.08%	10	2.75%	9	3.78%
1001～5000	4	9.23%	29	10.74%	14	9.66%
5001～10000	4	15.38%	26	17.91%	9	13.45%
10001～50000	7	26.15%	88	42.15%	42	31.09%
50001～100000	10	41.54%	41	53.44%	20	39.50%
100001～500000	11	58.46%	87	77.41%	42	57.14%
500001～1000000	5	66.15%	17	82.09%	22	66.39%
1000001～5000000	10	81.54%	37	92.29%	46	85.71%
5000001～10000000	4	87.69%	16	96.69%	12	90.76%
10000001～50000000	8	100.00%	12	100.00%	22	100.00%
>=50000000	0	100.00%	0	100.00%	0	100.00%
total shipyards	65	1	363	1	238	1

Source: own compilation, data collected from Clarkson Research.
Note: The total Chinese shipyards of number distribution comparison are 9 more than that of DWT because there is no related data of these 9 shipyards. We assume that the 9 yards are averagely distributed in the rest of interval groups.

Firstly, in the table above, we can see that, referring to the number of ships built until now, Chinese shipyards that each has built less than 10 ships are taking 51.61 per cent of all 372 Chinese shipyards. For South Korean shipyards, over one of three shipyards falls into the same group just as China with 20 shipyards. While Japanese shipyards, there are 48 shipyards having built from 101 to 200 ships of each. Only South Korea own 4 shipyards for building over 700 ships of each while neither China nor Japan has this sort of yards. However, Japan has more ships which have built above 300 ships than other two countries. In short, we may say that shipyards of both South Korea and China are smaller-sized and younger in terms of number of ships built when comparing with Japanese shipyards.

Secondly, then comes to the DWT comparison, over half of shipyards in China built below 500 thousands DWT, so are South Korean shipyards. Referring to the three

histogram figures in the Appendices 7, 8 and 9, it is demonstrated that trend line of China is steeper that other two countries. That is to say, the difference of capacity in Chinese shipyards is huger than Japanese and South Korean. That indicates the one of current situations confronted with China. Japan owns the most shipyards which construct more than one million DWT than other two.

Lastly, conclusions can be drawn that the differences of shipyards in China appear to be bigger than other two countries in ships built and total DWT aspects. The reason behind this difference, in our view, is that there too many small-sized and private shipyards lacking advanced manufacturing facilities and sufficient capital provision in China. That constrains their building capacity. Technology barriers are also one of factors illustrating it. For those shipyards, they are lack of policies and uninterrupted money support owned by state-owned or public shipyards, which can guarantee the number of orders. Reasons mentioned above explain the unbalanced developments among Chinese shipyards. On the contrary, even though the total numbers of shipyards in Japan and South Korea are much less than that of China, the capacity they owned indicates that both nations have economies of scale in shipbuilding. For example, the two biggest shipbuilders of South Korea, the Hyundai and the Dawoo groups can build up to four million tonnages together.

4.2.2 Top shipyards of three main products

From 1950s to 2011, the total gross tonnage of bulkers, tankers and containerships has occupied about two thirds of the whole volume of all the ships built in China. We will first have a look at shipyards of the three main products. Concrete data is referred to from Appendix 10 to Appendix 15. All the yards data of China contain that of Taiwan yards.

Bulk carrier shipyards

Table 4-3 Top 50 shipyards of all bulkers

Countries	number of top yards	number of ships	total DWT	Average size	Age
Japan	28	3682	243176871	66044.78	13.52
China	13	941	79455839	84437.66	8.17
South Korea	6	656	72204767	110068.24	10.32
Bulgaria	1	60	1795997	29933.28	23.11
Philippines	1	123	6829025	55520.53	5.28
Poland	1	47	1429249	30409.55	19.27

Source: own compilation, data collected from Clarkson Research.

From the table above, we can conclude that, in the top 50 yards, China ranks the second position when considering to the number of top yards and ships, the total DWT built and average size while Japan built the most bulkers and volume. The South Korea built the largest average size of bulkers, China built the second and Japan built the third. Bulgaria, Poland and Philippines each have one shipyard been listed. Among them, shipyard in Philippines built the most ships with volume of 6829025 dwt. Next when we look at the four main bulkers which include Handysize, Handy max. Panamax and Capsize. Referring to the Appendix 11, we notice that both South Korean and Chinese shipyards building bulkers are falling behind Japanese shipyards in terms of number of ships and total volume. We know the fact that China has the most market share in terms of tonnage now, however, in the list of top 50 yards, Japan has produced the most ships and volume for each type, China only takes the second most shipbuilding. This can be explained by that there are more middle-sized and small-sized shipyards in china than in Japan. What's more, Japan, China and South Korea still dominate the bulkers building in the whole world.

Tankers shipyards

Table 4-4 Top 50 shipyards of tankers

Countries	number of top yards	number of ships	total DWT	Average size	Age
Japan	25	1588	108519803	68337.41	10.65
South Korea	13	2005	209259411	104368.78	6.44
China	8	501	43223048	86273.55	5.50
Croatia	3	156	8185400	52470.51	11.60
Germany	1	49	1017494	20765.18	17.86

Source: own compilation, data collected from Clarkson Research

In the list of top 50 tanker yards, South Korea has built the most volume and numbers of tankers even though the number of yards reaches is only half of Japan's. The average size of tankers built in Chinese shipyards is bigger than that of Japan but smaller than that of South Korea. We can conclude that, China top yards get orders which bigger tankers just recent years than Japan and South Korea. When looking at the 5 kinds of tankers in Appendix 13, the number one place is taken by South Korean yards in terms of five types. Except that the panama type production in China shares one in three markets for dwt and ranks the

second position, other four types of tanker production in China is falling behind South Korea and Japan. The proposition of china yards in the world top yards reaches 15% which is far less than that of South Korea with nearly 50%. This shows us that, the capacity of Chinese top yards has huge potentials to improve.

Containerships shipyards

Table 4-5 Top 50 shipyards of all containerships

Countries	number of topyards	number of ships	total DWT	Average size	Age
China	13	727	21037617	28937.57	5.69
Germany	13	699	16083203	23008.87	12.07
Japan	11	521	22294823	42792.37	10.92
South Korea	7	940	57942718	61641.19	6.48
Poland	1	221	5814800	26311.31	10.52
Denmark	1	85	7568866	89045.48	12.04
Turkey	1	29	407324	14045	6.36
Romania	1	25	1290969	51638.76	3.74

Source: own compilation, data collected from Clarkson Research..

Among the top 50 containerships yards, both Germany and China come to the first place at the same time in terms of number of containerships yards. Japan follows as the third most and South Korea takes the forth place. But South Korea has built the most container ships with 940 ships and nearly 58 million tonnages. Japan and China follow respectively. In conclusion, for Chinese shipyards, the age of ships built explains that the volume of container shipbuilding has been increased during these recent 6 years. Other countries, such as Japan, Germany, Poland and Denmark, have longer history in container ships building. Then we consider feeder, panama and post-panamax to understand the situations of Chinese yards in top ranges. More details are contained in the Appendix 15. Germany appears to dominate the feeder building in top 50 yards in the world, leading to the third biggest market share. The leading role is played by South Korean yards in terms of number of container ships built and total volume in the top 50 yards in the world. China has produced the most panama ships, accounting for 18.8 per cent market share but still over 30 per cent less than that of South Korea. The situations demonstrated above can be explained by technologies barriers in China. Constructing container ships, especially high-tech ships, such as reefers, unlike bulk carriers, requires more advanced technology and supporting facilities. It can partly illustrate the appearance of German shipyards.

4.2.3 Top shipyards of other ship types

Beside three main products of Chinese shipbuilding, other kinds of ships are considered to understand the situations of Chinese yards weights in the world. Table in the following gives us the perspective.

Table 4-6 Proportion of Chinese yards in the worldwide top yards

ship types	number of yards	total number of top yards	proportion
Combined Carrier Top Yards	0	50	0.00%
LPG 40K-60K Cu. M. Top Yards	0	4	0.00%
LPG 60K + Cu. M. Top Yards	0	14	0.00%
Reefer Top Yards	1	50	2.00%
LPG Gas Carrier Top Yards	2	50	4.00%
Ro-Ro & Passenger Top Yards	2	50	4.00%
Ro-Ro Freight Top Yards	2	50	4.00%
Gas Carrier Top Yards	3	50	6.00%
LPG less than 5K Cu. M. Top Yards	3	50	6.00%
LNG Gas Carrier Top Yards	3	37	8.11%
LPG 5K-20K Cu. M. Top Yards	5	50	10.00%
Pure Car Carrier Top Yards	5	50	10.00%
LPG 20K-40K Cu. M. Top Yards	2	18	11.11%
Chemical Top Yards	7	50	14.00%
FPSO/FSU Top Yards	8	50	16.00%
Miscellaneous Top Yards	9	50	18.00%
Offshore Top Yards	9	50	18.00%
General Cargo Top Yards	15	50	30.00%

Source: own compilation, data collected from Clarkson Research.

As we can see from this table, generally speaking, Chinese shipyards of these sorts of ships are occupying not too much share. In the list of top 50 general cargo yards, there are one third yards coming from China. But for LPG which is over 40,000 dwt and combined carrier, none of Chinese yards has a place in the world top yards. Those proportions over 10 per cent of top yards includes yards of LPG 5K-20K, Car carrier, Chemical, FPSO/FSU, Miscellaneous and offshore. One common feature of these ships can be found that they require more technologies supporting than bulkers, tankers and containerships. The limitation of developed technology in China is also one of key factors affecting the building of high-tech

ships.

In summary, presenting yards comparisons with other countries makes us know Chinese yards situations clearly and directly. In terms of total ship numbers built in each country, both South Korean and Chinese shipyards are comparatively smaller-sized, which mean nearly half shipyards are built ships less than ten, while over half of Japanese shipyards each produced at least 100 ships. For deadweight built, Japan still leads the first role in larger ships. When looking at the comparisons for bulkers, tankers and containerships built in shipyards, Japan dominates the first place in terms of numbers and tonnage in bulker market. South Korea produced the most tankers in top 50 shipyards and China produced the second most Panamax tankers in top 50 shipyards. This can be partially attributed to the expansion of Panamax canal which requires new changes of ships in width and depth. In respect of containerships, Both Germany and China lead the first position in numbers. But South Korea still takes the first place in containerships building in top 50 shipyards. China produces the most panama containerships. For other high-tech or added-value ships, China shares little market in top shipyards. The reason of these market situations can be explained by the fact that the huge growth of demand for these three types of ships and the labor costs advantage of these three countries. Furthermore, the lack of technologies in shipbuilding such as LPG, LNG ships displays the situation which China shares little market in these high added-value vessels. Based on comparisons, even though recently China has leading role in bulkers, tankers and containerships building in terms of tonnage and numbers, we should also understand that most of Chinese shipyards are still small-sized and economies of scale is required for long-term and sustainable development.

Besides the historical and current situations presentations, it is also noticed some problems and challenges confronted with Chinese shipyards, such as the weak position on high value ships market and variations of exchange rates. As a result, we will recommend corresponding suggestions in chapter 6.

Chapter 5 Predictions for the Chinese Shipbuilding Industry Five Years from Now

Based on the estimations of last chapter, we summary the significant factors affecting Chinese orderbooks, contracting and deliveries as below. However, question about what the future situations of Chinese shipbuilding is also one of our topics in this thesis. Are they keep increasing as before or going down under the shadow of crisis? In order to figure out the looking-forward environment, in this chapter, we will predict three scenarios for the future development of shipbuilding according to the relations achieved from regressions.

Table 5-1 Significant variables affecting Chinese shipbuilding

Independent Variables	**Coefficients and P-values**		
	Orderbook	**Contracting**	**Deliveries**
Industry growth rates	-	0.0389*	-
Prob.	-	0.07	-
Exchange rates	0.3635***	5.9300***	-2.9115**
Prob.	0.00	0.01	0.02
LIBOR interest rates	-	-0.3534**	-0.4303***
Prob.	-	0.02	0.00
Price of steel plate	-	-	0.3959*
Prob.	-	-	0.06
Second-hand price	-	-	1.0102*
Prob.	-	-	0.06
the Clarkson Index Earnings	0.0311***	1.0469***	-
Prob.	0.00	0.00	-
Chinese government policies	0.0538***	1.5487***	0.4924***
Prob.	0.00	0.00	0.01

*Note: ***=significant level with 1%*
***=significant level with 5%*
**=significant level with 10%*
Source: own compilation.

5.1 Three Scenarios of Chinese Shipbuilding

5.1.1 Scenario One-Sluggish recovery

In Scenario one, we assume that the world economy will recover very slowly after

economy crisis 2008. The speed of Chinese industry growth will be slow (i.e. slow down). International trades will not be as flourishing as in 2007 but increase a little bit after the crisis. So if the world will look like we just described, then what will happen to the variables affecting shipbuilding of this research? Table below presented us the predictions of change of factors in future five years.

Table 5-2 Scenario One: Sluggish recovery

Variables	Scenario One	Explanations for variables prediction
Industry growth rates	10%	Within five years, Chinese economy will still keep growing as before but the speed will be slower.
Exchange rates	-9%	Since the United States are pushing Yuan to appreciate. Also, the economy in China requires appreciation of Yuan for better structure adjustment.
LIBOR interest rates	-10%	We predict the LIBOR interest rates will decrease due to the tight demand for new ships, thus lower interest rates will be given.
Price of steel plate	5%	Steel price will increase because China's potential demand will boost the price growth of raw materials.
Second-hand price	-10%	Slow recovery from crisis makes shipping market over supply and second-hand price are going down.
The Clarkson Index Earnings	5%	The exports and imports China runs are taking major role in sea transportation, shipping market are recovering very slowly. 5% increase of earnings will be acceptable.
Chinese government policies	1	With five years, National Plans are still putting into effect. Government policies are playing very important role.

Source: own compilation.

5.1.2 Scenario Two – Optimistic growth scenario

In this Scenario, an optimistic picture will be drawn for the world in general and the Chinese shipbuilding industry in particular. We assume, the world economy will grow very quickly. International trade will stimulate the shipping market to be busy, existed fleets cannot meet the demand for new ships. Then changes of factors affecting shipbuilding industry are discussed in the following.

Table 5-3 Scenario Two: Optimistic growth with government supports

Variables	Prediction	Explanations for variables prediction
Industry growth rates	20%	Chinese economy will still keep growing as before under the assumption that there will be no economy crisis.

Variables	Prediction	Explanations for variables prediction
Exchange rates	-5%	The appreciation of Yuan is still the trend under industry structure adjustments. But government will control the degree of appreciation.
LIBOR interest rates	5%	The booming market encourages ship owners to order new ships and banks will also increase the interest rates.
Price of steel plate	15%	China is heavily relying on the imports of iron ore, thus boosting the price growth of raw materials.
Second-hand price	0%	The price of second-hand ships won't change
The Clarkson Index Earnings	10%	High profits will be got from high freight rates.
Chinese government policies	1	With five years, National Plans are still putting into effect. Government policies are playing very important role in supporting shipbuilding.

Source: own compilation.

5.1.3 Scenario Three – Optimistic growth scenario without Chinese government support

This scenario is the same as Scenario 2 (i.e. the optimistic growth scenario), expect for the fact that we assume that the Chinese government will not support the domestic shipbuilding industry any longer: i.e., there will be no financing assistances from public and private banks.

Table 5-4 Scenario Three: Optimistic growth without government supports

Variables	Prediction	Explanations for variables prediction
Industry growth rates	20%	Chinese economy will still keep growing as before under the assumption that there will be no economy crisis.
Exchange rates	-5%	The appreciation of Yuan is still the trend under industry structure adjustments. But government will control the degree of appreciation.
LIBOR interest rates	5%	The booming market encourages ship owners to order new ships and banks will also increase the interest rates.
Price of steel plate	15%	China is heavily relying on the imports of iron ore, thus boosting the price growth of raw materials.
Second-hand price	0%	The price of second-hand ships won't change
The Clarkson Index Earnings	10%	High profits will be got from high freight rates.
Chinese government policies	0	In next five years, we assume Chinese government will not support the development of shipbuilding, so the dummy variable is zero.

Source: own compilation.

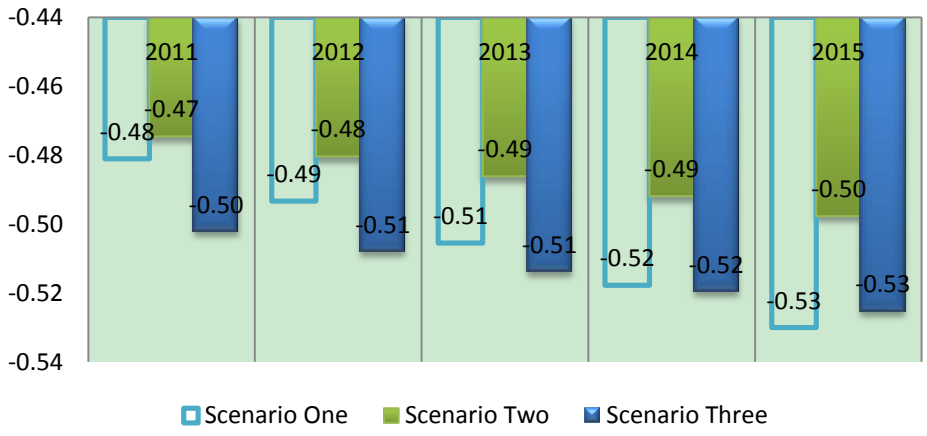
Next changes of orderbooks, contracting and deliveries in China in five years will be predicted by applying the equations 3.1, 3.2 and 3.3. Since all the data are taken in logarithmic format, the prediction will tell us the growths rates of the three indicators rather than concrete volumes. Even if factors that are not significant change, we take those as not influential enough. We take their average values in 2010 to be the base data.

5.2 Comparison among Three Scenarios

5.2.1 Orderbooks predictions

As presented below, we find among all the three scenarios, orderbooks are predicted to be reduced. In Scenario One which economy recovers slowly, the orderbooks will reduce by average 0.5% annually. Scenario two displays an optimistic trend. In this case, even though orderbooks will decrease in China, the fast growing market makes reductions less fast. This is can be explained by the highly positive correlation between economy development and shipping. Fast economy growth boosts the demand for transportation and then for the new vessels. Under the circumstance of flourishing market, we assume Chinese government will stop supporting the shipbuilding industry, so the most reductions are presented to us in next five years. From these comparisons, we understand how import government policies mean to shipbuilding.

Figure 5-1 Changes of orderbooks in three scenarios



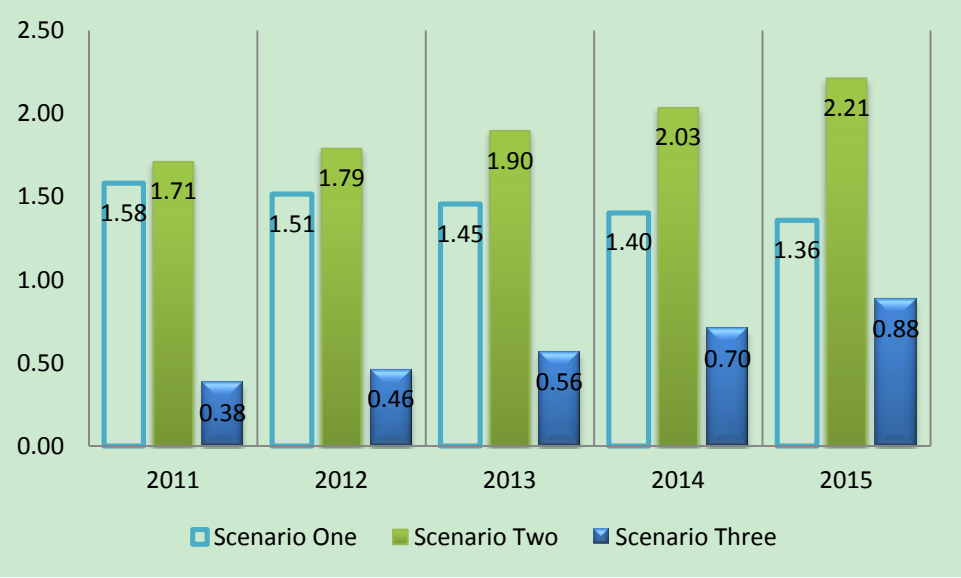
Source: own compilation

No matter what kinds of market we will be situated in, reduction of orderbooks will happen. In our views, that is because existed fleets and future deliveries are sufficient to supply demands of fleets. But even in a very booming market, if without government supports, the reduction will be most comparing with shipbuilding supported by government. From figure above, we find that nearly 0.3% point of decrease can be controlled by Chinese policies.

5.2.2 Contracting predictions

Coming to the predictions of contracting in three scenarios, we notice that if economy develops very fast as we assume, contracting in next five years will increase. In the case which world economy develops slowly, a downturn of contracting in China will be presented. It proves that development of economy and shipping market are highly related to each other. That is to say, demand for shipping determines the need for ships. However, it cannot be ignored that the significant role of Chinese government played in the predictions. With policies supports in a fast growing market, nearly 1.3% increase of contracting will be achieved every year.

Figure 5-2 Changes of contracting in three scenarios

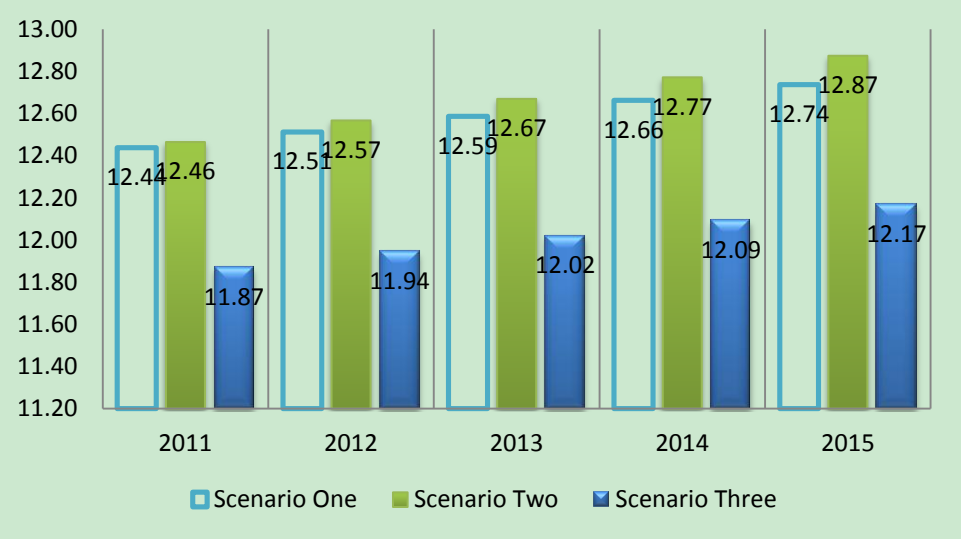


Source: own compilation

5.2.3 Deliveries predictions

In terms of deliveries, we find that deliveries will increase in all three scenarios. In the pessimistic case which both orderbooks and contracting are predicted to decrease, the deliveries are still increase flatly. This can be explained by the orderbooks and contracting existed before the crisis. Both shipyards and ship owners were affected by the crisis, problems such as shortage of capital, limitations of credit and inefficient operations, lead to them to postpone the date of delivery.

Figure 5-3 Changes of deliveries in three scenarios



Source: own compilation.

After two years, economy started to going up, ships ordered before are under construction. So deliveries will still be increasing in China. Another reason we think is that, domestic orders in China can also boost the growth of deliveries. In Scenario Two, the deliveries are a little bit higher than Scenario one but much higher than Scenario Two. It is not hard to understand that fast growing economy lets ship owners order new ships to meet growing demand in shipping. Besides, just as government policies supporting in orderbooks and contracting, deliveries are also heavily relying on the government policies. As we see in the figure above, there is nearly 0.6% decrease of deliveries every year if Chinese government stops supporting shipbuilding industry.

Taking an over view of three scenarios, it is clear that the differences between Scenario Two and Scenario Three are bigger than those between Scenario One and Scenario Two. That indicates that effects of Chinese government policies are more significant on shipbuilding than effects of world economy. The results of our regressions also illustrated this point. Among three regressions, the Chinese

government policies are positively and significantly affecting the orderbooks, contracting and deliveries. Chinese shipbuilding industry is definitely depending on the supports from government.

Chapter 6 Conclusions

6.1 Final Conclusions

The shipbuilding industry of China has developed rapidly since 1990s, especially in the year of 2010, Chinese shipbuilding has been in No.1 in terms of total tonnage produced in 2010. This goal has been achieved five years earlier than the Chinese government planned. The factors that may boost the development of shipbuilding in China are taking into consideration by us.

In order to figure out the effects of key variables on Chinese shipbuilding, we set up three regression models in terms of orderbooks, contracting and deliveries. Eventually, the exchange rates, LIBOR interest rates, industry growth rates in China, second-hand price for all the ships, earnings in freight rates Chinese government policies as dummy variable and steel plate price have been collected as independent variables in a regression analysis. In summary, exchange rates and Chinese government policies are the variable that affects all the indicators of shipbuilding though the relations are different. Exchange rates affect contracting most with coefficient of 5.93 while affect orderbooks least with only 0.36%. Chinese government policies are also proven to influence contracting most with coefficient of more than 1.5. Other six factors are also testified to influence Chinese shipbuilding at various degrees. Libor interest rates are proven to affect contracting with coefficient of -0.35 and deliveries with -0.43. Moreover, if earnings increase with 1% and other variables remain unchanged, then orderbooks will increase with 0.03% and contracting grows with about 1%. Besides, contracting is the only indicator that is affected positively by the growth of Chinese industry rates. Deliveries are influenced by the price of steel plate and second-hand prices. In short, contracting is the dependent variable which is affected by industry growth rates, exchange rates, earnings and government policies most. Deliveries are affected by exchange rates, LIBOR interest rates and second-hand prices most.

Apart from having a look at the historical data, we also compare the top yards situations with Japan and South Korea. The results tell us that Japan and South Korea still lead the roles in shipbuilding in general. In the top 50 shipyards, China has very big market share in terms of tonnage about three main products, but it is noticeable that the number of huge-capacity shipyards are still less than other two countries. There are more small-sized and low productivity shipyards in China. Differences exist among various sized shipyards. According to the comparison about the high-tech ships, Japan and South Korea are undoubtedly taking the paramount positions while Chinese shipyards share little market. Most of

orderbooks are hold by Japan and South Korea shipyards. This indicates that Chinese shipbuilding is lack of the advanced technology support in high value ships.

We also predicted the future development of shipbuilding in three different scenarios for next five years. The first one is made based on the pessimistic assumption that world economy is recovering very slowly. The second one is predicted that world economy will grow very fast with the strong supports from Chinese government. The last scenario present the situation without government supports even though market goes so well. The results tell us that orderbooks will decrease in all three scenarios. The least reduction is in Scenario Two with under 0.5% annually whilst the most reduction is predicted in Scenario Three with more than 0.5% decrease orderbooks every year. We know that the orderbooks were made before the crisis when market was very booming, oversupply of fleets warned ship owners that stop ordering new vessel is more rational. Thus our estimations make sense.

Among three scenarios, the change of contracting ranges from 0.38% in Scenario Three to 2.21% in Scenario Two. Contracting will grow in Scenario Two and Scenario Three but contracting in Scenario Two will be more than Scenario Three. If the world economy recovery rapidly, huge demand for shipping will encourage ship owners to sign contract with Chinese shipyards. However, there will be great difficulties of constructing ships and capital operation without government supports.

With respect to the deliveries, in next five years, deliveries will increase in three scenarios according to our prediction. From our understanding, in a sluggish market, increased deliveries with average 12.6% every year can be owed to the existed contracts signed before the crisis. If market goes very well as presented in Scenario Two, deliveries will increase nearly 0.1% more than Scenario One since more contracts will be made in the future. As the effects of government policies on orderbooks and contracting, the deliveries will shrink to below about 12% every year without Chinese government supports. Consequently, we draw that Chinese government policies will play more significant role in shipbuilding than world economy will do in next five years.

6.2 Limitations of Thesis

As for the analysis concluded above, there are still some points stated for further improvement of this thesis. Firstly, data collected are limited which cannot reflect the situations of Chinese shipbuilding. Secondly, factors affecting the Chinese shipbuilding are complicated, for example, labor costs and productivity as an very

important one should be contained theoretically. Thirdly, top yards comparisons cannot reflect the Chinese shipyards capacity in the round. Fourthly, even though government adopted policies to support the shipbuilding industry, how the shipyards or agencies put them into effect should be considered at the same time. Fifthly, it is a little bit robust to interpret the effects of factors on shipbuilding due to the authors' limited knowledge on shipbuilding.

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Appendices

Appendix 1 Data explanations

Dependent variables	***unit***	***explanations***
Volume of contracting	CGT	CGT refers to Compensated Gross Ton and is more accurate and most adopted in the world in measuring volume of shipbuilding.
Volume of orderbooks	CGT	
Volume of deliveries	CGT	
Independent variables	**-**	**-**
The growth rates of industrial added value	%	The industry growth rates can reflect the production situations in China.
Exchange rate	RMB / $	Shipbuilding is a dollar-based industry.
LIBOR interest rate	%	
Clarkson index earnings	$/day	Combination of earnings of bulkers, tankers and containerships according to the weights of these three kinds of ships built in China yards. More details are discussed in the following.
Japan steel plate commodity price	$/ton	The price of China steel plate is limited. This variable is based on that of Japan. Due to the fact that Japan is also the main shipbuilding and iron ore import country like China, referring to price of Japan steel plate is acceptable and feasible.
Import	$100 million	The value of China importing goods and services.
Export	$100 million	The value of China exporting goods and services.
Second-hand price for all ships	$/dwt	This is calculated by Clarkson Research for all kinds of second-hand ships.
Government policies	_	According to literature review, government supports are highly correlated to shipbuilding industry.

Appendix 2 Sources of data collection

Dependent variables	***Sources***
Volume of contracting	*The Clarkson Research*
Volume of orderbooks	*The Clarkson Research*
Volume of deliveries	*The Clarkson Research*
Independent variables	***Sources***
The growth rates of industrial added value	*The National Bureau of Statistics of China*
Exchange rate	*The State Administration of Foreign Exchange of China* *The Economics BBS of People University of China*
LIBOR interest rate	*The Clarkson Research*
Clarkson index earnings	*The Clarkson Research*
Japan steel plate commodity price	*The Clarkson Research*
Import	*The World Bank* *The National Bureau of Statistics of China* *The Economics BBS of People University of China*
Export	*The World Bank* *The National Bureau of Statistics of China* *The Economics BBS of People University of China*
Second-hand price for all ships	*The Clarkson Research*
Chinese government policies	*assumption made by the author*

Appendix 3 Variables explanations

Variables mentioned in literature		Data limitations	Variables used in models
Variables affecting supply and demand	Government initiatives	Quantitative variable, regarded as one or zero	Chinese government policies, 0 or 1
	Ships earnings of freight rates	Focus on three main kinds of ships	Clarkson Index earnings
	Exchange rates	Quantitative variable	Exchange rates
Variables affecting supply	Labor productivity	Quantitative variable without data	Not used in regression models
	Labor costs	Quantitative variable without data	Not used in regression models
	LIBOR interest rates	Quantitative variable	LIBOR interest rates
	Price of steel plate	Quantitative variable	Japan steel plate price
	Capacity and number of shipyards	Quantitative variable but difficult to use in models	Not used in regression models, but described by comparisons
Variables affecting demand	Volume of International trade	Quantitative variable	Not used in the regression duo to highly correlated to other variables
	Price of second-hand ships	Quantitative variable	Second-hand price
	Domestic economic growth	Quantitative variable	the growth rates of industrial added value
	Market expectations	Quantitative variable without data	Not used in models
	Credit availability	Quantitative variable without data	Not used in models

Appendix 4 Correlation matrix

	INDUSTRY	STEEL	SECONDHAND	EARNINGS	IMPORT	EXPORT	LIBOR	EXCHANGI
INDUSTRY	1	0.100706	0.33869	0.480929	0.308677	0.259205	-0.11136	0.007195
STEEL	0.100706	1	0.758122	0.48826	0.727989	0.786661	-0.13307	-0.70803
SECONDHAND	0.33869	0.758122	1	0.790532	0.677199	0.72313	0.227569	-0.49672
EARNINGS	0.480929	0.48826	0.790532	1	0.453757	0.463056	0.115059	-0.20464
IMPORT	0.308677	0.727989	0.677199	0.453757	1	0.983649	-0.34109	-0.87715
EXPORT	0.259205	0.786661	0.72313	0.463056	0.983649	1	-0.27453	-0.88626
LIBOR	-0.111364	-0.133065	0.227569	0.115059	-0.34109	-0.27453	1	0.380364
EXCHANGE	0.007195	-0.708031	-0.496718	-0.204639	-0.87715	-0.88626	0.380364	1

Appendix 5 Durbin-Watson test

Test for autocorrelation

Positive autocorrelation	Test is inconclusive	No evidence of autocorrelation	Test is inconclusive	Negative autocorrelation
0 dL	dU	2	4-dU	4-dL 4

H0: There is no first-order autocorrelation.

H1: There is first-order autocorrelation.

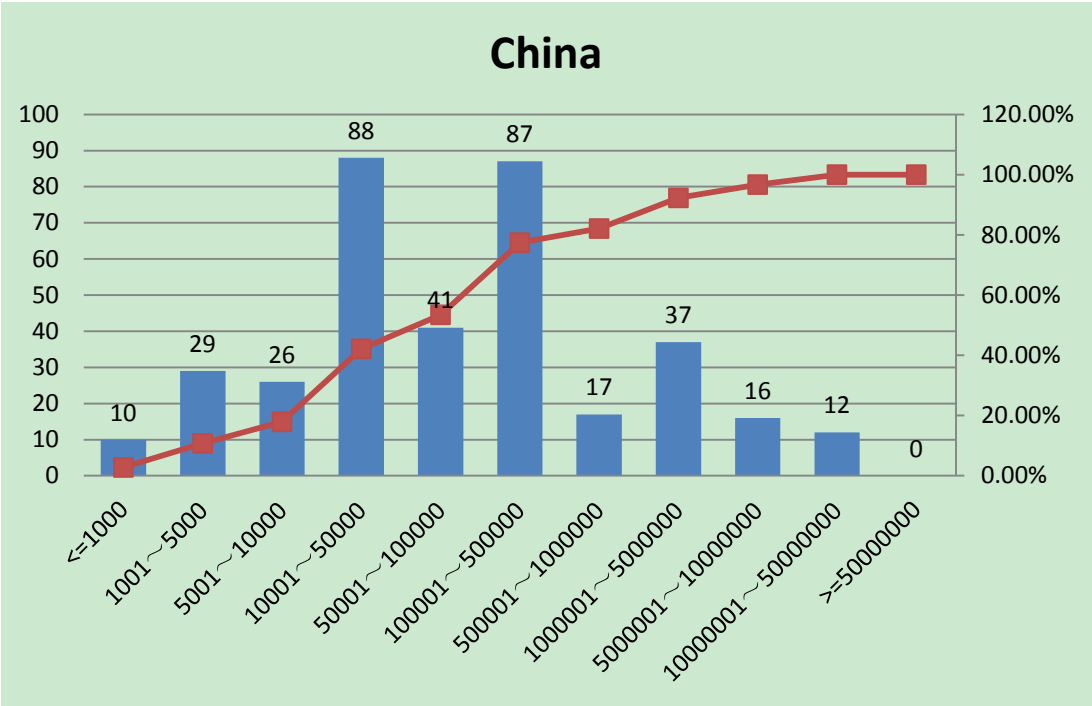
Source: adapted by Junhui Li (2011) according to the book of Managerial Statistics (2008).

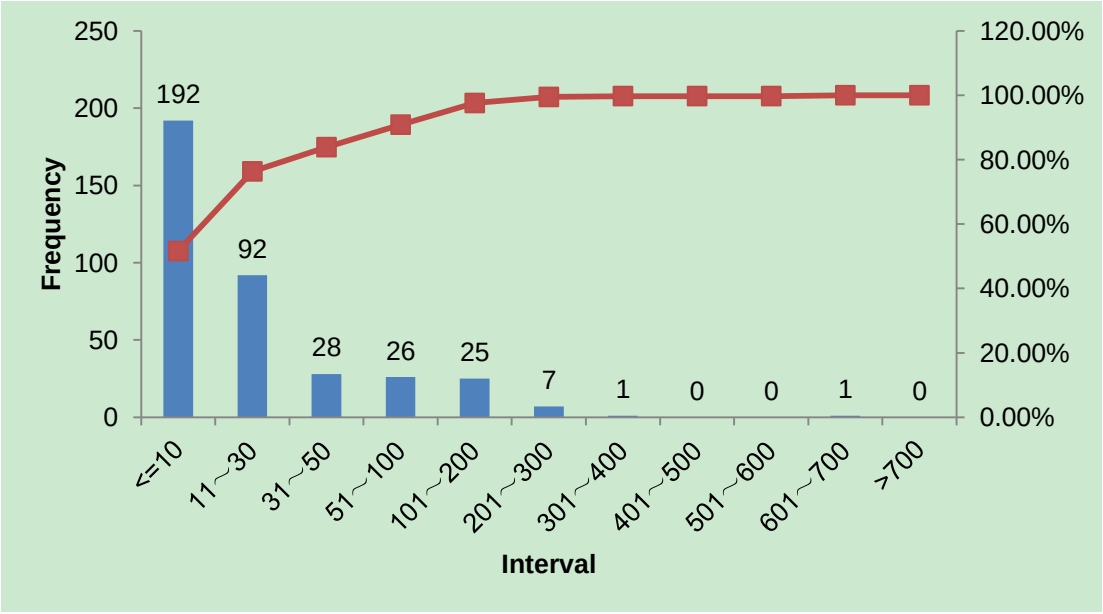
Note: in this test, the significance level will be 2α.

Appendix 6 Regression before adjustment

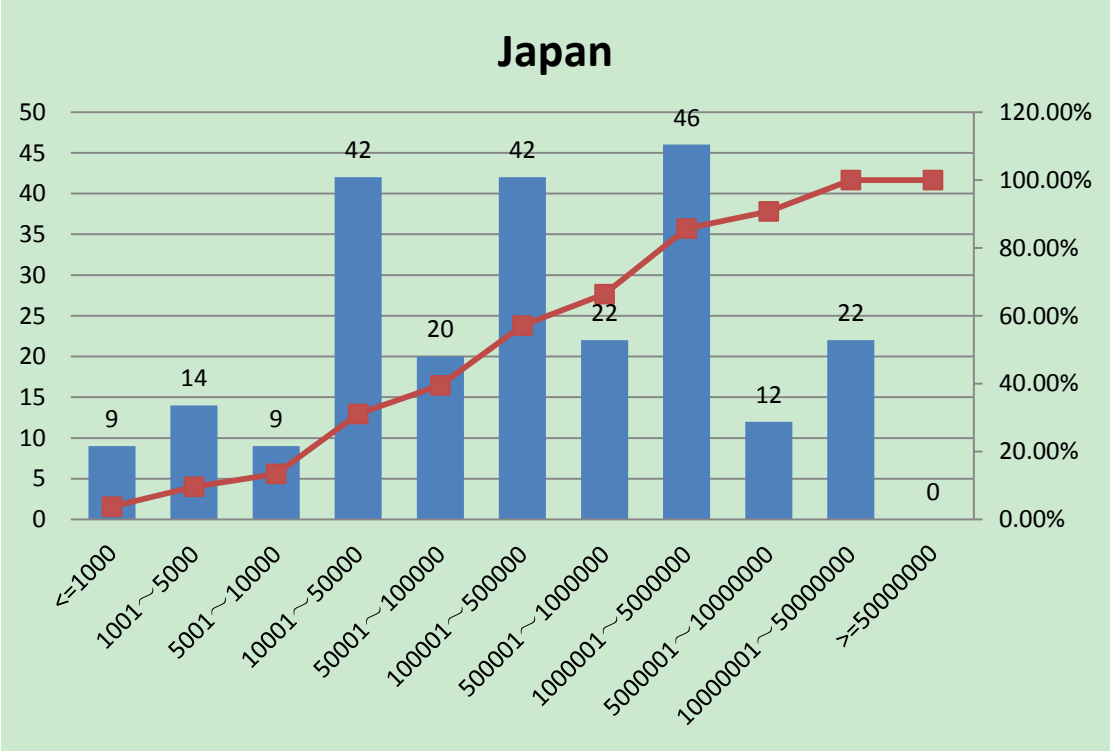
Dependent Variable: LOG(ORDERBOOK)				
Method: Least Squares				
Date: 09/01/11 Time: 17:08				
Sample (adjusted): 1999M11 2010M12				
Included observations: 134 after adjustments				
Variable	Coefficier	Std. Error	t-Statistic	Prob.
C	8.512532	1.383627	6.152334	0
INDUSTRY(-1)	-0.00191	0.005299	-0.36129	0.7185
LOG(EXCHANGE(-3))	-3.15908	0.495836	-6.37121	0
LOG(LIBOR(-1))	-0.37526	0.035723	-10.5047	0
LOG(STEEL(-1))	0.204159	0.086589	2.357808	0.0199
LOG(SECONDHAND(-1))	2.051918	0.2187	9.382336	0
LOG(EARNINGS(-1))	-0.03348	0.057929	-0.57788	0.5644
POLICY	0.561405	0.071517	7.84994	0
R-squared	0.979668	Mean dependent v		16.58036
Adjusted R-squared	0.978539	S.D. dependent va		1.084265
S.E. of regression	0.15884	Akaike info criteric		-0.78399
Sum squared resid	3.179014	Schwarz criterion		-0.61098
Log likelihood	60.52723	F-statistic		867.3252
Durbin-Watson stat	0.27982	Prob(F-statistic)		0

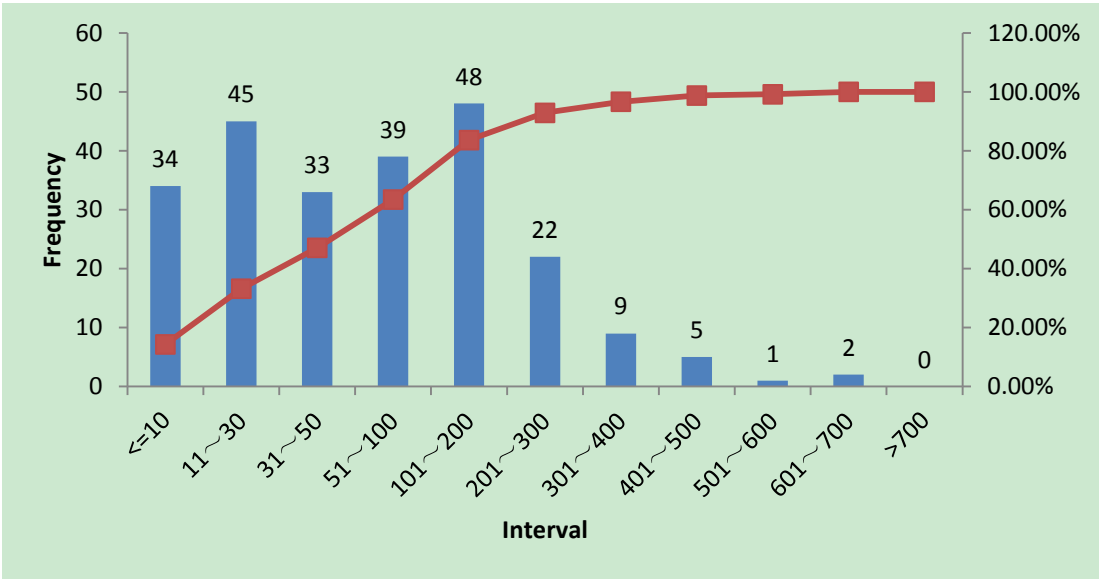
Appendix 7 Ships built in China and frequency distribution in terms of tonnage and number



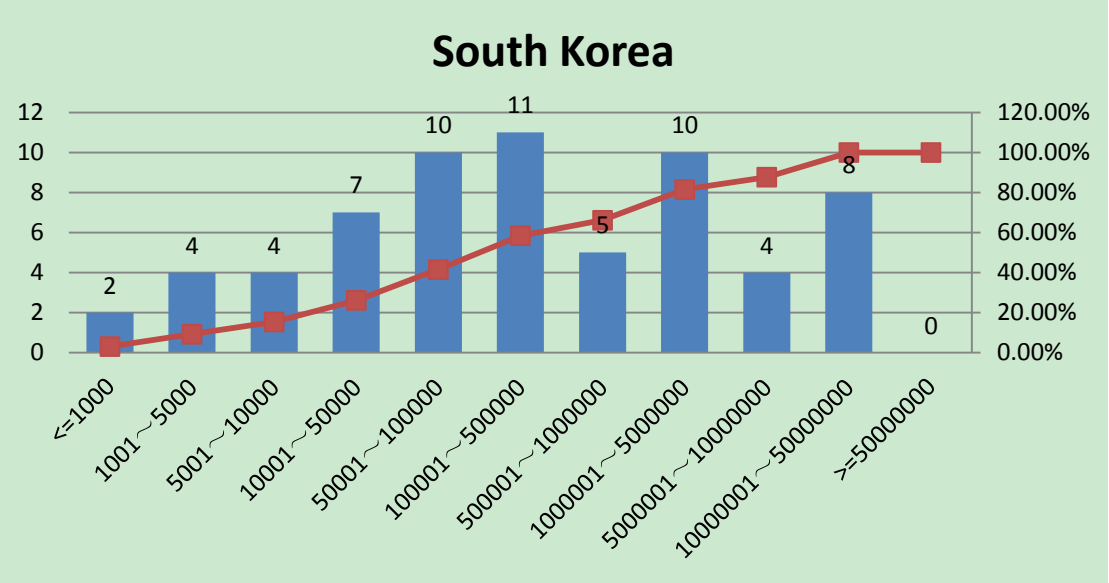


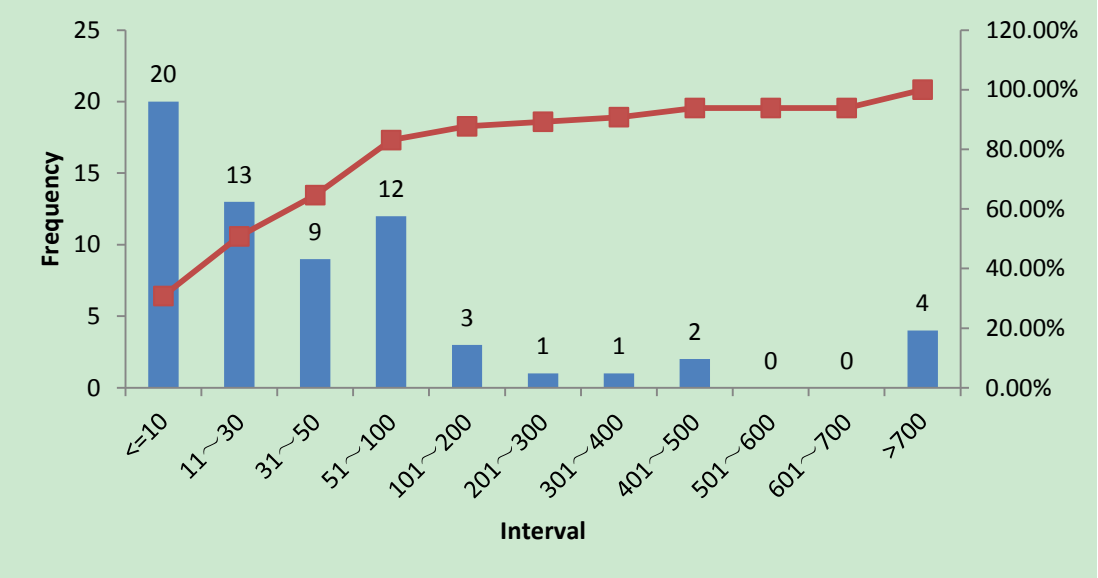
Appendix 8 Ships built in Japan and frequency distribution in terms of tonnage and number





Appendix 9 Ships built in South Korea and frequency distribution in terms of tonnage and number





Appendix 10 Top 50 bulker yards in the world

	number of ships built	total DWT	average size	age
china	116	6330086	54569	15.43
china	99	17498138	176748	3.29
china	80	10817180	135214	17.63
china	80	4594907	57436	1.83
china	69	3568332	51714	16.26
china	66	3216715	48738	8.91
china	63	4364441	69276	1.58
china	62	4799674	77414	3.89
china	60	5885890	98098	4.56
china	58	2908269	50142	2.21
china	54	1604443	29711	10.26
china	89	11195041	125786	15.24
china	45	2672723	59393	5.07
Bulgaria	60	1795997	29933	23.11
Japan	468	26568439	56770	9.37
Japan	350	21738645	62110	11.35
Japan	283	18218099	64374	11.86
Japan	214	13503730	63101	12.34
Japan	205	10770018	52536	10.32
Japan	183	5413167	29580	14.14
Japan	175	19046314	108836	11.67
Japan	172	13918131	80919	14.86
Japan	127	12205426	96105	13.07
Japan	123	3681462	29930	7.54
Japan	120	3734071	31117	12.33
Japan	110	3170690	28824	10.55
Japan	108	11835337	109586	16.04
Japan	106	3691428	34824	19.11
Japan	84	3409190	40585	17.52
Japan	79	5802673	73451	25.67
Japan	77	5892029	76519	16.68
Japan	74	4316328	58328	21.2
Japan	73	10302458	141129	16.49
Japan	72	1776739	24676	12.01
Japan	70	12912407	184462	3.94
Japan	69	1507402	21846	10.12
Japan	66	3462363	52460	10.56
Japan	65	3974780	61150	19.73
Japan	60	3726959	62115	4.34
Japan	53	7162933	135149	14.77
Japan	51	2044608	40090	27.44
Japan	45	9391045	208689	3.51
Philippines	123	6829025	55520	5.28
Poland	47	1429249	30409	19.27
South Korea	269	27406263	101882	18.7
South Korea	165	18292919	110866	14.79
South Korea	65	9055876	139321	1.5
South Korea	55	5878369	106879	17.19
South Korea	55	5293547	96246	1.89
South Korea	47	6277793	133570	7.83

Appendix 11 Top 50 bulker yards in the world in terms of four kinds of bulker

country	HANDYSIZE			HANDYMAX			PANAMAX			CAPESIZE				
	number of ships	total dwt	market share of dwt	number of ships	total dwt	market share of dwt	total dwt	total dwt	market share of dwt	total dwt	total dwt	market share of dwt	total dwt	total dwt
Bulgaria	47	1261716	2.32%	13	534281	0.53%	0	0	0.00%	0	0	0.00%	1795997	60
Brazil	0	0	0.00%	0	0	0.00%	9	667534	0.49%	0	0	0.00%	667534	9
China	349	10155636	18.67%	535	29729589	29.30%	380	30270482	22.37%	337	61748921	28.77%	131904628	1601
Croatia	0	0	0.00%	16	752938	0.74%	0	0	0.00%	0	0	0.00%	752938	16
Denmark	0	0	0.00%	0	0	0.00%	30	2062324	1.52%	8	1366198	0.64%	3428522	38
Germany	21	408307	0.75%	0	0	0.00%	0		0.00%	0	0	0.00%	408307	21
Italy	0	0	0.00%	0	0	0.00%	11	806893	0.60%	6	1061987	0.49%	1868880	17
Japan	1408	39223906	72.11%	1136	56170101	55.36%	1138	85433526	63.13%	471	86889673	40.48%	267717206	4153
Philippines	0	0	0.00%	108	5937084	5.85%	0	0	0.00%	6	1062916	0.50%	7000000	114
Poland	36	939121	1.73%	11	490128	0.48%	0	0	0.00%	4	699504	0.33%	2128753	51
Romania	0	0	0.00%	0	0	0.00%	0	0	0.00%	11	1940722	0.90%	1940722	11
South Korea	77	2404684	4.42%	146	6747230	6.65%	217	16084001	11.89%	333	58305296	27.16%	83541211	773
United Kingdom	0	0	0.00%	0	0	0.00%	0	0	0.00%	5	792447	0.37%	792447	5
Ukraine	0	0	0.00%	21	1102910	1.09%	0	0	0.00%	0	0	0.00%	1102910	21
Unknown	0	0	0.00%	0	0	0.00%	0	0	0.00%	4	769925	0.36%	769925	4

Appendix 12 Top 50 tanker yards in the world

Country	Number of ships built	Total dwt	Avg Size	Age
China P.R.	123	5120295	41628	4.84
China P.R.	80	13196250	164953	2.55
China P.R.	66	5059294	76655	3.65
China P.R.	64	3271849	51122	12.76
China P.R.	49	4721817	96363	5.78
China P.R.	41	411650	10040	2.4
China P.R.	41	6277732	153115	2.84
China P.R.	37	5164161	139571	9.14
Croatia	60	3938539	65642	9.2
Croatia	49	2488571	50787	10.53
Croatia	47	1758290	37410	15.09
Germany	49	1017494	20765	17.86
Japan	140	5483131	39165	7.96
Japan	130	6992897	53791	10.05
Japan	109	1369148	12560	12.73
Japan	95	1005745	10586	15.61
Japan	95	10693312	112561	7.3
Japan	78	592664	7598	17.91
Japan	74	1094301	14787	8.54
Japan	60	329653	5494	16.73
Japan	60	1171730	19528	8.09
Japan	60	5971355	99522	6.7
Japan	54	2546347	47154	10.73
Japan	52	14636229	281465	8.69
Japan	50	277229	5544	11.08
Japan	49	347190	7085	11.29
Japan	48	5259204	109566	12.47
Japan	48	1246804	25975	4.14
Japan	47	426804	9080	16.08
Japan	46	4136095	89915	12.17
Japan	46	4807221	104504	8.34
Japan	46	242068	5262	12.28
Japan	43	2027565	47152	3.96
Japan	42	11582266	275768	4.55
Japan	41	8711168	212467	16.02
Japan	38	7615691	200412	8.76
Japan	37	9953986	269026	14.11
South Korea	396	60904921	153800	9.24
South Korea	370	15699442	42430	4.56
South Korea	268	37938847	141562	8.48
South Korea	242	47113984	194685	9.44
South Korea	230	12554802	54586	4.25
South Korea	152	24813277	163245	4.84
South Korea	67	838124	12509	3.87
South Korea	60	781324	13022	3.11
South Korea	55	2489682	45266	2.32
South Korea	44	2477509	56307	2.01
South Korea	43	1578980	36720	8.84
South Korea	40	314848	7871	5.27
South Korea	38	1753701	46150	17.44

Appendix 13 Top 50 tanker yards in the world in terms of five kinds of tanker

HANDYSIZE				PANAMAX			AFRAMAX			SUEZMAX			VL/ULCC			total dwt	total numbers of ships
COUNTRY	number of ships	total dwt	market share of dwt	number of ships	total dwt	market share of dwt	number of ships	total dwt	market share of dwt	number of ships	total dwt	market share of dwt	number of ships	total dwt	market share of dwt		
Brazil	0	0	0.00%	3	200327	0.68%	2	183585	0.19%	5	720326	1.07%	0	0	0.00%	1104238	10
China	305	10573543	13.17%	137	9970409	33.95%	117	12663430	13.38%	52	8092575	12.04%	86	25930812	15.09%	67230769	697
Croatia	136	5422912	6.75%	24	1679655	5.72%	17	1698069	1.79%	3	499374	0.74%	8	2401124	1.40%	11701134	188
Denmark	0	0	0.00%	0	0	0.00%	16	1344084	1.42%	0	0	0.00%	0	0	0.00%	1344084	16
Finland	0	0	0.00%	0	0	0.00%	2	190663	0.20%	1	129154	0.19%	0	0	0.00%	319817	3
Germany	48	1138248	1.42%	0	0	0.00%	0	0	0.00%	2	298516	0.44%	0	0	0.00%	1436764	50
Hong Kong	0	0	0.00%	0	0	0.00%	0	0	0.00%	0	0	0.00%	1	275914	0.16%	275914	1
India	0	0	0.00%	0	0	0.00%	4	365744	0.39%	0	0	0.00%	0	0	0.00%	365744	4
Italy	0	0	0.00%	0	0	0.00%	5	471125	0.50%	2	298516	0.44%	0		0.00%	769641	7
Japan	626	19773816	24.62%	72	5028942	17.13%	316	33176990	35.06%	58	8633107	12.85%	206	61161896	35.59%	127774751	1278
Philippines	0	0	0.00%	0	0	0.00%	2	230848	0.24%	0	0	0.00%	0	0	0.00%	230848	2
Poland	0	0	0.00%	0	0	0.00%	7	681107	0.72%	0	0	0.00%	0	0	0.00%	681107	7
Romania	18	724970	0.90%	3	208959	0.71%	2	175043	0.18%	1	154448	0.23%	0	0	0.00%	1263420	24
Russia	20	702807	0.88%	2	140360	0.48%	0	0	0.00%	0	0	0.00%	0	0	0.00%	843167	22
Singapore	0	0	0.00%	0	0	0.00%	0	0	0.00%	7	1099535	1.64%	0	0	0.00%	1099535	7
South Korea	1051	39338255	48.99%	156	11312800	38.53%	403	43355596	45.82%	271	42250800	62.89%	263	81558722	47.46%	217816173	2144
Spain	37	1106855	1.38%	0	0	0.00%	0	0	0.00%	16	2140352	3.19%	0	0	0.00%	3247207	53
Sweden	0	0	0.00%	2	140047	0.48%	0	0	0.00%	1	136099	0.20%	0	0	0.00%	276146	3
Turkey	14	163868	0.20%	0	0	0.00%	0	0	0.00%	0	0	0.00%	0	0	0.00%	163868	14
United States	16	484554	0.60%	0	0	0.00%	1	92017	0.10%	14	2170346	3.23%	1	214862	0.13%	2961779	32
United Kingdom	0	0	0.00%	0	0	0.00%		0	0.00%	3	439607	0.65%	0	0	0.00%	439607	3
Ukraine	29	873114	1.09%	10	682433	2.32%	0	0	0.00%	0	0	0.00%	0	0	0.00%	1555547	39
Unknown	0	0	0.00%	0	0	0.00%			0.00%	1	123851	0.18%	1	301862	0.18%	425713	2
total	2300	80302942	100.00%	409	29363932	100.00%	894	94628301	100.00%	437	67186606	100.00%	566	171845192	100.00%	443326973	4606

Appendix 14 Top 50 containership yards in the world

country	number	total dwt	average	age
China	80	1927712	24096	5
China	63	814336	12925	4.53
China	61	1332237	21839	4.48
China	56	509245	9093	6.02
China	54	2371542	43917	2.76
China	51	618417	12125	6.5
China	43	1377955	32045	9.52
China	34	798281	23478	2.88
China	32	1456857	45526	1.82
China	31	352607	11374	6.6
China	141	6296164	44653	11.13
China	53	1171066	22095	7.39
China	28	2011198	71828	5.33
Denmark	85	7568866	89045	12.04
Germany	213	2097086	9845	14.67
Germany	74	3001678	40563	16.3
Germany	67	2090786	31205	9.17
Germany	56	1669475	29812	15.91
Germany	54	1821578	33732	4.8
Germany	51	954389	18713	6.16
Germany	48	461403	9612	7.52
Germany	36	1075864	29885	15.72
Germany	26	927689	35680	10.04
Germany	26	704246	27086	22.41
Germany	24	581347	24222	15.91
Germany	24	697662	29069	18.36
Japan	77	5229944	67921	6.92
Japan	76	1715342	22570	9.54
Japan	72	5249439	72908	13.12
Japan	59	3970145	67290	9.59
Japan	47	529207	11259	11.68
Japan	41	1005044	24513	13.99
Japan	38	2432951	64025	11.97
Japan	30	705926	23530	14.77
Japan	29	366650	12643	9.88
Japan	27	704304	26085	8.62
Japan	25	385871	15434	10
Poland	111	2047713	18447	14.91
Poland	81	2692858	33245	10.89
Poland	29	1074229	37042	5.75
Romania	25	1290969	51638	3.74
South Korea	272	19772172	72691	6.87
South Korea	180	13528429	75157	8.04
South Korea	179	10463815	58457	8.37
South Korea	98	8120579	82863	3.54
South Korea	88	3427413	38947	4.38
South Korea	82	782331	9540	10.39
South Korea	41	1847979	45072	3.78
Turkey	29	407324	14045	6.36

Appendix 15 Top 50 containership yards in the world in terms of three kinds of containership

FEEDER				PANAMAX			POST-PANAMAX			total dwt	total numbers of ships
COUNTRY	number of ships	total dwt	market share of dwt	number of ships	total dwt	market share of dwt	number of ships	total dwt	market share of dwt		
Bulgaria	4	35716	2.23%	0	0	0.00%	0	0	0.00%	35716	4
China	26	147638	9.23%	193	9593810	18.80%	61	4861674	6.06%	14603122	280
Denmark	0	0	0.00%	15	881574	1.73%	61	6463592	8.06%	7345166	76
Germany	68	306297	19.14%	62	2845341	5.58%	13	809229	1.01%	3960867	143
Indonesia	9	43438	2.72%	0	0	0.00%	0	0	0.00%	43438	9
Ireland	3	13554	0.85%	0	0	0.00%	0	0	0.00%	13554	3
Italy	0	0	0.00%	2	102321	0.20%	0	0	0.00%	102321	2
Japan	57	343199	21.45%	104	5576293	10.93%	186	14126530	17.62%	20046022	347
Netherlands	13	48691	3.04%	0	0	0.00%		0	0.00%	48691	13
Philippines	0	0	0.00%	12	626385	1.23%	4	206465	0.26%	832850	16
Poland	0	0	0.00%	29	1306899	2.56%	0	0	0.00%	1306899	29
Romania	2	6400	0.40%	11	697210	1.37%	7	528590	0.66%	1232200	20
Russia	3	17245	1.08%	0	0	0.00%	0	0	0.00%	17245	3
Singapore	13	99481	6.22%	0	0	0.00%	0	0	0.00%	99481	13
South Korea	72	420522	26.28%	526	29305766	57.43%	552	53189333	66.33%	82915621	1150
Spain	14	59842	3.74%	0	0	0.00%	0	0	0.00%	59842	14
Turkey	8	42944	2.68%	0	0	0.00%	0	0	0.00%	42944	8
United Kingdom	3	14923	0.93%	0	0	0.00%	0	0	0.00%	14923	3
United States	0	0	0.00%	3	92475	0.18%	0	0	0.00%	92475	3
total	295	1599890	100.00%	957	51028074	100.00%	884	80185413	100.00%	132813377	2136