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Analysis of China's import iron ore shipping market

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ANALYSIS OF CHINA' S IMPORT IRON ORE SHIPPING MARKET

By

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China

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DECLARATION

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

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

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ABSTRACT

Title of Dissertation: **Analysis of China' s Import Iron Ore Shipping Marke**t
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The world' s steel output has been increasing continuously in recent years. That increase drives up the demand of iron ore. China has been an importing country of iron ore for a long time. The fast developing iron ore market and its shipping market provide a sound opportunity for Chinese shipping companies. However, few researches focus on this market. China' s import iron ore market is not so mature that it is of great significance to make a clear research on this market for further operating and developing. That will be much helpful to the improvement and advancement of the whole market.

This dissertation starts with a generalization of the whole China' s import iron ore shipping market from the aspects of its overall situation, operating situation, and the influences of other dry bulk shipping markets. With the help of the principal of economics, characteristics and influential factors of the supply and demand of the market are expounded and analyzed. A forecast of the future supply and demand of the market is also made. Besides, the dissertation also mentions the bottleneck in China' s import iron ore shipping market, and proposes a conception for the port construction in the future.

The whole dissertation applies several mathematical methods. Time series analysis, simple linear regression and combination forecast are used to estimate the demand of China' s import iron ore market. Qualitative analyses are utilized on the supply of the market in order to make a study on the trend of the dry bulk fleet.

KEY WORDS: Dry bulk cargo, Iron Ore, Shipping market, Supply and demand, Iron ore ports

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LIST OF ABBREVIATIONS

ETV	Estimate of transportation volume
GDP	Gross domestic production
EGDP	Estimated GDP
IISI	The International Iron and Steel Institute
IMF	International Monetary Fund
Dwt	Deadweight tonnes
Mdwt	Million deadweight tonnes
Mmt	Million metric tons
Mt	Metric tonnes
M. tonnes	Million tones
TV	Transportation volume
VLC	Very large carriers
VLCC	Very large crude carriers

CHAPTER 1
INTRODUCTION

1.1 Background and significance

As the International Iron and Steel Institute (IISI) forecasts, the total use of finished steel products continues to show strong growth in all regions of the world. The total world steel demand is predicted to grow 7.3% to 1,087 million metric tonnes (mmt) in 2006, and a predicted growth of 5.8% to 1,150 mmt in 2007. The largest factor in this growth is the influence of China. The double digit growth in China is still predicted at 13% for 2006 and 12.1% in 2007. And it is such an increase that drives up the demand of iron ore.

As a country with a big steel output, China does not have a large reserve of iron ore. The only way to make up for the lack of iron ore is to import foreign ones. China has been an importing country of iron ore for a long time. Especially in recent years, the proportion of import iron ore to the total iron ore consumed in China increased rapidly. According to the data from The Drewry Monthly in the past years, China' s import volume of iron ore in 1999 is about 69.97 million tonnes, and it reached 208.06 million tonnes in 2004, which is about 3 times of that in 1999. Moreover, China has already been the world-largest iron ore importing country.

The fast developing iron ore market and its shipping market provide a sound opportunity for Chinese shipping companies. However, China' s import iron ore

market is not so mature. It is of great significance to make a clear research on this market for further operating and developing. That will be much helpful to the improvement and advancement of the whole market.

1.2 Review of previous research

China' s import iron ore shipping market is one part of the international shipping market. In the past years, a large number of high-valued research papers and essays have been published related to the field of international shipping market by different organizations inside and outside China such as government departments, colleges and universities, research institutions, and some related enterprises. However, most research papers mainly concerned the dry bulk freight market, only a few of them focused on the iron ore shipping market, which is among the dry bulk freight market, not to mention China' s import iron ore shipping market. Even those that are related to China's import iron ore shipping market, the researches did not focus on the market analysis, but other fields such as logistics integration system, iron ore ports construction, etc. In any case, these researches all help to improve the international shipping market. In addition, they also provide theoretic basis for the further study on China' s import iron ore shipping market.

Discussions on the iron ore shipping markets have taken the form of textbooks, research papers, reports, industry publications, and to a lesser extent, articles in academic journals.

A) Textbooks

Few textbooks are totally about iron ore shipping market. Textbooks usually only separate the freight markets and discuss generally and respectively. For example, in Shipbroking and Chartering Practice 6th edition, Chapter 1 (Arne Sandevarn, 2004,

pp. 1-15) divides the whole freight market into 5 markets according to the ship types – the dry cargo market, the tanker market, the reefer market, the car carrier market, and the passenger market. Within the dry cargo market, there are 7 sectors – bulker, tweendecker, container, ro/ro, liner, small ships, and special. Such kind of books only made a division into principal freight markets. No deep-going researches are available.

Textbooks may also provide some market research methodologies for readers to apply. Like Martin Stopford' s Maritime Economics, Chapter 4 (Martine Stopford, 1997, pp. 113-150) sets up a shipping market model include supply, demand, and freight market. It suggests some factors when analyzing a shipping market. In addition, Chapter 14 (Martine Stopford, 1997, pp. 489-514) deals with market forecasting and market research. In which, forecasting methodologies are proposed. And a freight rate forecasting methodology is well introduced. Those all offer a great help to the further research.

B) Research papers

With the respect to research papers, there are rarely papers only speak of China' s import iron ore shipping market. Most related papers refer to the dry bulk freight market; import iron ore shipping market is just a segment of it. Yao Zuhong' s research on international dry bulk cargo shipping market (2002) briefly introduces the international dry bulk cargo shipping market and makes an analysis on the supply and demand of it. Apart from that, it also forecast the dry bulk cargo transportation volume by means of Time Series Analysis and Grey Prediction, which help to propose a method of analyzing China' s import iron ore shipping market. Miao Fenglai' s research (2001) on that respect classifies the main cargo types of international dry bulk freight market. With regard to iron ore, it says that iron ore

is the main raw material in the world steel industry. As the major type of cargo, iron ore transportation volume has a great relationship with the world' s steel industry. Thus drops a hint that when considering the iron ore shipping market, the steel industry could never be neglected.

Some researches pay more attention to the logistics system of import iron ore. Sha Jidong' s study on the logistics system of import iron ore based on the minimum expenses (2003) studies the problem of port based import iron ore logistics system in detail in the light of the laggard dry bulk logistics of our country and the broad development prospect. In his thesis a mathematics model is built up to compute the least overall expense, for supporting the import ire ore logistics system. And the expense include port，shipping，cargo owner and other correlative sides. The author analyses the character and process of import ire ore logistics. After that, brings up the conception of iron ore supply chain, based on which, he builds up the theory of OTIS (Order – Transportation -- Inventory System) that is suitable for the reality of our country. He analyses the elements of OTIS and the relation among them. By mixed integer schedule，the author builds up the mathematics theory model, which aimed as the minimum expense. In addition, he also takes real data of a certain port of China for example，and validates the model of OTIS. Besides, Wang Yan also made a similar research on that field (2004). Wang expounds the concept of integrated logistics of dry bulk. She analyses the system of China import iron ore, constructs the China import iron ore network. And she also models the system based on the minimum cost of the system. Applies the MATLAB software, and exerted GA to compute the model.

Other researches are more related to ports and companies. For instance, Li Junmin analyses the technology and economic performances of river-sea barge

transportation between Beilun port and Wu Steel (2004) in his research papers. He put forward put forward a direct transportation mode of river-sea barge between Beilun port and Wu Steel by means of the analyses of the current transportation pattern of imported ores and the review of the transportation ways of river-sea barge in the different countries. In Zhen Qingyue' s paper on the rebuilding of the iron ore terminal in Tianjin Port (2001), according to the actual condition of Tianjin Port, the paper analyses the feasibility of the transformation and rebuilding of deep-water iron ore terminal of this port. Besides, the author also makes a forecast of the future transportation volume of iron ore in Tianjin Port after the rebuilding of the terminal. He applies both quantitative and qualitative analysis in the paper, which suggest a proper method to do forecast researches.

There are other kinds of researches that refer to dry bulk cargo or iron ore vessels. For example, in Zhou Pubin' s paper about optimizing bulk cargo vessels' type (2001), on the basis of the analysis of the advancing train of the bulk cargo vessels' type，the paper applies several different analysis theory to optimize the bulk cargo vessels' type, and implement statistics rate method to optimize the ore transportation vessels' type. Finally come to the conclusion that the import ore transportation vessels gradually advance larger, mainly above 100000 tonnages.

C) Reports

Almost every other period there appear to be some related reports on dry bulk cargo or iron ore shipping market. Relevant organizations both inside and outside China will issue regular reports on the dry bulk cargo shipping market or iron ore shipping market, such as Clarksons, Lloyd' s List, The Baltic Exchange, Shanghai shipping Exchange. Besides, the Drewry Shipping Consultants Ltd. will also publish the international dry bulk cargo transportation capacity. All those information play an

important role in the improvement of the paper.

D) Articles

There are much more publications and articles in the topic of China' s import iron shipping market. Journals, such as Water Transport Literature Information, Shipping Transaction Communique, Shipping Information, Maritime China, Lloyd's Shipping Economist, The Drewry Monthly, often publish some articles concerning China' s import iron ore shipping market.

The majority of the articles tend to mention that the iron ore shipping market is facing a relatively prosperous period because of China' s developing steel industry in the recent years. Nearly 60% of the output of steel comes from China. However, China does not have a large reserve of iron ore, the proportion of import iron ore to the total iron ore consumed in China is about 50%.

Others, such as one article written by Liu Xiangmei (2005) in Shipping Information, point out that the problems of China' s iron ore shipping ports are becoming more and more serious day by day. China' s import iron ore shipping market is facing the effect of 'bottle neck'.

Some articles make simple forecasts on the supply and demand of China' s import iron ore and steel. Most of them only use quantitative analysis, and are short-term forecasts.

Overall, it appears from the available literature that there have already published some researches related to iron ore shipping market. Some helps to provide some research methodologies, and some happens to offer some information for further

research. However, most papers or articles are not totally aimed at China' s import iron ore shipping market analysis and forecast. In other word, there are no articles or research paper, up to now, that is focus on the China' s import iron ore shipping market analysis and forecast in detail and in long term.

Therefore, in the light of the fast development of China' s steel industry and import iron ore shipping market, it is of great importance for this dissertation to make a thorough and deep analysis on the topic of China' s import iron ore shipping market.

1.3 Main contents and methodologies

China' s import iron ore shipping market is a complex one, which involves a variety of respects. This dissertation mainly orientates towards the future 5 years of the market.

The whole dissertation applies principle of economics and several mathematical forecasting methods.

The principle of supply and demand is applied to analyse the whole market. Time series analysis, simple linear regression and combination forecast are used to estimate the demand of China' s import iron ore market. Qualitative analyses are utilized on the supply of the market in order to make a study on the trend of the dry bulk fleet. Furthermore, an evaluation of the forecast results is made after the forecast.

CHAPER 2
GENERAL SITUATION OF CHINA' S IMPORT IRON ORE SHIPPING MARKET

2.1 Analysing the resource of China' s import iron ore

The most direct and fundamental influential factor of the output and trading quantity of iron ore is the world' s steel industry (Wang Yong, 1999, p. 181). According to IISI, the world crude steel production increased by 5.9% in 2005, to reach a total of 1,129.4 mmt in 2006. China accounted for most of the increase with it's share of the world' s total rose from 26.3% in 2004 to 30.9% in 2005, which is 349.4 mmt. However, the fact is that China does not have a large reserve of iron ore. Compared with those countries with rich ores, the quality of China' s iron ore is not good; most China' s iron ores are lean ores. The only way to improve this situation is to import foreign ones.

China has been an importing country of iron ore for a long time. Especially in recent years, because of the insufficient supply of national iron ore and the strong requisition of high-grade iron ore, Chinese steel companies import more foreign ores in order to reduce the production cost and increase the output. The proportion of the import iron ore to the total iron ore consumed in China has increased a lot. According to the data of past five years, China' s import iron ore reached 9.2 million tonnes in 2001 and rose to 275 million tonnes in 2005, which is about 3 times of that in 2001. In addition, China has already become the world-largest iron ore

importing country, exceeding Japan, in 2003.

At present, China mainly imports iron ore from Australia, Brazil, India, North Africa, and other ore-exporting countries. Chinese steel companies which import foreign ores include Shougang Group Corporation, Shanghai Baosteel Group Corporation, Wuhan Iron and Steel (Group) Corporation, Anben Steel Group Corporation, etc. Ports that deal with iron ore transport spread from the north to the south, and they are mainly decided by the geographic locations of those steel companies.

The fast developing China' s import iron ore market is caused by many reasons.

First of all, the continued stable economy keeps the increasing trend of the demand for steel. Due to the construction of infrastructure, the production of family electric equipments and mobiles, and the building of vessels, the demand for steel expand in a large scale. Iron ore, as the raw material of the steel production, tend to be more demanded with the increasing demand for steel.

Another very important reason is the lack of rich iron ore in China. Iron ore from Chinese companies' own mine is of lower and lower quality after being exploited for many years. The mining cost goes up, as well as the Chinese iron ore cannot meet the needs. It is a better way to import foreign ones to solve these problems. Besides, some steel companies have introduced some blast furnaces that have a high request for high-grade raw materials. Thus, importing foreign ores can not only reduce the costs but also meet the demand of furnaces. From the point of view of steel companies, Baosteel, one of the biggest steel companies in China, depends on import iron ore almost at 100% (Gong Yueming, 2004, p. 12).

The output of China' s steel and iron ore are the two radical factors of China' s import iron ore market. Table 1-1 and Figure 1-1 shows the variations in it.

Table 1-1 China' s crude steel production, Iron ore production, and Import iron ore volume (m. tonnes)

YEAR	2001	2002	2003	2004	2005	2001~2005 (2004) Average Annual Rate
Crude Steel Production	182	222	220	272	349	13.91%
Iron Ore Production	217	231	261	310	n/a	9.33%
Iron Ore Import Volume	92	112	148	208	270	24.48%

Source: Metal Industry Information Center

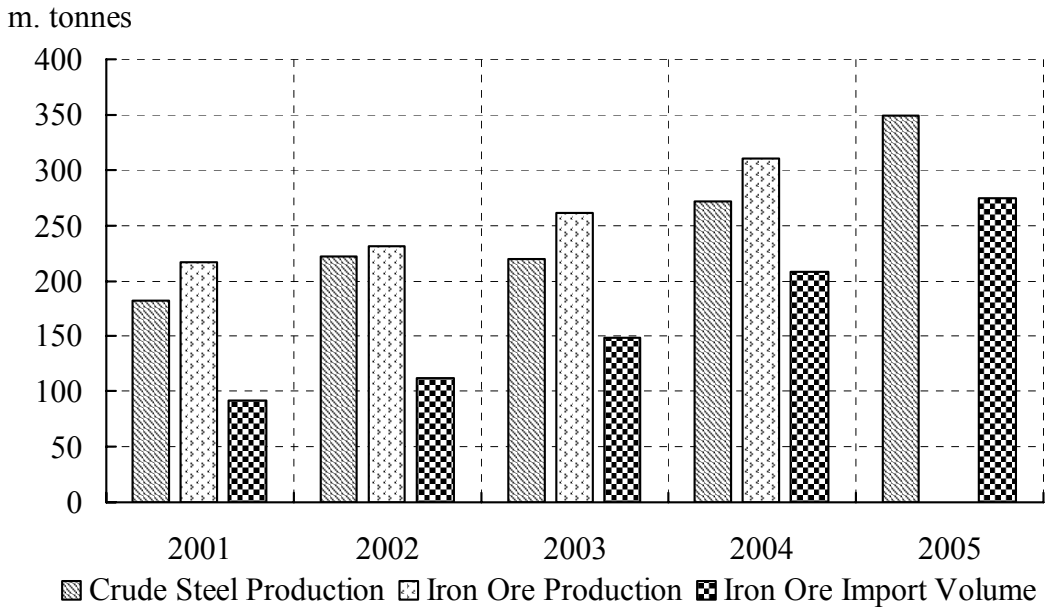

Figure 1-1 China' s crude steel production, iron ore production, and import iron ore volume (m. tonnes)

Figure 1-1 obviously indicates that the crude steel production, iron ore production and import iron ore volume in China all increase a lot in the recent 5 years.

According to Table 1-1, the increasing rate of the import iron ore quantity keeps higher than that of the crude steel production and national iron ore production. The import iron ore volume reached 92 million tonnes in 2001, and rose to 275 million tonnes in 2005, the average annual rate is about 24.48%, which is about 10 per cent higher than that of crude steel production, and about 15 per cent higher than that of national iron ore production.

Accompanied by the constant increasing of the steel output, the import iron ore volume also cannot help increasing rapidly. Iron ore has already become one of the most popular importing foreign trade cargoes.

2.2 Vessels in China' s Import Iron Ore Shipping Market

Among the international shipping fleets, the dry bulk fleet is the second largest fleet, which is mainly used to transport bulk cargoes like coal, ores, and grain.

The fleet falls into four main parts generally referred to Handysize bulk carriers (10-29,999 dwt), Handymax bulk carriers (30-49,999 dwt), Panamax (50-79,999 dwt) and Capesize (over 80,000 dwt).

Handysize bulk carriers (10-29,999 dwt): The draft of this type of vessels is between 9 to 10 meters, which can meet the waterway limitation of some rivers such as the Pearl River and the Yangtze River in China.

Handymax bulk carriers (30-49,999 dwt): The draft of this type of vessels is about 11 meters, which conforms to the requirements of most ports.

Panamax bulk carriers (50-79,999 dwt): Panamax bulkers means vessels

representing the largest measurements allowed in length, beam and draft for passage through the Panama Canal in loaded condition. These ships are mostly gearless and are busy in the main grain, coal and ore trades.

Capesize bulk carriers (over 80,000 dwt): In the daily communication brokers sometimes use a subdivision of this class, like “Cape” for capacity range 120,000-175,000 dwt and “Large Cape” for over 175,000 dwt and reserving VLC or VLCC for sizes above 200,000 tonnes.

According to Drewry’ s statistics, by end February 2006, the World’ s dry bulk fleet was reported to be of 6,239 vessels at 349.8 million dwt (mdwt), reaching an improvement of 7.27% over the corresponding period of last year, at 326.1 mdwt. Among them, there are 662 vessels over 100 thousand dwt at 111.7 mdwt, an improvement of 8.98%. The fact that the dry bulk carriers are becoming larger and larger is seemed to be an irresistible trend.

After a long period of structure perfection, different types of dry bulk carriers are determined to mainly serve different shipping market. The Capesize and VLC or VLCC mainly serve middle and long distance transportation of iron ore and coal. In the iron ore transportation, those vessels mainly serve in the European and Mediterranean lines, and from South America, South Africa and Australia to the Far East. The Panamax bulk carriers are the most representative type of vessels in the World’ s fleet. They are widely used in the transportation of dry cargoes such as coal, grain and chemical fertilizer. In the iron ore transportation, those vessels mainly take part in the short-distance transportation, such as the lines from India to the Far East. In addition, the Handysize and Handymax bulk carriers are popularly used in the short-distance transportation for other dry bulk cargoes such as

concentrates, fertilizers, cement, etc.

Since China' s import iron ore shipping market is open up to the outside world, vessels in this market come from different countries throughout the world. Chinese iron ore fleets are mainly centralized in several large shipping groups such as Cosco, China Shipping, Sinotrans, etc. And some local shipping companies also own some iron ore vessels.

In recent years, Chinese fleet has been enlarged a lot, and also the technical level of the fleet has been improved a lot. In the competition of foreign shipping companies, Chinese fleet is playing a more and more important role in the iron ore shipping market.

2.3 Scale and layout of China' s import iron ore ports

China's ports, which can accept and discharge iron ores, spread from the north to the south. From the point of view of the scale and layout of them, the northern ports are in better conditions, and are relatively more centralized.

A) Northern ports

Northern ports include port of Qingdao, Tianjin, Qinhuangdao, Dalian, Bayuquan, Rizhao, Yantai, Caofeidian, and Lianyun. These ports are all located in the north of China. All of them could accept Panamax bulk carriers. Usually, a panamax iron ore carrier can be discharged in 3 to 6 days.

Yantai port, which is located in Shandong Province, mainly accepts panamax iron ore carriers. In recent years, Yantai port began to fix cranes on the deck to less load vessels to accept some capesize carriers. However, such method is not popular

with ship owners since that will make some effects on the deck of the vessels. So, the business of accepting capesize carriers in Yantai port is not smooth going.

Port of Qingdao is another port along the coast in Shandong Province. It is one of the ports that are in fine natural conditions in the Northern China. Port of Qingdao owns an iron ore terminal of 200 thousand tonnages with perfect and advanced equipment. Accompanied with the proper management by the harbor bureau, it has played an irreplaceable role in the northern ports. Port of Qingdao not only could accept standard panamax iron ore carriers, but also could accept some larger-sized panamax carriers fully loaded 70 thousand tonnes directly berth and discharge cargoes. Meanwhile, port of Qingdao use floating cranes to less load large vessels to accept capesize iron ore carriers. Because of the appropriate arrangement of the port work, the average discharging speed is relatively ideal. Now, port of Qingdao has already become the main discharging port for capesize iron ore carriers in China' s northern ports.

B) Ports in the Yangtze River basins

Ports in the Yangtze River basins include port of Beilun, Mayishan, Shanghai, Nanjing, Nantong, and Zhenjiang. Beilun, and Mayishan are the main discharging ports that accept capesize iron ore carriers.

The iron ore vessels that are accepted by Shanghai Port are somewhat complex, including handymax, panamax, and capesize carriers. However, because of the limitation of water depth, those vessels of huge deadweight only could be docked in other ports or after being less loaded.

Nanjing, Nantong, and Zhenjiang are ports inside the Yangtze River in Jiangsu

province. They mainly accept handymax iron ore carriers. It is the draft of the Yangtze River waterway that restrains the vessels' type. Some of them can also accept panamax carriers, but can only accept those not fully loaded. Because of the restriction of pilot and night service, those ports also impose higher charges than other coastal ports.

C) Southern ports

Southern ports include port of Shekou, Huangpu, Zhanjiang, and Fangcheng. Those ports are all located between Guangzhou and Guangxi near the sea. They can accept both panamax and capesize carriers, after vessels being less loaded by floating cranes.

2.4 Influences of other dry bulk shipping markets

From the point of view of market demand, China' s import iron ore shipping market is determined by the influence of China' s annual steel production on the demand of import iron ore. However, another important factor is the whole international dry bulk cargo shipping market, which makes a great effect on the supply of vessels and the level of the market.

China' s import iron ore shipping market is one part of the international dry bulk shipping market. Other dry bulk cargo freight markets influence the iron ore shipping market directly. For example, China' s import grains from America are mainly transported by panamax bulk carriers, which influences the iron ore shipping market in which panamax bulk carriers are used to transport iron ore from Canada to China. With regard to younger vessels, there exists absolute replaceability between the transportation of two different cargoes at some time. Once one of the market changes, then the other market will adjust with it. For instance, China imports

some high-quality coal from Australia. Handymax bulk carriers transport most of it. That is a direct competition to the market in which China transport iron ore from Australia to the harbors of Yangtze River. On the contrary, the coal shipping market from China to the Southeast is beneficial to importing iron ore market from Australia.

Apart from that, there are influences between different types of iron ore shipping vessels. When the panamax bulk carrier market is low, it may be more economical to transport iron ore by handymax bulk carriers. With the proper condition of ports, it will reduce the transportation cost a lot by using capesize bulk carriers than panamax bulk carriers. Those kinds of organization of transportation undoubtedly form the competitions between different types of vessels in the import iron ore shipping market.

CHAPTER 3
SUPPLY AND DEMAND ANALYSIS OF CHINA' S IMPORT IRON ORE SHIPPING MARKET

Market is akin to the weather. They are always changing, dynamic, unpredictable, subject to frequent periods of storm and calm, complex, and fascinating. As with the weather, careful study of markets also shows certain forces and patterns underneath the daily and apparently random movements. The essential tool for understanding the movement of prices and outputs in individual markets is called the analysis of supply and demand (P. A. Samuelson & W. D. Nordhaus, 1998, p. 43).

The theory of supply and demand is the essence of economics. Demand is the reason for supply; supply is the basis of demand. The analyses on that will let us know more about the characteristics of the market, and provide strong theoretical basis for the development of Chinese steel industry and companies.

The following part will make analyses on the supply and demand of China' s import iron ore shipping market.

3.1 Demand analysis of China' s import iron ore shipping market

3.1.1 Features of demand of China' s import iron ore shipping market

Quantity demanded is the amount of good or service consumers are willing and able

to purchase during a given period of time[1]. A whole array of factors influences how much will be demanded at a given price: average levels of income, the size of the population, the prices and availability of related goods, individual and social tastes, and special influences (P. A. Samuelson & W. D. Nordhaus, 1998, p. 46).

Thus it can be seen that the quantity demanded in China' s import iron ore shipping market is the amount of transportation capacity and labor service needed during a given period of time under a certain level of freight rates. The consumers include all those owners of cargo and their agents that are engaged in China' s import iron ore trade market.

In terms of the object of demand, there are total demand and individual demand in the demand of China' s import iron ore shipping market.

The total demand in China' s import iron ore shipping market is the total amount of transportation capacity and labor service needed during a given period of time under a certain level of freight rates. Total demand actually is consisted of a variety of individual demand in the same period of time.

The individual demand in China' s import iron ore shipping market is the specific demand of different types of cargoes, different requirement of transportation during a given period of time under a certain level of freight rates. Each individual demand has its own particularity – different requirements on the time, area, speed and distance of the transportation of different types and levels of iron ore on different shipping lines. These particularities are called the heterogeneity of

[1] The definition of supply and demand, and other economic terms and jargons are well explained in "Economics 16th edition", written by Paul A. Samuelson, William D. Nordhaus.

individual demand.

In terms of the patterns of consumption, the market demand can be divided into direct demand and derivative demand.

Direct demand is the demand of final products, usually the demand of consumption material. Derivative demand is the demand resulted from the demand of final products, usually the demand of production material.

Transportation is the continuity of the production of goods during the circulation. It is closely connected with business trade, especially in the field of international shipping. Maritime transportation realizes the economical interchange and international trade in the whole world. Hence, the demand for international shipping is derived from that for international trade, the demand for China' s import iron ore shipping is derived from that for China' s import iron ore trade. That feature indicates that the situation of the international trade directly affects the development of international shipping market. China' s import iron ore shipping market, as a more specific part of the international shipping market, also has the same characteristics.

The character of the demand of China' s import iron ore shipping market can be listed as follows.

3.1.1.1 Regularity

China' s import iron ore shipping market is one part of the international shipping market. So, when analyzing the demand of it, the characteristics of the demand of international shipping market should firstly be considered.

Since the international shipping market is derived from the international trade, when analyzing the international shipping market, an analysis of it should be start with that of the international trade. The variation of the quantity, value and good-structure of the international trade is all represented by the demand for international shipping. When the global economy is in the stage of fast developing, the international trade will also be in the trend of increasing in a large scale, then the total demand for international shipping will consequently quickly increases, and keep in a spirit and prosperous atmosphere; and vise versa. Therefore, the total demand for international shipping follows the variation law of global economy and international trade.

The demand for China' s import iron ore shipping is derived from that for China' s import iron ore trade. The situation of China' s import iron ore trade is decided by the development of China' s economy in the environment of world' s economy. When China' s economy is fast developing and both the production of steel and demand for import iron ore are increasing, the demand for import iron ore transportation will also increase a lot, thus make China' s import iron ore shipping market in a lively prosperity, and vise versa. Therefore, the variation law of the total demand of China' s import iron ore shipping market follows that of China' s economy, production of steel and demand for import iron ore in the environment of world' s economy.

3.1.1.2 Latency

There exists some degree of latency in the demand of China' s import iron ore shipping market. On one hand, China' s economy influences the demand for steel and import iron ore, thus make a latency period; on the other hand, China' s import

iron ore trade affects the demand for maritime transportation, thus create the torpidity. A good control of the latency of China' s import iron ore shipping market will be beneficial to the production strategic decision of shipping companies.

3.1.1.3 Imbalance

The imbalance of shipping demand generally exists wherever between countries, areas, or transportation objects. This characteristic is not only the result of the imbalance of the distribution of resources, the development of economy, and the international trade, but also the reason for the development of shipping market. China' s import iron ore shipping market, not exceptionally, also has such a characteristic.

The imbalance of the distribution of iron ore resources in the world causes the trade and transportation of iron ore. Such imbalance of distribution includes the variety, the level and the output of iron ore that China needs to import from other countries. Moreover, the conditions of the geographical location and ports of these countries are also unbalanced. Those all cause the imbalance of the demand of China' s import iron ore shipping market in the light of different iron ore exporting countries and different exporting ports. Besides, the imbalance of the geographical location, scale of enterprises, demand for production, and related importing ports of China' s steel companies is also one of the reasons for the imbalance of the demand of China' s import iron ore shipping market.

Such imbalance advances the development of China' s import iron ore market, since it puts forward different proportion-requirements of the scale of the development of shipping, the structure of fleets, and the parameters of shipping, and also brings up the requirements of the type of transportation organization and the improvement of

transportation system, in order to adapt to the imbalance.

3.1.1.4 Particularity

The individual demand of China' s import iron ore shipping market is usually quite different with each other. Particularity of the individual demand results from the difference of the types of iron ore, the requirements of transportation, and etc. For example, when importing iron ore from Australia, vessels need to be in a good condition and conform to the authoritative requirements; however, when importing from India, the limitations are much fewer; and when importing from San Nicolas in Peru, the vessels must be San-Nicolas-suitable. Analysing and well knowing the particularities will help us to take relevant technical measures during the transportation. Meanwhile, with the development of the world' s economy and international trade, awareness of this characteristic is very important for companies to keep competitive in the international shipping market.

3.1.1.5 Identity

The identity of China' s import iron ore shipping market is represented in two aspects. One is the identity between the individual demands; the other is the identity between the demand of China' s import iron ore shipping market and the demand of other shipping markets.

The identity refers to the displacement of the objects of transportation whatever kind of demand is. At the same time, it does not have the physical form. This characteristic makes it possible for us to build demand function for making analyses such as quantitative analysis.

3.1.2 Influential factors of demand of China' s import iron ore shipping market

The demand of China' s import iron ore shipping market is the derived demand of China' s import iron ore trade. The development of China' s import iron ore trade is determined by the development of China' s economy and the world' s economy. And, the economy and trade is influenced by the social politics, scientific technology, and natural factors. These complex and variable factors all have influences on the international shipping market, including China' s import iron ore shipping market.

3.1.2.1 Economy

We can analyse the impact of economy on China' s import iron ore shipping market from the following aspects.

A) Impacts of World' s economy and international trade on China' s economy and China' s foreign trade.

With the integration of World' s economy, the economy of individual countries are supported and infiltrated with each other. Especially after the Asian financial crisis, the integration of World' s economy becomes more and more conspicuous. One slumps all slump; one flourishes all flourish. The economy of one country cannot be departed from the World' s economy as a big market. With the development of China' s opening to the outside world, China' s economy is gradually dissolving into the world' s economy. After the entry into WTO, China enjoys the most-favored nation treatment in over 100 countries and areas. That will be beneficial to break the trade barrier and economic blockade, and increase the export. As estimated, after the entry into WTO, the sea-borne trade volume, which accounts for 70% of the total volume, will increase at the rate of 8% every year. This will help to increase the profit of ship operating business, and bring about opportunities for

China' s shipping industry.

To make a comprehensive survey throughout recent years, according to the latest WORLD ECONOMIC OUTLOOK Database of the International Monetary Fund (IMF) in April 2006, the annual percent change of World' s GDP in 2006 is estimated to be 4.9%, and the annual percent change of World trade volume of goods and services 8.0%. Among which, the annual percent change of China' s GDP is expected to be 9.5%. China is playing a more and more important role in the development of world' s economy, and is now facing an economical environment full of opportunities and challenges.

B) Impacts of economy and trade on China' s steel output.

The steel consumption is closely connected with a country' s economy in any country in the world. When the economy grows, the demand of steel will also increase, vise versa.

The world' s economy and international trade will surely influence China' s economy and foreign trade, and directly influence china' s steel production in the mean time. If the world' s economy is in a good condition, the imbalance of the steel output in different countries will certainly cause the increase of the demand for iron ore trade.

Since 1990s, the steel output and consumption in China increases steadily. After the entry into 21st century, China increases the investment in the construction of infrastructure, enhances the exploitation of the real estate, and accelerates the development of the auto industry. The strong demand of steel from these industries stimulates the development of steel industry, which speeds up the increasing rate of

steel output and consumption in China.

In addition, with the development of China' s economy and foreign trade, the scientific technology level of Chinese steel industry keeps on going up. The competitive strength of Chinese steel in the international market continuously increases. Those all cause the increase of China' s steel output. On the other side, with the growth of China' s economy, there surely appears to be more infrastructures and more active consumption market inside China. Then the demand of steel naturally will increase. The increase of the export of Chinese steel and demand of national market finally inevitably results in the increase of China' s steel output.

C) Impacts of the variation of China' s steel output on the demand of China' s import iron ore shipping market.

Iron ore is the raw material of steel production. The steel output directly influences the consumption of iron ore. That naturally has an effect on the import of iron ore.

The steel output and consumption in China increase rapidly in recent years. The demand for iron ore also increases a lot. However, China is lack of high-level iron ore mines. Because of the few natural endowment and limited production capability, it is not possible to be self-sufficient. The contradiction between supply and demand is becoming more and more serious. In order not to influence the normal production, the only way is to import iron ore from foreign countries.

Besides, the type of products in individual steel companies is different. The production equipment such as blast furnaces and the technology are also different. So, the steel requirements of different steel companies are quite different. Since the types of China' s iron ore are not complete, the cost of mining is high, and the

level of iron ore could not meet the need of production, the best way to solve the problem is still to import foreign ores.

Apart from that, Chinese steel companies are widely distributed. Some companies have to buy iron ore from distant provinces for replenishment to meet the demand. Usually the distance is long, the transportation cost is very high. If these companies want to improve the output, the proportion of this part of iron ore with high transportation cost will increase. Then the unit cost of the production will also increase. With the improvement of the condition of China' s ports along the coast, many ports now can accept iron ore vessels of larger tonnages. The work in ports is more efficient; the unit cost of import iron ore is lower. This provides a way to lower the cost for those steel companies that once buy iron ore inside China. The increase of the steel output of those companies is also one hidden factor of the increasing demand for import iron ore.

3.1.2.2 Politics and laws

China' s import iron ore shipping market is influenced and restricted by the politics and laws of China and other relevant countries.

A) Relationship between nations

There are two aspects on this point. One aspect is that when the relationship between nations is going on a friend stage, the international trade usually would be in a good condition, and vise versa. The other aspect is that when the relationship between China and those iron ore exporting countries develops well, the process of China' s import iron ore trade would be more smooth going, and vise versa also.

B) Stability of political condition and situation

The political condition is very important to those countries of many political parties and groups, since the different policies between the political parties usually are the manifestation of the discrepancy between the party in office and the parties not in office. When the party in office changes, the policy of foreign trade will change totally. The economy and trade of some countries will be destroyed because of their poor stability of political situation due to the violent change of political power. Of course so does the shipping industry. As a part of the international trade, China's import iron ore shipping market will also be affected.

To China, a steady political situation and a stable social environment are not only the most basic guarantees to the development of national economy and foreign trade, but also the basic guarantees to the development of Chinese steel industry and the increasing demand for import iron ore maritime transportation.

C) Attitude to foreign trade

The attitude to the international trade is centrally represented by the outstandingly different levels of countries opening to the outside world. Some countries open to all foreign investment and trade, and take actions to support them; some countries adopt closed policies, refuse foreign capital investment by many limitations, and carry out quota restrictions; some countries even make use of different kinds of laws and decrees to forbid and limit foreign investment and trade. This is a typical closed mode of self-supporting economy. This form of policy has already been proved to be impracticable. Under such policy, the demand for shipping is very small.

Some countries and areas may implement open policies with some terms, and carry out national and regional trade protection. That is called trade barriers. The trade

protectionism seriously obstructs the development of international trade, and directly makes an effect on the demand of international shipping industry.

D) Tariff trade barriers

Tariff is the most common form of trade restriction. The tariff trade barriers are set with the intent of applying high tariffs to imported good so as to artificially inflate prices of imports and protect domestic industries from foreign competition, meanwhile, to raise money for the government. A protective tariff is a common method for a developing country to resist foreign goods import in order to protect domestic industries. Some developed countries not only propose the free trade, but also apply high tariffs to limit the import of competitors' commodities. Besides, some may apply import quotas or license system in the no-tariff trade barriers. The complex customs formalities are also a kind of limitation to foreign import goods. These methods all cause the decreasing amount of trade.

Other counties may keep themselves in protection by means of setting up economic laws. These laws all will bring about impacts on the foreign trade and the demand of international shipping as well.

E) Other factors

Other factors, such as foreign currency restraints, religion customs, government efficiency, may also have effects on the shipping markets on different levels.

3.1.2.3 Scientific technology

Scientific technology is a long-term environmental factor. In the development of man' s history, scientific technology, as a component of the productivity, accelerates the economy growth of individual countries, and enhances the globalization of the

world' s economy from the beginning to the end. As regards to China' s import iron ore shipping market, the development of scientific technology will improve the productivity, and reduce the transportation cost. These improvements will surely result in the increasing demand of China' s import iron ore shipping market.

3.1.2.4 Natural environment

Natural environment factors include geographical location, resource distribution, coastlines, climate, etc.

A) Geographical environment

China' s import iron ore shipping is a kind of maritime transportation of staple goods. Only can those countries that near the ocean transport cargos by sea. Maritime transportation is a main type of foreign trade transportation. The potential characteristic of shipping help the increasing foreign trade, and is also the prerequisite of the demand for import iron ore.

B) Resource distribution

Iron ore resources spread throughout the world. For example, there exists a huge imbalance of distribution. Ibitira iron mine, located in Mina Gerais in Brazil in South Africa, is one of the biggest iron mines of great quality, and it has a large reserves. Other examples, the total reserves of Pilbara in Australia achieve at over 10 billion tonnes, and the Kursk terrestrial magnetism extraordinary area is another big iron mine, the reserves of iron ore in Canada is about 30 billion tonnes, and hat in USA is over 9 billion tonnes. The imbalance distribution of iron ore has a decisive effect on the demand for import iron ore.

At present, China mainly imports iron ore from Brazil and Peru in North America,

Australia, India, North Africa, etc. It is the different location of exporting countries and areas that bring about the demand of China' s import iron ore shipping on different shipping lines.

C) Port conditions

Ports are the basis of international trade and shipping. To China, it is those ports that produce China' s import iron ore shipping industry.

With the improvement of China' s port conditions, the transportation cost of import iron ore goes down. That establishes fine foundation for those steel companies that located in the hinterland of ports, and prepares good conditions for the increasing quantity of China' s import iron ore.

In the mean time, with the continuous investment and construction by China's port companies, more ports are able to accept and discharge import iron ore vessels.

D) Climate

Climate is not only an important factor, but also a significant resource for human being' s living environment. Of course, the influence of it on shipping industry cannot be neglected. The climate variation of iron ore exporting countries and China' s import iron ore ports surely have effects on the demand and transportation of China' s import iron ore. For example, China imports a large number of iron ore from the west coast in India every year. However, there is a rainy season between May and September in the west coast in India every year. In this period, because of the influence of southwest monsoon from the India Ocean, the whole west coast in India would be attacked by strong winds and storms. The ports in this district have no choice but to close down. So, in this period, those Chinese steel companies

which import iron ore from the west coast in India have to stop the import, or try to use import iron ore from other countries and districts for replacement. It is proved that the variation of climate also has a great impact on China' s import iron ore shipping industry.

3.2 Supply analysis of China's import iron ore shipping market

3.2.1 Features of supply of China' s import iron ore shipping market

Quantity supplied is the amount of a good or service offered for sale during a given period of time.

Quantity supplied in the shipping market is the tonnages all the ship owners (suppliers) are willing to provide under a certain freight rate. Such supply must have the following two conditions at the same time. One is that the owners should have the wish to put the vessels into the market. The second is that the owner should have some vessels for hire. None of them could be neglected.

The supply in China' s import iron ore shipping market is one part of the supply in the whole shipping market. The character of it can be listed as follows.

3.2.1.1 Non-storability

The production of a shipping company is the movement of the shipping object by means of maritime transportation. So, the production of transportation as a commodity and the consumption of it proceed at the same time, which is the so-called non-storability.

Because of the non-storability, when the demand for international trade increases, the transportation capacity must also be improved in order to adjust the relationship

between supply and demand. However, the transportation capacity is influenced by the cycle of shipbuilding, so it is very necessary to have an awakening to build ships ahead of time.

In addition, the non-storability determines that the style of transportation storage is the transportation capacity. And such capability must adapt to the variation of the market.

Both the construction of transportation capacity ahead of time and the storage of transportation capacity can be the opportunity or the risk for the suppliers.

3.2.1.2 Imbalance

The imbalance of transportation is not only the characteristic of demand, but also that of supply. The different kinds of variation of demand, which is caused by this characteristic, result in the strike to the shipping companies by the risk of supply. Here, the imbalance is represented as the imbalance between supply and demand, the imbalance between boom season and low season, and the imbalance between the trip and its return trip.

The imbalance of transportation is absolute and existing for a long time period. The scale of the shipping companies is highly related with the market capacity, operation condition and market environment. When the scale of fleets and the transportation capacity increase, the ability to accommodate to the market demand will also increase. At that time, if the international trade increases, shipping companies may be more efficient to occupy the markets and earn more profits. However, if the market is in a dull period, there will be a risk of over supply. When the scale of fleets and the transportation capacity decrease, the mobility will

increase. At that time, the risk of over supply reduces, but companies may miss the chance of earning more if the market is in a prosperous period. So, it is very important to keep the fleets in a proper scale and structure and make suitable adjustment according to the market.

3.2.1.3 Discrepancy between time and space

Transportation benefit or transportation products can only be produced in the movement of transportation vehicles. The consumption of it is also be produced by that kind of mode. The economic effects of transportation are decided by the right combination of supply and demand both on the aspect of time and space. So, shipping companies should not only make analyses and researches on the change of shipping demand, but also should aim to keep their fleets in the best condition by adjust the shipping lines and supply arrangement in time according to the market information.

3.2.1.4 Changeability

The supply of the whole international shipping market is fixed on a certain point of time. However, the supply of China' s import iron ore shipping market is always ready to change at any time. There are two main reasons. One is that the vessels for transporting iron ore could also transport other kinds of cargoes, and the shipping lines are also replaceable. So ship owners can decide the service lines and shipping cargoes according to their own strategies or even their own preference. The other reason is that ship owners may change the operation tactic at any time for more profit when other shipping markets vary under the same prerequisite.

Because of the replaceability between vessels for iron ore shipping and vessels for other dry bulk cargo shipping, when the demand of China' s import iron ore shipping

market decreases, a portion of vessels will as a matter of course begin to transport other cargoes, and vise versa. And a good command of this characteristic will help us know more about the relationship between supply and demand in this market.

3.2.2 Influential factors of supply of China' s import iron ore shipping market

Those factors that have effects on the supply of the whole international shipping market will also influence the supply of China' s import iron ore shipping market in some degree. Because of the closed relationship between supply and demand, those factors that have impacts on the demand may also influence the supply. The factors include the World' s economy, international trade, policies and laws, natural environment, scientific technology, etc.

The followings will make analyses on the influential factors of the supply of China' s import iron ore shipping market, combined with the whole international shipping market and some other related shipping markets, in light of the characteristics of it.

First of all, when the total supply of international shipping market changes, the supply of China' s import iron ore shipping market will also changes in the same way. Meanwhile, when the freight rates of other related shipping markets changes, the supply of China' s import iron ore shipping market will also be influenced in some degree. Some examples below will be used to present the influences.

As we all know, most Capesize or Panamax vessels for transporting iron ore from North Africa, Australia, Peru, and India are ballasted back to loading ports from China after discharging. The freight rates are directly decided by the level of the Pacific market of the same type of vessels, and also influence the market itself. These vessels usually remain in the Pacific market. However, when the Pacific

market goes down but the Atlantic market goes up, in order to earn more, ship owners may make a try to transport cargoes such as coal from China to Europe or the Mediterranean to ship from the Pacific from the Atlantic. That will certainly cause the decrease of the quantity of vessels supplied in the Pacific market.

Besides, even without such changes and the quantity of vessels keeps stable in the Pacific shipping market, there are still some other changed that can result in the change in the supply of China' s import iron ore shipping market.

For example, Baosteel imports a great quantity of iron ore from Brazil every year. Capesize bulk carriers are the main type of vessels that are used for the transportation. This shipping line is a relatively special line, which crosses two shipping markets, since the loading port is in the Atlantic region while the discharging port in the Pacific region. This line is always be sensitive to the change in both the Atlantic and the Pacific shipping markets. When the Atlantic shipping market is in a very good condition, ship owners may not be willing to accept Baosteel' s cargoes to put their vessels into the Pacific market, and vise versa. Such changes will directly influence the supply of China' s import iron ore shipping market on the Brazil line. Moreover, the changes will also have impacts on the supply on the Australia lines in the Pacific market.

In short, there are many influential factors in the supply of China' s import iron ore shipping market. Whoever cargo owners or ship owners should analyse the market from a point of view of the overall situation. A more objective command of the development and trend of the market will help companies reduce loss, and seize the chance at the right time.

CHAPTER 4

FORECASTING CHINA' S IMPORT IRON ORE SHIPPING MARKET

China' s import iron ore shipping market is on the stage of developing. The forecast of the market could provide substantial basis for the establishment of China's related shipping policy. Meanwhile, it can provide significant reference material for the business strategy and developing plan of related shipping companies.

4.1 Forecasting demand of China' s import iron ore shipping market

Because the shipping lines of China' s import iron ore are relatively fixed, the transportation volume forecast is enough to reflect the trend of the demand of China's import iron ore shipping market.

This part analyses the prospect of China' s import iron ore shipping market, and forecasts the future 5-years import volume of iron ore by using quantitative analysis.

4.1.1 Forecasting methods

4.1.1.1 Time series analysis

Time series forecasting methods are methods using historical demand to make a forecast. They are based on the assumption that past demand history is a good indicator of future demand. There are many models of time series methods. Hereinafter, the Holt' s Model, which is also called "trend-corrected exponential

smoothing", will be applied to the transportation volume forecast.

The Holt' s Model is appropriate when demand is assumed to have a level and a trend in the systematic component. In this case, we have the following:

$$\text{Systematic component of demand} = \text{level} + \text{trend} \qquad 4\text{-}1$$

We obtain an initial estimate of level and trend by running a linear regression between demand D_t and time period t of the following form:

$$\mathrm{Dt} = \mathrm{at} + \mathrm{b}, \qquad 4\text{-}2$$

where the constant b measures the estimate of demand at period $t = 0$ and is an estimate of the initial level L_0. The slope a measures the rate of change in demand per period and is the initial estimate of the trend T_0.

In period t, given estimates of level L_t and trend T_t, the forecast for future periods is expressed as follows:

$$F_{t+1} = L_t + T_t \qquad \text{and} \qquad F_{t+n} = L_t + nT_t \qquad 4\text{-}3$$

After observing demand of period t, we revise the estimates for level and trend as follows:

$$L_{t+1} = \alpha D_{t+1} + (1-\alpha)(L_t + T_t) \quad \text{and} \quad T_{t+1} = \beta(L_{t+1} - L_t) + (1-\beta)T_t \qquad 4\text{-}4$$

Where α is a smoothing constant for the level, $0 < \alpha < 1$, and β is a smoothing constant for the trend, $0 < \beta < 1$.

4.1.1.2 Linear regression

Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable.

The simple linear regression equation is also called the least squares regression equation. It tells you the amount of variance accounted for by one variable in predicting another variable.

It has an equation of the following form:

$$\hat{Y} = a + bX \,, \tag{4-5}$$

where X is the explanatory variable and Y is the dependent variable. The slope of the line is b, and a is the intercept (the value of y when $x = 0$). And,

$$b = \frac{\sum_{i=1}^{n}(X_i Y_i) - n\overline{XY}}{\sum_{i=1}^{n} X_i^2 - n\overline{X}^2} \tag{4-6}$$

$$a = \overline{Y} - b\overline{X} \tag{4-7}$$

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \tag{4-8}$$

$$\overline{Y} = \frac{1}{n}\sum_{i=1}^{n} Y_i \tag{4-9}$$

4.1.1.3 Combination forecast

Combination forecast has been demonstrated to be a successful technique for enhanced forecast accuracy of economic and financial variables. There are different kinds of combination of forecast. Hereinafter, I will apply a combination

forecast method that is proposed by Professor Qu Linchi in his study on the problems related to the development of China' s maritime transportation and the construction of Shanghai international shipping center.

According to Professor Qu' s model, we can obtain an equation of the following form:

$$ETV = k_1 \cdot ETV_1 + k_2 \cdot ETV_2 \qquad 4\text{-}10$$

Where,

ETV – Estimate of transportation volume by combination forecast

ETV_1 – Estimate of transportation volume time series analysis

ETV_2 – Estimate of transportation volume by linear regression forecast

k_1, k_2 – parameters to be estimated

Based on the principle of combination forecast, provided that ETV_1 and ETV_2 both are the unbiased estimator of TV (transportation volume), with properly choice of k_1 and k_2, ETV will also be the unbiased estimator of TV and be more effective than ETV_1 and ETV_2. And,

$$k_1 + k_2 = 1 \qquad 4\text{-}11$$

The model can be in the following form:

$$ETV = k_1 \cdot ETV_1 + (1 - k_1) \cdot ETV_2 \qquad 4\text{-}12$$

Defining:

$$e = TV - ETV \qquad 4\text{-}13$$

$$e_1 = TV - ETV_1 \qquad 4\text{-}14$$

$$e_2 = TV - ETV_2 \tag{4-15}$$

Where *e* refers to error.

Then, obtain:

$$e = k_1 e_1 + (1 - k_1) e_2 \tag{4-16}$$

And,

$$\begin{aligned} \operatorname{var}(e) = k_1^2 \operatorname{var}(e_1) + (1 - k_1)^2 \operatorname{var}(e_2) \\ +2k_1(1 - k_1)\operatorname{cov}(e_1, e_2) \end{aligned} \tag{4-17}$$

In order to get minimum var(*e*), the essential condition is:

$$\frac{d \operatorname{var}(e)}{dk_1} = 0 \tag{4-18}$$

So,

$$k_1 = \frac{\operatorname{var}(e_2) - \operatorname{cov}(e_1, e_2)}{\operatorname{var}(e_1) + \operatorname{var}(e_2) - 2\operatorname{cov}(e_1, e_2)} \tag{4-19}$$

Apply 4-19 to 4-17, obtain:

$$\operatorname{var}(e) = \frac{\operatorname{var}(e_1)\operatorname{var}(e_2) - \operatorname{cov}^2(e_1, e_2)}{\operatorname{var}(e_1) + \operatorname{var}(e_2) - 2\operatorname{cov}(e_1, e_2)} \tag{4-20}$$

Then,

$$\operatorname{var}(e_1) - \operatorname{var}(e) = \frac{\left[\operatorname{var}(e_1) - \operatorname{cov}(e_1, e_2)\right]^2}{\operatorname{var}(e_1) + \operatorname{var}(e_2) - 2\operatorname{cov}(e_1, e_2)} \tag{4-21}$$

$$\operatorname{var}(e_2) - \operatorname{var}(e) = \frac{\left[\operatorname{var}(e_2) - \operatorname{cov}(e_1, e_2)\right]^2}{\operatorname{var}(e_1) + \operatorname{var}(e_2) - 2\operatorname{cov}(e_1, e_2)} \tag{4-22}$$

According to 4-21 and 4-22, if:

$$\mathrm{var}(e_1) + \mathrm{var}(e_2) > 2\,\mathrm{cov}(e_1, e_2) \qquad 4\text{-}23$$

Then obtain:

$$\mathrm{var}(e) < \mathrm{var}(e_1) \qquad 4\text{-}24$$

and

$$\mathrm{var}(e) < \mathrm{var}(e_2) \qquad 4\text{-}25$$

That indicates the combination model is more effective.

Generally speaking, if the correlation between two individual models is more weak – $\mathrm{cov}(e_1,e_2)$ is smaller, the Equation 4-23 will be more possible to be satisfied.

4.1.2 Demand forecast

In earlier period, those industrialized countries such as America, England, France, and Japan, all experienced the fast increasing demand of steel after their entry into the industrialized courses, and kept in that peak period for several years.

China is now in the middle stage of industrialization course. With the construction of state significant projects and the fast development of Chinese shipbuilding industry, the demand for steel keeps in a fine trend. As it' s steel output exceeded a hundred million tonnes in 1996, China has become the world-largest steel producing country.

The following part is the forecasting of China' s import volume of iron ore by different methods.

First of all, Table 4-1 shows the import iron ore volume from 1996 to 2005.

Table 4-1 China' s import iron ore volume from 1996 to 2005 (m. tonnes)

YEAR	1996	1997	1998	1999	2000
Import Iron Ore Volume	43.87	55.10	51.77	54.20	69.97
YEAR	2001	2002	2003	2004	2005
Import Iron Ore Volume	92.30	111.49	148.13	208.06	270.50

Source: Metal Industry Information Center

4.1.2.1 Time series analysis

According to Table 4-1, with the help of Excel, obtain Figure 4-1.

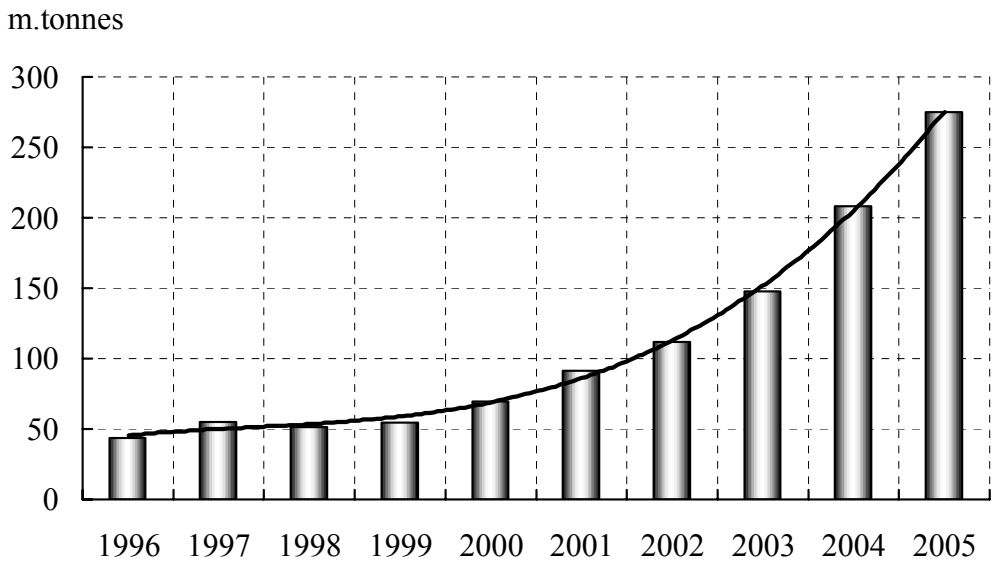

Figure 4-1 China' s import iron ore volume from 1996 to 2005 (m. tonnes)

According to Figure 4-1, it is easy to notice that China' s import iron ore volume keeps on growing in the recent years. And experts estimated that such trend will continue with the fast growing rate of China' s GDP. Hereinafter, the data from 1996 to 2005 would be used in the forecast of China' s import iron ore volume.

First we run a linear regression by using the Excel tool between demand and time periods, and obtain the following:

$$L_0 = -15.67 \qquad \text{and} \qquad T_0 = 22.95$$

Then according to Equations 4-3 and 4-4, the results can be seen in the Table 4-2. (Assuming $\alpha = 0.9$ and $\beta = 0.9$)

Table 4-2 Holt' s Model Forecast results and errors (m. tonnes)

Year	Period t	Transportation Volume TV_t	Level L_t	Trend T_t	Estimate E_t	Error e_t
1996	1	43.87	40.21	52.59	7.27	-36.60
1997	2	55.10	58.87	22.05	92.80	37.70
1998	3	51.77	54.69	-1.56	80.92	29.15
1999	4	54.20	54.09	-0.69	53.12	-1.08
2000	5	69.97	68.31	12.73	53.40	-16.57
2001	6	92.30	91.17	21.85	81.04	-11.26
2002	7	111.49	111.64	20.61	113.02	1.53
2003	8	148.13	146.54	33.47	132.25	-15.88
2004	9	208.06	205.26	56.19	180.01	-28.05
2005	10	270.50	269.59	63.52	261.44	-9.06

According to Table 4-2,

$$L_{2005} = 269.59 \qquad \text{and} \qquad T_{2005} = 63.52$$

Apply Equation 4-3, obtain the estimate of transportation volumes in the following 5 years:

$$ETV_{2006} = L_{2005} + T_{2005} = 269.59 + 63.52 = 333.12$$

$$ETV_{2007} = L_{2005} + 2 \times T_{2005} = 269.59 + 2 \times 63.52 = 396.64$$

$$ETV_{2008} = L_{2005} + 3 \times T_{2005} = 269.59 + 3 \times 63.52 = 460.17$$

$$ETV_{2009} = L_{2005} + 4 \times T_{2005} = 269.59 + 4 \times 63.52 = 523.69$$

$$ETV_{2010} = L_{2005} + 5 \times T_{2005} = 269.59 + 5 \times 63.52 = 587.22$$

4.1.2.2 Linear regression

As we mentioned before, China' s economy has a great impact on China' s import iron shipping market. Hereinafter, a relationship will be set up between China' s annual GDP in constant prices and China' s import iron ore volume by using simple linear regression.

First, Table 4-3 and Figure 4-2 exhibit China' s GDP.

Table 4-3 China' s Gross domestic product, constant prices from 1996 to 2007 (National currency in billions)

Year	1996	1997	1998	1999	2000	2001
GDP	3638. 105	3976. 448	4287. 407	4593. 527	4979. 384	5392. 672
Year	2002	2003	2004	2005	2006	2007
GDP	5883. 406	6471. 746	7125. 393	7830. 807	8574. 733	9346. 459

Source: World Economic Outlook Database. (April 2006).

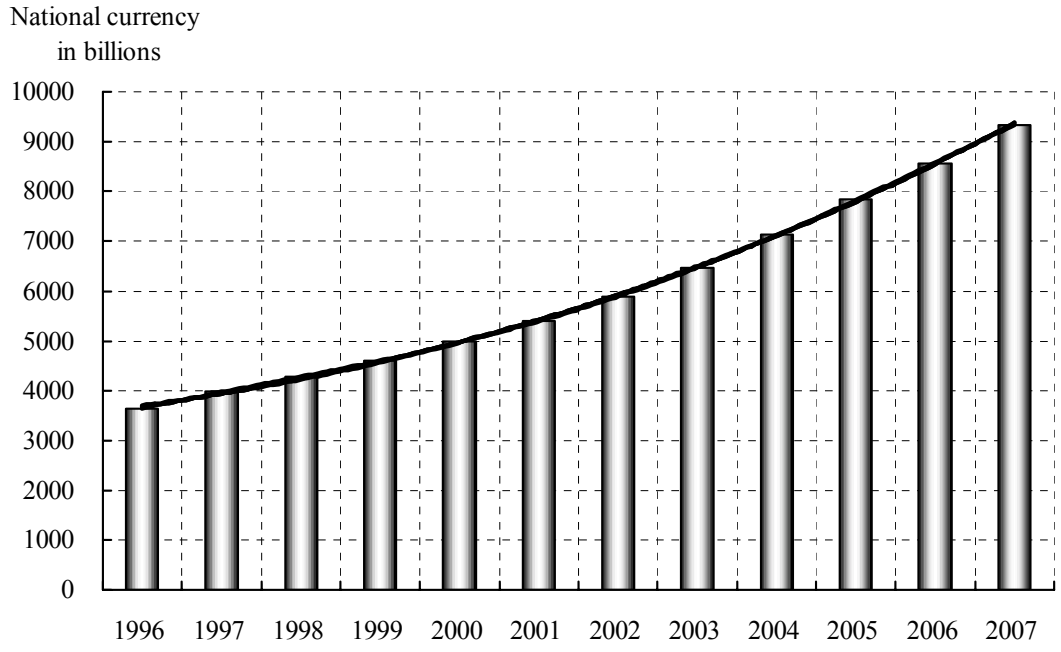

Figure 4-2 China' s Gross domestic product, constant prices from 1996 to 2007 (National currency in billions)

Figure 4-2 indicates that China' s GDP keeps on growing in the recent years, which is the same as China' s import iron ore volume.

According to Equations 4-6, 4-7, 4-8, and 4-9, with the help of Excel, we obtain:

$$b = 0.0528 \qquad \text{and} \qquad a = -175.622$$

As $\hat{Y} = a + bX$, here $TV_t = a + bG_t$. So,

$$TV_t = -175.622 + 0.0528G_t \qquad 4\text{-}26$$

Then the results can be shown in Table 4-4.

Table 4-4 Linear regression results and errors

Year	GDP G_t (in billions)	Transportation Volume TV_t (in millions)	Estimate E_t (in millions)	Error e_t (in millions)
1996	3638. 105	43.87	16.53	-27.34
1997	3976. 448	55.10	34.41	-20.69
1998	4287. 407	51.77	50.83	-0.94
1999	4593. 527	54.20	67.00	12.80
2000	4979. 384	69.97	87.38	17.41
2001	5392. 672	92.30	109.21	16.91
2002	5883. 406	111.49	135.13	23.64
2003	6471. 746	148.13	166.20	18.07
2004	7125. 393	208.06	200.73	-7.33
2005	7830. 807	270.50	237.98	-32.52

Then according to IMF' s estimation of China' s gross domestic product in constant prices, with the help of Holt' s model forecast, we can obtain the forecast of China' s GDP in Table 4-5.

Table 4-5 Estimate of China' s Gross domestic product, constant prices from 2006 to 2010 (National currency in billions)

Year	2006	2007	2008	2009	2010
Estimated GDP	8574. 733	9346. 459	10112. 823	10882. 716	11652. 609

According to Equation 4-26, we can obtain the estimate of transportation volumes in the following 5 years:

$$ETV_{2006} = -175.622 + 0.0528EG_{2006} = -175.622 + 0.0528 \times 8574.733 \approx 277.28$$

$$ETV_{2007} = -175.622 + 0.0528EG_{2007} = -175.622 + 0.0528 \times 9346.459 \approx 318.04$$

$$ETV_{2008} = -175.622 + 0.0528EG_{2008} = -175.622 + 0.0528 \times 10112.823 \approx 358.51$$

$$ETV_{2009} = -175.622 + 0.0528EG_{2009} = -175.622 + 0.0528 \times 10882.716 \approx 399.18$$

$$ETV_{2010} = -175.622 + 0.0528EG_{2010} = -175.622 + 0.0528 \times 11652.609 \approx 439.84$$

4.1.2.3 Combination forecast

According to above results, with the help of Excel tool, obtain:

$$\text{var}(e_1) = 542.80 \quad \text{(Time series analysis)},$$

$$\text{var}(e_2) = 436.16 \quad \text{(Linear regression forecast)},$$

$$\text{and,} \qquad \text{cov}(e_1, e_2) = -5$$

which confirm to 4-23.

Based on Equation 4-19, obtain:

$$k_1 = \frac{\text{var}(e_2) - \text{cov}(e_1, e_2)}{\text{var}(e_1) + \text{var}(e_2) - 2\,\text{cov}(e_1, e_2)} = 0.554$$

then,

$$k_2 = 0.446$$

Finally, we can obtain the combination forecast model as an equation of following:

$$ETV = 0.554ETV_1 + 0.446ETV_2 \qquad \text{4-27}$$

And, based on Equation 4-20,

$$\mathrm{var}(e)=\frac{\mathrm{var}(e_1)\mathrm{var}(e_2)-\mathrm{cov}^2(e_1,e_2)}{\mathrm{var}(e_1)+\mathrm{var}(e_2)-2\mathrm{cov}(e_1,e_2)}=239$$

So, the combination forecast is truly more effective than the individual forecasts.

According to Equation 4-27, we can obtain the estimate of China' s import iron ore volume in the following 5 years by combination forecast. Table 4-6 shows the results.

Table 4-6 Estimate of China's import iron ore transportation volume from 2006 to 2010 by Combination Forecast (m. tonnes)

Year	2006	2007	2008	2009	2010
ETV_1	333. 12	396. 64	460. 17	523. 69	587. 22
ETV_2	277. 28	318. 04	358. 51	399. 18	439. 84
ETV	308. 21	361. 58	414. 82	468. 15	521. 47

According to Table4-6, ETV represents the estimate of China's import iron ore transportation volume by combination forecast, the final result is:

$$ETV_{2006}=308.21$$

$$ETV_{2007}=361.58$$

$$ETV_{2008}=414.82$$

$$ETV_{2009}=468.15$$

$$ETV_{2010}=521.47$$

The trend of China' s import iron ore volume is shown in Figure 4-3. We can

easily find that it will keep on increasing in the following 5 years.

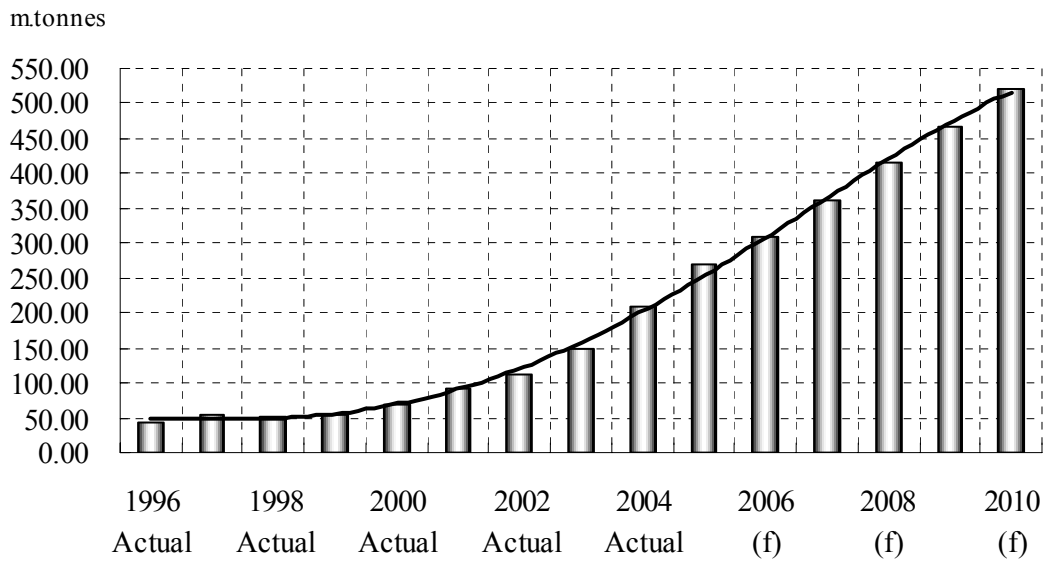

Figure 4-3 Final results and trend of China' s import iron ore volume (m. tonnes)

4.1.3 Evaluation of the result estimates

Up to now, I have already made forecast of China' s import iron ore transportation volume in the next 5 years by three different forecasting methods. Each of them has its merits and defects.

Holt' s Model is a kind of time series analysis, which actually is an extrapolation of the present data. Linear regression is a model that can reflect the relationship between two variables. Combination forecast of a forecast that combine the two forecasting methods and enhance the forecast accuracy.

According to Equation 4-16, obtain Table 4-7. It obviously shows that the forecasting errors of combination forecast are smaller than other two individual forecasting methods.

Table 4-7 Forecasting Errors by three different methods (m. tonnes)

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004
e_1	−36. 60	37. 70	29. 15	−1. 08	−16. 57	−11. 26	1. 53	−15. 88	−28. 05
e_2	−27. 34	−20. 69	−0. 94	12. 80	17. 41	16. 91	23. 64	18. 07	−7. 33
e	−32. 47	11. 65	15. 73	5. 11	−1. 41	1. 31	11. 39	−0. 73	−18. 81

So, to use the combination forecast is better than only use the two individual forecasting methods.

4.2 Forecasting supply of China' s import iron ore shipping market

According to Lloyd' s MIU, by January 1st 2006, the World' s dry bulk fleet was reported to be 5856 vessels at 335.98 million dwt (mdwt). Table 4-8 shows the current dry bulk fleet by size and age as at January 1st 2006.

Table 4-8 Dry bulk supply: current fleet by size & age as at Jan 1 2006

	10~39,999 dwt (Handysize)		40~59,999 dwt (Handymax)		60~79,999 dwt (Panamx)		80,000 dwt + (Capesize)		Total	
Age	**No.**	**m.dwt**	**No.**	**m.dwt**	**No.**	**m.dwt**	**No.**	**m.dwt**	**No.**	**m.dwt**
Unclassified	3	0. 06	10	0. 54	6	0. 44	7	1. 09	26	2. 13
0-4	226	6. 56	311	16. 28	223	16. 81	168	27. 18	928	66. 83
5-9	323	8. 39	306	14. 68	361	26. 54	161	26. 11	1, 151	75. 71
10-14	239	6. 06	230	10. 44	192	13. 63	163	25. 20	824	55. 32
15-19	129	3. 62	107	4. 81	120	8. 22	93	15. 57	449	32. 22
20-24	679	20. 17	233	10. 34	203	13. 48	106	17. 30	1, 221	61. 29
25+	995	24. 92	86	4. 08	128	8. 36	48	6. 12	1, 257	43. 48
Total	2, 594	69. 77	1, 283	61. 16	1, 233	87. 47	746	118. 58	5, 856	335. 98

Source: Lloyd's MIU (www.lloydsmiu.com)

According to Table 4-8, we can see that the Handysize bulk carriers were reported to be 2594 vessels at 69.77 mdwt; the Handymax 1283 vessels at 61.16 mdwt; the Panamax 1233 vessels at 87.47 mdwt; the Capesize 746 vessels at 118.58 mdwt. The tonnages distribution is: the Handysize accounted for 20.77% of the total dry bulk fleet; the Handymax 18.20%; the Panamax 26.03%; the Capesize 35.29%.

Based on Clarkson' s statistics, the tonnage distribution of the dry bulk fleet in 1996 is: the Handysize accounted for 33.02% of the total dry bulk fleet; the Handymax 16.07%; the Panamax 20.22%; the Capesize 30.69%. It is clear that the trend of building larger-sized vessels is more and more distinct. The proportion of Handysize bulk carriers reduced from 30.02% to 20.77%; but that of the Capesize and Panamax increase from 30.69% to 35.29% and from 20.22% to 26.03% respectively. The proportion of Handymax bulk carriers is relatively stable. Among the four types of vessels, the Capesize bulk carrier is becoming the main type of vessels in the dry bulk cargo transportation.

Such trend of building larger-sized vessels is the result of the economics of scale, and it is also the principal feature of the shipping development. With the fast development of Chinese steel industry in recent years, such trend is believed to continue.

In the light of structure of fleet age, it was reported to be 2079 vessels at 145.54 mdwt under the age of 10, which accounted for 42.43% of the world' s dry bulk fleet. 1257 vessels at 43.48 mdwt was said to be older than 25 years old, which accounted for 12.94% of the world' s dry bulk fleet. That is to say at least about one-eighth of the dry bulk carriers would be demolished in the near future.

Table 4-9 shows the dry bulk carriers on order.

Table 4-9 Dry bulk supply: on order as at Jan 1st 2006

	10~39,999 dwt (Handysize)		40~59,999 dwt (Handymax)		60~79,999 dwt (Panamx)		80,000 dwt + (Capesize)		Total	
For delivery	**No.**	**m.dwt**	**No.**	**m.dwt**	**No.**	**m.dwt**	**No.**	**m.dwt**	**No.**	**m.dwt**
2006	50	1.45	92	4.90	60	4.55	90	11.86	292	22.76
2007	49	1.38	74	3.97	56	4.24	57	8.37	236	17.96
2008	31	0.94	30	1.58	20	1.44	55	9.63	136	13.59
2009/10	2	0.07	6	0.32	8	0.58	25	4.96	41	5.93
Total	132	3.84	202	10.77	144	10.81	227	34.82	705	60.24

Source: Lloyd's MIU and Lloyd's Register/Fairplay

A lot of newly built dry bulk cargo vessels were delivered in 2005. According to the dry bulk orders, it is estimated to deliver 292 vessels at 22.76 mdwt in 2006. This year will be another booming year for new ships delivery. The delivery quantity is as much as 6.77% of the current dry bulk fleet. Among them, the delivery quantity of the Capesize bulk carriers is about 10% of current Capesize vessels.

However, with the growing oil price and bank interest rate, and down-slowing increase of the world's economy and trade, the demand for new vessels will reduce in some degree. Some ship owners is already in a mode of waiting and seeing whether to place new orders. According to Table 4-9, the delivery quantity lessened after 2006. Since the production plans in most shipyards have already

been arranged till 2008. In addition that it is difficult to estimate the world economy, the currency exchange rate and the steel price in 2009. Shipyards are not active to accept orders at a specified future date. The estimated delivery quantity in 2009 is obviously cut down.

Although in the coming years, the delivery quantity of new bulk carriers is large, the demolition number of vessels is not that large. It is estimated that the increasing rate of the transportation capacity of the dry bulk shipping market is 5% more or less. That may imply the end of the prime time for ship owners. However, in consideration of the fast development of China' s economy and rapidly increasing steel industry, the sea-borne trade volume of dry bulk cargoes will still increase in a large scale. So, the oversupply rate of the transportation capacity in the dry bulk shipping market will keep in a low level.

CHAPTER 5
BOTTLENECK IN CHINA' S IMPORT IRON ORE SHIPPING MARKET

China' s fast developing steel industry urges import iron ore volume to constantly increase. It cannot be denied that such increasing volume directly makes influences on the trend of the international dry bulk cargo freight market. However, with the swift and violent increase of iron ore import volume, the congestion problem of ports become serious day by day. Some experts have already pointed out that China' s import iron ore shipping market is meeting the bottle neck – the congestion in ports. Facing such situation, the fundamental way to meet the development of China' s prosperous steel industry is to improve the infrastructures in ports and advance the specialization of the iron ore docks.

5.1 Present situation of China' s import iron ore ports

In light of the distribution of China' s steel companies, import iron ores are mainly needed in the vast areas north to and along the Yangtze River, and in some parts of South China. Generally, China' s import iron ore ports spread in three major areas – North China, East China along the Yangtze River, and South China.

5.1.1 North China

At present, import iron ore ports in North China include port of Qingdao, Tianjin, Dalian, Qinghuangdao, Rizhao, Yantai, Lianyungang, Caofeidian, etc. Among them, Port of Qingdao is the main port, and others serve as assistant ports.

The northern area is a significant steel production base in China. Shougang Group Corporation, An Shan Iron & Steel Group Corporation, Tangshan Iron & Steel Group Co., Ltd., Han Dan Iron & Steel Group Co., Ltd., Baotou Iron and Steel (Group) Co., Ltd. are all located in this area. In 2003, northern ports accepted and discharged 80.45 million tonnes of foreign iron ores, accounted for 53.3% of the total amount of import iron ores accepted by all the ports throughout China.

From the point of view of terminal specialization, Port of Qingdao owns specialized iron ore berths of 200 thousand tonnes level and 50 thousand tonnes level. The designed passing through capability is 15 million tonnes and 6 million tonnes respectively. In 2003, Port of Qingdao directly accepted and discharged 35.06 million tonnes of iron ores, accounted for 44% of the total amount in the northern area. The berth of 200 thousand tonnes level in Port of Qinghuangdao made the import iron ore volume increase a lot in Liaoning and Hebei Province. The specialized iron ore port of 300 thousand tonnes level that is accomplished in 2004 in Port of Dalian rewrote the history of east-southern ports cannot accept large-sized iron ore vessels. In addition, Port of Rizhao and Port of Caofeidian also finished the construction of specialized iron ore ports of 250 thousand tonnes level in 2004 and 2005 respectively, which reduced Qingdao' s pressure in some degree.

5.1.2 East China along the Yangtze River

Now import iron ore ports in East China include port of Ningbo, Zhoushan, Shanghai, Nantong, Zhenjiang, etc. Among them, Port of Ningbo is the main port, and others serve as assistant ports.

The middle and lower reaches of the Yangtze River is a key area for Chinese steel industry. Shanghai Baosteel Group Corporation, Wuhan Iron and Steel (Group) Corporation, Maanshan Iron & Steel Co.,Ltd., Nanjing Iron & Steel Union Co., Ltd., Chongqing Iron & Steel (Group) Corporation, and Shagang Group Co., Ltd. are all located in this area. In 2003, ports in the Yangtze River Delta area accepted and discharged 59.43 million tonnes of foreign iron ores, accounted for 39.4% of the total amount of import iron ores accepted by all the ports throughout China.

Port of Ningbo owns one specialized iron ore berth of 200 thousand tonnes level and one of 100 thousand tonnes level. The designed passing through capability is 12 million tonnes and 10 million tonnes respectively. In 2003, Port of Ningbo directly accepted and discharged 27.26 million tonnes of iron ores, accounted for 46% of the total amount in East China. Port of Mayishan in Zhoushan is a newly-built large-sized iron ore discharging port. It mainly serves Baosteel. It owns one specialized iron ore berth of 200 thousand tonnes level. The designed passing through capability is 10 million tonnes. Port of Mayishan was put into operation in 2002, and it finished discharging 2.71 million tonnes of iron ores in that year. In 2003, it accepted and discharged 11.74 million tonnes.

5.1.3 South China

Presently import iron ore ports in South China include port of Zhanjiang, Fangcheng, Guangzhou, etc.

The southern area is an area which develops fastest in China. Guangzhou Iron & Steel Enterprises Group, Shaoguan Iron & Steel Group Corporation, and Liuzhou Iron & Steel (Group) Corporation are all located in this area. In addition, Panzhihua Iron & Steel (Group) Corporation and Kunming Iron & Steel (Group)

Co., Ltd. are in the southwest area. In 2003, ports in the southern area accepted and discharged 11.04 million tonnes of foreign iron ores, accounted for 7% of the total amount of import iron ores accepted by all the ports throughout China.

Now two iron ore terminals of 200 thousand tonnes level have been accomplished in South China – Zhanjiang and Fangcheng. That in some degree reduced the problem of South China being lack of iron ore specialized ports.

5.2 Bottleneck – existing problems

5.2.1 Lack of large-sized specialized iron ore ports

Although there are now 9 specialized iron ore ports which are of over 200 thousand tonnes level along the coast, including port of Qingdao, Caofeidian, Qinghuangdao, Dalian, Rizhao, Ningbo, Zhoushan, Zhanjiang, and Fangcheng. The passing through capability is 100 million tonnes. Compared with the fast developing steel industry and rapidly increasing demand of iron ore, the overall capability of the coastal ports is still not enough. The lack of large-sized specialized iron ore ports keeps being a serious problem. Now the only way is using the common berths to buffer the situation, however, it is of less efficiency. Some ports cannot meet the water-depth requirement of large vessels. Such contradictory is becoming more prominent.

5.2.2 Unreasonable terminal arrangement influences transportation efficiency

At present, due to the limitation of ports, water depth and waterway conditions, iron ore transportation usually adopts transshipment and less-loading methods. The problem of not fully using of loading capacity is serious. For example, because of the restriction at the estuary of the Yangtze River, present transport method is to less load large ships or to transship from Ningbo or Zhoushan. Another example,

before some ports of over 200 thousand tonnes level being put into operation in the northern area, because of lack of large-sized berth, the main iron ore transport method is to transship from Qingdao or Ningbo, or to less load large ships. Those all increase the transportation cost, and affect the transportation efficiency.

It is roughly estimated that the transportation cost accounts for about one-third of the purchasing cost of iron ore these days. So, an appropriate arrangement of large-sized terminals and a reduction of transportation segments will be of great importance for steel companies and help a lot to improve the transportation efficiency.

5.2.3 Weak in-land transportation capability causes congestion in ports

Foreign iron ores are usually transshipped inland by sea or by railway nowadays; few are by highway. Since the import iron ore volume increases rapidly in recent years, the transportation capability is becoming obviously insufficient. That limits the increase of import volume and causes the serious congestion in ports.

5.3 Conception of port construction in the future

5.3.1 A train of thought of the development of ports

China' s coastal ports have developed a lot in recent years, but such development still lags behind the requirement of the economic development. From now on China' s import iron ore volume will keep on increasing. Considering the characteristics of iron ore shipping – long distance and huge quantity, it is obvious that iron ore shipping is a kind of shipping that adapts to introducing large vessels of about 200 thousand tonnes and large-sized specialized terminals for iron ore.

According to the distribution of Chinese steel companies, China can be divided into

three districts – North China, East China alongside the Yangtze River, and South China. Due to the different resources and transportation condition, the import methods of foreign iron ores are also quite different. Taking account of the ports condition and in-land transportation system, and the geographical situation of Chinese steel industry, it would be better to construct large-sized iron ore port according to the geography, and focus on the 5 districts – the Bohai Sea area, the Yangtze River Delta, Southeast coastal area, the Pearl River Delta, and Southwest coastal area. Besides, reducing the international shipping costs and lessening the land transport distance is the overall guiding thought for the development of Chinese ports.

5.3.2 A proposal of the construction of ports

5.3.2.1 The Bohai Sea area

The steel companies are scattered in the North area. In this area, the railway network is relatively developed; the demand of individual steel companies is all somewhat large. Considering the port and in-land transportation condition, this area is in need of building large-sized iron ore ports. Presently there are 5 specialized iron ore port of over 200 thousand tonnes in this area, including Port of Qingdao, Caofeidian, Qinghuangdao, Dalian, and Rizhao. Port of Qingdao and Dalian will become the basic ports in this area, and other ports are the assistant ports. In the near future, combining the restriction of waterways, adopt less loaded or transship transportation method. In the long-term consideration, according to the construction situation of the waterways, actions should be taken to make the ports be able to accept and discharge vessels of larger tonnages.

5.3.2.2 The Yangtze River Delta area

Steel companies in the Yangtze River Delta Area are distributed alongside the

Yangtze River. Due to the restriction of water depth of the waterways, Port of Ningbo and Mayishan in Zhoushan are the main ports for accepting and discharging iron ore carriers. Most common transportation methods is to transship in Ningbo or Zhoushan, or to less load vessels in those two ports.

Since it is said that the waterway of the Yangtze River will be deepened to 12.5 meters in 2010, the transportation method will be changed a lot in the Yangtze River Delta area. Set Beilun in Ningbo and Mayishan in Zhoushan as the two basic ports, make full use of reconstructed waterway. Inside the estuary of the Yangtze River, build large specialized iron ore transshipment ports in Shanghai, Suzhou, and Nantong in order to accept and discharge large iron ore vessels less loaded in Ningbo and Zhoushan; build iron ore transshipment ports of a certain scale in Zhenjiang and Nanjing to accept and discharge second transshipped vessels. Besides, steel companies in the middle and upper reach of the Yangtze River could make use of barges for transshipment. In addition, a large-sized specialized iron ore terminal should be built in Lianyun Port to serve the metallurgy companies alongside the Longhai Railway.

5.3.2.3 Southeast coastal area

The southeast coastal area is mainly coastal area in Fujian province. Arrangements of ports could be made according to the distribution of metallurgy companies.

5.3.2.4 The Pearl Delta area

Port of Guangzhou should be focused as the main port in the iron ore transportation system in the Pearl Delta area. At present, Port of Guangzhou mainly serves Guangzhou Iron & Steel Enterprises Group, Shaoguan Iron & Steel Group Corporation, and etc. The scale of the ports for discharging iron ores is small; the

discharging tonnage is between 50 to 70 thousand tonnes. In the future, with the improvement of the waterway of the Pearl River, the ports should be developed to accept and discharge larger vessels.

5.3.2.5 Southwest coastal area

Port of Zhanjiang and Fangcheng are the main ports for discharging iron ore vessels in the southwest coastal area. Port of Zhanjiang mainly serves Liuzhou Iron & Steel (Group) Corporation, while Port of Fangcheng mainly serves Panzhihua Iron & Steel (Group) Corporation and Kunming Iron & Steel (Group) Co., Ltd. Now there are iron ore ports of over 200 thousand tonnes in both Zhanjiang and Fangcheng. We should make full use of the natural deep water ports, not only provide transshipment service for the hinterland, but also create opportunities for the distribution of large steel companies in this area.

5.3.3 In-land transportation system should be improved

Although in recent years some large-sized iron ore ports have already been built in China, the corresponding in-land transportation system falls far away behind the construction of ports. Thus seriously influences the passing through capacity of ports. So, the in-land transportation system near ports should be improved soon. In the northern area, the construction of the railway between Shenyang and Dalian should be accelerated in order to make full use of the iron ore terminal of 300 thousand tonnes in Port of Dalian. Port of Qingdao should enlarge the present store-up capability in docks to buffer the congestion in port. The construction of the waterway at the estuary of the Yangtze River should be quickened to allow more larger-sized vessels to pass.

With the construction of ports in the 5 major areas, only combined with mature

in-land transportation system could we make a proper overall arrangement of China's import iron ore shipping system.

CHAPTER 6
CONCLUSIONS

China' s import iron ore shipping market is one part of the international shipping market. It is closely related with the whole shipping market, especially the international dry bulk cargo shipping market. With the fast growing rate of the world' s economy and China' s economy, Chinese steel industry and shipping companies, which are involved in the import iron ore shipping market, are facing new opportunities and more challenges. Study on the present situation and existing problems of China' s import iron ore shipping market help Chinese enterprises to get a better command of the whole market and recognize their real position in the market. It will be very helpful for them to establish practical and feasible business tactics and strategies in order to conquer the difficulties and solve the problems in hand.

In this dissertation, an attempt has been made to analyse the whole China' s import iron ore market, including the material resources, transportation volume, dry bulk fleet, iron ore ports, etc. In the past years, a large number of high-valued research papers and essays have been published in the field of international shipping market by different organizations inside and outside China. Some may also have some relationship with the iron ore market. A survey and review of the literatures indicates that most of them mainly concerned the dry bulk freight market, only a few of them focused on the iron ore shipping market, which is among the dry bulk

freight market, not to mention China' s import iron ore shipping market. Anyway, those literatures provided some theoretic basis for the further study on China' s import iron ore shipping market.

Every effort has been made to present the work in a logical order. It starts with an introduction to the general situation of the present China' s import iron ore shipping market. Then leads to the analysis of supply and demand in this market. Finally, the dissertation makes a discussion on the existing bottleneck in this market, that is the current congestion problem in China' s ports.

The steel industry is an important fundamental industry in China. As iron ore is the principal raw material for steel production, the fast development in steel industry drives the iron ore trade and transportation. Since the reserve of iron ore in China is not very large, and the quality of China' s iron ore is poor, China imports large quantities of iron ore from Australia, Brazil, India, North Africa, and other ore-exporting countries every year. Chinese steel companies which import foreign ores include Shougang Group Corporation, Shanghai Baosteel Group Corporation, Wuhan Iron and Steel (Group) Corporation, Anben Steel Group Corporation, etc.

When making analysis on a market, the theory of supply and demand plays an important role in it. This dissertation devotes a large number of pages to the analysis and forecast of supply and demand.

The demand of China' s import iron ore shipping market is ever changing and influenced by many factors. The major features of it include regularity, latency, imbalance, particularity, and identity. The variation of the total demand follows that of China' s economy, the productivity of steel and the demand of import iron ore

in the environment of world' s economy. It is the imbalance of the distribution of iron ore resources in the world that causes the iron ore trade and transportation.

Since the demand of China' s import iron ore shipping market is derived from the demand of China' s import iron ore trade. The development of China' s import iron ore trade is determined by the development of China' s economy and the world' s economy. Those factors that may have influences on the economy and trade may also have impacts on the demand of China' s import iron shipping market, including social politics, scientific technology, and natural factors.

Since 1990s, the steel output and consumption in China increases steadily. After the entry into 21st century, China increases the investment in the construction of infrastructure, enhances the exploitation of the real estate, and accelerates the development of the auto industry. The strong demand of steel from these industries stimulates the development of steel industry, which speeds up the increasing rate of steel output and consumption in China. The steel output directly influences the consumption of iron ore. That naturally has an effect on the import of iron ore. China' s import iron ore shipping market is facing a prosperous future.

Quantity supplied in the shipping market is the tonnages all the ship owners (suppliers) are willing to provide under a certain freight rate. The supply in China' s import iron ore shipping market is one part of the supply in the whole shipping market. The characteristics of it include non-storability, imbalance, discrepancy between time and space, and changeability. And because of the closed relationship between supply and demand, those factors that have impacts on the demand may also influence the supply.

This dissertation not only makes careful analysis on the supply and demand of China' s import iron ore shipping market, but also make forecast on them. In Chapter 4, the Holt' s Model, linear regression method, and combination forecast are applied to estimate the future import iron ore volume in China. And qualitative analysis is made on the dry bulk fleet.

China is now in the middle stage of industrialization course. With the construction of state significant projects and the fast development of Chinese shipbuilding industry, the demand of steel keeps in a fine trend. As it' s steel output exceeded a hundred million tonnes, China has already become world-largest steel producing country in 1996. According to the forecast, China's import volume of iron ore will keep on increasing in the following 5 years. The dry bulk fleet for iron ore transportation would also become bigger and in the trend of building larger-sized vessels.

However, along with the fast developing China' s import iron ore shipping market, there is a bottleneck facing China' s import iron ore ports.

Generally, China' s import iron ore ports spread in three major areas – North China, East China along the Yangtze River, and South China. Although there are now 9 specialized iron ore ports that are of over 200 thousand tonnes level along the coast, the lack of large-sized specialized iron ore ports keeps being a serious problem. Due to the limitation of ports, water depth and waterway conditions, iron ore transportation usually adopts transshipment and less loaded methods. Those all increase the transportation cost, and make influences on the transportation efficiency. And because of the weak in-land transportation system, congestion problem in ports becomes more and more serious.

A conception of the port construction in the future is proposed in the dissertation.

Considering the characteristics of iron ore shipping – long distance and huge quantity, it is obvious that iron ore shipping is a kind of shipping that adapts to introducing large vessels of about 200 thousand tonnes and large-sized specialized terminals for iron ore. Due to the different resources and transportation condition, the import methods of foreign iron ores are also quite different. Taking account of the ports condition and the in-land transportation system, and the geographical situation of Chinese steel industry, it would be better to construct large-sized iron ore port according to the geography, and focus on the 5 districts – the Bohai Sea area, the Yangtze River Delta, Southeast coastal area, the Pearl River Delta, and Southwest coastal area. And reducing the international shipping costs and lessening the land transport distance is the overall guiding thought for the development of Chinese ports. In addition, the in-land transportation system should also be improve to meet the requirements of the fast growing import iron ore shipping market.

China' s import iron ore shipping market is a prosperous market with the rapidly developing steel industry and iron ore trade. Such development and prosperity provide a good chance for Chinese shipping industry. Undoubtedly, this dissertation will provide the relevant companies a good suggestion for future developing direction and methods.

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Drewry Shipping Consultants Ltd. (http://www.drewry.co.uk/)
International Iron and Steel Institution (http://www.worldsteel.org/)
International Monetary Fund (http://www.imf.org/)
Lloyd' s List (http://www.lloydslist.com/)
Shanghai Shipping Exchange (http://www.sse.net.cn/)
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