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## Ship investment decision analysis on Middle-East route of Sinochem

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# **World Maritime University**

Shanghai, China

ITL - 2010

## **“Ship Investment Decision Analysis on Middle-East route of Sinochem”**

By

**FAN JUN**

China

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

**MASTER OF SCIENCE**

**In**

**INTERNATIONAL TRANSPORT AND LOGISTICS**

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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.**

**(Signature):\_\_\_\_\_**

**(Date):\_\_\_\_\_**

**Supervised by**

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## **ABSTRACT**

Title of Dissertation: **Ship Investment Decision Analysis on  
Middle-East route of Sinochem**

Degree: **Master of Science in International Transport and  
Logistics**

**Abstract:** Ship investment is a capital investment as the most important investing activities to the shipping company. Since the ship capital is occupied above 30% of the total running cost, so the buyers should pay great attention to this investment which influences the ship's profit as to influence the fleet's cash flow and revenue. Owner must choose the proper investment style to reduce the ship's capital cost and for the target that the ship comes into the shipping market with low cost.

This article starts mainly from the situation on Middle East route of Sinochem Shipping Co., Ltd (Sinochem), combining the carrying demand and current transportation capacity ,then figures out the best investment decisions of Sinochem on chemical shipping.

**Keywords:** ship investment, chemical shipping market between Middle East and China; Investment on vessels; Net Present Value

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## **List of abbreviation**

IMO	International Maritime Organization
DWT	Deadweight ton
Sinochem	Sinochem Shipping Co., Ltd
SAT	Ship-building Association
GNP	Gross National Product
OECD	Organization for Economic Co-operation and Development
GDP	Gross Domestic Product
PP	Payback Period
IRR	Internal Rate of Return
NPV	Net Present Value
NPVR	Net Present Value Rate
INPV	Net Present Value Index
ARMA	Autoregressive Moving Average
MDI	Diphenylmethane diisocyanate
TDI	Toluene diisocyanate
SCIP	Shanghai Chemical Industry Park
BASF	BASF chemical company
CELANESE	CELANESE Corporation
BAYER	Bayer AG Company
SHELL	Shell Chemicals Company
Drewry	Drewry Shipping Consultants Ltd
Clarkson	Clarkson Research Services Limited
AIC	Akaike information criterion
SC	Schwartz Bayesian criterio

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## **Chapter 1 Introduction**

### **1.1. Background and meanings :**

Since stepping into 21 century, although went through the world financial crisis, the traffic of the international liquid chemicals still increases persistently. In recent 10 years, the total volume of the international liquid chemicals increased at the approximate rate of 3% annually: from 177.6million tons to 214.2million tons. And owing to the 2008 world financial crisis, it decreased appreciably, compared with 2007; it has dropped by 0.4%. At 2009, the market begins antibiosis, and the annual traffic volume up to the 210.8million tons. According to the first half of 2010 of its traffic volume situation, we can predict that it will up to 214.2million tons by the end of 2010. The annual growth rate will up to 1.8% as well, and it shows a stable develop tendency. Years starting from 2004 are the most strong-performing ones for international dry bulk cargo transport market, the need of the chemicals which are China-oriented upsurge unprecedentedly. With the country give support by the policy, China has become a leading power of the world chemicals imports and exports.

Sinochem is a large enterprise of China which business in international liquid chemicals transportation. The company owns 40 liquid chemicals vessel of DWT1000-18000 of IMO II altogether, the total transportation volume up to 400,000DWT. It has established a close-knit business relationship with many petrochemical corporations at home and abroad in the process of long-term corporations. The company can carry all kinds of petroleum products , Liquid chemicals, acids, oil and grease, edible oil and other special type products. The ship routes extend all over the Europe, America, the Middle East area and the Indian ocean.

Recent years, affected by the soar of liquid chemicals import, the import volume of 2009 reached the 254,490 million tons, and 30% among them are from the Middle East. Owing to

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the volume and the long distance, the transportation of liquid chemical tankers from the Middle East to China emerged a status of supply falls short of demand. In order to satisfy the need of the market, replenish the hauling capacity, The Sinochem has decided to add the liquid chemical tanker fleet. The selection of the subject is based on the practice of purchase of ships of the Sinochem.

Ship investment is one of the first and foremost contents of shipping management which is related to the strategic investment for the overall operation of the ship production, change of fleet structure and transport capacity. Make scientific decisions for approaches and timing of vessel investment according to modern, scientific decision theory and principle, and make objective analysis on decision-making index by relating evaluation indicators are vital safeguards for the survival and development of shipping company in the new situation. This article mainly aims at the transportation market from China to the Middle East, made a forecast to next few years of the tendency of the chemicals transportation market by analysis of the demand of the chemicals products and offers a reference to the shipping enterprises for their future development.

## **1.2. Literature review:**

The existing researches of the shipping investment analysis can be divided into two groups, the scholars of the first group try to make the investment decision-making through analyzing the price fluctuation of the ships, the second groups used financial and accounting tools to solve the problem

The typical studies in the first school are: In the last 70th , Japan Ship-building Association (SAT) established a predict model to reflect the market structure, this model is mainly used for long-term demand for new ships and transportation need, its logical structure is as follows:

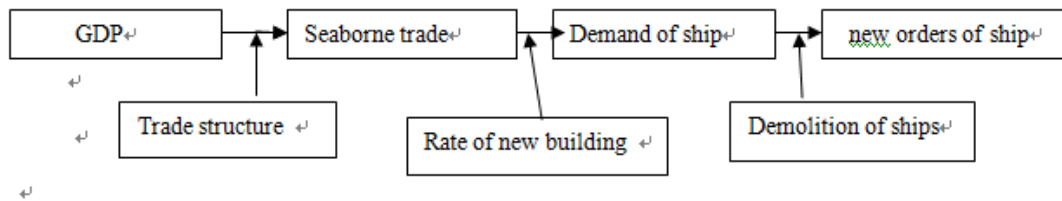


Figure 1.1 SAT logical structure

The exogenous variables of SAT model use the GNP of the OECD countries to predict the demand of the bulk market. SAT tests the index through hundreds of related formulas and great deal statistic data.

In 1981, Wojciech Charenmza and Mireslaw Gronicki in Gdansk, two scholars have put forth a model, they tried to find the best way to quantitative analysis the balance of supply and demand of the world shipping market and the world shipbuilding market. The biggest difference between this model and previous model is that he believed that the supply and demand of world shipping market and ship-building market stayed at an unbalance situation. Therefore, he defined the world shipping market, demand and supply side of new ship-building market through difference formulas. The model has two parts: the world shipping market model and the world ship-building market model, in which the main decisive factor is the World Trade traffic, which take place the GNP in the traditional models. Shipping Market Model is determined by global freight volume rather than GDP utilized in the conventional model. Long-term supply depends on the capacity of global fleet, freight rate, international economic inflation and etc. The models of worldwide ship-building market include the Tonnage-Demand Formula, Tonnage-Supply Formula, and Investment Circle Formula in the field.

In the same period in Norway, Norman, V., and Wergerland, T. proposed a log-linear model, namely, Nortank in 1981, In the same year. Wergerland, T. also proposed Norbulkl. Respectively, for bulk cargo market and the tanker market; In 1986 .Strandenes proposed Norshipls model based on Norbulk and Nortank, which

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contained the shipping market, second-hand ship market, the new shipbuilding market, and demolition market.

In 1985, Michael Beenstock gave a theory model which linked the freight market and the shipping market. In this model, Beenstock first proposed that the traditional theory of supply and demand in the market did not adopt to ships. He thought the ships belonged to the capital asset, which has a long time right to use. The operating decision of ships depended on the analysis of current market and forecast of the future market. Therefore Beenstock proposed that we should have used the capital theory to analysis and forecast the shipping market. He divided the study of ship operation into transportation market and shipping market, he got evolution of shipping market when factors which influenced the shipping market changes through solving 25 equations set..

In 1989 Michael Beenstock and Andreasve applied the model which Beenstock proposed in 1985, to forecast the world bulk market and the tanker market. The model attempted to correlate with freight rates, idle ships, new ships and second-hand ships' prices. They obtain satisfactory results through the dynamic solution. However, due to sample dates were taken from 1960 to 85 years, the data were unable to obtain the same statistical standards, then leading the non-accuracy of model results.

What mentioned above are some foreign research results, There are also a few papers in this regard which were written by the Chinese scholar.

In 1996, Professor Ren yi Zhang analyzed different factors which affected the second-hand price between qualitative and quantitative aspects. He established relationship of the different index of shipping and ship market by stochastic simulation. And then he took a 15 thousand DWT multi-purpose second-hand ship as an example, according to the routes, cargo types, and freight rates. He calculated and analyzed the profit, the net present and average annual earnings under different kinds

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of condition in order to determine the ship's purchase price.

In 1997, Dalian Maritime University, Professor Jing Lv used econometric principles and methods to establish a model to reflect the international second-hand ship freight based on the systematic analysis of the second-hand ship market operation mechanism market, including second-hand ship prices of the linear model, its explanatory variables were second-hand ship age, DWT, speed and unit fuel consumption, and second-hand vessel trade volume linear model, its explanatory variables were the price of new vessels, second-hand Vessel price, supply vessels and freight rates.

The main research methods in the second group are traditional methods, such as Han W. Pack. He used standard annual cost method, relative annual cost method and cash flow method for ship investment decisions. Through the analysis, the minimum shipping cost could be found. Han W Pack used the linear programming method to analyze profit contribution to the whole fleets, and the lowest contribution vessel will be replaced. Then the replacement vessel and investment opportunity would be chosen.

In 1979, American shipping financial experts Cheng P.C. in his book 'financial management in the shipping industry' he used some investment decision-making evaluation index such as payback period (PP), and internal rate of return (IRR) and the time value of capital, the opportunity cost and income tax, risks and uncertainties and practice of related problems to discuss this problem.

In 1982, American shipping experts Frankel EG MIT professor in his book 'management and operations of American shipping', used and selected NPV, IRR, ARR, PP, as evaluation indexes,

In 1987, world famous shipping economic professor of Wales University, Goss. R.O in his article 'assuming investment in shipping' comprehensively and systematically

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analyzed ship investment evaluation under different conditions of earnings, financing, inflation, tax and tax deduction.

In 1994 ,Andreassen.J.A and Tamvakis.M.N in article ‘Risk and investment decision in nonlinear shipping’ proposed to make decision-making through probability theory, he thought shipping market was flexible and cyclical variable . According to its rules ,they made ship investment decision-making by the method of weighted mean.

Frankel E G in 1992 discussed shipping policy and its making by the analytical hierarchy process and specialist options. He believed that on the basis of analytical hierarchy process and specialist options the influence of policy and decision-making can be considered qualitative and quantitative at the same time. Teng J and Tzeng G in 1996 researched urban public transportation system by the method of fuzzy evaluation Hsu T in 1998 discussed the similar articles by the method of fuzzy expertise. Although their mainly target was to discuss the investment of public transportation, it still can be draw lessons from it directly to the decision-making in the process of the investment of shipping events.

### **1.3 Methodology**

There are two methods and one software being introduced to forecast in this paper. The methods are Regression Method and Autoregressive Moving Average (ARMA).The software is Econometric Views (Eviews). Meanwhile economic analysis is also be used.

Regression analysis is a statistical technique for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. Most commonly, regression analysis estimates the conditional expectation of the dependent variable given the independent variables — that is, the average value of the dependent variable when the independent variables are held fixed.



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Autoregressive moving average (ARMA) models, sometimes called Box-Jenkins models after the iterative Box-Jenkins methodology usually used to estimate them, are typically applied to auto correlated time series data.

ARMA model is a stochastic model used frequently and is also a mean of short term time sequence prediction enjoying a relatively high accuracy. Its fundamental ideology is: some certain time sequences are random arguments dependent on time  $t$ . despite the uncertainty of a single sequential value, the change of a whole sequence can be described approximately by the relating mathematic model with some certain regulations. ARMA model is classified into three elementary patterns: autoregressive model, model of moving means and autoregressive moving average (ARMA) model.

Eviews (Econometric Views) is a statistical package for Windows. It used mainly for time-series oriented econometric analysis can be used for general statistical analysis and econometric analyses, such as cross-section and panel data analysis and time series estimation and forecasting.

Economic analysis in this paper is to be defined to use some financial method such as net present value(NPV), net present value index (INPV), Internal rate of return( IRR) to evaluate the result of the investment decision

#### **1.4 Structure of the research paper**

This paper deeply analysis the process of investment decision-making of Sinochem. The whole paper divided into five chapters. Chapter 1 is introduction, background and meanings and literature review . Chapter 2 is analysis on the demand of ship investment of Sinochem. Chapter 3 is ship investment style choice of Sinochem Chapter 4 discusses the ship investment opportunity of Sinochem. Chapter 5 is economic analysis on the ship investment decision of Sinochem. Chapter 6 draws the conclusion of the whole paper. The flow chart below indicates the whole structure of

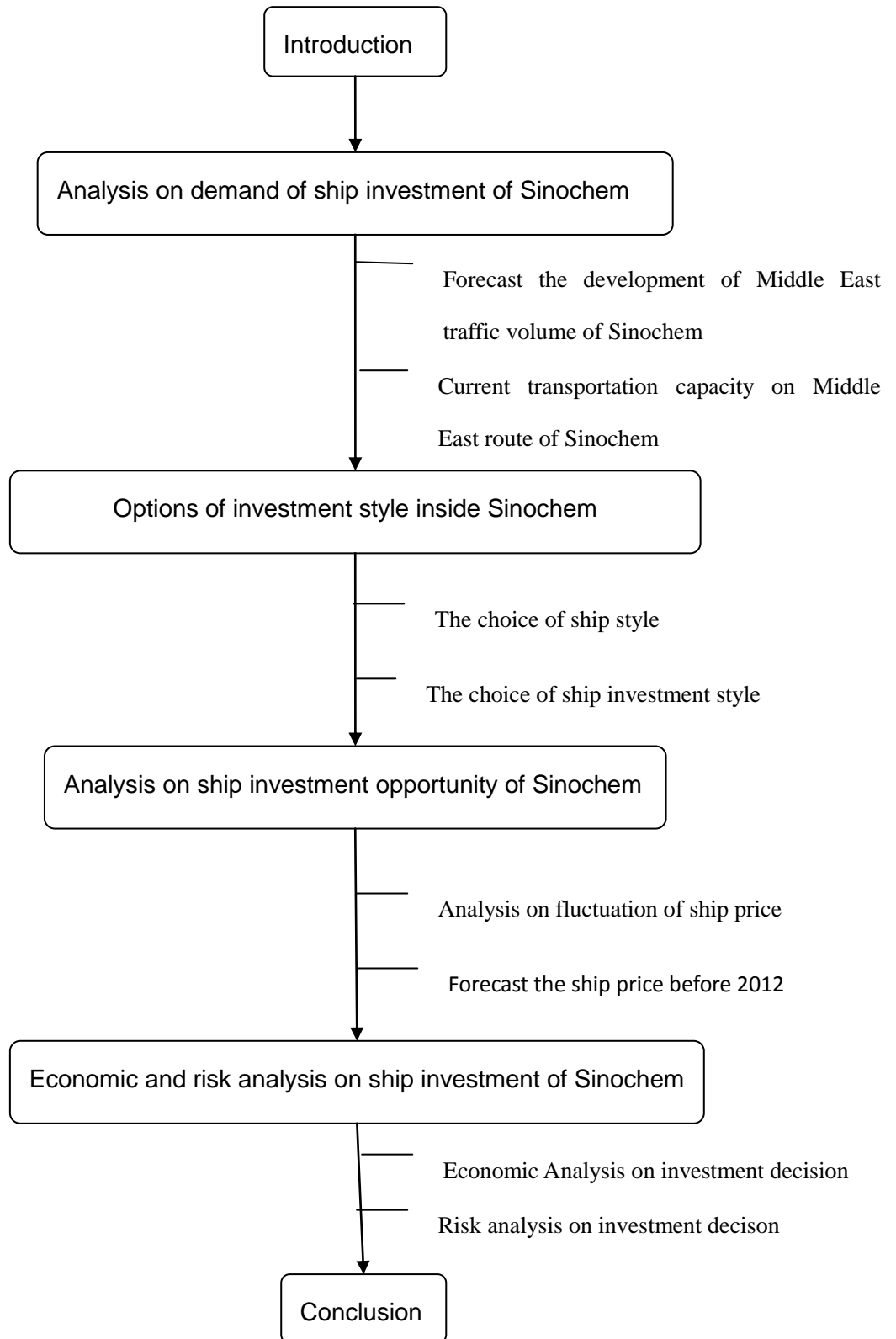


Figure 1.2 structure of paper

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## **Chapter 2 Analysis on necessity of ship investment of Sinochem**

### **2.1 Introduction**

Before the shipping company makes the decision to the vessel investment, it should consider prior to guarantee the demand of the transportation capacity from the clients and keep it balance to its actual transportation capacity. If there does exist a notable differences between them, the inescapable alternative is to strengthen the transportation capacity by the way of ship investment.

### **2.2 Overview of Sinochem**

Sinochem Shipping Co., Ltd. is a subsidiary of Sinochem International Corporation. Founded in 1994, it is now the largest business for liquid chemical shipping at home. It mainly deals in far-and near-sea international navigation routes and liquid chemical transport and ship management along the coastline of China. It has rich experience in ship operation and management for liquid chemicals and boasts a professional management team. Currently the company has 40 DWT 1000-14000 IMO II and III professional liquid chemical ships, with a total shipping capacity of over 300000 DWT. During its long years of business, it has built a close cooperative relationship with big petrochemical corporations at home and abroad; it has undertaken the transport of various kinds of finished oil products, liquid chemicals, acids, animal and plant oil, edible oil and other special products, with its navigation routes covering Europe, America, Middle East and the Indian Ocean.

Thanks to the support of the China policy and increasingly development of the chemical market in the Middle-East zone. The following several years will witness the dramatically growth of shipping demand from key customers of Sinochem

The future production planning of the Sinochem's main customers is as follows:

1. PowerDisk---Ningbo Daxie, 60,000 ton per year MDI project
2. Bayer---Caojing 350,000 ton per year MDI project
3. Bayer---Caojin 160,000 tons per year MDI project
4. Basifu, Heng the Si Mai 240,000 tons per year MDI project
5. Basifu--- Caojin 160,000 tons per year TDI project
6. Celanese---Nanjing 600,000 tons per year ethylic acid project
7. BP---Nanjing 500,000 tons per year ethylic acid project
8. Qingdao Lidong petrochemical world-class aromatic hydrocarbon project(70,0000 tons Para Xylene per year,20,0000 ton Benzene per year )
9. Inoes ZhangJiaGang phenyl hydroxide project
10. millions ton per year Ethylene pyrolysis project (SCIP, Tianjin )

Based on the planning above, we can conclude the future adding transport demand of these clients into the table:

Table 2.1 the newly increased transport demand of the Sinochem

	2010	2011	2012
<b>Shell</b>	4	8	90
<b>Secco</b>	3	50	60
<b>Basf-ypc</b>	3	60	60
<b>Shanghai BASF</b>			15
<b>Celanese</b>			25
<b>Nanjing Cycolin</b>			30
<b>Bayer</b>			15
<b>Lucite</b>			20
<b>Sabir</b>			20
<b>ExxonMobil Chemical</b>			15
<b>Sinopec Zhenhai</b>	28	48	48
<b>Cnooc</b>			60
<b>cumulative total</b>	38	166	458

### 2.3 Forecast the demand of Middle East traffic volume of Sinochem

### 2.3.1 The current situation of Middle East route of Sinochem

The Analysis of ship investment decision in this passage is based on chemical transporting of Sinochem between China and the Middle East area. Among all these, the major loading and discharging ports in Middle East are DAMMAM , ASSALUYEH, BANDAR ABBAS. According to Sinochem chemical transportation's statuesque, the major chemical importing and exporting ports in our country are Nanjing, Caojin, which form the following shipping route.( see Figure 2-1)

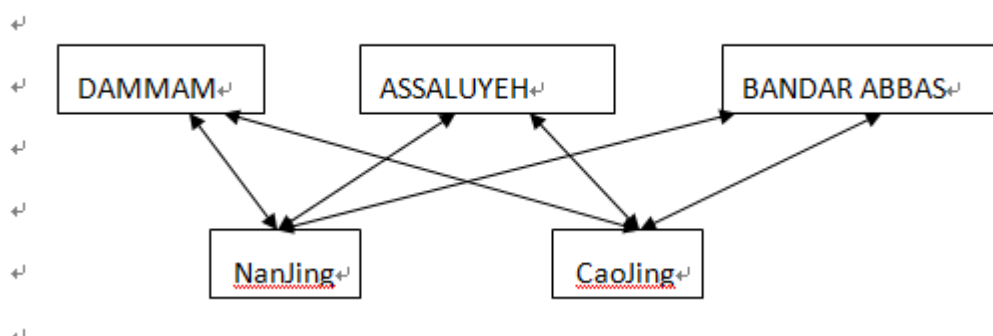


Figure 2.1 Middle east route of Sinochem

Distances among ports are manifested as the table 2-2

Table2.2 distance among ports Unit Nautical Mile

Distance(Unit Nautical Mile)	NANJING	CAOJING
DAMMAM	6045	5880
ASSALUYEH	5932	5767
BANDAR ABBAS	5732	5567

### 2.2.3. Prediction on transporting volume in Middle East route of Sinochem

In the recent years, with the Middle East keeping strengthening its leading role in liquid chemicals, many chemical manufacturers start to see the Middle East as their

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major client base in chemicals trading. Such as BASF ,CELANESE ,BAYER ,SHELL set the Middle East as a primary exporter for many newly settled chemical projects.

Those chemical enterprises mentioned above have already been Sinochem's vital clients. Therefore, meeting the client's demand for transport capacity in the Middle East has been the priority to Sinochem.

Transport capacity in the Middle East route of Sinochem has a tendency of increasing year by year; the table 2-3 is the transport capacity in the Middle East route of Sinochem from year 2001 to year 2009

Table 2.3 2001-2009 transport volume in the Middle East Unit/ton

2001	2002	2003	2004	2005	2006	2007	2008	2009
1144570	1210000	1192590	1421504	1548767	1571978	1663224	1644820	1687136

When these dates are transferred into regression analysis, then the formula can be gained  $y = 1E+06 * e^{0.054x}$ ,  $R^2 = 0.8955$ , (see figure 2.2)  $R^2$  is approximately to 1, that is to say the formula is credible. Prediction can be achieved that in year 2012 Sinochem's transport volume demand in middle east route will be 1911713.6 ton. (see table 2.4)

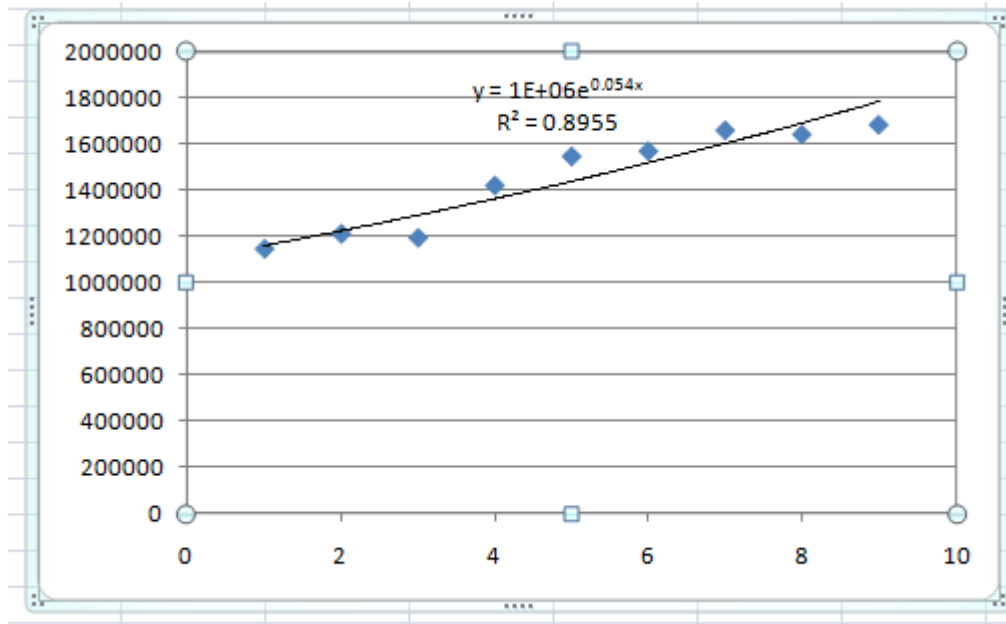


Figure 2.2 2001-2009 regression analysis of transport volume

Table 2.4 prediction on transport volume demand in middle east route from 2010 to 2012

2010	2011	2012
1716007	1811218.8	1911713.6

### 2.3 Transportation capacity on Middle East route of Sinochem at present

Sinochem owns 40 ships in operation, 13 of which are for domestic operation and the average age of vessel is 10 years. The types of vessels are : 9 vessels of 3000-8000 DWT, 4 vessels of 13000 DWT. 27 of which are for international operation and the average age of vessel is close to 15 years. Vessel's form is: 9 vessels of 3000-8000 DWT, 4 vessels of 13000 DWT. Vessel's form is: 15 vessels of 3000-5000 DWT, 12 vessels above 13000 DWT.

Seven of them are for Middle East route, of which 3 vessels of 13000 DWT, 4 vessels above 17000 DWT. as the table 2.5

Table 2.5 vessels for Middle East route

Ship name	Age	Classification Society	Tonner
Sc Shanghai	2007/2/15	KR	13000
Sc Tianjin	2007/4/25	KR	13000
SC Xiamen	2001/4/26	KR	13000
SC Beihai	2002/4/27	CCS	17000
SC Donghai	2009/5/19	CCS	17000
Sc Guangzhou	2008/11/4	LR	17000
Sc Hebei	2008/11/5	LR	17000

In this paper, the maximum transportation capacity on Middle East route of Sinochem will be calculated as follows

1.The important index of calculation is the time of the trip

$$T_v = T_s + T_p$$

$$T_s = \frac{L}{V}$$

$T_v$ ----time consumed for total voyage

$T_s$ - --time of ship sailing

$T_p$ --- the time consumed in loading and discharge port

$L$ — the distance between loading port and discharging port

$V$ —traveling speed , the actual traveling speed of the vessel

The  $L$  calculated in the passage has already been stated on the above analysis, we chose an average number, which is 5820.5 Nautical Mile, considering the speed  $V$ , according to the time and speed of Sinochem, is set as 14 knot/hour

So that the time of ship sailing  $T_s = 17.3$  days.

The loading and discharging time of the vessel depend on the efficiency loading and



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discharging equipment on the port. We supposed the  $T_p = 4.5$ days

$$T_v = T_s + T_p = 17.3 + 4.5 = 21.8 \text{ days}$$

According to the actual running days in a whole year of Sinochem ships, We Suggest that the operation time for the whole year is 330 days, the rest time is for inspection, repairing and so on.

2. The formula of a single vessel transport capacity for a whole year

$$P_c = \frac{330}{T_v} * P_s$$

$P_c$ --- in a whole year

$P_s$ ----the maximum transport capacity of a single vessel

According to the calculation, we can draw that the present vessel transport capacity of Sinochem for the Middle East route is 1619724.771 tons.

## Summary

After forecasting the development of traffic volume and calculating the current maximum transportation capacity on the Middle East route of Sinochem, it is easy to find there are 291988.8 tons of transporting disparity is revealed (see figure 2.3).Consequently, it can be considered that before 2012 the top priority task for Sinochem is to increase the transport capacity in order to meet the need the demand of the market.

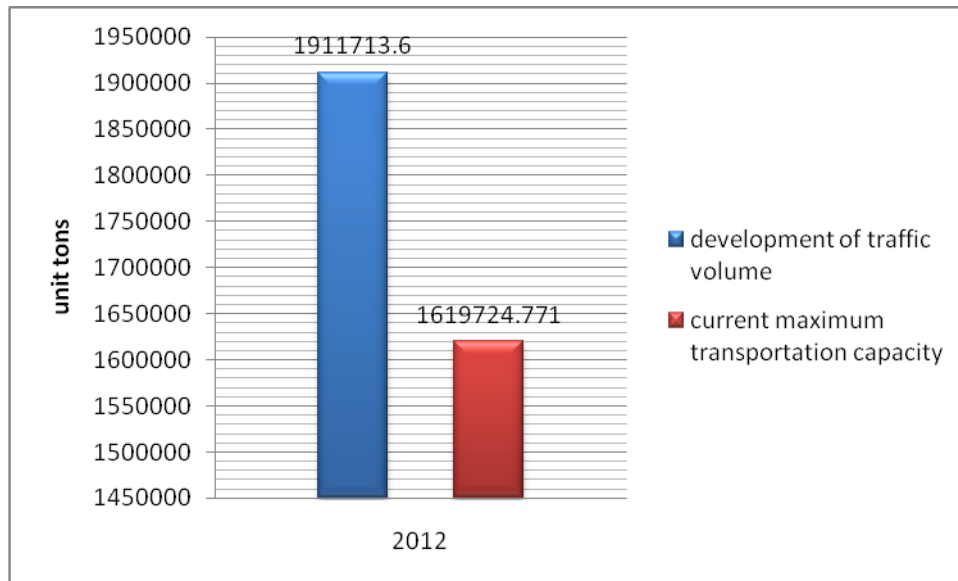


Figure 2.3 compare the development of traffic volume and maximum transportation capacity

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## **Chapter 3 Options of investment style inside Sinochem**

### **3.1 Introduction**

In the last chapter, we find it is necessary for Sinochem to make ship investment decision in order to meet its customers' need. However, when Sinochem begin to make the detail ship investment project, they need to solve such two problem which types of ship to investment and how to invest. The final objective of shipping companies make investment to the vessel is to enable the enterprise has the quality to meet the needs of the market; to be able to adapt to market needs by the age composition, technical equipment, marine safety, service quality or standard and economically competitive fleet. Therefore, when companies choose the style of ship investment (newbuilding, second-hand or chartering) they need to consider, according to the enterprise resources, and choosing the proper investment programs and meet the needs of marine transport volume number in order to make reasonable investment the tonnage of the vessel and configuration services, investment style of drawing up a detailed analysis.

### **3.2 Options of ship types**

As to the gap of the transporting demand, the average vessel speed of liquid chemicals tanker and the vessels' running time, we can conclude that the vessel's form Sinochem needs to add should be above 17000 DWT

When considering to port condition, import and export volume of Nanjing and Caojin, which are major ones in Chinese ports on Middle East route of Sinochem, it is showed in table 3.1

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Table 3.1 Condition of Nanjing and Caojing ports

Ports	Berth tonnage	Batch( $\pm 10\%$ )
Nanjing	3000-20000	15000-19000
Caojing	5000-25000	16000-19500

Nanjing and Caojing are main ports of chemical import and export in China. The products of Sinochem's customer around these ports have high demand of transportation volume on one voyage. However, their products do not have specially requirements of the transportation. So IMO II liquid chemical tanker is enough to meet their requirements

In Order to meet the demand of clients' import and export volume, with the present condition of Chinese ports and classification of liquid chemical tanker by Drewry, the ship type of Sinochem can put in investment is 18000-20000 DWT liquid chemical tanker.

### **3.3 Comparison of liquid chemical tanker investment styles**

#### **3.3.1 Investment on newbuilding market**

If the owner has enough funds, they usually select newbuliding a ship to cater for the development of shipping, since new vessel has the following advantages:

- 1) Usually for a specific trade or service, the major technology operating parameters such as the tonnage and speed of the vessel are optimized demonstrated and selected, as a result, the new vessel can meet the requirements of the routes by speed, specifications and technical performance etc., it may provide optimal service by the most economical cost.
- 2) New vessel usually can improve service quality so as to gain more earning

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capacity, which is especially important to the current fierce competition for the resource.

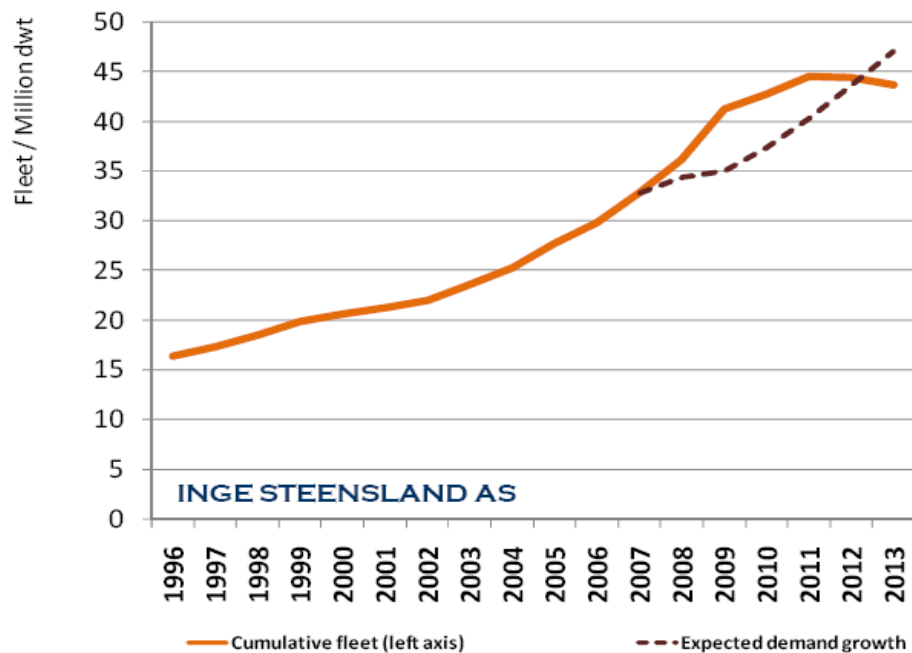
- 3) Build new vessels is to the benefit of optimizing operation of the vessel.
- 4) The new vessels could improve the reliability of the service.
- 5) The repair, inspection and insurance costs of the new vessels are low.
- 6) New vessels could coordinate development with modernization of the port handling facilities as a result that speeding up loading and reduce turnaround time in the port.
- 7) The new vessel's investment is easy to gain some of the benefits of their national government or other financial institutions in financial grants and concessionary loans and so on.

For this reason, the developed countries continue to modernize the construction or purchase new vessels, while selling out the old boat to the developing countries, making the developed countries always maintain a competitive advantage in shipping technology and economic.

But by the comparison of other ways, newbuilding ship still has some disadvantages, for example: expensive vessel price; if it takes long period from the vessel building to operation, during which funds cannot be recycled, and shipping market tends to change with the early orders, resulting the possibility of lost, the increases of risk, When the vessel is made overseas, due to be paid in foreign currency, may cause potentially resulting exchange rate risks; new vessel maintenance costs are higher, the economic losses may happen thus once idle. Therefore, the vessel-building decision needs to study carefully the market trends, calculating long-term repayment ability and profit/loss, taking attention seeking favorable financing and vessel yard meanwhile.

Talking about the liquid chemical tanker investment on newbuilding market, in the latest statistics show (Figure 3.1) which made by INGE STEENSLAND AS, now the

chemical fleet capacity is growing too fast as the result that hardly to meet predict chemical transportation market needs before 2012. Consider the period, money, and the present state of the shipping market to cater for the new ship, most of the chemical shipowners tricky to choose the catering for the newbuilding for investment.



Source: Inge Steensland AS

Figure 3.1 compare the cumulative fleet and expected demand growth

### 3.3.2 Investment in Second-hand Market

Compared with the construction of new vessels, purchasing second-hand has the following advantages:

(1) Capital cost is lower

Second-hand vessels' price is 1/2 to 1/3 of new vessel's price in general, and capital costs are lower, purchasing second-hand is a more realistic proposal for the company which is lack of funds. Especially with the growing price of the boat, it is quite attracting to the ship owner to purchase a quite modern, age more than 5 years of second-hand. Of course, purchased second-hand boats usually carry out some

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modifications, but in the situation that the shipyard lacking of new ship orders, the conversion cost is relatively lower. By the lower cost of capital, while operating performance is not worse than the new vessels, making shipping companies to purchase second-hand vessels with better repayment capacity, resulting less time wasting and risks. In addition, the purchasing of second-hand ships also can reduce or avoid the market deterioration and the risk of delay in shipping by building new vessels.

(2) Immediate delivery

Shipping market is changing every time. Successful shipping operators tend to hold the best time to purchase ships putting them into operation so as to get profit. It is imagined, if the freight of shipping market has been rising or some of these freight volume increases and make out the generation of new requirements, purchasing second-hand can immediately put into operation.

(3) Easy to acknowledge vessel performance

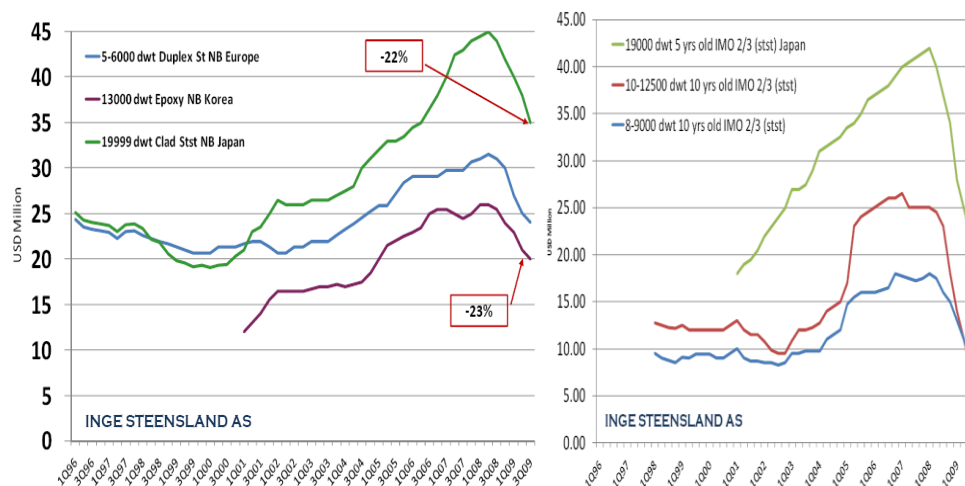
Before the ship is put into operation, it should be acknowledged the performance through trials of the ship, but for an old vessel, its operating conditions and sailing performance has a certain display. When the buyer purchased the old vessels, must notice the information to the ship and the ship's operating history and the basic properties such as models, the consumption speed etc., when all the conditions of the ship meet requirements, the purchasing will be practicable. In general, the operating conditions and performance of the understanding of an old ship is much easier to a new ship.

Since the second-hand has more advantages, as a result, many owners are targeted at the second-hand market, in the early stages of setting up offshore fleet in China is purchasing second-hand from trading ship market to develop the fleet.

However, we should recognize that second-hand ships are usually the old ones, they also have a series of shortcomings because of the physical abrasion and invisible abrasion: for example as a result of technology performance variation that turning up

handling capacity decreases, the host power declined, speed reduction, operating rate decreased etc.; as a result of poor economic performance that turning up high energy consumption, high costs of burning material and maintenance, repair, inspection and insurance costs are also relatively high; as a result of poor performance, difficult to coordinate with specific operating conditions, will cause for low handling efficiency and extent port parking time of the ship: as the result of low transportation service quality, the capacity of competition is lower, etc.

Also according to the statistics of Inge Steensland AS report, since the 2008 global financial crisis broke out, second-hand chemical tanker price declines to significantly higher than newbuilding price declines. (Figure 3.2)



Source : Inge Steensland AS

Figure3.2 newbuilding and second-hand price comparison

In addition, we can see that second-hand chemicals tanker prices since the ship price which encounter large landslide has entered a slow upward momentum from another world famous ship consulting company Derwy report (Figure 3.3), and relative to the newbuilding, second-hand has the obvious advantage in the part of money and time.



## Secondhand prices – IMO 2 – stainless\* (period averages; \$ million)

2008	13.3-16.2	16.9-20.6	21.8-26.7	26.8-32.7	30.0-36.7	33.3-40.7	40.1-49.0	48.1-58.8
2009	8.3-10.1	12.4-15.2	14.9-18.2	16.8-20.6	19.6-24.0	20.5-25.1	33.9-41.5	39.0-47.6
2010	7.8-9.6	11.5-14.1	13.1-16.0	14.7-17.9	18.0-22.0	19.8-24.2	33.1-40.5	36.9-45.1
2Q08	13.0-16.0	17.1-20.9	22.1-26.9	27.0-33.0	30.6-37.4	34.2-41.8	41.4-50.6	48.6-59.4
3Q08	13.9-17.0	17.1-20.9	22.1-26.9	27.0-33.0	30.6-37.4	34.2-41.8	41.4-50.6	48.6-59.4
4Q08	13.5-16.5	16.7-20.4	20.7-25.3	26.1-31.9	28.8-35.2	32.4-39.6	38.7-47.3	47.7-58.3
1Q09	10.1-12.3	16.0-19.6	19.8-24.2	24.5-30.1	27.5-33.5	29.2-35.7	35.7-43.7	42.7-52.2
2Q09	7.7-9.4	11.4-14.3	13.5-16.5	16.2-19.8	19.8-24.2	20.7-25.3	34.2-41.8	39.6-48.4
3Q09	8.0-9.8	11.7-14.3	13.5-16.5	15.8-19.3	18.9-23.1	19.8-24.2	33.3-40.7	37.8-46.2
4Q09	7.8-9.6	11.5-14.1	13.1-16.0	14.9-18.3	18.5-22.6	19.8-24.2	33.1-40.5	36.9-45.1
1Q10	7.8-9.6	11.5-14.1	13.1-16.0	14.7-17.9	18.0-22.0	19.8-24.2	33.1-40.5	36.9-45.1

\* Basis ten year-old vessels

Source: Drewry

Figure 3.3 second-hand chemical ship price

At the same time, within the context of the global chemicals market recovery process, Chinese and the Middle East chemicals imported and exported is growing by a large margin, China, for example, the country makes economic stimulus plan of 4 trillion, strong supporting to the chemical industry and makes China to become the largest importer of chemicals to increase the capacity needs, so purchasing second-hand to full the fleet of liquid chemical tanker has become the first choice of the owner of chemical tanker.

### 3.3.3 Chartering Business

Primarily it is a temporary measures to resolve short term deficient by the methods of adding capacity through charter way. It has the big advantage of little renting charge and getting ship immediately, at the same time there is no need to raise large sums of money and the repayment of each stage, only to pay rent in accordance with the provisions of the lease as scheduled. In addition, the economic lost could be reduced by acquisition ships since unable to use continuously and restricted capacity lost by the comparison that buying new ships (with the acquisition of old ships or new ships). Internationally, ship chartering can be divided into three categories: voyage charter, time charter and bareboat charter. cost allocation of ship owner and the charterer is differed from charter modes, but in all, the charter operations of capital has less taxing

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burden and applies to shipping companies in a certain period of missing ships or want to expand their fleet and do not want to spend a large sum of money to buy a boat, or in the situation of financing difficulties and can't afford to buy the ship.

Disadvantage of Chartering is that it may not has good rate of return by the comparison of own ships and its technical performance and operating performance may not be able to fully meet the requirements of the charter, especially unable to compared to the new boat with the ship type argument of the conclusions.

Since the chartering cannot be compared with its own fleet and because the liquid chemical tanker for shipping requirements, so that a rent of vessels in the area of technical performance and operating performance may not be able to fully meet the requirements of the charter, especially unable to compared to the new vessel with the ship type argument of the conclusions. Therefore, in a chemical transportation market, to increase the capacity for Charter's investment is not popular.

### **3.4 Selection of ship investment style of Sinochem**

Take capital into consideration, the purchase capital of Sinochem is mostly unified allocated by China Sinochem Group Corporation, on the grounds of the capital allocation of Sinochem Corp in 2009, expendable fund allocated to Sinochem Corp is 200million RMB. On the basis of the latest report of Derway, the price of a newly built liquid chemical vessel with a tonnage 18000-20000 is 23.1-28.2million dollars. Therefore the Corp fails to select making new vessels as a way of investment.

Take time into consideration, if the Sinochem Shipping Co., Ltd choose to invest by purchasing new vessels, a huge amount of money is needed and the time consumed (since the building period of a chemical vessel is 15-17 months)and an increasing operation risk will be imposed. As for the urgency to meet the clients' demand, building vessels can't be the corp.'s first choice.

When analyzing in a economical way, we can gain from Inge Steensland AS report that building the stainless steel vessel is still higher-priced, and price of second-hand vessels is or now reaching the bottom. (Figure 3.4). Second-hand vessels with its comparatively lower price can assure the Corp of enjoying cost-recovering as soon as possible.



Source : Inge Steensland AS

Figure 3.4 price comparison between newly built vessel and second-hand vessel in history

Meanwhile, as mentioned in the above analysis, investment in second-hand vessel enjoys a feature of Immediate delivery. Purchased ships are able to be in operation immediately to fully meet the demand of the clients.

Therefore investing second-hand ship is thought as the first priority to expand the fleet of Sinochem.

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## **Summary**

This chapter is divided into two main parts. In the first part, the type of ship (IMO II 18000-20000 DWT liquid chemical tanker) has been decided according to the condition of ports and requirement of customers of Sinochem. In the second part, the advantage and disadvantage of three different investment styles have been analyzed. Based on the analysis, investment on second-hand market is regarded as the first choice of Sinochem.

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## **Chapter 4 Analysis on ship investment opportunity of Sinochem**

### **4.1 Introduction**

When the ship types and ship investment style have been decided, the investment opportunity should be taken into consideration. In this chapter, the ship investment opportunity will be analyzed through the fluctuation of ship price. According to the ship type decided in the previous chapter, ARMA model will be applied to forecast the ship price of IMO II 18000-20000 DWT liquid chemical tanker before 2012.

### **4.2. Ship price analysis on ship investment**

#### **4.2.1 Qualitative analysis on the fluctuation of ship price**

The fluctuation of ship price mirrors the price level of global ship market, the study on the fluctuation of ship price can reveal the regulation of ships market, although ships market is influenced by many factors such as politics, military and weather, the absolute control of monopoly power between buyer and supplier hardly exists. With a relatively transparency and free competition, ship owner will compare with offers made by different brokers when they make decisions to purchase ships. As long as the technical requirements are satisfied, they will choose the ship offering the suitable price. The price of a ship is the consequence of free bidding among numerous sellers.

The prices of ships are the same with the prices of other tangible goods and intangible goods. Despite it is continuously varied by the prosperity and stagnation of the international market and with supply and demand relation of vessels market, it is always volatile according to the central uplift. In a certain period of time, the price of international ships are probably higher or lower (even far higher or lower) than the

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actual price of the vessel itself, nevertheless, in a long time, it still is a manifestation of the ship's value and is always keep a tendency of regressing to the central uplift.

#### 4.2.2 Time series analysis on ship price

The original data comes from the price of 18000 – 20000DWT IMOII liquid chemical tanker in Drewry report , the region of the sample is from the first quarter of the year 2002 to 2010, and there are 33 observations altogether.

By using Eviews software to analyze the time series data of ship price from first quarter of the year 2002 to the same period of 2010, The data of analysis are shows in following figure :

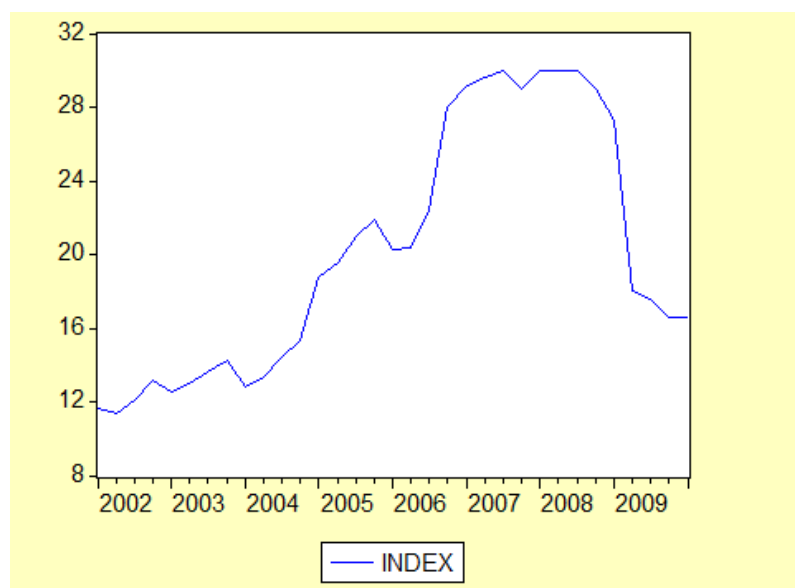


Figure 4.1 broken line graph of time series analysis on ship price

Meanwhile, Eviews also give us autocorrelation and partial correlation of data (figure 4.2). From figure 4.2, we can find autocorrelation index of the time sequence of the ship price does not approach to zero rapidly. It means the sequence is not pure random and non-stationary

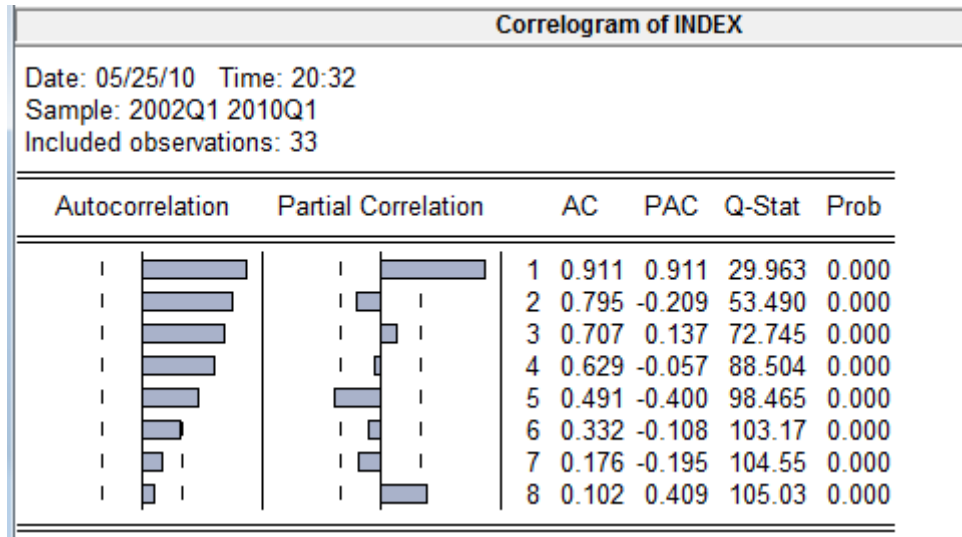


Figure 4.2 Correlogram of time series data

After making a first difference to the time series of the ship price, the autocorrelation index and the partial autocorrelation index shows in the following figure 4.3 .When the lag order is greater than 2, the autocorrelation index of the sequence approach to zero rapidly, namely, fall into the random region. It can be known that the time series is smooth, and does not have the tendency of season.

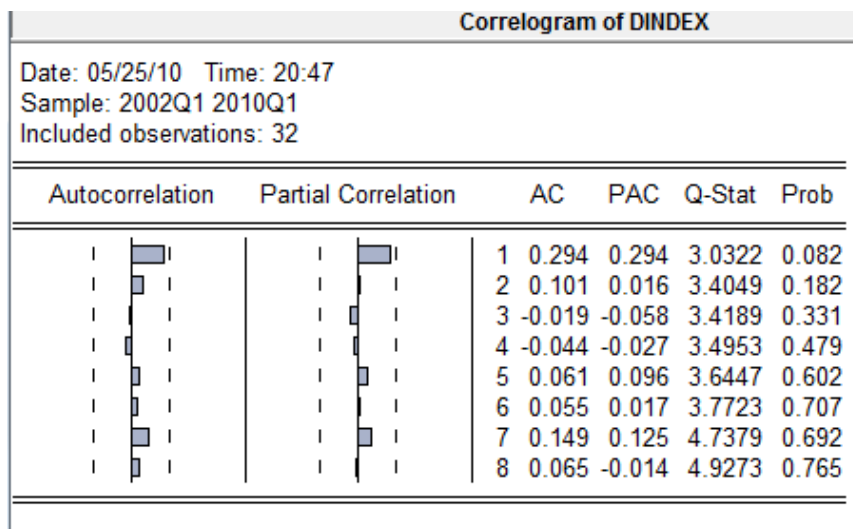


Figure 4.3 Correlogram after first difference of the time series

Meanwhile , when making a unit root test to the first difference time series of ship price ,the result also shows its smooth.(see table4.1). In the table, the index of statistical traits is -2.850381, smaller than the critical value of the 1% significance level, so we can refuse the original presumption, namely, the series is smooth.

Table 4.1 Augmented Dickey-Fuller Test on time series of ship price

Augmented Dickey-Fuller Unit Root Test on DINDEX		
Null Hypothesis: DINDEX has a unit root		
Exogenous: None		
Lag Length: 1 (Fixed)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.850381	0.0059
Test critical values: 1% level	-2.644302	
5% level	-1.952473	
10% level	-1.610211	

### 4.3 Forecast the ship price before 2012

It can be obviously concluded from the autocorrelation index and the partial autocorrelation index which comes from the first difference of the time series of the ship price (figure 4.3): in the part of the partial autocorrelation index, after the first, second and the third log the autocorrelation index 1 are not equal to zero apparently, but after  $k=1$ , the index approach to zero rapidly, so we choose  $p=1$ ; when  $k=1$  and  $k=2$ , the autocorrelation index is not equal to zero apparently. So we choose  $q=1$  and  $q=2$ . Make a comprehensive consideration, the proper  $(p, q)$  index will be  $(1, 1)$ 、 $(1, 2)$ . We can know from the table 4.1 that the ARMA(1, 1) got a better effect. So we can set up a ARMA(1, 1) to the time sequence of the vessel price. And the result follows:

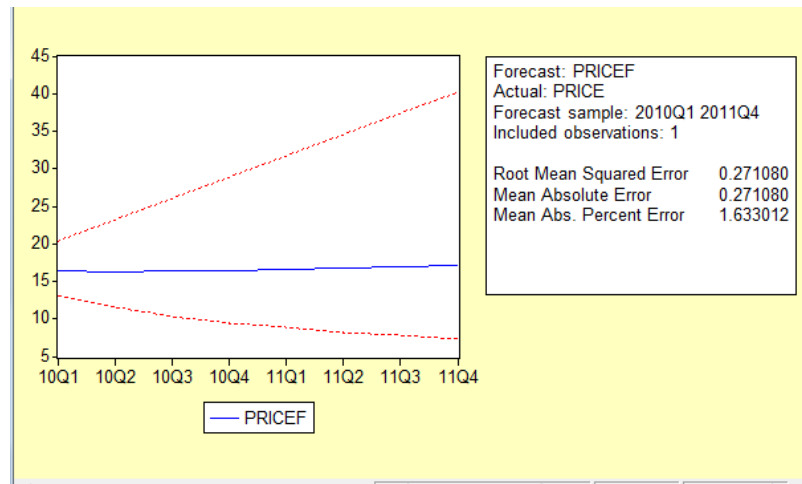
$$Y_t = 0.01 + 0.5262(Y_{t-1} - 0.01) - 0.2883U_{t-1}$$

Table 4.2 The result of the mode test:

$(p, q)$	Adjust R-square	AIC	SC
$(1, 1)$	0.02	4.543688	4.682461
$(1, 2)$	0.01	4.595199	4.780230

The forecast results are showed in the following figure: by the end of 2011, the vessel prices will maintain in a relative stable ranges and keep a tiny growth trend.





Year	2010Q2	2010Q3	2010Q4	2011Q1	2011Q2	2011Q3	2011Q4
US\$million	20.27	20.33	20.44	20.59	20.76	20.93	21.12

Figure 4.4 the results forecasted by the ARMA mode

## Summary

Although the predict index does exist a disparity to the absolute value of the fact price. But these is only a tiny gap. It can be predicted that before 2012, the second-hand ship price will still present a rising tendency .and by the end of 2011; it will be reached 21.12million. The result of forecast also imply that if Sinochem decide to invest a second-hand ship, they should take into action as soon as possible.

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## **Chapter 5 Economic and risk analysis on ship investment of Sinochem**

### **5.1 Introduction**

After the investment project has been decided, last thing should do is to test economic and risk of this project. Normally, some finance tools will be applied such as NPV, IRR, Pay-Back Period, NPVR, in this chapter, according to the actual condition of liquid chemical tanker, we try to analyzed the economic and risk of investment decision which made by Sinochem

### **5.2 Economic analysis on ship investment of Sinochem**

Generally the NPV (net present value) and IRR (Internal rate of return) method are often used to analyzed the economic return of a investment project, NPV method is a standard method for using the time value of money to appraise long-term projects. The IRR on an investment is the annualized effective compounded return rate that can be earned on the invested capital. But in this paper, the Payback period and NPVR are also be taken into account. Payback period in capital budgeting refers to the period of time required for the return on an investment to "repay" the sum of the original investment. NPVR (net present value rate) leverages NPV to reduce the cash flow constraints associated with community-owned energy projects.

Before these tools are utilized, some followed factor should be calculated

1. Time of the voyage

$$T_v = T_s + T_p$$

Based on the discussed on the chapter 2 , time of ship sailing  $T_s = 17.3$  days.

The loading and discharging time of the vessel depend on the efficiency loading and discharging equipment on the port. Since we choose the 18000-20000DWT liquid chemical tanker, which is bigger than the current tankers which own by the Sinochem so we supposed the  $T_p = 4.875$ days

$$T_v = T_s + T_p = 17.3 + 4.875 = 22.175 \text{ days}$$

## 2. Calculation on Operational Expense of the voyage

### (1) Cost of fuels

$$C_f = 16 * 17.3 * 16 * C_1 + 16 * 4.875 * 3 * C_M + 16 * 4.875 * 0.5 * C_1$$

Thereinto:  $C_1$  is price of heavy oil;  $C_M$  is price of paint oil. According to Marine Standards publicized by Clarkson for chemical type vessel of 18000-20000DWT, during the voyage, it consumes 16 tons MDO each day and during the anchorage in harbor it consumes 0.5 tons IFO and 3 tons MDO each day

The research period of this analysis is 20 years, on the ground of Drewry's report, average prices of heavy oil and plaint oil predicted are \$640/t and \$1038/t, the data are weighted results in the process of calculation.

### (2) Lube oil Charges $C_R = C_f * 8\%$

### (3) Expense of the voyage: $C_s = C_f + C_R = 3102284 + 248182.72 = 3350466.72$ dollars

## 3. Fixed expense

(1) The vessel price used in this passage is the liquid chemical tanker of an age within ten years. With all the price analysis above, the average value predicted is 20.63million dollars

### (2) Salaries &Benefits for crew

In the calculation related to this passage, it is from the actual salaries of crew, that it

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\$1400 in a single vessel per day and the whole year  $C_{crew} = 1400 * 365 = 511000$  dollars

(3) Annual allowances for repairs and maintenance:  $C_r = P_s * 5\%$  (\$10000) , 5% of the vessel price

(4) Annual insurance premium:  $C_b = P_s * 1\%$  (\$10000) , 1% of the vessel price

#### 4 . Port operating cost

Shore and terminal operating cost includes port agency fee, pilot fee. shore and terminal operating cost in this passage is

$$C_p = \$500,000/\text{year}$$

#### 6. Freight revenue

Freight revenue  $R_s$  is a main factor to affect revenue from ship invested, in this passage we suggest that vessels purchased and built are for chemical Voyage charter. Based on average freight rate  $R_{rate}$  in Drewry's predicting report which is \$50/ton, and transport volume on the ground of predicted differential value of 2012 which is  $T_{volume} = 291988.8294$  tons, the annual freight revenue is  $R_s = \$14029478.4$ , 2.5% of which is commission( $C_{com}$ ) .the formula of calculate is as follows:

$$R_s = T_{volume} * R_{rate}$$

$$C_{com} = R_s * 2.5\%$$

7. Set the shipping enterprise's benchmark yield  $r=10\%$ , time of vessel in operation as  $n=10$  years, residual value is 0, we can deduct that the formula of the net present value is:

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$$NPV = \sum_{t=1}^n \frac{C_t}{(1+r)^t} - P_s$$

$C_t$ -----the cash flow of year t = ( $R_s - C_p - C_b - C_r - C_s - C_{com}$ )

When we calculate the IRR ,use an unknown rate of return(irr) to replace r ,then get the formula :

$$NPV = \sum_{t=1}^n \frac{C_t}{(1+irr)^t} - P_s = 0$$

$$\text{Payback period} = P_s / C_t$$

$$NPVR = NPV / P_s$$

After calculation it resulted into :

NPV=32429487.71 dollars

IRR=40%

Pay-back period=2.4 years

NPVR=157.20%

### **5.3 Risk analysis on ship investment**

#### **5.3.1 Sensitivity analysis on traffic volume**

In the optimization option of the investment events, we have supposed that the running parameters are fixed, but as a matter of fact, it is truly changeable. The thesis choose two factors: the traffic volume and the price of bunker, in order to make an sensitivity analysis on the ship investment. When the analysis is making, we just change only one factor, and another fixed.

The change of the ship traffic volume will directly affect the net benefit of ship investment, we choose 5 conditions of the change of traffic volume

Table 5.1 analysis on sensitivity of the traffic volume

Change of traffic volume	NPV/dollars	IRR	Payback period/ years	NPVR
Up 20%	49922399.28	55%	1.8	241.99%
Up 10%	41175943.49	48%	2.1	199.59%
0	32429487.71	40%	2.4	157.20%
Down 10%	23683031.93	33%	2.9	114.80%
Down 20%	14936576.15	25%	3.6	72.40%
Down 30%	6190120.37	17%	4.7	30.01%
<b>Down 40%</b>	<b>-2556335.41</b>	<b>7%</b>	<b>7.0</b>	<b>-12.39%</b>

It can be concluded in table 5.1 that with the decreasing of the traffic volume of the ship , the return of investment for the Sinochem dropped apparently. When the traffic volume decreased by 40%, NPV just shows a negative value, the IRR is lower than the benchmark yield of shipping company, it is impossible to gain the profit. Therefore, the investment is not applicable.

### 5.3.2 Sensitivity analysis on bunker prices

The bunker of the vessel is one of the most sensitive factors from beginning to the end. With the decreasing of the bunker prices, the profits of the project investment are decreasing. However, in this case when the oil prices increased by 40%, the IRR of investment is still higher than the benchmark yield.

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Table 5.2 analysis on sensitivity of the bunker price

Change of bunker price	NPV	IRR	Payback period/ years	NPVR
Up 40%	24194620.67	33%	2.8	117.28%
Up 30%	26253337.43	35%	2.7	127.26%
Up 20%	28312054.19	37%	2.6	137.24%
Up 10%	30370770.95	39%	2.5	147.22%
0	32429487.71	40%	2.4	157.20%
Down 10%	34488204.47	42%	2.3	167.18%
Down 20%	36546921.23	44%	2.2	177.15%

### Summary

In hypothetical situations, find out the optimal solution for Sinochem to invest on liquid chemical tanker: if Sinochem choose to invest on liquid chemical tanker of 18000-20000DWT IMO II, the 32429487.71 dollars of NPV can be gained. Through sensitivity analysis, investing project get a good risk resistance capacity. Only if the traffic volume decreased by 40%, the investment project would be refused. So It is founded that Sinochem will strengthen fleet structure and gain a handsome revenue by this investment decision.

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## **Chapter 6 Conclusion**

This paper tries to find a better ship investment decision on Middle East route of Sinochem. The main body of the paper consists of four parts. In the first part, the necessity of ship investment has been discussed. According to combing the development trend of traffic volume and current transportation capacity on Middle East route of Sinochem, it is obviously to find there is a disparity between two sides. It stands that Sinochem should make ship investment so as to meet the customer needs. The second and third parts are study about the details of ship investment project. In these two parts, the ship investment style and type of invested ship have been determined through the actual condition of Sinochem and its customers. Meanwhile, the ship investment opportunity also be analyzed through the ARMA model. We find Sinochem had better to invest on IMO II 18000-20000DWT liquid chemical tanker as soon as possible before 2012. In the final part, the high risk resistance capacity has been proved by the some financial and accounting tools.



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