The University of Hull

SHIPPING COST SYSTEMS AND STRUCTURE IN THE KINGDOM OF SAUDI ARABIA: AN ANALYTICAL STUDY

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by
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To my Mother and my Children

Ohoud, Khalid and Duaa.

Abstract

This thesis is concerned with the analysis of shipping cost in theory and in the practice of Saudi shipping companies. Previous studies on cost structures and cost functions have been surveyed. Factors which affect each cost element have been derived from the surveyed studies to be used in establishing the cost functions of Saudi vessels.

The empirical part of the thesis covers many related topics. First, costing systems and cost reports in Saudi shipping companies have been evaluated. Second, cross sectional cost and operation data of vessel samples in Saudi Arabia have been analysed. The results of this analysis are cost structures and cost functions.

Several statistical techniques have been used for the analyses of cost data in the empirical part of the thesis.

On the basis of this investigation, the researcher has arrived at several propositions. The most important contribution of the thesis is that it presents to the management of Saudi shipping companies relevant information to establish policies for cost reduction.

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I hope that this study will be of use, and leads to further improvements within Saudi shipping companies.

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LIST OF ABBREVIATIONS

DEPR	Depreciation
DWT	Deadweight
GDP	Gross Domestic Product
GRT	Gross Registered Tonnage
INSR	Insurance
MAINT	Maintenance
MISC	Miscellaneous
OAPEC	Organisation of Arab Petroleum Exporting Countries
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of Petroleum Exporting Countries
SAMA	Saudi Arabian Monetary Agency
SAS	Statistical Analysis System
SLTTC	Saudi Livestock Transport and Trading Company
SNSC	Saudi National Shipping Corporation
UASC	United Arab Shipping Company
ULCC	Ultra Large Crude Carriers
VLCC	Very Large Crude Carriers

Chapter One

Introduction

1.1 Background

Cost information is considered one of the most important types of information needed by the top management of any industrial or service firm for performing its tasks of planning, control and decision-making. Such information is usually produced in these firms by the accounting system which usually contains a cost system.

There are several types of cost information, each produced for a designated purpose or field of use. The analysis of information and data varies accordingly. Perhaps the most important and complicated type of analysis is the analysis of cost as a function of the variables that affect it. That is, identifying the independent variables which affect the variable which is the cost element. We call this the "cost function." Identifying cost functions can benefit management in many ways.

1. Cost functions can be used to assess the value of each of the cost elements, which is a planning method needed by the management for setting estimated budgets for the future period.

2. Cost functions are used for identifying which variables are more effective than others at the level of each cost element. This is a control method which is useful for the top management to control cost levels and achieve profit targets.

3. Cost functions are used in the field of decision-making, such as pricing, operational and investment decisions, to which cost information provided by cost function is the most important input.

Generally speaking it can be said that without cost information the level of risk and chance of failure to realise profitability targets increase notably. Therefore, it is very important to look for accurate methods of producing cost information.

1.2 Statement of Problem

This study deals with the cost functions in the Saudi shipping companies. The researcher has chosen this subject for the following reasons:

1. There have been very few studies in the field of costs by Saudi researchers, despite the great importance of this specialisation, as indicated above.

2. There have been virtually no accounting studies, including cost studies, for the shipping companies in Saudi Arabia.

3. The activities of the shipping companies are generally distinguishable from the activities of other industrial facilities through many aspects which have effects on the costs, and consequently on the problem of control over the cost elements. Shipping companies carry out their activities by means of mobile units, "Vessels", in geographically wide-scale marine environments, "Marine Lines", and they serve customers in world-wide regions, "Ports". This is totally different from the activities of industrial companies, which are settled in certain areas with their fixed assets and where customers come to them. The significant problem of the shipping companies is checking and controlling costs because rates (prices) are almost fixed, as freight rates are

decided by marine conferences for each regular marine line, or by supply and demand in the market place, in the case of tramp vessels. Hence, the ability of the shipping company to affect the freight rates is almost nil. Hence, there is no way, except by reducing costs and increasing operational efficiency of vessels, to achieve acceptable profitability rates in this industry.

The researcher here has chosen the problem of analysing the cost structure in shipping companies in Saudi Arabia as a specified problem upon which this study will concentrate in order to realise the understated research objectives.

1.3 Research Objectives

1. Identifying the relative structure of cost in the shipping companies in general.
2. Identifying the independent variables which affect each of the cost elements in the shipping companies in general.
3. Identifying the relative structure of cost of Saudi vessels.
4. Measuring cost functions of samples of Saudi vessels.

In general, these objectives together serve a bigger objective, namely, providing an adequate information base for the top management of the Saudi shipping companies to help them to carry out their functions, especially in the fields of checking and controlling cost elements.

1.4 Research Methodology

The researcher has adopted more than one research method to achieve the research objectives indicated in the previous section, as follows:

A. To achieve the first and second objectives, the researcher has undertaken a library search of accounting literature in the field of shipping costs and of previous empirical studies in this field. The results of such works have been summarised, linked and related to the study objectives. From this literature survey, it was possible to identify the constituents of the cost structure in shipping companies in general, as well as identifying the independent variables which affect each one of the cost elements, to provide a basis for measurement of the cost functions of Saudi shipping companies.

B. To achieve the third objective of identifying the relative structure of costs in Saudi shipping companies, the researcher adopted a descriptive analytical methodology which necessitated designing and distributing a questionnaire to collect cost data for three samples of Saudi vessels: oil tankers, cargo ships and passenger ships. These costs were analysed and sub-divided into the main categories of marine costs, that is: capital costs, operational costs and voyage costs. They were then reclassified into two categories, that is, fixed costs and variable costs.

C. To realise the fourth objective, namely measuring the cost functions, the researcher adopted a statistical analytical methodology based on linear and

non-linear regression analysis, to achieve the best statistical function for each of the cost elements.

In addition to the above, the researcher, prior to making the cost analysis, has described and evaluated the cost systems in the sample shipping companies from which the cost data were obtained. For this purpose, a special questionnaire was used to identify the cost system elements and another questionnaire was used to obtain an assessment of those systems by top management. For this purpose, advanced analytical tools (non-parametric statistical tests), such as the Kruskal-Wallis and Mann-Whitney tests were used to analyse the opinions and measure the significance of differences among them.

1.5 Survey Population

The empirical study is confined to Saudi Shipping companies, namely, those companies which own and/or operate marine vessels on the high seas. Hence, the study does not cover companies which operate as shipping agencies or provide other shipping services.

The total number of Saudi companies conforming to the aforesaid criterion is 36.

1.6 Study Sample

The questionnaires were distributed and interviews were conducted in a number of shipping companies which were chosen on the following basis:

1. They practise marine transportation activities through their own or hired vessels.

2. They practise marine transportation activities on the high seas.

3. Their activities include one or more of the following:

   A. Operating oil tankers.

   B. Operating passenger ships.

   C. Operating cargo ships.

These conditions, for study purposes, were applicable to twenty one (21) Saudi shipping companies which represent 58% of the survey population.

1.7 Organisation of the Study

The thesis is divided into ten chapters. The first chapter is an introductory chapter in which a statement of the problem is presented, the research objectives are outlined and the contents of the thesis are indicated. This chapter also describes the population and the sample of the empirical study and discusses the research methodology and techniques of investigation used in this study.

Chapter Two examines the development of Saudi shipping. It first reviews the development of world shipping, then gives a brief history of Saudi shipping. It also analyses the structure of foreign trade and sheds light on the regional and Islamic environment.

The third chapter presents a review of literature on shipping cost. The classification of shipping costs is examined and factors which are expected to affect the level of such costs, as well as the cost indicators in shipping companies, are reviewed.

The shipping cost structure cannot be understood without looking into the relevant literature. In Chapter Four a survey of previous studies on shipping cost structure is examined with reference to tankers, cargo and passenger vessels.

The discussion in Chapter Five is based on a survey of previous studies of factors affecting shipping costs, to investigate the importance and effectiveness of such factors in terms of impact on each cost element.

The empirical study is described and discussed in detail in Chapters Six to Nine. Chapter Six describes and analyses the cost accounting systems in shipping companies in Saudi Arabia.

The discussion in Chapter Seven is based on the information obtained during the field study. This chapter discusses the evaluation of cost reports by managers in the sampled shipping companies.

The eighth chapter examines the cost structure of Saudi vessels.

Chapter Nine derives, and examines the cost functions in Saudi shipping companies.

Finally, Chapter Ten presents a summary of the study, draws conclusions, and makes recommendations accordingly.

Chapter Two

Development of Saudi Shipping

2.1 Introduction

The Kingdom of Saudi Arabia comprises the bulk of what is commonly known as the Arabian peninsula. It is bounded on the north by Jordan, Iraq, and Kuwait; on the south by Oman, North and South Yemen; on the west by the Red Sea and the Gulf of Aqaba; and on the east by Qatar, the United Arab Emirates and the Arabian Gulf.

Perhaps the most significant feature of the land is its geopolitical importance. Saudi Arabia dominates the Arabian Peninsula, the land mass being between Asia and Africa. Most of the oil fuelling the industrial economies of Europe, Japan and the USA is transported in the water surrounding this peninsula. If in pumping the life-blood of the industrial economies Saudi Arabia is characterised as the heart, then these sea routes, the Suez Canal, the Bab Al Mandab Straits, and the Strait of Hormuz are the arteries which bring oil to the western world.

In addition, Saudi Arabia plays a strategic role in the world of energy. It has shown a considerable degree of moderation in the role of manipulating the world wide influence which oil wealth has brought to the country. The main policy on oil resources has been to utilise them in a manner which will promote the economic development of the nation without disrupting the global economy.

The area of Saudi Arabia is 2,240,000 square kilometres or about 927,000 square miles, which amounts to the combined area of France, Italy, Spain, West

Germany and Norway (Ministry of Communication, 1986:6). It is almost half the size of India yet it was home to a population of only about 14.43 million people in 1989, while India has a population approaching one thousand million. There are many reasons why such a vast land contains such a small population, the main reason being the nature of the land itself.

After 25 years of tribal conquest and diplomatic efforts, Saudi Arabia was brought together into a form of statehood in 1932. It was an under-developed nation with a pastoral-based economy. During the war, even this pastoral-based economy was totally destroyed.

Since the exploitation of oil which brought an infiltration of western socio-economic values into the social fabric of the country, Saudi rulers have been able to continue developing in an Islamic way while at the same time benefiting from these civilisations in the same manner as in the early eras of Islam. However, whereas social values for some time have remained relatively stable, education and wealth are changing the living patterns of many Saudis.

The economic system of Saudi Arabia is based on the principles of free and open economy where a substantial part of the production of goods and services is left to individuals and groups enjoying freedom in their dealings and transactions. While the government of Saudi Arabia will uphold the market system and encourage the private sector to play a fundamental role in the accelerated growth and

development of the country, it will take all necessary measures to make the market system conform to the larger social interest of the country.

Throughout the second half of the 1950's and following the war of 1967 (Arab-Israeli war), Saudi Arabia faced a foreign-exchange crisis endangering the nation's stability and survival. In 1970 however, long term economic development planning was introduced in Saudi with the launch of the first five-year economic development plan.

Since Saudi has a single commodity, and very limited arable land, Saudi economists had no option but to base their development strategy on industrialisation, and diversification of the economy to reduce the country's dependence on a single depletable asset, oil.

Nevertheless, the problems were considerable because of the lack of manpower, inadequate administrative capacity, and the inability of physical infrastructure to absorb the increased expenditure. The first five-year economic plan concentrated on these factors, and on laying down a firm infrastructural foundation for future development, aimed mainly at import substitution. In order to overcome the serious shortage of trained manpower, the Saudi Arabian government promoted the establishment of foreign joint venture companies.

The second development plan was introduced at a time of high inflation, which forced the government to freeze budgetary appropriations for 1976/77 at the

1975/76 level of SR 110.9 billion. With the waiting time at Saudi ports reduced to nil, and with most of the physical bottlenecks which prevailed during the early years of the second plan reduced, major objectives of that plan relating to the movement of goods were met.

Although the third five-year economic plan was launched in 1980, and placed special emphasis on the development of Saudi manpower in order to curtail the amount of expatriate labour employed, there were more than 2,721,000 foreign workers in 1985, representing 62.7 percent of the total labour force. (Gulf Co-operation Council, 1988:168)

Saudi Arabian GDP in 1987 was $73465 million, or about $5091 GDP per capita, whilst GDP in 1973 was $11400 million, or about $1425 GDP per capita, product per capita in 1973 based on a population estimate of 8 million.

Many nations depend heavily on their national marine fleet to secure international trade in times both of peace and war. In essence marine transportation is a basic element of a nation's economy and plays an important role at sea. The rapid growth of Saudi economy and the ensuing expansion of trade volume has focused attention on the importance of the transportation sector in general, and maritime transportation in particular, which thus became even more critical.

Since Saudi is surrounded by sea on two sides and its coastline both east and west extends approximately 2,410 kilometres, or about 1,500 miles, 90 percent of the

Kingdom's total imports and more than 95 percent of the exports pass through the sea port. There was therefore no choice but to rely on sea transport for foreign trade.

Over the years, in line with Saudi development into a major trading nation, this dependence has deepened steadily, especially as the crude oil needed by industry must be imported and since the export of finished goods is the vital lifeline on which the Saudi economy relies.

This chapter reviews first the development of world shipping. It then gives a brief history of Saudi shipping. It also analyses the structure of foreign trade and the regional and Islamic environment.

2.2 The International Scene

When ships were powered by wind and sail, operators were not able to provide services to fixed time schedules. It was only with the invention of steamships that could be operated irrespective of weather conditions, that services could be run in accordance with pre-arranged timetables. Liner shipping, by its definition, is a formal ship operation on a fixed route between two ports or two series of ports, following the itinerary indicated in the published sailing list. The essential elements of the conference system emerged when steam took over from sail and introduced a reasonable predictability in sailing date and voyage times. (Chizanowski, 1989:25)

The characteristics of liner shipping were established around 1850-1870 while the total world fleet expanded over 300 percent in the period up to 1900, in order to meet the increased demand for sea-borne transportation resulting from the development of mass production in the western countries. (Drewry, 1986:1).

Important technical developments improved cargo ships' efficiency, but not their basic character. In the one hundred years between 1850 and 1950 all dry cargo vessels were built to broadly similar design.

2.2.1 Development of World Merchant Fleet

In 1960, the world merchant fleet was 129.8 million gross registered tons. (OECD, 1984:170). Despite the surplus of US built liberty and victory ships, there was a tremendous trend for expansion to replace the losses occasioned by the second world war. By 1980, the total was 419.9 million gross registered tons, and despite the world economic recession, world tonnage continued to grow. However, 1983 witnessed the first drop in tonnage since the mid 1960's.

As shown in Table 2.1, in 1992 the ownership of the world merchant fleet remained dominated by the traditional maritime countries which possessed one third of the world's shipping tonnage. This percentage is decreasing; it was 65.1 percent in 1970. However, an interesting phenomenon may be observed; at the same time, the tonnage of open-registry countries is on the increase. It was 18.8 in 1970 and 34 percent in 1992.

In reality the open registry fleets largely belong to shipping interests of the developed countries. In other words, the control of world tonnage by the traditional maritime countries is still a fact, amounting to 66.4 percent, despite an apparent shift of tonnage to other flags.

Between 1985 and 1992 the total fleet of developing countries increased by 22.9 million gross registered tons and stood at 94.6 million in 1992, representing 21.3 percent of the world fleet, compared with 6.7 percent in 1970. (United Nation, 1986:6). This increase can be partially attributed to the classification of Yugoslavia as a developing country in 1986 with 2.9 million gross registered tons. (OECD, 1988:133).

Moreover, the disparity between developing country cargo generation and fleet ownership is significant. In fact, in 1992 developing countries were the origin of 50.3 percent of all goods in sea-borne trade, but owned only 21.3 percent of the world gross registered tons. Conversely, developed market-economy countries loaded 43.4 percent of the world sea-borne trade and, either directly or indirectly through open registry fleet, controlled 66.4 percent of the world gross registered tons. The share of the countries of Eastern European and Socialist Asia in world international trade was slightly less than their share of the world's deadweight tonnage, amounting to 4.2 percent and 2.1 percent, respectively.

Table 2.1
World Merchant fleet
By groups of countries of registration, 1970,1985-1990 (Million GRT)

Flags of Registration by groups of countries	Gross Registered tons and Percentage Share								
	1970	1985	1986	1987	1988	1989	1990	1991	1992
1. World Total	217.9 (100)	410.3 (100)	399.0 (100)	397.7 (100)	397.1 (100)	404.2 (100)	417.6 (100)	435.3 (100)	444.9 (100)
2. Developed Market Economy Countries	141.8 (65.1)	176.7 (43.1)	156.0 (39.1)	140.5 (35.3)	134.9 (34.0)	134.5 (33.3)	141.5 (33.9)	145.1 (33.3)	142.3 (32.0)
3. Open registry countries	40.9 (18.8)	112.0 (27.3)	111.8 (28.0)	121.3 (30.5)	125.5 (31.6)	129.0 (31.9)	130.2 (31.2)	143.4 (33.0)	153.0 (34.4)
Total 2 & 3	182.0 (83.9)	288.7 (70.4)	267.8 (76.1)	261.8 (60.8)	260.4 (65.6)	263.5 (65.2)	271.7 (65.1)	288.5 (66.3)	295.3 (66.4)
4. Countries of Eastern Europe Including USSR	18.6 (8.5)	34.1 (8.3)	34.9 (8.7)	35.3 (8.9)	36.0 (9.1)	36.2 (9.0)	37.4 (9.0)	34.8 (8.0)	33.7 (7.6)
5. Socialist Countries of Asia	0.9 (0.4)	11.4 (2.8)	12.3 (3.1)	13.1 (3.3)	13.6 (3.4)	14.3 (3.5)	14.8 (3.5)	14.8 (3.4)	15.1 (3.4)
6. Developing Countries	14.5 (6.7)	71.7 (17.5	79.8 (20.0)	83.0 (20.9)	82.5 (20.8)	85.0 (21.0)	87.9 (21.0)	91.1 (20.9)	94.6 (21.3)
7. Other Unallocated	1.2 (0.5)	4.3 (1.0)	4.3 (1.1)	4.5 (1.1)	4.6 (1.1)	5.2 (1.3)	5.8 (1.4)	5.9 (1.4)	6.2 (1.4)

Source: United Nation, Review of Maritime Transport, 1985-1992

It is worth noting that there exists considerable disproportion among the developing countries as far as their fleets are concerned. Of the 13.7 percent of gross registered tons belonging to the group of developing nations, 86.3 percent are under control of a few Asian, European, and South-American countries. Africa is the poorest area in this respect, with only 5.1 percent of the tonnage belonging to developing countries within the continent. (United Nations, 1992).

Between 1983 and 1988 the world merchant fleet had sharply decreased. In 1988 the total deadweight of the world fleet was 628 million tons, representing a decline of 58 million deadweight. This decline was not matched in 1989. (OECD, 1989:159).

The group of socialist countries possess 3.4 percent of world shipping tonnage, their share having increased from 0.9 million gross registered tons in 1970 to 15.1 million gross registered tons in 1992. The growth is likely to continue with expansion of the Chinese fleet, as well as those of the other countries of this group.

In summing up this brief review of the structure of the world fleet by countries of registry, it should be emphasised that this structure has not essentially changed over the period under review and the ambitions of the developing countries to increase their tonnage face considerable difficulties.

2.2.2 Productivity of the World Fleet

During the decade of the 1980's the efficiency of the world fleet in terms of tons carried and ton-miles per deadweight followed a cyclical pattern. As can be seen in Table 2.2, from 1980 to 1983 both the annual tons of cargo carried per deadweight and ton-miles performed per deadweight decreased to a ten-year low of 4.70 and 18.34 respectively. In 1984, however, a turn around occurred and both productivity indicators continued to increase.

In 1992, the volume of cargo carried per deadweight increased marginally (by 0.13 percent) to 6.06 tons per deadweight, reflecting the difference in the rate of growth of world tonnage and international maritime trade. The figures for number of ton-miles performed per deadweight also increased from 25.44 ton-miles performed per deadweight in 1991 to 26.31 in 1992.

Between 1980 and 1983 the ratio of tons per deadweight diminished by nearly 13 percent for the total fleet, and the ratio of ton-miles per deadweight decreased by 25 percent. This fall can be attributed to the decreasing productivity of the tanker fleet. On average, in 1985 one ton deadweight of the tanker fleet was transporting less than two fifths of what it did five years previously.

Table 2.2

Cargo Tonnage Carried and Ton-Miles Performed per DWT of the Total Fleet, 1980 - 1990

Year	World fleet DWT (Millions)	Total cargo carried DWT (Millions)	Total Ton-Miles Performed (Thousand Millions)	Tons of Cargo Carried per DWT	Ton-Miles performed Per DWT (Thousands)
1980	682.8	3704	16777	5.42	24.47
1981	688.8	3555	15844	5.16	22.99
1982	693.5	3273	13699	4.72	20.46
1983	686	3230	12850	4.70	18.34
1984	674.5	3410	13368	5.06	19.82
1985	664.8	3382	13160	5.08	19.80
1986	639.1	3459	13856	5.41	21.68
1987	632.3	3505	14298	5.54	22.61
1988	628	3692	15299	5.88	24.36
1989	638	3891	16385	6.10	25.68
1990	658.4	4008	17121	6.09	26.00
1991	683.5	4050	17390	5.93	25.44
1992	694.7	4210	18280	6.06	26.31

Source: United Nations, Review of Maritime Transport, 1992, 29.

Although, with the increase in the world tanker fleet, the share of surplus tonnage in the tanker fleet decreased from 16.1 percent in 1989 to 15.4 percent in 1990, the tanker sector continued to have the largest excess tonnage, estimated at 41 million deadweight. At the same time, with the precautionary building-up of crude oil stocks in Very Large Crude Carriers (VLCC) and Ultra Large Crude Carriers

(ULCC) due to the Gulf crisis, the number of tankers engaged in oil storage increased by the end of 1990. (United Nations, 1990:27).

Finally, the overall balance between demand and supply in the world merchant fleet continued to improve slightly in 1992. Table 2.3 shows that in spite of a 0.7 increase in the surplus fleet over the previous year's figure equivalent to 71.7 million deadweight, its share in the world merchant fleet continued to diminish and stood at 10.1 percent. The 71.7 surplus in the world fleet reflects improved trading conditions and is well below the 1983 surplus peak of 195.8 million deadweight.

2.2.3 Development of International Sea-borne Trade

On the passenger routes of the world, airlines have won business from ships. However, in the international carriage of goods, shipping is still supreme. In terms of weight some 95 percent of the world's international trade moves by sea. This percentage clearly shows the significance of transport by sea.

Despite the occasional recession, world sea-borne trade is continuing its upward trend. In 1992 it was nearly 4 times the 1960 level. However the continuing stagnation of the world economy during the 1980's decade caused a fall in the volume of world trade from nearly 3.7 billion tons in 1980 to 3.2 billion tons in 1983, amounting to 13 percent of the total sea-borne trade. This was mainly due to a sharp decrease in oil shipments of nearly 410 million tons, which was not compensated for by dry cargo. (United Nations, 1990:2)

In 1990 tanker cargoes accounted for 44.4 percent of the total amount of international sea-borne trade. This share changed slightly from 1989, when tanker cargoes represented 43.8 percent. This increase should be attributed to the extraordinary growth of output in Saudi Arabia (from 5.6 million barrels per day in August to 8.35 million barrels per day in December 1990) after Iraq's invasion of Kuwait and a moderate but steady increase in output by African and Latin American OPEC member countries.

Table 2.4 indicates the distribution of world sea-borne trade by goods loaded/unloaded, broad commodity classifications and country groupings. The figures shown here give a good broad picture of the very unbalanced pattern of world trade.

The lack of symmetry arises because most groups are either large net exporters or large net importers, if trade is measured by weight. This means that the difference between outward utilisation and inward utilisation for much of the world shipping is very great, and that because of this pattern of trade a considerable amount of tonnage is sailing in ballast or with low utilisation factors.

Table 2.3
Tonnage oversupply in the World Merchant Fleet, 1983-1992

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
	Million DWT									
World Merchant Fleet (As at mid-year)	686.0	674.5	664.8	639.1	632.3	627.9	638.0	658.4	683.5	694.7
Surplus Tonnage	195.8	171.2	161.5	108.0	101.1	83.4	62.3	63.7	64.2	71.7
Active fleet	490.2	503.3	503.3	531.0	531.2	544.5	575.7	594.7	619.3	624.4
	Percentages									
Surplus Tonnage as a % of the World Merchant Fleet	28.5	25.4	24.3	16.9	16.0	13.3	9.8	9.7	9.4	10.1
Surplus Tonnage as a % of the Active World Merchant Fleet	39.9	34.0	32.1	20.3	19.0	15.3	10.8	10.7	10.4	11.3

Source: United Nations, Review of Maritime Transport, 1992,31

Taking developing countries first, this group in 1970 showed an imbalance as between cargoes loaded, amounting to two-thirds of the world sea-borne trade, and cargoes unloaded, amounting to 16.6 percent, which indicates that shipping was not able to obtain roughly equal cargoes in both directions. This disequilibrium appears to have held until 1992. Particularly alarming is the fact that the developing countries which generate one half of world trade (50.3 in 1992) possess merely 21.3 percent of the world shipping tonnage.

Whilst the effect would not be uniform among all developing countries, this would indicate that today, in order to provide the necessary shipping space for cargoes from developing countries, considerable tonnage is moving to developing countries with low utilisations.

This lack of balance arises from the fact that the exports of primary producing countries are bulkier and heavier than the exports of manufacturing countries, and the fact that many of the bulky raw materials come from areas where demand is low because of low populations, low incomes, or both.

Developed market-economy countries imported over twice as much as they have exported in 1970, amounting to 79.9 percent for goods unloaded and 31.1 percent of the goods loaded, compared with 67.6 percent and 43.4 percent respectively in 1992.

Table 2.4

World sea-borne trade in 1970, 1990, 1991 and 1992 (est.)
By type of cargo and country groups

Country Group	Year	Goods Loaded				Goods Unloaded			
		Oil		Dry Cargo	Total all Goods	Oil		Dry Cargo	Total all goods
		Crude	Product			Crude	Products		
		(Trade in millions of tons)							
World Total	1970	1 110	330	1 165	2 605	1 101	302	1 127	2 530
	1990	1 287	468	2 253	4 008	1 315	446	2 365	4126
	1991	1 333	457	2 330	4 120	1 355	441	2 449	4 245
	1992	1 390	460	2 360	4 210	1 410	445	2 480	4 335
		Percentage Share of each category of goods in total)							
World Total	1970	42.6	12.7	44.7	100.0	43.5	11.9	44.6	100.0
	1990	32.1	11.7	56.2	100.0	31.9	10.8	57.3	100.0
	1991	32.4	11.1	56.5	100.0	31.9	10.4	57.7	100.0
	1992	33.0	10.9	56.1	100.0	32.5	10.3	57.2	100.0
		(Percentage share of trade by groups of countries)							
Developed Market Economy Countries	1970	2.0	27.1	60.0	31.1	80.4	79.6	79.1	79.9
	1990	13.4	32.6	63.4	43.8	72.5	81.4	61.7	67.3
	1991	13.3	33.2	63.3	44.0	73.2	82.4	62.0	67.7
	1992	13.4	33.5	63.1	43.4	72.9	82.3	61.9	67.6
Countries of Central and Eastern Europe Including the former USSR	1970	3.4	8.0	6.9	5.6	1.2	1.0	3.8	2.3
	1990	4.6	11.8	3.8	5.0	2.6	0.3	5.8	4.1
	1991	4.0	10.3	3.6	4.5	2.2	0.2	5.5	3.9
	1992	3.6	9.8	3.5	4.2	2.0	0.2	5.3	3.7
Socialist Countries of Asia	1970	-	-	1.2	0.5	0.5	0.1	2.0	1.2
	1990	2.7	0.9	2.0	2.0	0.3	0.3	3.4	2.1
	1991	2.5	0.9	2.0	2.1	0.3	0.3	3.3	2.0
	1992	2.5	0.9	2.1	2.1	0.3	0.3	3.3	2.0
Developing Countries	1970	94.6	64.9	31.9	62.8	17.9	19.4	15.1	16.6
	1990	79.6	54.7	30.8	49.2	24.6	18.0	29.1	26.5
	1991	80.2	55.6	31.1	49.4	24.3	17.1	29.2	26.4
	1992	80.6	55.9	31.4	50.3	24.8	17.3	29.5	26.7
of which in: Africa	1970	25.5	2.4	9.1	15.2	1.7	4.7	3.6	2.9
	1990	24.1	7.6	4.3	11.2	5.6	2.3	4.3	4.5
	1991	23.8	7.5	4.2	11.0	5.5	2.1	4.2	4.4

Source: United Nations, Review of Maritime Transport, 1992,6.

In 1970 volumes loaded in Eastern Europe were over twice volumes discharged (at 5.6% and 2.3% respectively) though by 1992 this ratio decreased to 4.2 percent for goods loaded and 3.7 percent for goods unloaded. Conversely, for Socialist countries of Asia volumes unloaded were twice volumes loaded in 1970. This figure showed a reasonably good balance in 1992.

2.3 Historical Survey of Saudi Shipping

As Table 2.5 shows, between 1972 and 1990, the capacity of the Saudi merchant fleet measured in gross registered tons, grew at an annual rate of 33.5 percent. This trend was reversed from 1984 to 1988 due to the government's 1982 decision to withdraw concessionary bunker pricing. During the same period the gross tonnage of the world merchant fleet grew at an annual rate of only 2.95 percent. (OECD, 1992:169).

Thus, tonnage increased more rapidly and registered 1,018,713 gross tons in 1977, when it accounted for about 0.3 percent of the total world tonnage. In 1989 tonnage increased further and registered 2,734,657 gross tons, which represented about 0.7 percent of the world total tonnage. (Ministry of Communication, 1990:65).

In 1976 there was an accelerating annual growth trend which peaked at 226.6 percent in 1976. Meanwhile the second five-year economic plan was launched and placed special emphasis on the diversification of the economic base, through increasing agricultural and industrial production.

Table 2 . 5

Growth of the Saudi Merchant Fleet

Year	Number of Ships	Gross Registered Tons	Percentage Change
1972	35	50,369	10.7
1973	43	58,530	16.2
1974	43	61,275	4.7
1975	55	180,246	194.2
1976	86	588,745	226.6
1977	119	1,018,713	73.0
1978	154	1,246,112	22.3
1979	172	1,442,952	15.8
1980	214	1,589,668	10.2
1981	286	3,121,821	96.4
1982	347	4,301,789	37.8
1983	435	5,296,798	23.0
1984	422	3,853,272	-27.0
1985	398	3,137,178	-18.8
1986	380	2,978,016	-5.0
1987	349	2,692,044	-9.6
1988	320	2,269,398	-15.7
1989	312	2,734,657	20.5
1990	311	1,682,752	-38.5

Source:
Seatrade, Arab Shipping Guide, 1980,200
Ministry of Communication, Saudi Maritime Fleet, 1990,23
Lloyd's Register, 1990,16

In the mid to late 1970's there was an uneven growth pattern with an annual growth rate of approximately 220 percent alternating with a slower growth rate of 10 to 20 percent.

The expansion in 1979 and 1980 at 15.8 percent and 10.2 percent respectively was mainly due to a shift in government shipping policy to interfere in the evolution of the Kingdom's merchant marine. As a consequence of this favourable change, the establishment of the Saudi National Shipping Company was undertaken in conjunction with local owners in 1979, with a capital of 500 million Riyals. (Saudi Arabian government 25%; Saudi Arabian major public industry 35%; and the Saudi public 45%). Also during 1980 the government took an interest in the newly constituted Saudi Livestock Transport and Trading Company (SLTTC), capital $30 million, which was intended to secure up to 50 percent of the highly profitable Australia-Saudi Arabian sheep trade.

1981 recorded additional increase in tonnage at 96.4 percent as a result of the Kuwait reduction by 300,000 deadweight. It is, however, notable that this switch may be associated with the arrangement whereby Saudi flag ships were able to bunker at Saudi ports at very substantial discount on the fuel prices elsewhere, as well as the availability of capital for joint venture operation. (OECD, 1981:75)

Figure 2.1 graphically depicts the growth of the total capacity of the Saudi fleet between 1972 and 1990. From 50,369 gross tons in 1972 it sharply increased to 5,296,789 in 1983, mainly through the rapid expansion of the export/import trade.

In terms of number of ships, 35 ships in 1972 had increased to 311 ships in 1990, while the number of shipping companies was 144.

However, Saudi vessels only carried 7.7 percent equivalent to 5 million metric tons of the total sea-borne trade in 1988; nevertheless, this was a substantial improvement over 1987 when the proportion was only 6.6 percent, amounting to 4.2 million metric tons. This marginal increase of around 1.1 percent was still a very small share of foreign trade, while Libya carried 19 percent of total Saudi cargo and ranked the first, followed by Panama and Greece.

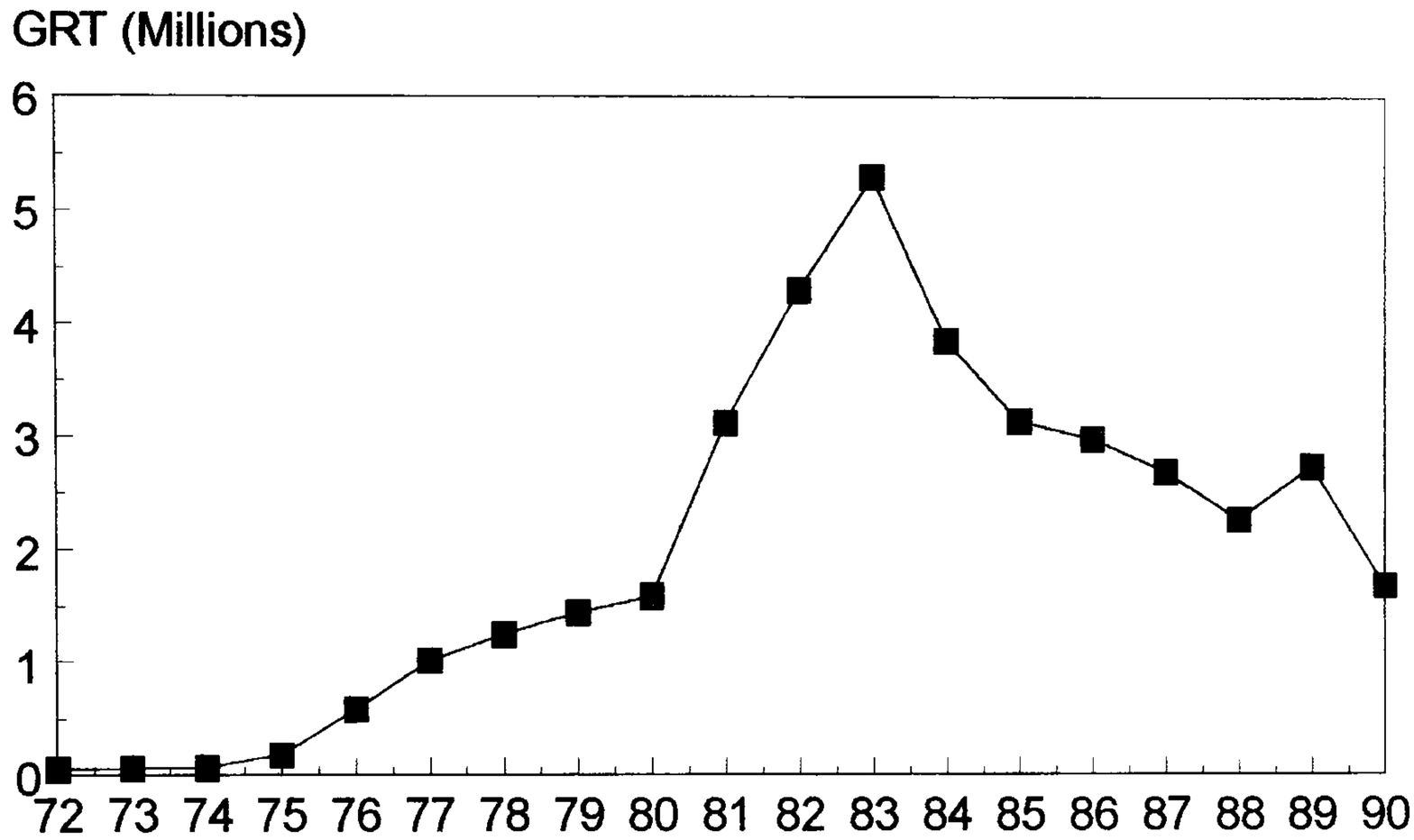
As revealed in Table 2.5, between 1984-1988 the total gross tonnage had sharply decreased as a result of the Saudi announcement at the beginning of 1983 that it was to terminate the concessional terms for the provision of bunkers from Saudi-flag ships, and the coming into full operation of the Ras-Tanura/Yanbu pipeline (92 million tons). Other factors were a tightening up of the Saudi registry and the effects of world economic recession.

In 1985 the gross registered tonnage of the Saudi fleet fell by 18.8 percent, to around 60 percent of its peak value at the end of 1983, amounting to a total loss of 29 vessels. Consistent with the trend seen over the previous year, 21 of these deletions to

the registry were general cargo vessels which traded deep sea and most of which were for demolition.

Figure 2.1

Growth of the Saudi Merchant Fleet



As noted in Table 2.6, in 1989 Saudi Arabia had 312 vessels and the total capacity of the Saudi flag fleet had settled to 2,734,657 GRT of which 2,673,726 or about 97.8 percent were for deep sea, (194 vessels), and 60,931 GRT were for short sea (118 vessels).

Saudi fleet by principal types in 1989 consisted of 57 percent oil tankers, 8 percent ore and dry bulk, 25 percent general cargo, and 10 percent miscellaneous.

Although in absolute volume terms more tonnage was added to the dry bulk and ore fleet, the general cargo sector recorded a higher rate of increase. In 1989 general cargo ships accounted for 25 percent equivalent to 521.3 thousand GRT of the total fleet, (OECD, 1989:161), compared with 12 percent in 1980. (OECD, 1980:132)

Table 2 . 6

Fleet Type Analysis

Ship Types	Number	G R T
Deep Sea		
Tanker	56	1,753,945.18
Ore/Oil	12	37,058.76
General Cargo	48	322,258.76
Bulk Carriers	7	101,630.90
Ro/Ro	11	137,232.94
Livestock	9	103,033.38
Reefer	5	32,664.20
Passenger Vessels	8	31,624.63
Container	3	65,662.00
Chemical Tanker	2	66,195.00
Fishing Vessels	25	12,873.06
Fire Tenders	8	9,548.38
Sub Total	**194**	**2,673,726.52**
Short Sea		
Coastal Ships	118	60,930.92
Total	**312**	**2,734,657.44**

Source: Saudi Maritime Fleet, 1990,21

Finally, in terms of ownership, in 1986 the Saudi government controlled 12.2 percent of the total tonnage, compared with 3.8 percent in 1980. There is a slight dichotomy in government policy in the shipping field. Hydrocarbon transport is left primarily to the private sector and joint venture. In dry cargo shipping, the Saudi

Arabian government established in 1979 a state shipping line, the Saudi National Shipping Corporation (SNSC). This signalled a withdrawal from its previous laissez-faire to a policy designed to gain a far greater share of its own maritime trade.

Although the Saudi government has a long-term objective of achieving 40 percent of its sea-borne trade, it has yet to introduce any rigorous cargo preference legislation.

Table 2 . 7

Ratio of Transport, storage, and Communication Sector to Gross Domestic Product (At Current Prices - Million Riyals)

Year	Transport, Storage and Communication Sector	G D P	Ratio (1 as % of 2)
1980	17,123	520,589	3.3
1981	19,871	524,719	3.8
1982	21,489	415,234	5.2
1983	23,668	372,023	6.3
1984	23,845	351,397	6.8
1985	23,719	313,941	7.6
1986	22,783	271,091	8.4
1987	22,087	275,494	8.0
1988	22,807	285,145	7.9
1989	23,121	310,823	7.4

Source: Saudi Arabian Monetary Agency, Annual Report, 1985,142.
Saudi Arabian Monetary Agency, Statistical Summary, 1990,132.

As indicated by Table 2.7, the Saudi transport, storage and communication sector has made a major contribution to Saudi Gross Domestic Product. In the early to late 1980's the transport sector accounted for between 3.3 and 8.4 percent of the Gross Domestic Product. These contributions rose from SR 17,123 million in 1980 to SR 23,845 in 1984.

The relative share of transport, storage, and communication in GDP rose steadily from 3.3 percent in 1980 to 8.4 percent in 1986. In 1981 the transport, storage and communication sector ranked fourth in the total contribution to GDP with 3.8 percent, compared with sixth in 1989, with 7.4 percent.

2.4 The Structure of Foreign Trade

As depicted in Table 2.8, import and export tonnage increased more rapidly in the 1980's. The total export/import tonnage was 28.1 million metric tons in 1980, and it increased two-fold to 62 million metric tons by 1990. So, between 1980 and 1990 the total export and imports had expanded at an average annual rate of 7.8 percent.

The data is more or less self-explanatory. It can be seen that imports and exports have generally moved in different directions, so imports increased from 26.9 to 41.1 million metric tonnes between 1980 and 1984, reflecting the dynamic processes of development which the economy was experiencing. In 1985 the imports turned around and recorded a sharp decrease, amounting to 17.4 metric tonnes.

As for exports, the picture is different. Exports registered a thirty-three fold increase in 1990 on the 1980 figure. This was due to the expansion in industrial commodities and the progressive growth of the agricultural sector in the Kingdom.

After the success of the third Five-year economic plan, Saudi exports made inroads into the Asian countries, particularly Japan, Singapore, India, South Korea, Taiwan, and ranked the first in 1989, representing 40 percent of the total exports. (Saudi Port Authority, 1989:22).

Table 2 . 8

Foreign Trade
(In Metric Weight Tonnes)

Years	Imports	Exports	Total	% Change
1980	26,853,521	1,282,374	28,135,895	-
1981	30,130,734	526,079	30,656,813	8.95
1982	36,417,915	1,738,630	38,156,545	24.5
1983	39,819,518	4,107,433	43,926,951	15.0
1984	41,443,945	8,735,214	50,179,159	14.2
1985	31,540,184	20,486,392	52,026,576	3.7
1986	27,102,575	27,857,868	54,960,443	5.6
1987	26,264,262	38,777,655	65,041,917	18.3
1988	21,468,486	46,683,957	68,152,443	4.8
1989	18,750,909	42,835,225	61,586,134	-9.6
1990	17,476,164	44,596,341	62,072,505	0.8

Source: Saudi Arabian Monetary Agency, Annual Report, 1980-1990.

In the mid to late 1980's there was an extreme decline in the pattern of imports, denoting a compounded annual fall of 7.4 percent. This fall in imports was

a natural adjustment to the completion of major infrastructure projects and rise in the prices of many foreign commodities due to higher exchange rates.

In 1985, there was an accelerating annual growth trend of exports which peaked at 134.5 percent. Meanwhile the Fourth Five-Year Economic Plan was launched and emphasised the promotion of operational efficiency of the existing ports, the improvement of safety of navigational aids and the completion of the wireless piloting network. It is noteworthy that, since government expenditure plays a dominant role in the level of activity in the Saudi economy, the Saudi government was affected by the fall in imports as a result of lower oil revenues and liner companies being subjected to low load factors and excessive competition, with the result that the United Arab Shipping Company (UASC), the largest company in the region, recorded severe losses for 1984, 1985, and 1986.

Between 1984 and 1989 there was an abrupt change in the commodity structure of Saudi foreign trade as petro-chemical exports filled the gap created by stagnating oil revenues. Saudi Arabia's growth as a major petro-chemical exporter caused concern and prompted protectionist measures in Europe.

As a result of the rapid development of the petroleum sector, exports constituted 72 percent of the total foreign trade in 1990, compared with 4.6 percent in 1980.

As Table 2.9 shows, between 1981 and 1986, oil exports had continued their downward trend for the fifth consecutive year, and amounted to $18 million reflecting a sharp drop of about $93.5 million. The factors which contributed to the fall in oil exports revenues were lower demand for oil, increased production by producers outside OPEC, and failure of some OPEC members to adhere to their agreed production quotas. The resulting glut in the market led to a precipitous fall in oil prices, particularly towards the end of 1985, when prices went down by nearly two-thirds from their level at the beginning of the year (from $28 a barrel to less than $10 a barrel).

Table 2 . 9

Oil Exports

($ Million)

Year	Crude	Refined	Total
1979	55,352	3,271	58,623
1980	96,325	5,096	101,421
1981	106,299	5,246	111,545
1982	68,610	4,653	73,263
1983	41,118	3,687	44,805
1984	32,503	3,764	36,267
1985	20,885	5,043	25,928
1986	14,652	3,408	18,060
1987	14,732	5,696	20,428
1988	14,701	5,505	20,206
1989	18,858	5,237	24,095

Source: Saudi Arabian Monetary Agency; Statistical Summary, 1990,93.

At its peak, between 1980 and 1981, the rise in oil export revenues can be attributed to the Kingdom's desire to offset, at least partly, the shortfall in international supplies resulting from the Arabian Gulf conflict (Iran-Iraq war).

Global economic recession and conservation measures adopted by most of the Western consumer nations effectively shifted demand for Saudi oil exports in 1982, causing a cutback in production to 2367 million barrels, or about a 34 percent decrease over 1981 (Saudi Arabian Monetary Agency, 1982:32).

Finally, a breakdown of oil exports by product indicates that exports of refined products accounted for 27.9 percent equivalent to $5.7 million of the total oil exports in 1987, compared with 4.7 percent in 1981, signifying the expansion and improvement of the refining sector in the Kingdom.

As revealed in Table 2.10, private sector imports financed through commercial banks increased by 5 percent from Rls 49.9 billion in 1988 to Rls 52.4 billion in 1989. However, they recorded a decline of 9 percent equivalent to Rls 52.5 billion in 1989, as compared with Rls 57.7 billion in 1984. The increase in import values during 1987 to 1989 could be attributable partly to the rise in the cost of imports resulting from appreciation in the exchange rate of some currencies and partly to the impact of inflation on some other partner countries.

Composition of imports financed through commercial banks during the period under review indicates that imports of foodstuffs declined by 3 percent to Rls 7.3

billion in 1989 and, with a share of 14 percent in total imports, occupied the third position, compared with the first position in 1986. The decline is indicative of the success in the Kingdom's policy of achieving self-sufficiency in food. Motor vehicle imports moved from the fourth in 1986 to the first position in 1989 due to a sharp increase of 70 percent since the decline which started in 1983. The rise in the value of motor vehicle imports was accounted for mainly by increases in their numbers. This was due partly to entry of new types of cars, increased sales promotion by car dealers and easier payment facilities. Rise in landed cost was also a contributory factor for increase in the value of motor vehicle imports. As a result, their share in total imports rose from 11 percent in 1986 to 16 percent in 1989.

Although in 1984 machinery and appliances accounted for 18 percent of the total imports and ranked in first position, the share of machinery and appliances had fallen to 15 percent of total imports (Rls 7.6 billion) by 1989. This decline was due to saturation of the Saudi market with this item. Whereas in 1984 construction materials accounted for 11 percent of the total imports, by 1989 the total share of construction materials had fallen to 8 percent of total imports (Rls 4.2 billion). The fall in this case resulted from the expansion in domestic production of building materials, a slowdown in construction activity following the completion of major infrastructure projects and over-supply of housing. Finally, it should be noted that textile and clothing maintained the same position which they had occupied in 1984.

Table 2 . 10

Private Sector Imports Financed through Commercial Banks
(Millions of Riyals)

	1984	% Share	1985	% Share	1986	% Share	1987	% Share	1988	% Share	1989	% Share
Foodstuffs	9,717	17	7,681	17	8,209	19	7,854	16	7,595.2	15.2	7,379.4	14
Textiles and Clothing	6,167	11	4,962	11	5,283	12	6,058	12	5,917.8	12	5,984.4	11
Construction Materials	6,173	11	4,887	11	4,314	10	3,872	9	4,149.3	8.3	4,196.4	8
Motor Vehicles	6,594	11	5,457	12	4,854	11	6,684	14	8,061.4	16.1	8,269.6	16
Machinery and Appliances	10,688	18	7,760	18	6,791	16	7,480	15	6,099.7	12.2	7,580	15
Other Goods	18,392	32	13,690	31	14,049	32	16,791	35	18,094.8	36.2	19,036.4	36
Total	57,731		44,437		43,500		48,739		49,918.2		52,445.9	

Source: Saudi Arabian Monetary Agency, Annual Report, 1988-1990.

North America and Western Europe are traditionally strong trading partners of Saudi, accounting for 74 percent of Saudi imports in 1978, worth Rls 51.4 billion and their importance as exporters continued to grow until the early 1980's (SAMA,1979:152)

However, the phenomenal increase in trade with other regions reduced these two countries' share to 53 percent in 1985 (total imports Rls 48.8 billion) and it maintained a downward trend afterwards. This was a result of the Saudi government's policy to diversify its import markets.

Japan and South Korea emerged as a major export market from 1980. Imports from that area rose by 22.7 percent in 1985 (SAMA, 1986:201), which accounted for a figure worth Rls 19.4 billion, compared with 12 percent in 1977, equivalent to Rls 6.6 billion (SAMA,1979,152).

As shown in Table 2.11, in terms of import origin, the United States (Rls 14.4 billion) replaced Japan in 1989 as the first trading partner of Saudi Arabia, accounting for about one fifth of the Kingdom's total imports. This increase followed a five-year period of a downward trend starting in 1983.

However, imports from West Germany declined from 9 percent in 1985 to 6 percent in 1989, whereas imports from UK (Rls 8.0 billion), which increased in 1989 by 35 percent, registered the highest growth rate among the major industrial countries group.

Table 2 . 11

Saudi Imports by Origin

	1985	% Share	1986	% Share	1987	% Share	1988	% Share	1989	% Share
U.S.A.	13557	17	12353	18	11492	15	13255	16	14392	18
Japan	14502	19	11131	16	12996	17	13045	16	11288	14
W.Germany	6768	9	5747	8	5827	8	5897	7	4959	6
U.K.	4806	6	5151	7	5847	8	5945	7	8064	10
Italy	5783	7	5182	7	5145	7	5266	7	4531	6
France	3963	5	3990	6	3966	5	4259	5	3410	5
Six Country Sub Total	49379	63	43554	62	45273	60	47667	58	46644	59
Other 8 Industrial Countries	7160	9	6690	9	7270	10	8033	10	9524	12
Total 14 Industrial Countries	56539	72	50244	71	52543	70	55700	68	56168	71
Rest of the World	21672	28	20536	29	22770	30	25882	32	23051.4	29
Total Import (cif)	78211	100	70780	100	75313	100	81582	100	79219.4	100

Source: Saudi Arabian Monetary Agency, 1985-1989

In 1989 imports from Italy (Rls 4.5 billion) recorded a marginal fall of 1 percent, while France (Rls 3.4 billion) maintained the sixth position which it had held in 1988. These six major industrial countries together accounted for 59 percent (Rls 46.6 billion) of the Kingdom's total imports, against a share of 63 percent in 1985. It is worth noting that the share of these countries tended to decline over the years; this decline was picked up by the other 8 industrial countries and accounted for 12 percent of total imports in 1989. Consequently, the 14 industrial countries contributed 71 percent of the Kingdom's imports, while the rest of the world contributed the balance of 29 percent.

As shown in Table 2.11, imports from West Germany and Japan recorded the highest fall of 26 and 22 percent respectively. This fall was due to the appreciation in the exchange rate of their currencies.

2.5 The Regional and Islamic Environment

It was widely believed that following the 1973 oil crisis and the subsequent rise in crude oil prices, the major oil exporting countries of the world would invest some of their new oil wealth in the development of national shipping fleets. Consequently, the Arab Maritime Petroleum Transport Company (AMPTC) was formed in 1983 with the support of OAPEC. The Arab oil producing countries (Saudi Arabia, Kuwait, Bahrain, Iraq, U.A.E. Qatar, Algeria, Egypt, Libya) are shareholders and the headquarters are in Kuwait. The company has a working capital of $500 million. It owns 10 oil tankers with a total net tonnage of more than 2.5 million.

In 1974 the Pan-Arab shipping company was formed with the support of Arab League. The Pan-Arab shipping company involved 13 countries, including Saudi Arabia with 14 percent of the shares.

In the interim, direct involvement not only in the oil sector but also in dry cargo trades was seen. As a result of these efforts, the United Arab Shipping Company (UASC) was formed by Saudi Arabia and five otherGulf countries, namely; Kuwait, Iraq The United Arab Emirates, Qatar and Bahrain, to operate cargo vessels

mainly from and to Gulf ports. The initial capital involved was over $1700 million of which the Kingdom holds a 19.3 percent share. The fleet includes mixed cargo and container ships with a total tonnage of 1.2 million. (Ministry of Communication, 1986:32).

Finally, the Islamic Ship-owners Confederation was established in 1984. The confederation's basic mission is to consolidate and co-ordinate the efforts of maritime transport companies of Muslim countries to make maximum use of their commercial fleets, and to assure a fair share of international sea trade. The confederation can also create an integrated marine transport network linking Muslim countries to the rest of the world.

Table 2 . 12

Islamic Ship-owners Confederation Fleet

Country	G R T
Turkey	3,423,745
Saudi Arabia	2,978,016
Iran	2,911,359
Kuwait	2,580,924
Indonesia	2,085,635
Malaysia	1,743,629
Egypt	1,063,020
Iraq	1,016,343
Algeria	881,670
Libya	825,231
Rest of Countries	4,196,220
Total	23,705,792

Source: Ministry of Communication, Saudi Maritime Conference, 1990,69

As Table 2.12 shows, the capacity of the Islamic Ship-owners Confederation totalled 23,705,792 Gross Registered Tons in 1987, representing 5.9 percent of the total world tonnage. The Table reveals that the fleets were headed by Turkey (3.4 million), followed by Saudi Arabia (3 million), reflecting the importance of the Saudi fleet, and Iran (2.9 million).

The other important regional development is the "Arab ship building and repair yard at Bahrain". This is supported by OAPEC and the dock can handle vessels of up to 500,000 DWT.

2.6 Summary and Conclusion

The vast oil revenues of Saudi Arabia have not only made it easier for the country to develop infrastructure, service and basic industries, when compared with other developing countries, but have also made it necessary that development should take place in all aspects of social and economic life at an unprecedented pace to enable the country to benefit from revenues derived from depletable oil resources.

The development of marine transportation has taken place along several lines, all within the framework of the Kingdom's responsibilities as an active member of the global community.

Before 1975 the Saudi fleet amounted to 58,500 gross registered tons. However with government support the national fleet has expanded rapidly. It totalled

over 5 million gross registered tons in 1983. In detail, between 1972 and 1990 the capacity of the Saudi fleet grew at an annual average rate of 33,5 percent in gross registered tons. In contrast, the corresponding capacity of the world fleet grew annually at an average rate of only 2.95 percent.

Compared with other major marine countries, the Kingdom carries a low percentage of its cargo on national carriers, amounting to 6.6 percent in 1987. This percentage had increased marginally to 7.7 in 1988, while the United Kingdom carried nearly 5 percent of Saudi total cargo and ranked the fifth in 1988.

In 1984, gross registered tons sharply decreased at 27 percent equivalent to 1,433,517 tons. This decrease was due to the government's decision to withdraw concessionary bunkers to Saudi-flag vessels from Saudi terminals.

Despite an increase in the share of export in the total foreign trade, which accounted for 4 percent in 1980 and increased to 71 percent in 1989, imports have decreased, mainly due to the reduction in the imports of construction materials and other industrial commodities, because of the completion of many major projects, the expansion of the industrial production output in the country and the continued progress in the agriculture sector.

After 1980, the share of Saudi imports from North America and Western Europe declined while the proportion from Japan and South Korea rose

conspicuously. In 1977 Japan and South Korea were the source of only 12 percent of Saudi total imports. In 1985 their share of Saudi total imports was 22.7 percent.

Finally, in 1990 ownership of the merchant fleet remained concentrated in the developed market-economy and open-registry countries, with a combined tonnage amounting to 65.1 percent of the total registered tonnage of the world merchant fleet. The share of developing countries increased slightly to 21.2 percent, 69.5 percent of which was concentrated in 10 countries (including Saudi Arabia).

In addition, the participation of developing countries in the world merchant fleet continued to be considerably lower than their share of international sea-borne trade. Thus in 1992, developing countries generated 50.3 percent of world cargo moving in international sea-borne trade, but owned only 21.3 percent of the world fleet. On the other hand, developed market-economy countries, either directly or indirectly through open-registry fleet, owned 66.4 percent of world tonnage while generating 43.4 percent of world trade.

Internationally, Saudi Arabia exercises great responsibility as a major member of the Organisation of Petroleum Exporting Countries (OPEC). The industrial west relies heavily upon oil to maintain its economies and Saudi Arabia is crucial in regulating both the price and supply.

Chapter Three

Literature Review on Shipping Cost

3.1 Introduction

Cost information in shipping companies represents a major component of the management information system. There are various classifications of cost information in such companies, each one serving a particular purpose, but it can be said that all cost classifications will contribute to efficient operation of the company fleet. The purpose of this chapter is to identify the classification of shipping cost structure and the factors affecting shipping cost. It also describes the cost indicators in shipping companies.

3.2 The Classification of Shipping Costs

Looking at the total cost structure in shipping companies, one can identify many classifications which may be inter-related to serve a certain purpose or purposes. These classifications are as follows:

a. The Natural classification.

b. Classification by object of expenditure.

c. Product-related classification

d. Classification by volume of activity

3.2.1 Natural Classification

Natural cost classification is based on the types of goods and services consumed in a production operation. In shipping companies, the product is a service,

the transportation of goods over the ocean. (Cheng,1985:71). For shipping companies, primary operating costs may be classified according to a natural system that identifies the major input components required to operate a vessel fleet. As in any business firm, the shipping company needs inputs to produce the shipping services to customers, i.e. shippers. These inputs, or production factors, include materials, manpower and other expenses.

Materials in a shipping company are needed to operate the vessels. They are not manufacturing materials such as are used, for example, in engineering industries. The most important material used in shipping companies is fuel. This material can be in liquid form, i.e. oil, or in solid form, i.e. coal. Some vessels are designed to operate by an atomic engine, though this is not the practice in commercial shipping. There are also other materials which are necessary but less costly, such as water, spare parts and victualling.

The second input is labour. The operation of a vessel needs many specialisations. Labour may be categorised according to the various functions associated with the operation of a vessel at sea. Conventional classification of labour in shipping companies is grouped into three categories: Deck, Engine and Saloon personnel. The labour cost is composed of basic salaries, overtime compensation, social insurance and bonuses. Labour cost in shipping companies will be affected by many factors, as will be shown in the following chapter.

The third input, according to the natural classification, is a group of cost items which are not material or manpower, which can be called "other expenses". This

group is composed of vessel depreciation and many items of cost such as maintenance, cargo handling, insurance, repairs, port dues, general expenses etc. No doubt any analysis of cost structure of any firm must begin with the recognition of cost elements categorised according to the above classification.

3.2.2 Classification by Object of Expenditure

Whereas the natural classification system for operating costs considers expenditure on the basis of the goods or service involved, such as labour, the object of expenditure classification considers operating costs within the context of the function or process involved in an operation. (Downard, 1988:14). The most important activities in a shipping company are those related to the vessel itself, the voyage and the cargo or passengers (Sletmo and Williams, 1986:66). Each activity needs inputs to enable it to be carried out. The associated costs can be grouped according to each activity as follows:

1. Vessel operating expenses: This group of cost items comprises cost elements which are directly related to the vessel but are common to all voyages of the vessel during the cost period. (Chrzanowski,1989:69). These cost items are:

- maintenance and repair expenses for the hull, engines, generators and other fixed facilities of the vessel;
- surveys: to be carried out every four years;

- insurance and indemnity;
- staff;
- victualling, laundry, clothing, etc.;
- annual cost of vessel depreciation.

2. Voyage costs: These are cost items which are directly related to a particular voyage. Most of these items will be affected by distance, ports of call, waterways and canals, steaming speed and other factors. Fuel consumption during steaming and during stoppage at ports is the main and the most significant item of voyage costs. Port charges and canal dues are two direct costs of the voyage. Port charges are composed of harbour dues, wharf dues, pilotage and light dues.

3. Cargo handling expenses: Cargo handling for loading and discharging needs hiring of special facilities such as cranes. Certain arrangements must also be carried out by stevedores, tally personnel, measures, weighing, etc. All of these activities must be paid for and their costs are directly related to cargo and vary with the quantity and nature of the cargo handled.

4. Passenger expenses: The cost items directly related to passengers are labour cost of staff and service personnel, food cost, handling cost of passengers, personal properties and commissions to tourist firms and agencies.

3.2.3 Product - related Classification

Product-related classification, when applied in the shipping industry, treats each voyage as a separate product. Thus, shipping companies following this cost classification procedure adopt a segmented reporting procedure based on the concept that each individual voyage is a separate product.

For the purpose of financial accounting, the voyage is the accounting entity for which expenses and revenues should be measured. The voyage is defined as the round trip of the vessel which begins from the port of origin on a certain date and ends at the same port on another date, after completion of all cargo unloading operations. For periodic income measurement in shipping companies it is necessary to measure the voyage cost and, by the end of the financial year, it is necessary also to know the costs of completed and incomplete voyages for each vessel. The financial accounting treatment of the cost of incomplete voyages varies from one shipping company to another. Two methods are followed in practice: The first one is to consider the cost of incomplete voyages as deferred expenses by the end of the financial year, and to consider revenue as pre-collected revenues (in advance). The expenses and revenue will be recognised on completion of the voyage during the new year. The second method, based on correct application of the accrual basis in financial accounting, allocates the cost and revenue as between the year in which the voyage begins and the year in which the voyage ends.

The voyage cost for financial accounting purposes is composed of direct and indirect elements (Cheng, 1985:139). The direct cost of the voyage contains the outlays necessary to perform the voyage plus the outlays which pertain to cargoes carried during the voyage. The indirect cost of the voyage is an allocation of vessel expenses and general expenses to the voyage.

There are no problems in tracing and accounting for the direct cost of the voyage since each direct cost element is supported by documents determining the cost element attached to the specified voyage and no other. The problem is centred on the indirect elements of costs: What are they? How can they be allocated - in a fair manner - to the voyage?

As has been mentioned, the indirect cost elements to the voyages - in shipping companies - can be divided into two separate groups: Vessel expenses and General expenses. Vessel expenses are those elements which the company incurs to preserve the vessel in an operational condition. These cost elements include, for example, vessel annual depreciation, repairs, maintenance, insurance, (hull and machinery), surveys .....etc.

General expenses are those items which are general to all vessels operated by the shipping firm, which can be named under the heading of ship operation costs. They are general maritime expenses, i.e. those cost elements of technical departments concerned with the operation of the shipping fleet.

The practices in shipping companies, with regard to calculation of the indirect costs of the voyage, are as follows:

1. Allocation of the general cost of operation to all working vessels on a suitable base of allocation such as deadweight, tonnage, working days, etc.

2. The indirect cost (IC) per day is calculated as follows

$$\text{IC per day} = \frac{\text{Allocation of general operation expenses} + \text{Vessel expenses}}{\text{Number of working days of the vessel during the costing period}}$$

3. Calculation of the indirect cost portion to the voyage:

IC for voyage = Number of voyages x IC per day

3.2.4 Classification of Shipping Cost According to Relation to Volume of Activity

It was explained above that the voyage is the accounting entity for the purposes of financial reporting. However, this accounting entity is not an exact measurement unit for volume of activity. The shipping activity is composed of steaming and transportation of cargoes and/or passengers. Hence, it is necessary to find a measurement unit reflecting both of those jointly-associated activities. The unit called ton-mile is usually used to express the volume of traffic. The question now, is how does shipping cost vary with the volume of traffic?

It is expected that there will be one group of costs which vary, and another group which will be constant or not affected by variation in the volume of traffic. It is

well known that liner vessels have a cost structure characterised mainly by constant cost, since the distance of the round trip is the same for each trip. The only variable costs in liner vessels are - approximately - the cost items attached to cargo handling which will depend on volume of transported cargo (Chrzanowski, 1989:69). Then for the ton-mile unit of measurement in liner vessels, the cost will be variable, since the volume of cargoes changes from one trip to another.

The cost structure of a tramp vessel is composed of fixed and variable costs. Fixed costs are those known as vessel expenses, i.e., maintenance, repairs, shipyards, insurance, depreciation and crew costs. Variable costs are: voyage expenses (mainly fuel, port dues....) and cargo and/or passenger costs.

The cost per ton-mile in tramp vessels is expected to vary from one trip to another, since distance and volume of cargoes are changeable.

The analysis of shipping costs to fixed and variable costs is a very important source of information which the shipping company management can use for planning, control, and decision-making. The most important use of such information is for pricing decisions, and for evaluating transportation requests, especially in the tramp business. Also, this analysis will be of great importance in profit planning in the shipping firm. Break-even analysis for each vessel, undertaken to achieve a profit target, depends on variable and fixed cost classification (Anthony and Reece, 1991:561)

Short-run costs at each output level are the "sum total of fixed costs (a constant) and total variable cost (Pappas, 1990:255). Unit costs, whether average or marginal, are used for a variety of decision-making purposes in shipping companies.

All shipping companies are required to deal with both controllable and uncontrollable costs. It is, therefore, incumbent on operating management to pay particular attention to controllable costs. Almost all controllable costs are variable costs, and , as such, are responsive to the control of the operating level of management because the amount of such costs varies with changes in the volume of production. (Niswong and Weygant, 1991:292).

3.3 Factors Affecting Shipping Cost

The structure of shipping cost will vary from one company to another due to various factors. These are as follows:

1. Differences in kinds and types of ships.
2. Country of registry.
3. Nationality of crew.
4. Trade route.
5. Heterogeneity of management.

The effect of the above-mentioned factors on the operating cost will vary from one company to another, assuming that there are no differences in cost accounting practice among shipping companies. (Heaver, 1985:42). These factors will be discussed as follows as follows:

3.3.1 Differences in Kinds and Types of Ships

Ships are not mass-produced to standard designs; relatively few vessels of any one design are produced. Any shipping company may have a fleet of vessels of many kinds such as passengers, cargo, bulk, liquid (tanker), and for each kind of vessel there may be several types based on design. Also, within each type, there will be variations in size as well as other characteristics. As a shipping company will have several vessels which vary in age, therefore it is expected that several shipping technologies will be in effect simultaneously. Thus, the efficiency of each vessel is unlikely to be the same. That is, the shipping cost will vary from one vessel to another, even though they do the same voyage.

3.3.2 Country of Registry

An investor in shipping will consider the country of registration of his vessel or vessels to be operated in a certain route or trade. This is because many economic consequences stem from the decision concerning country of registration. Some countries, for example, give advantages to ship owners who register their vessel with them and use their flags, such as exemption from taxes and granting shipowners financial facilities. Also, the country of registration may facilitate some difficult operating problems, for example by imposing simplified safety standards, therefore reducing maintenance costs.

3.3.3 Nationality of Crew

The cost of ship manning will be affected by the nationality of the crew, since employment regulations vary from one country to another, as do social insurance and pensions. However, the reduced cost of labour is not necessarily advantageous, since the quality of work performed by the crew will vary. In the case of highly trained sea personnel, there will be a trade-off between high salary and increased efficiency. However, it is expected to find a difference in the level of manning cost from one company to another and from one country to another.

3.3.4 Trade Route

The trade route in which a vessel is operating will affect the operating cost of the vessel. Distance, weather conditions, board conditions, and commodities carried on each route will affect many elements of shipping cost. Fuel will be affected by distance, seadays and prices of bunker along the route. Maintenance and repairs will be affected by sea conditions on the route. Kinds of cargoes on the route will affect cargo handling cost. Finally, port dues will vary from one route to another.

3.3.5 The Nature of Management

Operating costs will also be affected by the quality of the ship management, mainly differences in the general policy. For example, one firm may place greater stress on the maintenance of the ship to protect its resale value than another firm.

Management functions include rotation and travel arrangements, crew selection, bunkering and the arrangement of ship maintenance and repair plans. Spending under this cost category is affected by the diverse nature of the category, as well as the size and composition of the fleet.

Finally, it should be noted that cost categories are inter-dependent and the level of one element may influence the cost in another. For example, saving in crew cost may increase maintenance and repair costs.

3.4 Cost Indicators in Shipping Companies

3.4.1 Cost of one Ship - Day in Operation

In calculating ship operating costs, insurance, maintenance, repair, crew and fuel costs are usually all included. Most of these costs are incurred annually, and should be converted to the daily number per year a ship is in operation. The capital cost, or purchase price of the ship is transformed into an annual capital repayment figure, annualised at a chosen discount rate over the life of the ship (Pearson, 1988:93). All the above costs can therefore be converted into daily ship costs by using the following simple formula:

$$US - D = \frac{TC}{TO}$$

Where:

US - D = Cost of 1 Ship-day in Operation

TC = Total Cost

TO = Time of Operation (in days)

3.4.2 Cost per Ton-Mile

Calculating daily ship costs at sea takes into account the difference in fuel costs of different speeds, but not the difference in transport capacity achieved (clearly, considering time at sea only). This indicator measures unit costs over a given distance. Thus transport costs are compared over a given distance, in contrast to costs over a given time, as before. This cost is calculated by dividing the total cost over the number of ton-miles performed as follows:

$$Utm = \frac{TC}{(QL)}$$

Where:

Utm = Cost of One Ton-Mile

TC = Total Cost

QL = Ton-Mile.

3.4.3 Cost of one Tonnage-Mile

The analytical value of one ton-mile cost increases when it is combined with the cost of transporting one ton of cargo. The cost of one ton-mile decreases with the distance travelled. This indicator is defined by the formula:

$$Utd = \frac{TC}{Dn.L}$$

Where:

Utd = Cost of One Tonnage-Mile

TC = Total Cost

Dn.L = Tonnage-Miles.

This cost shows the cost of each ton-mile if the ship is fully loaded. This indicator is generally combined with the previous one. Comparing the two, it is possible to say what was the utilisation of the ship carrying capacity.

3.4.4 Cost of a Voyage

Clearly the above formulations (cost of one ship-day in operation, cost per ton-mile) are concerned solely with the ship cost of actually moving the cargo (the sea transport cost) while ignoring other costs involved in the transport chain. The voyage cost is calculated by dividing the total annual cost over the number of voyages made by the ship as follows:

$$Uv = \frac{TAC}{R}$$

Where:

Uv = Cost of a Voyage Made by the Ship.

TAC = Total Annual Cost of Operation.

R = Number of Voyages Made by the Ship.

The analytical value of this indicator is limited to ships of the same type and size, run over the same trade routes. It has little value for a series of voyages made over different distances.

3.4.5 Cost of Transport of One Ton of Cargo

This cost is calculated by dividing the total cost over the number of tons transported as follows:

$$Uc = \frac{TC}{Q}$$

Where:

Uc = Cost of Transport of One Ton of Cargo.

TC = Total Cost.

Q = Quantity of Cargo.

The cost of transporting one ton of cargo has a limited analytical value, since it takes into account only the quantity of cargo, ignoring its value, nature or distance of transport. Only when combined with the freight rate per ton can any significant comparisons be made. However, in bulk trades the unit cost of transport may be of some relevance for comparisons between ships of different sizes and types.

3.4.6 Cost of One Ton of Ship's Deadweight

This cost is defined by the following formula:

$$Udwt = \frac{TC}{Dn}$$

Where:

Udwt = Cost of One Ton of Ship's Deadweight.

TC = Total Cost.

Dn = Ship's Net Deadweight.

This cost tells how much one ton of the ship's deadweight capacity has cost. The general tendency is that this cost decreases with the ship's size. However, this indicator does not allow for the degree of utilisation of the ship's loading capacity.

It should be noted that the various type of unit costs described above can be relevant only under certain conditions. One cannot compare, for instance, the cost of one ton of cargo transported by two different ships employed over two trade routes of different distances. If, however, one compares this unit cost for two or more ships of different size, employed on the same trade route, one is able to indicate the most efficient alternative. (Chrzanowski, 1989:75).

To sum up, the elements which influence the unit cost of any given ship are the following:

a) degree of utilisation of ship's net deadweight capacity,

b) distance of transport,

c) number of voyages made by the ship in a year,

d) time of loading and discharge in the port(s) served, which, at a given ship's speed, determines the number of rotations (voyages) per year.

3.5 Summary and Conclusion

This chapter examined both the classification of shipping costs and those factors which may be reasonably expected to affect the level of such costs. It also discussed the cost indicators in shipping companies.

Four cost classifications were discussed. These were: (1) natural classification (2) object of expenditure classification, (3) product related classification, and (4) activity-related classification.

Natural cost classification is related to the types of goods and services consumed in a production operation. In shipping companies, the product is a service. Therefore, primary operating costs may be classified according to a natural system that identifies the major input components required to operate a vessel fleet. As in any business firm, the shipping company needs inputs to produce the shipping service to customers, (shippers), for example, materials, manpower and many other outlays.

On the other hand, the object of expenditure classification system considers operating costs within the context of the function or process involved in an operation. The most important activities in a shipping company are those related to the vessel itself, the voyage and the cargo or passengers.

Product-related classification, when applied in the shipping industry, treats each voyage as a separate product (or accounting entity). Thus, shipping companies

follow this classification procedure based on the concept that each individual voyage is a separate product.

The voyage cost for financial accounting purposes is composed of direct and indirect cost elements. The direct cost of the voyage contains the outlays necessary to perform the voyage plus the outlay which pertains to cargoes carried during the voyage. The indirect cost of the voyage is an allocation of vessel expenses and general expenses to the voyage.

Finally, volume of activity-related classifications segregate fixed and variable costs. The analysis of shipping costs to fixed and variable costs is a very important source of information which the shipping company management can use for planning, control and decision-making.

In brief, cost indicators in shipping companies which influence the unit cost of any given ship are the following:

a. Degree of utilisation of ship's net deadweight capacity.

b. Distance of transport.

c. Number of voyages made by the ship in a year.

d. Time of loading and discharge in the ports served, which, at a given ship's speed, determines the number of rotations (voyages) per year.

Chapter Four

A Survey of Previous Studies on

Shipping Cost Structure

4.1 Introduction

In this chapter several published works on shipping cost structure of different kinds of vessel, different voyage patterns and different sizes of vessel will be surveyed. The purpose of this chapter is to provide a picture of each cost element of vessels contributing to the total cost and investigate them from the perspective of this study. In other words, the proportion that each cost element represents of total costs will be identified. It is useful to examine the relative importance of each vessel cost component for the various vessel types, that is, tanker vessels, cargo vessels and passenger vessels, to recognise the factors which affect the cost structure.

This chapter will examine in the following sections, the cost structure of tankers, cargo and passenger vessels, in turn.

4.2 Tankers Cost Structure

Drewry (1980) introduced an estimated cost structure of 120,000 dwt and 260,000 dwt tankers. Table 4.1 indicates that in 1979, voyage costs represented 49 percent of total costs for the 120,000 dwt tanker compared with 41 percent of total costs for the 260,000 dwt tanker. Operating costs comprise 29 percent of total costs for the 120,000 dwt tanker and 13 percent of total costs for the 260,000 dwt tanker. Capital costs for the 120,000 dwt and 260,000 dwt tankers represented 22 and 46 percent of total costs respectively. It is obvious from Table 4.1 that there were considerable economies of scale in the operation of large tankers, 260,000 dwt as

opposed to 120,000 dwt; in terms of operating and voyage costs. Finally, Table 4.1 also indicates that the cost structure is affected by the steaming speed. Voyage cost will be relatively less as speed decreases.

Table 4.1

Percentage of Total Costs by Cost Component for 120,000 DWT and 260,000 DWT tankers

Cost Category	120,000 DWT 14.5 knots 1979	260,000 DWT 14.5 knots 1979	120,000 DWT 13.1 knots 1979	260,000 DWT 12.1 knots 1979
Voyage Costs	49	41	45	31
Operating Costs	29	13	29	15
Capital Costs	22	46	26	54
Total Costs	100	100	100	100

Source: Drewry Shipping Consultants Ltd. Tanker Freight, 1980,20

Another study of cost structure of different sizes for standard convenience flag tankers was introduced by Drewry (1983). Table 4.2 shows the percentage of the three groups of shipping costs. It should be noted that there were considerable economies of scale in the operation of large tankers such as economies of operating costs (operating costs represent 17 percent of total for a 120,000 dwt tanker, whereas they represent 28 percent for a 30,000 dwt tanker). Capital costs accounted for an average of 38 percent of total costs, being the second largest item. It should also be noted that the larger the vessel, the larger the proportion of costs accounted for by the voyage costs, representing 44 percent of total cost for a 120,000 dwt tanker,

compared with 37 percent for a 30,000 dwt tanker. Voyage costs are the largest component of the cost structure.

Table 4.2

Percentage of Total Cost by Cost Component for Tanker Vessels

Cost Category	30,000	60,000	80,000	120,000
Operating Cost	28	24	23	17
Capital Cost	35	38	38	39
Voyage Cost	37	38	39	44
Total	100	100	100	100

Source: Drewry. Shipping Consultants Ltd. Tanker Operating Cost, 1983,55

Drewry (1983) presented a standard breakdown of costs for 60,000 dwt and 250,000 dwt tankers over the period 1970 - 1981 and compared them for convenience flags and European flags. Table 4.3 indicates that voyage costs for a 60,000 DWT tanker accounted for an average of about 24 percent of total costs in 1970 and had increased to an average of 38 percent in 1981. Capital costs had declined in importance for vessels in both flag groups, decreasing from about 50 percent in 1970 to about 38 percent of total costs in 1981. Combined voyage and capital costs accounted for an average of three-quarters of the total costs. It should be observed that operating costs on European flag tankers had decreased from 32 percent to 26 percent of total costs, whereas on convenience flags, they had increased from 22 percent to 24 percent.

In the case of 250,000 dwt tankers the structure of costs, namely, the three elements of voyage, capital and operating cost, altered distinctly over the period 1970-1981. Voyage costs increased in importance over the ten year period, increasing from an average of 23 percent of total cost in 1970 to 50 percent. They were the largest component of total costs. It should be noted that capital costs represented 37 percent of total cost for convenience flags in 1981, while they represented 36 percent of total for European flags, and were the second largest item instead of the first in 1970. Conversely, operating costs represented 12 percent of total cost for convenience flags in 1981 compared with 16 percent of total costs for European flags. The above-mentioned comparisons indicate that the cost structure of vessels is affected by the nationality of registration since there are different regulations which influence some cost items.

Table 4.3

Percentage of Total Costs by Major Cost Component for Tankers

	60,000 DWT						250,000 DWT					
	Convenience Flag			European Flag			Convenience Flag			European Flag		
Cost Category	**70**	**75**	**81**	**70**	**75**	**81**	**70**	**75**	**81**	**70**	**75**	**81**
Operating Costs	22	19	24	32	29	26	23	14	12	28	19	16
Capital Costs	53	51	38	46	45	37	54	51	37	50	48	36
Voyage Costs	25	30	38	22	26	37	23	35	51	22	33	48
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: Drewry Shipping Consultants Ltd, Tanker Operating Cost, 1983,52-53

The Economic Intelligence Unit, (1985) revealed the relative significance of the components of tanker operating costs in 1973-1983. Table 4.4 shows that voyage costs increased considerably as a proportion of total costs from 19 and 20 percent in 1973 to between 38 and 47 percent in 1983 for 120,000 dwt and 240,000 dwt tankers respectively. There was a perceptible decrease in operating cost over the period, decreasing from 24 percent to 21 percent for 120,000 dwt and from 19 percent to 15 percent for 240,000 dwt. Capital costs declined in importance for both sizes of tanker, decreasing from 57 percent to 41 percent for 120,000 dwt and from 61 percent to 41 percent for 240,000 dwt tankers.

Table 4.4

Percentage of Total Cost by Cost Component for Tankers

Cost Category	120,000 DWT		240,000 DWT	
	1973	1983	1973	1983
Total Cost	100	100	100	100
Capital	57	41	61	41
Operating	24	21	19	15
Voyage	19	38	20	44
Operating + Voyage	100	100	100	100
Operating	56	36	49	25
Manning	13	15	11	7
Repair and Maintenance	9	9	8	4
Stores	2	4	2	1
Ins/Pand I	27	5	24	11
Admin	5	3	4	2
Voyage	44	64	51	75
Bunker	37	55	40	67
Port	7	9	11	8
Canal	-	-	-	-

Source: Economic Intelligence Unit, Eurocoal, 1985,26.

Finally, it should be noted from the Table that there were considerable economies of scale in the operation of large tankers (240,000 dwt) compared with 120,000 dwt tankers (i.e. manning, repair and maintenance, stores costs).

Another study of the cost structure for a sample of seven clean product tankers of varying ages, ranging from 21,217 dwt to 32,737 dwt, was produced by the Economic Intelligence Unit (1986). Table 4.5 reveals that average voyage costs represented the largest single element of total costs, accounting for approximately 50 percent, constituting a critical element of total costs. In particular, fuel cost accounted for approximately 65 percent of voyage costs. It should also be noted that average operating costs represented 29.6 percent of total cost, being the second largest component, followed by average capital costs, accounting for 21.2 percent of total costs.

Table 4.5

Percentage of Total Costs by Major Cost Component for Tanker Vessel

Cost Category	A	B	C	D	E	F	G	Average
Capital	16.9	9.7	36.1	16.9	15.9	38.9	14.3	21.2
Operating	30.5	35.7	28.0	34.7	29.8	22.3	26.3	29.6
Voyage Cost:								
Port and Canal	16.1	25.6	13.7	9.0	30.8	13.5	44.4	21.9
Fuel	36.5	29.0	22.3	39.5	23.6	25.6	15.0	27.4
Total	100	100	100	100	100	100	100	100
Age of Ship - Years	11	20	1	10	13	15	15	10.5
Ballasting (%)	41.4	31.1	41.1	43.3	31.7	42.8	21.0	36.1
Cargo Clean (0001)	20	20	29	18	20	30	30	23.9

NB: ROUTES: A. Black Sea-India, B. Mersin-Genoa, C. Bahrain-Singapore
D. Naples/USEC/Gulf, E. Rotterdam-Bilbao, F. Constanza-UK/Continent
G. Skikda-Genoa.
Source: Economic Intelligence Unit, Falling Oil, 1986,2

A study of the estimated cost structure was produced by Trace, Meyrick and Robinson (1989) for 100,000 dwt crude oil carriers operating between the Arabian Gulf and Australia. Table 4.6 indicates the percentage of the three groups of shipping costs and compares them for Australian and overseas vessels. It should be noted that capital costs accounted for an average of 47 percent of total costs, forming the largest component of total costs, followed by operating costs.

Table 4.6
Percentage of Total Costs by Cost Component for 100,000 DWT Tanker Vessel

Cost Category	Australian Vessel		Overseas Vessel	
	Cost	% of Total	Cost	% of Total
Crew Cost	2,806,000	19	1,750,000	13.5
Store and Lub	450,000	3	450,000	3.5
Insurance	534,000	4	534,000	4
Repairs and Maint.	1,000,000	7	850,000	7
Management	475,000	3	475,000	4
Total Operating Cost	5,265,000	36	4,059,000	32
Finance	6,519,000	45	6,274,000	48
Bunker Cost	1,608,000	11	1,608,000	12
Port Charges	1,022,000	7	1,022,000	8
Total Voyage Costs	2,630,000	18	2,630,000	20
Total Costs	14,414,000	100	12,963,000	100

Source: Trace, Meyric and Robinson, Australian Flag, 1989,17

The study showed that crew costs for Australian vessels accounted for 19 percent of total costs (53 percent of operating costs), reflecting the higher wages and fringe payments and also the war risk bonus payable to crews operating in the Arabian Gulf. Finally, it should be noted that fuel costs on Australian and overseas vessels represented 11 and 12 percent of total cost respectively, forming the third largest cost

component. Combined capital, crew costs, and bunker costs accounted for an average of about 74.5 percent for both Australian and overseas vessels.

A recent study on coastal shipping of Australia introduced by the Bureau of Industry Economics (1994) shows that capital is the major cost category, accounting for about 60 percent on average of total cost for a 30,000 dwt product carrier. Manning is generally the second largest cost category, accounting for 15 percent of cost on average, and bunkers (or fuel) the third largest, accounting for 7 percent of cost on average. Combined, Capital, Manning and Bunkers account on average for about 82% of total vessel cost.

Capital	60%
Manning	15%
Bunker	7%

The cost categories of next most importance are repairs and maintenance (R&M) and insurance, stores and administration (no data is available about ship-based port costs). The study reveals that the main cost category contributing to the industry's comparative cost gap is manning cost. The main determinants of difference in these costs between countries are crewing leave, the leave ratio and the nationality of the crew.

The researcher can conclude from the survey of studies on tanker cost structure, firstly, that the cost structure of tanker vessels is affected by many factors,

i.e. size, speed, changing prices over time, especially fuel, and nationality of the crew. Secondly, the cost structure of tankers is composed mainly of fixed cost (almost 80 percent in the last study), while variable costs are relatively less (20 percent of total costs).

4.3 Cargo Vessel Cost Structure

Drewry (1984) introduced standard costs for 25,000 dwt handy sized and 60,000 dwt panamax bulk vessels in 1973 and 1983 and compared them for convenience flags and European flags. It should be observed from Table 4.7 that capital costs represented 40 percent of total costs. It is evident from this Table that voyage costs for 25,000 dwt handy-sized bulk vessels had increased considerably from an average of about 26 percent of total costs to 35 percent in 1983, being the second largest item. Operating costs had decreased in importance for both flags, declining from 31 percent of total to 25 percent on convenience flags, and from 35 percent to 26 percent in 1983 on European flags.

In the case of 60,000 dwt standard panamax bulk carriers the relative proportions of total costs show that capital costs are the crucial element of expenditure, representing 43 percent of total costs in 1983, being the first item. Voyage costs increased significantly over the ten year period, increasing from an average 25.5 percent of total cost to 37 percent for both flags in 1983. Finally, operating costs declined considerably in both flag groups, decreasing from an average of 30 percent of total

costs to 20 percent in 1983. The study showed that the cost structure of bulk vessels, namely, capital, voyage and operating costs, changed considerably over the period 1973-1983. Capital costs remained the largest of total costs, but voyage costs increased by about 10 percent over the ten year period, constituting a critical element. However, operating costs accounted for a decreasing share of total cost, because of their moderate rate of increase over the period.

Table 4.7
Percentage of Total Costs by Cost Component for Bulk Carrier

Cost Category	Handy-Sized Bulk Vessel 25,000 DWT				Panamax Bulk Vessel 60,000 DWT			
	Convenience Flag		European Flag		Convenience Flag		European Flag	
	1973	1983	1973	1983	1973	1983	1973	1983
Operating Costs	31	25	35	26	29	20	31	20
Capital Costs	42	40	40	39	45	43	44	43
Voyage Costs	27	35	25	35	26	37	25	37
Total	100	100	100	100	100	100	100	100

Source: Drewry Shipping Consultants Ltd., Dry Bulk,1984,32

The researcher can conclude from the above-mentioned comparison the following results:

1. There are no significant differences in cost structure between convenience flag and European flag.

2. The cost structure of bulk carriers is composed mainly of fixed cost (nearly 63-75%), while variable cost is relatively less (25-27%).

A breakdown of estimated total costs for bulk carriers was introduced by the Economic Intelligence Unit (1985). Table 4.8 reveals the relative importance of the major cost components in 1973 and 1983. In 1973, operating costs were 29 percent of total costs, constituting the second largest item in the total, and 20 percent of total costs in 1983. Conversely, voyage costs increased from 26 percent of total costs in 1973 to 38 percent of total costs in 1983, becoming the second largest item of the total. The most significant changes over the ten years period include the increasing share of bunker costs and decreasing share of insurance costs for this type of vessel.

Table 4.8
Percentage of Total Costs by Cost Component for Bulk Carrier

Cost Category	60,000 DWT	
	1973	1983
Total Cost	100	100
Capital	45	42
Operating	29	20
Voyage	26	38
Operating + Voyage	100	100
Operating	53	37
Manning	19	16
Repair and Maintenance	11	6
Stores	8	5
Insurance/Pand 1	10	5
Administration	5	5
Voyage	47	63
Bunker	26	46
Port	9	9
Canal	12	8

Source: Economic Intelligence Unit, No.7, July 1985, p-26.

Heaver (1985) produced a breakdown of cost structure for three different types and sizes of vessels. The figures in Table 4.9 were derived from a sample of 4, 13 and 5

vessels for the container, 25,000 dwt and 110.000 dwt bulk carriers respectively and it should be noted that operating costs represented approximately one-fifth of the total cost for all three ship types. Manning costs were about one-half of the operating costs. Container vessels were shown to be more capital-intensive (accounting for 59 percent of total cost), then bulk carriers (where capital accounted for about 40 percent of total cost). Voyage costs were less influential for container vessels (representing 21 percent of total cost), than for bulk carriers, for which they made up nearly 40 percent of total cost.

Table 4.9

Proportional Breakdown of Total Cost

	Container vessel 1,000 ton	**Bulk Carrier 25,000 DWT**	**Bulk Carrier 110,000 DWT**
Capital Costs Total	59	40	42
Operating Costs			
Manning	9	12	9
Lube, Supplies/spare parts	2	3	2
Repairs and maintenance	4	3	3
Insurance	3	3	2
Administration	2	2	2
Operating Costs Total	20	23	18
Voyage Costs			
Fuel	19	30	37
Port	2	4	3
Canal fees	-	3	-
Voyage Costs Total	21	37	40
Total	100	100	100

Source: Maritime Policy and Management, Volume 12, 1985, p-40.

A study of the cost structure of US container ships operating in the North Atlantic, conducted by Long and RN.FBIM (1986) revealed that fuel costs represented 19 percent of total costs, being the largest item. The second largest item was corporate overheads, accounting for 11.5 percent of total costs, followed by terminal costs representing 11 percent of total costs. Combined, fuel, corporate overheads and terminal costs accounted for 41.5 percent of total costs. It should be observed from Table 4.10 that the next most important items were crew and container costs, representing 10 percent of total vessel costs. Finally, the study revealed that capital costs were 7 percent of total vessel costs.

Rearranging the cost elements into the three group classification of shipping cost, i.e. capital, operating and voyage cost, one will have the following cost structure:

Capital Cost	%	
Capital in vessels	7	
Capital in containers	10	
		17

Operating Cost	%	
Crew	10	
Maintenance	2	
Supplies	1	
Insurance	3	
Corporate Overheads	11.5	
		27.5

Voyage Cost	%
Fuel	19
Stevedoring	9.5
Terminal	11
Port	3
Positioning	3
Feeder	7
Agency Brokerage	3
	55.5
Total	100

Now, this classification reveals that fixed cost constitutes 44.5% of total cost while variable cost is 55.5%.

Table 4.10

Percentage of Total Costs by Cost Component for US Container Ship

Cost Category	Cost per Voyage $	% of Total
Crew	275,700	10
Fuel	500,000	19
Maintenance	44,000	2
Supplies	17,700	1
Insurance	70,200	3
Stevedoring	257,900	9.5
Terminal	285,200	11
Port	78,200	3
Container	270,300	10
Positioning	75,000	3
Feeder	185,700	7
Agency brokerage	87,800	3
Corporate overheads	307,400	11.5
Capital	205,800	7
Total	2,660,900	100

Source: Long and RN.FBIM, The Soviet Fleet, 1986,16.

Finally, one considers a study of the estimated cost structure for a typical 60,000 dwt bulk carrier, based on 1987 prices, introduced by Branch (1988). Table 4.11 shows that the dominant cost categories were capital, fuel and crew costs. Capital cost accounted for 30.2 percent of total costs, being the largest component of total costs, followed by fuel costs representing 25.6 percent of total costs. Crew costs comprised 25 percent of total costs, being the third largest component of total costs. Combined, capital, fuel and crew costs accounted for about 81 percent of total cost.

Table 4.11

Percentage of Total Costs by Cost Component
For 60,000 DWT Bulk Carrier

Cost Category	% of Total Cost
Fuel cost	25.6
Lubricating oil cost	0.9
Engine maintenance cost	1.2
Hull maintenance cost	4.0
Crew cost	25.0
General administration cost	0.4
Insurance cost	8.0
Capital cost (Depreciation, Interest charges)	30.2

Source: Branch, Economics of Shipping, 1988.101

Trace, Meyrick and Robinson (1989) presented the cost structure of 120,000 dwt bulk carriers. Table 4.12 shows the percentage of each cost element to the total for bulk carriers and compares them for Australian and overseas vessels. It should be observed that capital costs accounted for an average of 43 percent of total costs,

comprising the largest component of total cost. Operating costs recorded a lower percentage for overseas vessels, representing 29 percent of total costs, while it accounted for 37 percent of total costs for Australian vessels, being the second largest item for both flags. Among the major operating cost items, crew cost levels for Australian vessels accounted for 17 percent of total costs (46 percent of operating costs). Capital costs and crew costs accounted for 58 percent of total costs, for Australian vessels, while they accounted for 53 percent of total costs for overseas vessels. Finally, voyage costs represented the smallest proportion of total costs, accounting for an average of 24 percent of total costs.

Table 4.12

Percentage of Total Cost by Cost Component for 120,000 DWT Bulk Carrier

Cost Category	Australian Vessel		Overseas Vessel	
	Costs	% of Total	Costs	% of Total
Crew Cost	2,068,500	17	800,000	8
Stores and Lub	450,000	4	450,000	4
Insurance	519,000	4	489,000	5
Repair and Maintenance	1,000,000	8	850,000	8
Management	476,000	4	476,000	4
Total Operating Cost	4,513,500	37	3,065,000	29
Finance	5,024,000	41	4,779,000	45
Bunker cost	1,579,000	13	1,579,000	15
Port Charge	1,127,000	9	1,127,000	11
Total Voyage Costs	2,706,000	22	2,706,000	26
Total Costs	12,243,500	100	10,550,000	100

Source: Trace, Meyric and Ross Robinson, Australian Flag, 1989.13.

A recent study on coastal shipping of Australia (1994) shows that capital is the major cost category, accounting for about 61 percent on average of total costs, for a 5,000 dwt RoRo vessel. Maintenance and Repair costs are generally the second largest cost category, accounting for 12 percent of cost on average, followed by manning costs, accounting for 12 percent of total cost on average. Combined, capital, maintenance and repair and manning, account on average for about 84 percent of total vessel costs.

Capital	61%
Maintenance and Repair	12%
Manning	11%

The cost categories of next most importance are fuel costs and stores.

4.4 Passenger Vessel Cost Structure

A study of the cost structure of 1,200 standard berth cruise ships conducted by Drewry (1993) revealed that crew related costs represented 34.5 percent of total costs, being the largest item. The second largest item was administration and general costs, accounting for 22.6 percent of total costs, followed by capital costs representing 16.7 percent of total costs. Combined crew, administration and general and capital costs accounted for almost 74 percent of total costs. It should be noted from Table 4.13 that the next most important item was ship-related costs, representing 13.7 percent of total costs.

Table 4.13

Percentage of Total Costs by Cost Component
For 1,200 Standard Berth Cruise Ship

Cost Category	Cost per Day $000	% Of Total
Port Costs	4.1	5
Bunkers	1.02	1.2
Repair and Maintenance	3.07	3.7
Insurance	2.05	2.5
Stores	1.03	1.3
Total Ship Related Costs	**11.27**	**13.7**
Crew Wages, Vacation, Overtime, Standby	17.90	21.8
Victualling	2.4	3.0
Pension and Soc.	3.2	3.9
Travel	1.0	1.2
Insurance and Miscellaneous	3.8	4.6
Total Crew Related Costs	**28.3**	**34.5**
Passengers Food and Hotel	7.10	8.7
Entertainment	0.41	0.5
Security	0.95	1.2
Insurance and Miscellaneous	1.80	2.1
Total Passenger Related Costs	**10.26**	**12.5**
Total Administration and General Cost	**18.50**	**22.6**
Capital Recovery Cost	**13.70**	**16.7**
Total Cost	**82.03**	**100.0**

Source: Drewry Shipping Consultant Ltd, Cruise Ship and Ferry Costs, 1993,136.

Re-arranging the cost elements into the three group classification of shipping cost, i.e. capital, operating and voyage cost, one will have the following cost structure:

Capital Cost:		16.7%
Running Cost Includes:		
Repair and Maintenance	3.07	
Vessel Insurance	2.05	
Stores	1.03	
Crew Expenses	28.3	
Admin and General Expenses	18.50	
	———	64.6%
Voyage cost includes:		
Port Costs	4.10	
Bunkers	1.02	
Passenger food and hotel	7.10	
Entertainment	0.41	
Security	0.95	
Insurance and Miscellaneous	1.80	
	———	18.7%

From the above grouping of cost elements, one notes that the fixed cost of passenger vessels, that is, capital and running cost, represent 81.3 percent of total cost, while variable cost, that is voyage cost, represent 18.7 percent of the total cost.

Finally, Drewry (1993) presented a standard breakdown of costs for 2,050 berth cruise ships. Table 4.14 reveals the relative importance of major cost components.

Table 4.14

Percentage of Total Costs by Major Cost Component For 2,050 Standard Berth Cruise Ship

Cost Category	Cost per Day $000	% Of Total
Crew Related Costs	38.6	15.3
Ship Related Costs	25.0	9.9
Passenger Related Costs	23.35	9.3
Administration and General	25.0	9.9
Total Non-Fixed Costs	**111.95**	**44.5**
Capital Recovery	**139.73**	**55.5**

Source: Drewry Shipping Consultant Ltd. Cruise Ship and Ferry Costs, 1993, 137.

It should be observed that capital costs were 55.5 percent of total costs, constituting the first largest item in the total. The second largest item was crew related costs, accounting for 15.3 percent of total costs. Combined, capital and crew related costs accounted for 70.8 percent of total costs. It should be observed from Table 4.14 that the next most important items were ship related costs and administration and general costs, representing 9.9 percent of the cost structure.

4.5 Summary and Conclusion

It is clear from the previous studies on vessel cost structure that cost percentage level and structure may show wide variation in capital, operating and

voyage costs due to various factors relating to differences in voyage patterns, vessel type, size or capacity of vessel, ages and distance. Cost structure also varies according to the type of shipping activity. Moreover, cost differentials structure could vary considerably between similar vessels and may be influenced by the flag of registry, crew size, nationality and managerial efficiency of the ship operating company. The shipping cost will also vary from one vessel to another, even though they do the same voyage, since the efficiency of each vessel is unlikely to be the same. The researcher can conclude from the survey of the studies on shipping cost structure firstly, that the cost structure of vessels is affected by many factors such as size, speed, price changes over time, especially for fuel, and nationality of the crew; secondly, the cost structure is composed mainly of fixed cost. Fixed costs for tankers were almost 80 percent in the last study, while variable costs were relatively less (20 percent of total cost). Fixed costs of bulk carriers were 74 percent of the total, while the variable cost represented 26 percent of the total in Trace, Meyric and Robinson's study (1989).

Chapter Five

A Survey of Previous Studies on

Factors Affecting Shipping Cost

5.1 Introduction

I presented earlier, studies of the cost structure of shipping companies. However, those studies did not clarify the factors that affect each of the cost elements. In this chapter each element will be studied in detail in order to obtain some degree of insight into the nature of costs involved and to identify the factors which affect their level. Knowledge of such factors is very necessary for the following purposes:

1. To determine which factors are more effective than others in each of the cost elements.

2. As a guide to management for achieving effective control of each of the cost elements.

3. To apply these factors as independent variables of the cost functions, as I intend to do in the empirical study.

In what follows, a separate section will be devoted to each of the cost elements.

5.2 Depreciation Costs

Ships are long term investments and they are considered as fixed assets. Many fiscal periods are expected to benefit from the vessel's services. Therefore, it is logical to distribute the investment costs of the vessel among those periods in an objective way, as much as possible. The amount of this burden is called depreciation, and is determined by the following:

1. Vessel investment costs.

2. Vessel's hypothetical life.

Vessel investment costs can be viewed from many perspectives: do they, for the purpose of calculating depreciation costs, represent the actual costs, or do they represent the replacement costs which are determined after adjusting the actual costs against the index figures, or do they represent market prices which take into consideration changes in vessel price and technological development?

Each of these approaches has its own strengths and weaknesses; it is enough here to look at depreciation from the point of view that depreciation is the expired cost of the vessel, or a distribution of the actual investment cost of the vessel over its service life. Therefore, it is logical to charge each period with its share of the investment cost according to the utilisation of the vessel's services during that specific period. Consequently, from a theoretical point of view, the depreciation burden which is charged to the profit/loss account is calculated as follows:

$$\frac{AIC \times AOC}{EOC}$$

Where:

AIC = Actual Investment Cost of the vessel

AOC = Actual Operational Capacity of the vessel in a period.

EOC = Estimated Operational Capacity of the vessel during its service life.

The depreciation calculated in this way represents the cost of using the vessel during a specific period of time. As is known, the service life of the vessel, as a fixed asset, is not determined only on the basis of the technical validity of the vessel, but also on the basis of technological advance in the ship-building industry, which might render the useful life of the ship less than originally estimated, as is often the case. After the introduction of modern vessel designs, it might not be profitable to operate old vessels. This may be due to their high operational costs as compared with the operational costs of the newly designed vessels, or to lower revenues from the old vessels due to their lower service quality in comparison with the high quality service of modern vessels. Older vessels may have decreased operational capacity due to increased breakdown periods. There may also be greater demand for the services of more up-to-date vessels.

It is notable nowadays that the common trend in developed countries is to scrap vessels quickly in order to maintain competitive positions in the shipping transportation industry. On the other hand, a problem of financing replacement vessels after the hypothetical life of the vessel is expired, is that investment costs for the new vessel are expected to be higher than for the original vessel, due to decreased purchasing power of money in general and technological development in the ship-building industry. The reserve for increased cost in the future is not considered as part of cost, but a problem related to profit distribution.

For each voyage, depreciation cost represents that voyage's share of annual depreciation. Several studies have been carried out to assign and measure the factors which affect depreciation charges.

A regression study carried out by North Western University (1961) showed that a ship's annual capital costs (depreciation) were estimated on the basis of hull size and horsepower. (Benford, 1985.12). The former were derived from the cubic number (which is the product of ship's length, beam and depth divided by 100), while the latter were derived from the shaft horsepower as follows:

$$P = \$668\ (cn) + \$29600\ (shp)^{0.5}$$

Where:

P = Ship Capital Costs

cn = Cubic Number (in cubic feet = 100)

shp = Shaft Horsepower.

Foss carried out a statistical analysis of the coastal cargo services and determined depreciation as a function of the utilisation of the ship and its age (1969.213). The correlation coefficient was 0.86 and the depreciation equation can be expressed as:

$$K = BP\ (0.052 + 0.0016.D - 0.005.a) + 1.0$$

Where:

K = Capital Cost (£000's)

BP = Construction Costs (£000's)

D = Total sailing distance (000's Nautical Miles)

a = Age of ship (years)

Another statistical study by Jansson and Sheerson showed that capital costs were a function of ship size. The regression equation was as follows;

log (capital cost) = -4.236 + 0.655 log S

where: S is the dead weight tonnage of the ship.

The study concluded that vessel capital cost is proportional to the two-thirds power of the ship size (1987:130).

Finally, Tolofari and Pitfield studied the relationship between capital cost and vessel age, ship size, speed and time charter for bulk carriers. The coefficient of determination $R^2 = 0.93$. The regression results were:

Capital cost = 10.2 - 0.506 age + 0.000037 size - 0.374 speed + 0.0218 time charter

The equation shows the importance of ship size and time charter in determining capital costs (1985:412)

It can be concluded from these studies that the amount of depreciation is dependent upon many factors such as vessel size, shaft horsepower and time charter (voyage days).

5.3 Insurance Costs

Insurance costs consist of all premiums paid for the ship's hull and machinery (H and M) for total loss and damage and protection and indemnity (P and I) against

liabilities to third parties, war risk, loss of earning and strikes. Insurance premium levels depend upon a wide variety of factors. These factors include the value of the ship, propelling machinery, flag and classification society, area of operation, condition of insurance and performance record of the ship's operator (Tolofari, 1989:134). However, the most important factor is the age of the vessel (Proctor, 1985:65). Insurance costs are also affected by vessel size and type. A comparison of insurance costs by vessel size and type is presented in Table 5.1, it should be noted that bulk cargo carriers are more expensive to insure than tankers (Drewry,1991:70). The most important factors which influence the hull and machinery cost are the owner's claim record and the assessed value of the vessel (Tolofari, 1989:135).

Table 5.1
Insurance Costs as a Function of Ship Size and Type

Ship Size (DWT)	Type	Insurance Costs ($US 000's per annum)
20,000	Self-unloader	660
20,000	Bulk Cargo	585
20,000	Tanker	565
50,000	Bulk Cargo	1,090
50,000	Tanker	1,065
100,000	Self-unloader	1,890
100,000	Bulk Cargo	1,715
100,000	Tanker	1,565
200,000	Self-unloader	3,400
200,000	Bulk Cargo	3,120
200,000	Tanker	2,405

Source: Drewry Shipping Consultants Ltd. Tanker Operating Cost, 1991,70

It is obvious that age of the vessel will also affect its value. Because the hull and machinery premium covers the cost of repairing damage, it may be based on two

values, total loss or damage, and repair liabilities. Drewry (1991) offered an indicative trend in hull and machinery insurance costs which is presented in Table 5.2. It should be observed that H and M costs have increased steadily due to the increase in ship values and ship repairs.

On the other hand, protection and indemnity coverage is provided by P and I clubs which were established by shipowners for their mutual protection against loss of earnings. Cover for loss of earnings includes loss of hire, due to excess off hire time or damage/breakdown, and loss of freight due to non-receipt freight. P and I will be affected by many factors such as owner's claim record, geographical trading patterns, cargo types lifted, flag, crew composition and nationality (Drewry, 1990:79).

A regression study by Foss showed that insurance costs were a function of the age of the ship and construction costs. The relationships between age, construction costs and the insured value were very close, with correlation coefficients ranging from 0.97 to 0.99 (1969:213). The insurance equations were:

Coastal Passenger: $FV = 0.91.BP + 0.01.BP.\log a + 123$

Coastal Cargo $FV = 1.1.BP + 0.17.BP.\log a + 6.5$

Where:

FV = Insured value of the ship (£000's)

BP = Construction costs (£000's)

a = Age of ship (years)

Table 5.2

Indicative Trend in Hull and Machinery Insurance Costs
($ US '000 per annum)

	1987	1988	1989	1990	1991
Short Sea					
499 GRT	11.0	15.0	21.1	23.0	25.0
1,599 GRT	28.9	36.8	48.9	54.7	60.0
General Cargo					
15,000 DWT	65.3	86.3	112.1	123.6	135.0
Refrigerated Cargo Ship					
400,000 Cu.feet	90.0	114.8	149.8	165.8	180.0
Bulk carriers					
Handy	89.4	115.0	149.5	166.8	175.0
Panamax	141.0	181.7	236.9	264.5	275.0
Cape	223.4	287.5	373.8	419.8	430.0
Product Tankers					
30,000 DWT	165.0	188.6	230.0	241.5	250.0
Crude Tankers					
Aframax	175.3	224.3	356.5	373.8	385.0
Million bbl	209.7	293.3	465.8	488.8	500.0
VLCC	371.0	517.5	819.4	862.5	875.0

Source: Drewry Shipping Consultants Ltd. Second Hand Ships, 1992,52

Another statistical regression study was carried out by Tolofari for bulk carriers to see the relationship between insurance costs and vessel size. The study indicated insurance costs as a function of ship size. The regression equations for bulk and tanker carriers respectively were as follows:

$$\text{Insurance costs} = 38.86\ X^{-0.393} \quad \text{For Bulk Carriers.}$$

$$\text{Insurance costs} = 40.45\ X^{-0.376} \quad \text{For Tankers.}$$

Where:

X = Ship size.

It should be noted that R^2, the coefficient of determination, was a very small value, indicating that there is no strong relationship between insurance costs and ship size. It should also be observed that the performance of the insurance equation for tankers is worse than for bulk carriers. Tolofari concluded that ship size is not the main cause of variation in cost (1989:145). Therefore, he added another factor to determine insurance costs as a function of ship size and vessel age. The regression equations for bulk carriers and tankers respectively were as follows:

$$\text{Insurance cost} = 97.51\, X_1^{\,0.413}\, X_2^{\,-0.367}$$

$$\text{Insurance cost} = 119.10\, X_1^{\,-0.410}\, X_2^{\,-0.410}$$

Where:

X_1 = ship size per 1000 dwt

X_2 = ship age

It should be noted that R^2, the coefficient of determination, was still small, meaning that the variation in insurance cost is not affected greatly by ship size and age. The researcher believes that the most important factors which affects insurance costs are the owner's reputation and operating record.

It can be concluded from these studies that insurance costs are determined by many factors such as ship size and age and the owner's record.

5.4 Crew Costs

Crew costs include all items related to the manning of the vessel such as basic wages, social insurance, pension, overtime payments, victualling costs, travelling and repatriation expenses, medical expenses and any other payment or costs pertaining to manpower onboard the ship. Frankel states that crew costs are weakly dependent upon vessel size and type (1989:157). However, flag of registry, size and composition of the crew, crew nationality and conditions of service have a major impact on crew costs. (Drewry,1984:2) The proportion of crew costs to total costs varies widely as a consequence of the above mentioned factors. It accounted for between 8-29 percent of total cost, although for some types of ships this percentage may be lower (Moreby, 1985:57).

The flag of registry affects crew wage level, benefits, composition and manning regulations. It offers the owner wide scope to avoid high wage levels (Drewry, 1984:29). Crew costs on vessels operating under flags of the industrialised world are higher than third world and Far Eastern crews, usually employed on flags of convenience. The results of a comparative study by Drewry of crew costs for tanker vessels for flags of convenience and North European flags are presented in Table 5.3. The Table shows the variations in crew costs which are attributable to the flag of registry.

It should be noted from Table 5.3 that the manning cost differential between North European flag (high cost) and convenience flag (low cost) is about 32 percent on average.

Table 5.3

Tanker Crew Cost Comparison: North European Flag and Convenience Flag

($US in 1000's per annum)

Ship Size (Deadweight)	North European Flag	Convenience Flag
up to 40,000	2,800	1,950
40 to 70,000	3,090	2,100
70 to 100,000	3,300	2,300
100 to 175,000	3,750	2,550
over 175,000	3,820	2,630

Source: H.P.Drewry (Shipping Consultants) Ltd. Trends in Tanker Operation 1991,10

Crew nationality is considered one of the main determinants of manning costs, since there is extreme variability in the wages and salaries received by crews of different nationalities. A comparison of these wide disparities in the rate of pay is demonstrated in Table 5.4, which summarises average manning costs per crew member for various crew nationalities under European and convenience flags. It should be noted that in 1973 there were wide variations in cost levels between crew nationalities. Danish crews involved the highest costs per man, 24,000 per annum, while convenience flags with third world crew could operate for only 4,700 per annum. By 1982 Spanish crew had the highest manning costs, at 43,100 per man versus 23,400 per man for third world crew.

Another study showing the wide variation attributable to crew nationality was conducted by Eyre. It was found that crew costs for an American-flagged ship exceeded those of a Canadian-flagged ship by 86.7 percent. Crew costs on a Canadian-flagged ship exceeded those on a Liberian-flagged ship by 200 percent (1989:179)

Table 5.4

National Manning Cost Levels 1973 - 1982

(Total manning costs per crew member $p.a)

	1973	**1982**
<u>European Flag</u>		
Finnish crew	10,600	36,800
Danish crew	24,000	NA
German crew	16,300	35,600
Mixed crew	9,300	35,700
Average	12,300	35,900
<u>Convenience Flag</u>		
Spanish crew	NA	43,100
Mixed crew	7,600	32,000
Third world crew	4,700	23,400
Average	6,600	27,900

Source: Drewry Shipping Consultants Ltd, Dry Bulk Operating Costs 1984,3.

The result of a recent study, conducted by Drewry (1992) indicating the variation in manning costs by nationality is given in Table 5.5. It should be observed that Far Eastern officers and crew were the highest costs per man, 38,200 per annum followed by European officers and crew with an average cost per man of 32,200 per

annum. At the lower end of the scale, Indian officers and crew cost only 11,100 per man per annum.

Table 5.5

Average Crew Size and Manning Costs per Crew Member For Bulk Carriers in 1990

Nationality Officers/crew	Average Crew Size	Average No. Paid Leave	Costs/Man (US$000's p.a)
N.Europe/Asia	25	6	28.3
S.Europe/S.Europe	28	12	32.2
Far East /Far East	24	6	38.2
India / India	43	6	11.1

Source: Drewry Shipping Consultant Ltd, Trading Prospects, 1992,90.

Finally, regulations regarding social security and pension payments, can have a significant effect on the level of crewing costs. It is well known that social insurance and pension benefit requirements are much higher in the developed countries than in the developing countries. A comparison of these effects is presented in Table 5.6, which indicates the average proportion of social insurance and pension expenses in crewing costs for different flags and crew nationalities. It should be observed that social insurance and pension benefits accounted for 21.5 percent of crewcosts on a French-flagged ship. On aGerman-flagged ship,the proportion dropped to 14.5 percent, while the proportion dropped to 5.5 percent for a typical third world country crew. In addition, the proportion of social insurance and pension

expenses in total manning costs changes from one period of time to another for the same country. For insurance, in 1973 the proportion of insurance/pension expenses on a French crew were 15.3 percent of total manning costs compared with 21.5 percent in 1981.

Table 5.6

Proportion of Social Insurance/Pension Expenses in Total Manning Costs

	1973/4 %	1980/81 %
European Flag		
French Crew	15.3	21.5
German Crew	31.8	14.5
Danish Crew	6.1	7.0
Mixed Crew	11.2	13.8
Average	14.7	15.3
Convenience Flag		
Italian Crew	11.5	11.7
Mixed Crew	5.3	9.5
Third world Crew	4.4	5.5
Average	6.3	10.8

Source: Drewry Shipping Consultant Ltd. Tanker Operating Costs, 1983,15

To sum up, a crew cost comparison of vessel type, crew size and composition is given in Table 5.7. It can be seen that bulk carrier manning costs under the Korean flag were $34,900 per month, compared with $39,800 per month for tanker vessels. Technology also has the potential to affect crew size and crew composition.

A statistical regression analysis carried out by Foss for passenger and cargo vessels showed that crew costs are a function of the length of the ship, total

sailing distance and speed of the ship. Correlation coefficients for passenger and cargo vessels were .96 and .82 respectively. The study concluded, that crew costs for passenger ships of a given size and utilisation are 50 percent higher than for similar cargo ships (1969:207).

Table 5.7

Crew Cost Comparison of Vessel Type, Crew Size and Composition

	Costs (US$ per Month)
(a) Bulk Carrier/Tanker (10 Officers/14 Ratings)	
Norwegian International/Filipino	33,600
Filipino	33,800
Norwegian International/Indian	32,600/35,300
Korean	34,900/39,800
Greek	49,800
Spanish	52,500/55,100
(b) Refrigerated Cargo (9 Officers/9 Ratings)	
Indian/Bangladeshi	23,600
Filipino	27,900
European/Indian/Chinese	34,300
(c) Short Sea (4-6 Officers 9 Ratings)	
Hong Kong	17,900
Greek	21,100
British	35,700

Source: Drewry Shipping Consultant Ltd, Second Hand Ship, 1992,50

Jansson and Shneerson studied the relationship between crew costs and ship size. The coefficient of determination $R^2 = 0.003$ was a very trivial value. Therefore the size coefficient did not reveal any significant relationships between size and crew costs (1987:131). In contrast, Tolofari found that manning costs varied considerably

with variation in size, for bulk and tanker carriers. The coefficients of determination were 0.80 and 0.79 respectively (1989:150). The regression equations for bulk and tanker carriers respectively were:

$$\text{Manning cost} = 1685.81\ X^{-0.912} \text{ for Bulk carriers.}$$

$$\text{Manning cost} = 2465.13\ X^{-0.928} \text{ for Tankers}$$

Where: X = Ship size.

One can infer from these studies that many factors could determine crew cost, among them crew nationality, vessel size and composition of the crew. However, the most important factor is crew size.

5.5 Stores and Supplies Cost

This cost element includes all expenditure on consumable supplies and spare parts, marine and deck stores, engine room stores and steward's stores.

Marine and deck stores include specific needs and routine requirements. The former are related to drydocking. Routine store requirements include paints, safety equipment, ropes, wires and fresh water.

On the other hand, engine room stores consist of lubricating oil, spare parts, gaskets, electrical items, gases and chemicals. The cost of lubricating oil has become the most significant element of the expenses, especially in diesel-engined vessels such as bulk carriers, which consume up to 400 litres of lube oil per day at sea (Drewry,

1984:7). Consequently, stores and lubes expenses are lower for larger turbines than for small-sized motor ships. Vessel's engine type will also influence the cost of lubricating oil. The proportion of lubes and spares accounts, on average, for around 10-12 percent of total operating cost (Drewry, 1990:69). Steward's stores cover many items such as cleaning materials, ship-board administrative necessities, galley supplies, laundry needs and recreational needs. Stores and supplies are determined by vessel size and type (Drewry 1990:68) and changes in repair costs (Drewry, 1983:16). Drewry shipping consultants (1990) estimated annual stores and supplies expenses as presented in Table 5.8 for different kinds of vessel. It should be noted that this was a set of broad-brush cost levels.

A statistical analysis carried out by Tolofari (1987) for bulk carriers and tankers revealed that stores and supplies were determined by ship size and age. The coefficients of determination R^2 were 0.72 and 0.62 respectively. The study concluded that the explained variation had fallen in the case of tankers due to the unimportance of lubricating oil for steam-turbine ships against diesel-engined ships for bulk carriers (1989:157).

The regression equations were:

Bulk carriers - Stores and provisions = $165.57\ X_1^{\ -0.65}\ X_2^{\ -0.084}$

Tankers - Stores and provisions = $212.72\ X_1^{\ -0.85}\ X_2^{\ -0..249}$

Where:

X_1 = Ship size per 1,000 dwt

X_2 = Age.

It can be concluded that stores and supplies could be affected by many factors such as vessel size, type and age.

Table 5.8

Estimated Annual Outgoing on Stores and Supplies

($US 000's)

	Lubes*	**Other**	**Total****
1. Dry Cargo * **			
<10,000 dwt	25-50	25-50	85
10-50,000 dwt	20-60	40-125	120
50-100,000 dwt	35-120	50-150	160
>100,000 dwt	75-200	75-400	325
2. Container/Ro-Ro			
Deep Sea	25-100	45-125	110
3. Refrigerated Cargo Ship			
Deep Sea - Small/Medium	50-100	60-120	155
4. Tankers			
<10,000 dwt	15-20	15-30	45
10-40,000 dwt	40-80	40-125	175
40-100,000 dwt	40-135	70-400	275
100-200,000 dwt	40-160	70-500	500
>200,000 dwt	10-250	30-500	550

* Machinery and equipment
** Representative estimate
*** Bulk carriers and tween deckers

Source: Drewry shipping consultants. Ship Cost, 1990,68

5.6 Maintenance and Repair Costs

Maintenance and repair costs can be defined as those expenses related to the activities associated with repair and general upkeep of a ship to maintain it sea-worthy according to the standards specified by international insurance organisations and also according to national safety standards in which the ship is classified. (Drewry, 1991,17) It includes routine maintenance costs and ship survey, i.e. annual survey, special survey and dry dock survey.

Routine maintenance work could be undertaken by the crew. Poor quality work or failure to comply with normal maintenance procedure may increase the cost of subsequent docking. Maintenance and repair costs vary considerably with vessel size, type, age, condition of the vessel, (Drewry, 1992:51) and also with the owner's operating policy. (Tolofari, 1989:129).

Ship survey can be done annually, or every two or five years depending on the standard in which the ship is registered. Dry dock maintenance typically is the most costly form of ship maintenance. The costs associated with dry dock maintenance are approximately five times greater than those associated with operational maintenance. Ship age has a major influence on repair and maintenance costs (Drewry, 1991:19). The approximate costs of maintenance and repair as a proportion of a ship's original construction price are presented in Table 5.9. The age of the vessel will also affect

time in dry dock. Older vessels need more special survey, which takes time, than newer ships.

Table 5.9

Maintenance and Repair Costs as Function of Ship Age And Original Construction Cost

Age of Ship	Maintenance and Repair Costs as a Proportion of Original Cost of Ship Construction (%)
0 - 1 years	1.0
1 - 2 years	1.0
2 - 3 years	1.5
3 - 4 years	1.5
4 - 5 years	1.5
5 - 6 years	4.0
6 - 7 years	5.0
7 - 8 years	6.0
8 - 9 years	7.0
9 - 10 years	8.0
10 - 11 years	9.0
11 - 12 years	10.0
12 - 13 years	11.0
13 + years	12.0

Source: Drewry Shipping Consultants Ltd. Tanker Operating Costs 1991,19.

Another study conducted by Drewry (1992) showed that maintenance costs are also affected by ship size and type. Table 5.10 illustrates different cost levels of maintenance and repair as a function of ship size and type. It should be noted that dry bulk carriers are less expensive to maintain than tankers due to the extra costs of pipe

work and internal tank coating. Maintenance and repair costs increase with size but the trading circumstances of the ship will reverse this.

A regression analysis covering 56 ships carried out by Foss showed that maintenance costs were a function of length of the ship, sailing distance, cruising speed and output of main engine. Although the correlation is 0.84, a fair relationship is indicated.

Table 5.10

Maintenance and Repair Costs as a Function of Ship Size/Type

($US 000's per annum)

	Bulk Carrier DWT			Tanker DWT		
Year	**25,000**	**60,000**	**120,000**	**30,000**	**80,000**	**250,000**
1980	180	258	353	322	394	686
1981	212	349	378	477	673	830
1982	246	276	316	296	599	585
1983	195	206	221	154	245	252
1984	135	260	287	228	177	334
1985	108	165	228	245	275	410
1986	105	171	242	262	300	437
1987	125	170	240	220	230	275
1988	185	267	345	289	319	483
1990	207	298	386	323	482	657

Source: Drewry Shipping Consultants Ltd, Second Hand Ship, 1992,51

Whereas maintenance costs for the hull were constant regardless of utilisation, engine maintenance varied in proportion to utilisation. (1969:205) The regression equation was as follows:

$$VK = L^2 \left(0.00015 + 0.000005 \cdot \frac{D}{V}\right) + 0.55 \cdot (\log BHP) \cdot \frac{D}{V} - 2.5$$

Where:

VK = Maintenance costs (£000)

L = Length of the ship (feet)

D = Sailing distance (1000 nautical miles)

V = Cruising speed (knots)

BHP = Output of main engine

Tolofari studied the relationship between maintenance and repair cost and the vessel size and age. The study revealed that although the coefficients of determination R^2 were relatively small for bulk and tanker carriers, at 0.38 and 0.32 respectively, the predictors were very significant at the 5% level (1989:157). The regression equations were:

Bulk Carriers Repairs and Maintenance = $50.40\ X_1^{-0.518}\ X_2^{0.466}$

Tankers Repairs and Maintenance = $713.37\ X_1^{-0.904}\ X_2^{0.023}$

Where:

X_1 = Ship size per 1,000 dwt

X_2 = Age.

Finally, it may be concluded that this cost element can vary considerably among ships of the same size, due to a number of factors such as ship age, original construction cost, ship size and type as well as management policy.

5.7 Fuel Costs

Fuel, broadly speaking, embraces any substance which by its combination with oxygen evolves heat. It is the source of propellant power. Such fuel may be oil, coal, or nuclear power either to power engines directly or to generate steam to power engines to propel a ship. The nature and quality of solid fuel, namely coal, in respect of its heating value vary according to origin.

Liquid fuel is used either in its crude state or after it has been processed into distillates and residual fuel oils. Distillates include diesel oil, used to power some ships, while residual fuel oils include heavy fuel oil used to power other ships. Oil fuel is chemically composed of the same elements as coal, but hydrogen content is much greater. The proportion of fuel costs to total ship operating costs varies widely as a consequence of multiple factors such as oil prices, engine power and type, the size, operating speed of the ship (Stubbs, 1990:79). However speed is the most important determinant of fuel costs (Chrzanowski, 1987:76). In 1988 a study carried out by Stopford Martine showed that fuel accounted for 34 percent of total cost for a 70,000 dwt bulk carrier.

Diesel engines and steam generating turbine engines are the most frequently used engine types in ocean shipping. Diesel engines consume less fuel per hour (160 gallon per horse power per hour) than do turbine engines (200 gallons per horsepower per hour). Daily fuel consumption comparisons for steam turbine engines and diesel engines are presented in Table 5.11

Table 5.11

Fuel Consumption Comparison: Steam Turbine and Diesel Engine (tons per day)

Design shp	Marine Bunker	Marine Diesel
10,000	55	40
20,000	102	79
30,000	142	117
40,000	179	147

Source: Frankel, Management and Operation, 1989,166

Lavon and Shneerson have studied the relationship between fuel consumption and speed. Their objective was to derive a formula of optimal speed which would minimise fuel consumption per mile. This study was based on logical relationships under certain specific assumptions, and not on actual data (1981:31).

One study by Sletmo and Williams found that a fleet operating at an average speed of 22 knots was more costly to operate than was a fleet operating at an average speed of 18 knots. Fuel costs for the 22 knots fleet were 83 percent higher than for

the 18 knots fleet, while other operating costs were 9 percent higher for the 22 knot fleet than the 18 knot fleet (1986:130).

Another study by Stopford revealed that a reduction in the operating speed from 16 knots to 11 would result in a two-thirds saving in the fuel tonnage consumption per day (see Table 5.12).

Table 5.12

Fuel Consumption for Panamax Bulk Carrier

Speed Knots	Main Engine Fuel Consumption (Tons/Day)
16	55
15	45
14	37
13	29
12	23
11	18

Source: Stopford, Martin, Maritime Economics, 1988,111

A sound way to reduce fuel consumption, and thus fuel costs, is to reduce ship speed. Lower ship speed, however, must be justified by open market demand for the transport of cargo at lower speed. A comparison of ship speed, daily travel mileage and daily fuel consumption by Packard found that fuel consumption per mile travelled is cheaper at lower speed than in the case of higher speed. Table 5.13 reveals that at

15 knots, fuel costs per mile travelled were 152.8 pounds, compared to 91.7 pounds at 8 knots.

Jansson and Shneerson have estimated the elasticity of fuel consumption with respect to ship size by choosing a sample of different ship sizes (1987:132). The fuel cost equation was:

$$\text{Log fuel cost} = \text{Log } 6.25 + 0.72 \text{ Log } S$$

Where:

S = ship size

Table 5.13

Speed, Mileage and Fuel Consumption

Speed Knots	Daily Mileage	Daily Fuel Consumption tons	Fuel Consumption per Mile Travelled Pounds
15	360	25	152.8
12	288	18	137.5
10	240	13	119.9
8	192	8	91.7

Source: Packard, The Ship, 1984,13

Finally, Rotterdam transport centre carried out a statistical study to see the optimum size of container ships and the impact of user cost. This paper determined fuel consumption as a function of speed and ship size. (1991,57).

It may be concluded from these studies that speed is a factor directly affecting fuel consumption as well as ship size and engine types.

5.8 Stevedoring Costs and Agency Fees

Stevedoring costs are related to handling labour costs of the cargo itself. They will vary considerably according to the system of payment (Chadwin, Pope and Talley, 1990:87). If the shipper is at "gross terms" the shipowner pays for loading and unloading. In this case, freight rates are adjusted to cover them. If the shipper is on F.I.O. "free-in-and-out" terms, there is no charge to the shipowner for loading and unloading; in this case, freight rate would be for carriage only. "Free discharge" means that the shipowner pays for loading and discharging is charged to the shipper. On the other hand, agency fees are related to gross registered tonnage (Drewry, 1990:98). As stevedoring costs are labour costs, they vary from port to port according to the method and speed of working and the type of cargo. Table 5.14 reveals Los Angeles and New Orleans cost guidelines. It should be noted that bulk cargoes appear at the low end of the cost scale. The greatest cost is for containerised cargo, because of the nature of the various services required to load, discharge, and, perhaps restow at each port of call.

A regression analysis by Foss revealed that agents' fees were a function of passenger fares and freight rate (1969;211). The correlation coefficient was high, 0.99. The equation was:

$$PG = 0.072 .Ip + 0.128 Ig + 0.4$$

Where:

PG = Commission (£000's)

Ip = Passenger Fares (£000's)

Ig = Freight (£000's)

Table 5.14

Cargo Handling Cost Tariff

Los Angeles Cost Guidelines		**$ US**
1. Containers	20ft or 40ft full or laden, cellular vessel, grounded operations	110-135 per unit
2. Dry bulk cargo	Self trimming bulk carriers, say, working coal or petroleum coke	4.5-6 per tonne
3. General cargo	Steel Products	15-20 per tonne
	Others	25-35 per tonne
New Orleans Cost Guidelines		
1. Containers	20ft or 40ft	90-115 per unit
	plus Yard throughput charge	50
2. General Cargo	Approximately	20 per ton
	(Less for palletised cargo)	16-17 per ton
	Terminal Fees	
	(Warehousing,clerking) add	3-5 per ton

Source: Drewry Shipping Consultant Ltd, Ship Costs, 1990,108

Foss also related commission to the number of tons and number of passengers carried. The correlation coefficient was 0.91 and the equation was:

$$PG = 0.31 .P + 2.85 .T-3.0$$

Where:

P = Number of passengers (000's)

T = Quantity of cargo (tons 000's)

On the other hand, Kendall studied the relationship between cost per ton of cargo handled and ship size, assuming that larger ships would be handled by new, larger and faster equipment. Finally he concluded that handling costs per ton increase linearly with increasing ship size and inversely with increasing total annual tonnage (1972:131)

5.9 Port Costs

Port charges are levied on the vessel for the general use of port facilities i.e. pilotage, tuggage, dockage, port dues and line handling (Bureau of Transport, 1980 :66).

Pilotage fees are based on vessel size. Tuggage is a service for towing the vessel and the charge is based on vessel size and number of tugs and hours. Dockage is the charge for using the space alongside a wharf in which the ship ties up and is based on the gross registered tonnage of the ship as well as the number of days in port loaded and unloaded. Port dues based on the vessel size are levied on each visit. Finally, line handling is the tying and untying of the vessel to or from a wharf.

Some elements of port charge do not vary with length of stay in port, such as tuggage and pilotage.

Other costs, such as dockage, vary with the number of days the vessel would occupy. Drewry (1990) presented port disbursements for vlcc of 175-300,000 dwt. Table 5.15 reveals that there is considerable disparity in disbursement levels

depending on geographical location. The disparity between loading figures for Saudi Arabia and UK is striking.

Table 5.15

Representative Port Disbursements for VLCC's (175-300,000 dwt)

	Domestic	$ US
(a) Loading		
Iran : Kharg Island	IR 7-9.5 million	97-132,000
Sirri	IR 8-9 million	111-125,000
Saudi Arabia : Ras Tanura	SR 125-130,000	33-35,000
Sweden : Brofjorden	SK 600-875,000	93-136,000
Norway : Mongstad	NK 675-700,000	100-105,000
UK : Sullom Voe	£ 95-105,000	155-172,000
(b) Discharging		
Japan:	Y 9.5-10.5	68-76,000
Bahamas: South Riding Point	million	32-37,000
US Gulf : Offshore	BD 40-45,000	3-7,000
S.Africa : Durban (sbm)	-	19-21,000
Brazil : Angra dos Reis	SAR 50-55,000	35-40,000
Netherlands: Rotterdam	-	212-260,000
	DFL 450-550,000	

Source: Drewry Shipping Consultants Ltd; Ship costs, 1990,99

Foss has studied the relationship between port dues, size of ship and number of calls. He found that there was a poor relationship between them. Therefore, length of the vessel was used instead. The equation giving a correlation coefficient of 0.63 was as follows:

$$H = 0.015 .L .M + 0.17$$

Where:

H = Port dues per year (£000's)

M = Number of calls (000's)

L = Length of ship (feet)

It can be concluded that the factors which affect port charges are vessel size and length of the vessel (1969:209)

5.10 Administration and Miscellaneous Cost

Administration expenses consist of the owner's administrative overheads such as head office expenses and shore staff salaries as well as management fees paid to ship management. The administrative functions of shipping companies include planning and marketing, accounting, organising, controlling and monitoring the different ships, support functions such as bunkering, crew selection, dealing with agents to organise crew repatriation and determining areas of responsibility between onboard and shoreside department, as well as the establishment and supervision of ship maintenance and repair plans. On the other hand, miscellaneous expenses consist mainly of several smaller items (Drewry, 1990:80)

Management and miscellaneous costs can vary considerably amongst companies, according to the size and composition of the fleet, the location of the

management company and whether or not the company is self-managed. However, the primary cause of variation is fleet size (Tolofari, 1989:136).

Table 5.16

Dry Bulk Carriers Average Administration Cost Comparison

North European Flag and Convenience Flag

	1981	1982	1983
Convenience Flag			
± 25,000 dwt	145	170	175
± 40,000 dwt	165	180	190
± 60,000 dwt	180	190	200
±120,000 dwt	210	200	210
North European Flag			
± 25,000 dwt	160	180	160
± 40,000 dwt	180	200	190
± 60,000 dwt	185	220	215
±120,000 dwt	200	230	220

Source: Drewry Shipping Consultants Ltd. 1984.11

A comparison of average administration costs for North European and Convenience flags is given in Table 5.16. It is noticeable that administration expenses under North European flags are higher than for convenience flags.

A statistical regression analysis carried out by Foss showed that sundry ship and service costs were a function of ship length and yearly sailing distance (1969:211). The correlation coefficient was 0.84 and the sundry cost equation was:

$$DT = 0.065 .L + 0.00025 .L .D - 7.6$$

Where:

DT = Sundry ship and service costs (£000's)

L = Length of ship (feet)

D = Yearly sailing distance (000's n.miles).

Tolofari studied the relationship between administration cost and the vessel's size and age. The study showed that R^2 value for bulk carrier administration costs was relatively smaller than those of tankers, 0.26 and 0.72 respectively. The administration cost regression equations were:

For Bulk Carriers: Administration costs = $90.92\ X_1^{-0.615}\ X_2^{-0.050}$

For Tankers: Administration costs = $1286.91\ X_1^{-1.09}\ X_2^{-0.191}$

Where:

X_1 = Ship size per 1,000 dwt

X_2 = Age

5.11 Summary and Conclusion

This chapter examined in detail the factors that affect each of the cost elements in order to determine which factors are more effective than others and to achieve effective control of each of the cost elements.

For each voyage, depreciation cost represents that voyage's share of annual depreciation. Several studies have been carried out to assign and measure the factors

which affect depreciation charges. It was concluded from these studies that the amount of depreciation is dependent upon many factors such as vessel size, shaft horsepower and time charter (voyage days).

Insurance costs consist of all premiums paid for the ship's hull and machinery for total loss and damage and protection and indemnity. Insurance premium levels depend upon a wide variety of factors. These factors include the value of the ship, propelling machinery, flag and classification society, area of operation, condition of insurance and performance record of the ship's operator.

On the other hand, crew costs include all items related to the manning of the vessel such as basic wages, social insurance, pension, overtime payments and victualling costs. Crew costs are weakly dependent upon vessel size and type; however, flag of registry, the size and composition of the crew, crew nationality and conditions of service have a major impact on crew costs. It was found that crew costs for an American-flagged ship exceeded those of a Canadian-flagged ship by 86.7 percent. Crew costs on a Canadian-flagged ship exceeded those on a Liberian-flagged ship by 200 percent.

Stores and supplies cost include all expenditure on consumable supplies and spare parts, marine and deck stores, engine room stores and steward's stores. A regression analysis carried out by Tolofari for bulk carriers and tankers revealed that stores and supplies were a function of ship size and age.

Maintenance and repair costs can be defined as those expenses related to the activities associated with repair and general upkeep of a ship to maintain it sea-worthy according to the standards specified by international insurance organisations and also according to national safety standards in which the ship is classified. Maintenance costs are affected by ship size and type; however, ship age has a major influence on maintenance and repair costs.

Fuel, broadly speaking, embraces any substance which by its combination with oxygen evolves heat. The proportion of fuel costs to total ship operating costs varies widely as a consequence of multiple factors such as oil prices, engine power and type, the size, operating speed of the ship; however, speed is the most important determinant of fuel costs. One study by Stopford revealed that a reduction in the operating speed from 16 knots to 11 knots would result in a two-thirds saving in the fuel tonnage consumption per day.

Stevedoring costs are related to labour costs for the handling of the cargo itself. They will vary considerably according to the system of payment. As stevedoring costs are related to labour costs, they will vary from port to port according to the method and speed of working and the type of cargo. On the other hand, agency fees are related to gross registered tonnage.

Port costs are levied on the vessel for the general use of port facilities such as pilotage, tuggage, dockage, port dues and line handling. Foss has studied the relationship between port dues, size of ship and number of calls. He found that there

was a poor relationship between them. Therefore, the length of the vessel was used instead.

Finally, administration expenses consist of the owner's administrative overheads such as head office expenses and shore staff salaries as well as management fees paid to ship management. On the other hand, miscellaneous expenses consist mainly of several smaller items. Management and miscellaneous costs can vary considerably amongst companies, according to the size and composition of the fleet, the location of the management company and whether or not the company is self-managed. However, the primary cause of variation is fleet size.

Chapter Six

Description and Analysis of Cost Systems in Shipping Companies in the Kingdom of Saudi Arabia

6.1 Introduction

The researcher designed a questionnaire comprising 23 questions (Appendix No.1), which covered all elements of cost systems of the shipping companies in the Kingdom of Saudi Arabia, with a view to identifying whether these elements were present in actual practice, and to provide the necessary background to analysis of the actual cost structure produced by those systems. Aspects covered by the questionnaire included procedures, cost statements, cost element analysis and the use of cost reports. The results obtained from that questionnaire will be presented in this chapter.

The number of sampled companies was 21, out of 36 companies that own and operate vessels in the Kingdom. (Lloyd's, 1987:318) Of these 21 companies, 18 replied to the aforesaid questionnaire, a response rate of 86%, which is a high percentage. Hence, the results obtained and presented herein may be considered highly representative of the attitudes and practices of the whole of the sector under study. The following sections summarise the results of the analysis of responses of the sample companies to each question in the questionnaire. The discussion will show the profile of costing systems in Saudi shipping companies.

6.2 Questionnaire Responses

6.2.1 Chart of Cost Accounts

It is well known that the chart of accounts is a list that sets in logical numbered order the cost accounts so that they can be easily referred to in the accounts

books or on the computer, if any. The existence of a chart of cost accounts is considered a preliminary evidence of the existence of an advanced accounts system. Organisations which have advanced account systems rely on such a guide for recording entries, posting carrying over and preparing the trial balances. Besides, such a guide is a guideline for all accountants, which clarifies the meaning and concept of each account, leaving no room for personal guessing or estimation.

The number of companies in the study sample that had a chart of cost accounts was 8 out of 18, that is 44%, which is somewhat low. This could indicate that there is no independent cost system at all in these companies or that such a system is merged with the financial accounts and that cost statements are obtained by making an external analysis of those accounts. Hence, the researcher suggests that the companies which did not have charts of cost accounts had, as yet, no formal cost accounting system.

6.2.2 Use of Computer in Cost Department

The use of computers has become widespread in accounting departments in general, due to the accuracy, speed and low operational costs of computerised systems when compared with manual accounts systems. Of course, the use of computers requires capital outlay in the hardware as well as in the purchase of appropriate software, specifically prepared for cost accounting purposes. It is also necessary for accountants to be trained in the operation and manipulation of such advanced

systems. Nonetheless, this will be a very cost-effective investment in the long term, if the operational costs are low. However, because of the high capital outlay involved at the outset, the researcher anticipated that small and medium-sized companies or business firms may be deterred from installing computers. The responses to the questionnaire revealed that 10 companies out of 18 used computers (55%) while the remaining 8 companies did not. The researcher is of the view that the non-use of computers in those companies may be due to the high initial costs of introducing computer systems and converting from the conventional manual systems.

6.2.3 Accounting Manual

The accounting manual is considered the basic reference guide of accountants regarding the documentary cycle and accounting procedures. It indicates the documentation involved for each operation, and the relevant procedures, such as auditing and approval. It also indicates the accounting procedures for each document such as recording in the accounting books, accounting treatment of expense and revenue items, end of period adjustments and closing. Without such an accounting manual, many differences in the handling or treatment of a single item may be expected or the accounting work may even break down, if the staff are inexperienced in accounts work. It is most useful to new employees, since it indicates the forms to be used and the routes they will follow.

The existence of the accounting manual is a strong and significant indication that the accounting system is correct. In the sampled companies, it was found that 12

companies out of 18 (66%) had an Accounting Manual, while the other 6 did not. It is suggested that the lack of an accounting manual reflects a significant weakness in the accounting systems.

6.2.4 Cost Statements

Cost statements are the main outputs of any cost system. They indicate the cost elements of any specific activity or product, at departmental level, or on the level of the organisation as a whole. Nevertheless, cost statements must be attached to responsibility centres in order to realise the objectives of planning, control and performance evaluation. It was found that only 10 of the sampled companies prepared cost statements, and surprisingly, the other 8 did not, which raises the question, what is the purpose of cost systems in such companies? Is it merely to record transactions, without preparing reports? It looks as if that may, in fact, be the case, because it is likely that such companies have only one accounting system, namely a financial accounting system, which records transactions and movement of cost elements and serves the purpose of preparing financial statements at the end of the year.

Cost statements indicated in the replies of the study sample were as follows:

A. Cost statements of the operation of vessels (according to type).

B. Cost statements of voyages.

C. Reports of administrative expenses of vessels.

D. Reports of fuel consumption at sea and in ports.

E. Comparative statements for actual costs and estimated costs.

F. Statement for analysing costs into direct and indirect.

It was noticed that different names are given to cost statements or cost reports by various companies. It was also noticed that only two companies prepared comparative statements of the actual costs against the estimated costs for each ship. Comparative reports of this type have various advantages to those companies which use them, because they facilitate tighter control. The researcher noticed also that there were no comparative cost reports for each line, but instead, only "income statements" for each line, showing the result of the operation of each line. Most such reports are prepared on a monthly basis and/or after the completion of each voyage.

Finally, the researcher noticed that there was no classification of cost according to relation to volume of activity, that is, fixed and variable costs. Therefore, the analysis of Saudi shipping costs to fixed and variable will be considered in Chapter Eight.

6.2.5 Cargo Cost Elements

Cargo cost elements are different from costs of the voyage or vessel operating costs, as they are related to the cargo itself. For many reasons, knowing these costs is essential, in the first place, because they can be charged separately to clients, apart from transportation costs. Some goods need special care in handling, loading, unloading and stevedoring. Therefore, knowing the costs related to these operations

is important when invoicing the cargo owners and compiling their accounts. However, only 12 companies out of 18 under study replied to the inquiries about the classification of cost elements related to cargo, as follows:

A. Loading and unloading expenses.

B. Rental expenses of loading and unloading equipment.

C. Cargo ports charges.

D. Insurance premiums and protection clubs' expenses.

E. Shipping agents' commissions.

F. Trans-shipment and land transportation expenses.

G. Containers' rental expenses.

The aforesaid replies give an indication of the cost elements pertaining to cargo which are of a different nature from the vessel operational costs and voyage costs.

6.2.6 Cost Elements Related to Passengers

Only four companies of the study sample replied to the question related to this topic. Their answers revealed that the cost elements related to passengers are as follows:

A. Water consumption.

B. Passengers' transportation expenses within the seaport.

C. Costs of passengers' catering.

D. Housing costs in the ship.

E. Medical treatment for passengers.

F. Agents' commissions.

G. Passengers' luggage transportation expenses.

The aforesaid elements are of a special nature, as they are related to the number of passengers and they are different from voyage costs and vessel operation costs.

6.2.7 Elements of Vessel Operating Costs and Voyage Costs

Vessel operating costs are those elements that make the vessel ready to make voyages. They are different from voyage costs. The researcher discovered that there was some confusion on the part of cost accountants in maritime shipping companies about these two different elements. Thirteen companies considered the voyage costs as part of the vessel operating costs and did not differentiate between them. Only 5 companies made an accurate distinction between the vessel operating costs and the costs of the individual voyage. These elements are as follows:

First: Vessel Operating Costs

A. Costs of crew including wages, catering, treatment and transportation.

B. Maintenance and repair costs which include lubrication oil.

C. Consumable materials for the deck, the machinery and the cabins.

D. Nautical equipment.

E. Depreciation and vessel insurance premium.

Second: Voyage Cost Elements

A. Port Fees

B. Maritime canal dues.

C. Cost of fuel during sailing and at the ports.

D. Cost of water consumption.

The researcher found out that some companies added the cargo-related costs to the voyage costs, while others did not. Perhaps the reason is that in the former cases, the "freight rate" was inclusive of cargo-handling costs and consequently the shipper did not pay such costs separately from the freight rate, while in the latter case, the cargo costs were borne by the shipper, and as such were not included in the voyage costs.

6.2.8 Overhead Expenses Allocation

Overhead expenses cover the other costs, excluding the vessel operating costs and the voyage costs, that is, the administrative, marketing and general marine expenses which are applicable to all vessels. The researcher found that there were differences among companies with regard to the allocation of these expenses among

ships and also in the method of allocating them among the voyages. The following table (6.1) based on the empirical study, shows the basis and methods of allocation of these expenses:

Table 6.1

Basis of Allocating Overhead Costs to Voyages

Company	Basis of Allocation Among Vessels	Method of Costing Each Voyage
1	The number of operation days per year of all vessels	The daily average for all vessels X the number of days on both legs of the round trip
2	No allocation	No allocation
3	The number of operation days per year of all vessels	The daily average for all vessels X number of days of the round trip on both legs
4	No allocation	No allocation
5	Based on the number of vessels	The daily average of each ship X the number of days of the round trip
6	The ratio of total direct* and indirect costs of each vessel to the total of all vessels	The number of trips
7	No allocation	No allocation
8	The ratio of vessel's cargo to the total cargo of vessels	The daily average of each vessel X the number of days of the round trip
9	Vessel's distance against total distances of vessels	The single mile's average X the distance of the round trip in miles
10	No allocation	No allocation
11	No allocation	No allocation
12	No allocation	No allocation
13	The number of voyages of all vessels	The share of each voyage
14	Number of operation days of all vessels per year	The daily average of all vessels X the number of days of the round trip
15	No allocation	No allocation
16	No allocation	No allocation
17	Arbitrary Percentage	Arbitrary Percentage
18	Arbitrary Percentage	Arbitrary Percentage

* They are direct expenses of vessels such as depreciation, but they are indirect to voyage.

It can be seen from the above table that there were great differences in the basis of allocation of overhead expenditure, among those companies which allocated expenses. Some companies adopted a time basis, while others adopted distance or cargo. In the researcher's opinion, these differences are attributable to subjective and personal views of the accountants in these companies and do not have any objective basis.

It was noted also that some companies do not allocate the overhead expenses at all. The whole matter is connected with the well-known issue in accounting literature, namely, the common cost allocation problems. There have been many views regarding the question as to whether it is necessary to allocate overhead expenses. There are two options here:

(a) to allocate overhead expenses, or

(b) not to allocate overhead expenses.

If they are not allocated, the expenses are not linked directly to actual running costs or to the voyage, on the ground that they are linked to the existence of the organisation and are dealt with in the profit/loss account. In fact these elements here are not considered as costs or expenses, but as a frequent burden which occurs whether vessels are operated or not. The other option requires that such elements

target net profit by allocating each of the overhead expenses and the overall target net profit among the profit centres. In other words, allocation is considered a planning and control tool as each profit centre has a pre-set plan against which the actual results are measured, in order to see whether the concerned centre has earned enough revenues to cover the direct costs of the profit centre itself, in addition to its share of the overhead expenses and also its share of the target profit. The researcher supports the second option because allocation in this case is considered a means for urging the profit centre to work towards realising the targets of the organisation as a whole, rather than simply those of individual departments.

The important question to raise, then, is how to allocate those overhead expenses? So far there is no one single reply to this query in accounting literature. It seems that agreement on this issue is still far from being achieved. Yet the researcher is of the opinion that it is essential to have a logical rule for choosing the allocation basis. In this context it may be suggested that the most appropriate allocation basis is that whose application or implementation contributes to realising maximum efficiency of the organisation.

The importance of cost allocation, whether they are overhead expenses or indirect costs of the voyage, arises when obtaining a quotation for making a specific voyage, or when considering opening a new regular marine line. The determination

of such costs, whether they are direct or indirect for the ship or the voyage can play an important role in sound decision-making on such issues.

6.2.9 Joint Cost Allocation

After allocating the overhead expenses on the vessels and determining the round trip share, the resulting allocated share is added to the operation costs and the voyage costs. The total is what is called "joint costs" of the two-way trip. However, still there is a problem here regarding the joint costs, namely, is it necessary to allocate them between the two legs of the trip or not?

The researcher believes it is essential for the purpose of determining the shipping costs of each separate shipment to allocate the joint costs between the two legs of the trip, because the number and kind of shipments differ from one leg to another. Besides, such cost information might be necessary for the shipping company when preparing quotations, pricing or rates amendments in the shipping conferences. The most important problem here, is how to allocate such joint costs. The researcher found that 5 companies out of the 18 sampled companies did make such allocation while 13 companies did not do so. (See Table 6.2)

The following Table (6.2) shows the basis of allocating joint costs between both legs of the trip:

Table 6.2

Allocating Joint Costs Between Both Legs of the Trip

Company	Basis of allocation
1	Direct costs are allocated on the tonnage-revenue basis while the indirect costs are allocated on the number of days basis
2	No allocation
3	No allocation
4	No allocation
5	No allocation
6	No allocation
7	No allocation
8	There is no allocation problem because the departure trip is empty and the return trip is full
9	The basis of allocation is the carried cargo
10	No allocation
11	Allocation is made but allocation basis is not specified
12	No allocation
13	No allocation
14	No allocation
15	Allocation is made but allocation basis is not specified
16	No allocation
17	No allocation
18	No allocation

The researcher is of the opinion that non-allocation of joint costs by the companies in the study-sample may have been justified, because these companies dealt with transportation of general cargo and there were no shipments of different types. Consequently, the transportation cost per ton could be measured by dividing

the total joint costs of both legs by the number of tons transported. Here the question arises of whether this conclusion is valid if the weight of goods on the departure trip is different from that on the return trip. In this case, it is expected that the average cost per ton on the departure trip is different from that on the return trip. No doubt this objection is logical, but the researcher would rather say that all such costs are non-avoidable costs, due to the fact that the occurrence of the departure trip means that there must be a return trip. Consequently, all the goods (cargo) transported on both trips must be charged with equal shares of the joint costs.

As for those companies which allocate joint costs, it was found that there existed a number of different bases of allocation. Some companies used one basis, others used two bases. In addition, these bases may differ in their nature such as the cargo basis, the ton basis and the number of days basis.

6.2.10 Allocating Joint Costs to Shipments

After allocating joint costs to the two legs of the trip the joint costs of the shipments of each single trip are obtained. Whereas the allocation is made to each trip, logically, re-allocation of each trip's share should be made to its shipment in order to arrive at the transportation cost of each shipment.

The researcher found that three companies determined the cost of the shipment, though one of them did not actually need to make such allocation, because

it was engaged in the sheep transportation business, where the departure trip is always empty and the return trip is full. Hence, the costs of the round trip may be considered the transportation cost as a whole. The other two companies carried out the allocation process in order to determine the cost of each single shipment. One of the said companies indicated that the allocation process depended on the kind of shipment, which seemed to be an arbitrary percentage. The other (third) company indicated that the allocation used three bases, that is, the kind of cargo, the distance between the loading port and the unloading port and the quantity.

6.2.11 Fuel Cost

As shown in the previous presentation of studies in Chapter Five, the fuel cost is one of the most important cost elements of the voyage. The researcher found that it is considered very useful to know how to calculate the cost of such element and that there existed a general agreement on the method of determining the consumed quantity and the cost of such quantity among the study sample. Determination of the used-up quantity depended on actual measurements which took into consideration the stock at the beginning of the period and the stock at the end of the period. Hence, the consumed quantity was calculated as follows:

Quantity of fuel at the beginning of the trip + the quantity of fuel purchased at foreign ports during the trip - (minus) the remaining fuel in the ship at the end of the trip.

As for pricing method, three companies indicated the weighted-average method, while four companies indicated that they used the "FIFO" method. The remaining companies did not specify their method of pricing. The researcher believes that the weighted-average method is the best method, because it is simple to apply on the one hand and it includes all fuel prices on the other.

Table 6.3

The Factor	Number of Replies *	The Ratio Against Replies of 18 Companies
1. Speed	11 replies	61%
2. Fuel price	10 replies	55%
3. Weather conditions	5 replies	27%
4. Sailing distance	2 replies	11%
5. Dead weight	4 replies	22%
6. Gross tonnage	1 reply	5%
7. Draft	1 reply	5%
8. Maintenance and vessel condition	4 replies	22%
9. Waiting period at port	4 replies	22%

*The total of replies is greater than the number of companies since each company may have chosen more than one factor.

No doubt all the above factors have significant effect on the quantity of consumed fuel and it would be very useful for the cost accountant in a company to be able to present the top management of the shipping company with accurate information on the effect of each single factor on the quantity of fuel consumed. However, in practice, this is difficult to achieve because it requires advanced

statistical analysis prepared by the cost accountant with a help of an expert in the field of statistics. In other words, this matter requires measurement of the fuel cost as a dependant variable attached to those independent variables. If these elements could be ascertained, it would enable the management to subject some of these factors to control and consequently reduce fuel consumption cost.

6.2.12 Handling the Incompleted Costs at the End of the Fiscal Year

It is well known that the book-keeping of shipping transportation companies is based on voyage as the accounting entity. In other words, under this practice an account for each voyage vessel is opened as a profit/loss account, in which freight rate and ticket revenues are under the "credit" column and the "debit" column includes all the direct costs of the voyage such as wages and salaries of the vessel's staff, consumed materials, port charges and fees, insurance, etc., and depreciation which is charged to the profit/loss account as a fixed periodical burden. The profit or loss results of each voyage are transferred to a temporary or nominal account under the name of the vessel, and the balance of this account is carried over at the end of the fiscal year to the profit/loss account of the company.

Shipping companies are characterised by the service activity of making voyages, some of which may start late in the financial year and be completed as round trips sometime in the next fiscal year. Hence, they are different from the industrial activities which have production under processing whose direct and indirect costs can

be easily determined. The traditional solution for the accounting problem of incompleted voyages is simply to ignore them completely in the profit/loss account until such voyages are completed. Then at the end of the year, the balance accounts of the incompleted voyages are computed, and the debit column total is transferred to the assets column of the Balance Sheet, while the total of the credit column is transferred to the liabilities column as "assets" and "current liabilities" respectively. This is a common and accepted practice, which shipowners and accountants are reluctant to change, but modern telecommunications and computer developments have led to this tradition being subjected to scrutiny and review. The major weakness of this method is that it does not follow the accrual basis which is a basic principle for determining profits in modern projects. Moreover, it does not consider the revenues of incompleted voyages as liabilities, part of which represent a gained profit that must be added to the owner's equity, and the expenses of the incompleted trips as assets, part of which represent irrevocable expenses, with no reason to postpone them.

Finally, this method is considered as a hybrid, which uses a mixture of accounting methods in which direct expenses and revenues of the voyage are identified by the income statement of the year in which the trips are completed, while the other elements of revenues and expenses, such as depreciation, debit and credit interests, and overhead expenses are accounted for on the accrual basis.

For the purpose of upholding acceptable accounting principles and presenting more realistic statements about administrative performance, shipping companies must adopt a better method for assessing profit. The researcher suggests that they acknowledge a part of the revenues of incompleted voyages equivalent to the rate of actual expenses of the incomplete voyages against the estimated direct costs for such voyages in the profit/loss account as a means of assessing the profit. The shortcoming of this method is that it depends on the estimated direct costs of the incompleted voyages, which are difficult to estimate accurately.

The question raised now is "What is the actual accounting practice for handling incompleted voyages in Saudi Shipping companies?"

Table No. 6.4 shows that the prevailing method of handling the costs of incompleted voyages at the end of the year is to postpone them, that is, to leave the balances open and transfer them to the balance sheet. This solution, as indicated above, is open to much criticism, most significant of which is that the results of the whole voyage will appear in the new year, and that it does not conform to the accrual basis. A very small number of companies, only two, were found to adopt the right accounting method, which acknowledges the incompleted part of the voyage within the same financial year in which the said voyage commenced. This practice is consistent with the accrual basis and the "matching concept". The other method, employed by one company only, was a conservative concept, as it acknowledged the

anticipated loss but postponed acknowledging the anticipated profits of the incompleted part of the voyage to the year in which the voyage would be completed.

Table 6.4

Handling of the Incompleted Trips

	Accounting Treatment	Company No.
1	In case profit is expected from the completed round trip the costs and revenues of the voyage are distributed between the two financial years according to the number of days and they are presented as "assets" in the balance sheet. But in case losses are expected to be incurred by the round trip, all such losses are charged to the current year, i.e., no distribution is made.	1
2	Costs and revenues are distributed between the two financial years in proportion with the number of days and including the costs of the completed part of the trip among the current assets. The incompleted part is included in the liabilities.	12
3	The costs and revenues of the completed part of the trip are acknowledged in the accounts for the same year, that is, such costs and revenues are handled in the operations account of the same year.	2
4	No reply	3

6.2.13 Accounting of Materials

The questionnaire included a question about the accounting recording cycle of the elements of materials consumed in the vessel. The purpose of that question was

to find out to what extent internal control exists over the material elements and also over the correct accounting recording procedures. The replies included the following:

1. Materials requirements are ordered by the captain.
2. Purchase procedures such as price analysis, quotation study and tender awarding are done by the purchase department of the company.
3. The delivered materials are received directly by the captain from suppliers and he verifies them against the invoice.
4. Invoices are sent after delivery to the operation management.
5. The operation management approves the bills.
6. Approved bills (invoices) are sent to the financial department for settlement and recording.
7. Foreign purchases of the vessel's supplies such as fuel are done through marine agents.

The above points show that material purchase procedures are subject to internal control regarding work assignment and there is a separation between asset-holding and book-keeping, as accounts departments in shipping companies are independent from the vessel's management. Besides, the above procedures include a dependence system which does not allow approval authority to be in the hands of one person.

6.2.14 Accounting of Labour Costs

The costs of marine manpower include wages and salaries, catering and medical services. The cost of catering is based on the consumption during the voyage which is usually decided by the purser. The cost of medical services is calculated on the basis of actual accidents. Salaries and wages are calculated in the following manner:

1. The purser prepares a list of the names of officers and sailors on board.
2. Salaries of officers and sailors are calculated on a monthly basis pursuant to employment contracts.
3. These lists (payrolls) are checked by the auditing department.
4. The captain is given money to pay salaries and wages against signatures of the recipients on the payroll sheet after making the social security and other necessary deductions.
5. Some companies use time-recording cards.
6. Wages and monthly salaries are recorded in the accounts books on the accrual basis.

As shown above, the accounts recording procedures of salaries, wages and other marine manpower costs are subject to internal control in the maritime transportation companies, as payrolls and salary sheets are subject to review by the

auditing department of the company. In addition, accounts recording of such costs is subject to the accrual basis.

6.2.15 Accounting of Other Operational Expenses

The other operational expenses include those costs other than materials, wages, salaries and the like which are mostly incurred through marine agents and also include insurance expenses. The researcher found that these elements were, in each sampled company, subject to auditing and adjusted at the end of the year according to the accrual basis.

The questionnaire included also a question about the possibility of delay in receiving expense sheets from ship agents, because such delay affects the preparation of periodical financial reports in shipping companies. The answers were as follows:

Table 6.5

Delay in Receiving Expense Sheets from Ship Agents

Delay time	Number of replies	Ratio
1. No delay	2	11%
2. Short delay	3	17%
3. Medium delay	10	55%
4. Long delay	3	17%
Total	18	100%

The above table shows that delay times were varied but were relatively reasonable, as "medium delay" here means that the delay time is reasonable while "long delay", experienced by 17% of sampled companies means a delay which leads to real delay in preparing reports.

6.2.16 Estimating Voyage Costs in Advance

Cost control in shipping companies, as is the case with other firms, requires that cost estimations be made in advance. The firm can predict in advance what the costs would be under the normal conditions of operation, based on clear criteria, which are in turn based on study of operations and on past experience. These estimations are usually called the "standard costs". There is another, but less accurate, method for estimation which is based on previous experience only, that is, on the basis of actual costs in the past.

The questionnaire included a question about estimation of costs in Saudi shipping companies. The answers to that question reveal that 16 companies made cost estimations of the voyage in advance, while two companies did not do so. Methods of making such estimations varied among the companies. Six of them followed the "standard cost" and "past historical cost" methods. Eight other companies depended on past historical costs only as a basis of estimation, and the rest follow the standard cost method only.

6.2.17 Cost Variance Analysis

Control over costs requires that comparisons be made between the actual costs and the estimated costs for each of the cost elements, then the total variance be analysed to their causes. Some can be attributed to prices or quantities, while others can be attributed to capacity variances. Fifteen companies, that is, 83%, replied that they determined the total variances of a voyage's costs, while replies regarding analysis of variances to their causes were as shown in Table 6.6 below:

Table 6.6

Replies Regarding Analysis of Variances to Their Causes

Type of variance	Number of companies*
1. Price variances	10
2. Quantity variances	7
3. Capacity variances	6

*Total number exceeds 15, because most companies conducted more than one form of variance analysis.

It may be concluded from Table 6.6 that the sampled companies had a strong interest in the subject of measuring and analysis cost variances. That could be explained, from the researcher's point of view, by the fact that cost control in shipping companies is given much importance, because activities are not concentrated in one place. The active tools for exercising control over activities in various geographical

locations all over the world and under varied environmental conditions are cost estimation, variance analysis and identifying the responsibilities for every variance.

6.2.18 Use of Cost Variance in Evaluating the Performance of Vessel Officers

One of the main uses of cost reports and variance analysis is to evaluate performance. The party responsible for each variance must be identified. Some variances fall under the responsibility of the captain, others may fall under the responsibility of the chief officer or the purser. There are some other variances that fall under the responsibility of top management or the General Manager.

The questionnaire included a question about how to evaluate the performance of the persons in charge of the ship during the voyage. The replies indicated only three companies analysed variances on the basis of responsibility on the vessel; some variances were referred to the captain for explanation, others to the chief officer, and a third type to the purser. The remaining companies did not make analysis in this way. The researcher believes that this result indicates that cost reports are not used effectively for evaluating the performance of the officers of the vessel. This is considered a shortcoming which could be attributed to accounting staff being insufficiently skilled to make such analysis according to responsibility centres. It is not sufficient to analyse cost variances to their causes alone; they must also be analysed according to responsibility centres, to achieve fair performance evaluation.

6.3 Summary and Conclusion

The description and analysis of the cost systems in shipping companies in the Kingdom of Saudi Arabia presented in this chapter, has revealed that these systems varied tremendously. Some depended on integrated book-keeping, while others simply prepared statements, without making independent cost accounts. Another group of companies mixed cost accounting with financial accounting. It was also noticed that the accounting treatment of cost elements varied significantly among these companies. The same was true with regard to classification of those elements and the treatment of the uncompleted voyages. Moreover, cost reports varied, and their applications were not up to the appropriate standards, especially in the field of performance evaluation of the officers in charge of the vessel.

These results prompt us to suggest that it is necessary to start establishing a cost accounting system for the Saudi shipping companies, that is, a Uniform Cost-Accounting System, for the purpose of realising the following:

1. Unification of the terminology of the cost accounts.
2. Establishment of a uniform manual.
3. Unification of the accounting treatment of the cost elements.
4. Unification of the system outputs, such as cost accounts, cost-statements and cost reports.

Such standardisation is essential to minimise irregularities which currently occur in accounting practice in the cost departments of shipping companies, and would lead to the production of more reliable cost information.

The researcher suggests that this mission be undertaken by the shipping section of the Chamber of Commerce and Industry, in the Kingdom of Saudi Arabia, which could make use of the expertise of specialists in the field of shipping costs from a country with long experience in the field of navigation, such as the United Kingdom.

Chapter Seven

Empirical Evaluation of Cost Accounting Systems in Shipping Companies in Saudi Arabia

7.1 Introduction

The profile of costing systems in shipping companies in the Kingdom of Saudi Arabia was described in the previous chapter. However, for the appraisal of such systems to be complete, it is necessary to recognise and review the users' views, that is, the judgements of the users of cost reports in shipping companies. This chapter deals with the evaluation of cost reports by managers in the sampled shipping companies in the Kingdom of Saudi Arabia.

The researcher designed a questionnaire sheet (Appendix No.2) consisting of 14 statements representing essential elements for evaluating cost accounting systems in shipping companies in Saudi Arabia. Participants were asked to indicate their degree of agreement with each statement using a five-point "Likert Scale":

Strongly agree - Agree - Not Sure - Disagree - Strongly disagree

The questionnaires were distributed to 21 shipping companies in Jeddah, Riyadh and Damman, representing 58% of ship owning companies in the Kingdom, and were given to the General Managers, Accounting Managers and Operational Managers of each company. The following table shows the rate of response:

Number of sheets distributed	65
Number of replies received	42

Response Rate		65%

The responses were classified into three groups:

Group A:	General Managers	15
Group B:	Accounting Managers	16
Group C:	Operational Managers	11

7.2 Evaluation Criteria:

The cost system of the shipping company is considered, as is the case with any other company, one of the administrative information systems which include inputs, processing and outputs. Generally, information systems can be evaluated by the criterion of the quality of the outputs. If the outputs' quality is high, it means that the system producing them is a reliable and effective system. This is a reasonable and logical approach which will be applied to cost systems of Saudi Arabian shipping companies. But what are the criteria that can be used to evaluate the quality of cost reports? In this sub-section, the researcher will attempt to address this issue. Nevertheless, before proceeding to present those criteria, one should know how they can be used for evaluating cost reports.

First of all, these criteria are descriptive and the extent of their availability may be questionable. For example, if one of the company officers was asked whether a certain criterion is available, his answer may be something like, "I think it is available", but if he is asked about the degree or the extent of its availability, which is a different question, his answer may be along the lines that it is somewhat available. Hence, one now faces the problem of how to translate this "somewhat" into a measure acceptable to everybody.

A far deeper problem is that opinions regarding this criterion may differ from one officer to another within the same company for many reasons, such as differences in perception, or in the administrative level of the officers. Such factors may render evaluation by descriptive criteria more biased and inaccurate. However, this is the only method available to use and one can minimise the degree of inaccuracy or bias through careful design of the questionnaire as will be noted from the empirical study. The researcher can change the descriptive criteria which is to be presented later on from mere semantic judgement to a quantitative evaluation by using relative measures such as a Likert scale. With this method one can obtain a numerical evaluation.

7.2.1 Usefulness Criterion

A good cost system should produce useful reports for the management. There are many fields for making use of these reports.

7.2.1.1 In the Field of Control

Cost reports which are useful in the field of control must contain information about the actual costs of the voyages of each vessel on a certain shipping line during a specified period of time, in comparison with costs estimated in advance. Therefore, the Management Level in charge becomes capable of identifying the voyage costs structure and its most important items, as well as the amount of variance from the estimated costs. Consequently the officers can make the appropriate decisions which help the management of shipping companies to apply effective control over such elements on the future voyages (Anthony and Yong, 1994.713)

7.2.1.2 Planning and Making Operational Decisions.

The top management needs information about costs in order to make important decisions pertaining to preparing a vessel's operating plans during a specific period,. For example, such important decisions as to whether it is better to operate the vessel or to stop it; whether it is better to operate the vessel in a certain line rather than in others; whether it is better to charter a vessel for one trip (voyage) or for several voyages. These decisions need specific types and analysis of costs. Besides, operational managers need a different kind of information about costs in addition to the information needed by top management. For example, operational managers need to know the prices of fuel in various ports in order to make the

vessel's bunkering plan for a specific voyage. They also need to have estimates of the maintenance and repair costs which may be incurred in foreign ports. Naturally, such costs vary from one port to another.

7.2.1.3 Performance Evaluation

A. Analysing deviations: It is not enough that the cost reports contain comparisons between the actual costs and budgeted or predetermined standard costs; the reports should also contain an indication of the variances, that is, the difference between the actual costs and the estimated costs. Nevertheless, even this is not entirely sufficient. For the purpose of performance evaluation, variances should be analysed and the person responsible identified. Some variances are the responsibility of the Captain. Others are the responsibility of the Chief Officer or perhaps the purser. There are also variations which are the responsibility of the top management. It is essential for performance evaluation to analyse variances in this way.

B. Cost Variance analysis should be made on the basis of the criterion of the extent to which the specified cost element is subject to control within a certain management area.

7.2.1. 4. Follow Up:

Variances in the costs of voyages in each marine line should be followed up for each vessel.

7.2.2 Relevance Criterion

In this context, relevance means that the report should contain useful information which is relevant to the administrative level to which it is submitted. The "Relevance" criterion requires that the report should contain the following:

A. The information should be subject to the control and responsibility of the person who is receiving the report.

B. The reports should contain the most important information but not excessive details. Unnecessary detail should be omitted.

7.2.3 Timing Criterion

This criterion means that:

1. Reports should be presented on time, not too late, so that cost elements can be subjected to tight controls or the right decision be made just in time.

2. The report should contain fresh up-to-date information rather than old information.

7.2.4 Reliability Criterion

1. The information of the report should be accurate and valid.

2. There should be no changes in the measurement basis and in the method of information presentation from time to time which make the information inapplicable for purposes of comparison.

3. The cost reports should be clear and comprehensible so as to ensure that no differences in understanding, interpretation or use will occur on the part of those who receive such reports (Glautier, 1988:355)

7.2.5 The General Positive Effects Criterion

This criterion means that the cost reports have general effects in addition to their function of meeting the requirements of the report users. These effects can be summarised as follows:

A. Creating cost awareness among all personnel levels of shipping companies.

B. Contributing to reduction of the degree of risk in the company. Hence, they lead to general improvement of revenues.

The above presentation, indicates fourteen (14) criteria for evaluating the cost systems of shipping companies. These were used in designing the questionnaire for the empirical part of this study.

7.3 Inquiries of Field Study

The study was designed to ascertain opinions of managers in shipping companies in Saudi Arabia regarding the cost accounting system in those companies. By analysing

their replies to the questionnaire, it is hoped to obtain answers to the following questions:

1. How does each group, and the sample as a whole, rank the elements of a good costing system?

2. Are there any significant differences in the average total scores for all elements among the groups, or among each pair of groups?

3. Are there any significant differences in the average scores for each element among the groups or among each pair of groups?

7.3.1 Method of Analysis

The researcher scored the answers to the questionnaire statements numerically on a "Likert Scale" grade as follows:

Scale Level	**Strongly Agree**	**Agree**	**Not Sure**	**Disagree**	**Strongly Disagree**
Score	2	1	0	-1	-2

From the numerically-expressed opinions of each group, the researcher carried out the following statistical analyses:

1. Arithmetical - means of the numerical scores of each group of participants and the general average of these scores across all groups;

2. Kruskal-Wallis test for the mean rank of all-element scores to determine whether or not there are any significant differences in the averages among the three groups of participants;
3. Mann-Whitney test for the mean rank of all-element scores between each two groups;
4. Kruskal-Wallis test for the mean rank of each element for the three groups;
5. Mann-Whitney test for the mean rank of each element between each two groups.

The following section will show the results of the statistical analysis.

7.4 Results of Statistical Analysis of Managers' Evaluation of Cost Accounting Systems in Saudi Arabia

7.4.1 Arithmetical Means of Scores for Each Element

Table 7.1 shows the arithmetical mean for each element in each group and also general average for the three groups. The rank order of each element has been determined according to the general average.

It can be observed from Table 7.1 that the sample individuals in all groups evaluated highly the elements of planning, decision-making, control, cost awareness and performance evaluation, which come first to fourth in the general ranking. They represent elements related to the use of cost reports which is in line with a cost accounting orientation to serving the management in these areas. The element of

relevance was ranked fifth in the evaluation, followed by the element of up-to-date-ness, then the element of follow up of cost element variances. All these elements were favourably rated, with an average score of 1 or more. Scores for other elements showed agreement, though less strongly, with scores less than 1 but more than 0 - in other words, they are generally agreed with but they seem to have been assigned less importance than the elements indicated earlier. This ranking represents the average point-of-view of all participants in the questionnaire.

There may, however, have been a cross-compensation effect within and between groups. Therefore, to give a clearer picture, a comparison was made between the rank orders from the view-point of each group separately. Table 7.2 shows these comparisons.

The following observations can be made from the table:

1. Respondents were unanimous in ranking element no. 2 in first place.

2. Groups A and B agreed on the following ranking of elements:

   - Element no. 1, which was ranked second,
   - Element no. 5, which was ranked fourth.

   - Element No. 9, which was ranked Third.

3. Groups A and C agreed on the ranking of element no. 14.

4. Groups B and C agreed on the ranking of element no. 12 only.

5. The three groups did not agree on the ranking of the remaining eight elements.

Table 7.1

Arithmetical Means and the Ranking for Each Element

No. Description of Elements	Arithmetic mean for each group			General Mean	Rank of
	A	B	C	D	D
1. Cost reports contain useful information for controlling.	1.50	1.56	0.91	1.32	2
2. Cost reports contain useful information for planning & decision-making	1.60	1.62	1.36	1.53	1
3. Cost reports are easy to read and understand.	1.06	0.88	0.91	0.95	8
4. Cost reports are relevant to work.	1.06	1.06	1.00	1.04	5
5. Cost system follows-up the change in costs of each route.	1.06	1.19	0.64	0.96	7
6. Cost system analyses costs according to their controllability at various management levels.	0.86	1.06	0.36	0.76	14
7. Cost system presents reports on time.	1.06	1.06	0.36	0.83	12
8. Cost system produces up-to-date data	0.73	1.13	1.27	1.04	6
9. Cost reports are an effective tool to improve cost awareness.	1.26	1.31	1.36	1.31	3
10. Cost reports analyse variances and facilitate the evaluation of management performance.	1.06	1.13	1.27	1.15	4
11. Cost reports produce accurate and reliable data.	0.80	1.13	0.91	0.95	8
12. Cost reports are periodically comparable.	1.06	1.00	0.55	0.87	11
13. Cost reports contain essential information rather than unnecessary details.	0.86	0.75	0.82	0.81	13
14. Cost information contributes to the reduction of risk and improves return.	0.93	1.13	0.73	0.93	8

Table 7.2

The Rank of the Arithmetical Mean of Each Group

No.	Description of Elements	Group A	Group B	Group C
1.	Cost reports contain useful information for controlling.	2	2	6
2.	Cost reports contain useful information for planning and decision making.	1	1	1
3.	Cost reports are easy to read and understand.	4	13	6
4.	Cost reports are relevant to work.	4	9	5
5.	Cost system follows-up the change in costs of each route.	4	4	11
6.	Cost system analyses costs according to their controllability by various management levels.	11	9	13
7.	Cost system presents reports on time.	4	9	13
8.	Cost system produces up-to-date data.	14	5	3
9.	Cost reports are an effective tool to improve cost awareness.	3	3	1
10.	Cost reports analyse variances and facilitate the evaluation of management performance.	4	5	3
11.	Cost system produces accurate and reliable data.	13	5	6
12.	Cost reports are periodically comparable.	4	12	12
13.	Cost reports contain essential information rather than unnecessary details.	11	14	9
14.	Cost information contributes to the reduction of risk and improves return.	10	5	10

As can be seen in Table 7.1 the arithmetical means for each element differed from one group to another. The question now arises: are these differences among arithmetical-means significant or not?

To answer this question, it is necessary to use a suitable statistical method. It is known that there are two statistical methods of testing. These are:

1. Parametric statistical tests: These tests are often used when the statistical distribution for the society is known.

2. Non-parametric statistical tests: These tests are often used, when the statistical distribution for the society is unknown. Since the data are non-parametric, a non-parametric test was used to determine whether or not the differences in the opinions of the sample groups are significant.

Following are the results of the statistical test:

Table 7.3

Kruskal-Wallis Test
Comparison of Arithmetic Mean of all Variables Among all Groups of Significance Level 5%

Group	Arithmetical Mean	Mean Score (Rank)
A	1.064	22.21
B	1.143	26.04
C	0.889	16.25
CHISQ = 4.5465		Prob > CHISQ = 10.30%

It is to be observed from Table 7.3 that there are no significant differences for all groups, which means that they are in general agreement in their evaluation of all elements, despite the difference in administrative level between the individuals of each group. However, this does not preclude the possibility of the existence of differences between one group and another, which means that it was necessary to carry out another analysis, to compare the scores for each pair of groups.

Table 7.4

Mann-Whitney Test

Comparison of Arithmetical Means For All

Variables (N=14) at Significance Level 5%

	1st Comparison		**2nd Comparison**		**3rd Comparison**	
	A	**B**	**A**	**C**	**B**	**C**
Arithmetical Mean	1.064	1.143	1.064	0.889	1.143	0.889
Mean Score of Ranking	13	16	16.71	12.28	17.54	11.46
CHISQ	0.94		2.05		3.84	
Prob CHISQ	33.13%		15.19%		5.02%	
Nature of Differences	Insignificant Difference		Insignificant Difference		Insignificant Difference	

It can be observed from Table 7.4 that the differences between groups are not significant at the stated significance level of 5%. This confirms that there is unanimity of views, despite the differences in administrative level of each group. However, the disagreement between Groups B and C is almost significant, as 5.02% is very close to the significance level. If the significance level were raised to 6%, the differences between Groups B and C would become significant, which is to be expected, since members of Group B are accounts managers, while those of Group C are operation managers. Accounts managers in the companies are responsible for preparing such reports as cost-reports. Thus they may be expected to appreciate the significance of the reports which they submit to the top management, while operation managers may have a different point of view about the evaluation of such reports. This was, in fact, demonstrated in Table 7.2, where the ranking of elements of Group B was different from that of Group C. For example, it was found that element no. 1 ranked second for Group B while it ranked only sixth for Group C. Moreover, element no. 3 ranked thirteenth for Group B but sixth for Group C.

It may be observed from Table 7.5 that the differences for each variable among all three groups are statistically insignificant, since the probability of Null Hypothesis is greater than the 5% significance level. However this table does not indicate whether there are differences among each pair of groups; therefore this possibility was tested using Mann-Whitney Test.

Table 7.5

KRUSKAL-WALLIS TEST

For Each Variable Among All Groups
At Significance Level 5%

No.	Description of Elements	CHISQ	Prob>CHISQ	The Nature of Differences
1.	Cost reports contain useful information for controlling.	1.3366	51.26%	Insignificant
2.	Cost reports contain useful information for planning /decision making.	1.7470	41.75%	Insignificant
3.	Cost reports are easy to read and understand.	1.2415	53.75%	Insignificant
4.	Cost reports are relevant to work.	0.1052	94.88%	Insignificant
5.	Cost system follows-up the change in costs of each route.	2.5161	28.42%	Insignificant
6.	Cost system analyses costs according to their controllability by various management levels.	3.6095	16.45%	Insignificant
7.	Cost system presents reports on time.	3.4663	17.67%	Insignificant
8.	Cost system produces up-to-date data.	3.0679	21.57%	Insignificant
9.	Cost reports are an effective tool to improve cost awareness.	0.4535	79.71%	Insignificant
10.	Cost reports analyse variances and facilitate the evaluation of management performance.	0.6487	72.30%	Insignificant
11.	Cost system produces accurate and reliable data.	2.2970	31.71%	Insignificant
12.	Cost reports are periodically comparable.	2.0987	35.02%	Insignificant
13.	Cost reports contain essential inform-ation rather than unnecessary details.	0.1565	92.48%	Insignificant
14.	Cost information contributes to the reduction of risk and improves return.	0.3854	82.48%	Insignificant

Table 7.6

MANN-WHITNEY TEST

For Each Variable Between Group A and Group B At Significance Level 5%

No.	Description of Elements	CHISQ	Prob>CHISQ	The Nature of Differences
1.	Cost reports contain useful information for controlling.	0.1005	75.13%	Insignificant
2.	Cost reports contain useful information for planning and decision making.	0.0154	90.13%	Insignificant
3.	Cost reports are easy to read and understand.	0.9840	32.12%	Insignificant
4.	Cost reports are relevant to work.	0.0497	82.36%	Insignificant
5.	Cost system follows-up the change in costs of each route.	0.1665	68.32%	Insignificant
6.	Cost system analyses costs according to their controllability by various management levels.	0.4480	50.32%	Insignificant
7.	Cost system presents reports on time.	0.0050	94.27%	Insignificant
8.	Cost system produces up-to-date data.	1.2880	25.64%	Insignificant
9.	Cost reports are an effective tool to improve cost awareness.	0.03799	84.55%	Insignificant
10.	Cost reports analyse variances and facilitate the evaluation of management performance.	0.0283	86.65%	Insignificant
11.	Cost system produces accurate and reliable data.	2.8360	9.22%	Insignificant
12.	Cost reports are periodically comparable.	0.6740	41.15%	Insignificant
13.	Cost reports contain essential information rather than unnecessary details.	0.1630	68.60%	Insignificant
14.	Cost information contributes to the reduction of risk and improves return.	0.2200	63.83%	Insignificant

It is to be observed from Table 7.6 above that all the differences between Groups A and B are insignificant, as the null hypothesis of no difference is high and is in excess of the 5% level of significance. However, element no. 11 is somewhat closer to significance than other elements. This element is related to the degree of accuracy and reliability. By referring to Table 7.1 it can be seen that Group A gave it approximately 0.8 while Group B, accounts managers, gave it 1.13, which indicates that report producers, namely accounting managers, are strongly convinced that such reports contain accurate and reliable information, while general managers agree, but to a lesser extent. The researcher would suggest that the evaluation by general managers may be affected by various factors, as they do not rely on cost reports alone in making their decisions, but also on other information, which might be of greater significance. Another possibility is that general managers do not fully appreciate the importance of costing data. If that is proved by other experimental studies, it will then be necessary for those who are involved in producing internal reports to train those who are not specialised in accounts to understand and use those reports.

It is to be observed from Table 7.7 that the differences between Groups A and C are not significant since the null hypothesis of no difference is greater than the 5% significance level for each element. Elements no. 7 and 8 are closest to the significance level of 5%.

Table 7.7

MANN-WHITNEY TEST

For Each Variable Between Group A and Group C At Significance Level 5%

No.	Description of Elements	CHISQ	Prob>CHISQ	The Nature of Differences
1.	Cost reports contain useful information for controlling.	0.727	39.40%	Insignificant
2.	Cost reports contain useful information for planning and decision making.	1.302	25.39%	Insignificant
3.	Cost reports are easy to read and understand.	0.038	84.56%	Insignificant
4.	Cost reports are relevant to work.	0.078	78.04%	Insignificant
5.	Cost system follows-up the change in costs of each route.	1.318	25.10%	Insignificant
6.	Cost system analyses costs according to their controllability by various management levels.	1.653	19.85%	Insignificant
7.	Cost system presents reports on time.	2.446	11.78%	Insignificant
8.	Cost system produces up-to-date data.	2.413	12.03%	Insignificant
9.	Cost reports are an effective tool to improve cost awareness.	0.431	51.55%	Insignificant
10.	Cost reports analyse variances and facilitate the evaluation of management performance.	0.523	46.97%	Insignificant
11.	Cost system produces accurate and reliable data.	0.591	44.20%	Insignificant
12.	Cost reports are periodically comparable.	1.635	20.10%	Insignificant
13.	Cost reports contain essential information rather than unnecessary details.	0.061	80.54%	Insignificant
14.	Cost information contributes to the reduction of risk and improves return.	0.089	76.60%	Insignificant

Element no. 7, which concerns timely presentation of reports has a probability degree of 11.78% which is comparatively close to 5%. Referring to Table 7.1, it can be seen that the general managers gave this element approximately 1.06, while operational managers gave it a lower rank of approximately 0.36. The reason for such a difference could be that general managers usually obtain the reports and check them before any other administrative level in the organisation. Usually the flow of such reports to operational managers is rather delayed as the normal practice is that the manager gets the reports first, makes his comments, then directs them to the operational managers. Element no. 8, which is about up-to-dateness, was given a lower ranking by general managers than by operational managers, which according to the researcher's view, could be due to the fact that general managers make decisions which are different from those made by operational managers. Hence, they need more up-to-date data and even future-related data for making such decisions. On the other hand, operational managers attach more importance to the data related to past and current activities, as they are more concerned with the control aspect than with the planning aspect which concerns general managers.

It can be observed from Table 7.8 that the differences between B and C are not significant as the possibility of the null hypothesis of no difference is far in excess of 5%, except for elements no. 5, 6 and 7, which are relatively close to 5%. Element no. 5 is related to the cost-system's follow-up of changes in costs for each route.

Table 7.8

MANN-WHITNEY TEST

For Each Variable Between Group B and C
At Significance Level 5%

No.	Description of Elements	CHISQ	Prob>CHISQ	The Nature of Differences
1.	Cost reports contain useful information for controlling.	1.201	27.30%	Insignificant
2.	Cost reports contain useful information for planning and decision making.	1.289	25.62%	Insignificant
3.	Cost reports are easy to read and understand.	0.776	37.83%	Insignificant
4.	Cost reports are relevant to work.	0.034	85.31%	Insignificant
5.	Cost system follows-up the change in costs of each route.	2.381	12.28%	Insignificant
6.	Cost system analyses costs according to their controllability by various management levels.	3.224	7.26%	Insignificant
7.	Cost system presents reports on time.	2.947	8.60%	Insignificant
8.	Cost system produces up-to-date data.	1.019	31.27%	Insignificant
9.	Cost reports are an effective tool to improve cost awareness.	0.240	62.41%	Insignificant
10.	Cost reports analyse variances and facilitate the evaluation of management performance.	0.473	49.16%	Insignificant
11.	Cost system produces accurate and reliable data.	0.004	94.87%	Insignificant
12.	Cost reports are periodically comparable.	0.944	33.12%	Insignificant
13.	Cost reports contain essential information rather than unnecessary details.	0.0007	97.89%	Insignificant
14.	Cost information contributes to the reduction of risk and improves return.	0.283	59.48%	Insignificant

It is observed that this element was given a higher ranking by accounting managers than by operational managers. Accounting managers gave it approximately 1.19 while operational managers gave it 0.64. The reason for this difference, in the researcher's view, could be the fact that operational managers usually need much more data about the changes in cost elements of routes, while accounting managers might have limited time and effort to allocate to providing such information and may believe that what they are producing is sufficient.

As for element no. 6, which is related to analysis of cost items according to their being subject to control and to administrative level, accounting managers, as observed from their 1.06 ranking, see that such reports include very sufficient analysis while operational managers, with their 0.36 ranking of it, may feel that in some respects the analysis is not sufficient. The researcher is of the view that the reason for this difference may be attributed to several factors, particularly the time and effort available from the accountant's point of view, as with the previous element. Another reason could be a difference in view as to what is subject to control, between operational managers and accounting managers. For example, the cost report may contain an item which according to an accountant should be referred to the operational manager, while the latter may have a different view about it. Shipyard costs are a clear example of this situation, as the accountant believes that such costs are subject to the control of the operations manager, since he is the one who makes the decision to undertake repairs in a certain shipyard at a certain port. However, the operations manager may have the view that the cost of repairs falls outside the scope of his responsibility if they exceed a certain level. Hence, there exists a difference in points of view and consequently in the evaluation of this element.

As for element no. 7 which is related to appropriate timing, the accounting manager's view is that the cost reports flow to administrative sections at the appropriate time, without delay. Therefore, their evaluation of this element scored 1.06 on average, which is higher than the evaluation of operation managers. The reason for this difference was discussed previously, i.e., cost reports do not usually flow directly from the cost department to the executive administrative levels but are initially submitted to the general managers who make their own comments, remarks, footnotes and decisions on such reports, and only then are the reports referred to operation managers. This explains why the evaluation by operation managers of this element is less than that of the accounting managers who produce the reports.

7.4.2 **The Final Evaluation:**

The researcher has presented above an evaluation of each single element, without classifying them into homogenous groups as the researcher did in section 7.2 in this chapter. Five criteria were identified:

1. The usefulness criterion, which includes five elements, namely, nos. 1, 2, 4, 5 and 10.
2. The relevance criterion, which includes elements nos. 6 and 13.
3. The timing criterion, which includes elements nos. 7 and 8.
4. The reliability criterion, which includes elements nos. 3, 11, and 12.
5. The general positive effect criterion, which includes elements nos. 9 and 14.

To evaluate the system in relation to these main criteria, it was necessary to find out a measure for each criterion, which is actually the average of scores obtained

by dividing the total means of elements by the number of these elements. The following table shows these results:

Table 7.9

Criterion	**Mean**
Firstly: Usefulness criterion	
Criterion elements:	
1	1.32
2	1.53
4	1.04
5	0.90
10	1.15
Criterion's general mean	1.19
Secondly: Relevance criterion	
Criterion elements:	
6	0.76
13	0.81
Criterion's general mean	0.78
Thirdly: Timing criterion	
Criterion elements:	0.83
7	1.04
8	
Criterion's general mean	0.94
Fourthly: Reliability criterion	
Criterion elements:	
3	0.95
11	0.95
12	0.87
Criterion's general mean	0.92
Fifthly: Positive effect criterion	
Criterion elements:	
9	1.31
14	0.93
Criterion's general mean	1.12

The importance of the evaluation elements can be arranged according to their means, as indicated in Table 7.10 below:

Table 7.10

Arrangement of Criteria According to the Evaluation of the Sample Members

Rank	Criterion	Average (Mean)
First	Usefulness	1.19
Second	General positive effect	1.12
Third	Timing	0.94
Fourth	Reliability	0.92
Fifth	Relevance	0.78

It is observed from Table 7.10 above that the sample as a whole attached maximum importance to the usefulness criterion, a result which is justified in that cost reports aim primarily to serve the management that handles the main functions, such as planning, control, follow-up and evaluation of performance.

The aforesaid results highlight the significance of cost reports in the maritime transportation companies in the Kingdom of Saudi Arabia and show that such reports are perceived by their users to be highly reliable and of good quality.

7.5 Summary and Conclusion

An evaluation of the cost system in Saudi shipping companies was carried out, based on a questionnaire consisting of essential elements for evaluation. These elements are based on criteria for evaluation of information systems in general. The responses of a sample of managers in these companies with regard to the appraisal of cost reports have been analysed. A Likert Scale was used to indicate the degree of agreement and statistical analysis using the Kruskal-Wallis test and Mann-Whitney test was carried out to determine whether or not the differences in the opinions of the sample group are significant.

The sample individuals in all groups evaluated highly the elements of planning, decision-making, control, cost awareness and performance evaluation, which come first to fourth in the general ranking. They represent elements related to the use of cost reports which is in line with a cost accounting orientation to serving the management in these areas. The element of relevance was ranked fifth in the evaluation, followed by the element of up-to-date-ness, then the element of follow up of cost element variances.

All these elements were favourably rated, with an average score of 1 or more. Scores for other elements showed agreement, though less strongly, with scores less than 1 but more than 0, in other words, they are generally agreed with but they seem to have been assigned less importance than the elements indicated earlier. This ranking represented the average point of view of all participants in the questionnaire.

Re-organising each element into the five homogenous criteria, that is, usefulness, relevance, timing, reliability and the general positive effect, the results of the analysis revealed that the sample as a whole attached maximum importance to the usefulness criterion, a result which is justified in that cost reports aim primarily to serve the management that handles the main functions, such as planning, control, follow-up, decision making and evaluation of performance. In addition, there was general agreement among participants that cost reports in shipping companies in the Kingdom of Saudi Arabia are highly reliable and of good quality.

Chapter Eight

Analysis of the Cost Structure of Saudi Vessels

8.1 Introduction

In the previous two chapters the researcher has dealt with description and analysis of cost-systems in Saudi maritime companies and evaluation of those systems' reports. This chapter focuses specifically on the cost figures produced by those systems, with a view to becoming acquainted with the analysis of the costs of maritime voyages.

The researcher designed a questionnaire form for collecting cost data (Appendix No. 3), which contained details of operation data, direct costs, indirect costs, and each voyage's share of general administrative expenses. The questionnaire was distributed among the sample companies, and the researcher obtained from the responses the following data:

1. Operation and cost data of 15 voyages in 1992 for tanker vessels.

2. Operation and cost data of 16 voyages in 1992 for cargo vessels.

3. Operation and cost data of 10 voyages in 1992 for passenger vessels.

This chapter will examine in the following sections, the cost structure of the sample of vessels for which data were collected.

8.2 A Study of Cost Structure of Tankers

Tables 8.1 and 8.2 show the cost and operation data of the sample of tanker vessels, respectively.

Table 8.1

Tanker Vessels
Cost Elements

Voyage No.	Depreciation	Insurance	Wages & victualing	Stores	Maint & Repairs	Fuel	Port & Agency Fees	Misc. & Admin Expenses	Total
1.	307,564	56,344	268,639	54,300	108,784	178,845	236,250	218,085	1,491,811
2.	425,021	77,216	440,265	85,339	163,305	226,871	371,876	465,901	2,255,794
3.	776,005	173,651	844,643	208,110	397,088	659,543	663,750	1,239,060	4,961,000
4.	343,100	57,300	325,500	108,300	313,200	320,000	550,000	209,300	2,226,700
5.	349,800	58,200	324,700	124,500	391,800	325,000	551,000	215,000	2,340,000
6.	589,100	92,800	281,900	63,500	72,800	370,000	560,000	222,960	2,253,060
7.	603,200	92,800	206,300	85,700	111,000	370,400	565,000	221,760	2,229,160
8.	157,995	19,312	110.100	39,600	28,700	137,980	42,000	36,900	572,587
9.	157,995	15,450	110,100	39,600	28,700	147,200	29,436	36,900	565,381
10.	910,113	105,060	598,944	215,424	156,128	885,840	293,000	146,336	3,310,845
11.	1,397,260	253,253	751,027	436,644	349,315	436,644	1,309,931	314,374	5,248,448
12.	3,929,794	1,135,274	873,288	611,301	1,047,945	698,630	1,091,609	314,374	9,702,215
13.	523,973	87,328	785,959	349,315	785,959	523,973	1,222,603	349,315	4,628,425
14.	---	829,623	873,288	331,849	1,091,609	1,135,274	1,047,945	314,374	5,623,962
15.	4,366,438	1,309,931	873,288	261,986	1,848,589	1,309,931	1,746,575	313,511	11,666,249

Table 8.2

Operation Data for Tanker Vessels

Voyage No.	Dead-Weight	Gross Tonnage	Cargo Transported	Average Speed	Voyage Days	Distance	Vessel Age	Crew No.
1	23,000	13,088	14,805	15.63	19.2	5,010	12	28
2	24,700	15,817	20,500	14	31.3	7,060	6	29
3	28,000	16,586	26,328	17	53.3	14,148	18	30
4	39,359	25,614	35,595	14.5	19	5,406	20	32
5	39,359	25,614	35,595	14.5	19	5,406	20	32
6	47,763	24,655	41,988	13.75	19.8	5,406	12	25
7	47,815	31,521	41,988	13.75	19.8	5,406	12	25
8	8,178	4,462	6,000	13.5	22	7,314	20	23
9	8,178	4,462	7,393	13	25	6,305	20	23
10	11,233	5,297	34,000	13	135	30,671	20	27
11	290,000	162,000	285,000	15	85	24,500	1	26
12	304,000	127,000	300,000	14.5	85	24,500	3	26
13	300,000	158,000	290,000	15	85	24,500	1	26
14	261,000	115,000	250,000	15	85	24,500	17	30
15	405,000	194,000	395,000	15	85	24,500	15	30

These data are used in the following analysis:

8.2.1 Cost Percentages

Table 8.3 shows the percentage of each cost element to the total of tanker vessels.

Table 8.3

Percentage of Costs Components for Tanker Vessels

Voyage No.	Depreciation	Insurance	Wages & victualing	Stores	Maint & Repair	Fuel	Port & Agency Fees	Misc. & Admin	Total
1.	20.6	3.8	18	3.6	7.3	12	15.8	18.8	100%
2.	18.8	3.4	19.5	3.8	7.2	10.1	16.5	20.6	100%
3.	15.6	3.5	17	4.2	8	13.3	13.4	25	100%
4.	15.4	2.6	14.6	4.9	14	14.4	24.7	9.3	100%
5.	14.9	2.5	13.9	5.3	16.7	13.9	23.5	9.2	100%
6.	26.1	4.1	12.5	2.8	3.2	16.4	24.9	9.9	100%
7.	27	4.1	9.3	2.6	5	16.6	25.3	10	100%
8.	27.6	3.4	19.2	6.9	5	24.1	7.3	6.4	100%
9.	27.9	2.7	19.5	7	5.1	26	5.2	6.5	100%
10.	27.5	3.2	18	6.5	4.7	26.8	8.8	4.5	100%
11.	26.6	4.8	14.3	8.3	6.7	8.3	25	6	100%
12.	40.5	11.7	9	6.3	10.8	7.2	11.3	3.2	100%
13.	11.3	1.9	17	7.5	17	11.3	26.4	7.6	100%
14.	---	14.8	15.5	5.9	19.4	20.2	18.6	5.6	100%
15.	37.4	11.2	7.5	2.2	12.7	11.2	15	2.6	100%
Averages	22.5	5.2	15	5.2	9.5	15.5	17.4	9.7	100%

It should be noted that the relative importance varies from one element to another and the cost elements can be ranked as follows (using the averages):

Depreciation Expenses	22.5%
Port and Agency Fees	17.4%
Fuel Expenses	15.5%
Crew Cost	15%
Miscellaneous and Administration Expenses	9.7%
Maintenance and Repair Expenses	9.5%
Insurance Expenses	5.2%
Stores Expenses	5.2%
Total	100%

Reorganising and summarising these cost elements to the three groups of shipping cost, that is capital cost, running cost and voyage cost, it will be found:

Capital Cost:	Depreciation	22.5%

Running cost includes:

Insurance Expenses	5.2%
Crew Expenses	15%
Stores Expenses	5.2%
Maintenance and Repair Expenses	9.5%

Misc. and Admin. Expenses	9.7%	44.6%

Voyage cost includes:

Fuel expenses	15.5%	
Ports and Agency Fees	17.4%	32.9%

Total Voyage Cost	100%

From the above mentioned grouping of cost elements it should be noted that the fixed cost of tanker vessels, that is capital cost and running cost, represents 67.1% of the total or just over 2/3 of total cost while the variable cost (i.e., voyage cost) represents 32.9% or about 1/3 of the total cost.

This information is valuable to the management of shipping companies in Saudi Arabia in the following respects:

1. They can focus particular attention on the fixed part of total cost and attempt to reduce the cash items, so that the profitability of the vessel can be increased.
2. The higher percentage of fixed cost needs a thorough planning technique for operating the tanker vessels, so that break-even point can be achieved at a lower level of operation, hence increasing the margin of safety.

In the next sub-section research will focus more closely on the cost structure, to deduce its statistical characteristics.

8.2.2 The Statistical Characteristics of the Cost Structure of Tanker Vessels

Table 8.1 represents the costs of each-element in Saudi riyals. In themselves, they do not give a clear picture of the characteristics of these elements. Therefore these figures have been converted into a meaningful indicator, as shown in Table 8.4, namely the "cost per ton dwt/day". The cost of each element was divided by (dead weight X no. of voyage days), to arrive at this figure.

In order to identify the characteristics of the sample, the following indicators have been obtained:

1. Average ton cost of each element in all voyages;
2. Standard deviation of the values of each element from average;
3. Coefficient of variance, which equals the standard deviation divided by the mathematical means X 100.

The vessels in the study sample varied in size. Hence, the vessels have been divided into two groups:

A. Large vessels of 261,000 dwt or more load.

B. Small vessels of less than 261,000 dwt load.

The differences between the cost means of large vessels and small vessels and whether these differences are statistically significant or not were then studied. The

answer to this question required making a t-test of the difference between the means of each element.

The hypotheses and significance level for this test are as follows:

- Test Hypothesis
  Null hypothesis H_0 $\bar{X}_1 = \bar{X}_2$

  or

- Alternative hypothesis H_1 $\bar{X}_1 \neq \bar{X}_2$
  $\propto = 0.05$

The researcher conducted this test by applying the following formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S^2 . P \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$S^2 = \frac{(n_1 - 1) S^2_1 + (n_2 - 1) S^2_2}{n_1 + n_2 - 2}$$

where:

$S^2.P$ = pooled variance of the two groups

X_1 = sample mean in population$_1$

X_2 = sample mean in population$_2$

n_1 = sample size or population$_1$

n_2 = sample size or population$_2$

Table 8.4

Tanker Vessels Average Cost per Ton DWT/Day

Voyage No.	Depreciation	Insurance	Wages and Victualing	Stores	Repair and Maintence.	Fuel	Port Charges and Agents' Fees	Miscellaneous and Admin Expenses	Total Voyage Cost	DWT
1	.7	.1	.6	.1	.2	.4	.5	.60	3.323000	23,000
2	.5	.1	.6	.1	.2	.3	.5	.61	2.9	24,700
3	.52	.12	.57	.14	.27	.44	.45	.83	3.33	28,000
4	.46	.08	.44	.14	.42	.43	.74	.27	2.97	39,359
5	.47	.07	.43	.16	.52	.43	.74	.28	3.13	39,359
6	.62	.09	.298	.07	.08	.39	.59	.232	2.38	47,763
7	.64	.09	.22	.06	.12	.39	.59	.231	2.35	47,815
8	.87	.10	.61	.22	.15	.76	.23	.19	3.18	8,178
9	.77	.07	.53	.19	.14	.71	.14	.17	2.76	8,178
10	.60	.06	.39	.14	.10	.58	.19	.09	2.18	11,233
11	.05	.01	.03	.02	.01	.02	.05	.012	.212	290,000
12	.152	.044	.03	.02	.042	.027	.042	.011	.375	304,000
13	.021	.003	.031	.014	.031	.021	.041	.013	.181	300,000
14	-	.037	.039	.015	.049	.051	.047	.014	.253	261,000
15	.126	.038	.025	.008	.043	.038	.051	.01	.339	405,000
Small Tankers - Less than 261,000 dwt										
Average	.26	.09	.47	.13	.22	.48	.47	.35	2.85	
Standard Deviation	.14	.02	.14	.05	.14	.15	.22	.24	.42	
Coefficient of variance %	21.8	20.2	29.3	39	65.8	31.3	46	69	14.6	
Large Tankers - 261,000 dwt or more										
Average	.087	.026	.03	.015	.04	.03	.046	.0125	.272	
Standard Deviation	.06	.018	.005	.005	.015	.013	.0045	.0012	.083	
Coefficient of variance %	69	69.2	16.8	33.2	37.5	43.6	9.7	10.3	30.5	

S_1 = sample variance in population$_1$

S_2 = sample variance in population$_2$

By comparing the calculated (t) with the tabulated (t) it is possible to decide whether or not the difference is significant. (Berenson and Levin, 1984:414)

The results of the t-test on the average cost of each element/ton dwt/day for large and small vessels are shown in Table 8.5.

Table no. 8.5 shows that calculated (t) is bigger than the tabulated (t). Thus the difference between the two averages is a significant one, which implies that the size of the vessel has a clear influence on all cost elements. Hence, the alternative hypothesis H_1 that the average cost per ton dwt per day is less for large vessels than for small vessels, is correct.

8.3 A Study of Cost Structure of Cargo Vessels

Tables 8.6 and 8.7 show the cost and operation data of the sample of cargo vessels.

Table 8.5

The Results of T-Test

	Depreciation	Insurance	Wages and Victualing	Stores	Maintenance and Repair	Fuel	Port Charges and Agency Fees	Admin. and Misc. Expenses	Total Voyage Cost
Average cost of the small ships' group X_1	.62	.09	.47	.13	.22	.48	.47	.35	2.85
Number of Observations N_1	10	10	10	10	10	10	10	10	10
S^2_1	196	.0004	0.196	.0025	.0196	.02255	.484	.0576	.1764
Average cost of big ships group X_2	.87	.026	.03	.015	.04	.03	.046	.012	.272
Number of Observations. N_2	5	5	5	5	5	5	5	5	5
S^2_2	.0036	.00032	.000025	.0000225	.000225	.000169	.000020	.0000014	.006889
Calculated T	8.027	6.032	6.90	5.037	2.81	6.57	4.229	3.09	13.353
Tabulated T at Significance Level 5%	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
ANALYSIS RESULTS	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant

Table 8.6

Cargo Vessels Cost Elements

Voyage No.	Depreciation	Insurance	Wages and Victualing	Stores	Maintenance and Repairs	Fuel	Stevedoring	Port Charges	Agency Fees	Miscellaneous and Administration	Total Voyage Cost
1.	1,833,000	390,000	340,750	136,300	885,950	1,162,000	3,912,000	2,429,000	1,511,000	1,265,000	13,865,000
2.	1,396,000	302,000	294,250	117,700	765,050	956,000	2,460,000	458,000	734,000	1,064,000	8,547,000
3.	1,594,000	324,000	523,500	209,400	1,361,100	1,574,000	4,591,000	2,515,000	1,629,000	1,725,000	16,046,000
4.	766,000	134,000	294,250	117,700	765,050	938,000	2,029,000	294,000	444,000	1,178,000	6,960,000
5.	462,330	111,650	400,489	144,045	104,396	367,275	618,750	216,875	135,843	126,420	2,688,073
6.	416,107	91,553	413,325	36,300	44,126	639,600	312,500	127,300	95,625	67,126	2,243,562
7.	220,560	44,660	192,188	29,700	21,525	314,000	425,084	89,100	98,000	46,525	1,481,342
8.	341,080	89,320	364,545	29,260	43,050	600,000	436,000	107,310	97,500	68,080	2,176,115
9.	120,560	44,660	214,125	17,765	34,440	310,000	227,345	105,600	96,500	42,525	1,213,520
10.	0	138,46	297,846	119,138	474,398	744,203	532,000	72,500	23,438	64,178	2,466,147
11.	0	127,281	464,953	185,981	708,879	780,818	696,875	65,625	23,438	73,969	3,127,819
12.	187,175	55,825	107,566	43,026	279,672	175,301	1,082,000	56,250	23,438	41,100	2,051,353
13.	262,045	78,155	154,454	61,782	201,581	225,303	450,000	234,375	23,438	32,941	1,724,074
14.	0	66,990	202,991	81,197	327,777	386,876	450,000	16,875	23,438	33,698	1,589,849
15.	17,000	3,300	11,000	4,400	7,000	7,000	9,000	9,000	3,500	8,500	79,700
16	312,960	71,456	357,375	34,650	34,440	481,056	253,220	107,600	97,000	56,440	1,806,197

Table 8.7

Operation Data for Cargo Vessels

Voyage No.	Dead Weight	Gross Tonnage	Cargo Transported	Average Speed	Voyage Days	Distance	Vessel Age	Crew No.
1	42,600	25,031	56,861	16.80	67	19,124	10	26
2	42,600	25,031	49,271	18	51	16,381	10	26
3	38,000	43,841	62,094	13	93	21,721	12	35
4	22,853	14,835	32,764	16.09	60	17,191	16	28
5	15,077	8,843	28,500	11.5	97	11,903	16	24
6	17,249	9,903	7,500	15.5	41	20,088	18	22
7	15,546	8,166	11,664	17.5	20	10,920	6	18
8	18,037	10,526	4,000	12	40	16,128	17	19
9	15,855	9,371	802	14	20	11,424	13	19
10	6,082	3,059	3,743	17.5	62	21,020	23	25
11	6,085	3,059	3,750	17.3	57	20,844	24	25
12	7,212	3,606	3,442	16	25	6,460	5	25
13	7,212	3,606	3,427	15.4	35	11,022	5	25
14	6,082	3,059	3,764	17.8	30	9,306	23	25
15	1,450	722	3,000	12	7	300	21	39
16	6,522	5,131	1,724	15	32	17,280	1	21

These data are used in the following analysis.

8.3.1 Cost percentage

Table 8.8 shows the percentage of each cost element to the total of cargo vessels. It gives a detailed breakdown of total cost for the sample of study.

Table 8.8

Percentage of Cost Components For Cargo Vessels

Voyage No. / Cost Element	Depreciation	Insurance	Wages and Victualing	Stores	Maintenance and Repairs	Fuel	Stevedoring	Port Charges	Agency Fees	Miscellaneous and Administration Expenses	Total Voyage Cost
1.	13	2.8	2.5	1	6.4	8.4	28.2	17.5	10.9	9.2	100
2.	16.3	3.5	3.5	1.4	9	11	28.8	5.4	8.6	12.4	100
3.	9.9	2	3.3	1.3	8.5	9.8	28.6	15.7	10.1	10.8	100
4.	11	1.9	4.2	1.7	11	13.5	29.2	4.2	6.4	16.9	100
5.	17.2	4.2	14.9	5.4	3.9	13.7	23	8	5	4.7	100
6.	18.5	4	18.4	1.6	2	28.5	14	5.7	4.3	3	100
7.	14.9	3	13	2	1.5	21.1	28.7	6	6.6	3.2	100
8.	15.7	4	16.8	1.3	2	27.6	20	4.9	4.5	3.5	100
9.	10	3.7	17.6	1.5	2.8	25.5	18.7	8.7	8	2.6	100
10.	0	5.6	12.1	4.8	19.2	30.2	21.6	2.9	1	2.3	100
11.	0	4.1	14.9	5.9	22.7	25	22.3	2.1	.7	2	100
12.	9.1	2.7	5.2	2.1	13.6	8.8	52.7	2.7	1.1	1.9	100
13.	15.2	4.5	9	3.6	11.7	13.1	26.1	13.6	1.3	2.2	100
14.	0	4.2	12.8	5.1	20.6	24.3	28.3	1	1.5	10.7	100
15.	21.3	4.1	13.8	5.5	8.8	8.8	11.3	11.3	4.4	3.1	100
16.	17.3	4	19.8	1.9	1.9	26.6	14	5.9	5.4	3.1	100
Average	11.8	3.6	11.4	2.9	9.1	18.5	24.7	7.2	5	5.7	100

It should be noted from Table 8.8 that the relative importance varies from one element to another. The cost elements can be ranked as follows:

Stevedoring Expenses	24.7%
Fuel Expenses	18.5%
Depreciation Expenses	11.8%
Crew Cost	11.4%
Maintenance and Repairs Expenses	9.1%
Port Charges	7.2%
Administration and Miscellaneous Expenses	5.7%
Agency Fees	5%
Insurance Expenses	3.6%
Stores Expenses	2.9%
Total	100%

Reorganising these cost elements to the three groups of shipping cost, that is capital cost, running cost and voyage cost it was found:

Capital Cost:	Depreciation	11.8%
Running cost which includes:		
	Insurance Expenses	3.6%
	Crew Cost	11.4%
	Stores Expenses	2.9%

	Maintenance and Repair Expenses	9.1%	
	Misc. Admin. Expenses	5.7%	32.7%
Voyage cost which includes:			
	Stevedoring Expenses	24.7%	
	Fuel Expenses	18.5%	
	Port Charges	7.2%	
	Agency Fees	5%	55.4%
Total Voyage Cost			100%

The aforesaid grouping of cost elements shows that capital cost and running cost represent 44.6% of the total, while the variable cost (i.e., voyage cost) represents 55.4% of the total. As will be seen from analysis of the figures, the proportion of stevedoring expenses represents nearly a quarter of the total, occupying the first position, and accounting for half the voyage cost. The higher percentage of variable costs requires that each one of the variable cost elements must be controlled for the purpose of minimising it as much as possible and, in turn, increasing the relative profitability of the voyage.

8.3.2 The Statistical Characteristics of the Cost Structure of Cargo Vessels

Tables 8.6 and 8.7 show the cost elements and operation data of cargo vessels. As indicated previously, these figures alone do not give a clear picture or enable valid

comparison, due to the differences in the period of each voyage, as well as the variation in size of vessels.

The researcher obtained from Tables 8.6 and 8.7 the average cost of each element (ton dwt/day) as shown in Table 8.9 which demonstrates considerable variation in these averages. Such a variation may be attributed to several factors such as the differing nature of each element, different vessel sizes or capacity. Moreover, it was noticed that means of averages vary from one trip to another for the same element, due to the different circumstances of each voyage.

It can also be seen from Table no. 8.9 that vessel sizes in the study sample are varied. Hence, we have divided the vessels into two groups:

1. Large cargo vessel of 15000 dwt or more load.
2. Small cargo vessel of less than 15000 dwt load.

Finally, Table 8.10 indicates the following:

1. With regard to the cost elements of depreciation, insurance, wages and victualling, stores, maintenance and repair, stevedoring, fuel and total voyage cost, it can be discerned that the calculated (t) value is higher than the tabulated (t). This means that there is a significant difference between these cost elements for big vessels if compared with those of smaller ones, by a confidence degree of 95%. In other words, size has a direct effect on these elements.

Table 8.9

Cargo Vessels Average Cost per Ton DWT/Day

Voyage No.	Depreciation	Insurance	Wages and Victualing	Stores	Maintenance and Repair	Fuel	Stevedoring	Port Charges	Agency Fees	Misc. and Admin Expenses	Total Voyage Cost	DWT
1	.64	.137	.119	.047	.31	.41	1.37	.85	.53	.443	4.857	42,600
2	.64	.139	.135	.54	.35	.44	1.13	.21	.34	.487	3.933	42,600
3	.45	.09	.148	.059	.39	.45	1.29	.71	.46	.492	4.54	38,000
4	.56	.097	.214	.085	.56	.68	1.48	.21	.32	.856	5.07	22,853
5	.32	.079	.27	.098	.07	.25	.42	.15	.09	.08	1.83	15,077
6	.59	.129	.58	.05	.06	.90	.44	.18	.14	.09	3.17	17,249
7	.71	.14	.69	.095	.06	1	1.37	.29	.32	.15	4.76	15,546
8	.47	.12	.51	.04	.059	.83	.60	.15	.14	.09	3	18,037
9	.38	.14	.68	.05	.11	.97	.72	.33	.30	.13	3.83	15,855
10	0	.37	.79	.32	1.26	1.97	1.4	.19	.06	.17	6.54	6,082
11	0	.37	1.34	.54	2.04	2.3	2	.19	.07	.21	9.02	6,082
12	1.04	.31	.6	.24	1.55	.97	6	.31	.13	.23	11.37	7,212
13	1.04	.31	.6	.24	.80	.89	1.78	.93	.09	.13	6.83	6,082
14	0	.37	1.1	.45	1.8	2.12	2.47	.09	.13	.19	8.71	1,450
15	1.67	.33	1.08	.43	.69	.69	.89	.89	.34	.83	7.85	6,522
16	1.5	.34	1.7	.17	.17	2.3	1.2	.5	.46	.28	8.65	6,522
Large vessels 15,000 dwt or more												
Average	.53	.12	.36	.06	.22	.66	.98	.34	.29	.31	3.89	
Standard Deviation	.13	.02	.23	.02	.19	.28	.43	.26	.26	.27	1.06	
Coefficient of variance %	24.5	16.6	63.9	33.3	86.4	42	43.9	76.5	76.5	87.1	27.2	
Small Vessels Less than 15,000 dwt												
Average	1.3	.34	1.03	.34	1.19	1.6	2.25	.44	.18	.29	8.4	
Standard Deviation	.32	.03	.40	.14	.67	.72	1.74	.34	.15	.24	1.6	
Coefficient of variance %	24.6	8.8	38.8	41.2	56.3	45	77.3	77.3	83.3	82.8	19	

The Results of T-Test

	Depreciation	Insurance	Wages and Victualling	Stores	Maintenance and Repair	Fuel	Stevedoring	Port Charges	Agency Fees	Admin. and Misc. Expenses	Total Voyage Cost
Average cost of the small ships' group X_1	1.3	.34	1.03	.34	1.19	1.6	2.25	.44	.18	.29	8.4
Number of Observations N_1	7	7	7	7	7	7	7	7	7	7	7
S^2_1	.1024	.0009	.16	.0196	.4489	.5184	3.028	.1156	.0225	.0576	2.56
Average cost of big ships group X_2	.53	.12	.36	.06	.22	.66	.98	.34	.29	.31	3.89
Number of Observations N_2	9	9	9	9	9	9	9	9	9	9	9
S^2_2	.0169	.0004	.0529	.0004	.0361	.0784	.1849	.0676	.0225	.0729	1.124
Calculated T	6.655	18.03	4.26	6.03	4.2	3.60	2.14	.674	-1.467	-.1554	6.839
Tabulated T at coefficient f.o	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14
ANALYSIS RESULTS	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Insignificant	Insignificant	Insignificant	Significant

Table 8.11

Passenger Vessels

Cost Elements

Voyage No.	Depreciation Expenses	Insurance Expenses	Wages and Victualing Expenses	Stores Expenses	Maintenance and Repairs Expenses	Fuel Expenses	Stevedoring Expenses	Port Charges	Agency Fees	Miscellaneous and Admin Expenses	Total Voyage Cost
1.	11,000	3,000	15,000	5,000	7,000	11,000	8,000	9,000	3,500	8,500	81,000
2.	16,000	3,500	20,000	6,500	12,000	15,000	10,000	11,000	3,500	9,000	106,500
3.	22,000	4,200	24,000	6,500	14,000	18,000	12,000	13,000	3,500	4,500	126,700
4.	5,625	5,000	15,500	12,000	6,000	29,751	6,000	14,791	4,000	4,500	103,167
5.	5,625	5,000	15,710	10,000	7,000	35,682	4,000	18,750	5,000	9,850	116,617
6.	12,595	2,000	18,750	10,000	10,000	34,284	5,000	12,000	5,000	9,250	118,879
7.	16,200	16,700	8,000	10,000	10,000	25,000	7,500	20,100	7,000	9,000	129,500
8.	11,418	7,000	15,826	6,851	10,194	43,523	5,500	19,200	1,000	7,133	127,645
9.	11,418	7,000	17,500	8,000	10,000	29,751	6,000	18,958	4,00	8,000	120,627
10.	99,000	39,285	41,400	4,600	18,000	72,380	4,000	60,800	25,600	64,355	429,420

2. As for other elements such as port charges, agency fees and miscellaneous and administration expenses, there are minimal insignificant differences between these cost elements for large vessels and small vessels, which implies that the effect of size on them is limited, with a probability degree 95%.

8.4 A Study of Cost Structure of Passenger Vessels

Tables 8.11, 8.12 show the cost and operation data of the study sample of passenger vessels.

Table 8.12

Operation Data for Passenger Vessels

Voyage Number	Dead-weight	Tons	Average Speed	Voyage Days	Distance	Vessel Age	Crew No.
1	1,002	407	11	7	300	28	50
2	1,432	700	12	7	300	30	55
3	1,766	850	12.5	7	300	26	55
4	2,209	860	10	5	300	33	58
5	2,209	860	11	35	300	33	55
6	1,991	4,630	14.5	4	1,300	25	76
7	4,000	6,242	14	4	1,300	34	65
8	4,614	1,720	15.9	4	1,300	24	59
9	4,630	1,990	15.5	4	1,300	26	72
10	4,716	750	16	7	1,600	23	58

These data are used in the following analysis.

8.4.1 Cost Percentage

Table (8.13) shows the percentage of each cost element of passenger vessels.

It gives a detailed breakdown of total cost for the study sample.

It should be observed from Table 8.13 that the relative importance varies from one element to another. The cost elements can be ranked as follows:

Fuel Expenses	22.5%
Wages and Victualling Expenses	14.4%
Port Charges	13.2%
Depreciation Expenses	12.1%
Admin and Misc. Expenses	8.1%
Maintenance and Repairs Expenses	7.9%
Stores Expenses	6.7%
Stevedoring Expenses	5.8%
Insurance Expenses	5.4%
Agency Fees	3.8%
Total Cost	100%

Reorganising these cost elements to the three groups of shipping cost, that is capital cost, running cost and voyage cost, it will be found:

Capital Cost : Depreciation 12.1%

Running Cost includes:

Insurance Expenses	5.4%	
Crew Expenses	14.4%	
Stores Expenses	6.7%	
Maintenance and Repairs Expenses	7.9%	
Admin and Misc. Expenses	8.6%	42.5%

Table 8.13

Percentage of Cost Components for Passenger Vessels

Voyage No./ Cost Element	Depreciation Expenses	Insurance Expenses	Wages and Victualing Expenses	Stores Expenses	Maintenance and Repairs Expenses	Fuel Expenses	Stevedoring Expenses	Port Charges	Agency Fees	Miscellaneous and Administration Expenses	Total Voyage Cost
1.	13.6	3.7	18.5	6.2	8.6	13.6	9.9	11	4.3	10.5	100%
2.	15	3.3	18.8	6.1	11.3	14	9.4	10.2	3.3	8.5	100%
3.	17.4	3.3	18.9	5.1	11	14.2	9.5	10.3	2.8	7.5	100%
4.	5.5	4.8	15	11.6	5.8	28.8	5.8	14.3	3.8	4.4	100%
5.	4.8	4.3	13.5	8.6	6	30.6	3.4	16.1	4.3	8.4	100%
6.	10.6	1.7	15.8	8.4	8.4	28.8	4.2	10.1	4.2	7.8	100%
7.	12.5	12.9	6.1	7.7	7.7	19.3	5.8	15.5	5.4	7	100%
8.	9	5.5	12.4	5.4	8	34	4.3	15	.8	5.6	100%
9.	9.5	5.8	15.5	6.6	8.3	24.7	4.9	15.7	3.3	6.6	100%
10.	23.1	9.1	9.6	1.1	4.2	16.9	.9	14.15	6	14.9	100%
Average	12.1	5.4	14.4	6.7	7.9	22.5	5.8	13.2	3.8	8.1	100%

Voyage cost includes:

Fuel Expenses	22.5%	
Port Charges	13.2%	
Stevedoring Expenses	5.8%	
Agency Fees	3.8%	45.3%
Total Voyage Cost		100%

From the above grouping of cost elements, it should be noted that the fixed cost of passenger vessels, that is capital and running cost, represents 54.6% of total cost, while variable cost, that is voyage cost, represents 45.3% of the total cost. It should be observed from the above figures that fixed cost represents a high percentage of the total and deserves more attention so that the management could reduce it and/or operate the fleet to achieve a minimum break-even point. Finally, variable costs, namely fuel expense and port charges, represent a high percentage of the total, more than 1/3, and they must be controlled for the purpose of minimising them as much as possible and, in turn, increasing the relative profitability of the voyage.

8.4.2 The Statistical Characteristics of the Cost Structure of Passenger Vessels

As with the other vessel types, the figures in Tables 8.11 and 8.12 were converted into a useful indicator as shown in Table 8.14, namely the cost per ton dead

weight/day. It can be observed from Table 8.14 that vessel sizes in the study sample are varied. Hence, the vessels were divided into two groups:

1. Large passenger vessels of 4000 dwt or more load.

2. Small passenger vessels of less than 4000 dwt load.

Table 8.14 shows the varied averages of each element per ton dwt/day, reflecting the different nature of each element and different vessel size.

From Table 8.15, the following should be noted:

1. There are real and significant differences between the cost elements of wages and victualling, stores, maintenance and repairs and stevedoring expenses of large vessels in comparison with those of smaller vessels which means that the factor of size has a significant and real effect on these elements, with a probability of confidence degree of 95%.

2. As for other elements such as depreciation, insurance, fuel, port charges, agency fees and miscellaneous and administration expenses, there are minimal differences between these cost elements for large vessels and small vessels, which implies that the effect of size on them is limited with a confidence degree of 95%.

Table 8.14
Cargo Vessels
Average Cost per Ton DWT/Day

Voyage No.	Depreciation Expenses	Insurance Expenses	Wages and Victualing Expenses	Stores Expenses	Maintenance and Repair Expenses	Fuel Expenses	Stevedoring Expenses	Port Charges	Agency Fees	Misc. and Admin Expenses	Total Voyage Cost	DWT
1	1.6	.4	2.1	.7	1	1.6	1.1	1.3	.5	1.2	11.5	1,002
2	1.6	.3	2	.7	1.2	1.5	1	1.1	.3	.9	10.6	1,432
3	1.8	.3	1.9	.5	1.1	1.4	1	1.1	.3	.8	10.2	1,766
4	5	.5	1.4	1.1	.5	2.7	.5	1.3	.4	.4	9.3	2.209
5	7	.6	2	1.3	.9	4.6	.5	2.4	.6	1.3	15	2,209
6	1.6	.25	2.3	1.3	1.3	4.3	.6	1.5	.6	1.2	14.9	1,991
7	1	1	.5	.6	.6	1.6	.5	1.3	.4	.55	8.1	4,000
8	.6	.4	.9	.4	.5	2.4	.3	1	.1	.4	6.9	4,614
9	.6	.4	.9	.4	.5	1.6	.3	1.1	.2	.5	6.5	4,630
10	3	1.2	1.3	.1	.5	2.2	.1	1.8	.8	.2	13	4,716
Small vessels - Less than 15,000 tons												
Average	1.3	.39	1.95	.93	1	2.7	.78	1.45	.45	.97	11.9	
Standard Deviation	.55	.136	.30	.34	.28	1.4	.28	.49	.14	.34	2.5	
Coefficient of variance %	42.3	34.9	15.4	36.6	28	51.9	35.9	33.8	31	21	27.2	
Large Vessels - 15,000 tons or more												
Average	1.3	.75	.9	.38	.53	1.95	.3	1.3	38	.86	8.6	
Standard Deviation	1.1	.41	.33	.21	.05	.41	.16	.36	.31	.76	3	
Coefficient of variance %	84.6	54.7	36.7	55.3	9.4	21	53.3	27.7	81.6	88.4	34.9	

Table 8.15

The Result of T-Test

	Depreciation Expenses	Insurance Expenses	Wages and Victualing Expenses	Stores Expenses	Maintenance and Repair Expenses	Fuel Expenses	Stevedoring Expenses	Port Charges	Agency Fees	Admin. and Misc. Expenses	Total Voyage Cost
Average cost of the small ships' group X_1	1.3	.39	1.95	.93	1	2.7	.78	1.45	.45	.97	11.9
Number of Observations N_1	6	6	6	6	6	6	6	6	6	6	6
S^2_1	.3024	.0185	.09	.1156	.0784	1.96	.0784	.2401	.0196	.1156	6.25
Average cost of big ships group X_2	1.3	.75	.9	.38	.53	1.95	.3	1.3	.38	.86	8.6
Number of Observations N_2	4	4	4	4	4	4	4	4	4	4	4
S^2_2	1.21	.1681	.1089	.0441	.0025	.1681	.0256	.1296	.0916	.5776	9
Calculated T	.6429	-2.041	5.22	2.859	3.259	1.024	3.073	.5213	.4933	.3171	1.894
Tabulated T at significance level 5%	2.306	2.306	2.306	2.306	2.306	2.306	2.306	2.306	2.306	2.306	2.306
Analysis Results	Insignificant	Insignificant	Significant	Significant	Significant	Insignificant	Significant	Insignificant	Insignificant	Insignificant	Insignificant

8.5 Summary and Conclusion

Analysis of the cost structure of Saudi vessels was carried out. Actual cost data of voyages from each type of vessel (tanker, cargo and passenger) were collected using a questionnaire for this purpose. The data cover a cross-section of several sizes and ages of vessels, for the year 1992. These cost data and operating data were analysed by several techniques: percentage analysis, fixed and variable cost analysis, average cost per ton dwt/day analysis, average standard deviation, coefficient of variance and t-tests.

The analysis revealed that the fixed costs of tanker vessels, that is capital costs and running costs, represent 67.1 percent of the total or just over 2/3 of total cost, while the variable costs (i.e. voyage costs) represent 32.9 percent or about 1/3 of the total cost. Therefore, the higher percentage of fixed cost needs particular attention and thorough planning technique for operating the tanker vessels, so that break even point can be achieved at a lower level of operation, hence increasing the margin of safety.

On the other hand, the fixed costs of cargo vessels were 44.6 percent of the total, while the variable cost represented 55.4 percent of the total. The higher percentage of variable costs requires that each of the variable cost elements must be controlled with a view to minimising it as much as possible and, in turn, increasing the relative profitability of the voyage.

Finally, the analysis also showed that the fixed costs of passenger vessels were 54.6 percent of total costs, while variable costs were 45.3 percent of the total cost.

Chapter Nine

Cost Functions in Saudi Shipping Companies

9.1 Introduction

This chapter aims to determine the cost equations of the maritime transportation companies using cost and operation data gathered by the researcher by means of questionnaire no. 3, attached to appendix no. 3. It should be pointed out here, that there have not been any previous published studies in the field of cost analysis of Saudi ships, nor is there any official source for such data. It was for this reason that the researcher had to resort to the questionnaire-method to obtain cost data from the Saudi maritime companies. In fact, this was a difficult task, due to the confidential and sensitive nature of such data in those companies. For this reason, the names of those companies which agreed to give the data, will not be disclosed.

The researcher experienced difficulty in obtaining information about voyage costs from a large proportion of the sample. This is attributable to the following reasons:

1. Many shipping companies had no cost accounting system.
2. A large number refused to co-operate and to provide voyage cost data.

However the researcher succeeded in getting information from some companies as follows:

A. 15 voyage cost for tanker vessels representing 18% of sheets distributed.

B. 16 voyage cost for cargo vessels representing 19% of sheets distributed.

C. 10 voyage cost for passenger vessels representing 12% of sheets distributed.

Although this is a small number, it was the only data available to the researcher. Therefore, the following results should be understood in the light of this lack of information.

The cost and operation data which are subjected to statistical analysis here are for the year 1992 only and for different voyages of various vessels. The aim is to find out the relationship between each of the cost elements and the independent variables which affect such elements.

To obtain the cost function of each element, it was necessary to make many attempts, testing the strength of each function and its suitability after each attempt, until eventually the most accurate function was attained within the limits of the available observations, that is, within the limits of the cost and operation data gathered by the researcher.

The costs that were subject to analysis can be categorised as follows:

A. Capital costs which represent the trip's share of the annual depreciation element of the ship.

B. Operating costs which stand for all the costs and expenses incurred in the day-to-day operating of the ship and at the port. These costs are the costs associated with manning, supplying, maintaining and insuring the vessel.

C. Voyage direct costs which are the variable costs incurred in undertaking a particular voyage, and they include fuel, port charges, cargo handling cost, agency fees and canal dues if applicable.

In the following sections, each of these cost elements is studied separately and the cost function found for it. Then the total cost function of the voyage is found, including all direct and indirect cost elements of the voyage.

9.2 Purposes of the Statistical Analysis of Maritime Cost

1. Identifying the factors that affect each of the cost elements.
2. Determining which factors are more effective than others in each of the cost elements. Ascertaining the "Cost Functions" will provide important information about each element which will help the management of maritime companies to apply effective control over such elements through controlling the factors that affect them. Furthermore, such information can help in estimating each of the cost elements and setting budgets for maritime cost elements, to be used as a basis for setting standard cost and performance criteria in Saudi maritime companies.

9.3 Selecting the Probable Independent Variables

As mentioned previously, the statistical analysis conducted here focuses on finding a relationship between dependent variables (specific cost elements) and independent variables that result in cost being incurred. The researcher should monitor such influential factors prior to entering into statistical analysis and should depend in his first choice on a logical justification. As for the relative importance of each independent variable, it cannot be determined until the statistical analysis has

been accomplished. In the following subsections, the researcher will present the items selected as probable independent variables for each of the cost elements, which are analysed statistically later in the chapter.

9.3.1 Depreciation Cost Element

Basically, the depreciation cost element is associated with the capital cost of the vessel as well as its age. As known, the annual depreciation amount is determined by dividing the capital cost of the vessel by its estimated age. A specific voyage's share of the depreciation element is determined by the number of days of the voyage. The investment cost of the vessel is associated with its deadweight. Therefore, according to the available data it will be assumed that the depreciation element of the voyage is a "function" of three variables, that is, the vessel's deadweight, age and number of days of the voyage.

9.3.2 Insurance Cost Element

The insurance cost element of the vessel is associated with many factors. They are the capital cost of the vessel, operating conditions and age. Since capital cost information was not available, another variable, i.e., "deadweight" was used, on the grounds that the capital cost is basically affected by this variable. As the specific voyage's share of the vessel's insurance expenses is determined by the number of days of the voyage, the independent variables of the insurance element are the deadweight, age and number of days of the voyage.

9.3.3 Wages and Victualling

This element consists of the basic wages, overtime payment, bonuses, insurance, victualling costs, travelling and repatriation expenses, training and end of service compensation and any other payments or costs pertaining to manpower on board the ship. Manpower costs are normally affected by many factors such as the number of men working on the ship, and labour regulations which include some terms and conditions pertaining to wages and victualling. The number of the crew of a vessel may vary from one vessel to another according to its size and type. The voyage's share of costs is affected by the number of days of the voyage. Therefore, the voyage's share of the manpower (labour) cost is likely to be a "function" of the crew number and voyage days number.

9.3.4 Stores Element

This element includes lubrication oils, small equipment and consumable tools on board the vessel and in the engine room, as well as cleaning materials, paints, ropes, safety equipment, water, kitchenware, spare parts and other items needed for the day-to-day operating of the vessel.

It can be said that these elements are in total associated with the size of the vessel, which is expressed by the term "Deadweight". The share of a specific voyage of such costs is determined by the number of days of that voyage. Hence, the Stores

cost of the voyage is a "Function" of the vessel's deadweight and the number of days of the voyage.

9.3.5 Maintenance and Repair Element

The vessel, like any other fixed asset, needs regular repair and maintenance work in order to maintain it sea-worthy according to the standards specified by international insurance organisations and also according to international safety standards. This element includes routine maintenance costs along with the vessel's share of periodical survey costs which are also associated with the size of the vessel, since a huge vessel naturally needs more maintenance than a small one. Moreover, this cost is associated with the vessel's age, as an old one needs more repair and maintenance work than a new one. Hence, it will be assumed that the voyage's maintenance cost is associated with the vessel's size, that is, its "deadweight", age and number of days of the voyage.

9.3.6 Fuel Element

The fuel cost is the vessel's consumption of petroleum oils used for running the engines, whether during sailing or in port. Fuel consumption of a specific vessel is associated with the engine capacity, the vessel's speed and the distance of the trip.

The researcher did not get data about the capacity of the engines of the vessels under study. Therefore, the vessel-size or "deadweight" is used instead, on the ground that there is a positive relationship between the vessel's size and its engine capacity. Hence, the fuel consumption cost in a specific voyage is affected by the "deadweight", speed and distance. Since the distance divided by speed equals the number of sailing

days plus the number of stopping days at ports, which equals the number of voyage-days, the researcher will check the relationship between the fuel cost on one hand and the voyage-days and the "deadweight" only as two independent variables. The decision as to the choice of a suitable function will be dependent upon the predictive power of the function test.

9.3.7 Stevedoring Cost Element

Stevedoring costs are associated with the actual goods transported during the voyage. Therefore, it will be assumed the independent variable which affects this element is the cargo weight expressed in tons.

9.3.8 Port and Dock Charges

This element includes piloting fees, canal navigation fees, and dock anchorage fees, which are usually calculated on the basis of the gross tonnage, not the cargo transported alone. But because of the high correlation between deadweight and gross tonnage, it is assumed, therefore that the independent variable for this element is the deadweight of the vessel.

9.3.9 Agency Fees

The shipping (Maritime) agent receives charges against the services he renders. Such charges are represented by commissions for goods, and charges for services rendered to the vessel during anchorage at port, which are all considered as

associated with the cargo weight. Therefore, the independent variable for this element is the actual cargo transported.

9.3.10 Miscellaneous and Administration Expenditure

This expenditure is the voyage's share of the expenses of the head office of the maritime company. That is, it represents a share allocated from general expenses of the company to the voyage. It is usually associated with the vessel's size and number of voyage-days. Hence, the researcher will assume that this element is affected by two independent variables, namely, deadweight and number of voyage-days.

9.4 Cost Models Analysis

According to the information presented in the previous chapter, there are three types of vessels:

1. Tankers
2. Cargo vessels
3. Passenger vessels

Cost elements models for each of the above three types will be presented. The cost elements are:

1. Depreciation Expenses
2. Insurance Expenses
3. Wages and victualling Expenses
4. Stores Expenses

5. Maintenance and Repairs Expenses
6. Fuel Expenses
7. Stevedoring Expenses
8. Port Charges
9. Agency Fees
10. Miscellaneous and Administration Expenses
11. Total Cost

Any of the above elements is considered a dependent variable which depends on several independent variables such as:

1. Deadweight
2. Cargo Transported
3. Speed
4. Voyage Days
5. Vessel Age
6. Crew Number

Therefore, any of the cost elements depends on some of these independent variables. Accordingly, the appropriate multiple regression models are being searched for to represent this relationship in the following format:

$$Y_i = F(X_1, X_2, \ldots X_j, \ldots X_k) + E_i \qquad i = 1, 2, \ldots 11 \qquad (1)$$

where:

Y_i represents the cost element

X_j represents the independent variable j which affects the cost element

E_i is the random error of the cost element i

F $(X_1 , ...X_k)$ is the "Function" which relates the dependent variable Y_i with independent variables X_1, ... X_k.

If there is a linear relationship between the dependent variable Y_i and the independent variables X_1, ... X_k then, equation (1) can be written in the following form:

$$Y_i = B_0 + B_1 X_1 + B_2 X_2 + \ldots B_k X_k + E_i \quad i = 1, 2, \ldots 11 \qquad (2)$$

As B_0 , B_1, ... B_k are usually unknown coefficients representing the population parameters from which the sample used in the study has been taken. It is required to estimate these parameters.

However, if the relation is not linear, equation (1) may take more than one form. One of these forms is:

$$Y_i = B_0 X_1^{B1} X_2^{B2} X_k^{Bk} E_i \, . \qquad (3)$$

This form is not a linear relationship in the parameters B_0 , B_1, ... B_k , but by taking the natural logarithms for both sides of equation (3), it becomes a linear relationship in the parameters as follows:

$$\text{Ln}(y) = \text{Ln}(B_0) + B_1 \text{Ln}(X_1) + B_2 \text{Ln}(X_2) + \ldots B_k \text{Ln}(X_k) + \text{Ln}(E_i) \quad i = 1,2, \ldots 11 \qquad (4)$$

That is equation (3) can easily be altered into the linear form, where all the variables are in the Logarithmic form. In this case, the linear model can be used. (Kaplan, 1982:93).

Another non-linear form for equation (1) is:

$$Yi = A_1 X_1^{B1} + A_2 X_2^{B2} + \ldots A_k X_k^{Bk} + E_i \quad i = 1, 2, \ldots 11 \tag{5}$$

This last form cannot be altered into a linear form.

In building a multiple regression cost model, two basic problems must be faced:

1. The model's form - (is it linear or non-linear?)
2. Which of the independent variables must be included in the model?

First, from previous studies, (see Chapter 5), the independent variables which affect cost were determined. Then SAS software was used on an IBM 3080 Mainframe, using PROC GLM for equation (2) and equation (4), Hence, a statistical comparison between the two models was made. In some models, some independent variables did not have statistically significant effect; therefore, stepwise regression procedures were used to test the best independent variables of the model. The same approach was used for all vessels and all cost elements, as will be shown later.

9.5 Tanker Vessels Regression Model Results

9.5.1 Depreciation Expenses

The following independent variables were determined as the best variables that affect depreciation (DEPR): deadweight (DWT), vessel age (AGE) and voyage days (DAYS). Then, the following linear model was determined (using equation (2)).

$$DEPR = B_0 + B_1 (DWT) + B_2 (AGE) + B_3 (DAYS) + E \tag{6}$$

Then, the non-linear model equation (3) was applied after transforming it into the linear model given by equation (4) as follows:

$$L\,DEPR = L\,B_0 + B_1\,(L\,DWT) + B_2\,(L\,AGE) + B_3\,(L\,DAYS) + E \qquad (7)$$

Where:

L DEPR = Ln (DEPR)

L DWT = Ln (DWT)

L AGE = Ln (AGE)

L DAYS = Ln (DAYS)

By comparing the computer results of equation (6) and equation (7) it was found that for equation (6) R^2 (R-square) = 0.70310, that is, about 70% of the change in depreciation, namely, the sample variation in depreciation, is attributable to or can be explained by the independent variables of deadweight, voyage days and vessel age. For equation (7) R^2 = 0.855717, that is, about 86% of depreciation change can be attributed to the same variables, which can be referred to using the non-linear model. Moreover, for equation (6) the observed significal level for the parameters of the independent variables DWT, AGE and DAYS were 0.0041, 0.1843 and 0.6541 respectively. This means that if we test the null hypothesis $H_0 : B_3 = 0$ against the alternative hypothesis $H_1 : B_3 \neq 0$, the alternative will be accepted at significance levels greater than 0.6541 (observed significance level), which is very high. That is, the alternative hypothesis of $H_1 : B_3 \neq 0$ cannot be supported. In other words the independent variable DAYS seems to be important for determining depreciation.

Table 9.1
Regression Models Results of All Vessels

Cost Elements		Tanker Vessels			Cargo Vessels			Passenger Vessels		
DEPR	Model	$17.548(DWT)^{0.637}(AGE)^{0.464}(DAYS)^{.701}$			$22.843(DWT)^{0.760}(AGE)^{-0.272}(DAYS)^{.811}$			$1.1799\ (AGE)^{-3.4}$		
	R^2	0.8557			0.9532			0.3594		
	PR>T	DWT 0.006	AGE 0.0165	DAYS 0.0049	DWT 0.0010	AGE 0.0371	DAYS 0.0032	AGE 0.0669		
INSUR	Model	$0.2758(DWT)^{0.845}(AGE)^{0.459}(DAYS)^{0.683}$			$23.1778(DWT)^{0.453}(DAYS)^{1.08}$			$.00000006(DWT)^{1.85}(AGE)^{2.25}(DAYS)^{2.03}$		
	R^2	0.8656			0.9066			0.8603		
	PR>T	DWT 0.0001	AGE 0.0105	DAYS 0.0161	DWT 0.0076	DAYS 0.0001		DWT 0.0010	AGE 0.0835	DAYS 0.0118
WAGES	Model	$O.78028(CREW)^{3.128}(DAYS)^{0.763}$			$1766835.19(CREW)^{-1.96}(DAYS)^{1.16}$			$4994.33\ (DAYS)^{0.781}$		
	R^2	0.8569			0.9081			0.3094		
	PR>T	CREW 0.0012	DAYS 0.0001		CREW 0.0002	DAYS 0.0001		DAYS 0.0949		
STORES	Model	$330.790(DWT)^{0.304}(DAYS)^{0.732}$			$319.246\ (DAYS)^{1.43}$			$27796.13\ (DAYS)^{-0.8011}$		
	R^2	0.8762			0.8341			0.5406		
	PR>T	DWT 0.0025	DAYS 0.0004		DAYS 0.0001			DAYS 0.0154		
MAINT	Model	$49.1035(DWT)^{0.771}$			$212.320\ (DAYS)^{0.180}$			$1453107.98\ (AGE)^{-1.48}$		
	R^2	0.6393			0.5618			0.4072		
	PR>T	DWT 0.0003			DAYS 0.0008			AGE 0.0471		

(Contd.....)

Table 9.1 (Continued)

Cost Elements		Tanker Vessels			Cargo Vessels			Passenger Vessels	
FUEL	Model	$7440.23(DWT)^{0.175}(DAYS)^{0.566}$			$44.0285(DWT)^{0.539}(DAYS)^{1.11}$			$61.108(DWT)^{0.7805}$	
	R^2	0.6982			0.8084			0.6222	
	PR>T	DWT 0.0960	DAYS 0.0088		DWT 0.0288	DAYS 0.0024		DWT 0.0067	
PORT	Model	$154.284(DWT)^{0.731}$			$1.9191(DWT)^{1.17}$			$49.7977(DWT)^{0.744}$	
	R^2	0.7373			0.5159			0.6061	
	PR>T	DWT 0.0001			DWT 0.0017			DWT 0.0080	
MISC	Model	$6091.518(DWT)^{0.333}$			$0.1615(DWT)^{1.13}(DAYS)^{0.761}$			$1.251(DWT)^{0.816}(DAYS)^{1.60}$	
	R^2	0.2718			0.7811			0.4694	
	PR>T	DWT 0.0463			DWT 0.0023	DAYS 0.0825		DWT 0.0761	DAYS 0.0654
STEV	Model	---			$850.059(CARGO)^{0.727}$			$10291.27(CARGO)^{-0.966}$	
	R^2	---			0.4583			0.0252	
	PR>T	---			CARGO 0.0040			CARGO 0.6609	
AGEN	Model	---			$16.7037(CARGO)^{0.961}$			$4650.78(CARGO)^{-0.0060}$	
	R^2	---			0.5871			0.000044	
	PR>T	---			CARGO 0.0005			CARGO 0.9855	
TOTAL	Model	$5.491(CREW)^{2.314}(CARGO)^{0.404}(DAYS)^{0.299}$			$1.361(DWT)^{0.656}(SPEED)^{1.73}(DAYS)^{0.966}$			$99.719(DWT)^{0.719}(DAYS)^{0.949}$	
	R^2	0.8976			0.9438			0.6667	
	PR>T	CREW 0.0170	CARGO 0.0008	DAYS 0.0912	DWT 0.0002	SPEED 0.0085	DAYS 0.0001	DWT 0.0086	DAYS 0.0381

PR>T = Observed significance level of the parameters.

In contrast, the computer results for equation (7) show that observed significance levels for the parameters of the independent variables L DWT, L AGE and L DAYS are 0.006, 0.0165, and 0.0049 respectively.

Consequently, we can conclude that equation (7) is better and takes the following form:

L DEPR = 2.864985339 + 0.637163794 (L DWT) + 0.464605171 (L AGE) + 0.701276305 (L DAYS)

By transforming that model into the non-linear form, the following was obtained:

$$DEPR = 17.5487959\ (DWT)^{0.637163794} \times (AGE)^{0.464605171} \times (DAYS)^{0.701276305}$$

Figure 9.1
Tanker Vessels
Observed Vs. Predicted Depreciation Costs

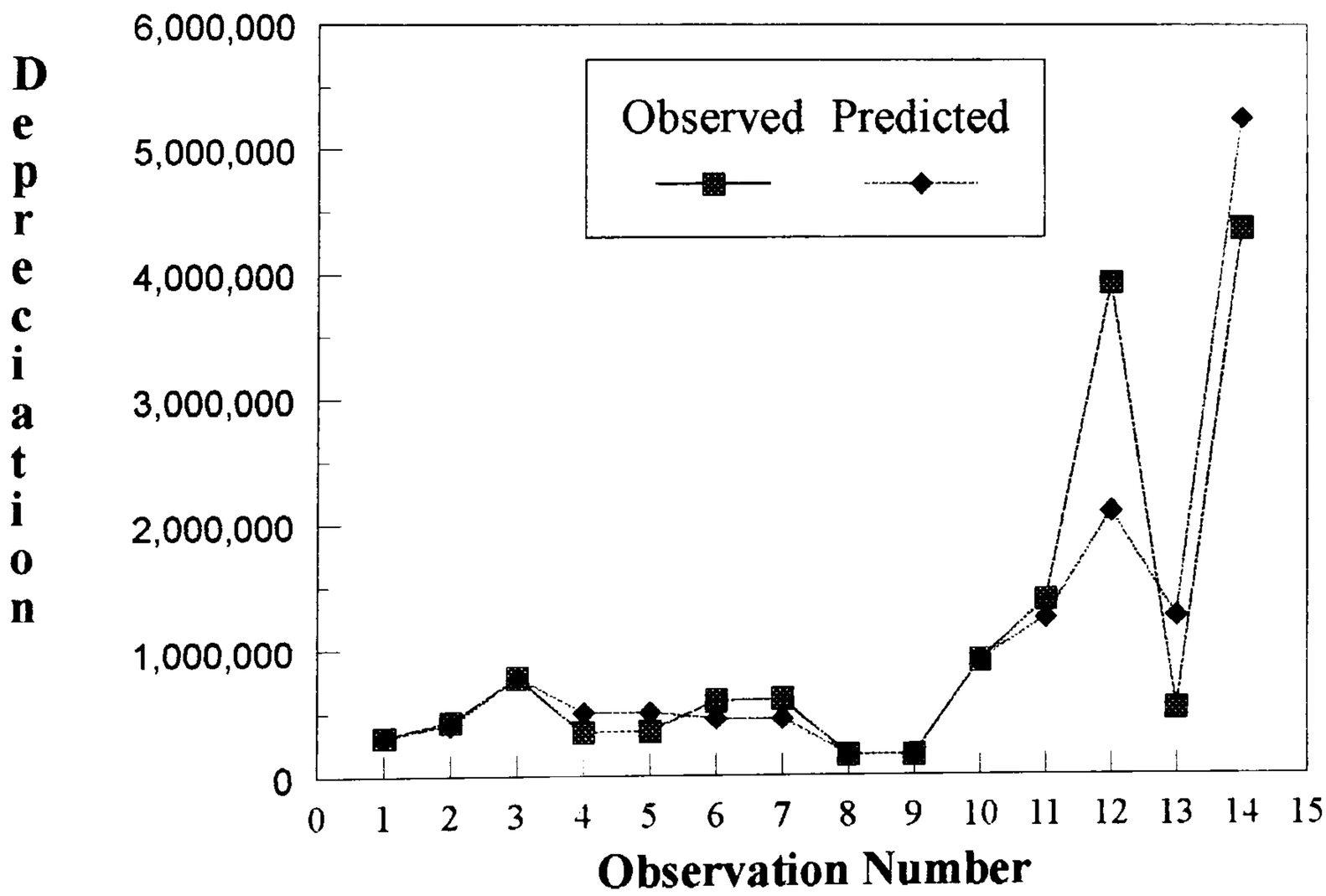


Table 9.1 shows the summary of the computer results for that model as well as the computer results of the other models described later. Also, Figure 9.1 shows the comparison between the observed y values and predicted depreciation values.

From the above model, it can be concluded that each of DWT, AGE and DAYS has a positive relationship with depreciation. That is, by increasing each of the vessel's deadweight, age or voyage days, depreciation increases. Nevertheless, voyage days has more effect than the vessel's age or deadweight.

9.5.2 Insurance Expenses

Independent variables were determined as follows: deadweight, vessel age and voyage days, and the same procedures were followed as previously employed for the "Depreciation" element, to determine the model to be used. Similarly, preference went to the non-linear model equation (7), that is, the model used is:

$$INSR = B_0 (DWT)^{B1} \times (AGE)^{B2} \times (DAYS)^{B3} \times E$$

The computer results are shown in Table 9.1. Hence, it was found that $R^2 = 0.86566$, that is, about 87% of the sample variation in insurance is attributed to or explained by the independent variables of deadweight, vessel age and voyage days.

The observed significance levels for all the parameters (B_1, B_2, B_3) are statistically significant at any significance level greater than or equal to 0.0161 which

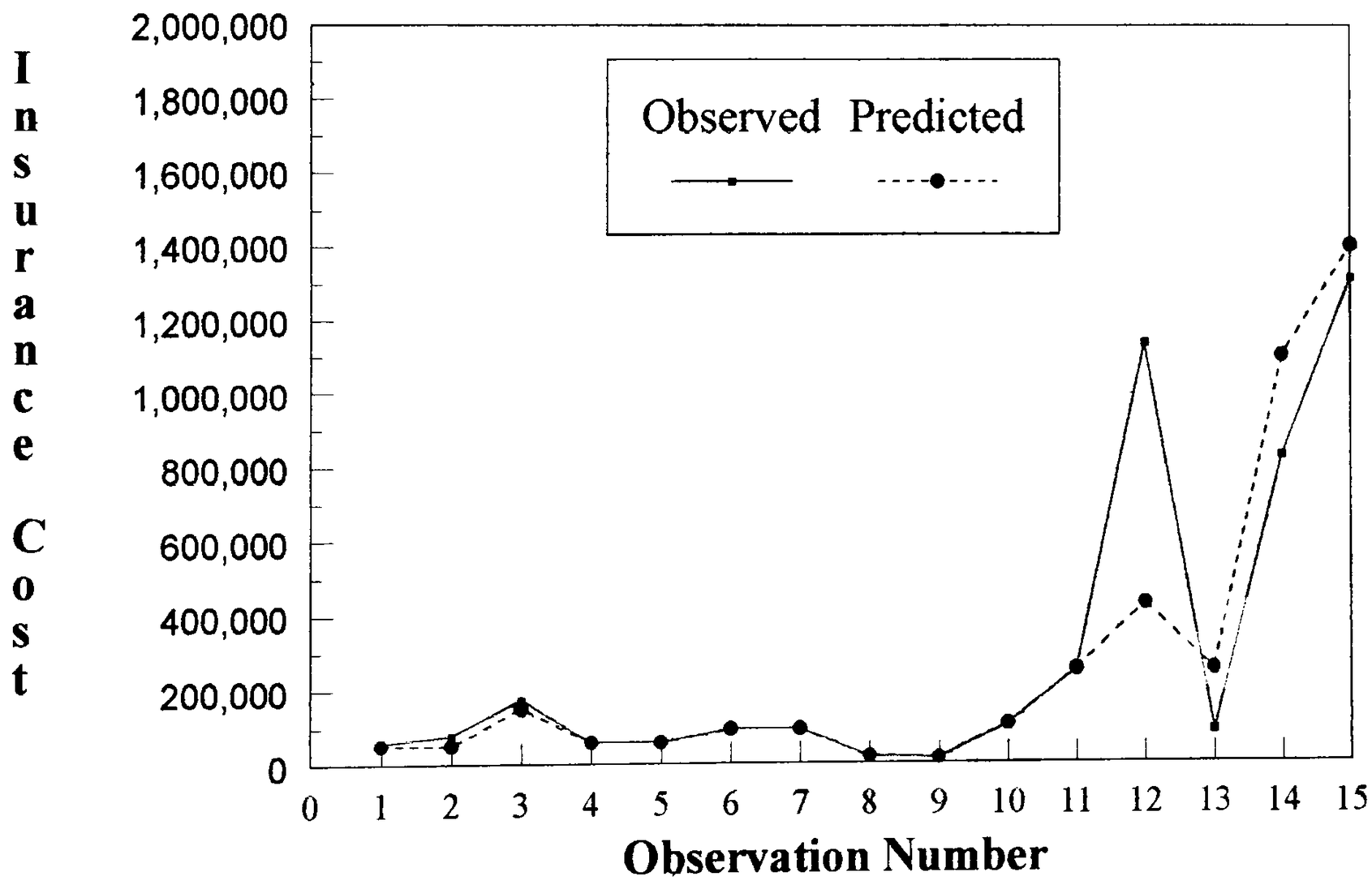
means that the three independent variables contribute actively to determining the costs of insurance. The model takes the following form:

$$INSR = 0.275803812\ (DWT)^{0.84534603} \times (AGE)^{0.459406085} \times (DAYS)^{0.683586045}$$

The above model shows that the three independent variables, deadweight, vessel's age, and voyage days have a positive relationship with insurance, but the effect of deadweight is the biggest of all. Figure 9.2 shows the comparison between the observed y values and predicted insurance values.

Figure 9.2

Tanker Vessels
Observed Vs. Predicted Insurance Cost



9.5.3 Wages and Victualling Expenses

The independent variables crew number and voyage days were determined. The non-linear model equation (7) was used and the computer results are shown in Table 9.1.

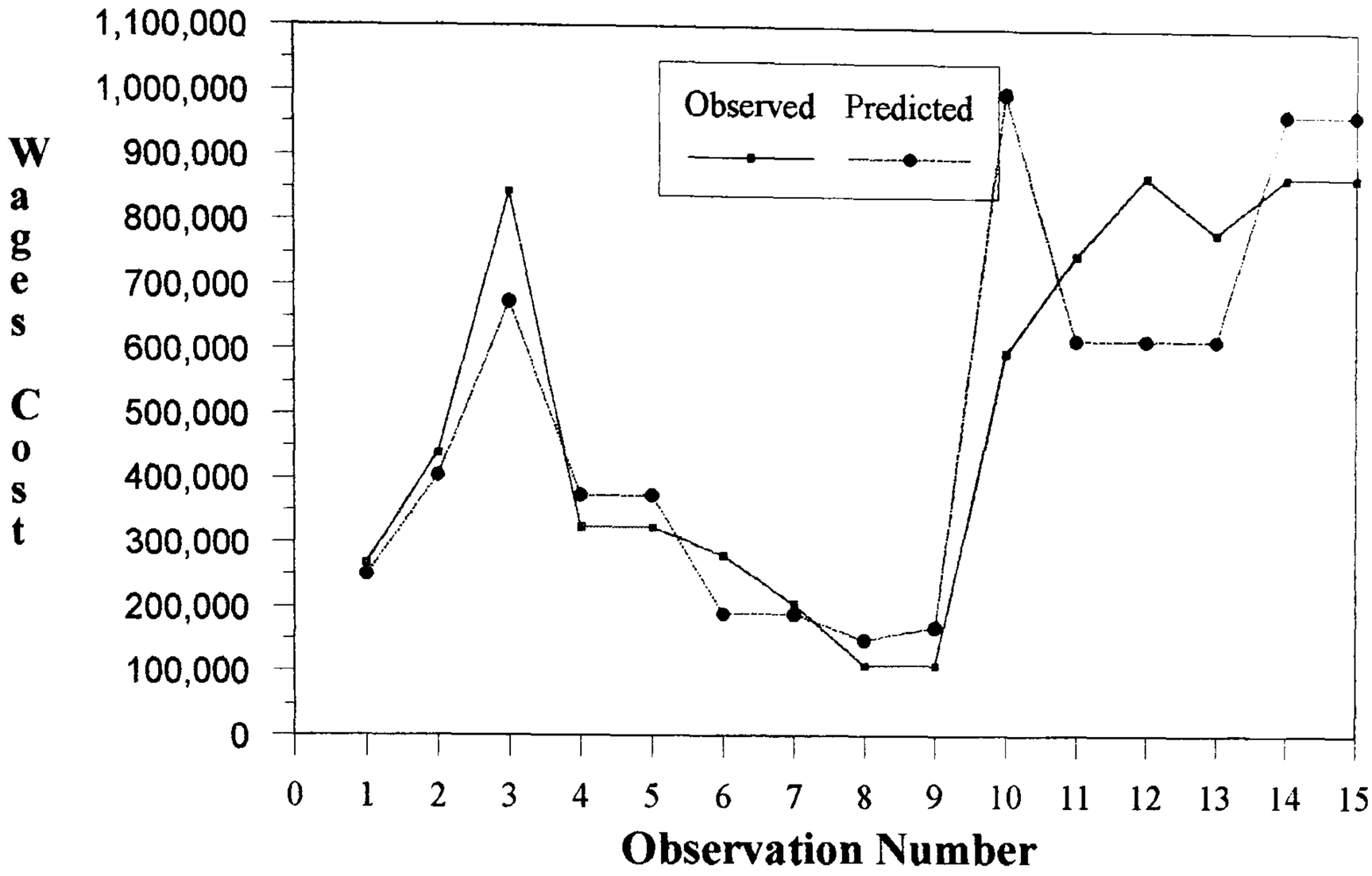
From the results, we see that $R^2 = 0.856968$ and that all the parameters (B_1, B_2,) are statistically significant (see the observed significance levels) and the model takes the following form:

$$WAGE = 0.78028676\ (CREW)^{3.12858773} \times (DAYS)^{0.763225196}$$

The above model shows that the independent variables (CREW) and (DAYS) have a positive relationship with the dependent variables (wages and victualling expenses). That is, if the crew number of the vessel increases, the victualling and wages costs increase too and the same thing applies if the number of voyage days increases, which is a logical relationship. It can be seen that the effect of crew number is bigger than that of the number of days. This can be seen by comparing the exponent of the independent variable (CREW) which is 3.128538773 with the exponent of (DAYS) which is 0.76322519.

Figure 9.3 shows the comparison between the observed y values and predicted wages and victualling values.

Figure 9.3
Tanker Vessels
Observed Vs Predicted Wages Cost



9.5.4 Stores Expenses

The independent variables, deadweight and voyage days, were determined and the non-linear model was used. The results are shown in Table 9.1. The results show that $R^2 = 0.876238$ and that all the parameters are statistically significant and that the model is as follows:

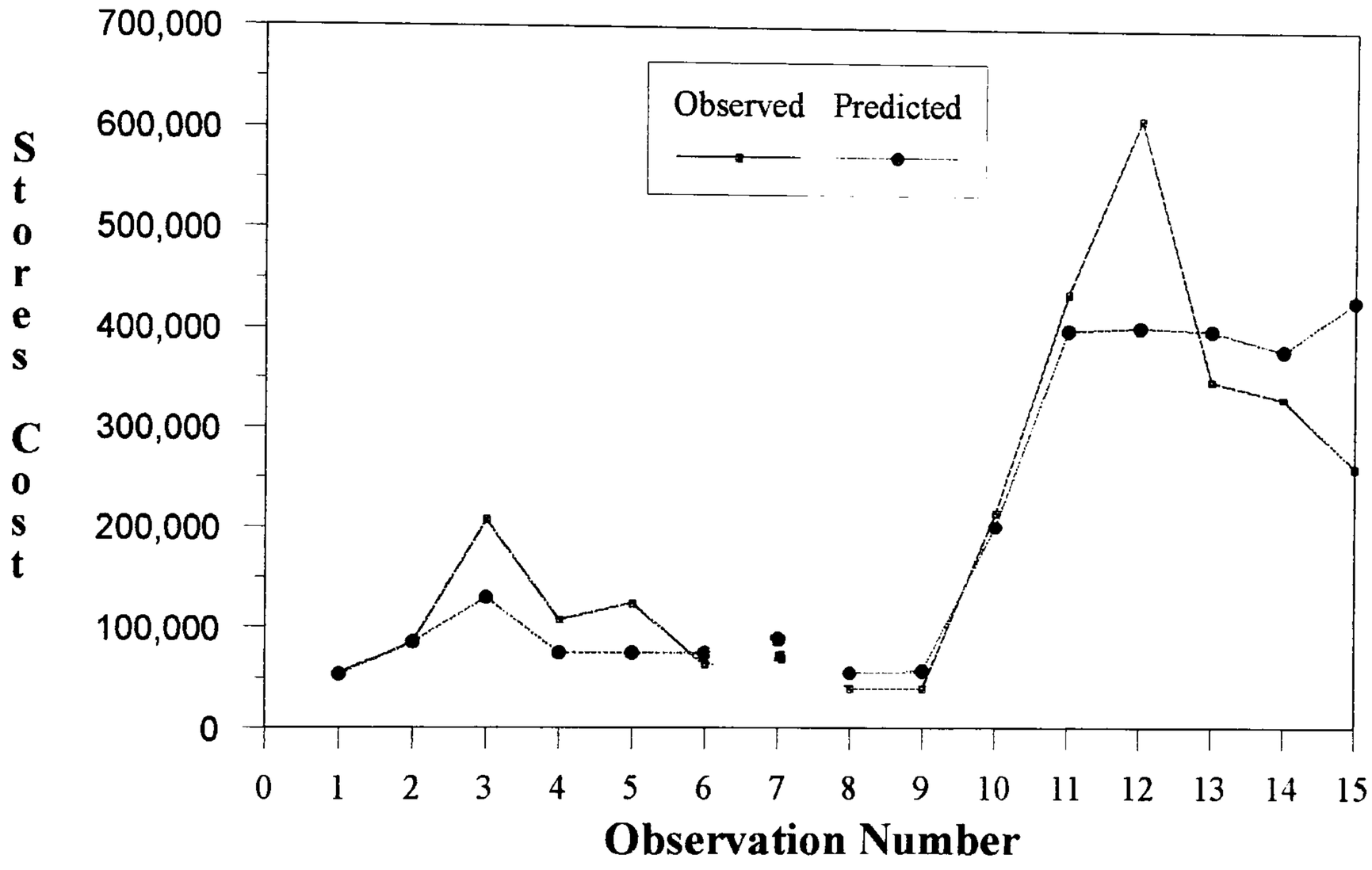
$$STORE = 330.7906768\ (DWT)^{0.304397760} \times (DAYS)^{0.732016288}$$

This means that each of the two independent variables, deadweight and voyage days, have a positive relationship with the dependent variable, Store Expenses. In other words, the costs of stores do increase upon increased deadweight and the number of

voyage days. However, the effect on costs of the number of days is bigger than that of the vessel's deadweight.

Figure 9.4 shows the comparison between the observed values and predicted stores expenses values.

Figure 9.4
Tanker Vessels
Observed Vs. Predicted Stores Cost



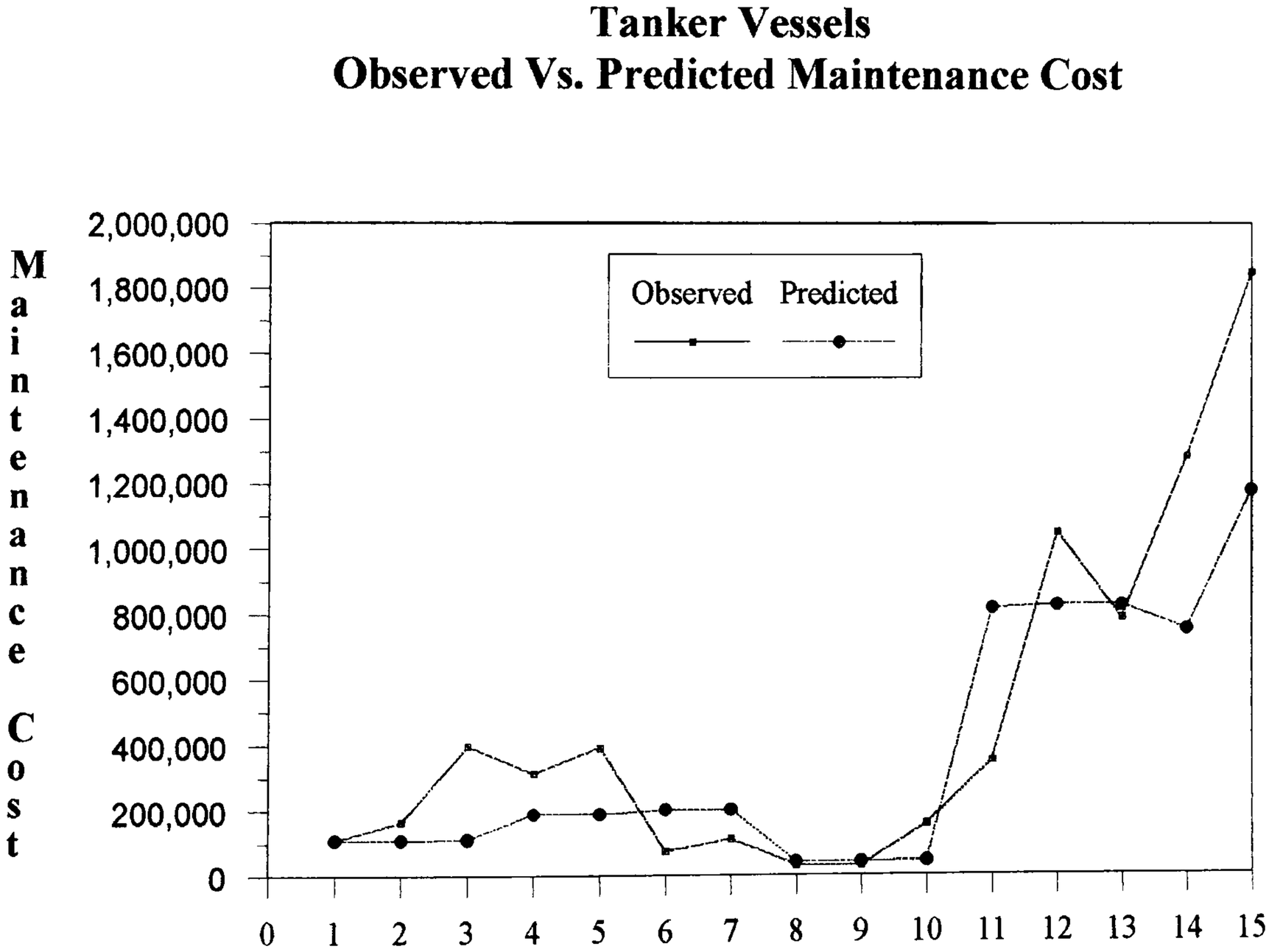
9.5.5 Maintenance and Repair Expenses

The variables, Deadweight, Vessel Age and Voyage Days, were identified as independent variables which affect maintenance costs then the non-linear model was applied. The results show that $R^2 = 0.745169$ but it can be seen that the parameter of the independent variable, vessel age, is significant at the level of 0.1749, and also the

parameter of the independent variable, voyage days, is significant at a level of 0.1077. Thus, the confidence level of the regression model should be below 90%. In order to handle this problem, stepwise regression was conducted in order to choose the best independent variables, in other words, to see which of these independent variables met the 0.1 observed significance level for entry into the model. The computer results indicate that only the independent variable, deadweight, meets this criterion.

Table 9.1 shows the computer results of the model which includes the variable deadweight only as an independent variable where $R^2 = 0.639335$, which is somewhat small in this case. But the observed significance level seen for the parameter B_1 is very small, that is, 0.0003.

Figure 9.5
Tanker Vessels
Observed Vs. Predicted Maintenance Cost



The model takes the following form:

$$MAINT = 49.1035799\ (DWT)^{0.771575510}$$

That is, there is a positive relationship between deadweight and maintenance and repair expenses. Figure 9.5 shows the observed values against the predicted maintenance and repair expenses values.

9.5.6 Fuel Expenses

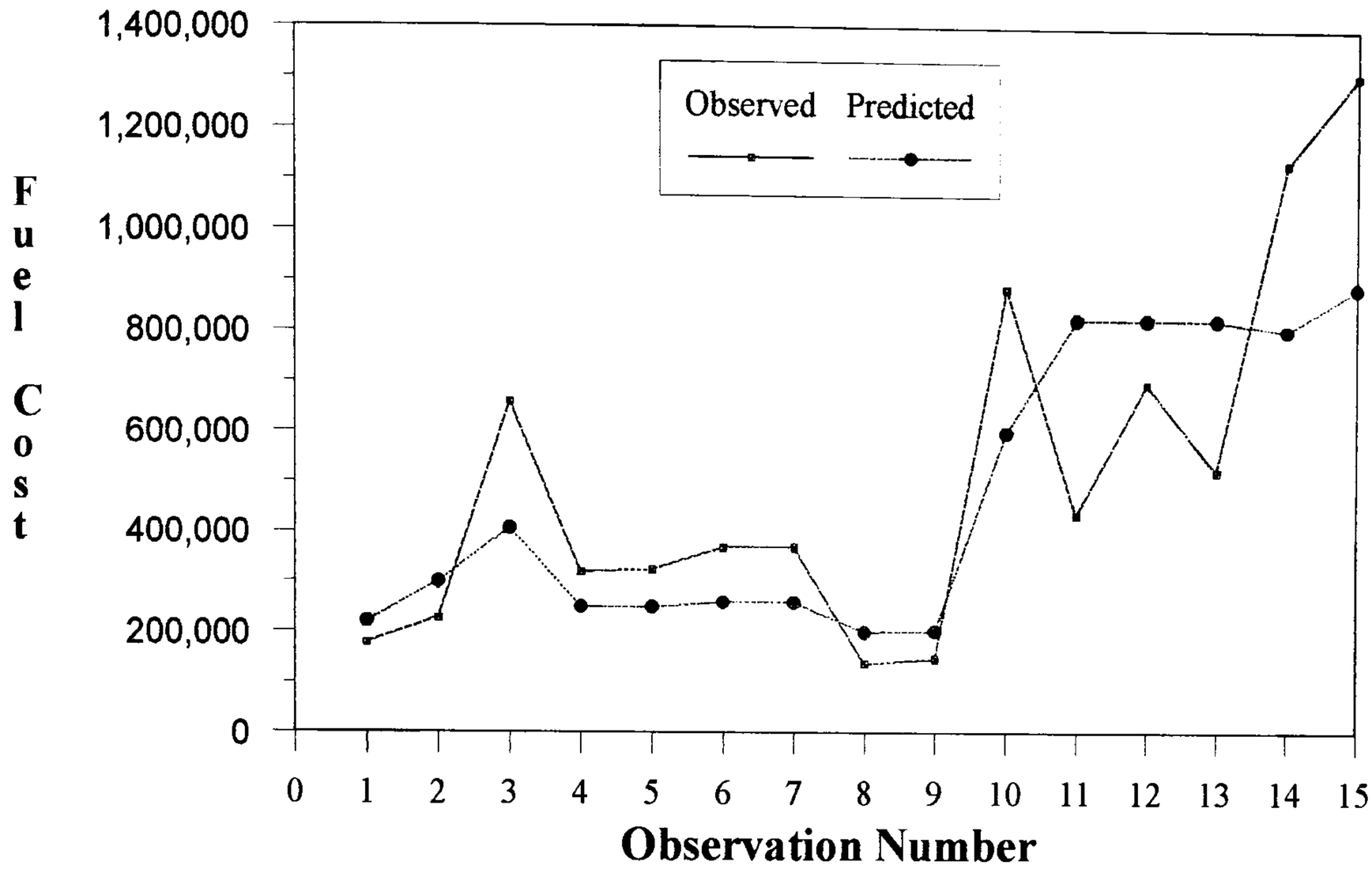
The variables, deadweight and voyage days, were identified as independent variables which affect fuel costs and the non-linear model was applied. The results were as shown in Table 9.1, where $R^2 = 0.698219$ and the parameters B_1 and B_2 for each of DWT and DAYS are statistically significant (See observed significance level) at significance level less than 0.1. The model takes the following form:

$$FUEL = 7440.237512\ (DWT)^{0.175016170} \times (DAYS)^{0.566733179}$$

That is, there is a positive relationship between each of deadweight and voyage days, and fuel costs. However, the effect on costs of voyage days is bigger than that of deadweight, which is a logical result.

Figure 9.6 shows the comparison between the observed y values and predicted fuel values.

Figure 9.6
Tanker Vessels
Observed Vs. Predicted Fuel Cost



9.5.7 Port Charges

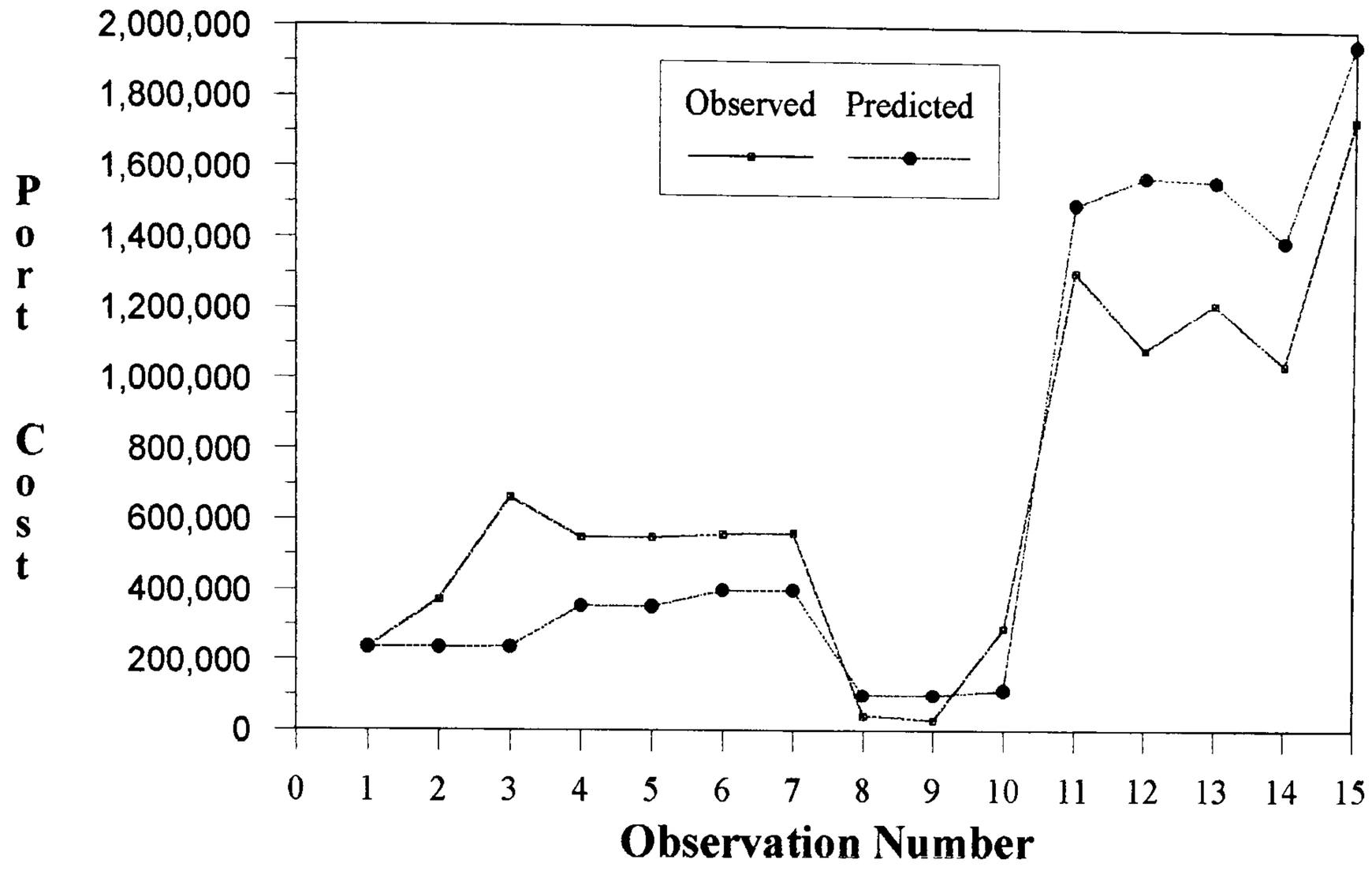
The independent variable, deadweight, was identified as the only variable that affects port charges. The non-linear model was applied and the results are shown in Table 9.1, where $R^2 = 0.737320$ and the parameter B_1 which corresponds to that variable was statistically significant, where the observed significance level is 0.0001. That strongly confirms the existence of the variable deadweight as an independent variable, and the model takes the form:

$$\text{Port} = 154.2845837\ (\text{DWT})^{0.731460591}$$

That is, there is a positive relationship between port charges and deadweight.

Figure 9.7 shows the comparison between the observed values and predicted port values

Figure 9.7
Tanker Vessels
Observed Vs. Predicted Port Cost



9.5.8 Miscellaneous and Administration Expenses

The variables, deadweight and voyage days, were identified as independent variables which affect the miscellaneous and administrative expenses. The non-linear model was applied and the results show that $R^2 = 0.275002$, which is a very small value. This indicates that the independent variables, Voyage Days and Deadweight, do not have a strong relationship with the miscellaneous and administration expenses. It was also noticed that the observed significant levels for B_1 and B_2 were 0.1270 and 0.8220 respectively. Thus it is difficult to add voyage days as one of the independent variables. The researcher conducted stepwise regression to choose

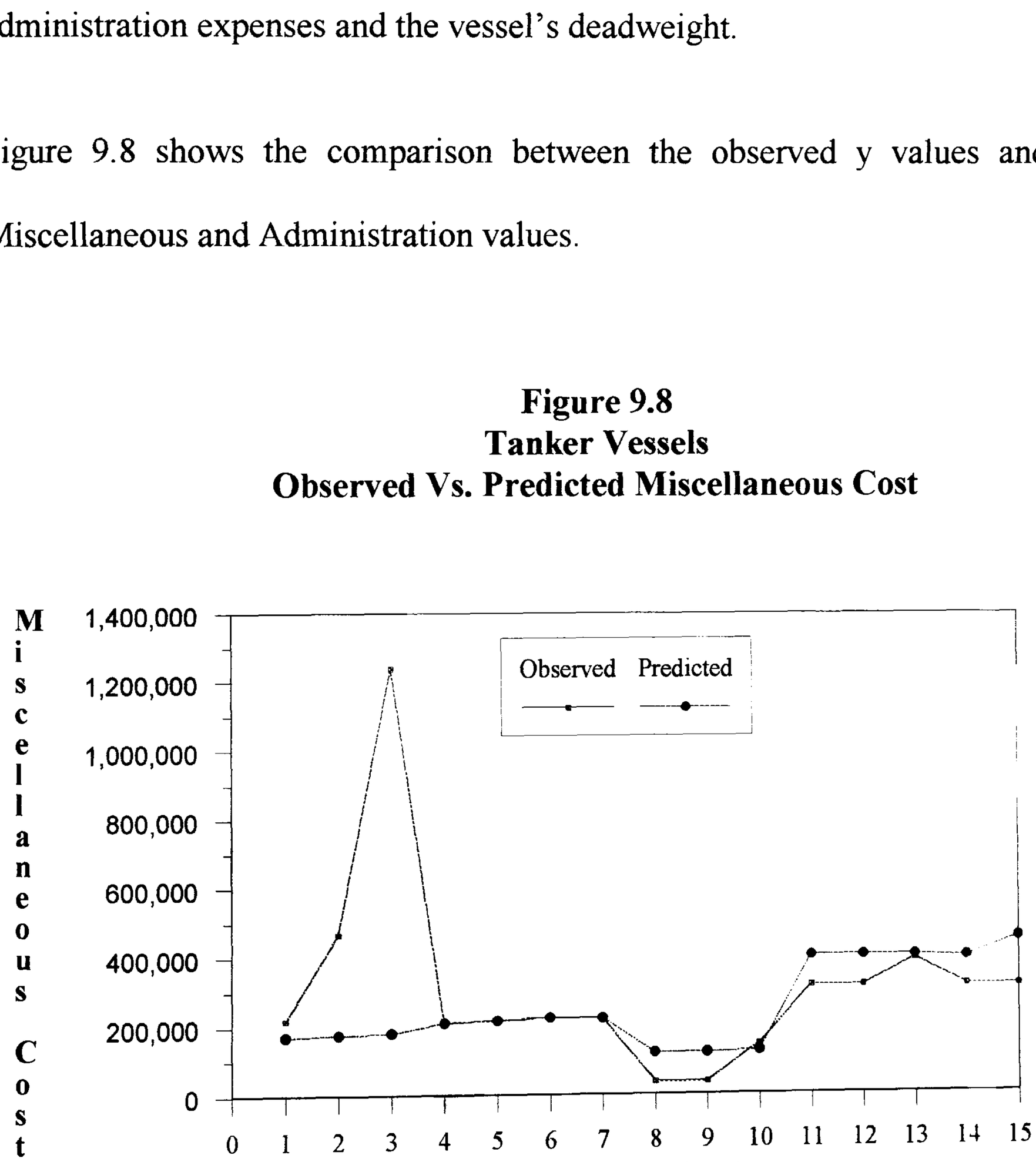
the best independent variable in the model and deadweight was selected. Then the non-linear regression model was applied, using deadweight only as an independent variable. The results were shown in Table 9.1, namely $R^2 = 0.271807$ and the model takes the following form:

$$MISC = 6091.518471\ (DWT)^{0.333046719}$$

Which means that there is a positive relationship between the miscellaneous and administration expenses and the vessel's deadweight.

Figure 9.8 shows the comparison between the observed y values and predicted Miscellaneous and Administration values.

Figure 9.8
Tanker Vessels
Observed Vs. Predicted Miscellaneous Cost



9.5.9 Total Cost

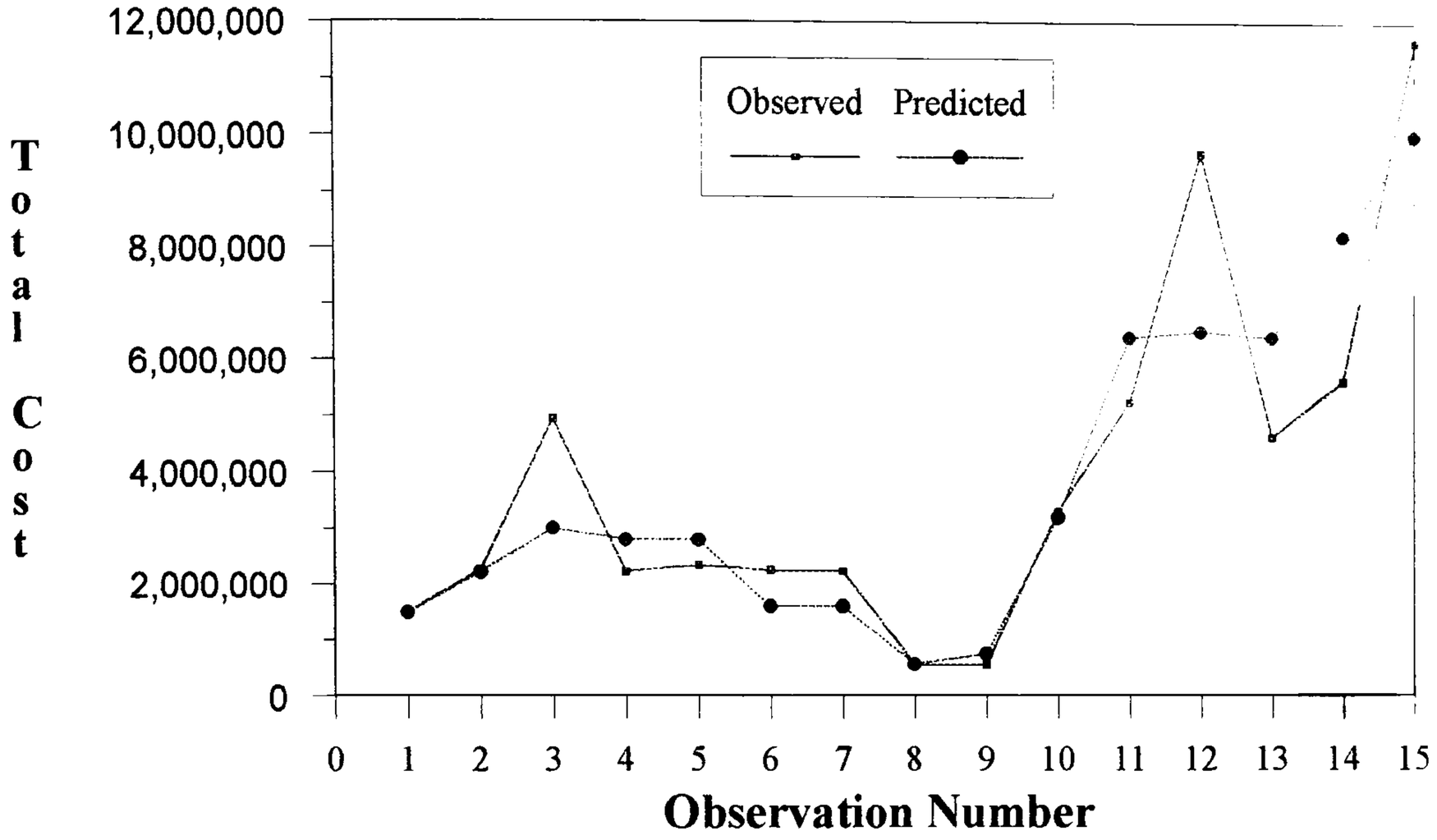
First, all the independent variables which may affect the total costs, namely, deadweight, vessel age, crew no., speed, distance, cargo transported and voyage days were selected, then the non-linear model was applied. The results showed that R^2 = 0.936484 but all the parameters B_1, B_2, B_3, B_4, B_5, B_6 and B_7 are statistically insignificant at a level less than 0.1. Therefore, the researcher conducted a stepwise regression procedure to choose the best independent variables from among these seven hypothetical ones. All variables significant at 0.1 level are left in the model. From the stepwise regression results, CARGO, CREW and DAYS were selected and all of them were significant at 0.1 significance level. The results of the regression model for these three variables were shown in Table 9.1, where R^2 = 0.897696, that is, about 90% of the sample variation of the total costs is attributable to or explained by these three independent variables. The model takes the following form:

$$TOTAL=5.491150157\ (CREW)^{2.314860414}\ X\ (CARGO)^{0.404588903}$$

$$X\ (DAYS)^{0.299355148}$$

The above is evidence that there is a positive relationship between the total cost and each of the crew number, cargo transported and voyage days, but the effect of the crew number is the greatest one. Figure 9.9 shows the comparison between the observed values and predicted total cost values.

Figure 9.9
Tanker Vessels
Observed Vs. Predicted Total Cost



9.6 Cargo Vessels Regression Models Results

The same independent variables which were selected for each of the cost elements of tanker vessels were also selected for each of the cost elements of cargo vessels as follows:

9.6.1 Depreciation Expenses

Table 9.1 shows the results of the depreciation model using deadweight, vessel age and voyage days as independent variables, where $R^2 = 0.953273$. That is, about 95% of the sample variation in depreciation is attributable to or explained by

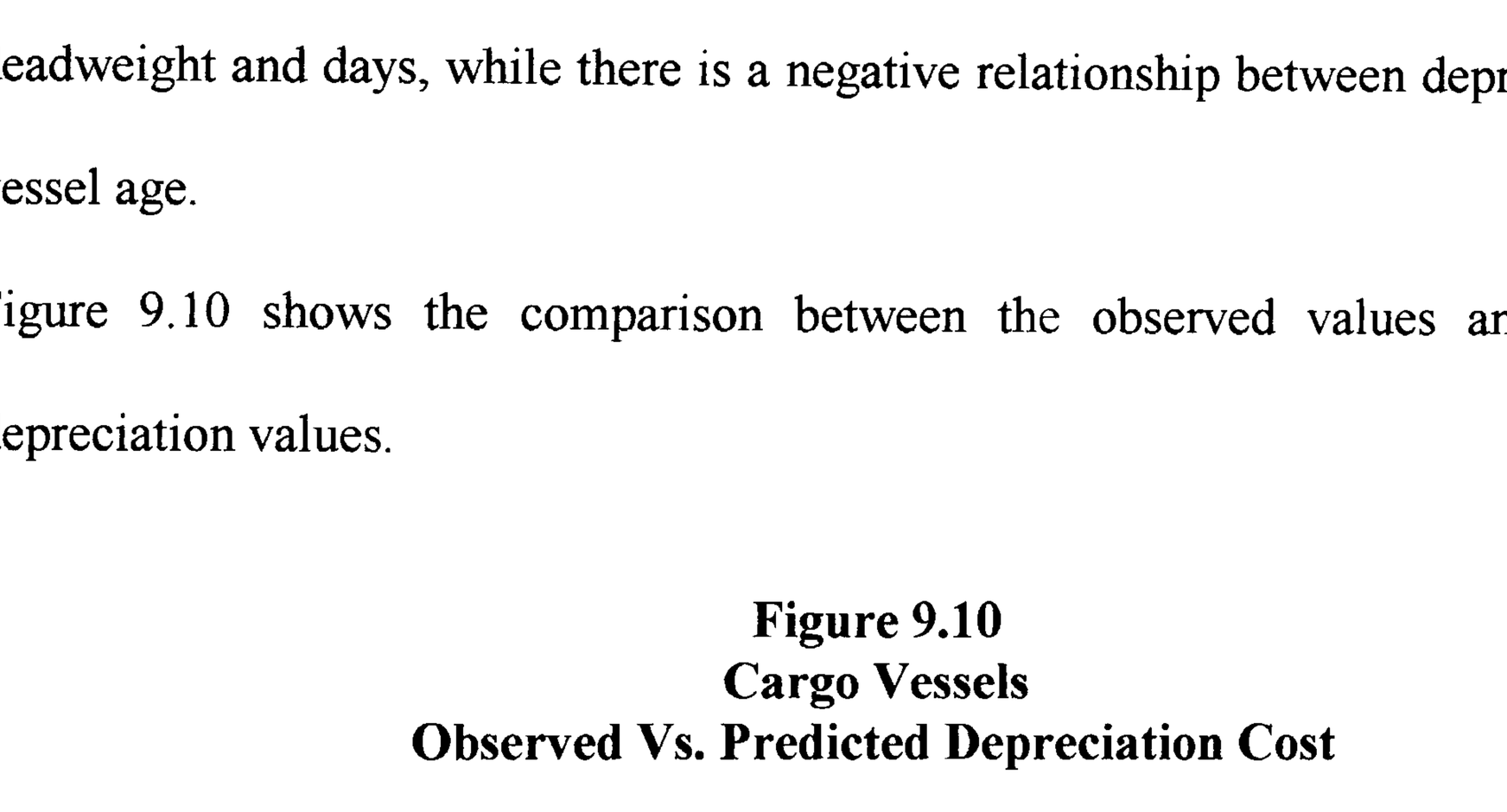
these three variables. Also all the parameters of the independent variables are statistically significant. The highest observed significance level belongs to the independent variable, vessel age and equals 0.0371. This means that the three independent variables contribute effectively in determining depreciation costs at a confidence level not less than 96.19% and the model takes the following form:

$$DEPR = 22.84331118\ (DWT)^{0.7600819}\ X\ (AGE)^{-0.27255809}\ X\ (DAYS)^{0.811611562}$$

This model shows that there is a positive relationship between depreciation and deadweight and days, while there is a negative relationship between depreciation and vessel age.

Figure 9.10 shows the comparison between the observed values and predicted depreciation values.

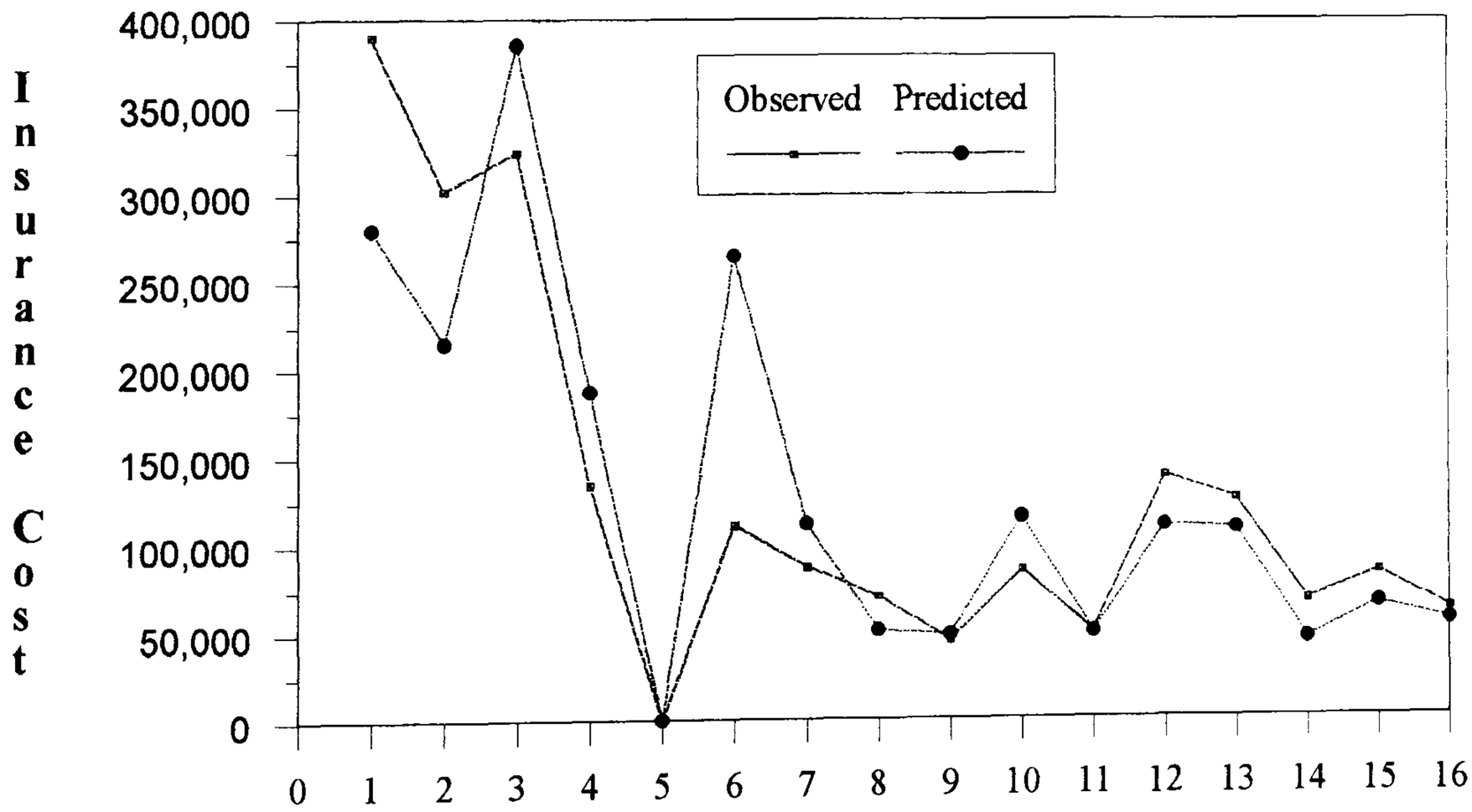
Figure 9.10
Cargo Vessels
Observed Vs. Predicted Depreciation Cost



9.6.2 Insurance Expenses

Deadweight, Vessel Age and Voyage Days were selected as independent variables which may affect insurance costs. The results of applying the non-linear model indicated that $R^2 = 0.906617$. It was also found that the parameter of independent variable age is insignificant, as its observed significance level is 0.2303. Therefore, stepwise regression procedure was conducted and the results showed that only deadweight and voyage days were selected. Table 9.1 shows the complete results of that model where $R^2 = 0.894186$. The parameters of the variables deadweight and voyage days are statistically significant and the biggest observed significance level is 0.0076.

Figure 9.11
Cargo Vessels
Observed Vs. Predicted Insurance Cost



The model takes the following form:

$$INSUR = 23.17782125\ (DWT)^{0.453717629}\ X\ (DAYS)^{1.087713876}$$

This indicates that there is a positive relationship between insurance costs and each of deadweight and number of voyage days. Nevertheless, the effect of days is the bigger. Figure 9.11 shows the comparison between the observed values and predicted insurance values.

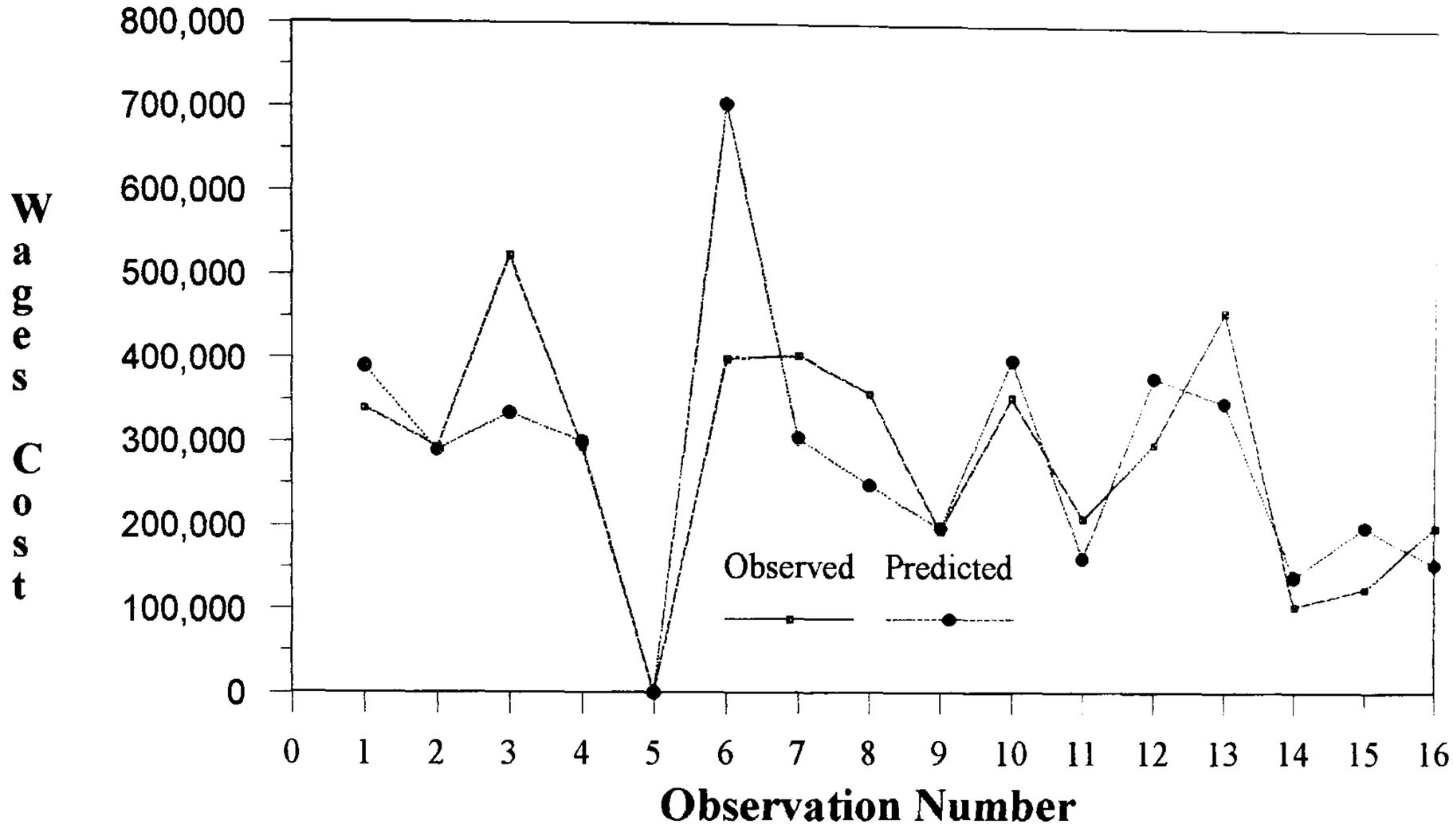
9.6.3 Wages and Victualling expenses

Crew number and voyage days were determined as independent variables and the non-linear model was used. The results are shown in Table 9.1, where R^2 = 0.908129 and the model's form is as follows:

$$WAGE = 1766835.197\ (CREW)^{-1.96034716}\ X\ (DAYS)^{1.16248699}$$

The results show that both the variables, Crew and Days, are significant, but strangely, there is a negative relationship between wages and victualling expenses and vessel crew number. This may be because some Saudi maritime companies employ unskilled manpower from third world countries, at lower wages than are paid by other companies. Figure 9.12 shows the comparison between the observed values and predicted wages and victualling values.

Figure 9.12
Cargo Vessels
Observed Vs. Predicted Wages Cost



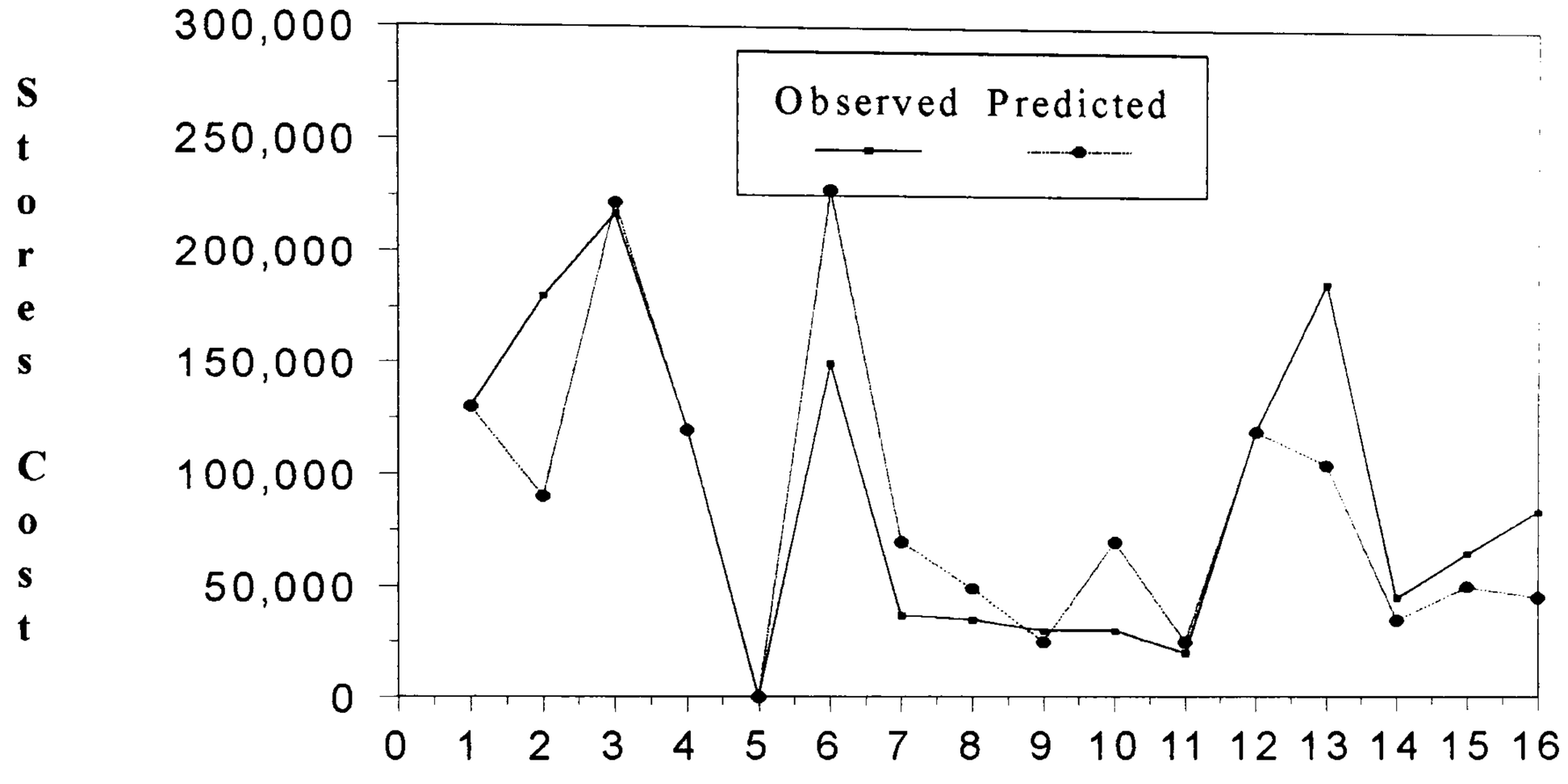
9.6.4 Stores Expenses

The first results show that the independent variable, Deadweight, is insignificant and, therefore, has been omitted in the stepwise regression procedure. Table 9.1 shows the results of the model which includes only Days as an independent variable, where $R^2 = 0.834189$. That is, about 83% of the sample variation of maintenance can be attributed to or explained by the independent variable, Days. The model takes the form:

$$STORE = 319.2467006\ (DAYS)^{1.436119151}$$

Fig. 9.13 shows the comparison between observed values and predicted stores values

Figure 9.13
Cargo Vessels
Observed Vs. Predicted Stores Cost



9.6.5 Maintenance and Repair Expenses

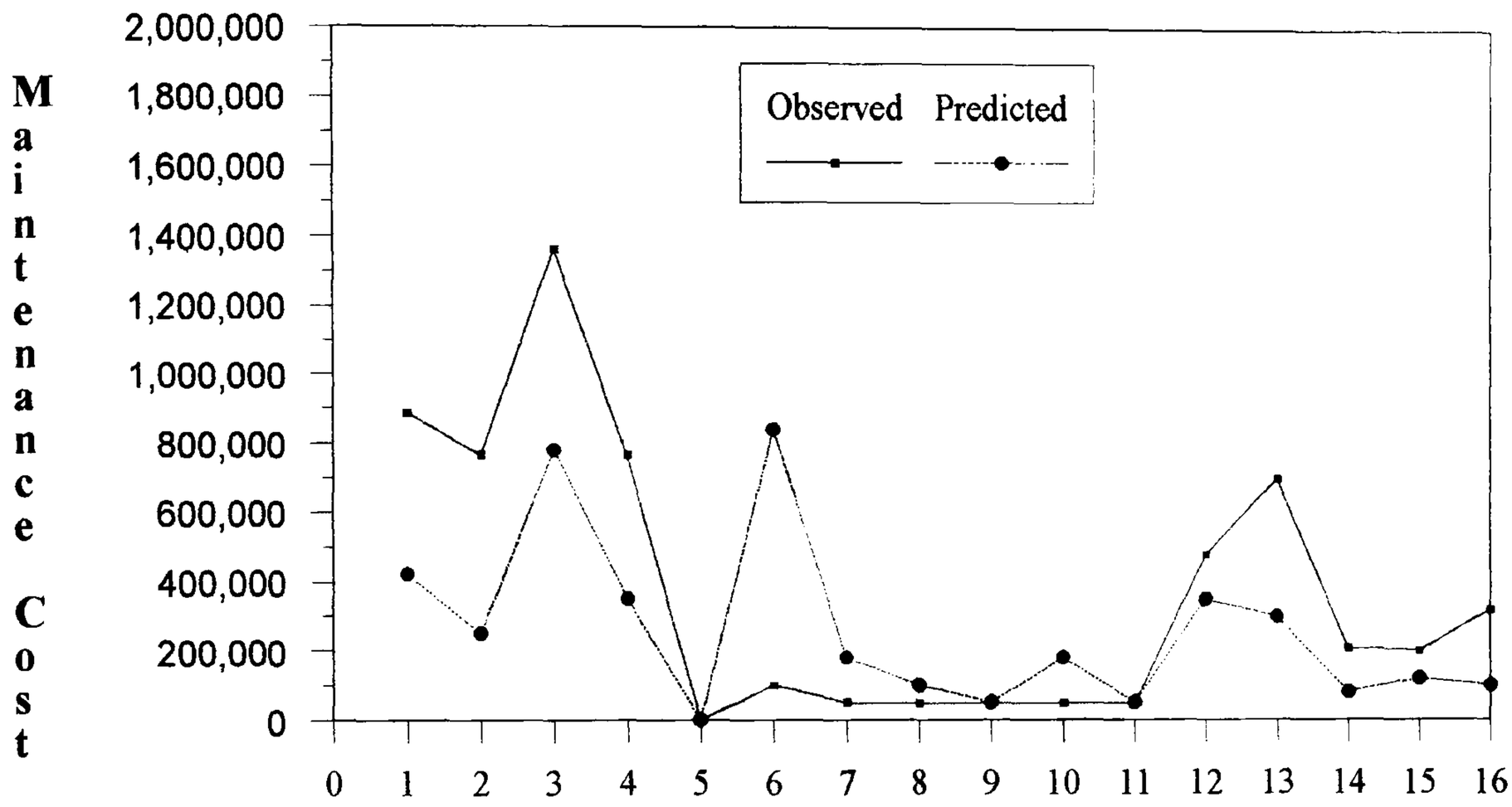
The results of the model including the independent variables, deadweight, vessel age and voyage days, show that the parameters of the variables deadweight and vessel age are insignificant. A stepwise regression procedure was conducted and the variable (DAYS) was selected as the only independent variable. Table 9.1 shows the results of that model where $R^2 = 0.561867$, a small value. The model takes the following form:

$$MAINT = 212.3203201\ (DAYS)^{0.1809324117}$$

That is, there is a positive relationship between maintenance and repair costs and the number of days of the voyage. Figure 9.14 shows the comparison between the observed values and predicted maintenance and repair values.

Figure 9.14

Cargo Vessels
Observed Vs. Predicted Maintenance Cost



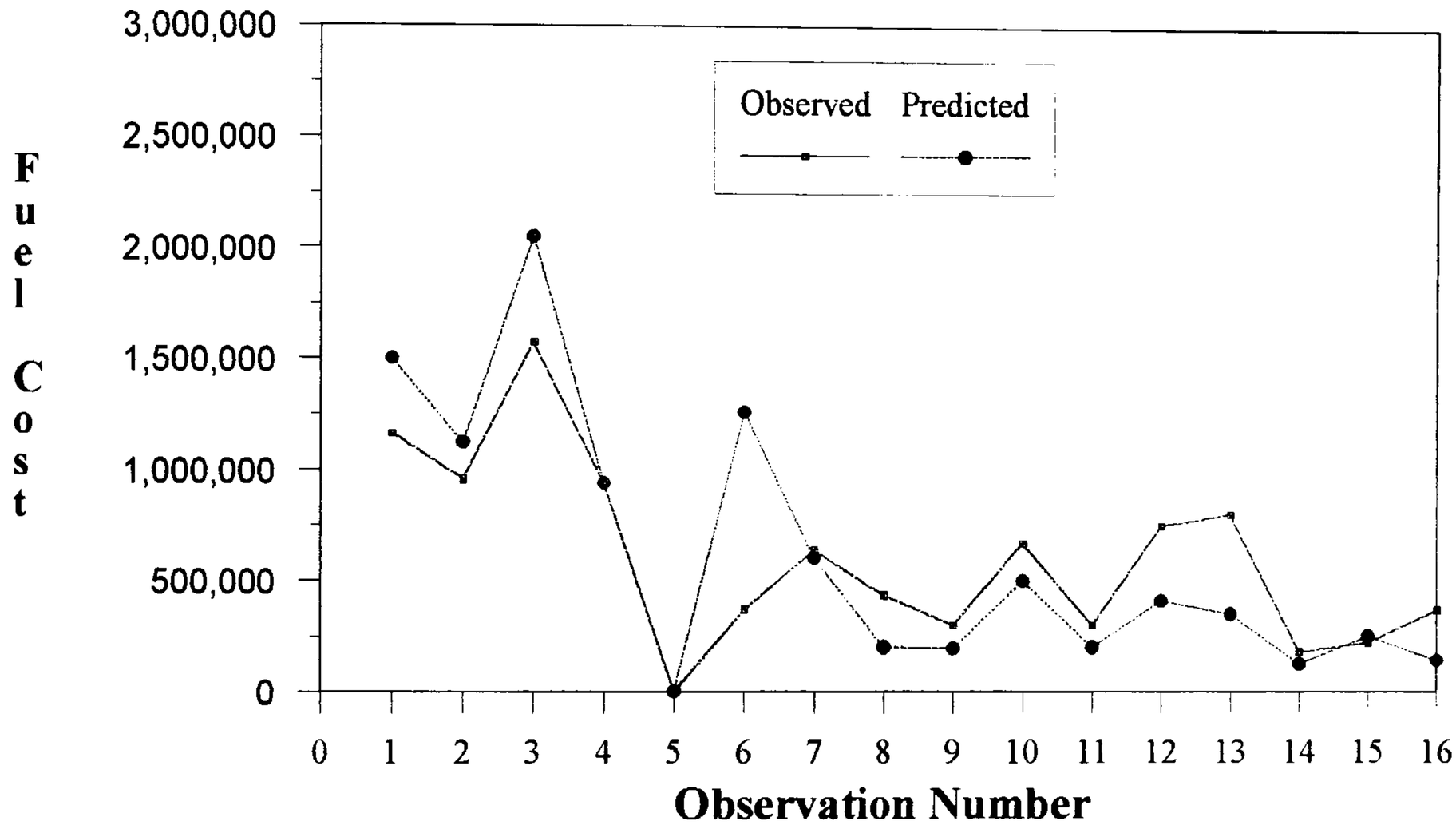
9.6.6 Fuel Expenses

Deadweight and Voyage Days were determined as independent variables which affect fuel costs. The non -linear model was applied. The results are shown in Table 9.1 where $R^2 = 0.808480$ and the parameters B_1 and B_2 for each of deadweight and days are statistically significant. The model takes the following form:

$$FUEL = 44.02850319\ (DWT)^{0.539825756}\ X\ (DAYS)^{1.113115885}$$

That is, there is a positive relationship between each of the vessel's deadweight and the number of the voyage days on one hand and the fuel costs on the other. But the effect of voyage days on cost is bigger than that of the deadweight. Figure 9.15 shows the comparison between the observed values and predicted fuel values.

Figure 9.15
Cargo Vessels
Observed Vs. Predicted Fuel Cost



9.6.7 Stevedoring Expenses

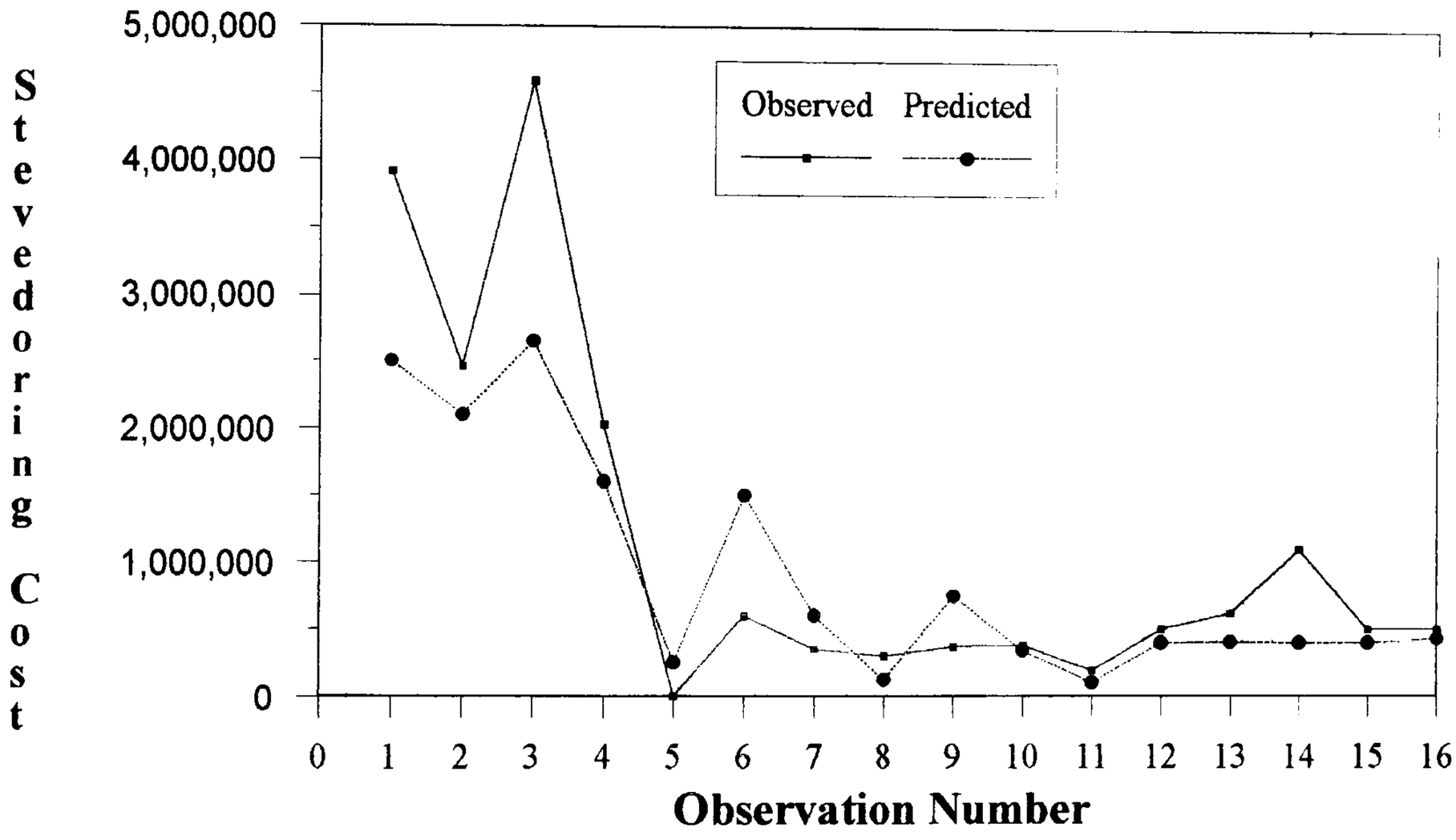
Cargo transported was determined as an independent variable which affects stevedoring. The non-linear model was applied and the results are shown in Table 9.1 where $R^2 = 0.458321$, which is a very small value. It can be seen that the parameter B_1 corresponding to cargo transported is statistically significant and that the observed

significance level is 0.0040 which strongly confirms the importance of Cargo Transported as an independent variable. The model takes the following form:

$$STEV = 850.059131\ (CARGO)^{0.727993661}$$

Figure 9.16 shows the comparison between the observed values and predicted Stevedoring values.

Table 9.16
Cargo Vessels
Observed Vs. Predicted Stevedoring Cost



9.6.8 Port Charges

Deadweight was determined as the sole independent variable which affects the costs of port charges. The non-linear model was applied and the results are shown in

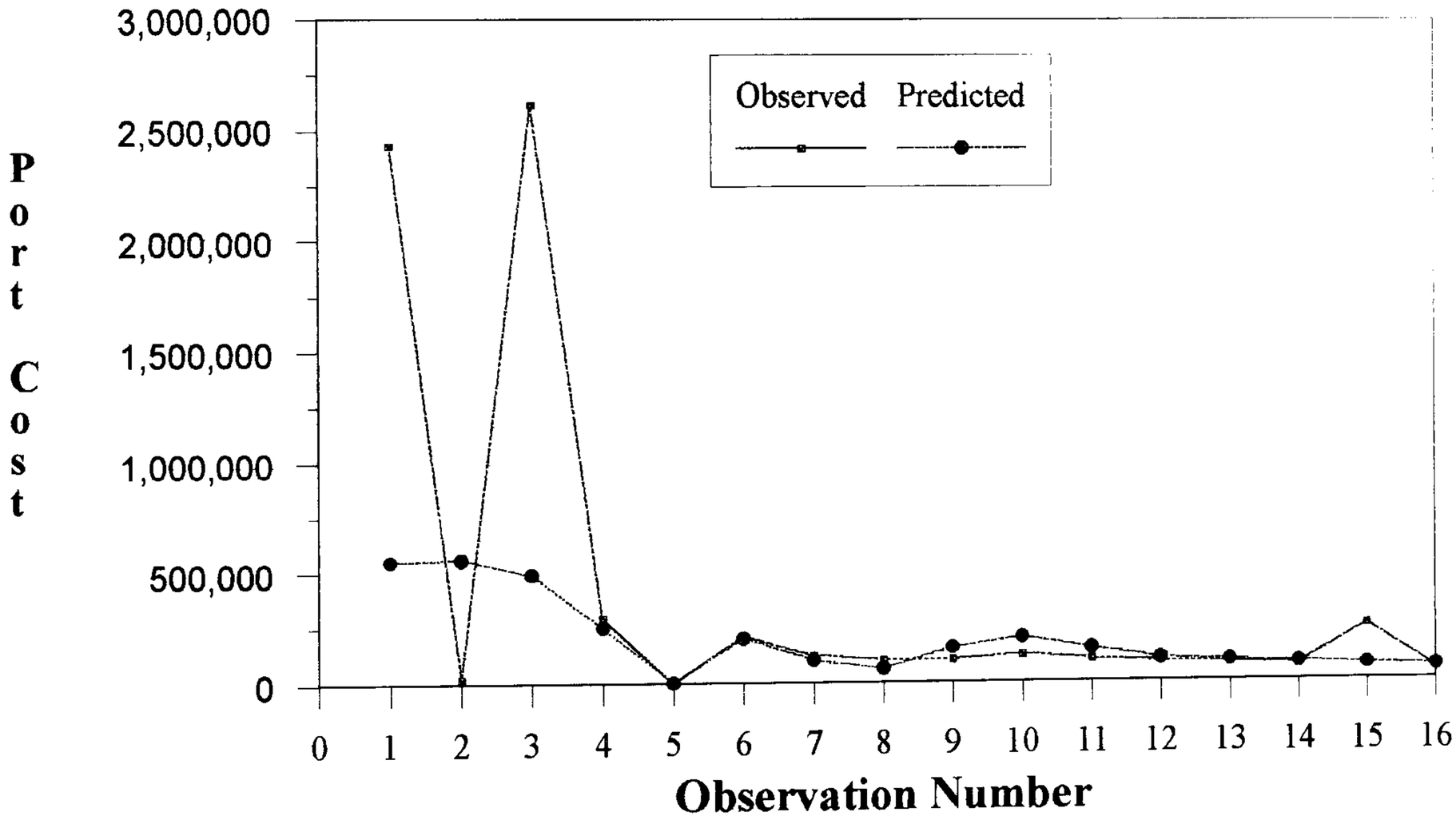
Table 9.1 where $R^2 = 0.515908$, which is a small value. Also the parameter B_1 is statistically significant and the model takes the following form:

$$PORT = 1.9191161332\ (DWT)^{1.176659787}$$

That is, there is a positive relationship between the port charges and the deadweight.

Figure 9.17 shows the comparison between the observed values and predicted port values.

Figure 9.17
Cargo Vessels
Observed Vs. Predicted Port Cost



9.6.9 Agency Fees

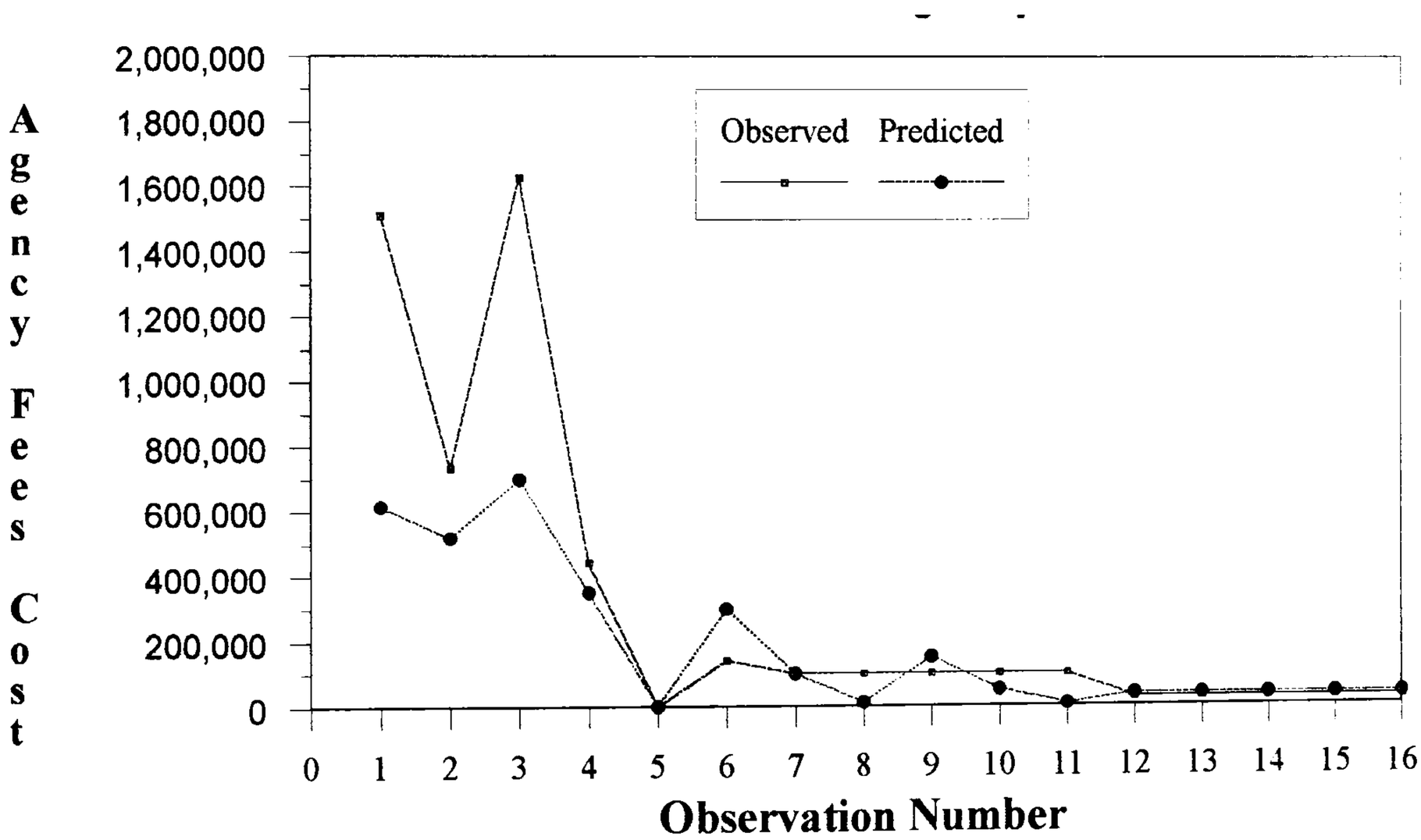
Cargo transported was determined as an independent variable which affects the costs of Agency Fees. The non-linear model was applied and the results are

shown in Table 9.1 where $R^2 = 0.587149$, and it can be noticed that the parameter B_1 is statistically significant. The model takes the following form:

$$AGEN = 16.70374509\ (CARGO)^{0.961837987}$$

This means that there is a positive relationship between the agency fees and the cargo transported. Figure 9.18 shows the comparison between the observed values and predicted Agency values.

Figure 9.18
Cargo Vessels
Observed Vs. Predicted Agency Fees Cost



9.6.10 Miscellaneous and Administration Expenses

The variables, deadweight and voyage days, were determined and the non-linear model was used. The results are shown in Table 9.1 where $R^2 = 0.7811$, that

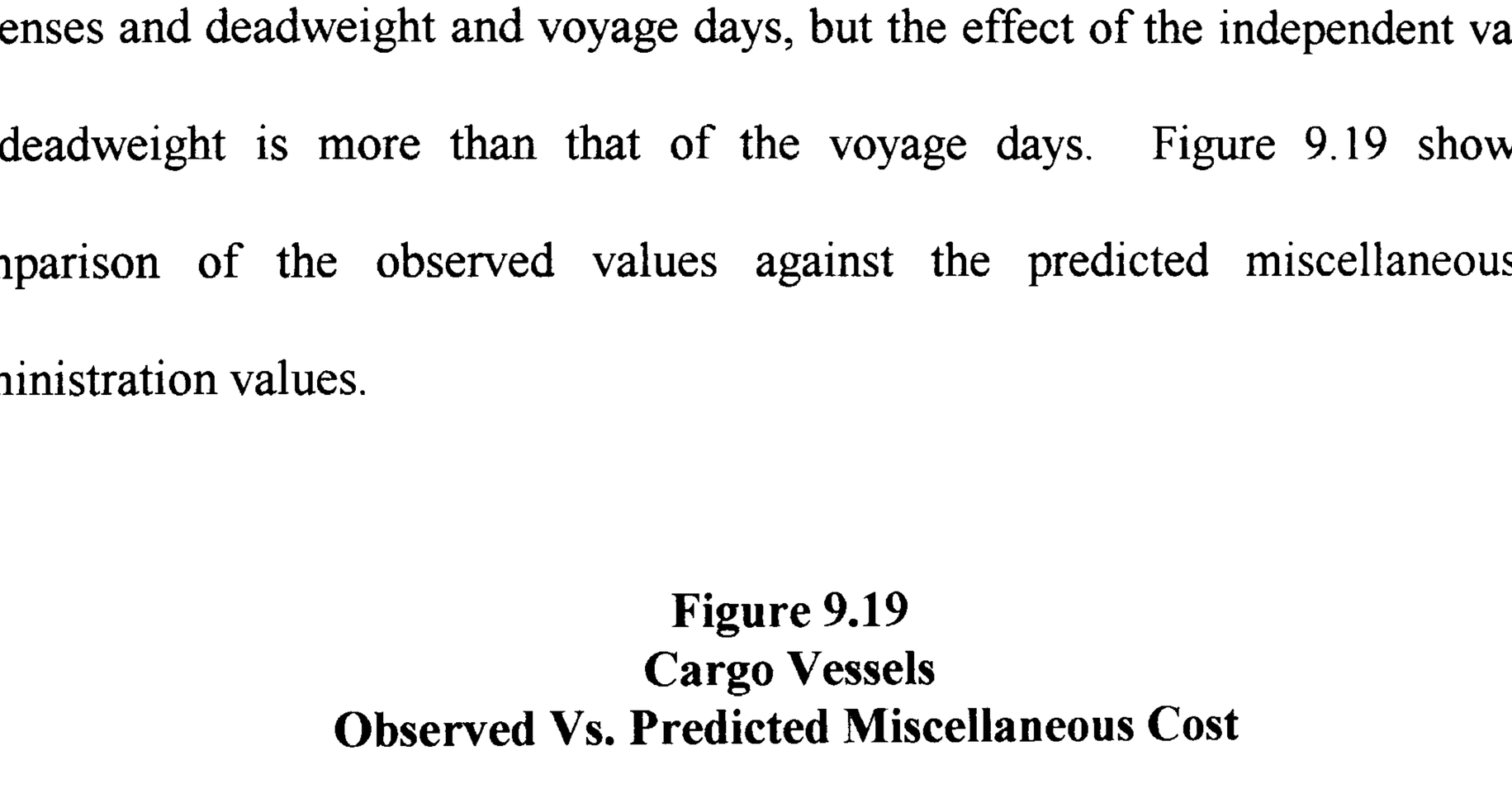
is 78% of the sample variation of the miscellaneous and administration costs are attributable to or explained by the above-mentioned independent variables. The parameters B_1, B_2 are statistically significant at a significance level below 0.1 and the model takes the following form:

$$MISC = 0.161546937\ (DWT)^{1.130744361}\ X\ (DAYS)^{0.761198404}$$

That is, there is a direct relationship between the miscellaneous and administration expenses and deadweight and voyage days, but the effect of the independent variable of deadweight is more than that of the voyage days. Figure 9.19 shows the comparison of the observed values against the predicted miscellaneous and administration values.

Figure 9.19

Cargo Vessels
Observed Vs. Predicted Miscellaneous Cost

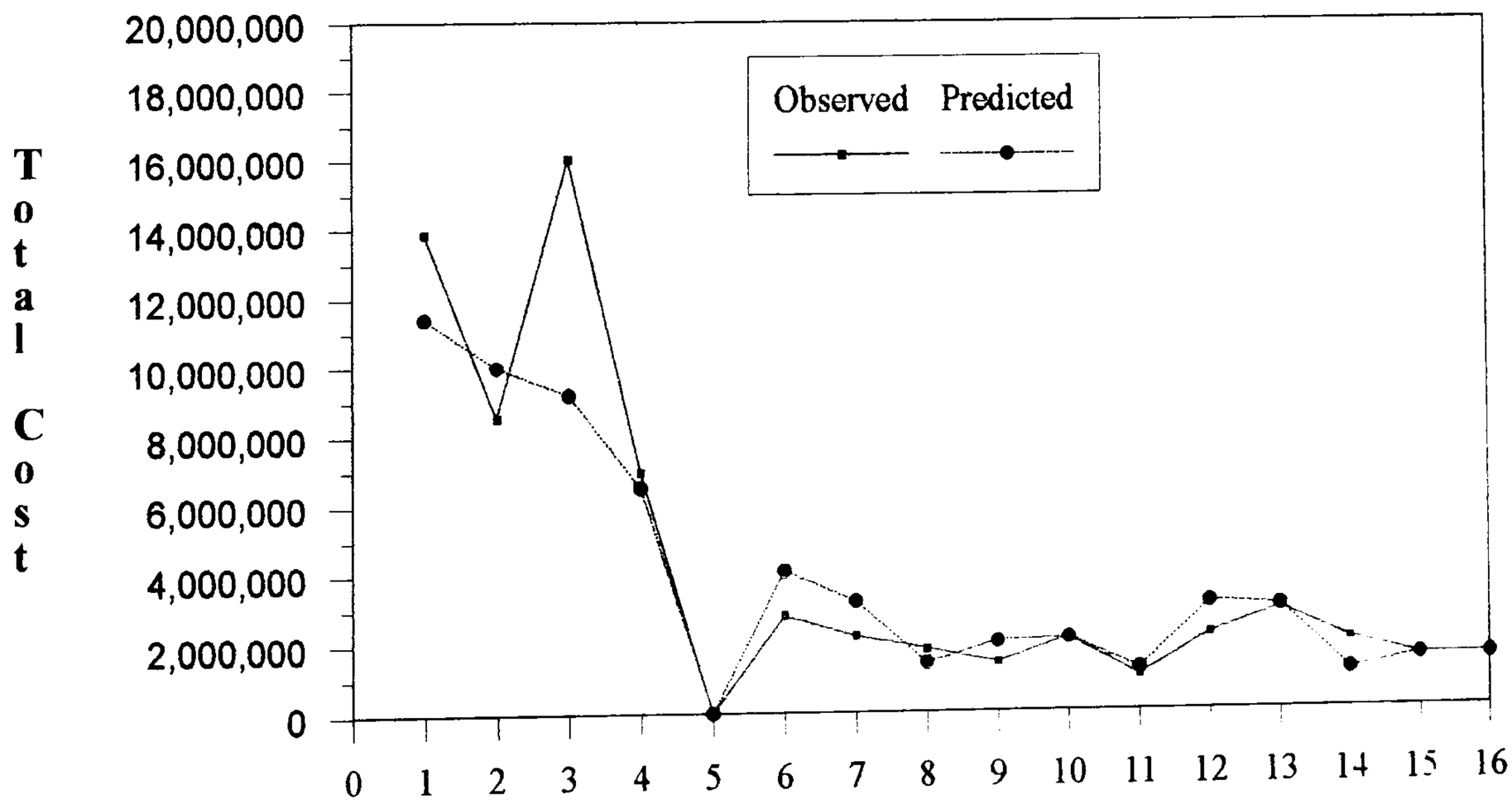


9.6.11 Total Costs

All the independent variables of deadweight, vessel age, crew no., speed, distance, cargo transported and voyage days, which may affect the total cost, were selected, as done previously. The results of the application of the non-linear model showed $R^2 = 0.978838$; but the parameters B_5, B_6, B_7 were statistically insignificant at a level less than 0.1. Hence, the stepwise regression procedure was used and only three variables were chosen, namely, voyage days, deadweight and speed. Table 9.1 shows the detailed results of the model which contains these three variables, where $R^2 = 0.943837$ and for all the three parameters are statistically significant.

Figure 9.20

Cargo Vessels
Observed Vs. Predicted Total Cost



The model takes the following form:

$$TOTAL = 1.361404295\ (DWT)^{0.656876127}\ X\ (SPEED)^{1.730446604}\ X\ (DAYS)^{0.966295972}$$

That is, there is a positive relationship between the total cost and deadweight, speed and voyage days, but the effect of speed is bigger than that of other variables. Figure 9.20 shows the comparison between the observed values and predicted total cost values.

9.7 Passenger Vessels Regression Model Results

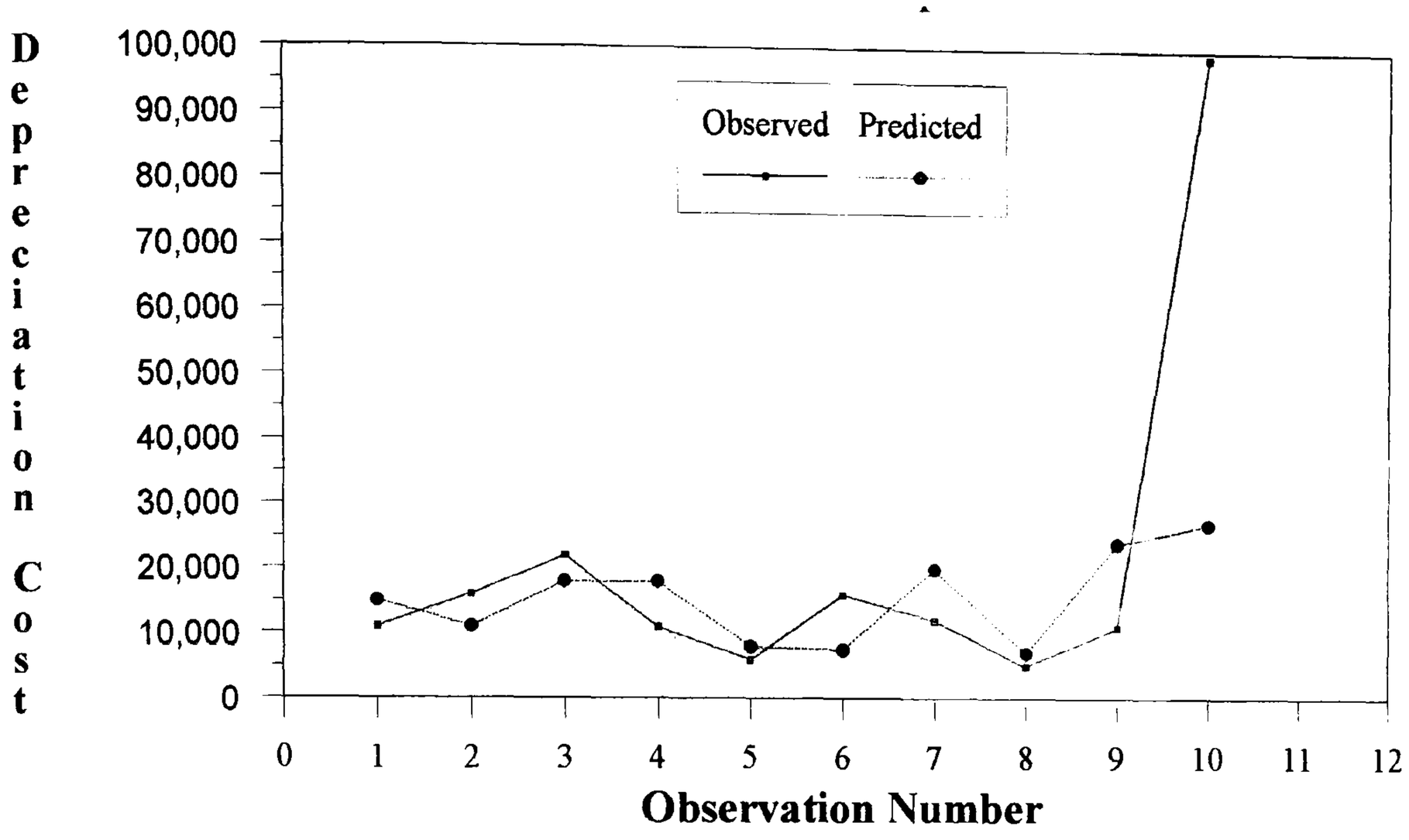
9.7.1 Depreciation Costs

The preliminary results of the non-linear regression model showed that the parameter of the independent variable vessel age is insignificant at a significance level of 0.3614. Therefore the stepwise regression procedure was used and only the variable, vessel age was selected. Table 9.1 shows the results of the model which contains that variable and $R^2 = 0.359476$, which is a very small value, indicating that this variable has no strong relationship to depreciation costs, but the observed significance level of the parameter B_1 is small and equals 0.0669. The model takes the following form:

$$DEPR = 1{,}179{,}947{,}025\ (AGE)^{-3.4}$$

Figure 9.21 shows the comparison between the observed values and predicted depreciation values.

Figure 9.21
Passenger Vessels
Observed Vs. Predicted Depreciation Cost



9.7.2 Insurance Expenses

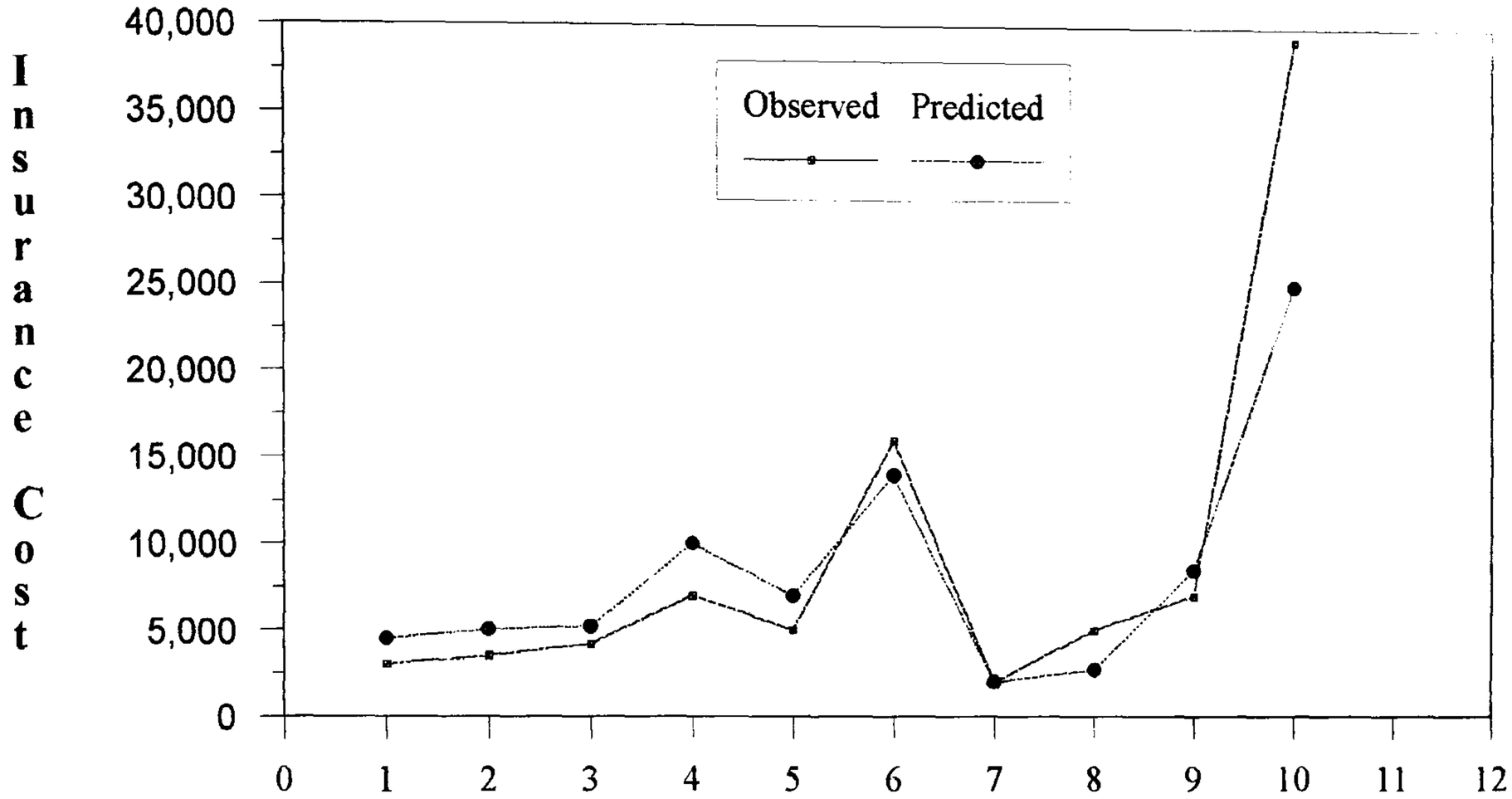
Table 9.1 shows the results of the model where $R^2 = 0.860338$, that is, about 86% of the sample variation of insurance costs is attributable to or explained by the independent variables, deadweight, vessel age and voyage days, and the model takes the following form:

$$INSUR = 0.00000006\ (DWT)^{1.85531620}\ X\ (AGE)^{2.25440344}\ X\ (DAYS)^{2.03910695}$$

The above is evidence that there is a positive relationship between the insurance expenses and each of the deadweight, vessel age, and voyage days, but the effect of

vessel age is bigger than that of either deadweight or voyage days. Figure 9.22 shows the comparison of the observed values against the predicted insurance values.

Figure 9.22
Passenger Vessels
Observed Vs. Predicted Insurance Cost



9.7.3 Wages and Victualling Expenses

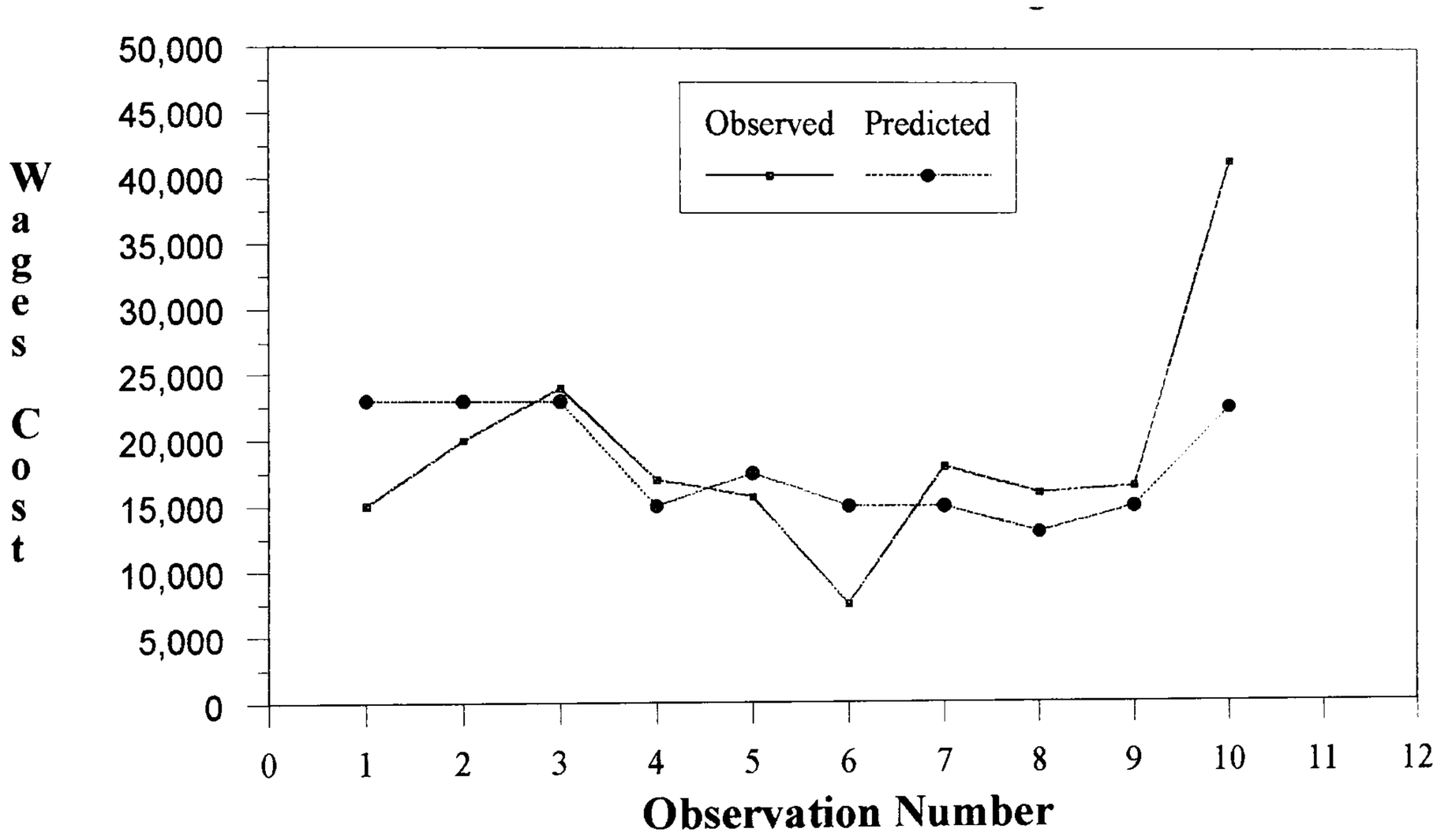
When the non-linear model was applied, the results showed that the independent variable, (parameter B_1) of crew number is significant at level 0.4625, which is a high value. Therefore, to handle this problem a stepwise regression procedure was conducted to select the best independent variable so that any independent variable to enter into the model should be at a significance level no higher than 0.1. From the results, only the variable Days was selected. Table 9.1

shows the complete results of the model where $R^2 = 0.309495$, which is a very small value. The model's form is as follows:

$$WAGE = 4994.33340\ (DAYS)^{0.781402673}$$

That is, there is a positive relationship between wages and victualling expenses on the one hand, and the number of voyage days on the other. Figure 9.23 shows the comparison of the observed values against the predicted wage and victualling values.

Figure 9.23
Passenger Vessels
Observed Vs. Predicted Wages Cost



9.7.4 Stores Expenses

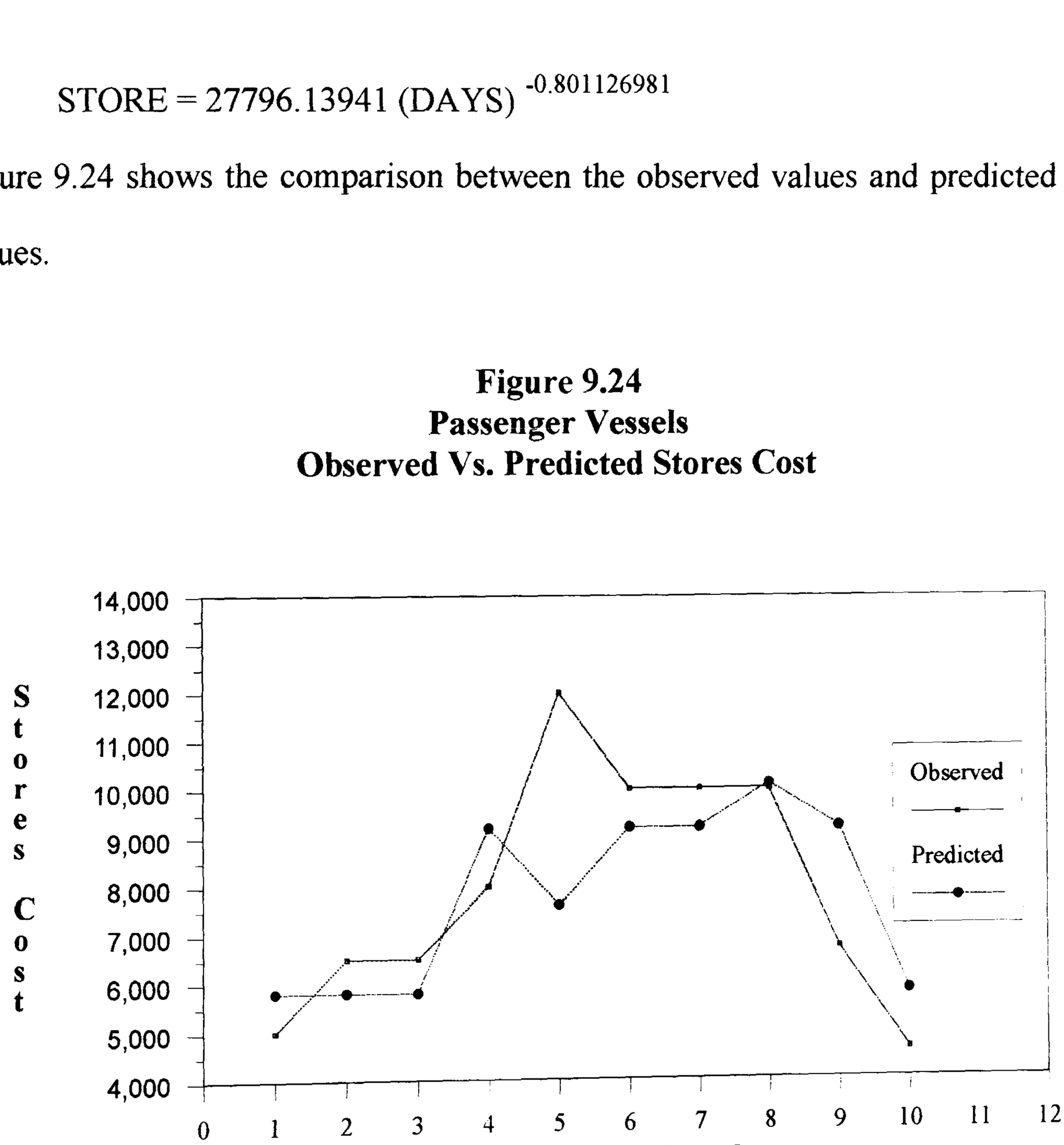
The preliminary model results showed that the parameter B_1 is significant at 0.2626 level, which is a high value. That means that the researcher is confident that

the independent variable, Deadweight, has an effect on Stores at a confidence level of 73.74%. A stepwise regression procedure was then conducted to select the best independent variables at a significance level not exceeding 0.1. According to the results, only the variable, Days, was selected. Table 9.1 shows the results of the model where $R^2 = 0.540643$ and observed significance level of the parameter B_1 is statistically insignificant. The model takes the following form:

$$STORE = 27796.13941\ (DAYS)^{-0.801126981}$$

Figure 9.24 shows the comparison between the observed values and predicted stores values.

Figure 9.24
Passenger Vessels
Observed Vs. Predicted Stores Cost



9.7.5 Maintenance and Repair Expenses

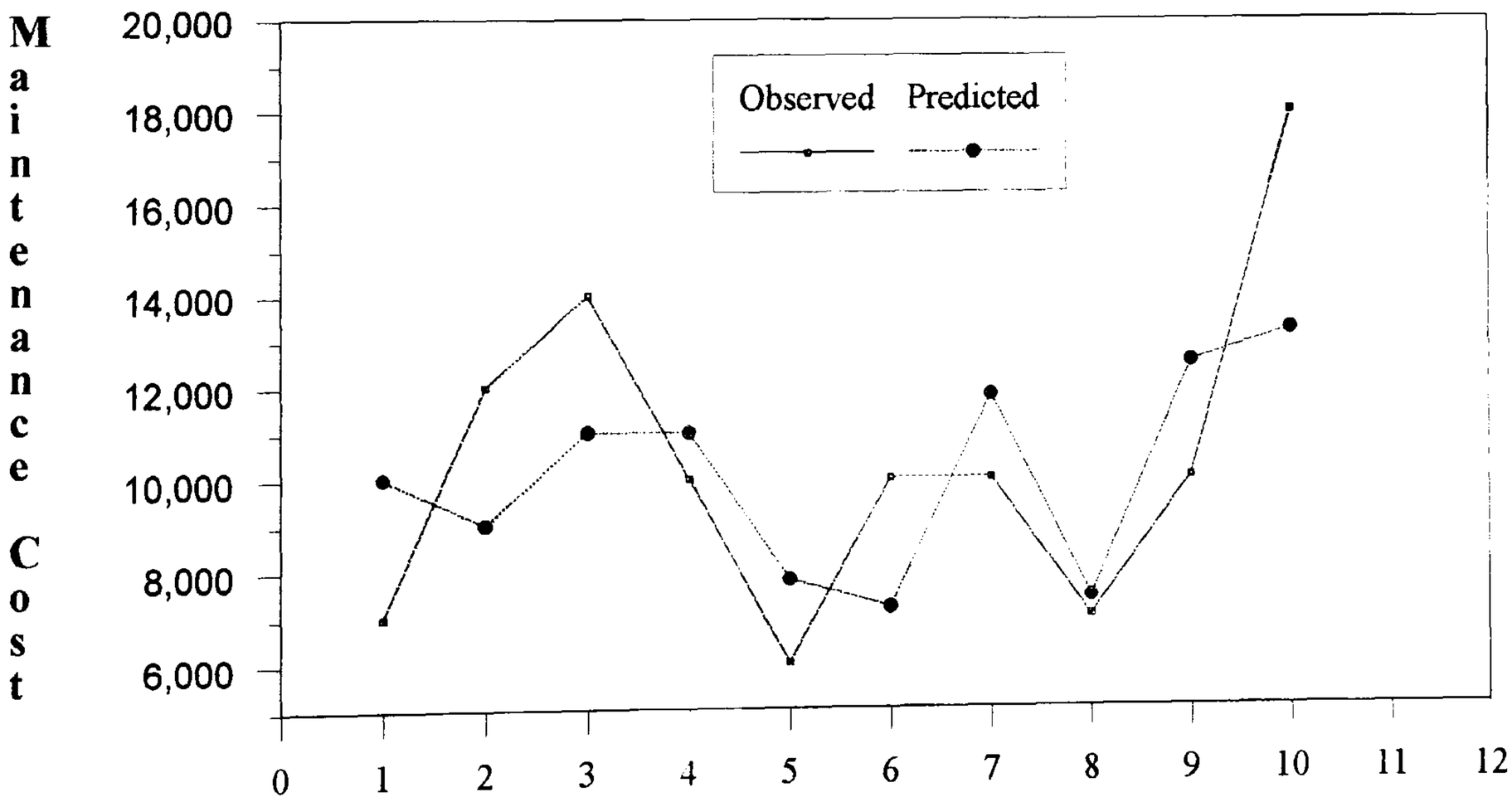
The preliminary results of the non-linear regression model including the three independent variables, deadweight, vessel age and voyage days, showed that the independent variable deadweight's parameter B_1 is significant at 0.1200 level and vessel age's parameter B_2 is significant at 0.27 level. Therefore, a stepwise regression procedure was conducted to select the best variables at a significance level not exceeding 0.1. From the results, only vessel age was selected. Table 9.1 represents the results of the model where $R^2 = 0.407244$. The model takes the following form:

$$MAINT = 1453107.987\ (AGE)^{-1.4804927}$$

Figure 9.25 shows the comparison between the observed values and predicted maintenance and repair values.

Figure 9.25

Passenger Vessels
Observed Vs. Predicted Maintenance Cost



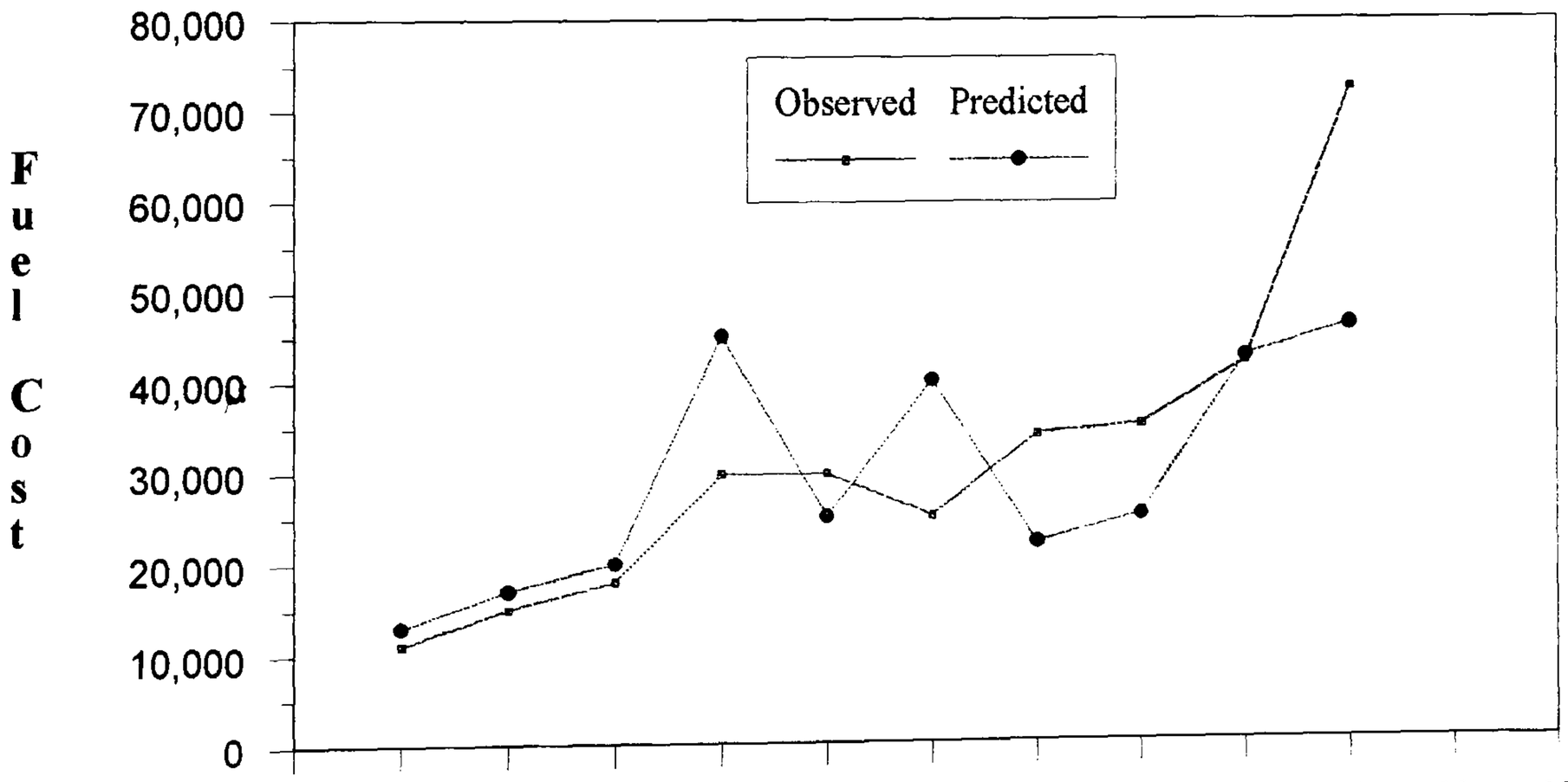
9.7.6 Fuel Expenses

The preliminary results using the independent variables, deadweight and voyage days, showed that days parameter B_2 is significant at 0.9036 level, which is a very high value. Consequently, it is difficult to add this variable as one of the independent variables to determine the cost of fuel. Therefore, a stepwise regression procedure was conducted to select the best variables at a significance level not exceeding 0.1. The variable, deadweight, was chosen. Table 9.1 shows the results of the model, where $R^2 = 0.622213$. The model takes the following form:

$$FUEL = 61.10830065\ (DWT)^{0.780555055}$$

Figure 9.26 shows the comparison of the observed values against the predicted fuel values.

Figure 9.26
Passenger Vessels
Observed Vs. Predicted Fuel Cost



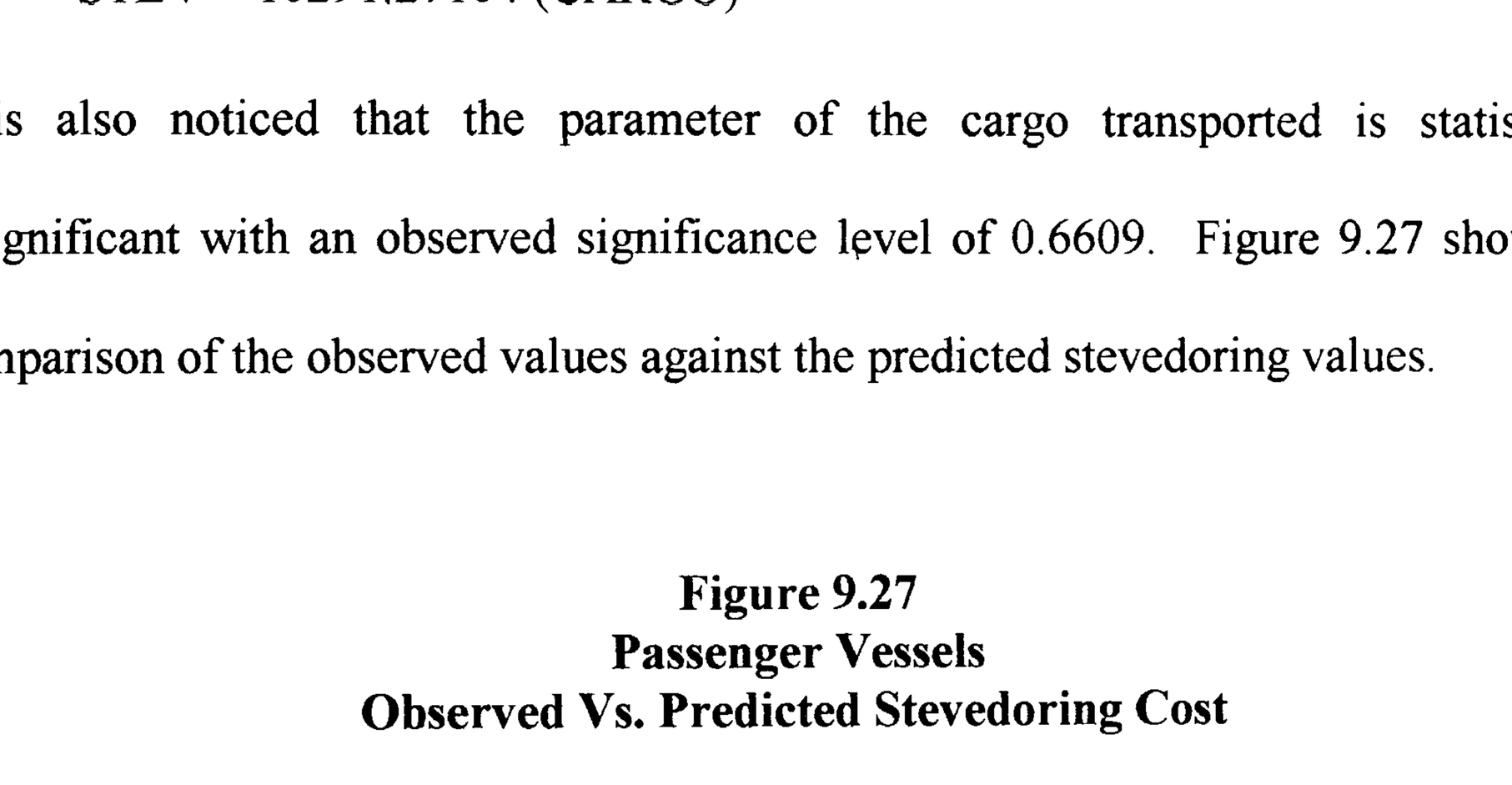
9.7.7 Stevedoring Expenses

Table 9.1 shows the results of the stevedoring costs model using cargo transported as a sole variable which affects such costs, where $R^2 = 0.025274$ which is a very small value. This indicates that this variable does not have a strong relationship with stevedoring cost. The model takes the following form:

$$STEV = 10291.27104\ (CARGO)^{-0.966431826}$$

It is also noticed that the parameter of the cargo transported is statistically insignificant with an observed significance level of 0.6609. Figure 9.27 shows the comparison of the observed values against the predicted stevedoring values.

Figure 9.27
Passenger Vessels
Observed Vs. Predicted Stevedoring Cost



9.7.8 Port Charges

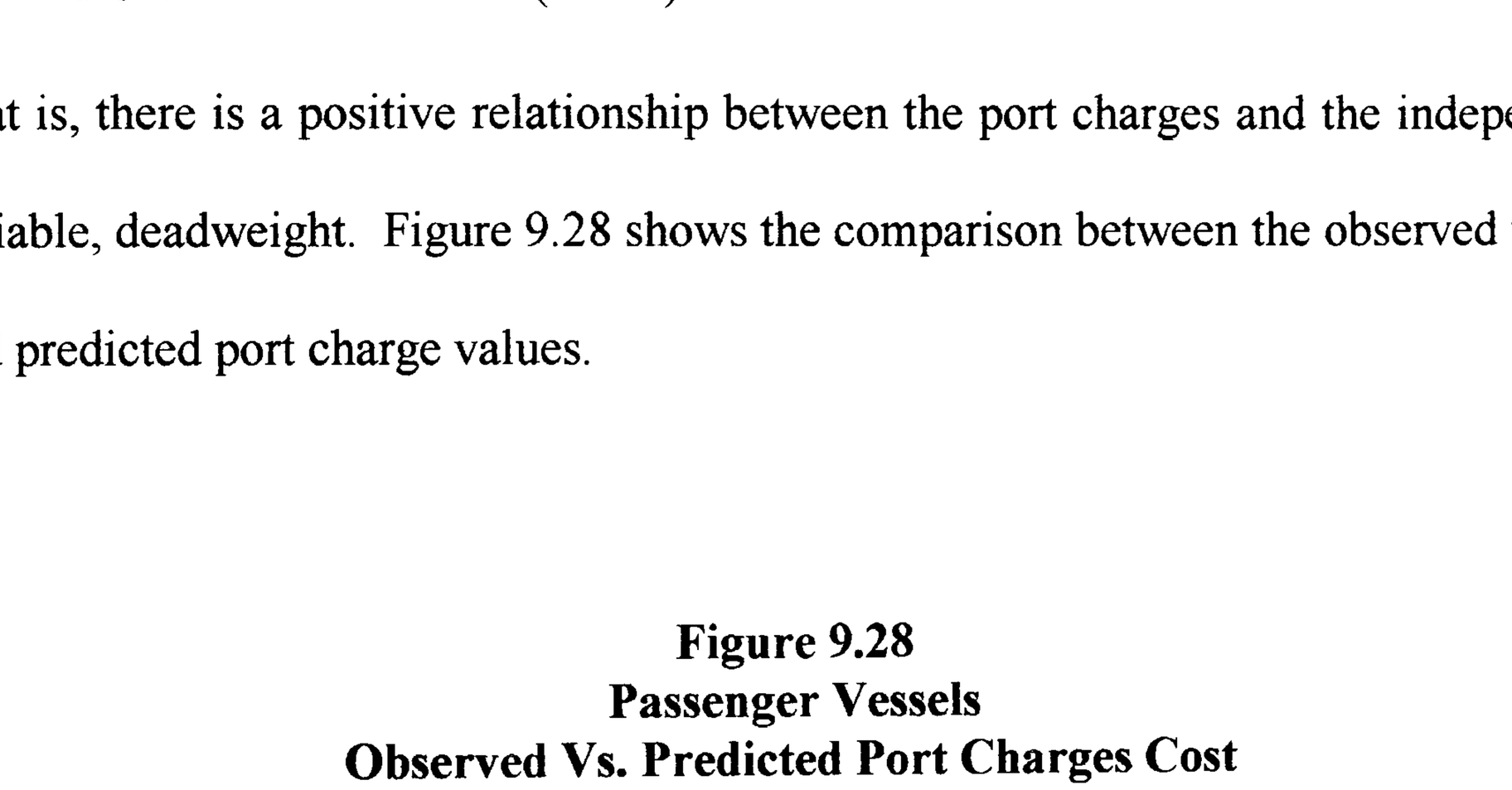
Deadweight was determined as a sole independent variable which affects port charges expenses and the non-linear model was applied. The results are shown in Table 9.1 where $R^2 = 0.606119$. Observed significance level of the parameter B_1 is statistically significant. The model takes the following form:

$$PORT = 49.79778071\ (DWT)^{0.744423986}$$

That is, there is a positive relationship between the port charges and the independent variable, deadweight. Figure 9.28 shows the comparison between the observed values and predicted port charge values.

Figure 9.28

Passenger Vessels
Observed Vs. Predicted Port Charges Cost



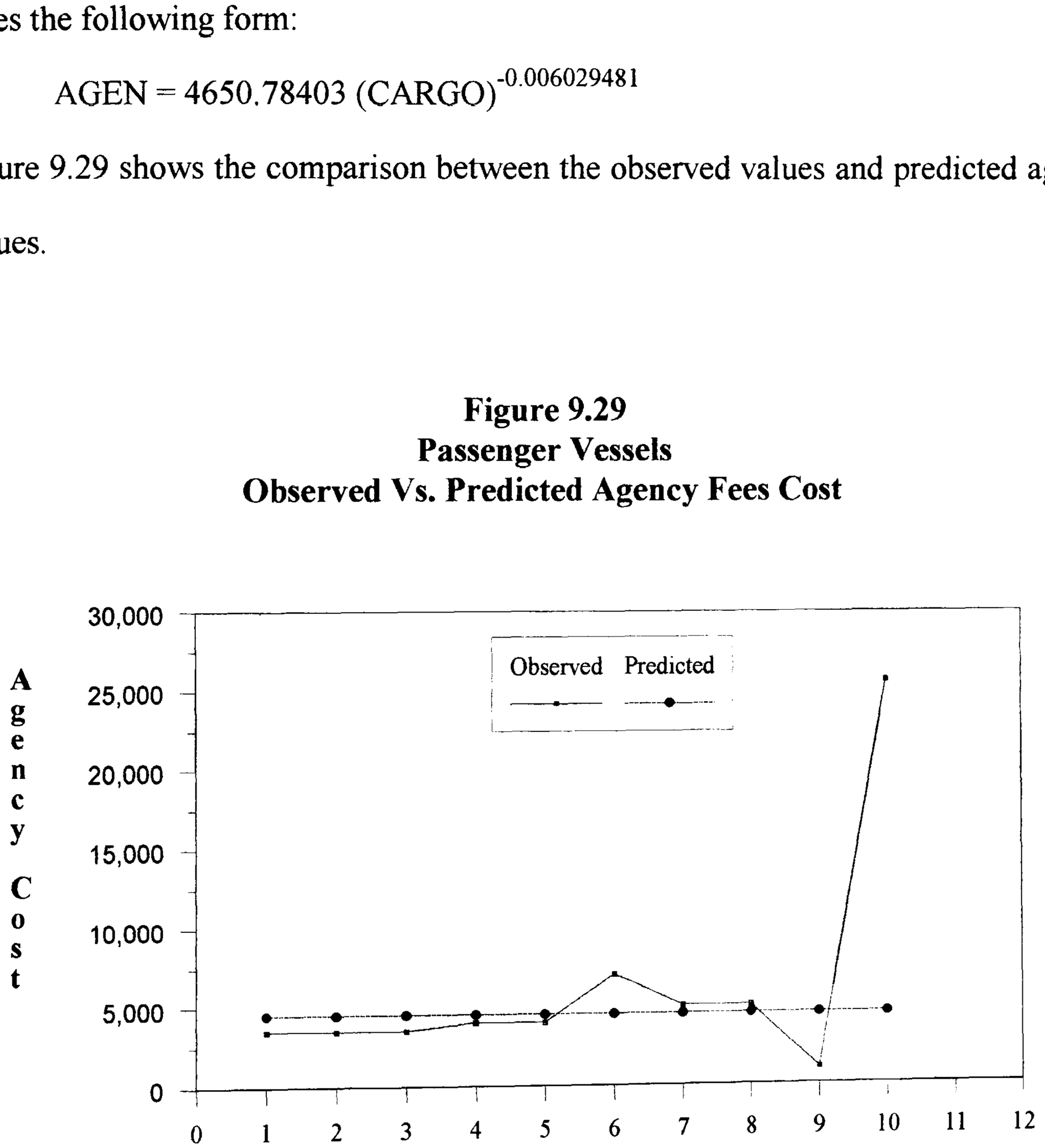
9.7.9 Agency Fees

Table 9.1 shows the results of the agency fees model, using cargo transported as an independent variable affecting such costs, where $R^2 = 0.000044$, which is a very small value. This indicates that this variable is not strongly related with agency fees. The significance level of parameter B_1 is 0.9855, which is also very high. The model takes the following form:

$$AGEN = 4650.78403\ (CARGO)^{-0.006029481}$$

Figure 9.29 shows the comparison between the observed values and predicted agency values.

Figure 9.29
Passenger Vessels
Observed Vs. Predicted Agency Fees Cost



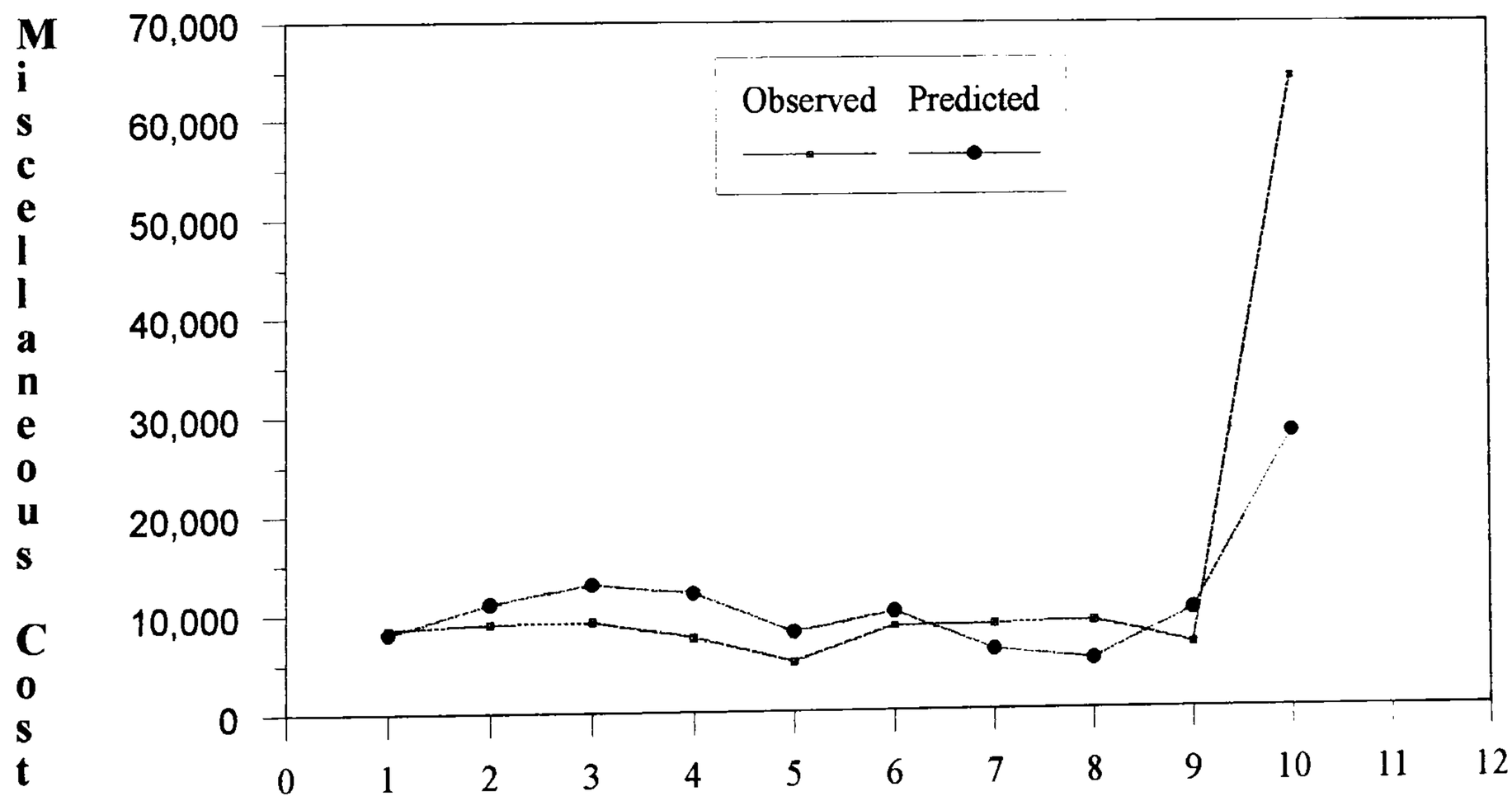
9.7.10 Miscellaneous and Administration Expenses

Table 9.1 shows the results of the model of miscellaneous and administration expenses using deadweight and voyage days as independent variables, where R^2 = 0.469485, which is a small value, and it can be seen that all the parameters are statistically significant. The model is as follows:

$$ISC = 1.251342351\ (DWT)^{0.816059267}\ X\ (DAYS)^{1.603658283}$$

That is, there is a positive relationship between the miscellaneous and administration expenses and deadweight and voyage days, but the effect of the number of voyage days is greater than that of the deadweight. Figure 9.30 shows the comparison between the observed values and predicted miscellaneous and administration values.

Figure 9.30
Passenger Vessels
Observed Vs. Predicted Miscellaneous Cost



9.7.11 Total Costs

All the independent variables which may affect the total costs, namely, deadweight, vessel age, crew number, speed, distance, cargo transported and voyage days were selected, then the non-linear model was applied to them. The results showed that all the parameters of all the independent variables are statistically insignificant at a level below 0.1. Therefore stepwise regression was conducted and the variables deadweight and voyage days were selected as the best variables.

Figure 9.31
Passenger Vessels
Observed Vs. Predicted Total Cost

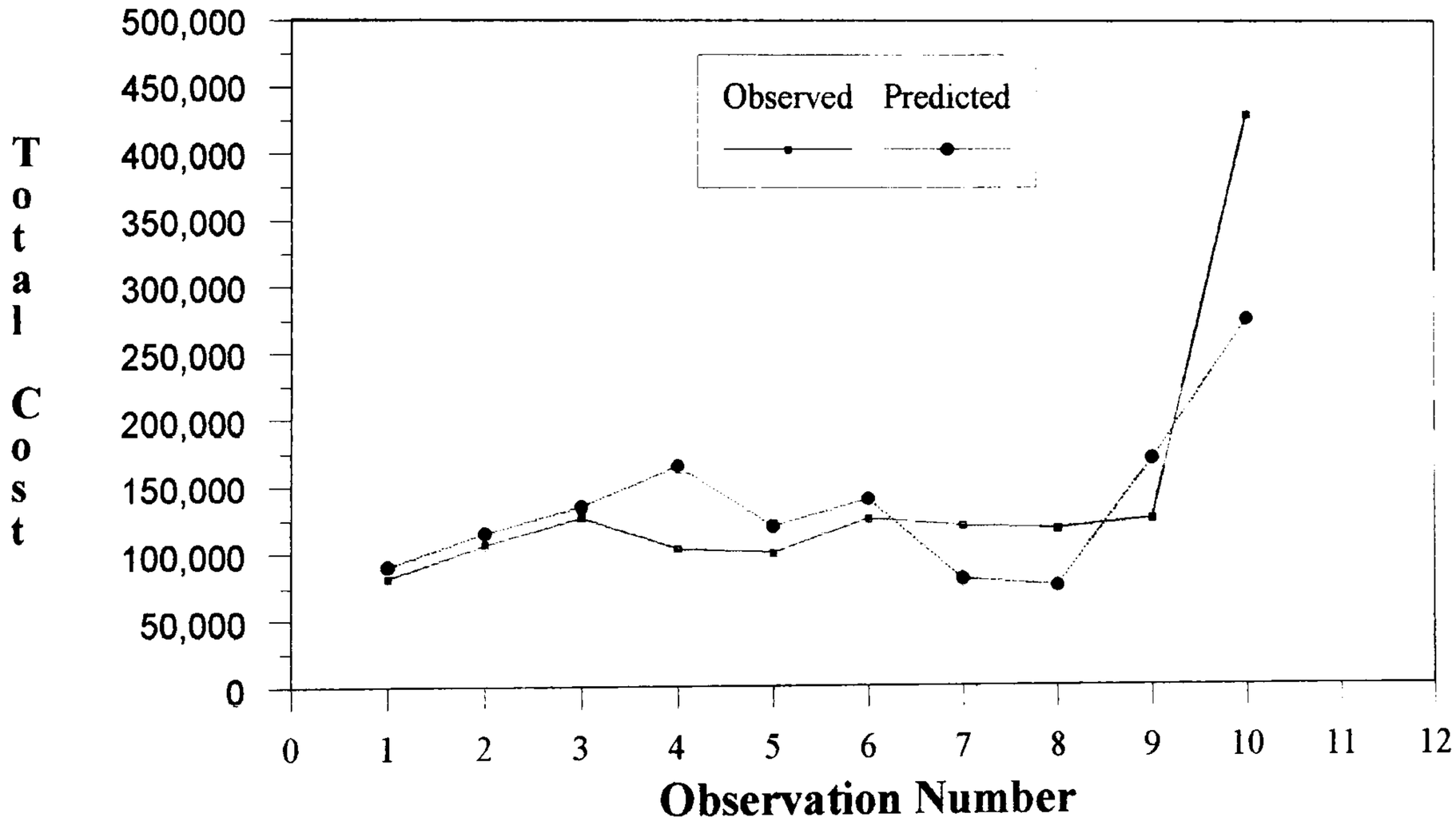


Table 9.1 shows the results of this model, where $R^2 = 0.66795$. The model takes the following form:

$$TOTAL = 99.71936352\ (DWT)^{0.719487894}\ X\ (DAYS)^{0.949804734}$$

That means, there is a positive relationship between total cost and deadweight and voyage days, but the effect of the number of voyage days is bigger than that of deadweight.

Figure 9.31 shows the comparison between the observed values and predicted total costs.

9.8 Summary and Conclusion

Cost functions were developed from the raw cost data and the operation data. The cost equation for each cost element and for the total cost was reached using statistical regression analysis. In building a multiple regression cost model, the following two basic problems were faced:

1. The model's form (Is it linear or non-linear?)
2. Which of the independent variables must be included in the model?

First, from previous studies (see Chapter 5) the independent variables which affect each cost element were determined. It was then found that the logarithmic cost function was most representative of our data. In some models, some independent variables did not have statistically significant effect. Therefore, stepwise regression procedures were undertaken to test the best independent variable(s) of the model. The objective of this empirical analysis was to discover the effective factors causing

variation in each cost element. Moreover, the developed equations show the ranking of each factor so the management of the shipping companies can give more attention to controlling the most important factor. The end results of the statistical analysis were shown in Table 9.1.

Chapter Ten

Summary, Conclusions and Recommendations

10.1 Summary

This thesis consists of ten chapters. The first chapter is an introductory one which outlined the research problem, the objectives of the study and the contents of the thesis. This chapter also described the survey population applicable to this study as well as the sample of study and discussed the research methodology and techniques of investigation used.

Chapter Two discussed the development of Saudi shipping. It was indicated that Saudi Arabia's oil revenues have not only made it easier for the country to develop infrastructure, services and basic industries, but have also made it necessary that development should take place in all aspects of social and economic life.

The development of marine transportation has taken place along several lines, all within the framework of the Kingdom's responsibilities as an active member of the global community.

Before 1975, the Saudi fleet amounted to 58,500 gross registered tonnes. However, with government support the national fleet has expanded rapidly. It totalled over 5 million gross registered tonnes in 1983. Between 1972 and 1980 the capacity of the Saudi fleet grew at an annual average rate of 33.5 percent in gross registered tonnes. In contrast, the corresponding capacity of the world fleet grew annually at an average rate of only 2.95 percent.

Compared with other major maritime countries, the Kingdom carries a low percentage of its cargo on national carriers, amounting to 6.6 percent in 1987. This percentage had increased marginally to 7.7 percent by 1988.

Chapter Three reviewed the literature on shipping cost, examining both the classification of shipping costs and those factors which may be reasonably expected to affect the level of such costs. It also discussed cost indicators in shipping companies.

In this consideration of the cost structure in shipping companies, four types of cost classification were discussed, namely: (1) natural classification; (2) object of expenditure classification; (3) product-related classification; and (4) volume of activity-related classification.

Natural cost classification is based on the types of goods and services consumed in a production operation. In shipping companies, the product is a service. Therefore, primary operating costs may be classified so as to identify the major input components required to operate a fleet. As in any business firm, the shipping company needs inputs to provide the shipping service to customers, i.e. shippers. These inputs are materials, manpower and many other outlays.

On the other hand, the objects of expenditure classification system considers operating costs within the context of the function or process involved in an operation. The most important activities in a shipping company are those related to the vessel itself, the voyage and the cargo or passengers.

Product-related classification, when applied in the shipping industry, treats each voyage as a separate product (or accounting entity). Thus, shipping companies following this classification procedure adopt a reporting procedure based on the concept that each individual voyage is a separate product.

The voyage cost for financial accounting purposes is composed of direct and indirect cost elements. The direct costs of the voyage are comprised of the outlays necessary to perform the voyage plus the outlay which pertains to cargoes carried during the voyage. The indirect cost of the voyage is an allocation of vessel expenses and general expenses to the voyage.

Finally, volume of activity-related classification segregates costs to fixed and variable. It is well known that there will be some costs which vary and others which will be constant or not affected by variation in the volume of traffic. The analysis of shipping costs to fixed and variable cost is a very important source of information which the shipping company management can use for planning control and decision-making.

Chapter Four discussed previous studies on vessel cost structure. Cost percentage analysis has revealed wide variation in capital, operating and voyage costs due to various factors relating to differences in voyage patterns, vessel type, size or capacity of vessel, age and distance. Cost structures also vary according to the type of shipping activity. Moreover, cost structures could vary considerably between similar vessels and be influenced by the flag of registry, crew size and nationality and

managerial efficiency of the ship operating company. Shipping costs will also vary from one vessel to another, even though they do the same voyage, since the efficiency of each vessel is unlikely to be the same.

It was noticed that the structure of shipping costs, namely capital, voyage and operating costs, has changed distinctly over the survey period 1980-1994.

Chapter Five examined in detail each cost element of shipping to identify the factors that affect each of them. In other words, the researcher tried to relate variation in cost to some causal factors such as size, age, speed, flag of registry etc. The factors which affect each cost element are summarised in Table 10.1 It can be inferred that ship size is the most significant factor which affects all cost elements.

Table 10.1

Factors Affecting Shipping Cost Elements

Cost Element	Factors
Depreciation costs	Ship size, shaft horse power and time charter (voyage days)
Insurance costs	Ship size, age and owner's record
Crew costs	Ship size, crew composition and nationality.
Stores and Supplies costs	Ship size, type and age.
Maintenance and Repair costs	Ship size, age, sailing distance and speed.
Fuel costs	Ship size, speed and engine power.
Stevedoring and Agency costs	Ship size, passenger fares, freight, number of passengers and quantity of cargo
Port costs	Ship size and number of call
Admin.& Misc. costs	Ship size, length of ship and distance

These factors, all or some of them, have been used in developing the cost functions in the empirical study of the thesis.

A description and analysis of the cost systems in shipping companies in Saudi Arabia were presented in Chapter Six. The analysis revealed that these systems differ tremendously. Some depend on integrated book-keeping while others prepare cost statements, without opening independent cost accounts. Another group of companies mixed cost accounting with financial accounting. The researcher noticed that the accounting treatment of cost elements varied significantly among these companies. The same was true with regard to classification of those elements and the treatment of incompleted voyages. Moreover, cost reports varied, and their applications were not up to the appropriate standards, especially in the field of performance evaluation of the officers in charge of the vessel.

These results prompt the suggestion that it is necessary to start establishing a cost accounting system for the Saudi shipping companies, that is, a uniform cost-accounting system, which includes the following:

1. Unification of the terminology of the cost accounts.
2. Establishment of a uniform manual of cost accounts.
3. Unification of the accounting treatment of the cost elements.
4. Unification of the system outputs, such as cost accounts, cost statements and cost reports.

Such standardisation is essential to minimise irregularities which currently occur in accounting practice in the cost departments of shipping companies, and would lead to the production of more reliable cost information.

The researcher suggests that this mission be undertaken by the shipping section of the Chamber of Commerce and Industry in the Kingdom of Saudi Arabia, which could make use of the expertise of specialists in the field of shipping costs from a country with long experience in the field of navigation, such as the United Kingdom.

In Chapter Seven, evaluation of cost accounting reports was discussed. The responses of a sample of individual managers from shipping companies, with regard to the appraisal of cost reports, were analysed. A Likert scale was used, and non-parametric statistical analysis was carried out to determine whether or not the difference in the opinions of the sample groups is significant. For this purpose, the Kruskal-Wallis test and Mann-Whitney tests were carried out. Five criteria were introduced to evaluate the uses of cost reports by top managers in shipping companies. These were, usefulness, relevance, timing, reliability and the general positive effect. The results of the analysis revealed that the sample as a whole attached maximum importance to the usefulness criterion, a result which is justified in that cost reports aim primarily to serve managers in carrying out major functions, such as planning, control, follow-up, decision making and evaluation of performance. In addition, there is general agreement among participants that cost reports in shipping companies in the Kingdom of Saudi Arabia are highly reliable and of good quality.

Analysis of the cost structure of Saudi vessels was undertaken in Chapter Eight. The analysis of that chapter revealed that the fixed cost of tanker vessels, that is capital costs and running costs, represent 67.1 percent of the total or just over 2/3 of total cost, while the variable costs, (i.e. voyage costs) represent 32.9 percent or about 1/3 of total cost. Therefore, the higher percentage of fixed cost needs particular attention and thorough planning technique for operating the tanker vessels, so that break-even point can be achieved at a lower level of operation, hence increasing the margin of safety.

On the other hand, the fixed costs of cargo vessels were found to be 44.6 percent of the total, while the variable cost represented 55.4 percent of the total. The higher percentage of variable costs requires that each of the variable cost elements must be controlled with a view to minimising it as much as possible and, in turn, increasing the relative profitability of the voyage.

Finally, the analysis revealed that the fixed costs of passenger vessels were 54.6 percent of total costs, while variable costs were 45.3 percent of the total cost.

Since there are many factors that can cause variation in each cost element, it was necessary to know each factor and to identify the cost variation that can be attributed to those factors, in order to identify which factors are most significant. These were the matters dealt with in Chapter Nine, where a regression analysis was undertaken to identify the cost function of Saudi shipping companies for eleven cost elements of capital, operating and voyage for tanker, cargo and passenger vessels. It

was found that the logarithmic cost functions best represented the researchers data. In some models, some independent variables did not have a statistically significant effect. Therefore, stepwise regression procedures were undertaken to test the best independent variable(s) of the model.

The end results of the statistical analysis were the most important independent factors, which affect each cost element. Table 10.2 shows these factors.

Table 10.2

The Most Important Factors Which Affect Each Cost Element

No	Cost Element	Tanker	Cargo Vessels	Passenger vessels
1	Depreciation	DWT, AGE, DAYS	DWT, AGE, DAYS	AGE
2	Insurance	DWT, AGE, DAYS	DWT, DAYS	DWT,AGE,DAYS
3	Wages and Victllg.	CREW, DAYS	CREW, DAYS	DAYS
4	Stores	DWT, DAYS	DAYS	DAYS
5	Maintenance/Rep.	DWT	DAYS	AGE
6	Fuel	DWT, DAYS	DWT, DAYS	DWT
7	Port charges	DWT	DWT	DWT
8	Misc.& Admin.	DWT	DWT, DAYS	DWT, DAYS
9	Stevedoring	---	CARGO	CARGO
10	Agency fees	---	CARGO	CARGO
11	Total cost	CREW,CARGO,DAYS	DWT,SPEED,DAYS	DWT, DAYS

10.2 Conclusions

The research study in this thesis has realised the four main objectives which the researcher defined at the beginning in the introductory chapter. Chapter 4 has dealt

with the first objective, that is identifying the relative formation of the cost structure in shipping companies. Chapter 5 has dealt with the second objective, that is identifying the independent variables which affect each of the cost elements in the shipping companies in general. Finally Chapters 6, 7, 8, and 9 have dealt with all the problems associated with the third and the fourth objectives, i.e. identifying the cost structures and measuring the cost functions of samples of Saudi vessels. The following conclusions can be drawn from this research study:

1. Saudi shipping industry has been growing dramatically at a rapid and large annual rate; huge capital has been invested in shipping industry, hence it is important to control costs of the fleet as a possible way to increase the rate of return on investment in this industry.

2. To control shipping cost it is necessary to analyse costs in shipping companies in many ways so that cost information can be used easily for the control purposes.

3. The components of the cost structure of each type of vessel vary. The information about cost structures constitutes a data base to be used by shipping company management in planning, control and decision making.

4. Information about casual factors impacting on shipping costs is very important to establish policies aiming at cost reduction in shipping companies.

5. Cost accounting systems in Saudi shipping companies are still in a state of trial and error. Cost reports in these companies are not up to the appropriate standards.

6. Fixed cost is relatively high, especially for tankers and passenger vessels. The implication of this fact is that break even point of such types of vessels may come late; hence it is necessary to give more attention to reducing fixed cost and minimising it as far as possible.

7. The most important information derived from cost functions of Saudi vessels are the variables causing changes in each cost element for each type of vessel. The management in shipping companies in Saudi Arabia can depend on this information to establish cost reduction policies.

10.3 Recommendations

Based on the results of the empirical component of this study, the researcher recommends the following:

1. It is necessary to start establishing a uniform cost accounting system for Saudi shipping companies.

2. Top management in shipping companies in Saudi Arabia should direct their attentions to reducing fixed cost to the minimum as much as possible, since this action will increase the safety margin and will promote profitability.

3. Attention should be given to the most important factors which affect each cost element. This needs an in depth study of the cost function of each vessel in the company fleet. Cost accountants who are specialists in statistical cost analysis should be recruited for this purpose.

4. Finally the researcher recommends that Saudi universities give special attention to direct researches to cover accounting problems of shipping companies.

Appendix 1

Description and Analysis of Cost Accounting Systems
In Shipping Companies in K.S.A

Please tick the appropriate box or give written answer for each of the following questions:-

1) Do you have a Chart of Accounts in your cost system?

☐ Yes ☐ No

2) Do you use any computer system within your cost department?

☐ Yes ☐ No

3) Do you have an Accounting manual in your cost system?

☐ Yes ☐ No

4) What types of cost statement does your cost system produce?

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5) How frequently does your cost system produce your cost statements?

☐ Monthly ☐ 1/2 Annually

☐ Annually ☐ After Each Trip

6) What are the cargo cost elements?

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7) What are the cost elements related to passengers?

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8) What are the elements of your vessel operating costs?

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9) What are the voyage cost elements?

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10) How do you allocate overhead costs to vessels and then to voyages?

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11) Are the vessel running and voyage costs allocated on both legs of the round trip?

☐ Yes ☐ No

If yes, please specify the bases of allocation?

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12) Do you allocate the costs on the different types of cargo shipped in the round trip?

☐ Yes ☐ No

If yes, what is the basis of allocation?

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13) How do you determine the cost of fuel used in your voyages?

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14) What are the practical factors affecting your fuel cost?

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15) Describe in detail the accounting recording procedures of materials purchased (fuel, water, paint, spare parts, tools)?

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16) Describe in detail the accounting procedures of labour costs?

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17) Describe in detail the accounting procedures of other operating expenses?

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18) How do you deal with the uncompleted voyage costs at the end of the Financial year?

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19) Is there any delay of expense documents coming from your agents?

Please indicate its seriousness.

☐ Long Delay ☐ Medium Delay

☐ Short Delay ☐ No Delay

20) Do you estimate the costs of each voyage prior to its commencement?

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21) In the case when you estimate the costs of each voyage prior to its commencement:

a) Do you use standard costs? □

b) Do you estimate the costs according to previous voyage costs? □

22.) Do you analyse the variance between the estimated and actual voyage costs?

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23) When variance occurs, are they analysed to:

a) price variance ☐

b) quantity variance ☐

c) capacity variance ☐

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24) How do you use the variance reports of cost elements to evaluate the performance of the following managers of each voyage?

a) The Captain

b) The Chief Officer

c) The Purser

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Appendix 2

The Evaluation of Cost Accounting Systems In Shipping Companies in K.S.A.

The following table includes essential elements used in the evaluation of the cost accounting systems of shipping companies. Please indicate the degree of your agreement with each of the statements by ticking in the column that corresponds to your opinion against each statement.

Serial No.	Elements of Evaluation	Strongly Agree	I Agree	Not Sure	I don't Agree	Strongly Disagree
1	Cost system produces reports containing useful information for the control of costs in the company					
2	Cost system produces reports containing useful information for the vessel's operational planning and operational decision making.					
3	Cost reports in the company are easy to read and understand					
4	We receive cost reports relevant to our work in the department					

Serial No.	Elements of Evaluation	Strongly Agree	I Agree	Not Sure	I don't Agree	Strongly Disagree
5	The cost system follows-up the change in the costs of each shipping route and vessel.					
6	The cost system analyses the elements of cost according to their controllability by the various management levels in the company.					
7	The cost system presents the reports on time.					
8	The cost system produces up-to-date cost data					
9	Cost reports are considered an effective tool to improve cost awareness at responsibility centres in the company					
10	Cost reports which include analysis of cost elements variances do facilitate the evaluation of management performance in the company					

Serial No.	Elements of Evaluation	Strongly Agree	I Agree	Not Sure	I don't Agree	Strongly Disagree
11	The cost system produces accurate and reliable information.					
12	Cost reports are periodically comparable since they are based on consistent evaluation methods.					
13	Cost reports include essential information rather than unnecessary details.					
14	Cost information produced by the cost system contributes to the reduction of risk and improves return in the company.					

Appendix 3

The Cost Structure in Shipping Companies

Please fill in the following table to show the operational and cost data of voyages of all vessels operated by your firm during the year 1992 (Only one voyage per vessel).

Please tick the appropriate box for each kind of the following vessels:

Passenger vessel ☐

General Cargo vessel ☐

Container vessel ☐

Bulk vessel ☐

Tanker ☐

Other ☐

Data	Vessel 1	Vessel 2	Vessel 3	Vessel 4	Vessel 5
Operational Data					
Dead weight					
Gross tonnage					
Cargo or passengers transported (tons)					
Fuel consumption (tons)					
Steaming speed (Average)					
Steaming days					
Port days					
Distance for round trip (mileage)					
Year of Building					
Crew on board					
Officers on board					
Indirect Voyage Expenses (S.R.)					
Depreciation					
Insurance					
Annual and Special survey					
Inactive vessel expenses					
Direct Voyage Expenses					
Wages + Victualling					
Stores					
Maintenance and repairs					
Fuel					
Stevedoring and other cargo expenses					
Wharfage and dockage					
Port charges					
Agency fees					
Miscellaneous expenses					
Administrative Expenses					
Total Voyage Cost					

Bibliography

Anthony, R.N. and Reece, J.S. (1991), Accounting, (9th edition). Homewood, Illinois: Richard D.Irwin, Inc.

Anthony, Robert Newton, and Yong, D. W. (1994), Management Control in No-profit Organisation, United States of America, Richard D. Irwin, Inc.

Belkaoui, A. (1991), Handbook of Cost Accounting Theory and Techniques, Westport, Connecticut: Quorum Books, An imprint of Green Wood publishing group, Inc.

Benford, H. (1985), "Ships' Capital Costs." Maritime Policy and Management, Vol.12, pp.9-26

Berenson, M. L. And Levin, D. (1992), Basic Business Statistics: Concepts and Application, Englewood Cliffs, News Jersey: Prentice-Hall International, Inc.

Branch, A. (1988), Economics of Shipping Practice and Management, (2nd edition), London: Chapman and Hall Ltd.

Bureau of Industry Economics. (1994), International Performance Indicators Coastal Shipping, Canberra: Australian Government Publishing Service.

Bureau of Transport Economics. (1980), Trans-Tasman Shipping, Canberra: Australian Government Publishing Service.

Chadwin, Mark L., Pope, J.A and Talley, W. (1990), Ocean Container Transportation: An Operational Perspective, New York: Taylor and Francis.

Cheng, Philip C. (1985), Steamship Accounting, (3rd edition). Cambridge, Maryland: Cornell Maritime Press, Inc.

Chrzanowski, I. (1989), An Introduction to Shipping Economics, London: Fairplay Publications.

Downard, J. M. (1988), Running Costs, London: Fairplay Publication.

Drewry, H.P. (Shipping Consultants), (1980), Tanker Freight Costs and Crude Oil Prices, Study No.86, H.P. London: Drewry.

Drewry, H.P. (Shipping Consultants), (1983), Tanker Operating Cost Trends: 1970-1981, Economic study No. 113, London: Drewry.

Drewry, H.P. (Shipping Consultants) Ltd. (1984), Dry Bulk Operating Costs, London: Drewry.

Drewry, H.P. (Shipping Consultants), (1984), Dry Bulk Carrier Operating Costs - Past, Present and Future, Study No. 122, London: Drewry.

Drewry, H.P. (Shipping Consultants). (1986), Traffic and Competition on Round-the-World Container Routes, London : Drewry.

Drewry, H.P. (Shipping Consultants) Ltd. (1990), Ship Costs: Their Structure and Significance, London: Drewry.

Drewry, H.P. (Shipping Consultants) Ltd. (1991), Tanker Operating Cost Trends. London: Drewry.

Drewry, H.P. (Shipping Consultants) Ltd. (1992), Trading Prospects for the Dry Bulk Carrier Fleet: Demand, Employment, Rates and Profitability, London: Drewry.

Drewry, H.P. (Shipping Consultants) Ltd. (1992), Second Hand Ships Market Sector Prospects and Investment Options During the 1990's. London: Drewry.

Drewry, H.P. (Shipping Consultants) Ltd. (1993), Cruise Ship and Ferry Costs in the 1990's : The Economic Impact of Increased Safety Demand, London: Drewry.

Economists Intelligence Unit. (1985), Euro Coal: What Next, London: EIU, No.7

Economists Intelligence Unit. (1986), Falling Oil and Energy Prices, London: EIU, No.11.

Erasmus Universiteit Rotterdam. (1991), Current Issues in Maritime Economics, International Conference at the Erasmus University Rotterdam.

Eyre, J. L. (1989) "A Ships' Flag - Who Cares?" Maritime Policy and Management. Vol 16, pp. 179-187.

Foss, B. (1969), "A Cost Model For Coastal Shipping", Journal of Transport Economics and Policy, iii No.2, pp.195-222

Frankel, E.G. (1989), Management and Operation of American Shipping, (3rd edition) Boston: Auburn House Publishing Company.

Glautier, M.W.E. and Underdown, B. (1988), Cost Accounting, Long Acre London: Pitman Publishing.

Goodwin, E.M. and Kemp, J.F. (1979), Marine Statistics: Theory and Practice, London: Stanford Maritime Limited.

Gulf Co-operation Council. (1988), Economic Publication, Saudi Arabia

Hamburg, M. (1977) Statistical Analysis for Decision Making (2nd Edition) New York: Harcourt Brace Inc.

Heaver, Trevor D. , The Treatment of Ships' Operating Costs, Maritime Policy and Management, 12 No.1 (1985)

Hirsch, M. L. and Joseph G. Louderback, J.G. (1992), Cost Accounting: Accumulation, Analysis, and Use, (3rd edition). Cincinnati, Ohio: South-Western Publishing Co.

Huda, M. (1983), Maritime Transport Economics, Alexandria: Egypt Universities Ltd. (Published in Arabic)

IBJ. (1993), "Freight Rates and Dry Bulk Shipping Costs", International Bulk Journal, Vol.13,5 p.17.

Jansson, J.O. and Shneerson D. (1987), Liner Shipping Economic, London. Chapman and Hall Ltd.

Kaplan, R. S. (1982), Advanced Management Accounting, Englewood Cliffs, New Jersey: Prentice-Hall International, Inc.

Kendall, P.M.H. (1972), "A Theory of Optimum Ship Size", Journal of Transport Economics and Policy, NI No.2, pp.128-146

Lanny, S. M., Vargo, R. J. and Walther, L. M. (1986), Accounting Principles, New York: Harper and Row.

Lavon, B. and Shneerson, D. (1981), "Optimal Speed of Operating Ships", Maritime Policy and Management, Vol 8, pp. 31-39.

Lloyd's Maritime Directory (1987) The International Shipping and Shipbuilding Directory, Colchester. Essex: Lloyds of London Press Ltd.

Long, D.M. and Fbim, R.N. (1986), The Soviet Merchant Fleet: Its Growth, Strategy, Strength and Weakness, Lloyds of London Press Ltd.

Ministry of Communication. (1990), Maritime Transport Conference, Kingdom of Saudi Arabia: Jeddah, Chamber of Commerce and Industry.

Ministry of Communication. (1990), Saudi Maritime Fleet, Kingdom of Saudi Arabia: Tihama for Advertising, Public Relation and Marketing Co., (Published in Arabic)

Ministry of Communication. (1986), Transport and Communications Progress and Achievements, Kingdom of Saudi Arabia: Tihama for Advertising, Public Relation and Marketing Co.

Moreby, D. H. (1985), "Crew Costs." Maritime Policy and Management, Vol 12. pp.55-60.

Needles, B., Anderson, H., R. And Caldwell, J. (1991), Managerial Accounting, New York: Houghton Mifflin Company.

Niswonger, C.R., Fess, P.E. and Weygant, J.J. (1991), Accounting Principles, (16th edition). Cincinnati Ohio: South-Western Publishing Co.

Organisation for Economic Co-operation and Development (1980, 1981, 1983, 1984, 1989, and 1992), Maritime Transport, Paris: OECD

Packard, William V. (1984), Sea Trading: The Ships, Vol.1, London: Fairplay Publications.

Pappas, J.L. and Brigham, E.F. (1990), Fundamentals of Managerial Economics, (3rd edition). Chicago: The Dryden Press

Pearson, Roy. (1988), Container Ships and Shipping, London: Fairplay Publications Ltd.

Proctor, N.C. (1985), "Marine Insurance." Maritime Policy and Management, Vol 12, pp 61-69.

Saudi Arabian Monetary Agency. (1990), Statistical Summary, Kingdom of Saudi Arabia. Riydah

Saudi Arabian Monetary Agency. (1979-89), Annual Report, Kingdom of Saudi Arabia; Riydah.

Saudi Ports Authority. (1979 and 1989), Annual Report, Kingdom of Saudi Arabia: Jeddah.

Seatrade (1983, 1984, 1985, 1986, 1987), Arab Shipping, Colchester: Seatrade Publications Ltd.

Siegel, G. and Markoni H. (1989), Behavioural Accounting, Cincinnati, Ohio: South-Western Publishing Co.

Sletmo, Gunnar K. and Williams, E. W. (1986), Liner Conferences in the Container Age, (3rd edition). New York: Macmillan Publishing.

Stopfor, Martine. (1988), Maritime Economic, London, Unwin Hyman Ltd.

Stubbs, Peter (1982), Australia and the Maritime Industries, Melbourne: AIDA Research Centre.

Talley, W.K. (1988), Transport Carrier Costing, London: Gordon and Breach.

Tolofari, S.R. (1989), Open Registry Shipping: A Comparative Study of Costs and Freight Rates, New York: Gordon and Breach Ch Science Publisher.

Tolofari, S., Button, K. and Pitfield, D. (1985), "Shipping Costs and the Controversy Over Open Registry." The Journal of Industrial Economics Vol.XXXIV, p.412

Trace, K., Meyric, S.J and Robinson, R. (1989), Australian Flag Shipping and the Balance of Payments: What is it Worth? Wollongong: University of Wollongong, Center for Transport Analysis.

UNCTAD. (1985), Review of Maritime Transport, New York: United Nations.

UNCTAD. (1986), Review of Maritime Transport, New York: United Nations.

UNCTAD. (1990), Review of Maritime Transport, New York: United Nations.

UNCTAD. (1992), Review of Maritime Transport, New York: United Nations.

Whitehead, G. and Upson, Arthur. (1992), Success in Management Accounting: An Introduction, London: John Murray.