F THE PANAMAX
B CHARTERMARKET
1989-1994

IN RELATION TO THE DESIGN CHARACTERISTICS

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prof. dr. ir. N. Wijnolst   ir. M. Bartelds

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The bulk carrier on the cover is the Burmeister & Wain Skibsvaerft A/S 1994 built Romandie, one of the most modern designs available. The photograph and the general arrangement (**Appendix G**) are used by courtesy of B&W.

Ir. F.A.J. Waals prepared the manuscript for printing

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INTRODUCTION

Since the nineteenth century the volume of seaborne trade has grown enormously and, to exploit economies of scale, there has been a corresponding increase in the use of bulk shipping. The first bulk carrier, as we know them nowadays, was built in 1922. It was a 22,000 DWT ore carrier, at that time the world's largest ocean going cargo ship.

Using large, specially designed ships has become very common. Although their size increased during the next fifty years, varying from 120,000 DWT in the 1960s to 300,000 DWT in the 1980s, the basic operational principles remained the same.

One of the problems of these larger ships, was that they were no longer able to load and discharge in every port, due to the restricted depth of the ports. The main sailing route from the east coast of North and South America is through the Panama Canal. This canal has beam and depth restrictions and the ships which meet the maximum requirements to sail through it are called panamax vessels.

As long as ships have sailed around the world, shipowners wanted to know what to expect from the future. Questions Like: "Is now a good moment to order a new ship?", "Should I buy a second hand one?" or "Should I wait another year?", lead companies to compose their own index figures, indicating the freight level of their specific market. The freight level is determined by the balance of supply and demand of the ships and the transport requirements. For large ships, index figures are provided by several companies. Presently, the best known index figure is the *Baltic Freight Index*. This index is especially useful for shipowners and charterers of panamax and capesize vessels. It gives a good impression of the complete market, but the technical and design characteristics of each shiptype is 'invisible'.

The purpose of this study is to examine whether there is a relation between the freight/charter rates and the ships' design characteristics, which are given in the fixtures or are known by charterers by any other way.

This study is about ships which can still sail through the Panama Canal. The main design characteristic is the beam restriction The beam must be smaller than 32.20 meter, to sail through the locks of the canal. The length is also limited, but for bulk carriers this is not a restriction. The maximum depth can also be a restriction for panamax bulk carriers.

From the figure on the following page, which shows the business cycles of the charter market two remarks can be made. First, there is some cycle in the graph. Second, the range is not very narrow but very wide, with a large variance. ***So one question to be answered is: "Are there bulk carriers out-performing the overall market?".*** In order to answer this question, the market has to be analyzed in detail.

Part 1 of this study gives a detailed picture of the panamax bulk carrier charter market, based on the analysis of some 10,000 fixtures over the period 1989-1994. The data were provided by the Sheffield based company *Plymouth Maritime Analysis Ltd.*. This company collects fixtures and puts these fixtures in a database. Each month they provide an update of these fixtures. Plymouth makes a distinction between several types of charters:

* Period time charters;
* Trip time charters;
* Single voyage charters.

All three fixtures types are discussed in **Part 1**.

Part 2 of this study gives an overview of the design characteristics of panamax bulk carriers. This analysis is based on the database of the London based shipbroker/research institute *Clarkson Research Ltd.* We are indebted to them for the use of their comprehensive bulk carrier database. The ships' databases of *Shipmair B.V.*, the Rotterdam based operator, has been used as well.

The Baltic Freight Index gives a good feeling of the strength of the market at a specific moment. However, it does not tell anything about the design characteristics. In **Part 3** a charter index has been made with the purpose to eliminate the business cycles in the charter rates and to see which design characteristics influence the charter rate. The outperforming as well as the underperforming ships are selected and analyzed further.

The last part, **Part 4**, of this study, summarizes the research and formulates the conclusions.

This study is part of the master thesis of ir M. Bartelds at the Faculty of Mechanical Engineering and Marine Technology of the Delft University of Technology. We are grateful for the financial support of the Faculty in preparing this thesis in the present format. If you wish to react to this study, please contact prof. dr ir N. Wijnolst, Mekelweg 2, 2628 CD Delft, The Netherlands, tel. +31-15-784682, fax. +31-15-620620

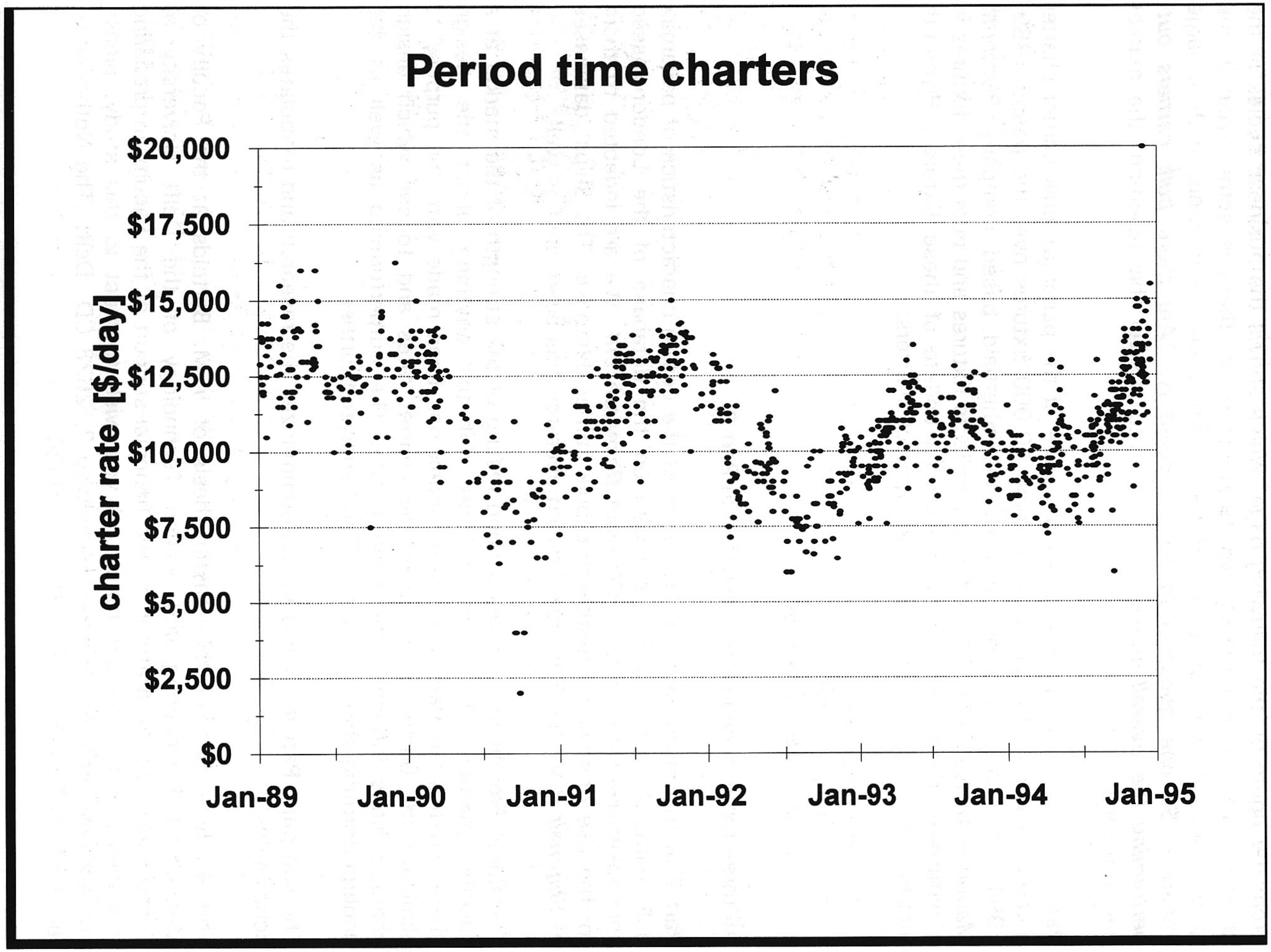


Figure 1: Period time fixture, charter rates

PART 1 - PANAMAX BULK CARRIER CHARTER MARKET

1 METHODOLOGY

Shipping companies often prefer to charter a vessel, rather than to buy one. When a shipowner charters out his ship on a contract basis (for example, at an agreed rate per day) it's called a charter. These charters are reported by shipbrokers and published in weekly and monthly reports.

Shipbrokers send their information to their clients. Also consultancy companies receive this information. One of these companies is *Plymouth Maritime Analysis Ltd.*, Sheffield. They have put all information about these fixtures in a database, which has been purchased for this study. Every month, the database is updated.

The bulk carrier charter market is a very diverse market, which consists of several types of fixtures. The Plymouth database contains information about the three major fixtures types from the years 1989 up to and including 1994. According to Plymouth, these reports cover roughly between 30 and 40% of the actual volume of major bulk trading (for the three major fixture types together). Especially the long term contracts by the major shippers of coal and iron ore, are not included in the database. The coverage of the single voyage and the trip markets will therefore be somewhat better than the figures mentioned above. 30 to 40% of the considered markets, or even higher for some specific markets, should be representative enough for the following analysis.

Based on the Plymouth database a new database has been created which comprises all fixtures in the DWT range of 50,000 - 76,000 mton. The three major fixture types consist of 9717 records over a period of 6 years, which is an average of about 133 fixtures per month.

The Plymouth database gives an accurate overview of the development of the charter rates as a function of time. A dimensionless index can be made for all vessels, to enable the comparison on an objective basis. This is quite complicated since there are three types of fixtures to be compared, period time charters, trip time charters and single voyage charters. The main questions are:

* What are the differences between the fixtures of the vessels?
* To what performance indicators of the ships are they related?

The Clarkson database of the ships' characteristics consists of 5,014 bulk carriers, of which only a part (834) are of panamax size.

The Clarkson and the Plymouth database have been related by the unique Clarkson number. This means that while viewing the Plymouth database, information from the Clarkson database can be shown as well.

Database and spreadsheet programs

For this study several database programs have been used. The work is done with Quattro Pro for Windows, version 5.0. In this version a database program is included, Database Desktop, DBD. This program is a dBASE-look-a-like and does have nearly all its possibilities. The main difference between dBASE IV and DBD is that DBD very easily exports the data to the speadsheet program Quattro Pro, to make all the required graphs

2 THE PLYMOUTH DATABASE STRUCTURE

Several databases have been composed for this study. First of all, three databases containing information about the three most important charter types were made. These three charter types are period time charters, trip time charters and single voyage charters. Another database was composed, containing information about the vessels. This database contains information about 35 items of each vessel from, retrieved from the Clarkson Database. Analysis of this information is presented in **Part 2**.

2.1 Contract information

Charter party information is gathered by Plymouth Maritime Analysis LTD. This database contains nearly all fixture types from 1989 up to and including 1994. It contains several tens of thousands fixtures, divided in five groups:

* Tanker spot rates;
* Tanker period charter rates;
* Dry bulk single voyage rates;
* Dry bulk trip time charter rates;
* Dry bulk period charter rates.

The program which contains the information is called Plymouth Maritime Analysis Ltd. Fixtures database, shortly PMALF. It is a plain database program which can be used to select fixtures on one or more of the following characteristics:

* Month;
* Route;
* Charterer;
* Clean/Dirty (Tanker);
* Cargo Size;
* Vessel name.

The required category was Cargo Size. The definition of a panamax bulk carrier is: a bulk carrier which is just able to sail through the Panama Canal. These vessels are in the range of 50,000 - 76,000 DWT. All fixtures of the three charter types for the six years under consideration (1989-1994) comprised 15 files. With the database program, these files were converted into three files, one file for every charter type.

2.2 The fixture database structure

Each fixture consists of 15 or 16 fields, depending on the type of fixture. The sequence of individual fields within a given record is the same. The export files of the Plymouth database are described, for the three types separately. First a general description of charters is given for each type of charter .

Dry trip time charter records

A general definition of time charters according to Mr. M. Stopford:

> In a time charter the vessel is hired for a specified period of time for payment of a daily, monthly or annual fee.

A more precise definition of trip time charters:

> These vessels are chartered on the basis of a time charter for the period of a specific voyage and for the carriage of a specific cargo. The shipowner earns a lumpsum per day for the period determined by the voyage.

There are 16 fields in each record in the following order:

1.	Delivery port:	place where the charter starts
2.	Redelivery port:	place where the charter ends
3.	Vessel name:	the name of the vessel; changes of the name during the years have been taken into account, as the vessel are registered with their unique Clarkson code.
4.	Fuel consumption:	(if available) this information is not as reliable as in the Clarkson database, so it is not used.
5.	Year of build:	information about the year the vessel is built.
6.	Dates:	information about the commencing and cancelling dates of the charter.
7.	Charterer:	the company which is a party in the contract, operates the ship and pays the charter hire to the owner.
8.	Comments (if any):	additional information.
9.	Trip via location:	place where the vessel will sail along and/or stop for loading additional cargo.
10.	Vessel DWT:	information about the deadweight of the vessel; see also the Clarkson database.

11.	Charter rates $/day:	this is the price in U.S. dollars per day, which is due during the contract. It does not include bonuses and the like.
12.	Day of the month fixture reported:	the date ...
13.	Month fixture reported (1 - 12):	
		... and the month in which the fixture was reported.
		Numeric codes indicating the zone of (see Appendix A):
14.	Delivery:	numbered from 1 to 18 indicating the geographical sub-divised area where the vessel is deliverered to the charterer.
15.	Redelivery:	numbered from 1 to 18 indicating the geographical sub-divised areas where the vessels is redelivered from the charterer.
16.	Trip via:	numbered from 1 to 12 indicating the geographical sub-divised area where the vessel will proceed to for the loading of cargo.

Dry period charter records

Period charters are based on time charters. A definition of period charters according to Mr. M. Stopford:

> This type of charter the ship earns a daily hire, paid monthly or semi-monthly in advance. The shipowner retains possession and mans and operates the ship under instructions of the 'charterer' who pays voyage costs, inclusive of bunkers.

There are 16 fields in each record in the following order:

Points 1. to 8. and point 10. to 15. are the same as for trip time charters. The following changes are made for period charters:

9. Duration of charter, information about the length of the charter;

16. This field is not used.

Dry single voyage charter records

The last charter type to be discussed is the single voyage charter. The definition of single voyage charters according to Mr. M. Stopford:

In this type of charter the ship earns freight per ton of cargo transported on terms, set out in the charter party, which specifies the precise nature and volume of cargo, the port(s) of loading and discharge and the laytime and demurrage. All costs paid by the shipowner.

There are 15 fields in each record in the following order:

1.	Loading port:	port where the vessel is loaded.
2.	Discharging port:	port where the vessel is discharged.
3.	Vessel name:	the name of the vessel; changes of the name during the years of the database have been taken into account for as the vessel are recorded with their unique Clarkson code.
4.	Cargo description:	information about the type of cargo to be transported by the vessel under contract.
5.	Load/discharge terms:	detailed information about the terms of loading and discharging.
6.	Dates:	information about the starting dates of the charter.
7.	Charterer:	the company which is a party in the contract, operates the ship and pays the charter hire to the owner.
8.	Comments (if any):	additional information.
9.	Cargo type code:	letter indicating the type of cargo to be transported.
10.	Vessel DWT:	information about the deadweight of the vessel; see also the Clarkson database.
11.	Freight rates $/ton:	this is the price in U.S. dollars per ton cargo transported.
12.	Day of the month fixture reported:	the date ...
13.	Month fixture reported (1 - 12):	... and the month in which the fixture was reported.
		Numeric codes indicating the zone of:
14.	Origin:	numbers from 1 to 18 indicating the geographical sub-divised area where the vessel is deliverered to the charterer.
15.	Destination:	numbers from 1 to 12 indicating the geographical sub-divided area where the vessel will proceed to for the loading of cargo.

Since the information in the Plymouth Database is not complete, not all fields are used, especially those related to the ships' characteristics. This is the main reason for not using the ships' characteristics supplied by the Plymouth Database, but the Clarkson Database instead, as mentioned in paragraph 7.1

3 GENERAL CHARTER MARKET CHARACTERSITICS

This chapter discusses the information from the entire bulk carrier market in general and some specific items extracted from the Plymouth database.

3.1 Number of fixtures

For several fixtures the charter rate was not available. Those records have been removed. The number of fixtures, contained by each of the three files, are given in **Table I**.

Fixture type	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*Total*
Period	136	119	181	146	185	235	1,002
Trip	714	840	866	842	708	908	4,878
Voyage	603	720	526	733	587	436	3,605
Total	1,451	1,678	1,573	1,721	1,480	1,579	9,485

Table I: Annual number of fixtures

The total number of fixtures per year is determined, for each type of charter. As can be seen in **Figure 2** the smallest charter type is the dry period fixture type.

The years 1989, 1990 and 1992 were bad years for the period charters. The other years have been better and many long term contracts were concluded. 1994 started on a low level, but as the year proceeded, the rates increased and at the end of the year they were very high. The Baltic Freight Index had a maximum at the end of December 1994.

As shown in **Figure 2**, the more period fixtures were concluded, the less single voyage fixtures were concluded. In the figure the total amount of fixtures is given for the charter types together. This gives an idea of the accuracy of the Plymouth database.

ANNUAL NUMBER OF FIXTURES

Year	Period	Trip	Voyage	Total
1989	134	714	603	1451
1990	118	840	720	1678
1991	181	866	526	1573
1992	146	842	733	1721
1993	185	708	587	1480
1994	265	985	460	1710
Total :	1029	4955	3629	9613

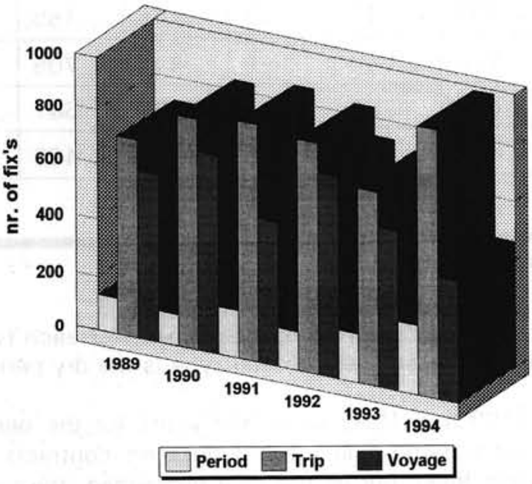


Figure 2: Annual number of fixtures

3.2 Average deadweight (DWT)

The monthly average deadweight of the chartered vessels in the panamax-range is shown in **Figure 3** . Deadweight has been defined as:

Deadweight (DWT) = Displacement - Weight of empty ship

The deadweight comprises the following weights:

* Cargo;
* Bunkers (Heavy fuel oil, diesel oil or gas oil);
* Lubrications oils;
* Fresh water;
* Food and stores for crew;
* Inventory.

The deadweight in the Plymouth database is based on the maximum deadweight of the vessel.

The above mentioned definition of the deadweight is valid for period and trip time charters. The deadweight of the single voyage charters is based on the amount of cargo to be loaded by the vessel (DWCT) and is therefore not a characteristic of the ship.

The period and trip time s both have the same monthly average, about 66,000 mton.

The average deadweight of the single voyage fixtures is usually around the 56,000 mton, but as explained before, this is the cargo size. Most cargoes are offered to the shipowners in this size. **Figure 3** shows that the sizes gradually increase since 1991. The average cargo size before 1991 was slightly less than 56,000 mton while after 1991 the average cargo size is nearly 57,000 mton.

The same figure shows that the average deadweight for the vessels which had a period or a trip time charter increases as well. From the yearly reviews from the larger shipbrokers this is evident, since the vessels are becoming larger. According to Barry Rogliano Salles, a Paris based shipbroker, the average deadweight of newly built panamax bulk carriers is moving to an average of more than 72,000 mton.

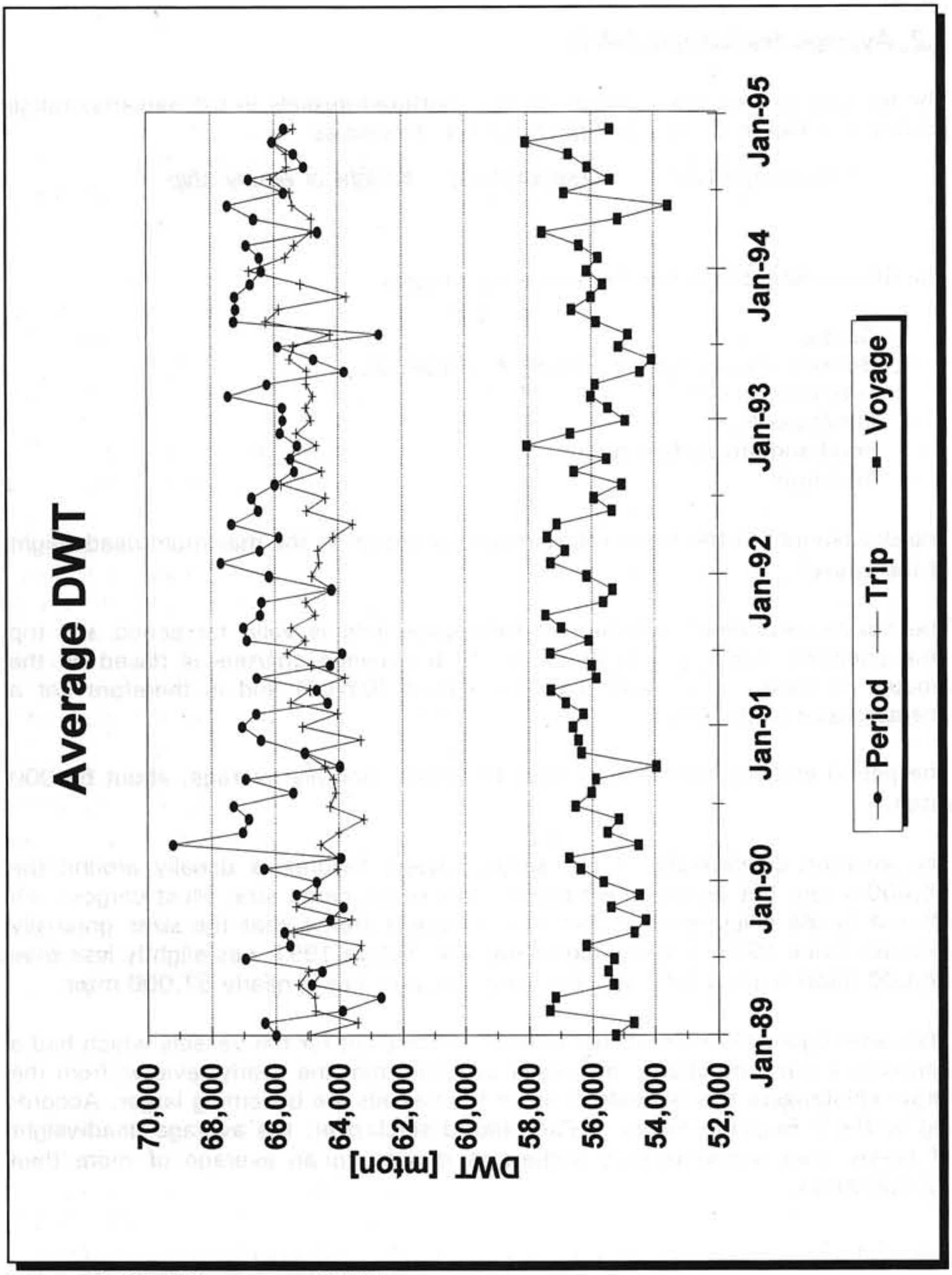


Figure 3: Monthly average DWT

3.3 Monthly average charter rate

According to **Figure 4**, charter rates of all three fixture types fluctuate, though time charters fluctuate more than voyage charters. The monthly average single voyage charters freight rates vary between nearly $12/ton and more than $20/ton. 1989, the first half of 1990, 1991 and 1993 were good periods to conclude a single voyage fixture contract. It was also a good period to conclude a fixture of another type.

The second half of 1990 and 1992 were very bad periods. The contract prices decreased by 50% in six months time. As can be seen in the diagram, a trip time charter was in the beginning of 1990 nearly $13,500/day, while in june 1990 the price had decreased to less than $8,000/day.

In the first half of 1993 many ships were chartered to transport ore and coal to China, a country which is turning from a closed, communist country into a market economy, which triggered a strong demand for ships.

In January 1994 the charter rates started to increase (**Figure 4**), and during September and October the Baltic Freight Index rised quickly, passing it's all time high on October 11 when it registered 1,788. Even then, the index increased as well as the charter rates. At the beginning of December 1994 the price for transporting heavy grain from the US Gulf to Japan was about $30.50 per ton, the capesize average rates were $19,514 per day while the handymax average charter rates were $15,550 per day.

The monthly average period time charters fluctuated over the period 1989-1994 from $7,000/day to $13,500/day while the monthly average trip time charters fluctuated from $7,500/day to $14,500/day. The absolute minima and maxima are given in **Table II**.
The absolute minimum rate of $2.80/mton stands for the transportation of iron ore, a commodity for which the prices are always low. The absolute maximum of $81.20/mton stands for a voyage from U.S. Gulf to Mozambique and transported maize for the world food programme.

3.4 Total DWT

The total DWT represents the summation of DWT of each fixture. As mentioned in paragraph 3.2 the DWT mentioned in the Plymouth Database is not the transported amount of cargo, for period and trip time charters, but the DWT of the ship. For single voyage fixture it is the amount of cargo transported.

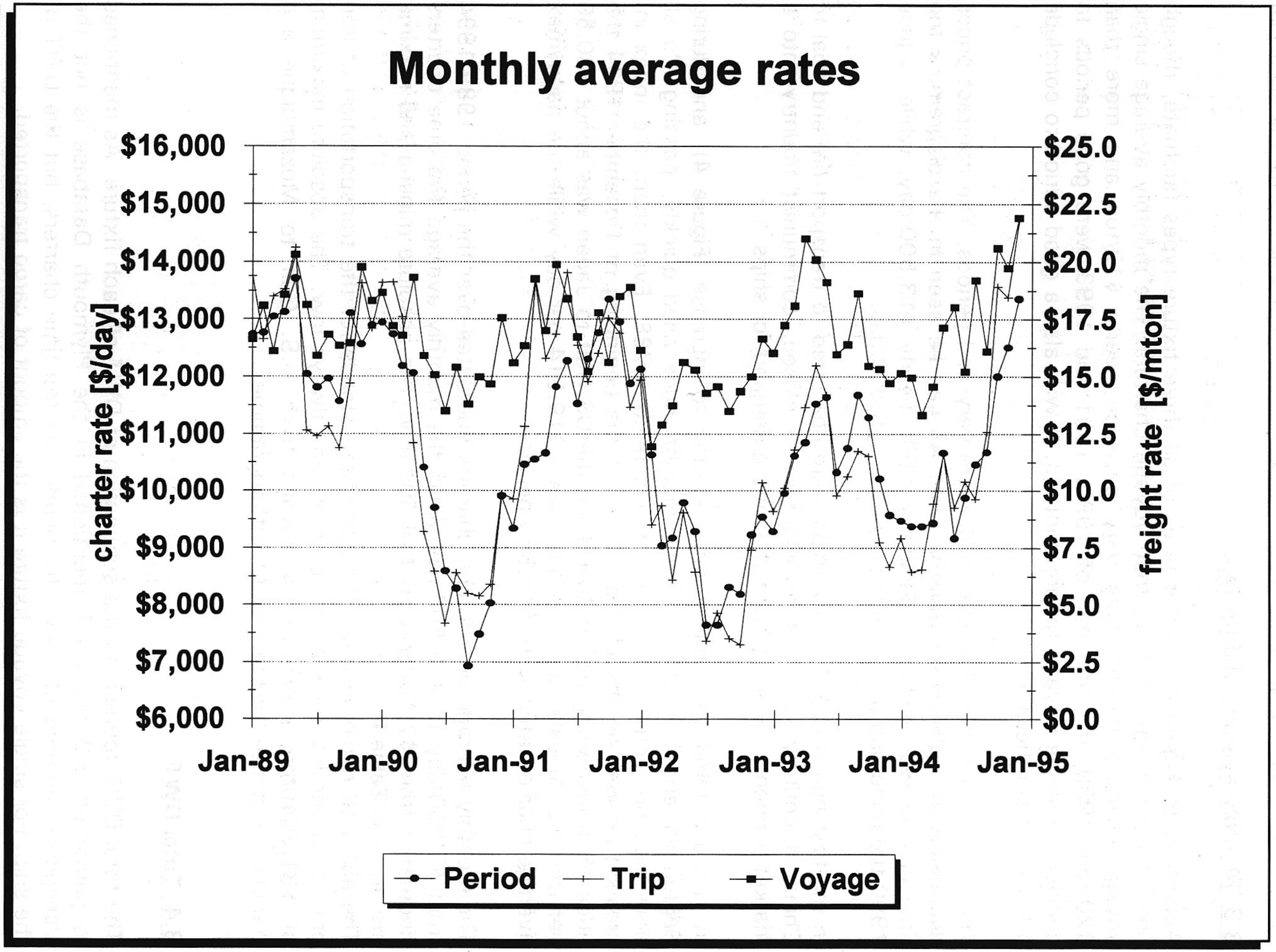


Figure 4: Monthly average charter rates

Fixture type	*absolute minimum*	*absolute maximum*	*monthly average minimum*	*monthly average maximum*
Period ($/day)	2,000	16,250	6,933	13,711
Trip ($/day)	3,850	19,000	7,301	14,246
Voyage ($/ton)	2.80	81.20	11.95	21.01

Table II: Maximum and minimum charter rates

Several conclusions can be drawn from **Figure 5**. The period charters make up only a small part of the business. The average, monthly chartered DWT is around 30,000,000 tons. The total DWT of the single voyage and the trip time charters together, is approximately 80,000,000 tons per month.

3.5 Turnover

The calculation of the annual turnover for the trip time fixtures, is rather difficult, since only the commencing and cancelling dates are given and not the duration of the charter. The comments of the Plymouth database contain more information about the trip, like whether a ballast bonus is given.

Using the geographical sub-division codes, it is possible to estimate the total number of sailing days. By taking the most important port for every part of the world and determining the distances between all these ports, the length of the trip can be calculated. Dividing the length of trip by the service speed, given in the fixture, gives an estimate of the number of sailing days.

$$\text{Days At Sea} = \frac{\text{Distance}_{\text{load port vs. discharge port}}}{24 * \text{Service Speed}}$$

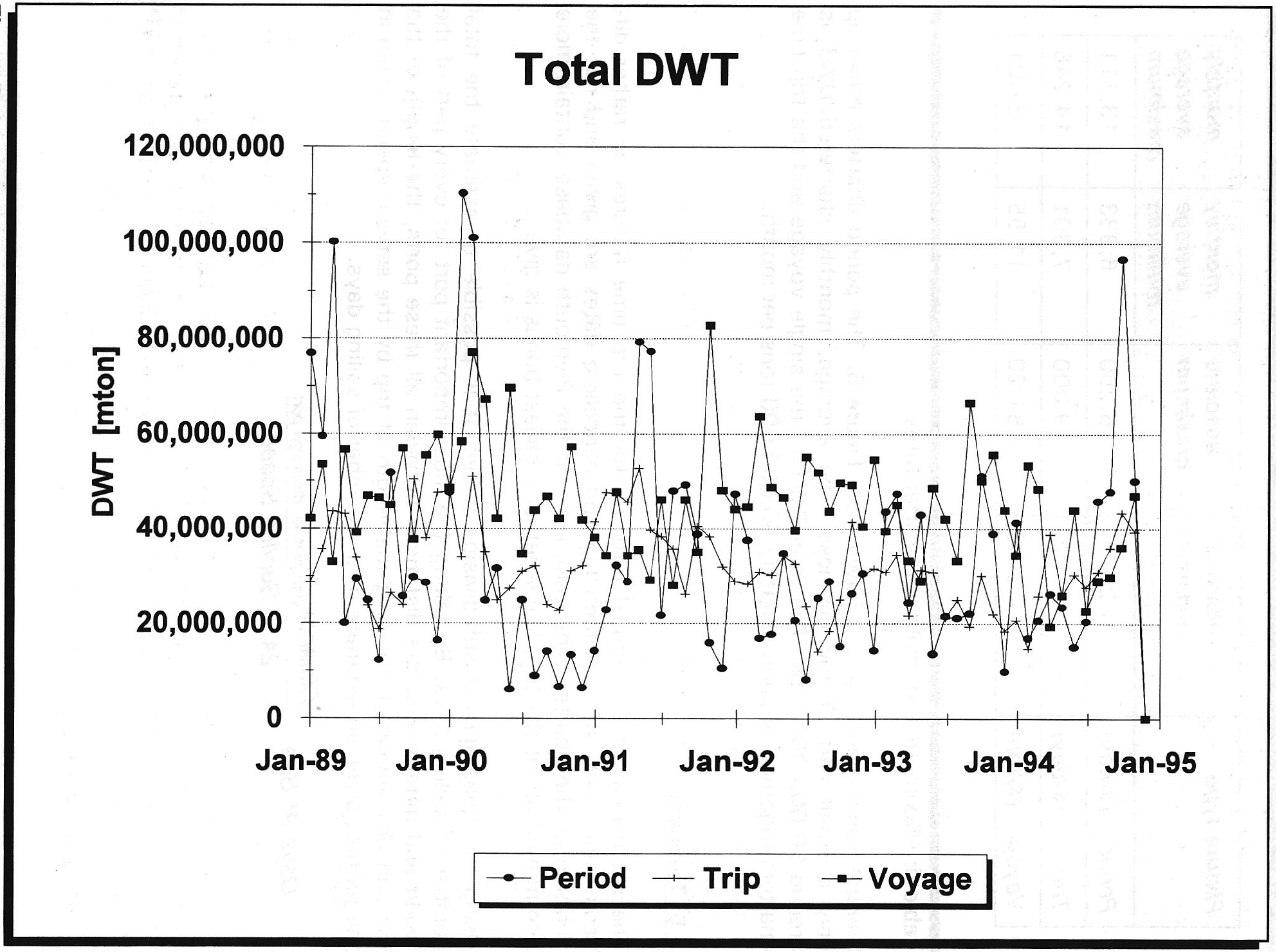


Figure 5: Monthly total transported DWT

Usually every charterer will increase the estimated number of days at sea with 5% for bad weather. The duration of the trip can be determined more accurate by increasing the number of days at sea, by the time used for loading and discharging the vessel. Take the DWT of the vessel and divide it by a general figure which represents the loading and discharging speed, in mtons/day.

$$\text{Loading Days} = \frac{DWT}{\text{Loading Speed}} * \frac{7}{5.5}$$

$$\text{Discharging Days} = \frac{DWT}{\text{Discharging Speed}} * \frac{7}{5.5}$$

The loading speed has been estimated on 15,000 mton per day and the discharging speed on 10,000 mton per day.

The duration of the trip can be determined as follows:

$$\text{Duration} = \text{Days At Sea} + \text{Loading Days} + \text{Ballast Bonus}$$

Then the turnover per trip time fixture can be determined by the following formula:

$$\text{Turnover}_{Trip} = \text{Duration} * 30 * \text{Charter Rate} + \text{Ballast Bonus}$$

The annual turnover of the trip time charters is the summation of the turnover of the seperate fixtures.

$$\text{Annual Turnover}_{Trip} = \sum \text{Turnover}_i$$

i = 1..n fixtures per year

The calculation the annual turnover of the single voyage fixtures is simple. The amount of cargo shipped per fixture (DWCT) and the charter rates are known, so the turnover can be calculated. The loading and discharging terms do not have to been taken into account.

$$\text{Annual Turnover}_{Voy} = \sum (\text{freight rate})_i * DWCT_i$$

i = 1..n fixtures per year

The calculation of the period time charters is not difficult as well. It is calculated in the following way:

$$\textit{Annual Turnover}_{Per} = \sum (\textit{Charter Rate})_i * 30 * \textit{Duration}_i$$

i = 1..n fixtures per year

The multiplication factor 30 stands for the number of days in each month, since the duration is stated in months.

These numbers are graphically represented in **Figure 6**. This figure shows that the annual turnover of the period charters is relatively large compared to that of the single voyage charters, especially if it is compared with the number of fixtures for each fixture type.

ANNUAL TURNOVER

Year	Period	Trip	Voyage	Total
1989	$475,885,500	$414,321,872	$572,866,785	$1,463,074,157
1990	$396,756,000	$394,570,387	$629,823,803	$1,421,150,190
1991	$439,336,500	$486,280,873	$505,384,275	$1,431,001,648
1992	$310,283,700	$339,118,002	$577,606,980	$1,227,008,682
1993	$351,850,500	$318,177,610	$541,869,295	$1,211,897,405
1994	$461,623,575	$334,250,173	$420,115,077	$1,215,988,825
Total :	$2,435,735,775	$2,286,718,917	$3,247,666,215	$7,970,120,907

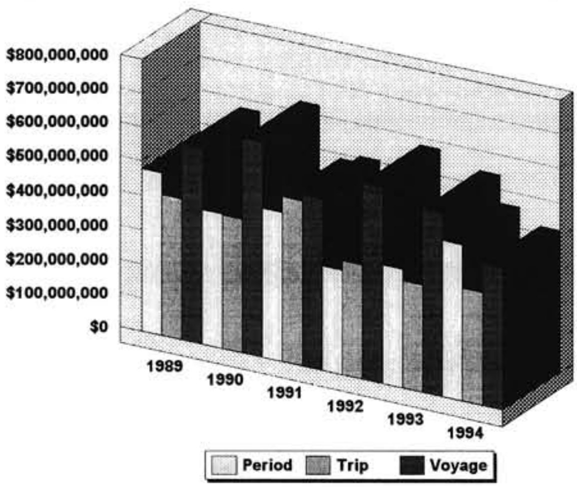


Figure 6: Annual turnover of the three fixture types

4 PERIOD TIME CHARTER MARKET CHARACTERISTICS

Before a comparison can be made between the three fixture types, first the characteristics of each fixture type separately, needs to be known. The characteristics of all three fixture types are given in paragraph 2.2. These items will be discussed briefly. **Chapter 4** discusses the period fixtures, **Chapter 5** the trip time fixtures and **Chapter 6** the characteristics of single voyage fixtures.

4.1 Delivery/redelivery port/place

The ports where the vessels are delivered, is of no use for this analysis. Usually there is a company that needs a vessel for a certain period. The company calls a shipbroker who knows which vessels are available or will be available soon. The shipbroker obtains a rate for every vessel and usually the vessel with the lowest rate is chartered. It is possible that the vessel is already close to the port where the cargo is located, otherwise, the shipowner will ask for a ballast bonus. A ballast bonus is a compensation for the costs the owner makes to sail from the last discharging port to the loading port of the new charter.

When the charter-deal is concluded, the redelivery port is usually not known. Since on every fixture a redelivery port has to be stated, usually an area is given. For example the Skaw-Cape Passero range, this means that the vessel will be redelivered somewhere between Denmark and Italy.

The items 'Vessel names', 'Fuel consumption', 'Flag' and 'Year of build' do not give any additional information.

4.2 Forward chartering

The date on which the fixture was reported is registered in the Plymouth database by two numbers. The first one indicating the day of the month and the second one indicating the month of the year. The date gives information on when the charter starts. This can be prompt, or a month or a specific date is given. This is known as early positioning or forward chartering. According to Plymouth many long term contracts are not put into their database.

Figure 7 shows the number of days the charter was reported before the charter was supposed the start. Negative values are possible because several ships were recorded after the day of publication of the fixture.

4.3 Charterers

It may be worthwile to see if there are any charterers who systematically pay higher charter rates. This will be carried out after the index has been determined (see **Chapter 13**).

For all three fixture types the 10 major charterers have been identified. They are shown in paragraph 6.5.

The item 'Comments' in the Plymouth Database will not be discussed, because of the very large numbers of different comments given by Plymouth.

4.4 Duration of the charter

The Plymouth database usually gives the duration like: 2-4 months trading. So a minimum and a maximum is given. Only the minimum duration is used, since this is the shortest period the vessel will be chartered.

For every year the average duration of the charters is determined, see **Figure 8**. It is obvious that the average length of the charters is steadily decreasing since 1990. In 1990 the average was 10.1 months, three years later it was 5.9 months.

The duration is usually given in months but for short period charters it is given in days rather than parts of the month. The shortest duration is 10 days and the longest duration is 120 months trading.

The number of fixtures in 1990 is rather low compared to other years. This could be caused by low charter rates. The first months of 1990 many period fixtures were closed at a reasonable charter rate, see paragraph 4.5. Six months later the charter rates collapsed from about $13,000/day to about $5,000/day. So many shipowners tried to get a period charter to get 'over' this period. This is what actually happened early 1991.

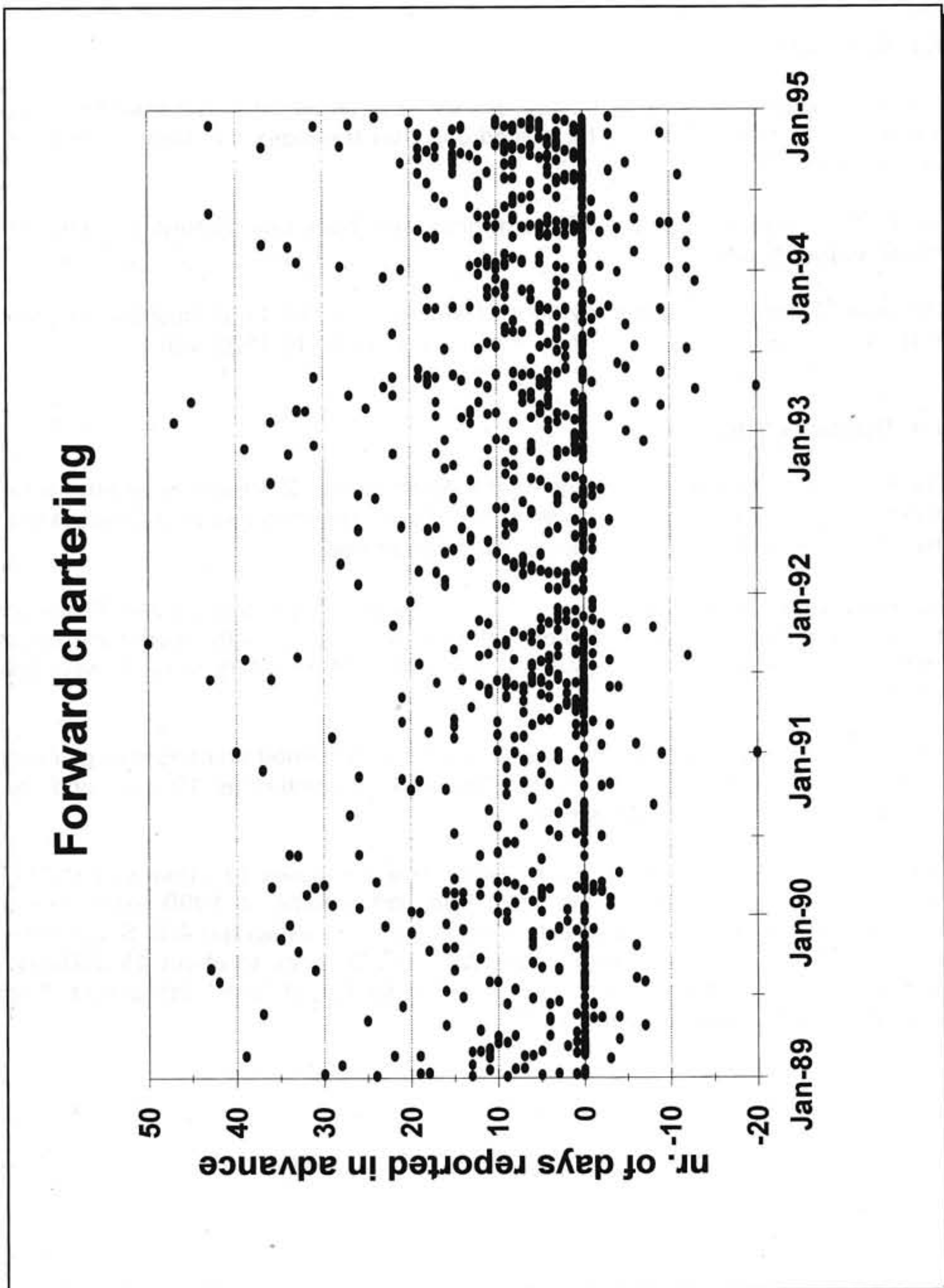


Figure 7: Forward chartering of period time fixtures

Average Duration

Year	Nr. of vessels	Average duration	min duration	max duration
1989	134	9.5	1.0	60.0
1990	118	10.1	1.0	120.0
1991	181	6.9	1.0	60.0
1992	146	7.2	0.8	60.0
1993	185	5.9	0.3	36.0
1994	265	5.3	1.0	24.0

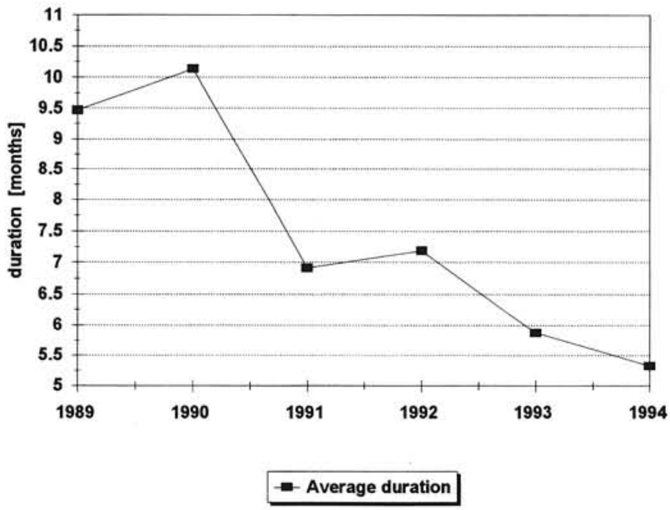


Figure 8: Average duration of period time fixtures

In 1994 many period time fixtures were concluded with the lowest average duration. The reason is that the rates increased early 1994 and the owners forecasted even higher charter rates for later that year.

The periods are also put into 'months groups'. For every group, the number of fixtures, the average charter rate and the turnover have been calculated. This is shown in **Figure 9**.

Most period charter fixtures are concluded for the duration of 3, 4 or 5 months. However the largest turnover is made with a duration of 12, 13 or 14 months. This group comprises 50% of the fixtures of the above mentioned group, but their turnover is twice as high.

4.5 Charter rates

This is the most exploratory field of all. In **Part 3** charter rates will be related to to ships' characteristics. Now only the charter rates of all fixtures are given in a scatter diagram.

As shown in **Figure 10** it is clear that there is a cycle in the charter rates due to supply and demand of ships. The second half of 1990 as well as the second half of 1992 were bad periods to charter out a vessel for a long period. These cycles occured because of the related business cycle in the economy.

Number of fixtures

Month group	Nr. fixtures	Average Rate	Turnover	Average Duration
< 3	147	$10,746	$90,305,700	1.9
3-6	490	$10,905	$551,545,500	3.4
6-9	88	$11,022	$189,856,875	6.5
9-12	41	$11,299	$142,923,750	10.3
12-15	203	$11,057	$808,665,000	12.0
15-18	3	$12,167	$17,527,500	16.0
>18	57	$11,366	$629,178,000	31.9
	1029	***Total turnover =***	$2,430,002,325	

Month groups go from the first number up to the last number,
i.e. 3-6 means from 3 months to 5.99 months and 6-9 means

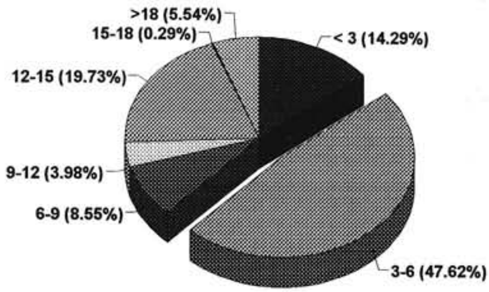


Figure 9: Number of fixtures of each month-group

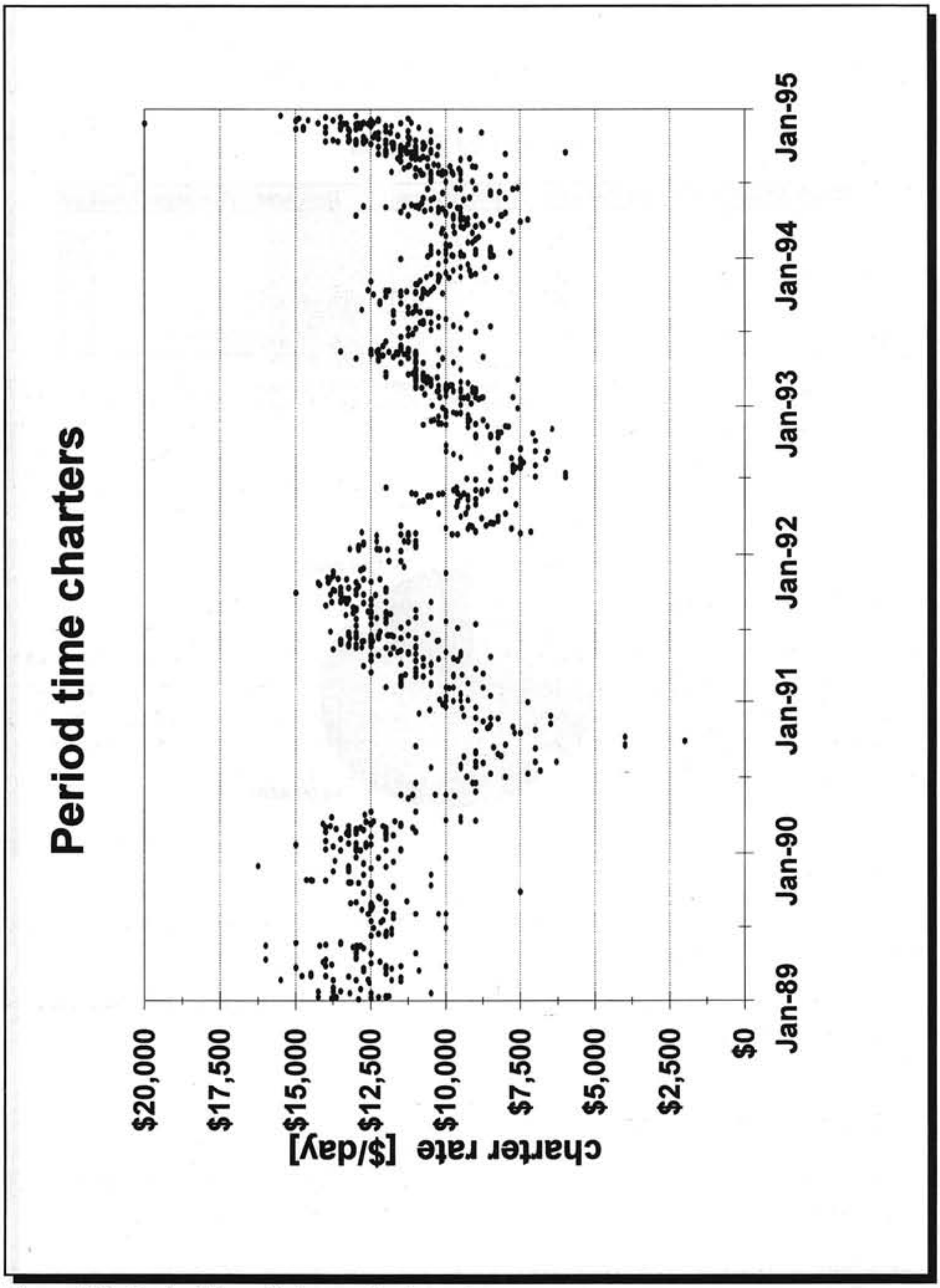


Figure 10: Period time fixture, charter rates

5 TRIP TIME CHARTER MARKET CHARACTERISTICS

This chapter discusses trip time fixtures, the following chapter discusses the single voyage fixtures.

5.1 Delivery/redelivery port and via location

For this charter type the same priciples as for period time charters apply.

The information about the 'Via location' does not give any additional information either, since in the Plymouth database it is not stated whether the ship loads or discharges in the port mentioned in 'via location'. Sometimes the vessels will call in more than one port than mentioned in 'via location'. This item will only be used to estimate the turnover of the charter.

5.2 Forward chartering

Figure 11 shows the number of days a charter is reported to the open market, before the real trip takes place. It shows that there is no big difference between those dates. The maximum number of days that the trip takes place after it is reported, is 60 days or two months. This type of charter, trip time charter, is also known as spot charter. The ships are available on the spot.

5.3 Charterers

The 10 major charterers have been located for all three fixture types. They are shown in paragraph 6.5.

The item 'Comments' will not be discussed, because of the very large number of items given by Plymouth.

5.4 Duration of the charter

The duration of the charter can only be estimated. It was done by calculating three items:

* The sailing distance from the loading port to the discharging port;

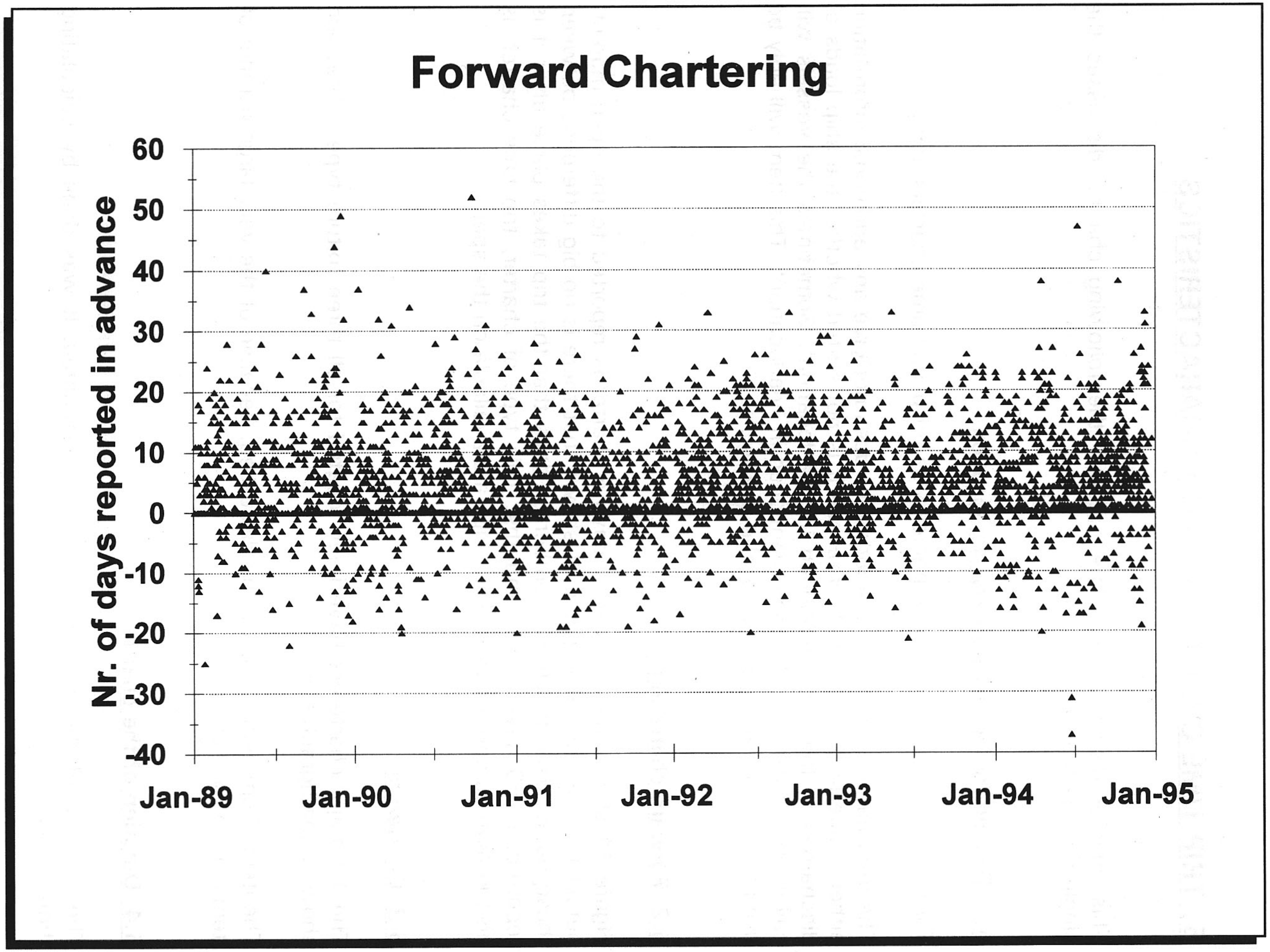


Figure 11: Forward chartering of trip time fixtures

* The loading time;
* The discharging time.

Since the loading/discharging speed is unknown, a constant speed has been assumed. Loading speed is 15,000 mton per day and discharging speed 10,000 mton per day. These figures are rather high and many ports will not be able to reach these speeds, so the calculated loading and discharging days may be too low.

5.5 Charter rates

In **Part 3** charter rates will be related to ships' characteristics. At this time the charter rates of all fixtures are given in a scatter diagram.

As with the period time fixtures there is, some kind of cycle in the charter rates. Exactly the same occurs with the trip time fixtures, see **Figure 12**.

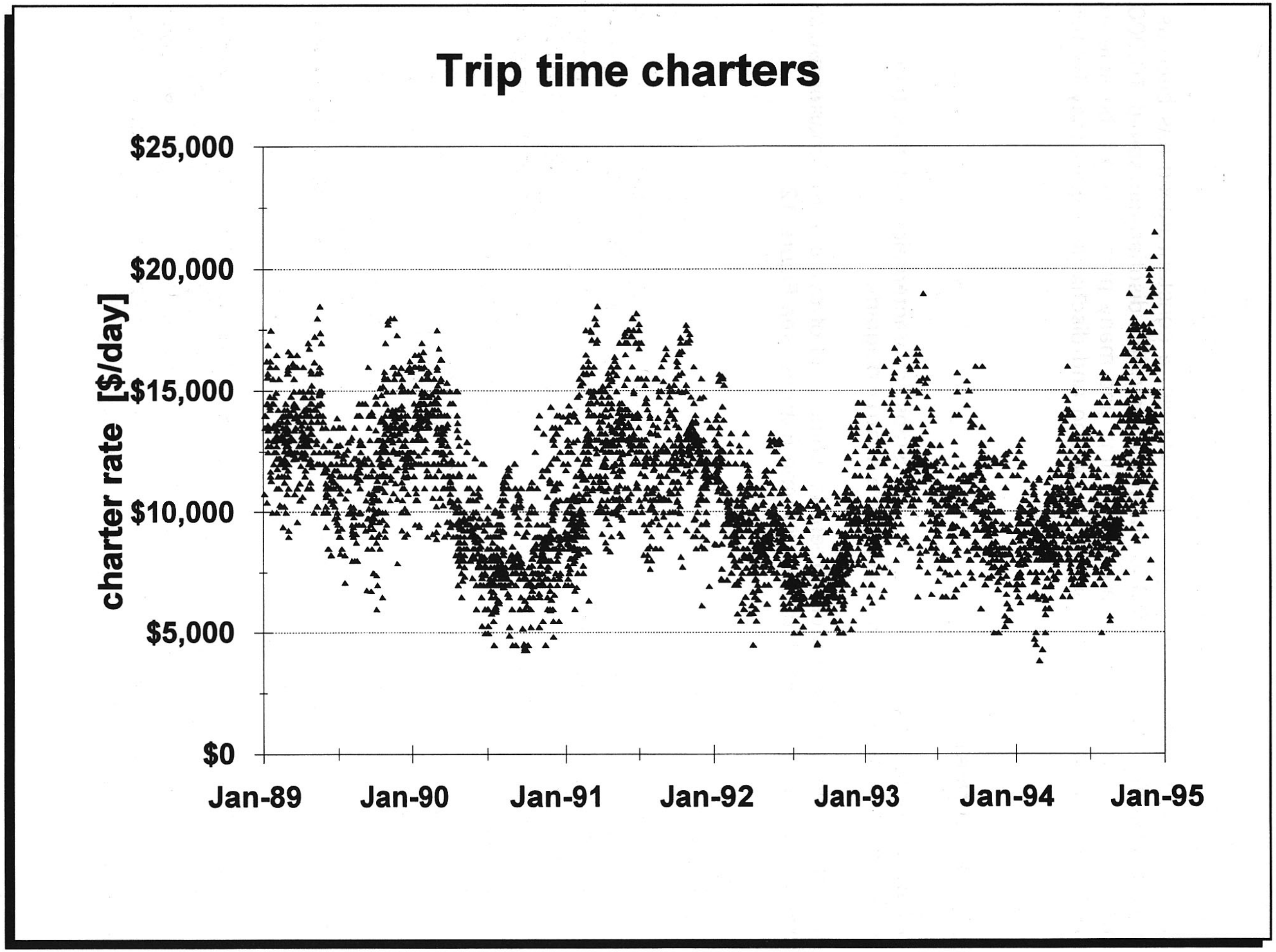


Figure 12: Trip time fixtures, charter rates

6 SINGLE VOYAGE CHARTER MARKET CHARACTERISTICS

This chapter discusses the characteristics of the single voyage fixtures.

Instead of trip time fixtures, single voyage fixtures give some information about the sailing distances. According to the definition of single voyage charters (Mr. M. Stopford):

> In this type of charter the ship earns freight per ton of cargo transported on terms set out in the charter party, which specify the precise nature and volume of cargo, the port(s) of loading and discharge and the laytime and demurrage. All costs paid by the shipowner.

So the charter party identifies exactly *where* the vessel will be loaded, *which* type of cargo and *where* it will be discharged.

6.1 Loading and discharging port

The first two fields of a record in the Plymouth database concern the loading and the discharging port. But since it is too complex to determine all distances between two ports (there are 4000 records with at least 1000 different loading and discharging ports), the last two fields of the record were used. Plymouth has already determined in which world part the port is situated by using a numeric code for every major part of the world, according to:

Numeric codes indicating the zone of (see **Appendix A**):

14 origin:	number from 1 to 18 indicating the geographical sub-divised area where the vessel is deliverered to the charterer;
15 destination:	number from 1 to 12 indicating the geographical sub-divised area where the vessel will sail along.

For example, origin code 3 concerns all ports in the area from Maine to Miami, Florida, U.S.A. and discharging code 11 concerns all ports in Africa. All area codes are given in **Appendix A**. Plymouth has plotted 18 major parts of world for the loading ports and 12 major parts for the discharging ports. For our convenience the areas are grouped in the following areas:

* NA North America
* SA South America
* EU Europe (North and South)
* AF Africa (North, Southern and West)
* ME Mid East
* AU Australia (and New Zealand)
* AS Asia (Far East, including Japan, Korea and Taiwan)
* O Other. At the time of distribution of the database, sometimes not all information is available or a vessel is making a transatlantic journey. These are put into this group.

Figure 13 shows that most single voyage fixtures collected by Plymouth, concern a port in North America. Here many vessels load grain or iron ore. This can be deduced from **Figure 14** which shows the average freight rates, paid per ton cargo. The number of North America is systematically higher then those of all other continents. The total amount of transported cargo from Northern America is more than three times as high for all the other continents together, as can be seen in the **Figure 15**. The total turnover, see **Figure 16**, is much higher as well.

The same figures are shown for the discharging ports. **Figure 17** shows that there are two major discharging areas. Asia (Japan) has the largest intake and Europe is a good second best. The Mid East also needs to import lots of dry bulk commodities. Europe and Japan both are not able to grow all their required grain, and do not have enough cokes and ore. Therefore they have to import it from other parts of the world.

Figure 18 shows that the cargo for Europe has a much lower average freight rate ($10-13/ton) than for the Mid East ($17-22/ton) and Asia ($18-22/ton). This is related to the cargo-mix and transport distance.

Figure 19 shows the total transported tonnage. It shows very clearly that Asia and Europe are the two largest import regions of the world.

Figure 20 shows the annual turnover of single voyage charters. For calculation of the turnover, the number of fixtures, the DWCT and the freight rates, are multiplied. Since the number of fixtures and the average freight rates to Asia are both high, it is obvious that the annual turnover will be large as well. **Figure 20** shows that the annual turnover of fixtures to Asia is twice as high as of the fixtures to Europe.

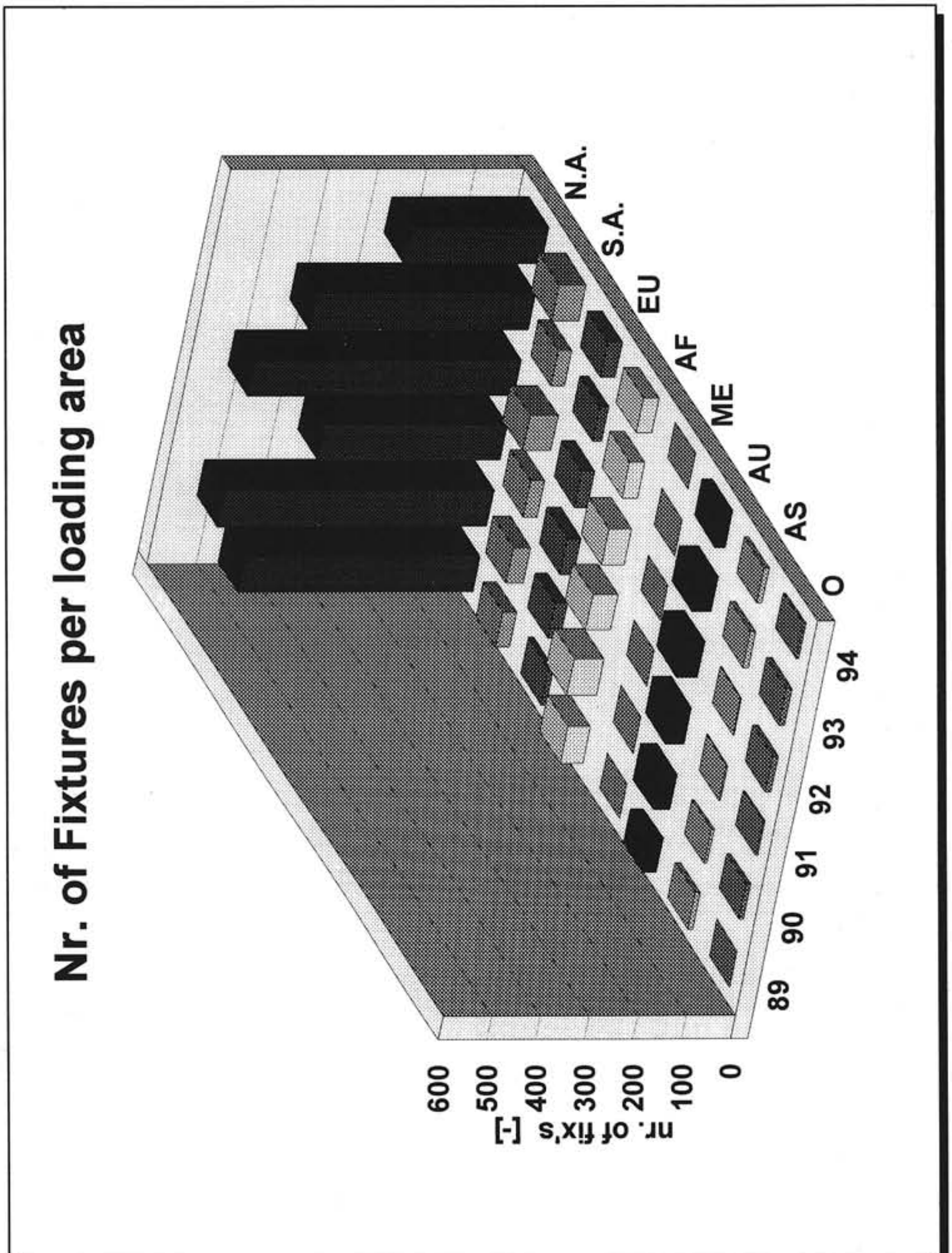


Figure 13: Number of single voyage fixtures from port of origin

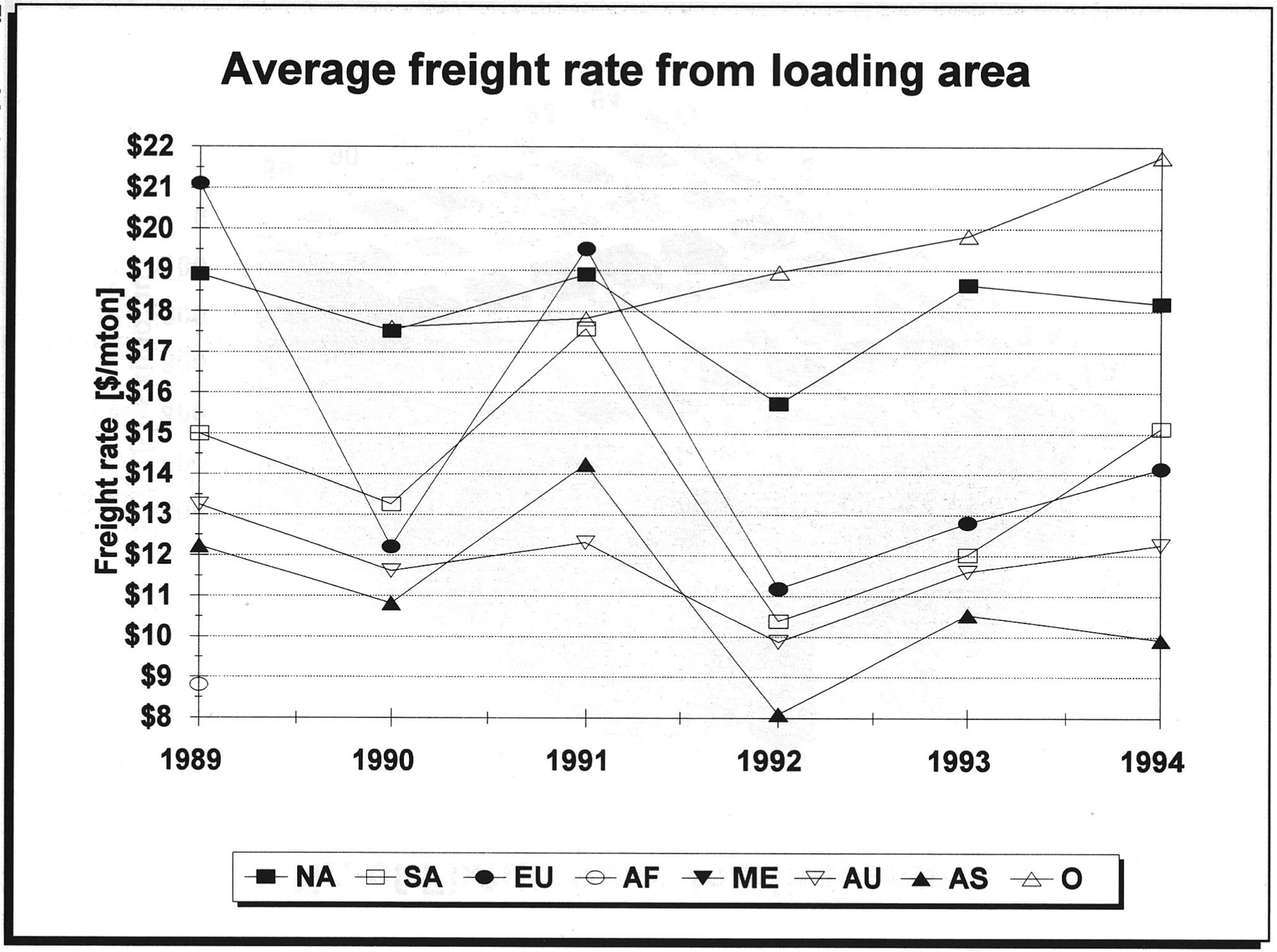


Figure 14: Average freight rates from port of origin

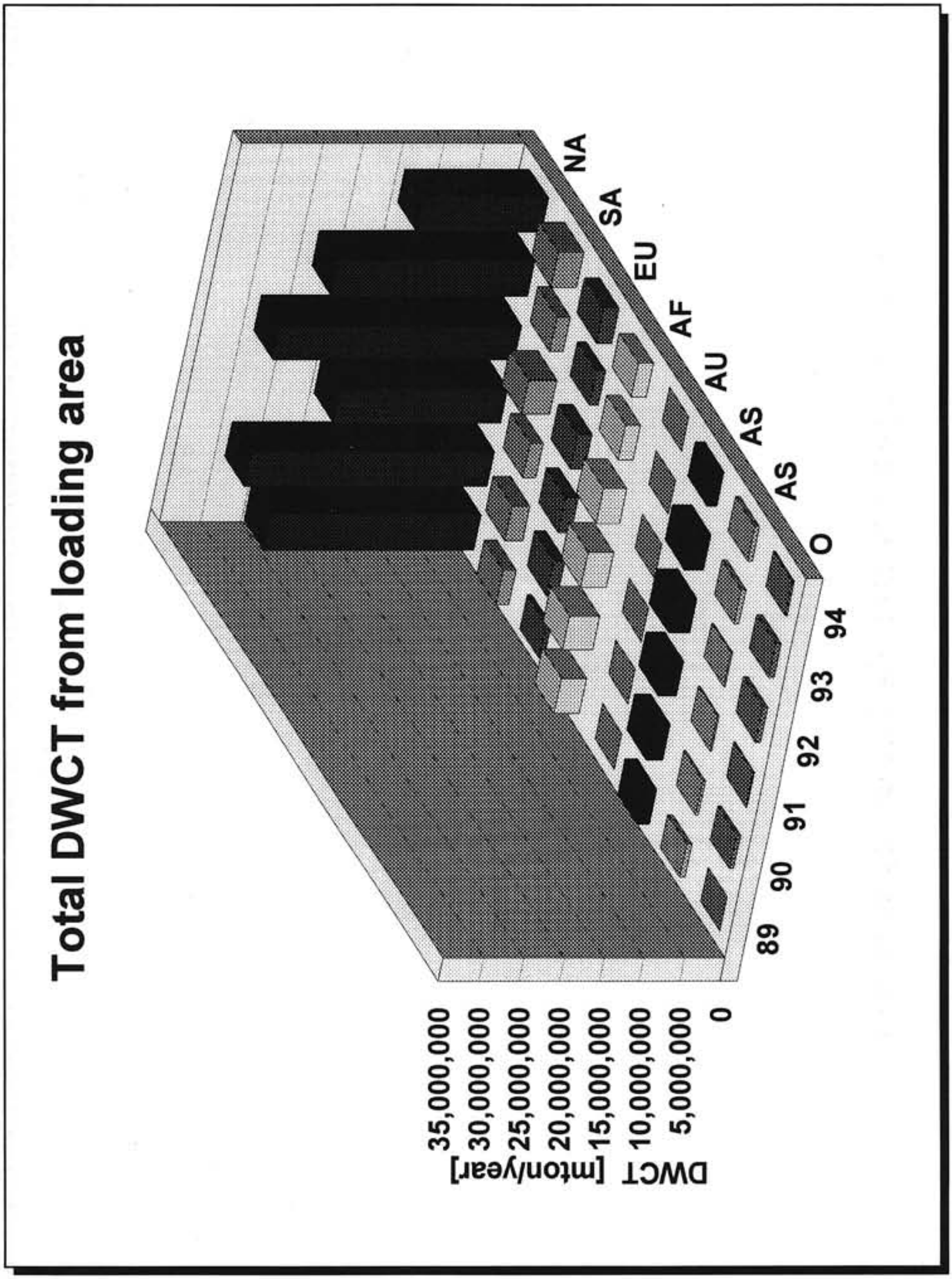


Figure 15: Total DWCT from loading area

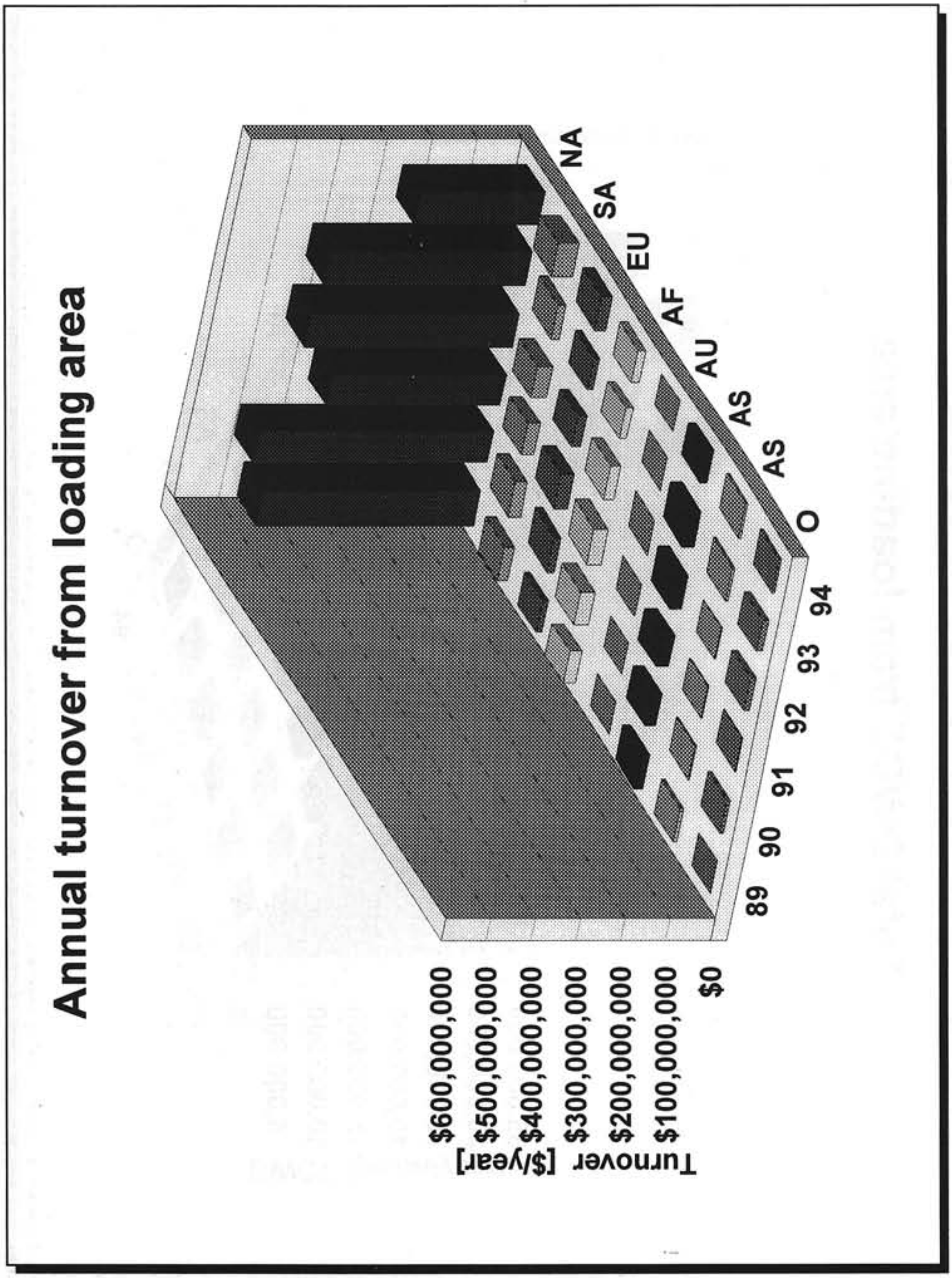


Figure 16: Annual turnover from loading area

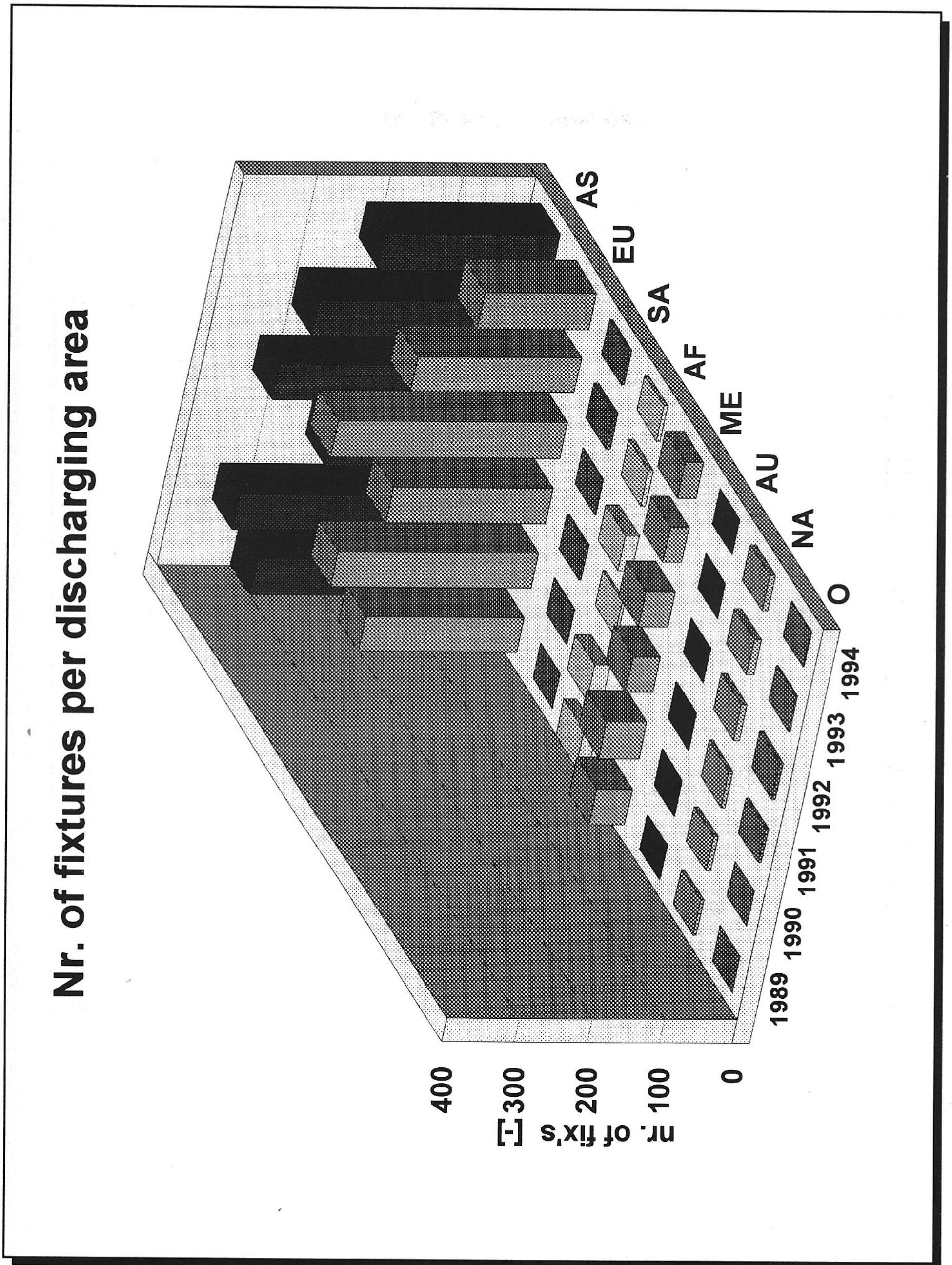


Figure 17: Number of fixtures per discharging area

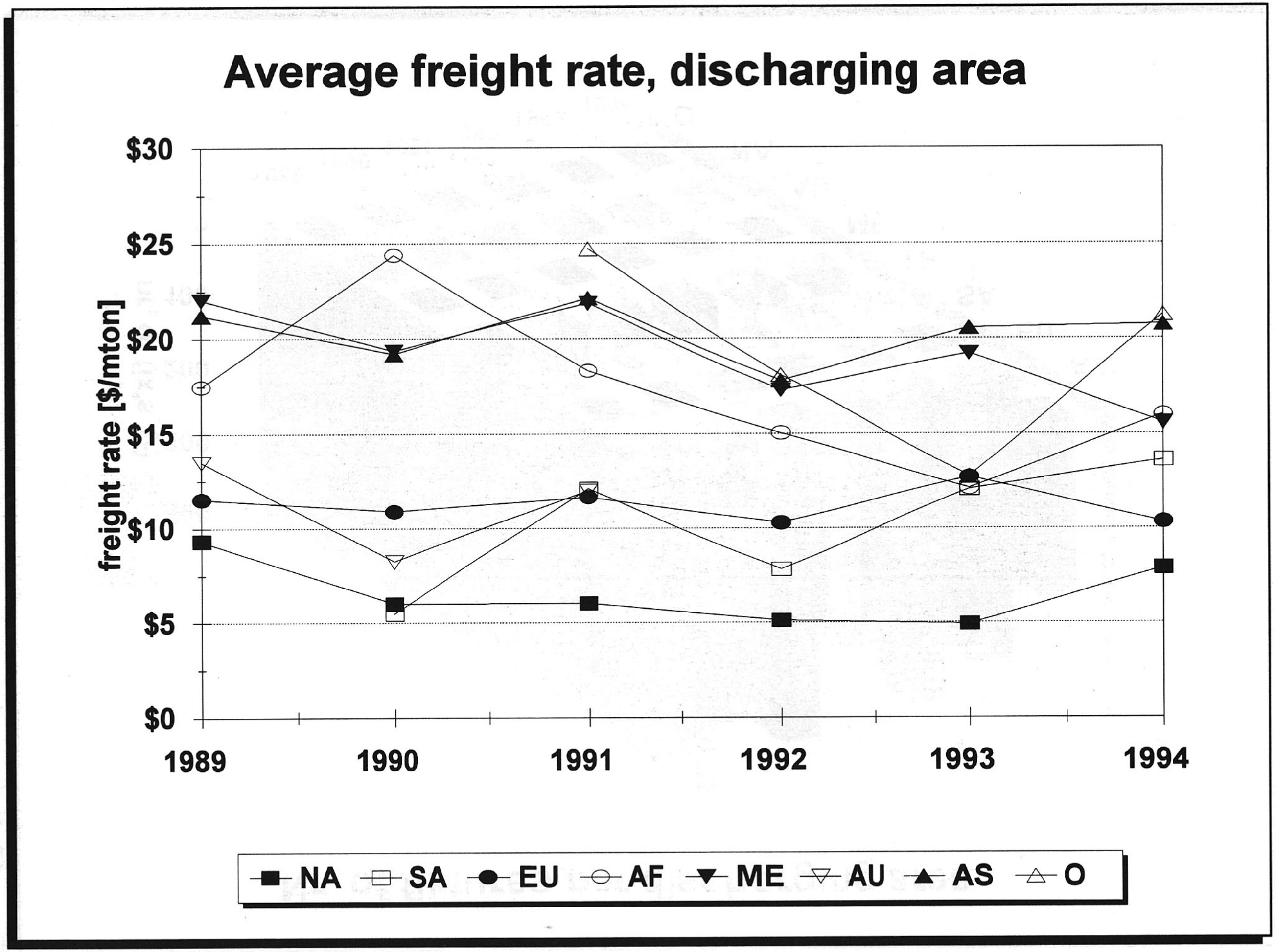


Figure 18: Aerage freigh rates for each discharging area

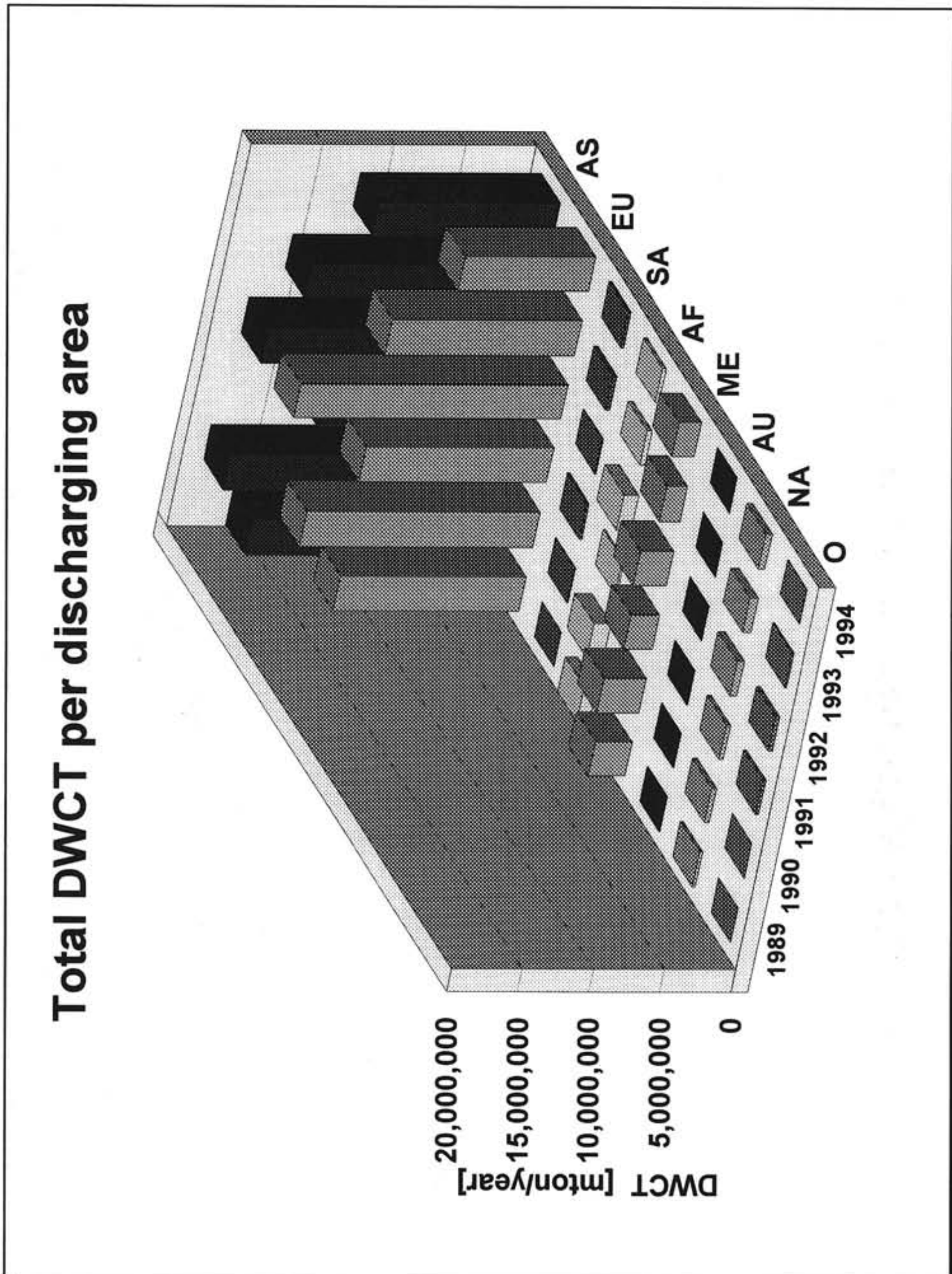


Figure 19: Total DWCT per discharging area

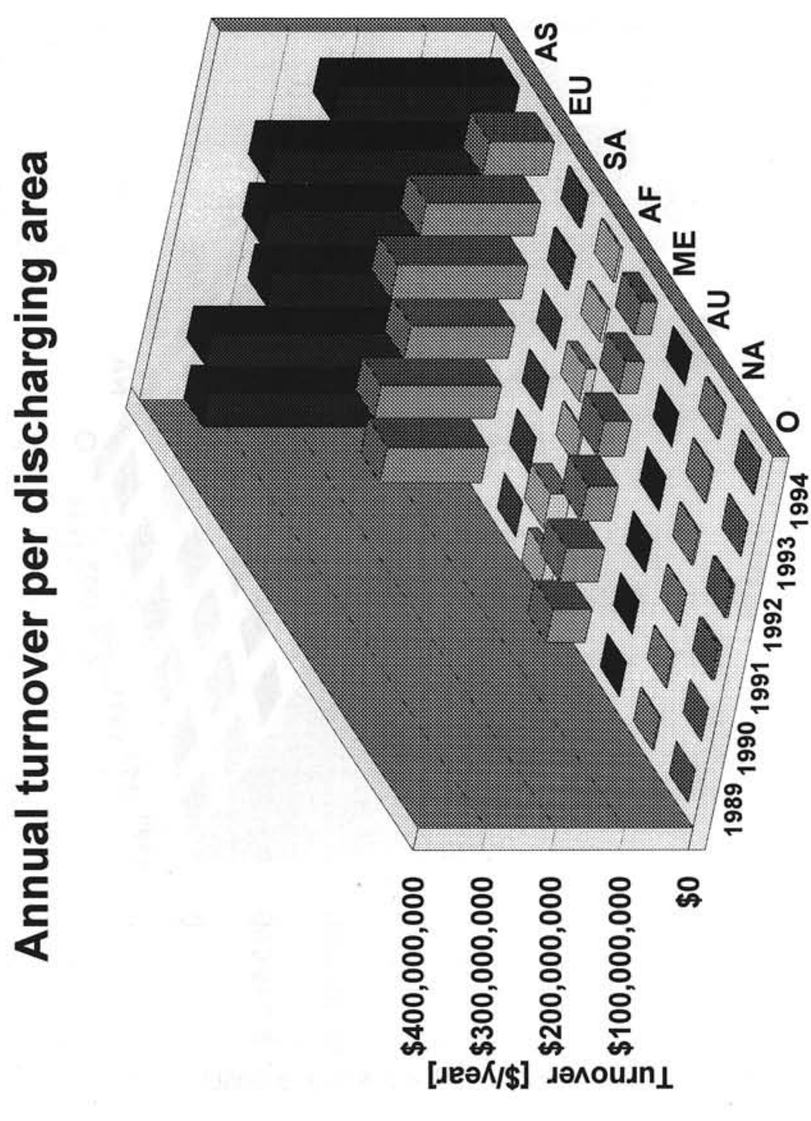


Figure 20: Annual turnover per discharging area

6.2 Cargo description

Since for every single voyage charter, the volume and type of cargo has to be stated in the charter party, Plymouth enters this information into the database as well. The volume is put into the field DWT, but this is incorrect as stated in paragraph 3.2.

The type of cargo is stated in the cargo description and in the cargo code. In the cargo description the cargo composition is described, while this is abbreviated in the cargo code. The next codes are applicable (in **Appendix B**) for each cargo type a full description is given:

* G Grain;
* S Sugar;
* C Coal;
* F Fertilizers;
* O Ores;
* M Miscellaneous.

Figure 21 shows that most single voyage fixtures, collected by Plymouth, are for grain-transport. The second most transported commodity, is coal and the third one is ore. Fertilizers or others are rarely transported by panamax bulk carriers. These commodities are probably transported by smaller vessels, while most ore is probably transported by larger vessels. There are hardly any fixtures for sugar and therefore this cargo type has been left out of the following analysis.

Figure 22 shows that the average freight rate for grain is systematically higher than those of the other large commodities. Fertilizer is more expensive to transport though it is not necessary that these figures represent the market average, since so few fixtures are reported.

Figure 23 shows that the total turnover of grain-transport is relatively higher than the other commodities. This is obvious, since the amount and the freight rate are higher than for the other commodities.

Figure 24 shows that most commodities have standard cargo sizes for panamax bulk carriers. This size depends on the stowage factor of the particular cargoes. The standard cargo size for grain is about 52,500 tons; 50,000 tons plus 5% extra. The stowage factor for grain is 45-50 cuft./ton, so the vessel needs, on the average, a grain capacity of about 2,250,000-2,625,000 cuft.. The average

Number of Fixtures per cargo type

Year	Grain	Coal	Ores	Fertilisers	Sugar	Miscellaneous
1989	392	125	61	7	0	18
1990	449	183	80	6	0	2
1991	315	153	54	2	0	2
1992	499	152	71	4	0	7
1993	401	104	54	20	0	8
1994	283	94	29	22	0	7

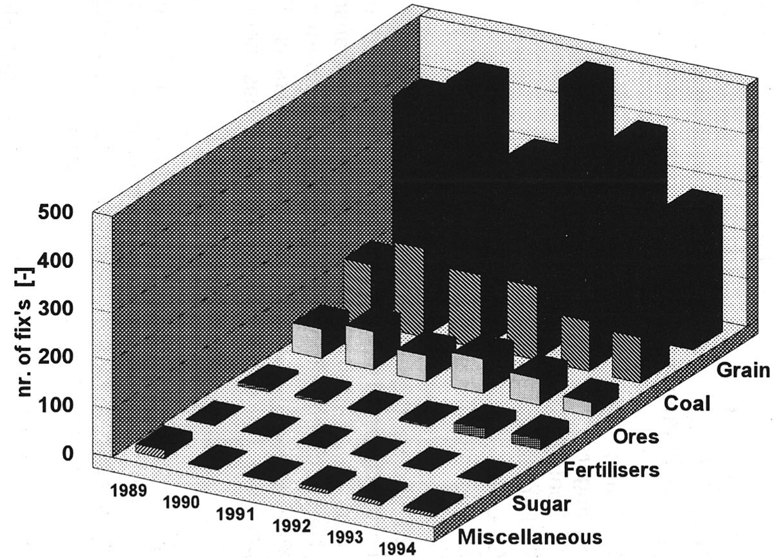


Figure 21: Number of fixtures per cargo type

Average Freight Rate per cargo type

Year	Grain	Coal	Ores	Fertilisers	Miscellaneous
1989	$20.48	$12.63	$8.43	$26.59	$17.12
1990	$19.03	$12.10	$8.22	$19.94	$8.33
1991	$21.52	$12.25	$8.84	$30.63	$11.65
1992	$16.81	$9.45	$7.35	$17.65	$10.71
1993	$19.72	$10.37	$8.06	$22.55	$14.88
1994	$19.20	$10.30	$7.74	$20.92	$8.86

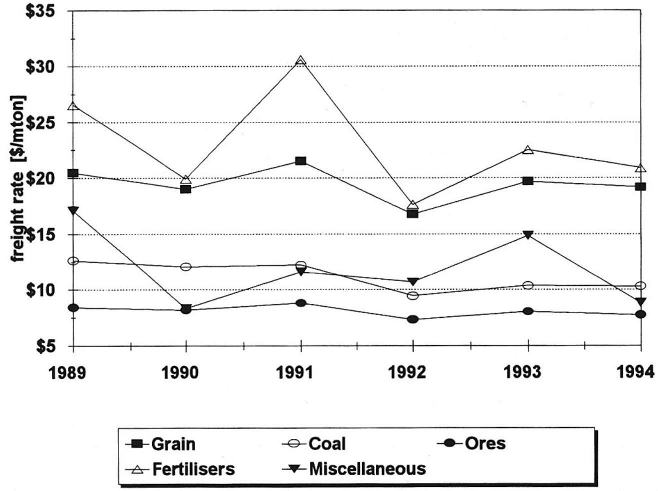


Figure 22: Average freight rate per cargo type

Total Turnover per cargo type

Year	Grain	Coal	Ores	Fertilisers	Miscellaneous
1989	$420,092,160	$93,914,525	$32,863,350	$9,336,000	$16,660,750
1990	$451,759,803	$129,834,550	$41,102,900	$6,169,550	$957,000
1991	$358,470,075	$112,341,550	$30,025,750	$3,149,500	$1,397,400
1992	$450,850,080	$86,352,300	$32,814,200	$3,647,900	$3,942,500
1993	$421,553,445	$65,227,550	$25,419,950	$23,212,300	$6,456,050
1994	$291,599,541	$57,798,880	$13,739,000	$23,841,750	$3,561,600

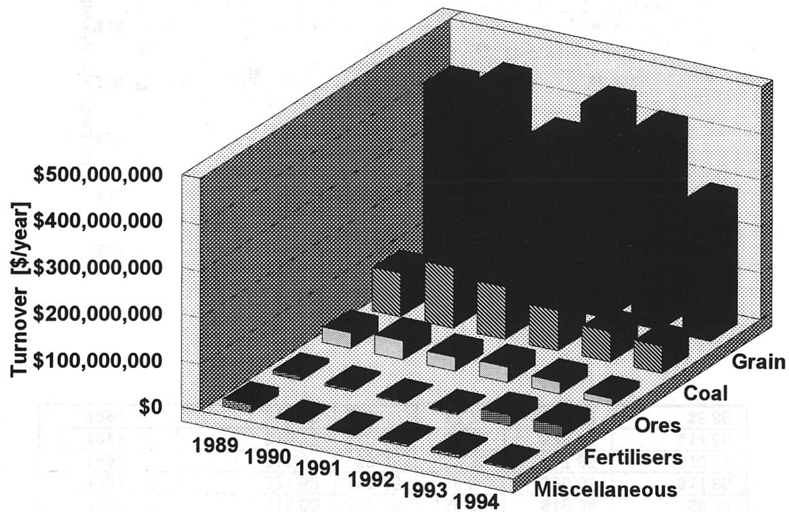


Figure 23: Turnover per cargo type

Total DWCT per cargo type

Year	Grain	Coal	Ores	Fertilisers	Miscellaneous
1989	20,591,263	7,560,500	3,936,500	352,000	971,500
1990	23,767,845	10,894,700	5,055,000	308,500	115,000
1991	16,743,500	9,290,500	3,426,000	103,000	120,000
1992	27,035,250	9,274,500	4,525,500	209,000	369,000
1993	21,496,567	6,403,500	3,200,000	1,028,000	433,500
1994	15,374,893	5,669,000	1,789,000	1,155,000	409,000

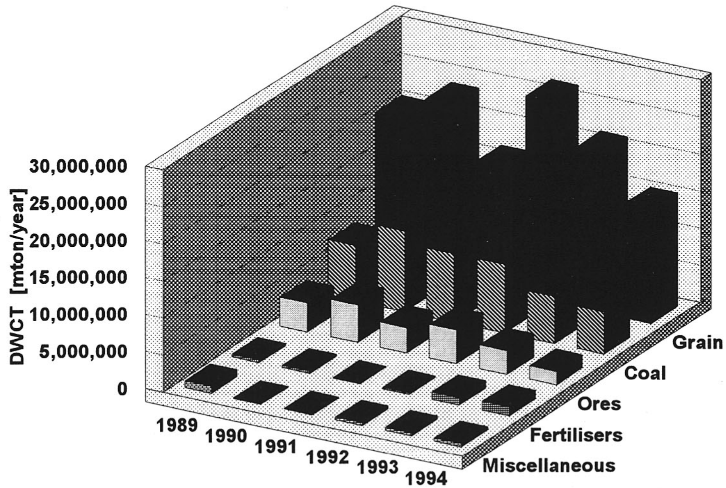


Figure 24: Total transported tonnage per cargo type

grain capacity of the panamax bulk carriers is about 2,657,591 cuft., as can be seen in **Part 2**, where a general analysis of the panamax bulk carrier fleet is made. When a vessel is loaded with grain, the holds will be filled completely, but the vessel will not reach its maximum draught.

The stowage factor of iron ore is about 18 cuft./ton. The vessel can carry more tons of iron ore, but the maximum draught will be reached while not all holds will be full.

6.3 Load/discharge terms

The loading and discharging terms in the contract determine the costs a charterer will make in the ports. The terms mentioned in the fixtures have not been taken into account. The most used terms in the contract are:

* FIO 5 DAYS/8000T: FIO means Free In and Out; 5 days to load the vessel; discharging speed is 8,000 ton/day;
* 5000T/6000T FREE DISCHARGE: loading speed is 5,000 tons/day; discharging speed is 6,000 tons/days; discharging is free, it will be paid by the reciever;
* 3 DAYS SHINC/15000T SHEX: loading time is maximum 3 days, sundays and holidays included, discharging speed is 15,000 tons/day, sundays and holydays excluded.

The used numbers change per loading/discharging port and depend mainly on the loading and discharging capacities of the cranes in the respective ports.

6.4 Forward chartering

According to **Figure 25**, the time before the charter starts is about 30 days, though excesses of 300 days occured. This specific charter was made in January for the third quarter of 1989. There seems to be little difference between the forward chartering of the three fixtures types.

6.5 Charterers

For all three fixture types, the 10 major charterers have been identified and put into **Table III**. This table states the total number of fixtures for the period 1989-1994.

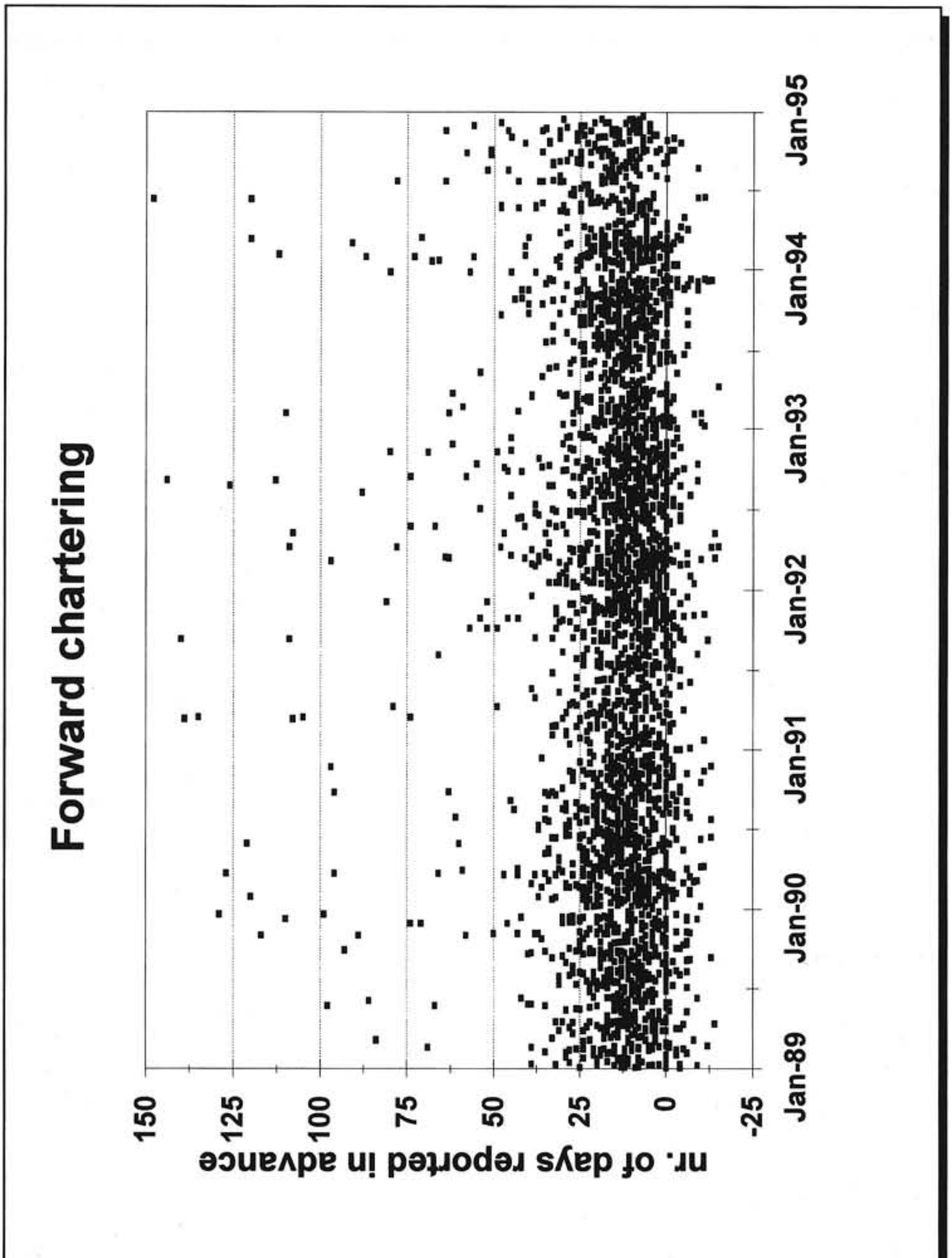


Figure 25: Early positioning in single voyage fixtures

Period fixtures		*Trip time fixtures*		*Voyage fixtures*	
Charterer	*Number of fixtures*	*Charterer*	*Number of fixtures*	*Charterer*	*Number of fixtures*
MITSUI OSK	57	MITSUI OSK	280	CARGILL	405
SHINWA	56	SHOWA	260	DREYFUSS	175
NYK	48	NYK	234	MSK	138
KLAVENESS	47	YUKONG	202	SIDERMAR	135
DOCENAVE	27	NAVIX	187	CONTINEN-TAL	106
SEATRANS	27	HANJIN	153	TAIWAN PO-WER	97
K-LINE	26	SHINWA	146	YUKONG	93
YUKONG	25	SOVFRACHT	115	HYUANDAI MERCHANT MARINE	78
HALLA MARI-TIME	23	HYUNDAI ME-RCHANT MA-RINE	106	HANJIN	74
BTT	22	NSAC	87	RICHCO	69

Table III: Ten largest charterers, annual number of fixtures

6.6 Freight Rates

In **Part 3** freight rates will be related to ships' characteristics. Now only the freight rates of all fixtures are given in a scatter diagram.

Figure 26 shows only those fixtures with a freight rate of less than $40/ton. This is because higher freight rates are not representative. These concern 10 fixtures in a total of nearly 3600, so about 0.3% of the total number of fixtures. These extreme high freight rates are paid in special circumstances for several voyages to third world countries and several places in the Mid East.
There is a cycle in the charter rates of the period and trip time fixtures. This appears in **Figure 26** for the single voyage fixtures as well. Nevertheless it is better to speak of two cycles, one $20/ton, and a lower one around $10/ton.

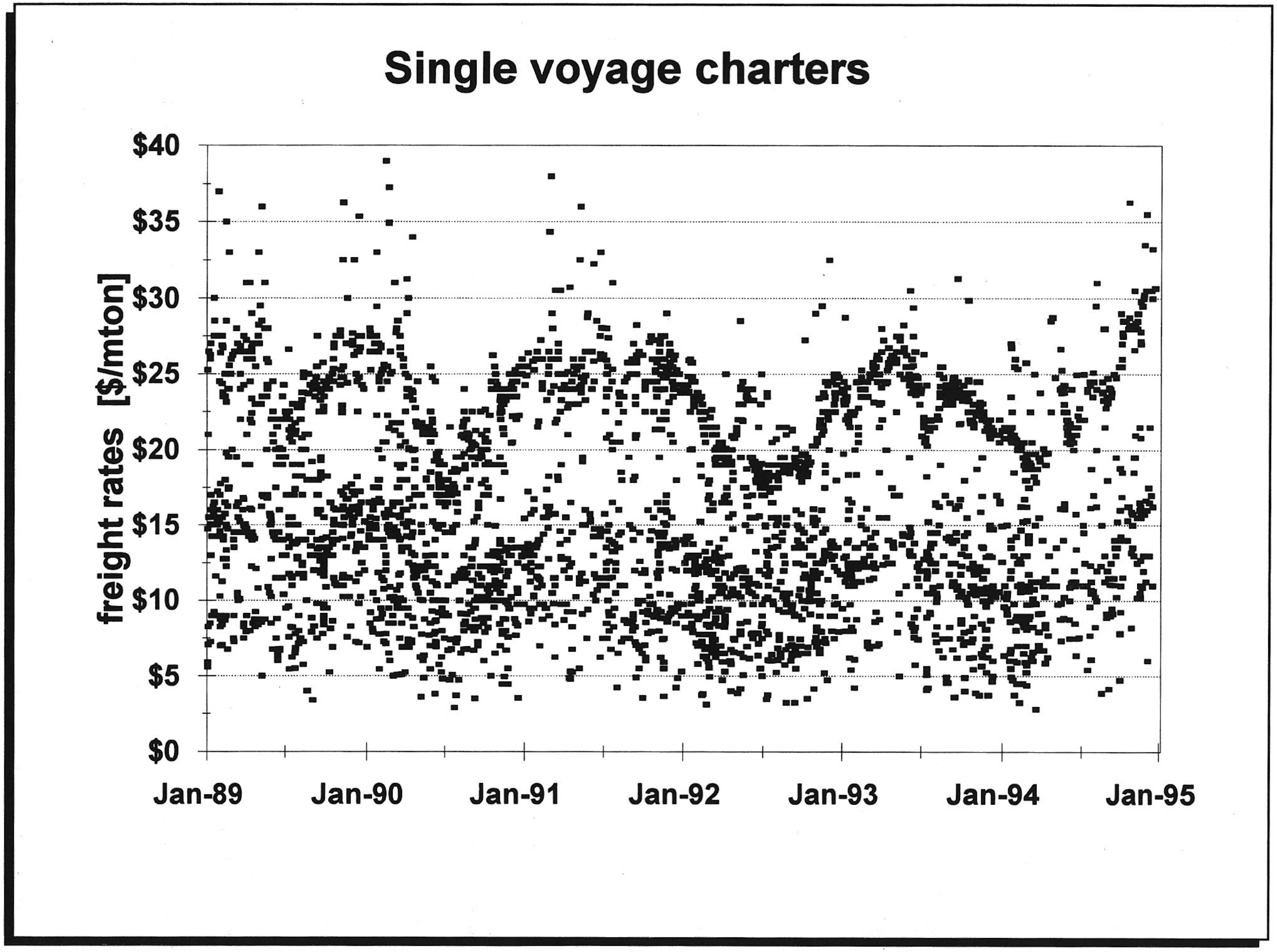


Figure 26: Single voyage fixture freight rates

PART 2 - PANAMAX BULK CARRIER DESIGN CHARACTERISTICS

7 THE CLARKSON DATABASE STRUCTURE

The Clarkson Database of the bulk carrier design characteristics, can be divided into three categories. The first category contains general information about all vessels in the range 50,000 to 76,000 DWT. The second category contains information about other, less relevant items. The third category contains items, important for designers and charterers. First, some explanation on the structure of the Clarkson Database will be given and then the three above mentioned items will be discsussed.

7.1 The Clarkson vessel database structure

Since the information on ships in the Plymouth database is not complete, not all fields are used. This is the main reason for not using any ships' characteristics supplied by the Plymouth fixture database.

The records in the Clarkson database consist of 35 fields. The fields are in the following order:

1.	CRSLCODE:	the unique Clarkson code number
2.	Name of Vessel:	current name
3.	DWT:	deadweight in metric tons
4.	Flag:	the country of the vessel's flag
5.	Year of Build:	year of delivery
6.	Draught:	on summer freeboard (metres)
7.	TPC:	tons per centimeter immersion
8.	LOA:	length over all (metres)
9.	LBP:	Length between perpendiculars (metres)
10.	Beam:	maximum width (metres)
11.	Cargo Capacity:	total cargo capacity (cubic metres)
12.	Grain Capacity:	grain cargo capacity (cuft)
13.	Containers:	indicator field, showing whether the vessel can carry containers (Y/N)
14.	TUE Capacity:	total TUE capacity
15.	GT:	gross Tonnage
16.	Class:	classification society
17.	Strengthened for Ice:	ice Class indicator (Y/N)
18.	Carrier Type:	as indicated by the owner and/or classification at time of delivery or subsequent updating

19.	Last Ex-Name:	
20.	Benifial Owner:	parent owner or manager (if known) of the vessel, otherwise the registered owner
21.	Builder:	yard name of original builder
22.	Service Speed:	service speed in knots
23.	Consumption:	main fuel consumption in tons per day at service speed
24.	HP:	horsepower: B = brake; I = Indicated; N = Nominal; S = Shaft; e.g. HP 13,500S at 123 rpm
25.	Engine Make:	main engine make
26.	No. of Holds:	number of holds
27.	No. of Hatches:	number of hatches, this value differs for several vessels from number of holds
28.	Hatch Description:	indicator Field: F = Fore & Aft-Rolling Hatches; S = Side-Rolling Hatches (F/S)
29.	Hatch Operation:	indicator fields H = Hydraulically operated; M = Mechanical operated (H/M)
30.	Strengthened for Ore:	(Y/N)
31.	Strengthened for Heavy Cargo:	(Y/N)
32.	Geared Indicator:	indicator field showing whether or not the vessel has Cargo Gear (Y/N)
33.	Gt. Lakes Capable:	indicates whether the vessel is capable of trading on the Great Lakes (Y/N)
34.	Gt. Lakes Only:	indicates that the vessel is only capable of trading on the Great Lakes (Y/N)
35.	Owner Code:	a unique code Clarkson has given to every owner.

There are 5014 bulk carrier vessels in the database of which 834 bulk carriers in the DWT-range from 50,000 up to 76,000 mton. Those last vessels were put into separate files.

In the database software, links can be made between the files containing the Plymouth fixture databases and the file containing the ships' characteristics.

7.2 General analysis

Carrier type

There are 834 vessels in the Clarkson Database in the range of 50-76,000 DWT. 755 of them are common bulk carriers, 40 are bulk/oil carriers, 5 are ore carriers and 1 is a ore/oil carrier. The other vessels are designed for specific trades, like bauxite carriers (1), chip carriers (12), lumber carriers (3) and car carriers (17).

Classification Society
The most used classification societies are Lloyds Register (189), American Bureau of Shipping (165), Nippon Kaji Kyokei (138), Det Norske Veritas (138) and Bureau Veritas (78). All other classification societies have less than 20 registered vessel in this DWT-range.

Flag State
The vessels are registered all over the world. The countries with the most ship are those with a flag of convenience like Cyprus (93), Liberia (90), Panama (83), Malta (46), Philipines (44), Norway (41, second register). The largest flag state is Greece with 130 vessels. The other countries have less than 20 vessel registered.

Owner
Most vessel are owned by companies. Some are owned by governments. The ten largest owners are given in **Table IV**.

Number	*Name of owner*	*Number of ships*
1	Chinese Goverment	23
2	Petromin Shipping Co.	23
3	Ocean Tramping	22
4	Black Sea Shipping Co.	15
5	Yick Fung Shipping Co.	12
6	Zegluga Polska	9
7	A.P. Moller	8
8	Lygnos Bros. Shipping	8
9	Wah Kwong Shipping	8
10	Livanos Group	7

Table IV: Ten largest panamax bulk carriers owners

Even a large company has a very limited number of vessels. This means that no single company can influence the market by itself.

Builder/Yard

The 834 vessels which were analysed, were built between 1969 and 1994. There are/were 100 yards capable of building panamax bulk carriers. Although most vessels are built in Japan and South Korea, the yard which has built the most is Burmeister & Wain in Copenhagen. The top ten yards are given in **Table V**.

Number	*Name of yard*	*Number of ships*
1	A/S Burmeister & Wain, Copenhagen	57
2	Hyundai S.B & Heavy Ind.Ltd, Ulsan	48
3	Mitsubishi Heavy Ind. Ltd	46
4	Nippon Kokan K.K.	40
5	Ishikawajima	36
6	Hitachi S.B. & Eng. Co, Innoshima	35
7	Koyo Dock K.K., Mihara	34
8	Imabari S.B. Co.	29
9	Namura Zosensho K.K., Imari	27
10	Okean Shipyard	27

Table V: Ten largest builders of panamax bulk carriers

Main engine make

Of almost all 834 considered vessels, the engine producer is known. There are only 8 known producers of engines, see **Table VI**. The two largest manufacturers produce 82% of all engines placed in bulk carriers. 50 ships have engines of unknown producer.

7.3 Other characteristics

Several items of the Clarkson Database are less important for this study. For example, for someone who wants to ship 52,500 tons of grain, it is not important whether the vessel can transport containers. Grain is one of the major - target groups. The amount of containers that the vessel can carry, the TEU capacity, is unimportant in the framework of this analysis.

Number	*Name of main engine producer*	*Number of ships*
1	Sulzer	369
2	B&W	316
3	M.A.N.	72
4	Pielstick	12
5	Mitsubishi	10
6	Doxford	2
7	Fiat	2
8	Krupp	1

Table VI: Ten largest main engine producers

Whether the way hatches open, to the front or to the side, is not important for this study. Whether they operate mechanically or hydraulically is important for the operations in port, but again not for this study.
The number of hatches may differ from the number of holds, since one hold can have more than one hatch cover, especially on old ships.

Dues are determined by the gross tonnage (GT). The GT usually determines the dues to be paid, like port and canal dues and registration taxes. The GT is partly related to the DWT-capacity.

The power of the engines is of no direct importance to the study as well. This number tells us only indirectly something about the speed of the vessel and the fuel consumption. These two items are specified in the Clarkson Database.

7.4 Important items

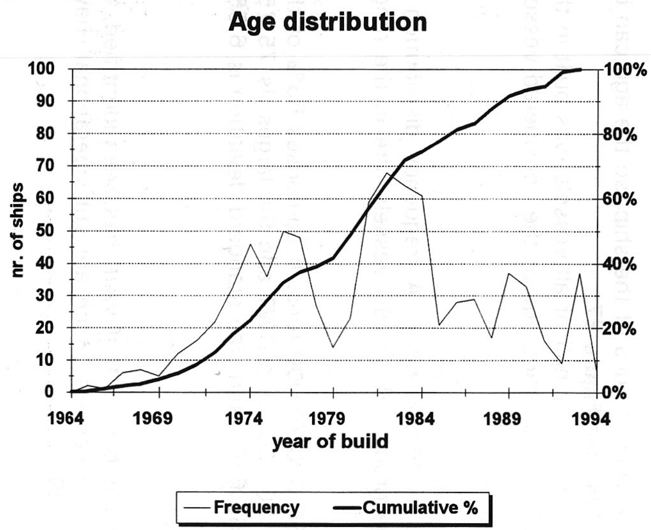
Age
Clarkson provides information on the year of build of the ship, so the age can be calculated. The reference year is 1994, see **Figure 27**.
All vessels were built in 1965 or later. Nearly half of all vessels was built in the periods 1974-1978 and 1981-1983. The average age of the considered vessels is 12.9 year.

DWT
The DWT ranges from 50,000 up to 76,000 mton. A frequency distribution is shown in **Figure 28**. A rather large group, about 150 vessels, are in the range from 50,000-55,000 mton.

The largest group is in the range 60,000-70,000 tons. It comprises 55% of the total group. The smallest vessel is 50,000 mton DWT and the largest is 75,751 mton DWT. The average DWT is 63,630 mton, the standard deviation is 6,559 mton.

Age vs. DWT
Every year the total number of vessels built in that year, has been identified, as well as the average DWT. Only those vessels which are still operational, have been taken into account, see **Figure 29**.

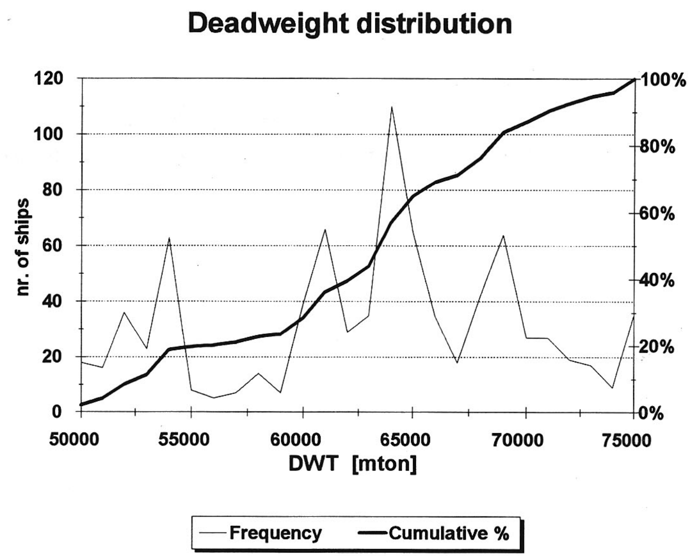
Year of Build	Frequency	Cumulative %
1964	0	0.00%
1965	2	0.24%
1966	1	0.36%
1967	6	1.08%
1968	7	1.92%
1969	5	2.52%
1970	12	3.96%
1971	16	5.88%
1972	22	8.51%
1973	33	12.47%
1974	46	17.99%
1975	36	22.30%
1976	50	28.30%
1977	48	34.05%
1978	27	37.29%
1979	14	38.97%
1980	23	41.73%
1981	59	48.80%
1982	68	56.95%
1983	64	64.63%
1984	61	71.94%
1985	21	74.46%
1986	28	77.82%
1987	29	81.29%
1988	17	83.33%
1989	37	87.77%
1990	33	91.73%
1991	16	93.65%
1992	9	94.72%
1993	37	99.16%
1994	7	100.00%



Statistical :	Year of build
Mean	1981
Standard Error	0.2
Median	1982
Mode	1982
Standard Deviation	6.5
Variance	41.6
Kurtosis	-0.7
Skewness	0.0
Range	29
Minimum	1965
Maximum	1994
Sum	1652289
Count	834
Confidence Level(0.950000)	0

Figure 27: Age distribution of ships in panamax-range

DWT	Frequency	Cumulative %
50000	18	2.16%
51000	16	4.08%
52000	36	8.39%
53000	23	11.15%
54000	63	18.71%
55000	8	19.66%
56000	5	20.26%
57000	7	21.10%
58000	14	22.78%
59000	7	23.62%
60000	39	28.30%
61000	66	36.21%
62000	29	39.69%
63000	35	43.88%
64000	110	57.07%
65000	65	64.87%
66000	35	69.06%
67000	18	71.22%
68000	42	76.26%
69000	64	83.93%
70000	27	87.17%
71000	27	90.41%
72000	19	92.69%
73000	17	94.72%
74000	9	95.80%
75000	35	100.00%



Statistical :	DWT
Mean	63652
Standard Error	227
Median	64489
Mode	52451
Standard Deviation	6558
Variance	43013845
Kurtosis	-0.7
Skewness	-0.3
Range	25751
Minimum	50000
Maximum	75751
Sum	53085794
Count	834
Confidence Level(0.950000)	445

Figure 28: Deadweight distribution of ships in panamax-range

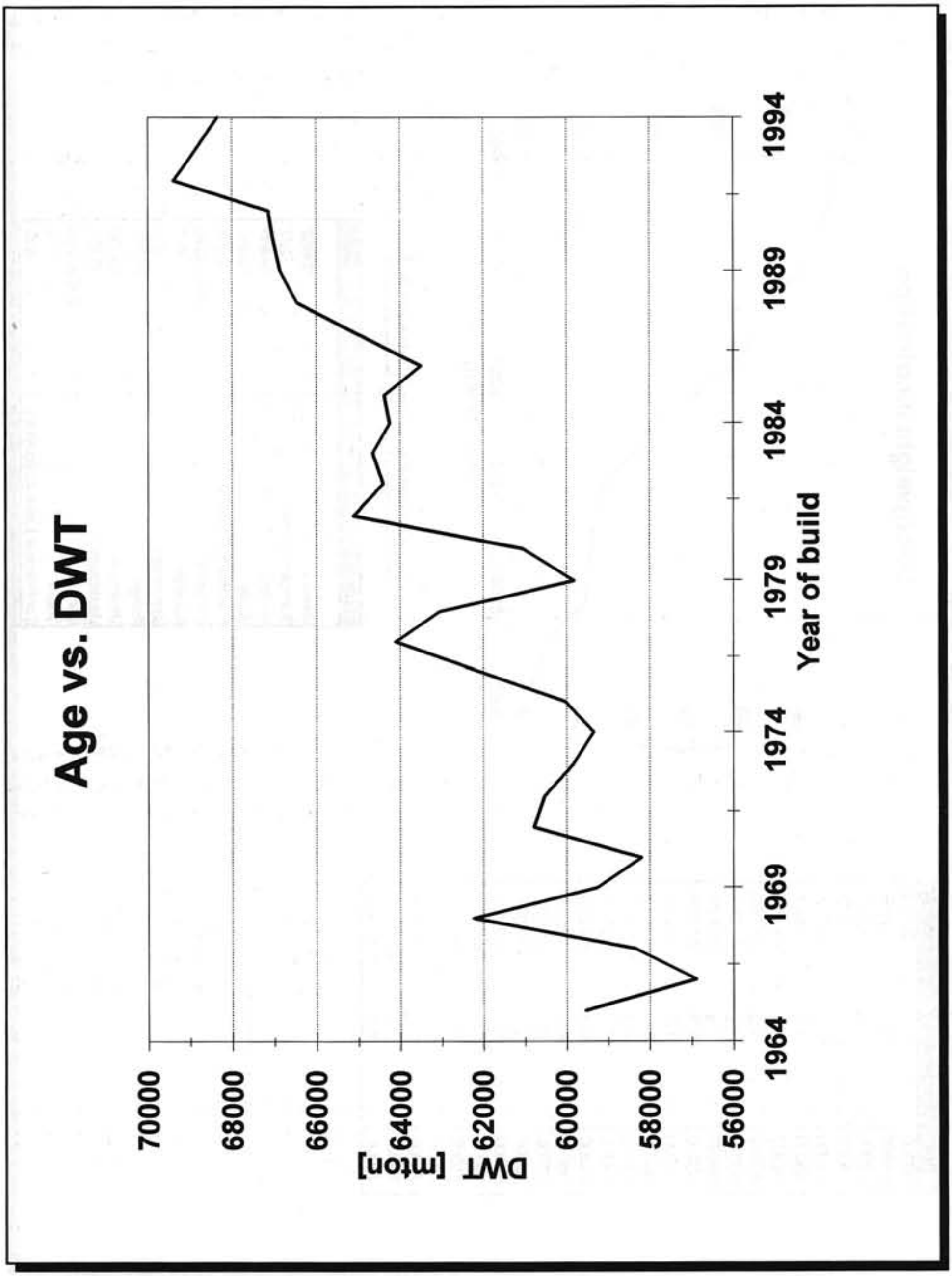


Figure 29: Average deadweight of the panamax bulk carriers

As can be seen in **Table VII**, the DWT has increased since 1984. The yearly average DWT has increased from about 59,500 mton to 69,000 mton, an increase of nearly 16%. Burmeister and Wain delivered in November 1994 their first of a new series of ships, a 75,000 mton DWT vessel.

Year of build	*Average DWT [mton]*
1994	68354
1989	66863
1984	64241
1979	59832
1974	59354
1969	59288
1965	59554

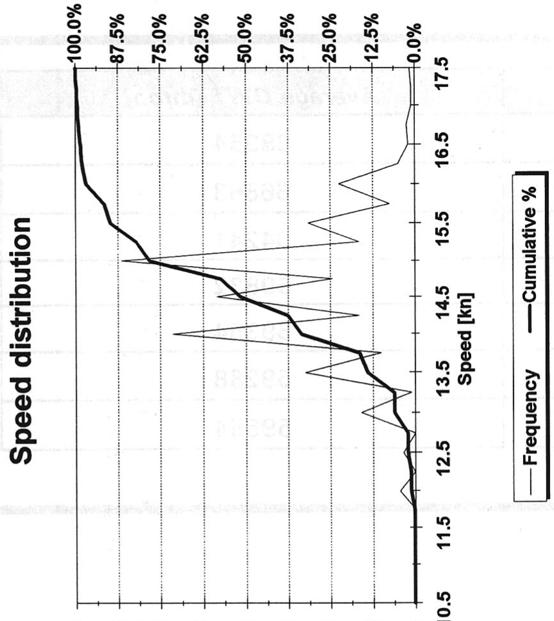
Table VII: Average DWT

Service speed
A distribution of the service speed is shown in **Figure 30.** The minimum service speed is about 10.5 knots, the maximum about 17.60 knots, the average speed is 14.6 knots with a standard deviation of 0.9 knots. Nearly 75% of all vessels have a speed in the range 13.5-15.5 knots.

Service speed vs. age
Figure 31 shows that the average Service speed of the vessels, built before the second oil-crisis, 1979, was 15 knots. The average service speed of the vessels built in the 1980's was about 14 knots. Recently built vessels show that the average service speed is increasing again to about 15 knots.

Service speed vs. DWT
Figure 32 shows that there is no close relation between the service speed and the DWT tonnage. The spread of the service speed is very large, but most vessels in the DWT-range sail between 14 and 16 knots.

Speed	Frequency	Cumulative %
10.50	1	0.12%
10.75	0	0.12%
11.00	1	0.24%
11.25	0	0.24%
11.50	0	0.24%
11.75	0	0.24%
12.00	9	1.32%
12.25	0	1.32%
12.50	7	2.16%
12.75	0	2.16%
13.00	32	6.00%
13.25	2	6.24%
13.50	65	14.03%
13.75	20	16.43%
14.00	143	33.57%
14.25	33	37.53%
14.50	117	51.56%
14.75	49	57.43%
15.00	173	78.18%
15.25	33	82.13%
15.50	63	89.69%
15.75	15	91.49%
16.00	45	96.88%
16.25	10	98.08%
16.5	4	98.56%
16.75	5	99.16%
17	2	99.40%
17.25	2	99.64%
17.5	3	100.00%



Statistical :	Speed :
Mean	14.6
Standard Error	0.03
Median	14.7
Mode	15.0
Standard Deviation	0.9
Variance	0.8
Kurtosis	1.0
Skewness	-0.2
Range	7.1
Minimum	10.5
Maximum	17.6
Sum	12193
Count	834
Confidence Level(0.950000)	0.1

Figure 30: Service-speed distribution in the panamax-range

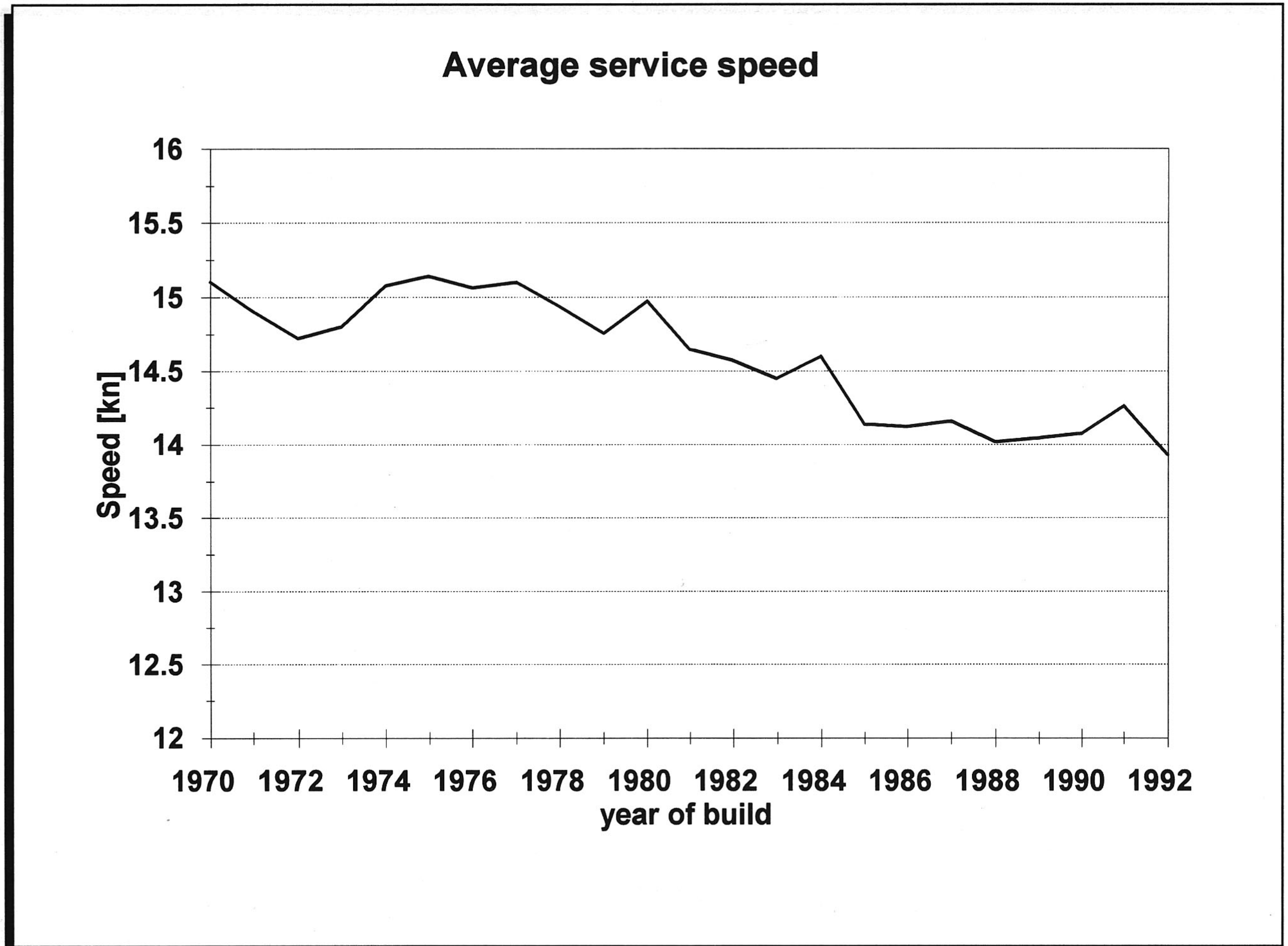


Figure 31: Average service-speed of ships in the panamax-range for every year

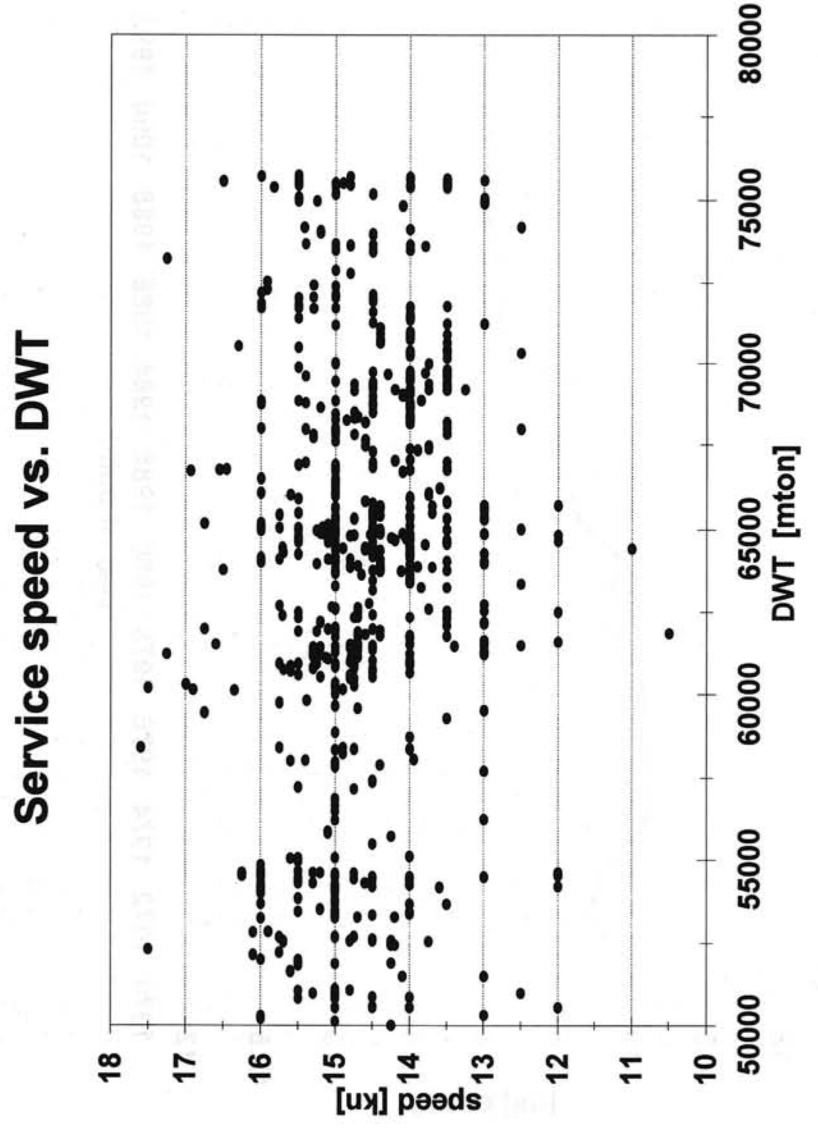


Figure 32: Service speed vs. DWT

Consumption
As discussed in paragraph 7.2, the power of the engines is of no direct importance for this study. However, the fuel consumption is, because it determines to a large extent the voyage costs, see paragraph 8.1. **Figure 33** shows the fuel consumption distribution.

Consumption vs. Age
Figure 34 shows clearly that newer ships have better main engines which consume less oil than older ones.

Length, Beam, Draught
These characteristics are important, since many canals, locks, harbors and quays, cause restrictions for the vessels. This is shown in the distributions of the specific items.

Figure 35 shows a distribution of the length of the panamax bulk carriers. It shows that 90% of the considered vessels has a length less than 225m and nearly 65% has a length in the range between 210 and 220m. The length restriction is imposed by several ports where the quay length is about 220 meter and longer ships can not be accepted.

More than 85% of the considered vessels has a width less than 32.20m, the restriction of the locks in the Panama Canal, see **Figure 36**. The smaller vessels are usually older. Twenty-four of the vessels are wider than 32.20 meter and will not be able to sail through the Panama Canal and are eliminated from the analysis.

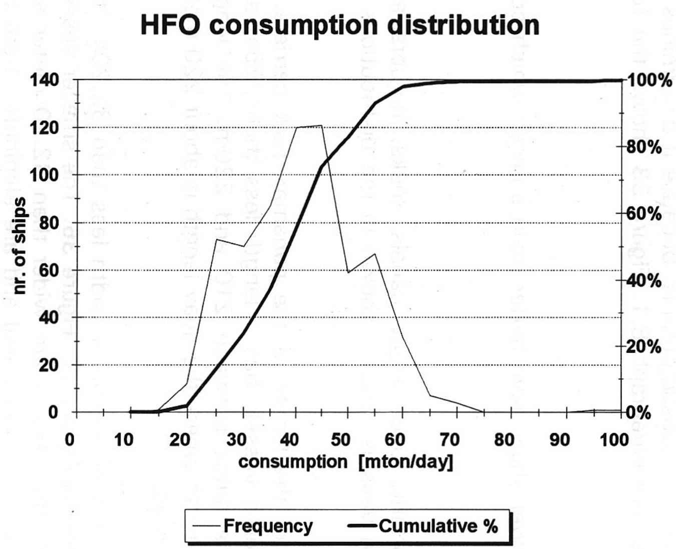
Figure 37 shows the draught distribution. The draught given in the Database is the maximum allowable draught. The distribution shows two peaks, each peak representing about 180 vessels. The first peak is at a draught of approximately 12.25 meter, the second one at approximately 13.00 meter.

The minimum draught is 10.7 meters, the maximum draught is 15.2 meters. The average maximum draught is 12.9 meter with a standard deviation of 0.6 meter.

Cargo capacity/grain capacity
This item is of extreme importance since this number gives the amount of cargo, a vessel can carry in its holds. The capacity is given in the units cuft. or m^3. The relation between cuft. and m^3 is:

1 cuft = 0.0283 $m.^3$;
1 m^3 = 35.3 cuft.

HFO Consumption	Frequency	Cumulative %
10	0	0.00%
15	1	0.15%
20	12	1.98%
25	73	13.11%
30	70	23.78%
35	87	37.04%
40	120	55.34%
45	121	73.78%
50	59	82.77%
55	67	92.99%
60	32	97.87%
65	7	98.93%
70	4	99.54%
75	0	99.54%
80	0	99.54%
85	0	99.54%
90	0	99.54%
95	1	99.70%
100	1	99.85%
105	0	99.85%
110	0	99.85%
115	0	99.85%
120	0	99.85%
125	0	99.85%
130	0	99.85%
135	0	99.85%
140	0	99.85%
145	0	99.85%
150	0	99.85%
155	0	99.85%
160	1	100.00%



Statistical :	HFO consumption
Mean	34.6
Standard Error	0.8
Median	39.4
Mode	0
Standard Deviation	22.8
Variance	519.6
Kurtosis	13.2
Skewness	1.3
Range	231.5
Minimum	0
Maximum	231.5
Sum	28858.1
Count	834
Confidence Level(0.950000)	1.5

Figure 33: Consumption distribution of ships in panamax range

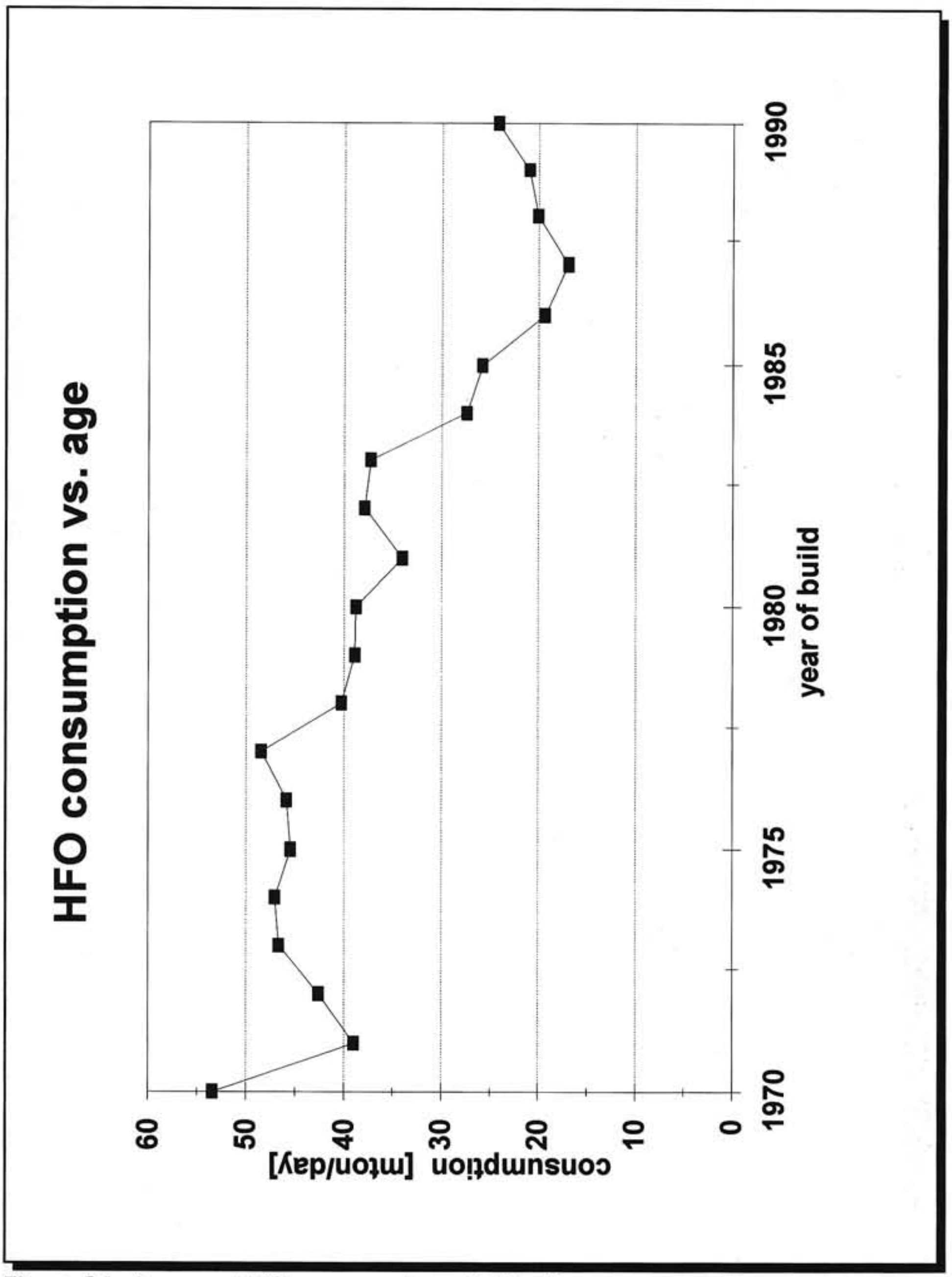
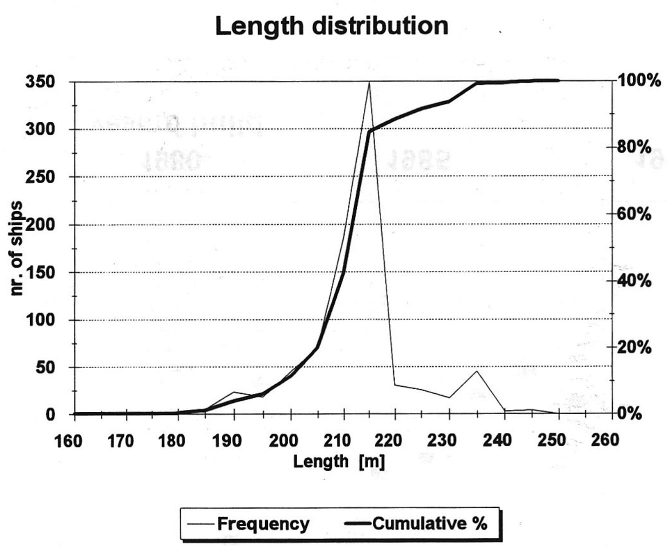


Figure 34: Average HFO consumption of ships in panamax-range

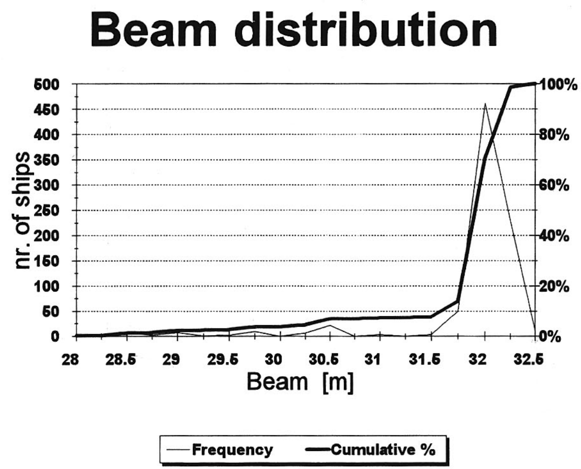
Length	Frequency	Cumulative %
160	2	0.24%
165	0	0.24%
170	0	0.24%
175	0	0.24%
180	2	0.48%
185	5	1.09%
190	24	3.99%
195	18	6.16%
200	45	11.59%
205	70	20.05%
210	187	42.63%
215	349	84.78%
220	31	88.53%
225	26	91.67%
230	17	93.72%
235	45	99.15%
240	3	99.52%
245	4	100.00%
250	0	100.00%



Statistical :	Length
Mean	214.6
Standard Error	0.3
Median	215
Mode	215
Standard Deviation	10.0
Variance	100.9
Kurtosis	3.2
Skewness	-0.0
Range	88.51
Minimum	160
Maximum	248.5
Sum	177720.5
Count	828
Confidence Level(0.950000)	0.7

Figure 35: Length distribution of ships in panamax-range

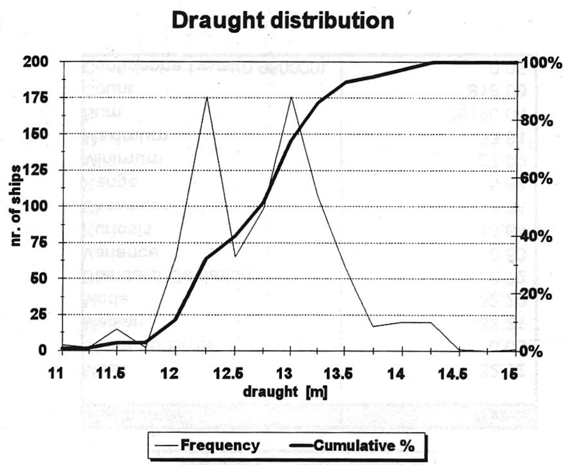
Beam	Frequency	Cumulative %
28	2	0.25%
28.25	0	0.25%
28.5	7	1.11%
28.75	2	1.35%
29	7	2.21%
29.25	1	2.33%
29.5	2	2.58%
29.75	9	3.69%
30	0	3.69%
30.25	6	4.42%
30.5	21	7.00%
30.75	0	7.00%
31	3	7.37%
31.25	0	7.37%
31.5	3	7.74%
31.75	50	13.88%
32	461	70.52%
32.25	229	98.65%
32.5	11	100.00%



Statistical :	Beam
Mean	32.02
Standard Error	0.03
Median	32.21
Mode	32.20
Standard Deviation	0.72
Variance	0.53
Kurtosis	13.64
Skewness	-3.61
Range	5.82
Minimum	27.99
Maximum	33.81
Sum	26190.04
Count	818.00
Confidence Level(0.950000)	0.05

Figure 36: Beam distribution of ships in panamax-range

Draught	Frequency	Cumulative %
10.75	1	0.12%
11	4	0.60%
11.25	2	0.84%
11.5	15	2.65%
11.75	2	2.89%
12	65	10.71%
12.25	176	31.89%
12.5	65	39.71%
12.75	99	51.62%
13	176	72.80%
13.25	108	85.80%
13.5	59	92.90%
13.75	17	94.95%
14	20	97.35%
14.25	20	99.76%
14.5	1	99.88%
14.75	0	99.88%
15	1	100.00%
15.25	0	100.00%



Statistical :	Draught
Mean	12.91
Standard Error	0.02
Median	12.95
Mode	12.40
Standard Deviation	0.59
Variance	0.35
Kurtosis	0.48
Skewness	0.14
Range	4.38
Minimum	10.83
Maximum	15.21
Sum	10725.62
Count	831.00
Confidence Level(0.950000)	0.04

Figure 37: Draught distribution of ships in panamax-range

The data about grain capacity have been combined with data from a database of the Rotterdam-based company Shipmair, which consists of more than 1,700 vessels in the DWT range 15,000-150,000 mton. Nearly 550 vessels are in the panamax-range.

The minimum grain capacity is 2,011,409 cuft. (56,957 m^3), the maximum grain capacity is 3,115,980 cuft. (88,2345 m^3), the average grain capacity is 2,657,591 cuft (75,255 m^3). The largest group is in the range between 2,600,000 and 2,700,000 cuft. **Figure 38** shows the grain capacity distribution.

Geared vs. gearless
In the Clarkson Database it is registered whether the vessels are provided with gear, see **Figure 39** and **Figure 40**. The vessels are subdivided as shown in **Table VIII.**

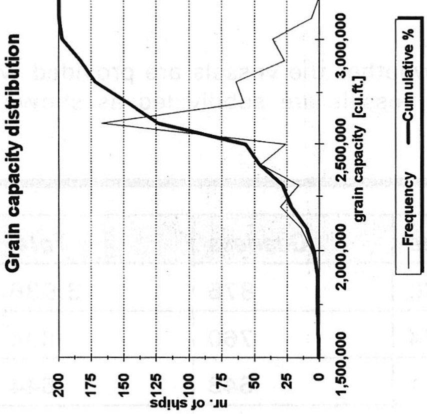
DWT-range	*Geared*	*Gearless*	*Total*
A	2660	876	3.536
B	74	760	834
C	1	643	644
Total	2.735	2.279	5.014

Table VIII: Geared vs. gearless bulk carriers

* Range A = vessels < 50,000 DWT;
* Range B = vessels between 50,000-76,000 DWT (panamax-range);
* Range C = vessels > 76,000 DWT.

About 55% of all vessels in the Clarkson Database are geared. But more than 97% of the geared vessels are in Range A, the smallest ones. Less than 3% is in the panamax-range. The panamax-range consists of 74 geared vessel, which is 11.3% of the group. In the Plymouth Database all 74 vessels are registered, so this is an item which needs to be examined more closely.

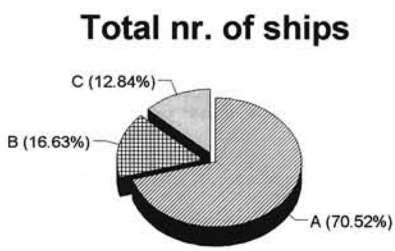
Grain capacity	Frequency	Cumulative %
1,500,000	1	0.20%
1,600,000	1	0.40%
1,700,000	1	0.60%
1,800,000	0	0.60%
1,900,000	1	0.80%
2,000,000	6	2.00%
2,100,000	14	4.80%
2,200,000	30	10.80%
2,300,000	16	14.00%
2,400,000	45	23.00%
2,500,000	26	28.20%
2,600,000	167	61.60%
2,700,000	58	73.20%
2,800,000	64	86.00%
2,900,000	27	91.40%
3,000,000	36	98.60%
3,100,000	6	99.80%
3,200,000	0	99.80%
3,300,000	0	99.80%
3,400,000	1	100.00%

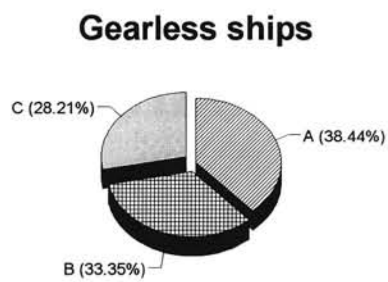


Statistical :	Grain capacity
Mean	2651242
Standard Error	11185
Median	2652059
Mode	2782435
Standard Deviation	250110
Variance	62555076819
Kurtosis	1.1
Skewness	-0.7
Range	1918200
Minimum	1504000
Maximum	3422200
Sum	1325621022
Count	500
Confidence Level(0.950000)	21923

Figure 38: Grain capacity distribution for ships in panamax-range

DWT-range	Total nr. of ships	Gearless ships	Geared ships
A	3536	876	2660
B	**834**	**760**	**74**
C	644	643	1
Total	5014	2279	2735





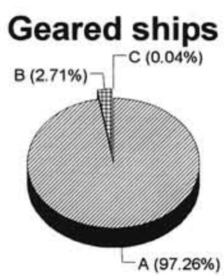


Figure 39: Geared vs. gearless ships, all ships in the Clarkson Database

Figure 40: Geared vs. gearless ships in panamax-range

8 OBJECTIVES OF THE CHARTER MARKET

Every fixture involves two parties, the owner of the vessel and the charterer. What are the objectives of these people to build or buy or charter a specific vessel? In this chapter relations between the relevant ship-parameters and the charter rates will be discussed.

As shown in paragraphs 4.5, 5.5 and 6.6, cycles occur in the charter rates. This may be caused by major drastic developments in the world. Small changes may also be caused by several major charterers/operators. These are called market-makers and they have the power to influence charter rates.

Another important item is the oil price. Increase of the oil price results in more expensive fuel. If the fuel price increases, often the charter rates increases.

For the single voyage charters, it is also important who pays for the loading and discharging of the cargo. This is usually stated in the fixture. It may also influence the charter rates.

What are the objectives of the owner and the charterer if they conclude a deal? For both parties this will be discussed briefly.

8.1 Owner

Generally the owner earns money by hiring out his vessel to the charterer. But the owner has to pay for the daily operating cost of the vessel and in most cases he has to borrow money to purchase the vessel. The owner tries to maximize his return on his investment, R.o.I.:

$$R.o.I_{Per,Trip} = \frac{Charter\ Rate - Costs}{Investment}$$

Per = Period time fixtures
Trip = Trip time fixtures

Fixtures have to be treated different, since period and trip time charters are paid per day and voyage charters are paid per ton. The costs an owner has to make when he charters out his vessel on a time charter basis are:

$$Costs = OC + K(+CHC) \quad [\$]$$

It depends on the charter party who pays the cargo handling costs.

For single voyage fixtures another formula is applicable:

$$R.O.I_{Voy} = \frac{FreightRate * DWCT - Costs}{Investment}$$

Voy = single voyage fixtures

The costs in this formula consist of the following:

$$Costs = OC + VC + CHC + K \quad [\$]$$

with:

OC = Operating costs consist of:
* Manning/crewing;
* Stores on board the ship;
* Repairs and maintenance;
* Insurance of the ship and cargo (P & I);
* Administration costs.

VC = Voyage costs:
* Fuel costs for main engines and auxiliaries;
* Port and light dues, etc.;
* Tugs and pilotage, etc.;
* Canal dues.

CHC = Cargo handling costs:
* Cargo loading charges;
* Cargo discharging costs;
* Cargo claims.

K = Capital costs:
* Depreciation;
* Interest

The owner can maximize the return on investment by maximizing the charter rate, combined with minimal investment, operating and capital costs. For the single voyage charter he wants to minimize the voyage costs and possibly the cargo handling.

8.2 Charterer

The objectives of the charterer are more difficult to explain. The charterer only has costs. So his main objective is to minimize these costs. The costs depend on the charter type.

Chartertype:

Voyage: The charterer pays a unit freight rate. The freight rate is generally specified as a fixed amount per unit of cargo transported. Under this arrangement, the shipowner generally pays for all costs, except maybe cargo handling, and is responsible for running the ship, planning the voyage and sailing.

Time: The charter hire is specified as a fixed daily payment for the hire of the vessel. The owner manages the day-to-day running of the ship, and pays the operating and capital costs. The charterer pays fuel, port charges, stevedoring and other cargo-related costs, and directs the ship's operation.

By using single voyage charters the charterer will limit the risk, as he pays a fixed amount per ton.

The estimated location of the vessel at the moment of concluding is important because a ballast bonus may have to be paid. This will increase the charter rate, but even with a balast bonus, some vessels are still cheaper than others.

The charterer can minimize the costs by examining the design characteristics. What design characteristics of panamax bulk carriers are important for the charterer?

* DWT [mton];
* Grain capacity [cuft. or cu.m];
* Length [m], Beam [m], Draugth [m];
* Service speed [kn];
* HFO consumption [mtons/day at service speed], plus MDO consumption;
* Age of the vessel;
* Geared or gearless;

The DWT and the grain capacity are units for the amount of cargo that can be transported. The draught is important because several ports have draught restrictions. The length, because in some ports the quay length is restricted. The beam of the vessels, because the ships have to sail through the Panama-Canal, which allows a maximum beam of 32.20 meters. The service speed and the consumption of the main engine determine the duration of the voyage and the amount and type of fuel. An old vessel will have less capital costs than a new vessel.

Other important items a charterer will consider, are:

* Trade route;
* Reliability of the owner.

The trade route, is only important for single voyage charters, because the longer the voyage, the higher the freight rate. The reliability of the shipowner gives some information about the likeliness that the vessel will arrive in time at the port of destination.This item cannot be quantified.

The charterers' behaviour for period time fixtures and for trip time fixtures can be described with the following formula:

$$\mathit{Minimise}_{Per,Trip} \quad \Sigma\ (\mathit{CharterRate} + \mathit{Voyagecosts} + \mathit{CargoHandlingCosts})$$

For single voyage fixtures, the voyage costs and sometimes the cargo handling costs have to be paid by the shipowner. For this type of fixture the following formula is more applicable for the charterer:

$$\mathit{Minimise}_{Voy} \quad \Sigma\ (\mathit{FreightRate})$$

This behaviour is responsible for the relation between the charter rate and the ship's characteristics. These are best represented by means of scatter diagrams, see the next chapter.

9 SHIP'S CHARACTERISTICS VERSUS CHARTER RATES

For all important ships' characteristics, scatter diagrams have been made. These are given in the **Appendices D**, **E** and **F**. The following items will be discussed in the following paragraphs:

* DWT [mton];
* Grain capacity [cuft. or cu.m];
* Length [m], Beam [m], Draugth [m];
* Service speed [kn];
* HFO consumption [mtons/day at service speed], plus MDO consumption;
* Age of the vessel;
* Geared or gearless;
* Number of holds;
* Number of hatches.

For period time fixtures one more item will be discussed:

* Duration of the fixture.

For single voyage fixtures one more item will be discussed:

* Cargo type.

Paragraph 9.1 discusses the period time fixtures, paragraph 9.2 discusses the trip time fixtures and paragraph 9.3 discusses the single voyage fixtures.

9.1 Period time charters

The last six years, Plymouth recorded 1002 period time charters in its database. So each scatter diagram in **Appendix D** consists of 1002 points. The year of contract has not been taken into account because, the reason for making these scatter diagrams is to get a general overview of the market of the last six years.

Age
The age range of ships sailing in period time charters is wide, see **Figure 41** (and **Figure D.1** in **Appendix D**). The youngest vessels were built in 1994, the oldest ones in 1972 and are 22 years old. There appears to be no particular age limit after which ships are chartered for a dramaticly lower charter rate, though the rates are slightly lower for older ships.

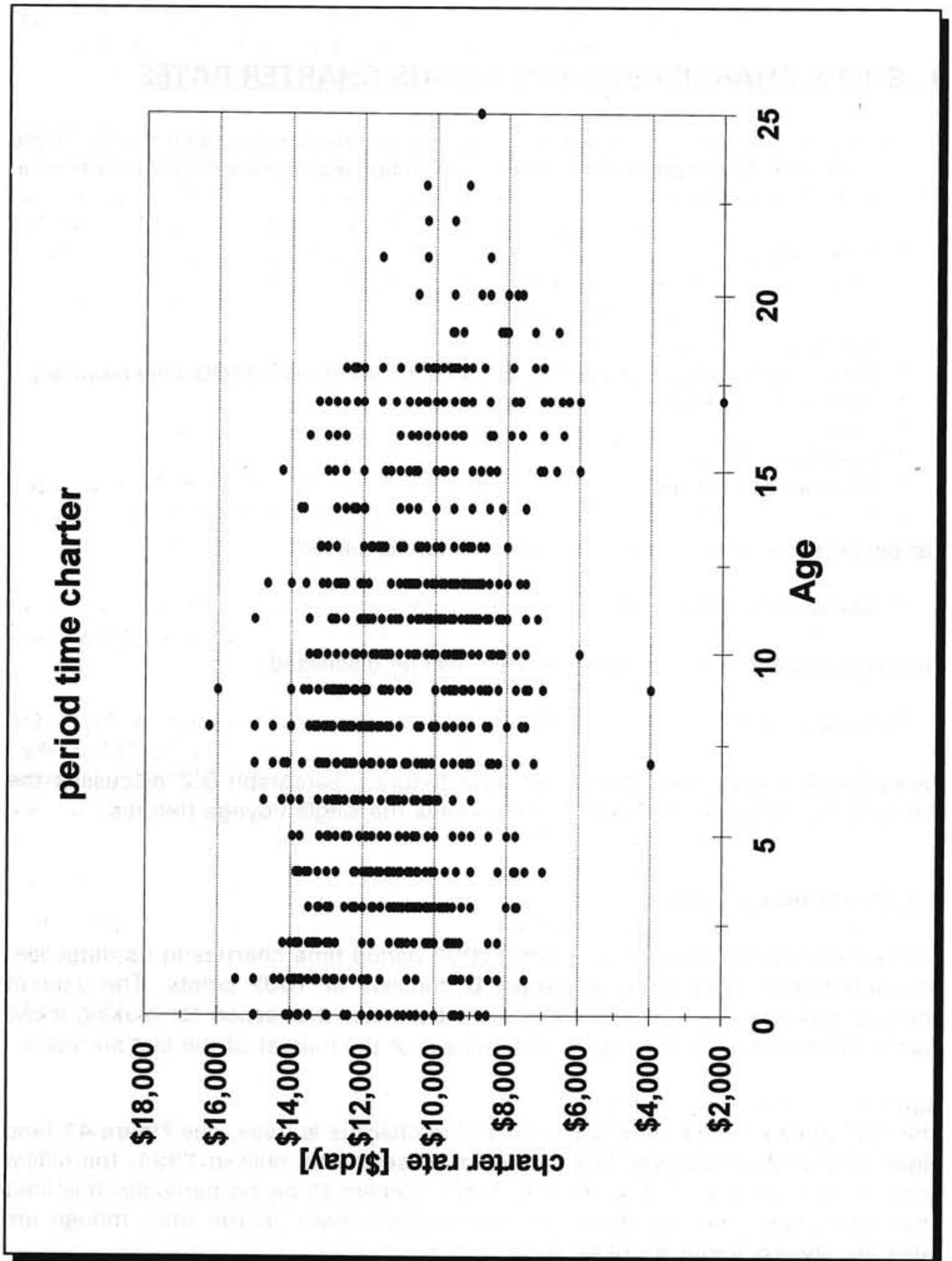


Figure 41: Charter rates vs age, period time charters

The variance in charter rates is also wide. The lowest rate is $2,000/day while the highest rate is over $16,000/day. Of course, these rates will be the same for all following period time charter scatter diagrams.

DWT
The considered DWT-range of panamax bulk carriers is from 50,000 mton to 76,000 mton. **Figure 28**, shows the deadweight distribution of all panamax bulk carriers. It shows two groups. The first group is smaller than 55,000 mton and the second group is between 60,000 mton and 70,000 mton. **Figure D.2** shows that nearly all ships in period time charter are in this last group.

Service speed
Most ships have a service speed between 13.5 and 15.5 knots, see **Figure 30. Figure D.3** is also valid for ships in period time charters.

Length, Beam and Draught
Figure 35 shows clearly that nearly half of the considered vessels have a length of about 215 meters. This is the same for ships in period time charters, see **Figure D.4.**

Since nearly 700 of the 834 ships have a beam of 32 - 32.3 meters, the scatter diagram showing rates vs. beam is almost a straight vertical line around 32.2 meters, see **Figure D.5** and **Figure 36.**

The scatter diagram of the draught vs. the charter rates shows clearly that there are two draught-groups, see **Figure 37.** The first groups has a draught between 12 and 12.5 meters. The second group between 12.5 and 13.5 meters. **Figure D.6** shows that more vessels of the second group are sailing in period time charters than of the first group.

Grain capacity
The grain capacity of ships sailing in period time charters is larger than 2,600,000 cuft. According to **Figure 38** the average grain capacity of the considered panamax bulk carriers is about 2,650,000 cuft. A second hump in this figure shows that many ships have a grain capacity of about 2,800,000 cuft. **Figure D.7** shows this as well.

Fuel consumption
The fuel consumption of ships in period time charters are as divers as of all ships in the panamax-range, see **Figure 33. Figure D.8** shows there there is a large group with a higher than average HFO consumption, more than 43 mton/day. **Figure 34** may show the cause of it, because many older vessels are sailing in period time charter.

Number of holds/Number of hatches
The number of holds determines, in conjunction with the average loading/discharging speed of the loading/discharging gear ashore, the time required to load and discharge. But, since 628 out of the 834 vessels about 75%) have 7 holds, this will give a small range in number of holds and number of hatches, see **Figure D.9** and **Figure D.10**.

Duration of the fixtures
As shown in **Figure 8**, there is a wide range of the duration of the period time charters. There are two large groups. This is also shown **Figure D.11**. But it does not show whether a fixture of twelve months gets a higher charter rate than a three month fixture.

Conclusions
From the figures in **Appendix D** it can be concluded that the variance in charter rates of the important items, is very large. This is obvious, since 6 years are considered in these diagrams. From **Figure 10** we already learned that a cycle appeared in the charter rates during these 6 years. This cycle can be eliminated by calculating a neutral index.

9.2 Trip time charters

The same problems as in the period time charters appear here as well. Due to the cycle in charter rates over the years, see **Figure 12**, a wide variance appears.

Since Plymouth did not mention all the names of ships in its database, over 100 records had to be removed. So the scatter diagrams consist of nearly 4,900 fixtures.

The figures will not be discussed as detailed as those of the period time charters, because of the similarity between period and trip time charters. The figures are given in **Appendix E**.

9.3 Single voyage charters

This fixture type contains an extra item which causes extra problems: the various cargo types. The different cargo types cannot be compared with each other. So, for discussing single voyage charters in a proper way a set of scatter diagrams should be produced for each type of cargo. But the following cargo types are rarely transported by panamax bulk carriers, see **Figure F.12** in **Appendix F**:

* Fertilizers;
* Sugar;
* Miscellaneous.

Ores and coal do have enough fixtures per year, but respectively there are only about 4 and 8 fixtures a month reported by Plymouth. This is not enough to give a good overview of the market.

Figure F.12 shows only 2112 fixtures while paragraph 3.1, **Table I**, stated that the total number of single voyage fixtures is 3169. The reason is that for one third of the single voyage fixtures Plymouth did not enter the ship names, but the names of the owner, the charterer, the operator or the ship manager.

The scatter diagrams in **Appendix F** will not be discussed in detail, but several remarks will be made.

Figure F.1 indicates that the average age of vessels in voyage charter is higher than of those in time charter. The fuel consumptions, given in **Figure F.9** confirms this assumption, since older vessels usually have a higher fuel consumption.

Figure F.2, DWT versus freight rate, shows another problem with single voyage charters. Plymouth gives the cargo size instead of the DWT. Therefore vessels with a DWT of nearly 180,000 mton can appear in the scatter diagram, because these large vessels may carry more than one fixture or only one fixture assuming that the vessels will not be loaded to the vessels maximum draught. These large vessels have been eliminated and the panamax DWT-range has been put into **Figure F.3**. It shows a large group of vessels around 65,000 mton DWT. This number is higher than for time fixtures. Also more vessels of over 70,000 mton are chartered.

Figure F.10, number of holds, shows that many voyage charters concern vessels with 7 or 9 holds, while time charters more often concern 7 or 8 holds.

9.4 Problem discussion

Before discussing the scatter diagrams, several remarks have to be made. First of all, the figures concern a time interval of 6 years. **Chapters 4, 5** and **6** showed that over these six years a cycle appears in the charter rates. By decreasing the time interval, a more accurate diagram can be made. **Figure 10**, period time charters, shows that the maximum and the minimum charter rate may occur in a one year period. For example, in January 1990 a maximum and in January 1991 a minimum appeared in the cycles. Since the charter rates of time charter and period time fixtures follow each other, January 1990 is a maximum in the cycle and January 1991 is minimum in the cycle of trip time fixtures, see **Figure 12**.

Figure 26, single voyage freight rates, show a cycle as well, though not as clear as for time charters. This is obvious because several cargo types are combined in this figure. Now another problem occurs, see **Figure 26**. There is still a cycle but it is better to speak of two cycles. Both cycles depend on unknown aspects, but are probably due to different trade routes and or commodities.

PART 3 - PANAMAX BULK CARRIER CHARTER INDEX

10 CHARTER MARKET INDEX

By plotting charter rates against time as, in **Figure 10**, **Figure 12** and **Figure 26**, cycles can be observed. To eliminate these business cycles, an index for every fixture type will be made. These indexes can depend on the following variables:

* Ship size;
* Trade route;
* Cargo type.

Shipsize
The shipsize is for the three fixture types the same, a DWT-range from 50,000 to 76,000 mton. A subdivision will not be made since the difference between the lowest and the highest DWT is too small.

Trade route
For the period time fixtures the trade route is unknown and for trip time fixtures the trade route is only vaguely known. It does not have to be stated, as in the Plymouth database. Often a range of ports is stated in the fixture. So, only for the single voyage fixtures the trade route is completely known and a differentiation will be made.

Cargo type
The cargo type is stated only in the single voyage charters and a differentiation will be made here as well.

The general idea of a charter market index, is to have a single index figure which represents the market. This index is composed in such a way that it eliminates all technical aspects. Since we are interested in these technical aspects a different approach is required. As shown in the figures of **Appendices D**, **E** and **F**, a very large variance in charter rates, induced by the economic business cycles, appeared in the figures. The purpose is to eliminate the variance to get an index figure, per fixture type, at comparable levels over the period 1989 up to and including 1994.

Time Interval
The time interval, chosen for the indexes, will be as small as possible to achieve the highest accuracy. First, a monthly index will be made. Due to the low number of fixtures per month for period time fixtures, a quarterly index can be

considered, though **Figure 10** shows that the market can change dramatically in a period of 3 months time.

For trip time charters and single voyage charters a large number of fixtures is recorded each month, so it is justifiable to use a monthly index for these fixture types.

Index by average charter rate
For each time interval, each month, the average charter rate is calculated by the following formula:

$$AverageFreightRate_j = \frac{\Sigma\ CharterRate_{i,j}}{N}$$

i = 1..N fixtures per time interval
j = 1..m, time interval
N = total number of fixtures of that time interval

Figure 42 to **Figure 44** show the average charter rates for each fixture type. **Figure 42** shows the monthly average charter rates of period time fixtures, **Figure 43** shows the monthly average charter rates of trip time fixtures and **Figure 44** shows the monthly average freight rates of single voyage fixtures, for the three most important cargo types seperately.

The index is composed according to the following formula:

$$Charter\ Index_i = \frac{CharterRate_{i,j}}{AverageCharterRate_j} * 100$$

The multiplication factor 100 is used to get easier readable results.

Deviations
The basic assumption is that in this way the relative performance of the ships is obtained, while the unpredictable 'noise' of the world economy is neutralized. The cycle fluctuation will be filtered out. An index level can be set (in this case set to 100) and the fixtures with the highest deviations can be detected. The deviation of each fixture type is determined in the following paragraphs.
To determine which ships to select for a more detailed analysis, boundary levels are determined. These boundary levels may not be too small because too many vessels would be selected, and for a large boundary level, the selected number of ships would be too small. When not enough ships and fixtures are selected the boundaries have been adjusted.

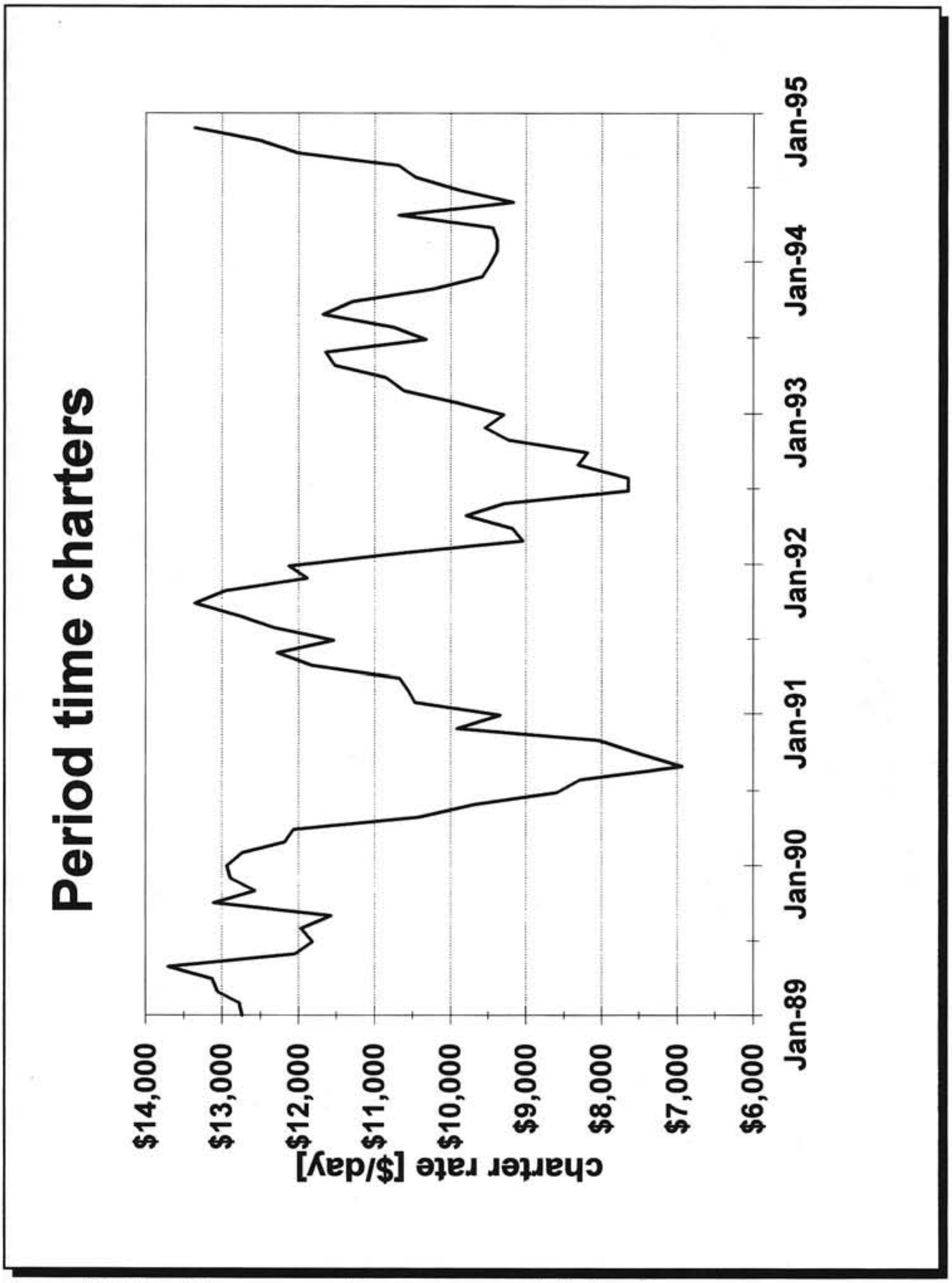


Figure 42: Monthly average charter rates, period time fixtures

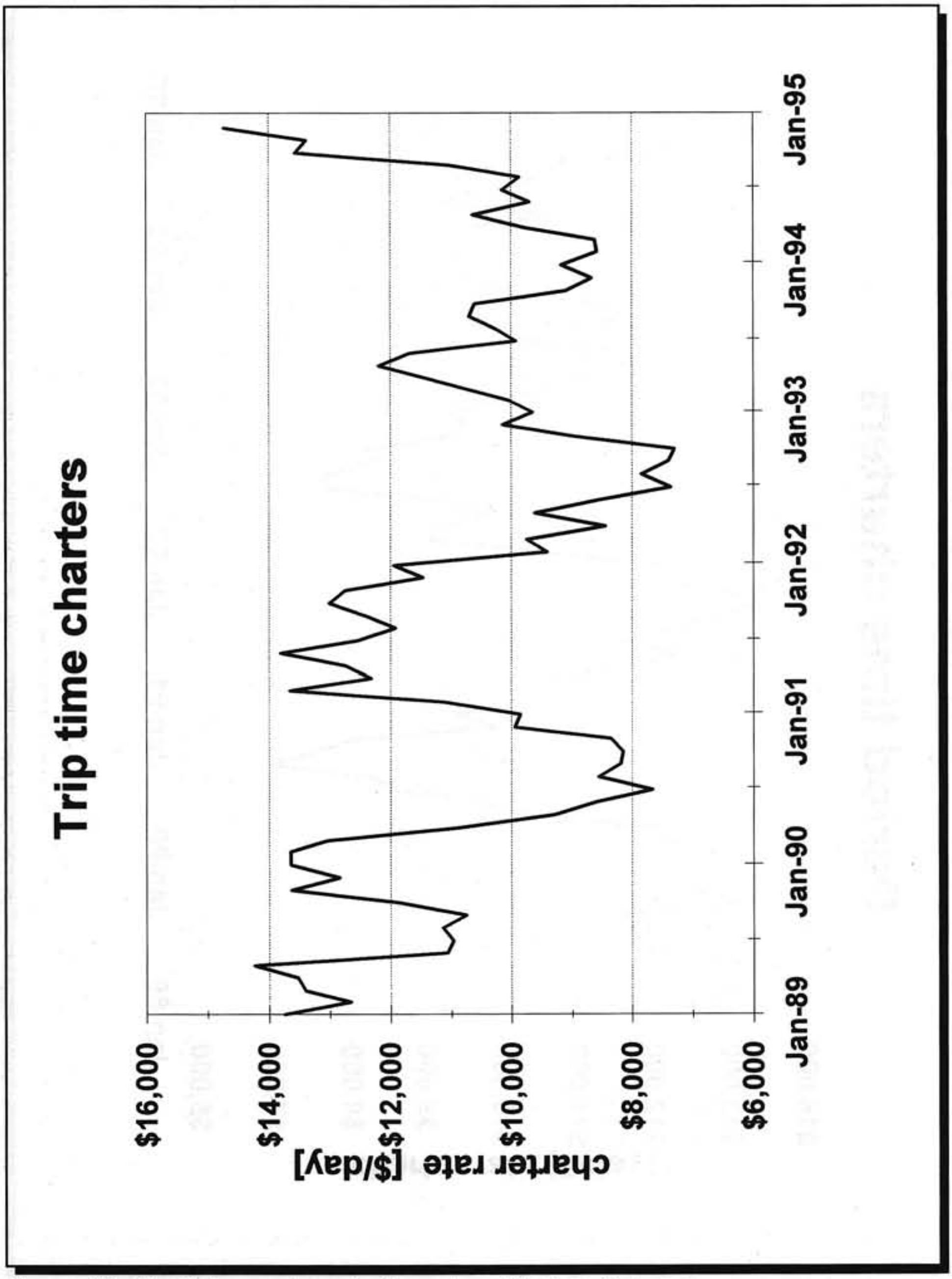


Figure 43: Monthly average charter rates, trip time fixtures

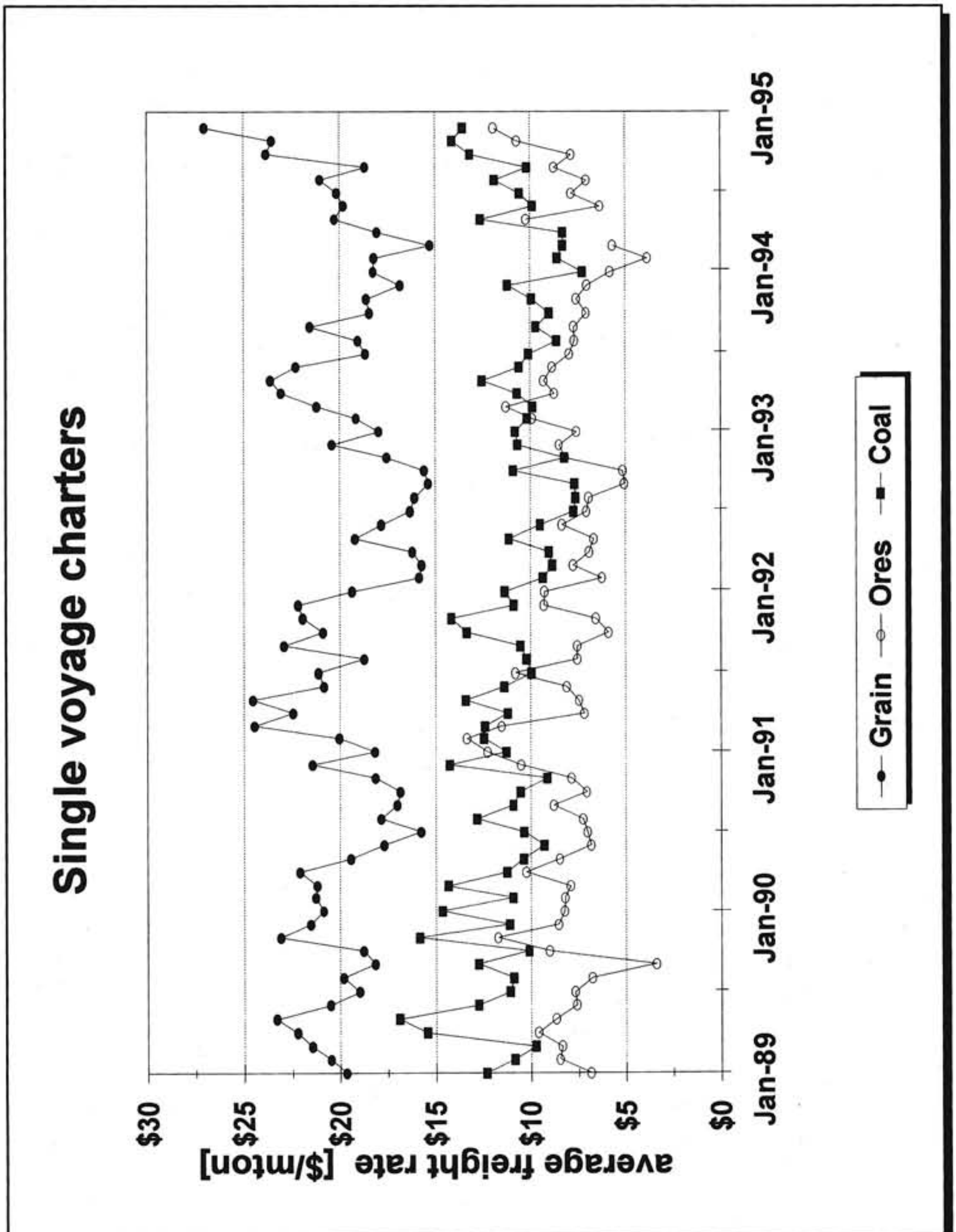


Figure 44: Monthly average freight rates, single voyage fixtures for each cargo type

The boundary level has to vary at least 10% from the index level (100), to filter out most of the 'noise' induced by the economic business cycles.

The market is self regulating, regulated by supply and demand for ships' capacity. If demand for ships is high, the charter rates will increase and if demand for ships is low, charter rates will decrease. This is why this market is very efficient. A deviation of 10% is rather high. The average charter rates of all period time fixtures, is about $10,000/day. Suppose a ship outperforms and gets a 10% higher rate. This means that the ship earns about $1,000 per day more or on an annual basis 350 * $1,000 = $350,000.

For a first selection the boundary levels will be set at 100 plus Standard Deviation for the upper boundary, and 100 minus Standard Deviation for the lower boundary. Or in formula:

$$\textit{Upper Limit} = 100 + \sigma \qquad \textit{Upper Limit} = 100 - \sigma$$

The standard deviations (σ) is calculated as one of the important statistical data of the histogram.

Fixtures with an index figure higher than the upper limit and fixtures with an index figure lower than the lower limit will be selected for further analysis.

Which causes can be identified as being important for the deviations of the index figures? Possible major causes are:

* Differences of contracts per fixture type;
* Market mechanics;
* Quality of the ship.

Differences of contracts
The differences of the contracts are for example positioning, type of contract, loading and discharging area, the duration period, the cargo type, sailing distance.

Market mechanism
The general market cycles have been eliminated by the indexes. Since, there are so many shipowners with only a small number of ships, the market is very diverse. Not one single shipowner is able to determine the market.

Quality of the ships
The quality of the ship does not only concern the technical performance, but also the management, the crew, the flag state and the reliability, though the crew and the reliability cannot be expressed in an index figure.

One of these items has to be the cause of a much higher or lower charter rate than average. The objective of this research is to find an explanation for the differences of the index figure. These differences may also depend on the various design and operating characteristics of the ships.

The index of each fixture type will be discussed in the following paragraphs. Paragraph 10.1 discusses the period time fixtures, Paragraph 10.2 discusses the trip time fixtures and paragraph 10.3 discusses the single voyage fixtures.

10.1 Period time charter index

Figure 45 shows the period time charter index of 1989 up to and including 1994. **Figure 46** shows a histogram and several statistical data. The lowest index is 28.85 and the highest is 158.65.

The total number of the period time fixtures is 1002. **Figure 45** shows a narrow range with almost all index figures in it. The width of this range is about 40% of the index level (100), the range of the index figure is from 80 to 120.

The limits
The Standard Deviation is 10.14, according to **Figure 46**.
The lower limit: $100 - \sigma = 100 - 10.14 = 89.86$ and
The upper limit: $100 + \sigma = 100 + 10.14 = 110.14$
The selected ships and fixtures will have to meet the following requirements:

$$Index_i \leq 89.86 \qquad\qquad Index_i \geq 110.14$$

i = 1..n fixture

With this selection, about 150 ships and 179 fixtures are selected for further analysis. This number of fixtures is small. It means that over the 6 considered years, each month only an average of 4 fixtures are selected. Another point of consideration, is that the number of times a ship is more than once in this list, is low. Only 19 vessels are twice or more times in the list. Only 4 vessels are three of more times in the list while only 1 vessel is 4 times in the list.

By decreasing the boundary levels more vessels will be selected and the number of times vessels will show in the list increases. However, the standard deviation is already a very low 10%. By decreasing the boundary levels, an unacceptable decrease in accuracy will appear in the results.

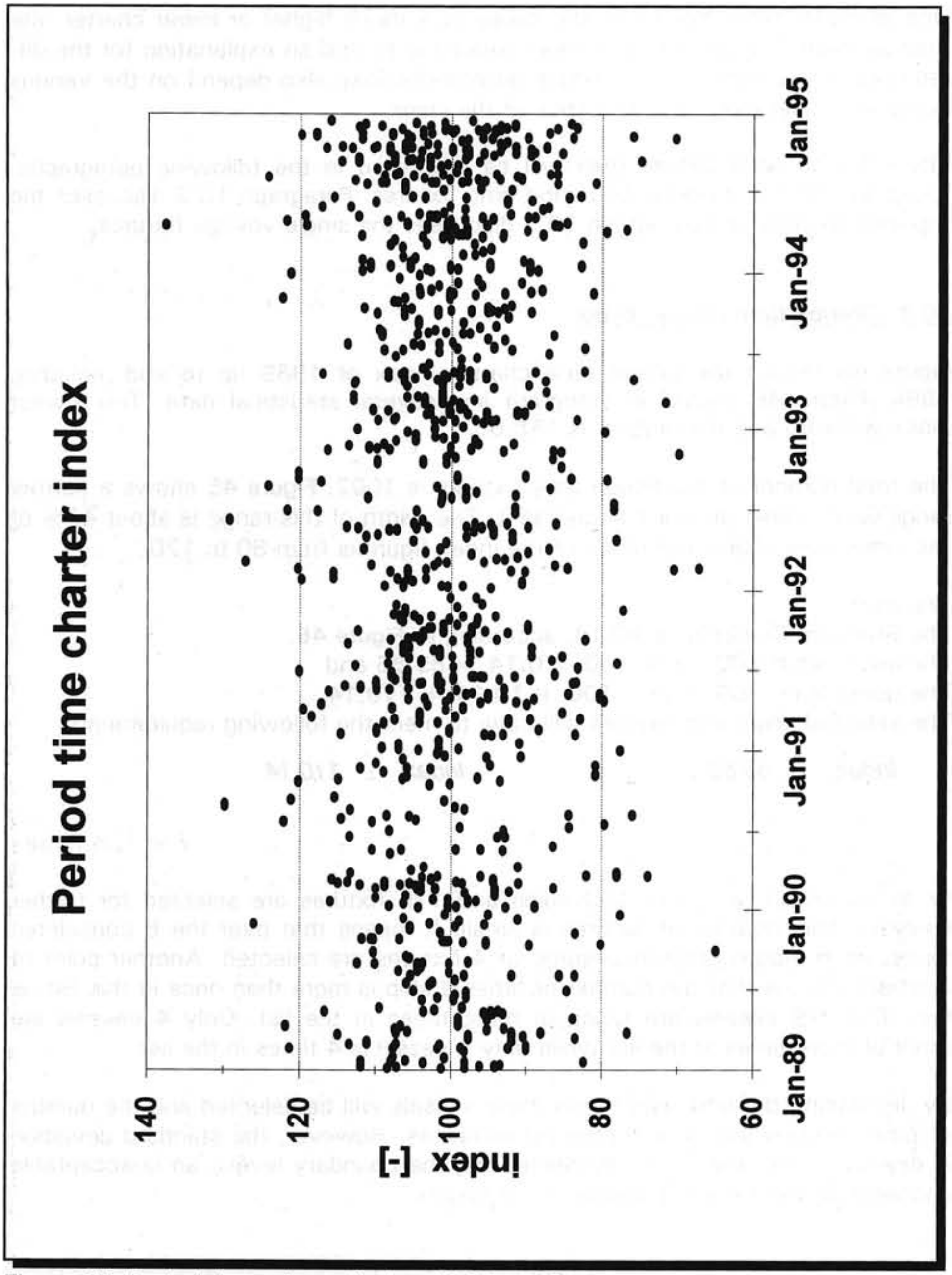
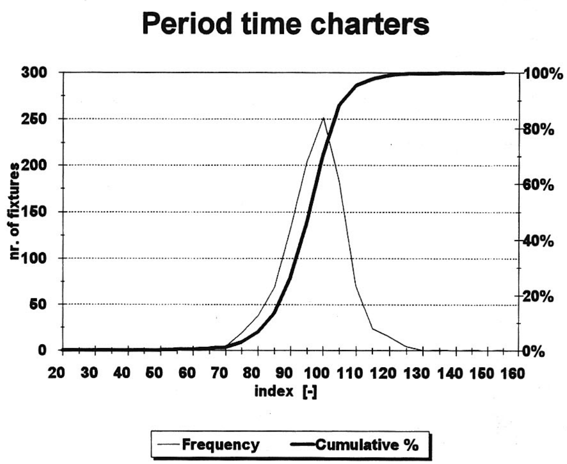


Figure 45: Period time charter index 1989 - 1994

Histogram :

Index value	Frequency	Cumulative %
20	0	0.00%
25	1	0.10%
30	0	0.10%
35	0	0.10%
40	0	0.10%
45	0	0.10%
50	1	0.19%
55	3	0.49%
60	1	0.58%
65	2	0.78%
70	5	1.26%
75	19	3.11%
80	38	6.80%
85	69	13.51%
90	132	26.34%
95	204	46.16%
100	252	70.65%
105	184	88.53%
110	71	95.43%
115	24	97.76%
120	15	99.22%
125	5	99.71%
130	0	99.71%
135	1	99.81%
140	0	99.81%
145	1	99.90%
150	0	99.90%
155	1	100.00%
160	0	100.00%



Statistical :	Index
Mean	100.00
Standard Error	0.37
Median	100.63
Mode	101.32
Standard Deviation	10.14
Variance	104.35
Kurtosis	4.91
Skewness	-0.46
Range	129.81
Minimum	28.85
Maximum	158.65
Sum	102904
Count	1029
Confidence Level(0.99)	0.82

Figure 46: Histogram period time charter index 1989 - 1994

10.2 Trip time charter index

Figure 47 shows the trip time charter index from 1989 up to and including 1994. **Figure 48** shows a histogram and several statistical data. The lowest index is 59.76. and the highest is 205.24.

The total number of the trip time fixtures is 4879. **Figure 47** shows a wide range. The width of this range is about 40% of the index level.

The limits
The Standard Deviation is 17.58, according to **Figure 48**:
The lower limit: 100 - σ = 100 - 17.58 = 82.42 and
The upper limit: 100 + σ = 100 + 17.58 = 117.58
The selected ships and fixtures will have to meet the following requirements:

$$Index_i \leq 82.42 \qquad Index_i \geq 117.58$$

i = 1..n fixture

51 ships and 316 fixtures are selected.

10.3 Single voyage charter index

Figure 49 shows the single voyage charter index 1989-1994. **Figure 50** shows a histogram and several statistical data. The lowest index is 19.63, the highest is 428.04. There are two peaks in the frequency line of the index-histogram. This means that perhaps, a differentiation has to be made. First a differentiation in cargo types will be made.

The total number of the single voyage fixtures is 3,605. **Figure 51** is the same figure as **Figure 49**, however, in this figure index figures higher than 200 are eliminated. It shows a wide range. The width of this range is about 75.

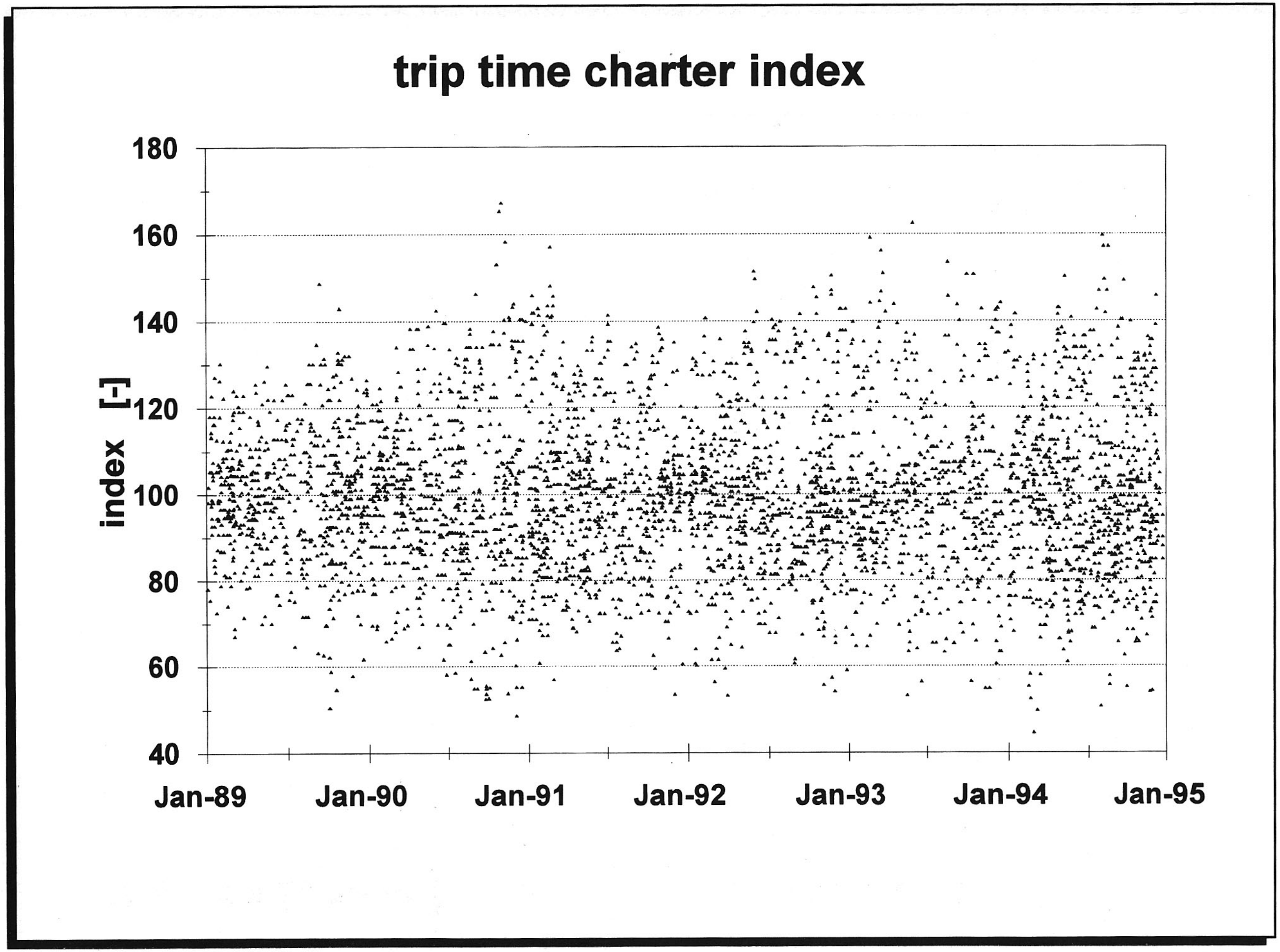
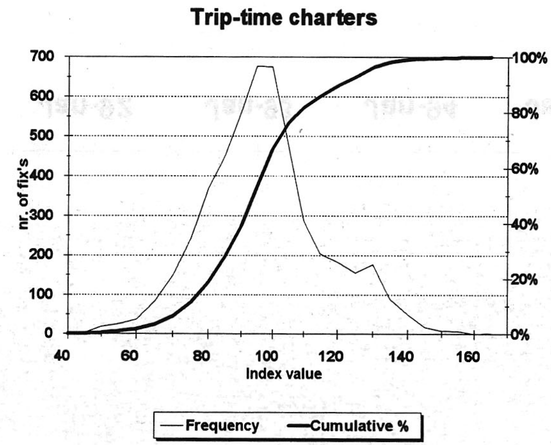


Figure 47: Trip time charter index 1989 - 1994

Index value	Frequency	Cumulative %
40	1	0.02%
45	2	0.06%
50	19	0.44%
55	26	0.97%
60	37	1.72%
65	83	3.39%
70	149	6.40%
75	244	11.32%
80	370	18.79%
85	450	27.87%
90	563	39.23%
95	677	52.90%
100	676	66.54%
105	477	76.17%
110	286	81.94%
115	203	86.03%
120	183	89.73%
125	156	92.88%
130	176	96.43%
135	90	98.24%
140	50	99.25%
145	18	99.62%
150	9	99.80%
155	7	99.94%
160	1	99.96%
165	2	100.00%



Statistical :	Index values
Mean	100.00
Mean	100.00
Standard Error	0.25
Median	98.95
Mode	91.25
Standard Deviation	17.58
Variance	310.03
Kurtosis	0.23
Skewness	0.32
Range	122.69
Minimum	44.64
Maximum	167.33
Count	4955.00
Confidence Level (0.99)	0.64

Figure 48: Histogram trip time charter index 1989 - 1994

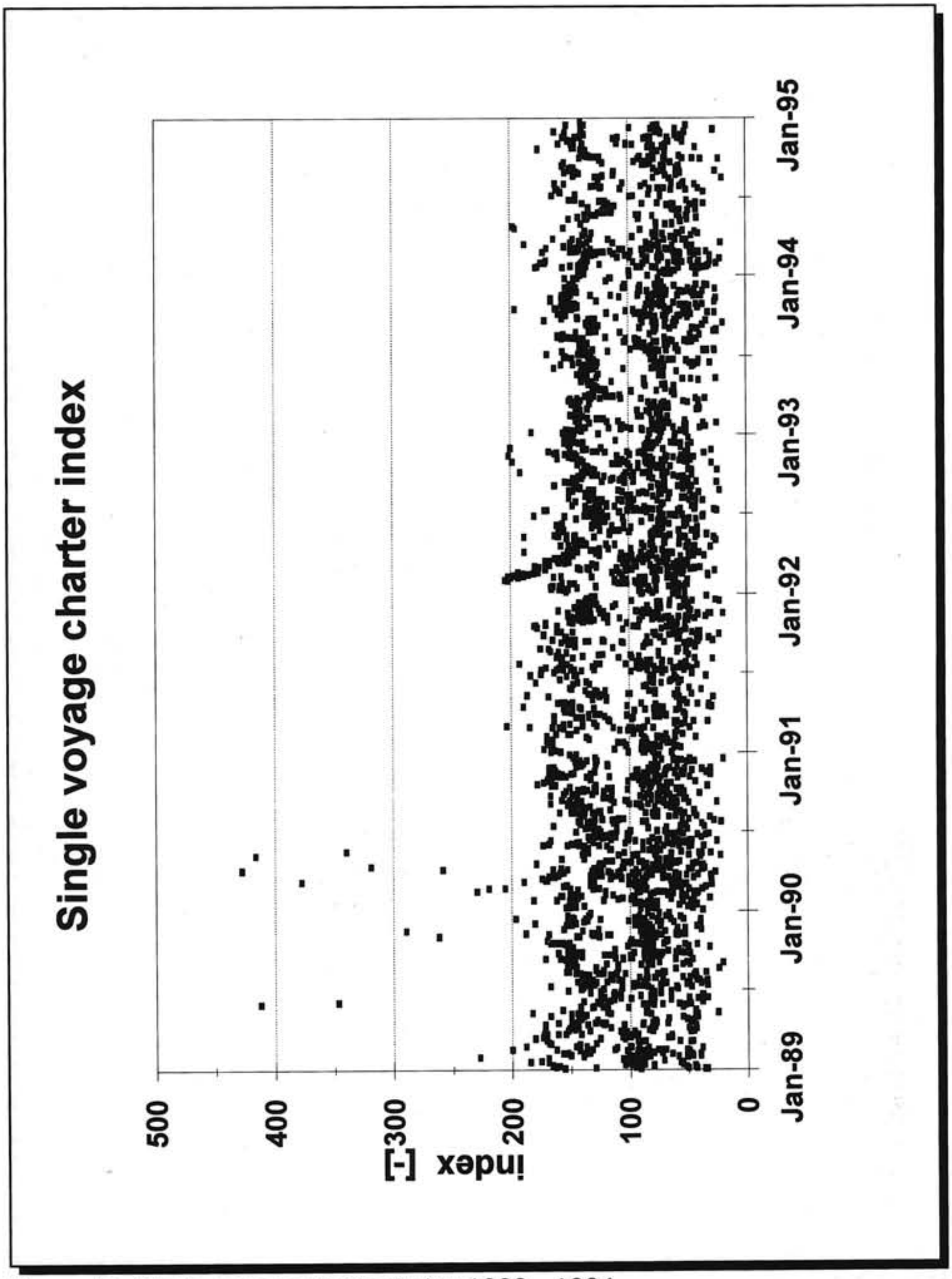
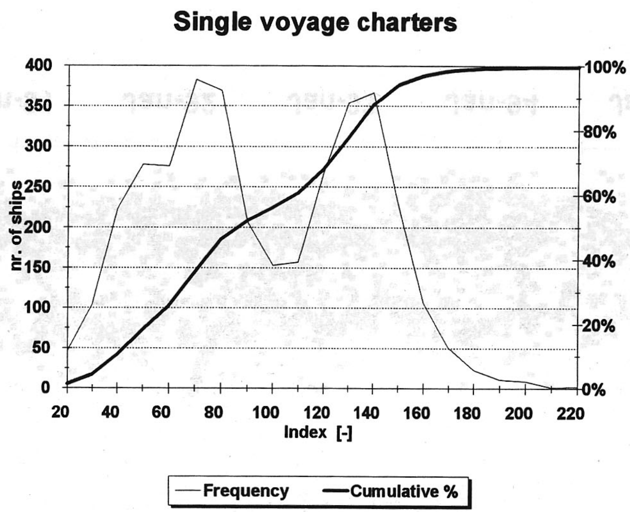


Figure 49: Single voyage charter index 1989 - 1994

Index	Frequency	Cumulative %
20	47	1.30%
30	104	4.16%
40	224	10.34%
50	278	18.00%
60	276	25.61%
70	383	36.16%
80	370	46.36%
90	207	52.07%
100	153	56.28%
110	157	60.61%
120	267	67.97%
130	354	77.73%
140	367	87.84%
150	228	94.13%
160	106	97.05%
170	51	98.46%
180	23	99.09%
190	11	99.39%
200	9	99.64%
210	1	99.67%
220	2	99.72%
230	0	99.72%
240	0	99.72%
250	1	99.75%
260	1	99.78%
270	0	99.78%
280	1	99.81%
290	0	99.81%
300	0	99.81%
310	1	99.83%
320	0	99.83%
330	1	99.86%
340	1	99.89%
350	0	99.89%
360	0	99.89%
370	1	99.92%
380	0	99.92%
390	0	99.92%
400	0	99.92%
410	2	99.97%
420	1	100.00%



Statistical :	Index
Mean	102.17
Standard Error	0.75
Median	96.51
Mode	129.37
Standard Deviation	42.14
Variance	1774.82
Kurtosis	2.77
Skewness	0.67
Range	408.42
Minimum	19.63
Maximum	428.04
Sum	370771
Count	3629
Confidence Level(0.990)	1.80

Figure 50: Histogram single voyage charter index 1989 - 1994

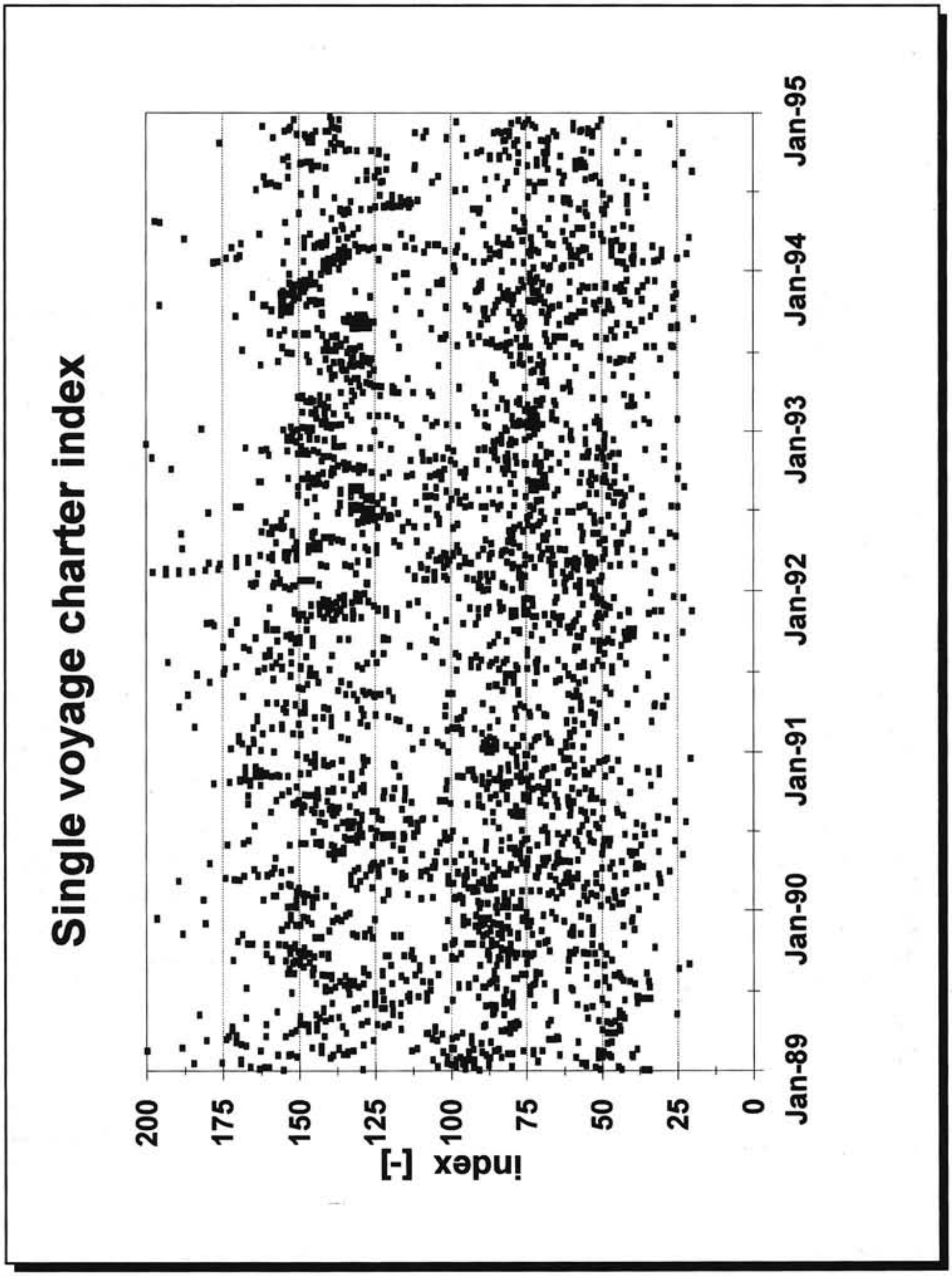


Figure 51: Single voyage charter index 1989 - 1994 (reduced)

The limits
The Standard Deviation is 42.14, according to **Figure 50**:
The lower limit: 100 - σ = 100 - 42.14 = 57.86 and
The upper limit: 100 + σ = 100 + 42.14 = 142.14
The selected ships and fixtures will have to meet the following requirements:

$$Index_i \leq 57.86 \qquad\qquad Index_i \geq 142.14$$

i = 1..n fixture

The standard deviation is nearly half of the index level, so it is much too large. A differentiation in commodities will be made. As discussed in paragraph 9.3, not enough fixtures are collected to justify the continuation of the analysis of the following commodities:

* Fertilizers;
* Sugar;
* Ores;
* Coal.
* Miscellaneous;

The only commodity which is analysed further, is Grain.

Figure 52 shows the single voyage charter grain index 1989-1994. The following figure shows the nearly the same picture, but the index figures higher than 200 have been eliminated. **Figure 53** shows the grain index histogram and several important statistical data.

The histogram shows that at the frequency line there are still two peaks. The first peak is around an index figure of 75 and the second one around an index figure of 140. Since only one peak should occur in the frequency line, as in **Figure 45** and in **Figure 47**, another differentiation has to be made. The problem is, which differentiation has to be made? The most probable differentiation is in loading and/or discharging ports.

Figure 16 shows that a differentiation of discharging ports, ports of destination as they are called by Plymouth, is likely. The two largest importing continents are Asia and Europe. **Figure 54** shows the grain index of fixtures with destination North or South Europe (area codes 1 or 2 of **Appendix A2**) and **Figure 55** shows the grain index of fixtures with destination Japan, South Asia or Far East (area codes 5, 6 or 7 of **Appendix A2**)

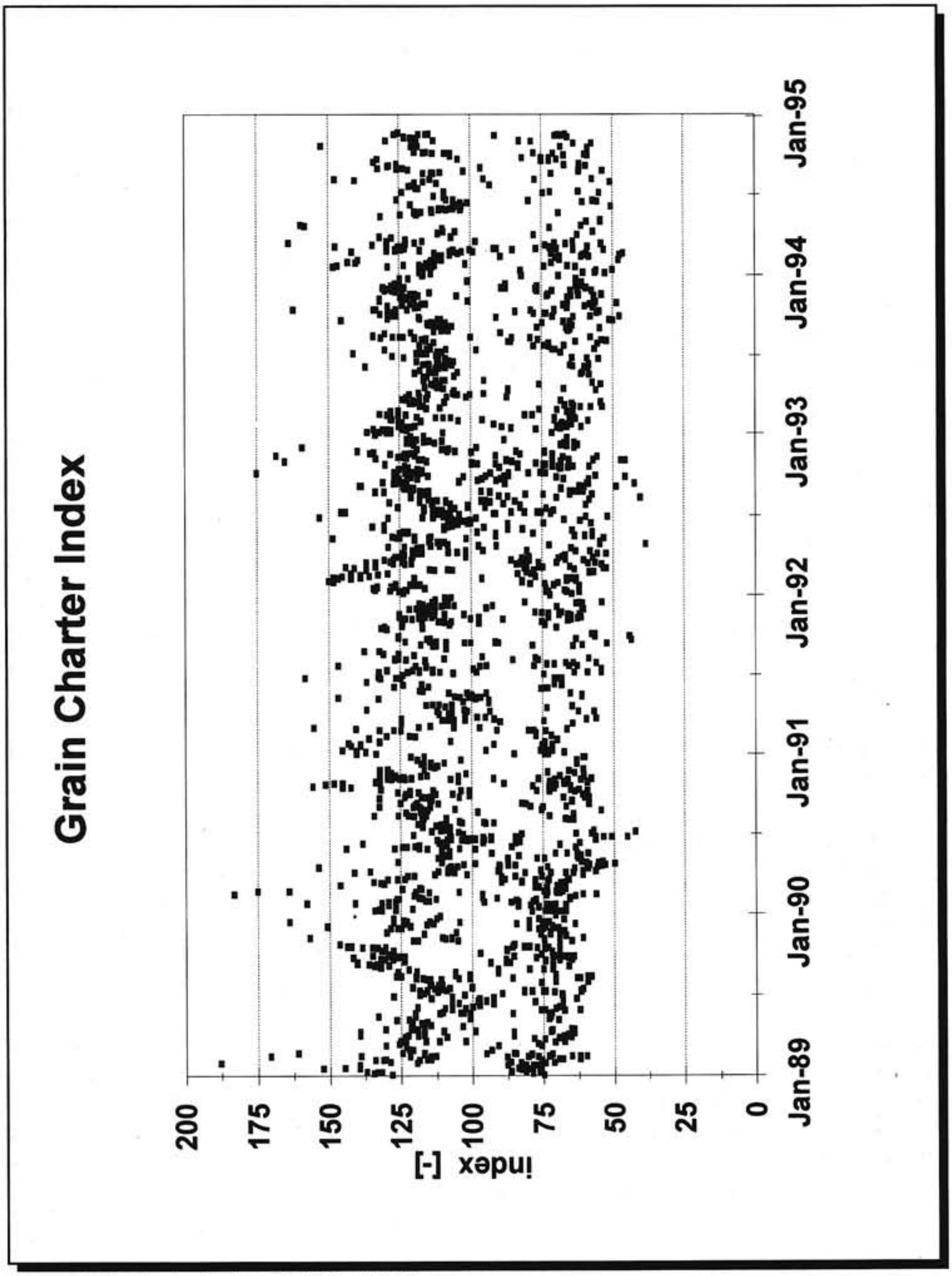
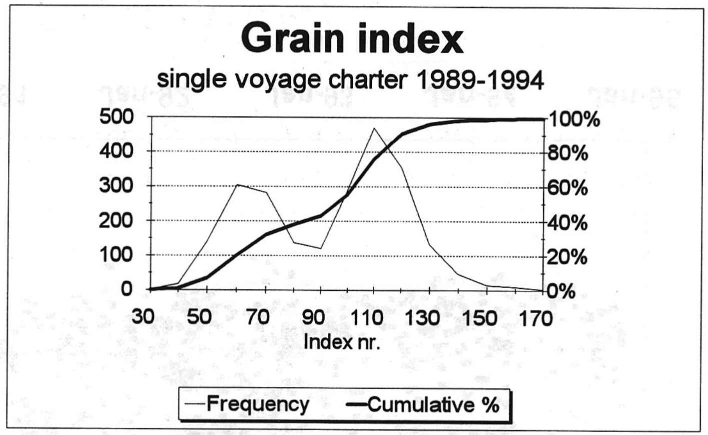


Figure 52: Grain index 1989 -1994

Grain Index value	Frequency	Cumulative %
30	1	0.04%
40	18	0.81%
50	142	6.88%
60	305	19.92%
70	282	31.98%
80	137	37.84%
90	121	43.01%
100	288	55.32%
110	471	75.46%
120	355	90.64%
130	132	96.28%
140	48	98.33%
150	15	98.97%
160	10	99.40%
170	3	99.53%
180	2	99.62%
190	0	99.62%
200	0	99.62%
210	1	99.66%
220	1	99.70%
230	0	99.70%
240	1	99.74%
250	0	99.74%
260	0	99.74%
270	2	99.83%
280	0	99.83%
290	2	99.91%
300	0	99.91%
310	0	99.91%
320	0	99.91%
330	1	99.96%
340	0	99.96%
350	0	99.96%
360	1	100.00%



Statistical :	Grain index
Mean	100.00
Standard Error	0.63
Median	106.61
Mode	0.00
Standard Deviation	28.76
Variance	827.20
Kurtosis	5.58
Skewness	0.28
Range	367.28
Minimum	38.56
Maximum	367.28
Sum	233899.97
Count	2354.00
Confidence Level(0.990)	1.53

Figure 53: Grain index, destination Asia

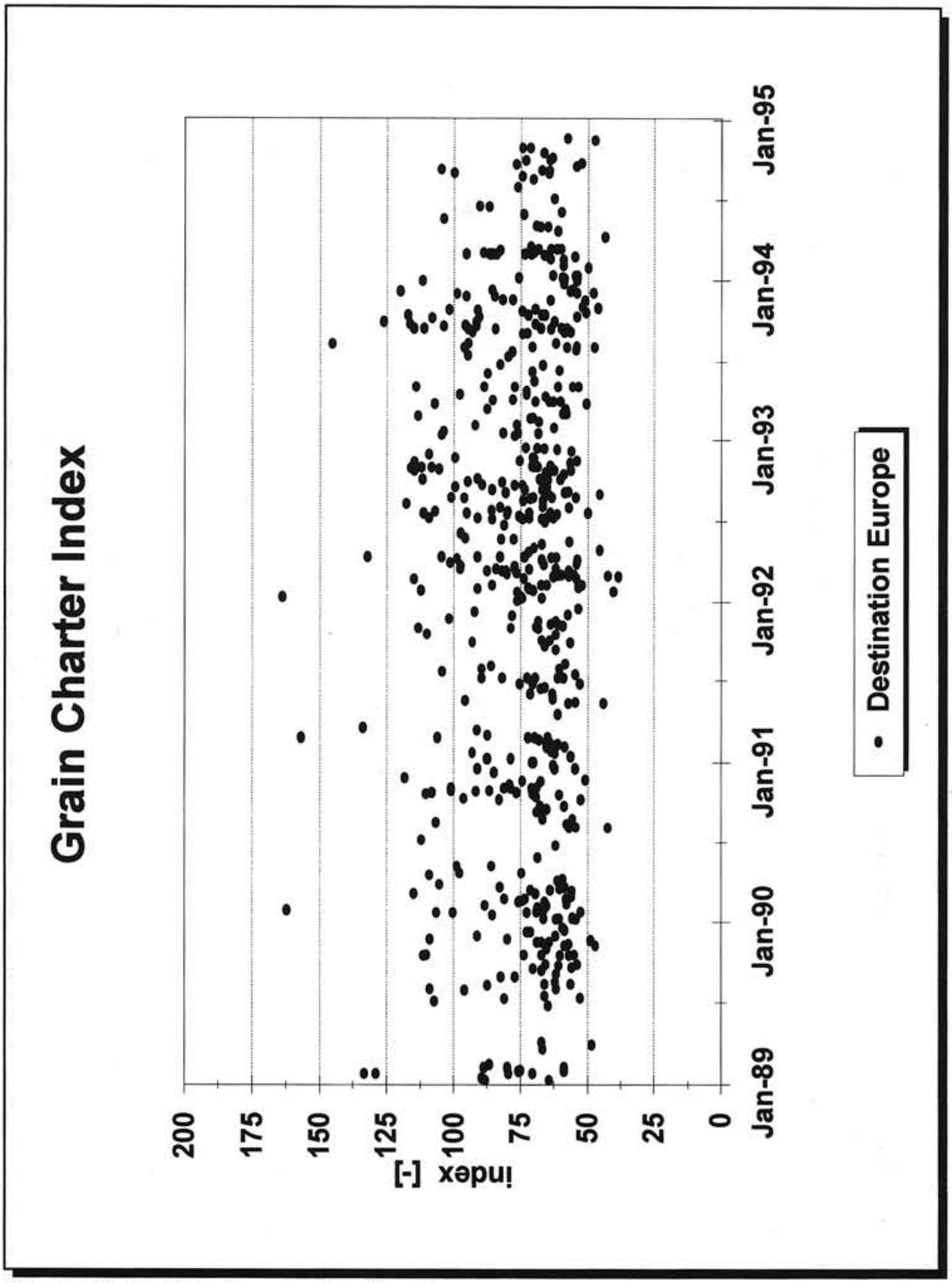


Figure 54: Grain index, destination Europe

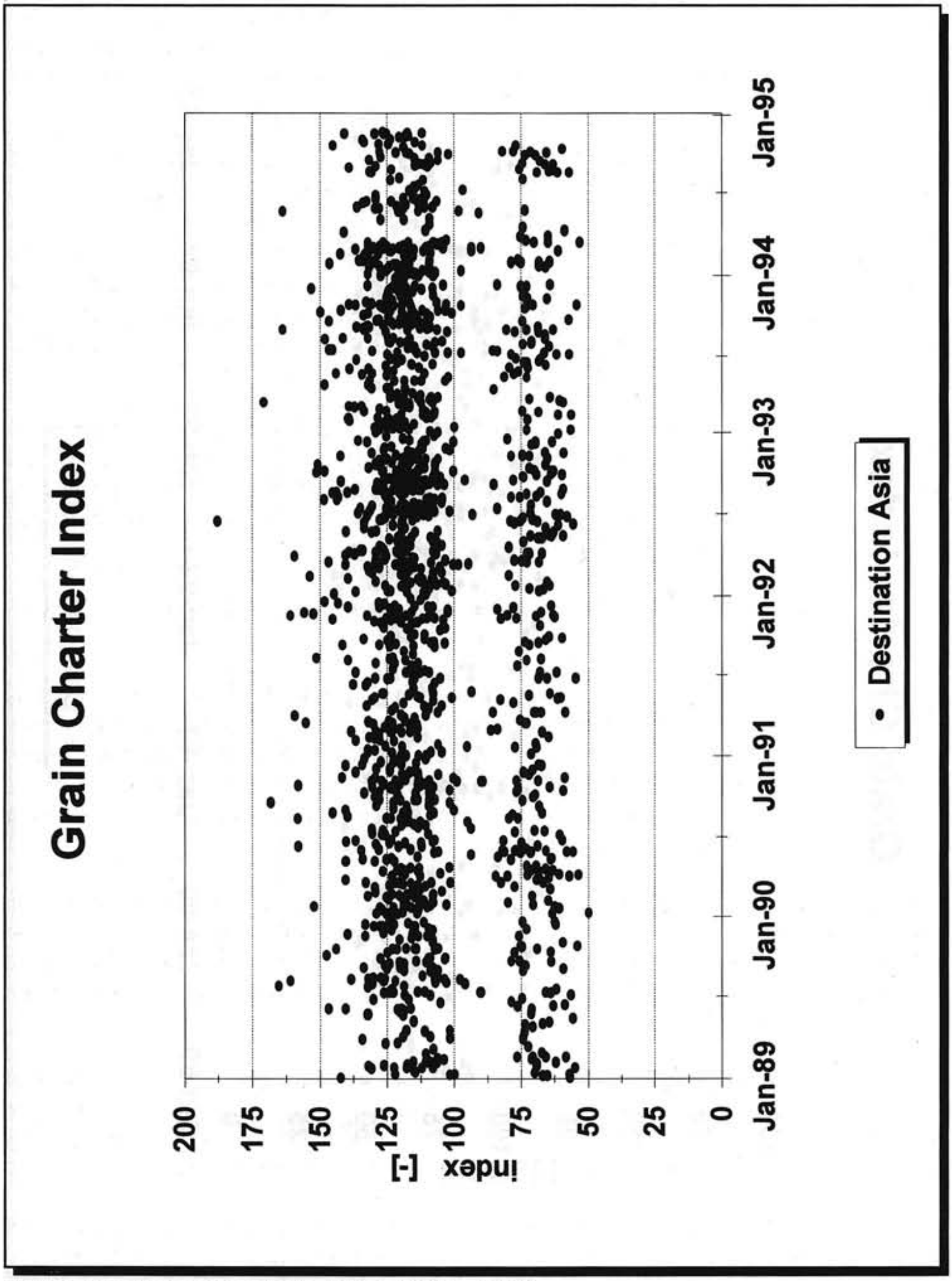


Figure 55: Histogram grain index 1989 -1994

Many fixtures with destination Europe have an index figure lower than 100, while most fixtures (955 out of 1302 or 73.3%) to Asia have an index figure higher than 100. This means that there are still 347 fixtures (or 26.7%) with an index figure lower than 100. Therefore, this is not the right differentiation.

A differentiation of loading ports, ports of origin as they are called by Plymouth, seems not usefull according to **Figure 13**. There is only one continent which exports large amounts of cargo, North America. However, **Figure 13** represents all fixtures with ports of origin in North America. But North America is very large and ports are situated at the east, the south and at the west coast. The two largest importers, Europe and Asia, are known. These continents are situated at different sides of North America. So, the right differentiation is a differentiation in loading ports, from east coast and west coast North America.

Figure 54, the grain index for ships with destination Europe, shows that most index figures are lower than 100, which means that the charter rates are lower than the monthly avererage. About 15% of these fixtures have a higher index than 100. **Table IX** gives the number of fixtures with different loading ports, all with destination Europe.

Of all 468 grain fixtures with destination Europe, 374 load at the U.S. Gulf, (nearly 80%).

Figure 55 shows the grain index for fixtures with destination Asia. The fixtures in the largest group have higher index figures than 100, while the fixtures in the smaller group have index figures lower than 100. The difference between these groups is that the first, large group has its loading ports at the east coast of North America, while the second, small group has its loading port at the west coast of North America. **Figure 56** shows this clearly

Table X gives the same data for fixtures with destination Asia. **Table X** shows clearly that fixtures with an index figure lower than 100 have a loading port at the west coast of North America (93.7%), while fixtures with an index figure higher than 100, so a higher charter rate, have a loading port at the east coast of North America (93.2%).

The reason of this behaviour is rather simple. The distance sailing from the east coast of North America to Asia is about twice as long as the distance from the west coast of North America to Asia. The sailing distance is longer, so the sailing time is longer, which means that the costs are much higher.

Concluding, the charter rates of single voyage charters depend very much on the sailing distance between the loading and the discharging port, so the trading routes, mentioned in the fixture.

Index < 100		***Index > 100***	
Port of origin	*Nr. of fixtures*	*Port of origin*	*Nr. of fixtures*
4. U.S. Gulf	23	2. St. Lawrence	5
9. W.C.North America	**320 (93.7%)**	3. U.S. Atlantic	12
16. Australia	4	**4. U.S. Gulf**	**890 (93.2%)**
		6. Brazil	6
		7. Argentina	16
		9. W.C.North America	6
		10. North Africa	8
		17. Far East	1
		18. Other	11

Table IX: Grain index, destination Asia

Figure 54, **Figure 55** and **Figure 56** show that the range width of the fixtures is small. Calculating the monthly averages, depending on destination and port of origin, and selecting fixtures with a higher deviation than 10% is of little use. Since the range width is rather small, only a few ships will be selected. This is not enough to make a more detailed analysis.

Chapter 11 gives the selected ships. Only some ships have a larger deviation than 10% for the period time charters. So, not enough to make a selection. The same goes for single voyage charters. Therefore only ships sailing in trip time charter will be selected and discussed in detail.

Index < 100		***Index > 100***	
Port of origin	*Nr. of fixtures*	*Port of origin*	*Nr. of fixtures*
2. St. Lawrence	19	2. St. Lawrence	2
3. U.S. Atlantic	10	**4. U.S. Gulf**	**56 (87.5%)**
4. U.S. Gulf	**318 (78.3%)**	7. Argentina	4
6. Brazil	30	18. Other	2
7. Argentina	1		
9. W.C.North America	5		
10. North Africa	4		
17. Far East	8		
18. Other	9		

Table X: Grain index, destination Europe

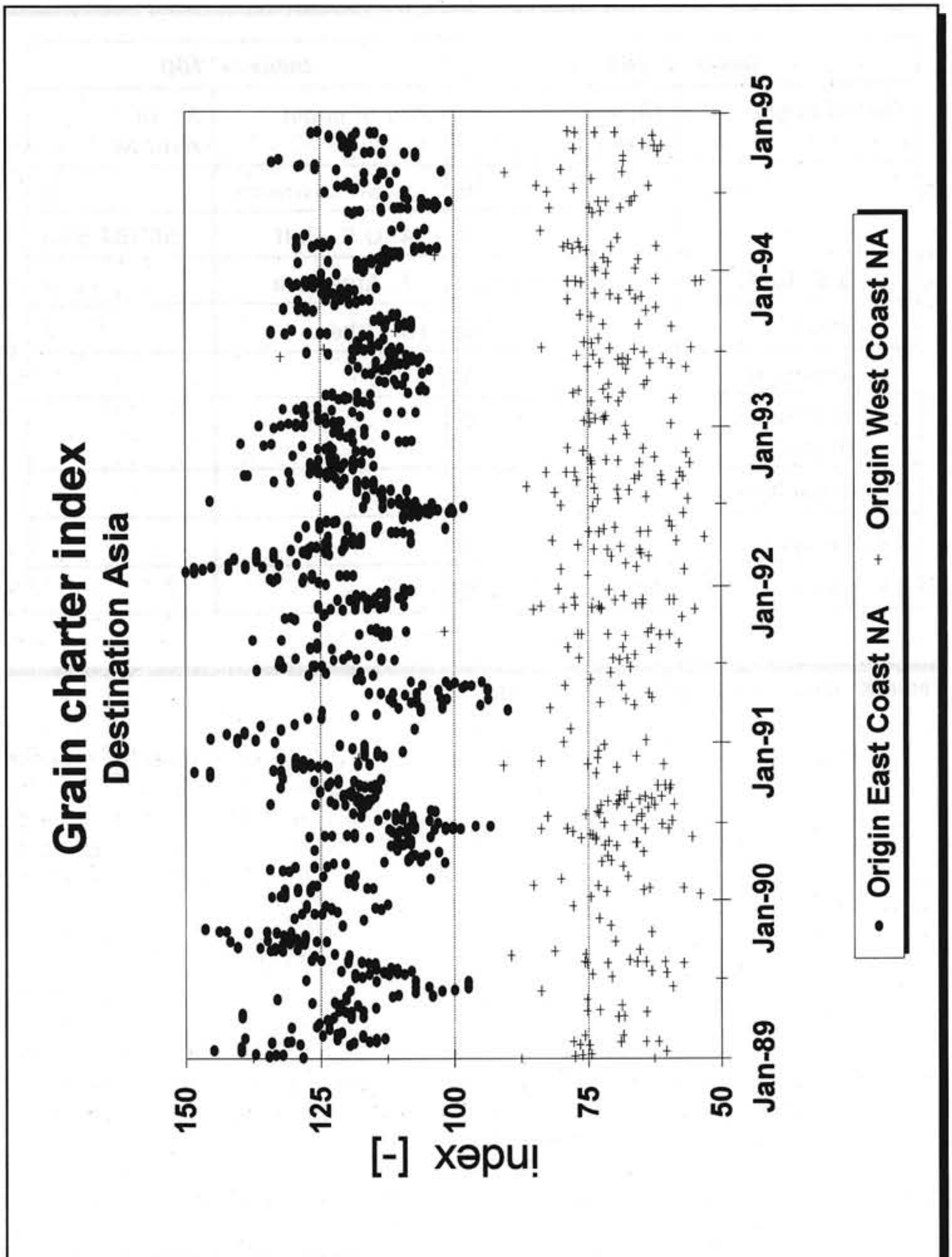


Figure 56: Grain index, destination Asia and different loading ports

11 SELECTION OF SHIPS

The selection of the ships is based only on trip time fixtures, since it is not possible to select enough ships for period time charters and single voyage charters.

The selection of the ships depends on the number of times the ships has an index figure (= 100) lower than 82.42 (100 minus the standard deviation) or higher than 117.58 (100 plus the standard deviation). These are ships which substantially under-, respectively outperform. To get this selection, a list has been made containing all 834 bulk carriers in the panamax DWT-range of the Clarkson Database. This list contains also the number of times, each ship under, respectively outperforms as well as the summation of under- and outperformces. To make the selection more clear, the percentage of under- and outperformce has been stated.

Of all 834 ships, nearly 500 ships occur more than once in the list, making a total of about 1400 fixtures. To reduce this number, another selection has to be made. This selection is based on selecting the vessels, which are stated more than five times in the above mentioned list. A differentiation in under- and outperformance will be made.

Outperformance
This list concerns ships which occur at least 5 times in the Plymouth Database and with index figures higher than 117.58. The selection is as follows: the percentage of occurence of the index figures higher than 117.58 has to be at least 75%. This means that if a ship occurs 8 times in the Plymouth Database, the number of times it outperforms is at least 6. See **Table XI** for more details of the selection criteria.

This selection procedure gives the following ships, see **Table XIII**.

Underperformance
This selection criteria selects ships with index figures less than 82.42. These ships have to be in the list at least 5 times, and the percentage of occurence lower than 82.42 has to be at least to 75% of the total occurence. The number of underperformances is mentioned in **Table XII**

This selection procedure gives the following ships, see **Table XIV**.

Total number of occurence	***Least number of outperformance***	***Percentage of outperformance***
12	9	75
11	9	82
10	8	80
9	7	78
8	6	75
7	6	86
6	5	83
5	5	100

Table XI: Outperformance selection criteria

Total number of occurence	***Least number of underperformance***	***Percentage of underperformance***
10	8	80
9	7	78
8	6	75
7	6	86
6	5	83
5	5	100

Table XII: Underperformance selection criteria

Table XIII: Outperforming ships

CLKSN_CODE	NAME	TOTAL nr. of FIX'S	Nr. of FIX's > 117.58	Nr. of FIX's < 82.42	Perc (>) (%)	Perc (<) (%)
405827	Petropolis	6	5	1	83.33%	16.67%
406441	Petriana	5	4	1	80.00%	20.00%
406529	Ascona	11	10	1	90.91%	9.09%
406536	Vitali	6	5	1	83.33%	16.67%
406565	Atlantic Splend	5	4	1	80.00%	20.00%
406580	Titian Jaya	8	6	2	75.00%	25.00%
406592	Titus	9	8	1	88.89%	11.11%
406636	Atlantic Statesr	5	5	0	100.00%	0.00%
406642	Anangel Expres	5	5	0	100.00%	0.00%
406852	Lamyra	5	5	0	100.00%	0.00%
406910	Ioannis Zafiraki	5	4	1	80.00%	20.00%
406933	Elpis	5	4	1	80.00%	20.00%
407067	Ateni	5	4	1	80.00%	20.00%
407113	Angelic Spirit	9	8	1	88.89%	11.11%
407168	Amorgos	12	9	3	75.00%	25.00%
407264	California	5	4	1	80.00%	20.00%
407402	Madonna Lily	5	5	0	100.00%	0.00%
407472	Atlantic Savior	6	5	1	83.33%	16.67%
407645	Bulktrieste	6	5	1	83.33%	16.67%
408125	Ios	9	7	2	77.78%	22.22%
408126	Flavia	6	6	0	100.00%	0.00%
408333	Oinoussian Fat	5	4	1	80.00%	20.00%
408335	Oinoussian Nav	8	7	1	87.50%	12.50%
408385	Crystal Grace	5	4	1	80.00%	20.00%
408410	Glory Cape	5	4	1	80.00%	20.00%
408610	Baumare II	7	6	1	85.71%	14.29%
408741	Anangel Ventur	8	7	1	87.50%	12.50%
408745	Sapphire	5	5	0	100.00%	0.00%
408773	Mui Kim	5	5	0	100.00%	0.00%
408778	Western Trade	5	4	1	80.00%	20.00%
408819	Sindia	5	5	0	100.00%	0.00%
408854	Maritime Grace	5	4	1	80.00%	20.00%
		201	173	28		

Selected ships with the following selection criteria :

- ***Index figures are at least larger than 117.58 or smaller than 82.42***
- ***Total selected fixtures are more than 5***
- ***Perc(G) is larger than 75%***

Table XIV: Underperforming ships

CLKSN_CODE	NAME	TOTAL nr. of FIX'S	Nr. of FIX's > 117.58	Nr. of FIX's < 82.42	Perc (>) (%)	Perc (<) (%)
402989	Thios Costas	6	0	6	0.00%	100.00%
403225	Marijeannie	5	0	5	0.00%	100.00%
403229	Zouzou	11	0	11	0.00%	100.00%
403250	Sea Sky	6	0	6	0.00%	100.00%
403328	Sirena	5	0	5	0.00%	100.00%
403360	Caryanda	9	0	9	0.00%	100.00%
403363	Global Makatcl	5	1	4	20.00%	80.00%
403371	Marylou II	7	0	7	0.00%	100.00%
403492	Pontus	5	0	5	0.00%	100.00%
404152	Nena	5	1	4	20.00%	80.00%
404302	Sea Luck	5	0	5	0.00%	100.00%
404362	Zalongo	6	1	5	16.67%	83.33%
404385	Meraklis	7	0	7	0.00%	100.00%
404386	Minos	5	0	5	0.00%	100.00%
404412	Strahlhorn	5	1	4	20.00%	80.00%
404438	Jalavijaya	8	0	8	0.00%	100.00%
404872	Velos	5	1	4	20.00%	80.00%
405837	Heliopolis	5	1	4	20.00%	80.00%
406907	Akrop	5	1	4	20.00%	80.00%
		115	7	108		

Selected ships with the following selection criteria :

- ***Index figures are at least lrager than 117.58 or smaller than 82.42***
- ***Total selected fixtures are more than 5***
- ***Perc(K) is larger than 75%***

12 VALIDATION OF THE INDEX

Before starting the analysis of the index figures, first a validation of the used method was made and checked with the results. This validation method has been used for all three fixtures types,. The used formulas will be stated here again to make the validation easier to understand.

Charter index by average charter rate
For each time interval, each month, the average charter rate is calculated by the following formula:

$$\text{Average Charter Rate}_j = \frac{\sum \text{Charter Rate}_{i,j}}{N}$$

i = 1..N fixtures per time interval
j = 1..m, time interval
N = total number of fixtures in that time interval

The index is made by using the following formula:

$$\text{Charter Index}_i = \frac{\text{Charter Rate}_{i,j}}{\text{Average Charter Rate}_j} * 100$$

The multiplication factor 100 is used to get easier readable results.

To see whether the charter index is valid, the monthly average of the charter index will be determined. It is determined by the following formula:

$$\text{Monthly Average Charter Index}_j = \frac{\sum \text{Charter Index}_i}{N}$$

Charter Index can be written in another way. Substituting this in the previous formula, it becomes:

$$\text{Monthly Average Charter Index}_i = \frac{\sum \left(\frac{\text{Charter Rate}_{i,j}}{\text{Average Charter Rate}_j} \right) * 100}{N}$$

But *Average Charter rate* can be written in the following formula way as well:

$$\text{Average Charter Rate}_j = \frac{\Sigma \ \text{Charter Rate}_{i,j}}{N}$$

Substituting this in the formula in the one standing on top of the page, gives:

$$\text{Monthly Average Charter Index}_i = \frac{\sum \left(\frac{\text{Charter Rate}_{i,j}}{\sum \frac{\text{Charter Rates}_{i,j}}{N}} \right) * 100}{N}$$

This formula can be transformed in the following way:

$$\text{Monthly Average Charter Index}_i = \left(\frac{\Sigma \ \text{Freight Rate}_{i,j}}{N} * 100\right) * \left(\frac{N}{\Sigma \ \text{Freight Rates}_{i,j}}\right)$$

So the *Monthly Average Charter Index* should be 100 for every month, which is the index level. This means that for every calculated index, the *Monthly Average Charter Index* must be checked to be 100, for every month or other time interval. This a simple calculation with a database or a spreadsheet program.

This has been checked and for every month the average charter index is indeed 100. For the trip time charter as well for the other two analysed fixture types.

13 INDEX ANALYSIS

This chapter tries to explain why the selected ships have a better performance record than the other, not selected ships, the ultimate purpose of this analysis.

This is done by showing tables, indicating design or fixture characteristics and several statistical data like the number of occurances, average charter rates, average index figures and average ages. On this basis, scatter diagrams are made in which the index figures are plotted against design characteristics. The figures show the selected outperforming and the selected underperforming ships in one figure, while other design characteristics are shown in two tables, one for the outperforming and one for the underperforming ships.

The selected ships are shown in **Chapter 11**, in **Table XII** and in **Table XIV**. The selection criteria are shown in it as well.

Number of bulk carrier
The selected outperforming ships consist of 32 bulk carriers while the under-perfoming ships form a group of 19 bulk carriers. This brings the total number of selected ships to 51 bulk carriers which will be analysed more closely. These 51 selected ships made, in the years 1989 up to and including 1994, 316 fixtures.

Flag State
Of the 51 considered ships, the total number of occurances, the total number of fixtures, the average charter rates, the average index and the average age of the ships of that flag state are given in **Table XV**.

Of all selected outperforming ships, a majority is registered in Greece. Of the selected 32 ships, 19 ships are registered in Greece. These 19 ships made 126 fixtures and earned an average charter rate of $12,677/day. The average of the index figures is 120.93. The average age at the moment the contract is signed, is stated in **Table XV** as well. The selected underperforming ships are given in **Table XVI**. Here as well most, ships are registered in Greece. The main difference between both tabes is the difference in average age of the ships. The average age of the outperforming ships is less than 8 years while the average age of the underperforming ships is about 17 years, so twice as old.

Since four countries of registry are mentioned in both tables, and the other countries of registries only have few ships registered, no conclusions can be drawn from these tables.

Flag State	*Total ships*	*Total fixtures*	*Average Rate*	*Average Index*	*Average age*
Greece	19	126	$12,677	120.93	8
Philipines	4	20	$13,050	124.82	5
Panama	3	15	$14,240	127.56	3
Norway	2	16	$12,178	125.33	8
Singapore	1	5	$12,750	123.20	2
Hong Kong	1	5	$12,100	113.88	10
Malta	1	6	$13,392	125.04	8
Malaysia	1	8	$11,591	113.91	9

Table XV: Flag state of selected outperforming ships

Flag State	*Total ships*	*Total fixtures*	*Average Rate*	*Average Index*	*Average age*
Greece	7	41	$7,810	77.85	16
Cyprus	5	35	$7,633	73.65	18
Liberia	3	15	$7,957	81.84	18
India	1	8	$6,469	63.62	16
Malta	1	6	$7,133	66.71	18
Norway	1	5	$7,770	73.20	17
Panama	1	5	$6,810	72.62	17

Table XVI: Flag state of selected underperforming ships

Classification Society

Another table shows the classification societies. According to paragraph 7.1, the largest classification society is Lloyds Register and according to **Table XVII** and **Table XVIII** this goes for the selected outperforming as well as for the selected underperforming ships. With a total of 19 ships, this is nearly 25% of all selected ships.

Class	Total ships	Total fixtures	Average Rate	Average Index	Average Age
LR	13	90	$12,502	121.61	7
NK	6	34	$12,740	120.69	7
AB	5	29	$13,126	117.24	8
NV	3	20	$12,535	129.21	8
BV	3	15	$13,427	123.70	7
NK/NV	1	7	$13,236	122.96	4

LR = Lloyds Register
NK = Nippon Kaiji Kyokei
AB = American Bureau of Shipping
NV = Det Norske Veritas
BV = Bureau Veritas

Table XVII: Classification society of selected outperforming ships

Class	Total ships	Total fixtures	Average Rate	Average Index	Average Age
LR	8	148	$7,285	72.63	17
NV	7	35	$8,376	80.52	16
AB	3	21	$7,262	76.07	18
GL	1	11	$7,164	66.68	18

LR = Lloyds Register
NV = Det Norske Veritas
AB = American Bureau of Shipping
GL = Germanischer Lloyd

Table XVIII: Classification society of selected underperforming ships

Three of the 6 classification societies appear in both tables, Lloyds Register, American Bureau of Shipping and Det Norske Veritas. Only one ship of Germanischer Lloyd is selected and only three of Bureau Veritas. Since several classification societies are mentioned in both tables no conclusions can be drawn from these tables.

Engine producer
For the selected ships the manufactures of the main engines have been determined. This item has also been put into two tables, one for outperforming ships, (**Table XIX**), and one for underperforming ships, (**Table XX**).

Engine Producer	Total Ships	Total Fixtures	Average Rate	Average Index	Average Age
B. & W.	16	96	$13,961	126.33	7
Sulzer	12	74	$12,602	121.69	7
Pielstick.	1	12	$11,662	115.94	7
Mitsubishi	1	5	$14,750	116.70	7
M.A.N.	1	9	$11,356	127.14	11
Unknown	1	5	$12,570	117.64	9

Table XIX: Main engine producer of outperforming ships

Engine Producer	Total Ships	Total Fixtures	Average Rate	Average Index	Average Age
Sulzer	10	61	$7,621	76.25	18
B&W	4	20	$8,450	79.37	15
M.A.N.	2	16	$7,578	72.76	18
Unknown	3	18	$6,611	68.49	17

Table XX: Main engine producer of underperforming ships

From the selected 51 ships, 22 ships are provided with a Sulzer engine and 20 with a B&W engine, together their market share in the panamax bulk fleet is over 80%. B. & W. has 16 out of the 20 (75%) entries in the table of the out-performing ships, Sulzer only 12 out of the 22 (just over 50%). The average ages of the ships and their main engines is about the same in the respective tables.

Strengthened for ore
Of all considered 51 ships, 28 ships are strengthened for ore (of which 12 ships outperform the market and 16 underperform the market), 2 ships cannot carry ore and for the other 21 ships it is not known.

Strength for heavy cargo
Of the considered 51 ships, 17 are strengthened to carry heavy cargoes, one ship cannot carry heavy cargoes, and for the 33 others it is not known.

Of the 17 ships which are strengthened to carry heavy cargo, 15 ships are outperforming the market. The average charter rate is $12,693/day with an average charter index of 122.74. The average age of these 15 ships is 7 years.

Ice-class
Of the 51 selected ships, only one ship can sail through ice, 4 cannot sail through ice, while for the remaining 46 ships it is not known whether these ships are able to sail through ice.

The ship which can sail through ice is one of the selected underperforming ships. It concluded 6 fixtures with an average charter rate of $7,133/day and an average charter index of 66.71, so both values are very low. But it is more likely that these values are that low because the ship is old, the average age is 18 years.

Geared vs. gearless
Of the total 51 ships, 9 vessels (8 outperform the market and 1 underperforms the market) are not geared while only one ship is provided with some kind of loading and/or discharging gear. It is not known whether the other ships are provided with gear to load and/or dischargs its cargo.

The only ship with gear has an average charter rate of $10,100/day and average charter index value of 86.48, an underperforming ship. Another underperforming ship which does not have gear has an average charter rate of $7,430/day and an average charter index of 75.54. The difference in charter rate is nearly $3,000/day.

Since only one ship is registered to have gear, it is not possible to speak of a trend that geared ships earn higher charter rates than gearless ships.

Builder/Shipyard
The selected 51 ships are built at 30 different yards. Nippon Kokan KK/Tsumuri has built 4 of the selected panamax bulk carriers. From the top 5 shipyards of

the outperforming ships, see **Table XXI**, the ships built at the Hyundai S.B. & Heavy Industry Ltd., Ulsan South Korea, have the highest average charter index while the ships built at the Hitachi S.B. & Engineering Co., Ariake Japan have the highest average charter rates.

Shipyard	*Selected Ships*	*Selected Fixtures*	*Average Rate*	*Average Index*	*Average Age*
Nippon Kokan KK/Tsumuri	4	32	$12,672	120.32	7
Hyundai SB LTD/Ulsan	3	18	$12,900	125.15	3
Koyo Dock KK/Mihari	3	20	$12,764	120.32	7
Hashihama Zosen/ Tadotsu	3	16	$13,262	125.07	7
Hitachi/ Ariake	2	16	$13,722	123.73	11

Table XXI: Builder/Yard of selected outperforming ships

From the underperforming ships, 4 were built at the Hitachi S.B. & Engineering Co., Maizuru Japan, although their average charter rates and their average charter index are rather high compared to the other yards in **Table XXII**. Ships built at the Rheinstahl Nordseewerke GmbH, Emde Germany and at the Astileros Espanoles S.A., Matagorda Spain have the lowest average charter rates and the lowest average charter index.

Again it is evident that a large gap exist between the average ages of the out-performing ships and the underperforming ships. No conclusions can be drawn from this.

Shipyard	*Selected Ships*	*Selected Fixtures*	*Average Rate*	*Average Index*	*Average Age*
Hitachi/ Maizuru	4	26	$8,027	80.24	18
Rheinstahl Nordseewe rke GmbH/ Emde	3	18	$6,611	68.49	17
Astilleros Espanoles/ Matagorda	3	19	$6,513	66.53	17
Ishikawaji-ma/ Aioi	2	11	$8,668	83.15	18
N.V. Boel-werf S.A./ Tamise	1	5	$8,490	86.12	17

Table XXII: Builder/Yard of selected underperforming ships

Owner
The 51 selected ships are owned by 41 owners. Separate tables have been made for outperforming and underperforming ships. The owners with the most selected outperforming ships are put into **Table XXIII**, while the owners with the most selected underperforming ships are put into **Table XXIV**.

The difference in average age is obvious again although not as obvious as for the other items. The average age of the ships of the Livanos Group is 10 years while the average age of the ships of Metrofin Ltd. is 10 years as well, but there is a very large difference in average charter rates, $12,752/day for the Livanos Group and for Metrofin Ltd. $9,410/day, a difference of $3342/day or per ship about $1.1m per year.

Nomikas Evangelos owns 3 panamax bulk carriers of which 2 ships outperform the market. The average age of these ships 13 years so it is possible to get good charter rates with old ships, although it is apparent that it is not true in general.

Efploia Shipping Co. owns 5 ships, all panamax bulk carriers, of which 2 are mentioned in **Table XXIII**. Considering ships which have an average charter

Owner	*Selected Ships*	*Total Panamax Bulkers*	*Average Rate*	*Average Index*	*Average Age*
Livanos Group	4	7	$12,752	121.37	10
Efploia Shipping Co	2	5	$12,123	123.25	4
Nomikas, Evangelos	2	3	$11,473	117.54	13
Alafouzos Shipping Co	2	3	$12,198	115.06	7
Anangel Shippping	2	5	$12,558	124.47	5

Table XXIII: 5 Largest owners of outperforming ships

index higher than 110, even 4 of the 5 ships of Efploia Shipping would appear in the table. These ships have an average age of 4 years, so are rather new ships.

N.J. Goulandris owns 7 panamax bulk carriers of which 2 are mentioned in **Table XXIV**, but they also have two ships which outperform the market although the company is not in **Table XXIII**.

Phocean Ship Agency owns 4 panamax bulk carriers of which 2 are put into **Table XXIV**, this company has the absolute minimum average charter rates and the absolute minimum charter index, but they have quite old ships with an average age of 17 years.

Both tables show that it is hardly possible to get the same charter rate for old ships than for newer ships.

Charterers
The charter rates are paid by the charterer to the shipowner. The index is made by dividing the charter rate of each fixture by the monthly average charter rate. A low index means a low charter rates, compared to the monthly average rate of that moment. The first objective of a charterer is to get an as low as possible charter rate.

Owner	*Selected Ships*	*Total Panamax Bulkers*	*Average Rate*	*Average Index*	*Average Age*
Phocean Ship Agency	2	4	$6,350	69.38	17
N.J. Gou-landris	2	7	$8,018	81.32	17
Metrofin Ltd.	1	3	$9,410	88.26	10
Pearl Carriers	1	1	$7,407	76.30	18
Tsatsakis Shipping Co	1	1	$7,133	66.71	18

Table XXIV: 5 Largest owners of underperforming ships

Secondly, the charterer will look at the competition, what they are paying for a comparable trip, and if possible he will try to pay less than the competition. The required information is available via his brokers. So the second objective is to get an as low as possible index figure. The charterer wants to minimize his costs. So he will always try to get a charter rate which is as low as possible.

All 4879 trip time fixtures are concluded by about 325 charterers. Shipmair, the Rotterdam based operator, chartered 79 ships during the last 6 years. 41 (over 50%) of these fixtures have an index figure of less than 82.42. The average charter rate of all 79 charters by Shipmair is $8,605/day, a very low amount. Shipmair chartered several ships out of the underperforming group, these ships made 16 fixtures. The average charter index of these selected 16 fixtures is very low, 68.15, one the lowest of all charterers while the average charter index of all 79 fixtures is only 82.92, the lowest of the charterers mentioned in the top 15, see **Table XXV**. The average age of the chartered ships is rather old, 15.3 years.

The largest charterer in the list is Mitsui OSK. They chartered 272 ships in the considered 6 years on a trip time charter basis. 41 of the 272 ships (nearly 15%) fixtures were selected for the analysis. The average charter rate is about $11,220/day and the average index is about 102.67. The average age of the selected ships is much lower than those chartered by Shipmair, namely 7.4 years.

Charterer	*Total fixtures*	*Selected fixtures*	*%*	*Average Rate*	*Average Index*	*Average Age*
Mitsui OSK	272	41	15,07	$11,220	102.67	7.4
Showa	245	20	8,16	$10,507	100.84	7.3
NYK	219	17	7,76	$10,801	101.84	7.6
Yukong	195	61	31,28	$10,362	99.93	10.5
Navix	180	35	19,44	$10,806	104.73	7.7
Hanjin	149	70	46,98	$11,613	110.19	9.4
Shinwa	136	17	12,50	$11,182	103.29	6.4
K Line	135	30	22,22	$10,749	104.51	7.7
Sovfracht	108	9	8,33	$12,200	98.25	11.2
Hyundai	100	32	32,00	$11,376	103.18	8.8
NSAC	99	50	50,51	$11,929	111.41	9.6
Doce-nave	95	26	27,37	$9,266	90.96	12.8
Daiichi	92	7	7,61	$10,970	102.07	7.5
Shipmair	79	41	51,90	$8,603	82.92	15.3
Continental	76	27	35,53	$10,474	98.59	13.6

'%' = ('Selected Fictures'/'Total Fixtures') * 100%

Table XXV: 15 Largest charterers

The average rate, the average index and the average age in **Table XXV** are the averages of all fixtures made by the respective charterer.

The following pages describe several design characteristics versus the index figures of the selected fixtures and ships.

Index vs. Date
This graph has been made to see whether the selected fixtures are concluded in a specific period. **Figure 57** shows that this is true. At moments when the charter rates changed dramatically, like the period from January 1990 to January 1991, the variation of the index figures is very high. The period from March 1991 to January 1992 the changes in charter rates are rather low, the varation of index figures is very small, nearly within the 10% range.

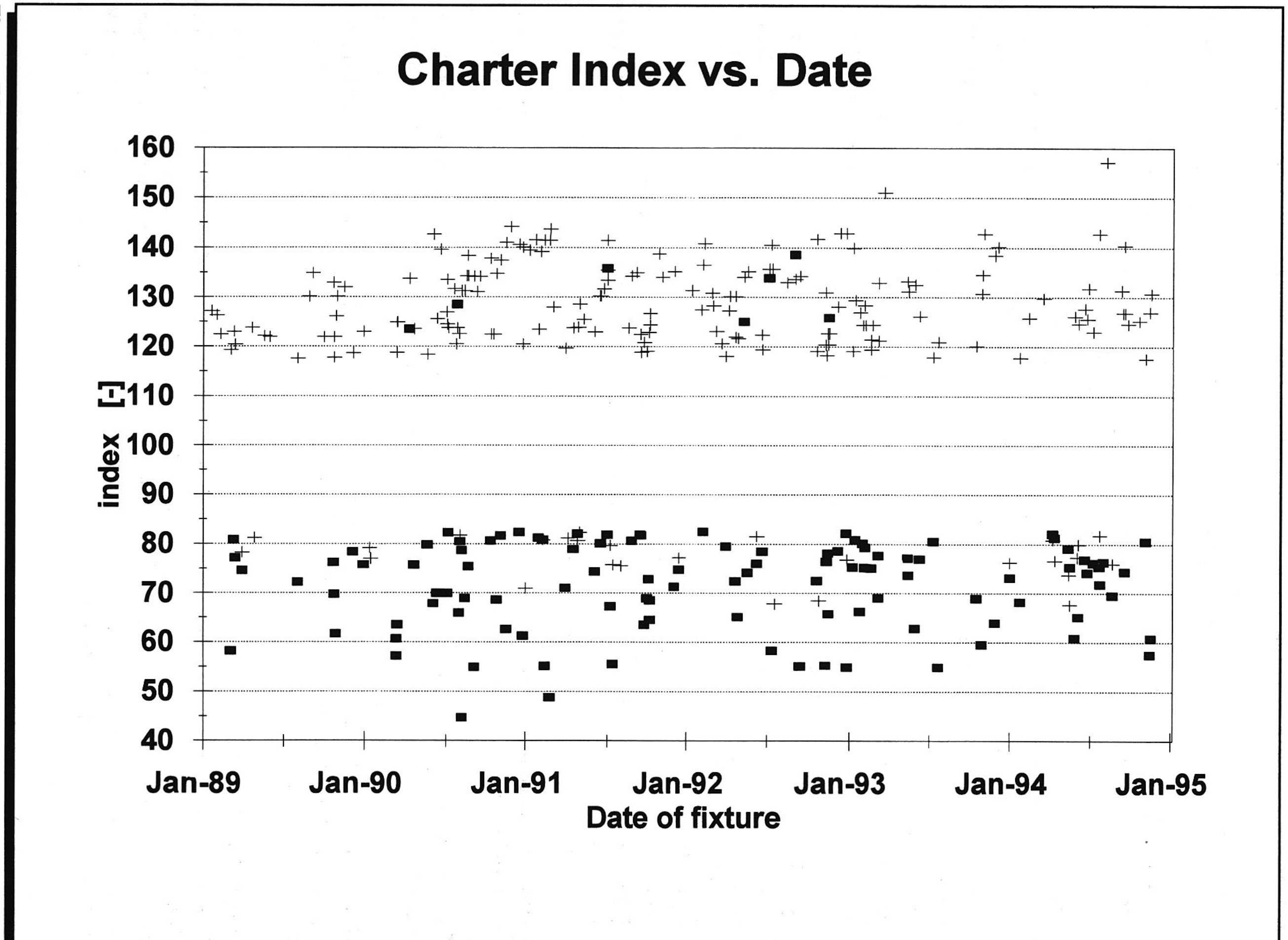


Figure 57: Index vs. date

Index vs. DWT
Figure 58 shows that the under- and outperforming ships are in the same DWT-range. A group is in the range 50,000 to 55,000 DWT and another group is in the 60,000 to 67,000 DWT. This figure indicates that there is no particular DWT-range, which gets systematically a higher charter rate.

Index vs. length
Figure 35 Shows the length distribution of all ships in the Clarkson database. It shows clearly that 500 of these ships are in the range from 212.50 meters up to 217.5 meters. **Figure 59** shows that the length of many selected ships is in the same range, though several ships have a smaller length.

The underperforming ships are in the same range as the outperforming ships. There is no particular length, which gives a systematically higher charter rate.

Index vs. beam
The most important design characteristic of panamax bulk carriers is the beam restriction of the Panamax canal, 32.2 meter. So **Figure 60** speaks for it self.

Index vs. draught
The draught distribution of all panamax bulk carriers is from 12 up to 14.5 meters, as can be seen in **Figure 37. Figure 61** shows that these values are valid for the selected ships as well.

Index vs. grain capacity
According to **Figure 38**, most panamax bulk carriers have a grain capacity of around 2.6 mln. cuft. (or 73,600 m^3), with a small peak at 2.8 mln. cuft. (or 79,300 m^3) as well. **Figure 62** shows that the most of the selected outperforming vessels have a capacity of around 2.6 mln. cuft.. Just as the underperforming vessels, it seems that the probability of getting a lower charter rate (and index figure) is slightly higher when sailing with a smaller ship. And it looks as if the probability of getting a slightly higher charter rate is larger when sailing with a larger ship.

Index vs. GT
The GT determines, to a large extent, the canal and port dues. For trip time charters this is paid by the charterer. The charterer will try to get a ship with a minimal GT-value. But according to **Figure 63**, it is not that simple. Different ships, with different GT-values, can get a good freight rate or can get a low freight rate. It is not possible to say that a ships with a low GT-value will get a high charter rate and a high index figure. Since the GT-value is determined to a large extent by the DWT of the vessel, a correlation between these two factors should apear.

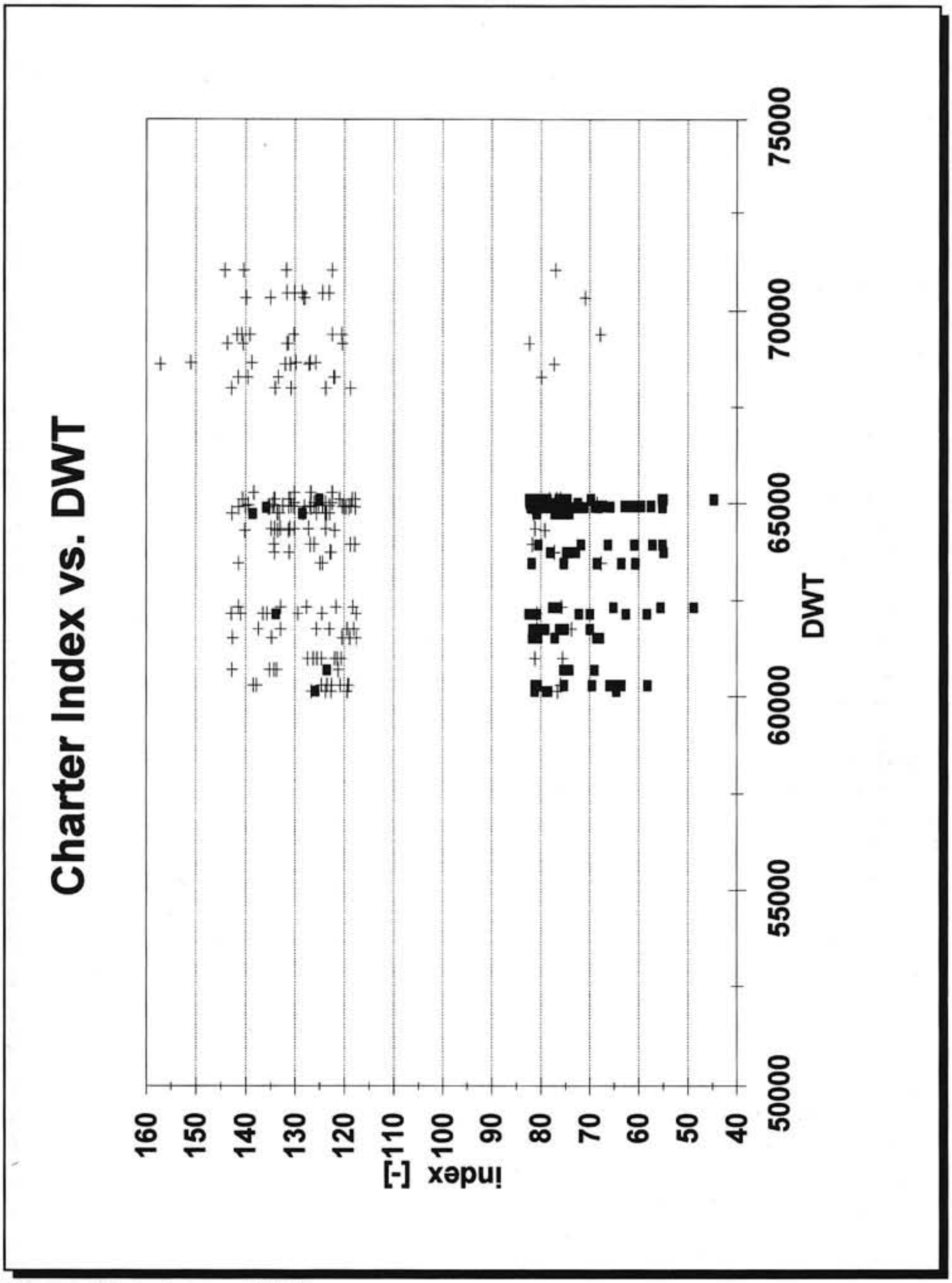


Figure 58: Index vs. DWT

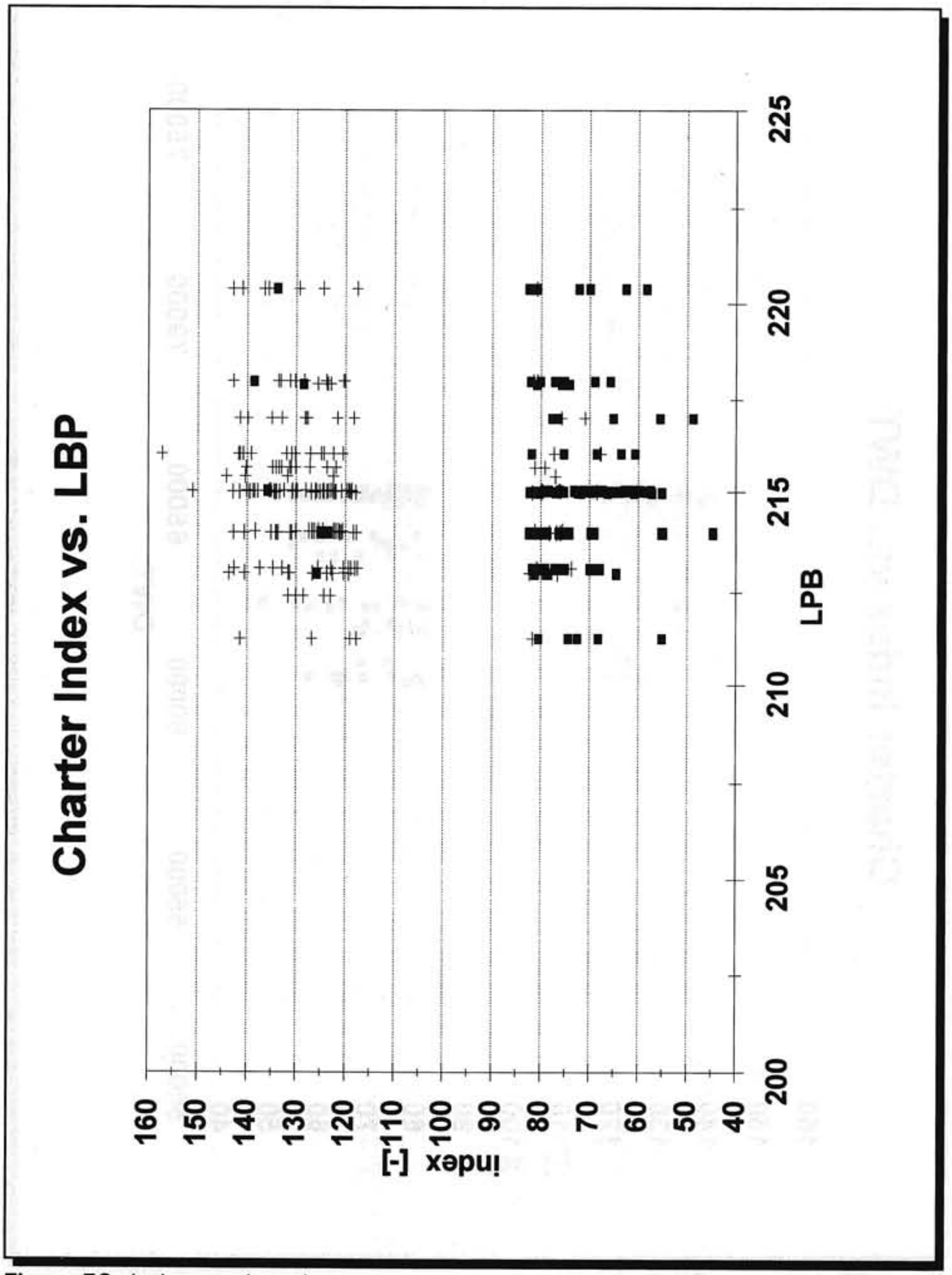


Figure 59: Index vs. length

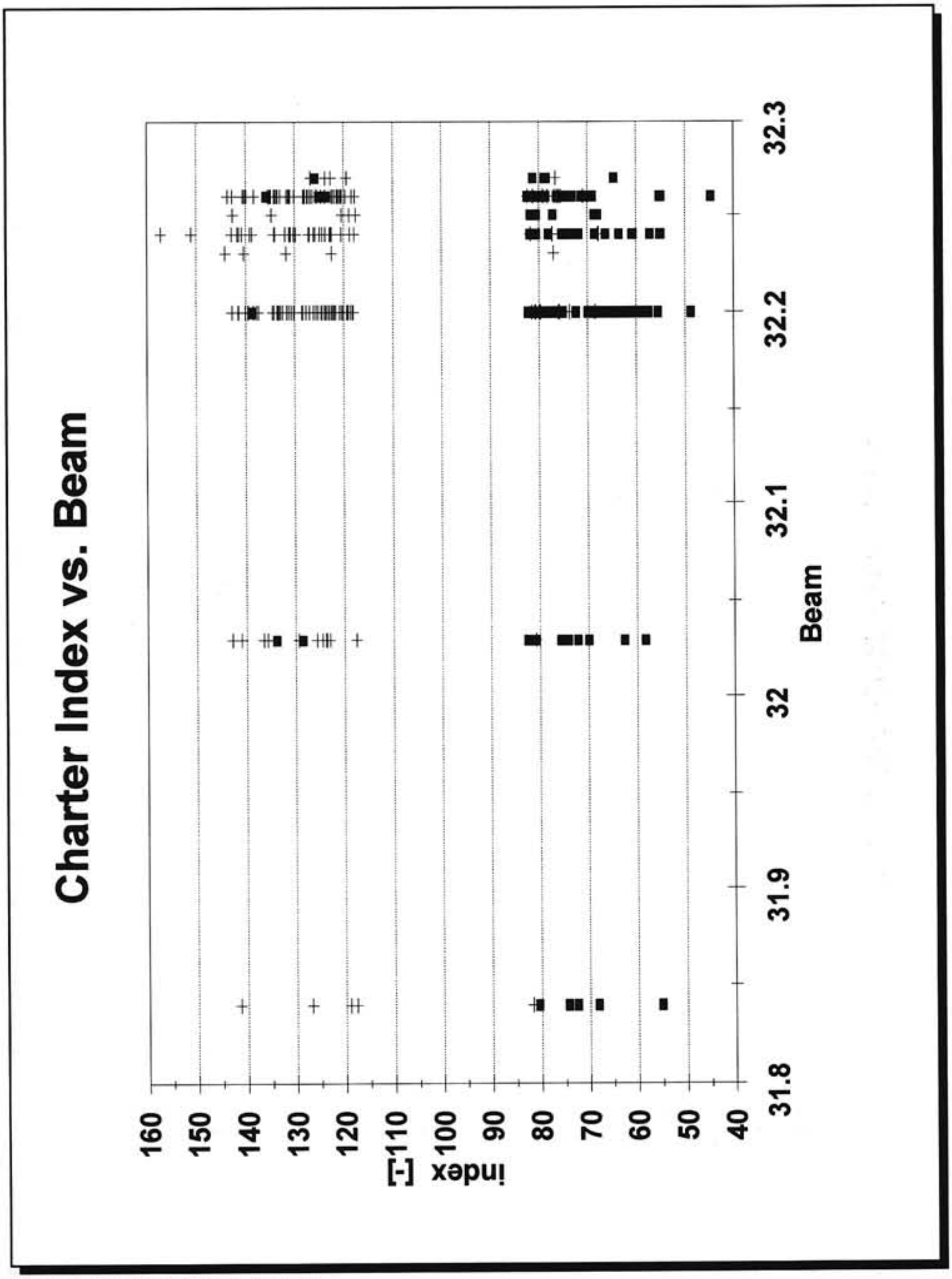


Figure 60: Index vs. beam

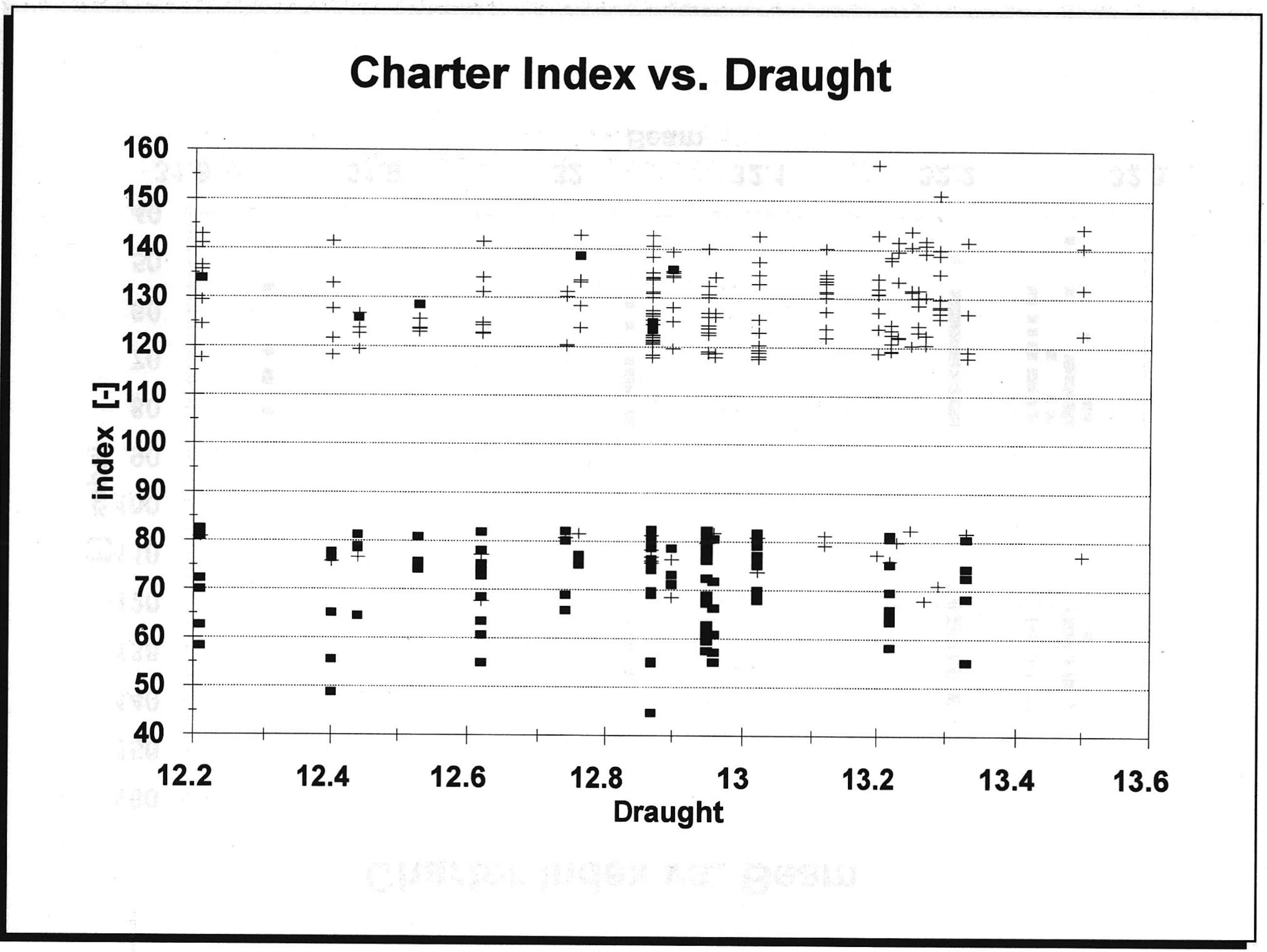


Figure 61: Index vs. draught

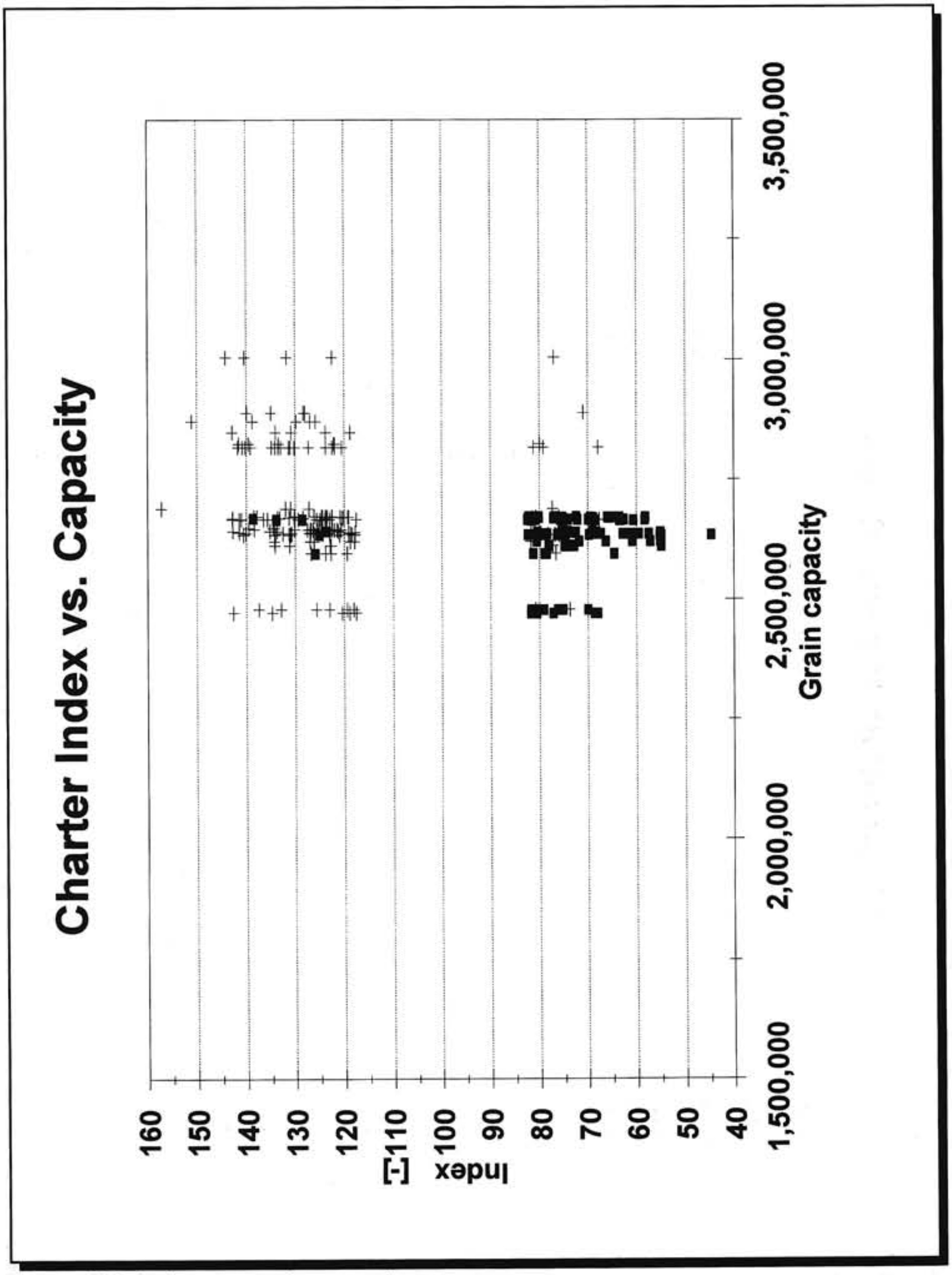


Figure 62: Index vs. grain capacity

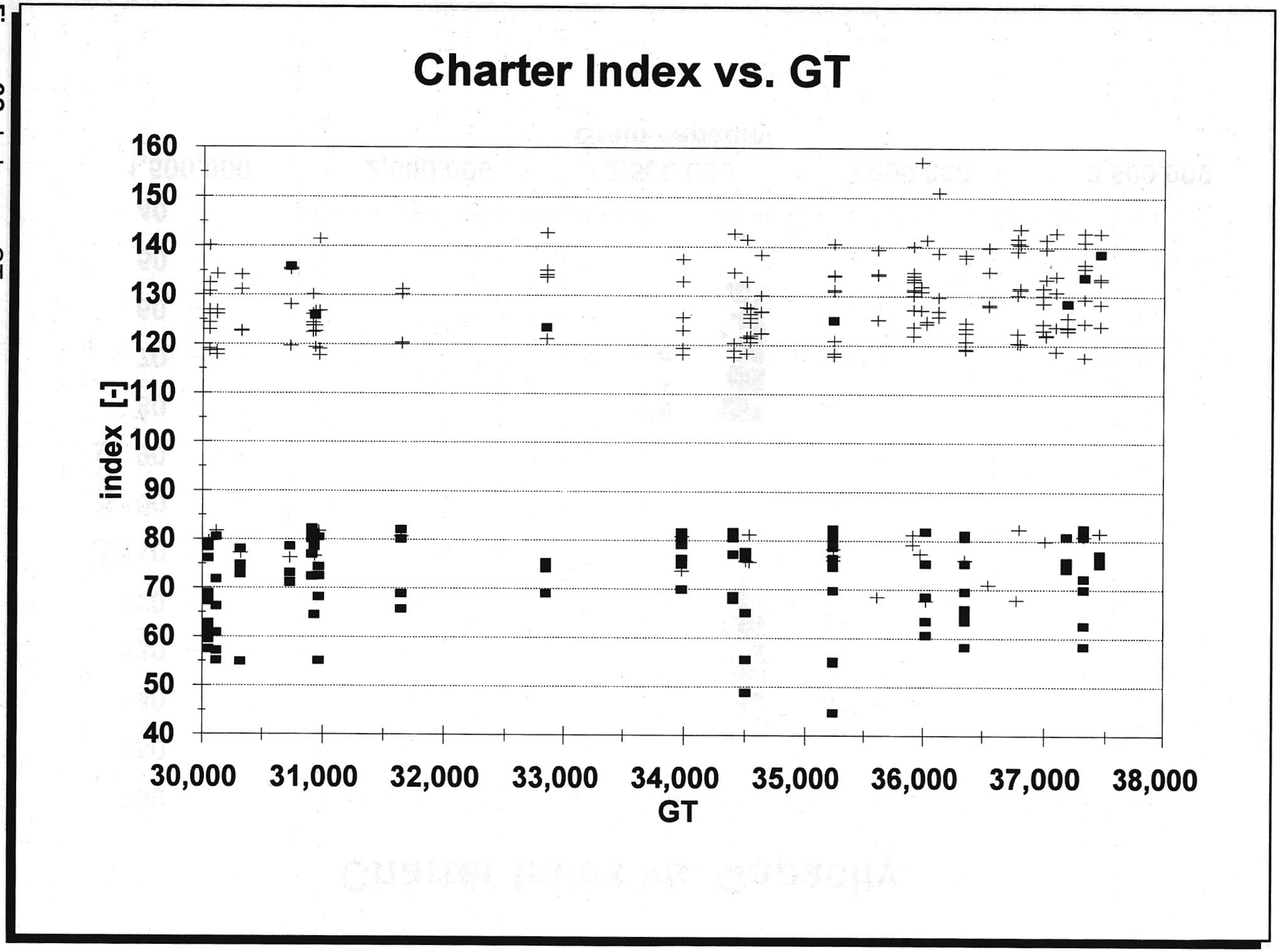


Figure 63: Index vs. GT

Index vs. HFO consumption
The HFO consumption determines, to a large extent, the voyage costs. These voyage costs are paid by the charterer. This means that if a ship has a high HFO consumption the charterer will try to get another ship. If this is not possible the charterer will try to get a lower charter rate as compensation for the high consumption. So ships with a high consumption will have a low index figure. **Figure 63** shows this very clearly.

Index vs. number of holds
This item partly determines the cargo handling costs. But since most of the ships have 7 holds, little variation is expected,see **Figure 65**.

Index vs. sailing distance
Figure 66 shows that many fixtures with a low index figure concern a sailing distance of 10,000 up to 15,000 nautical miles. Most of the fixtures with a high index figure are in this range as well, but some fixtures with a high index figure have a smaller sailing distance, about 5,000 to 7,500 nm. This can be explained by the fact that short voyages usually have relatively long loading and discharging times which are paid for indirectly via a slightly higher charter rate.

Index vs. speed
The speed range is from 12 up to 14.5 knots, independent of the index figure (**Figure 67**).
Table XXVI gives several averages for speeds. Fixtures with a speed of 12.5 or 14.5 are not important, since there are only a few of these fixtures. Most fixtures have a speed of 13 knots. These fixtures have an average age of about 12 years. Ships with a speed of 13.5 or 14 knots are newer ships, which shows in the average charter rates and in the average index as well. Ships with a speed of 13.5 knots earn about $1,000/day more than ships with a speed of 13.0 knots. The average index of the faster ships is about 10 points higher.

Index vs. age
Figure 68 shows the index figures of the selected figures, plotted against the age of the ships. The age of the ships is determined by the following formula:

Age = *Year of Fixture* - *Year of Built*

Figure 68 shows all selected ships. According to this figure old ships get a lower index figure, which means that they get a lower charter rate than the average of that month. To see whether this is true in general, another figure has been made. Of all trip time fixtures the average charter rates and the average index figures have been calculated for each age from 0 to 20 years (0 means ships build in 1994), see **Figure 69**.

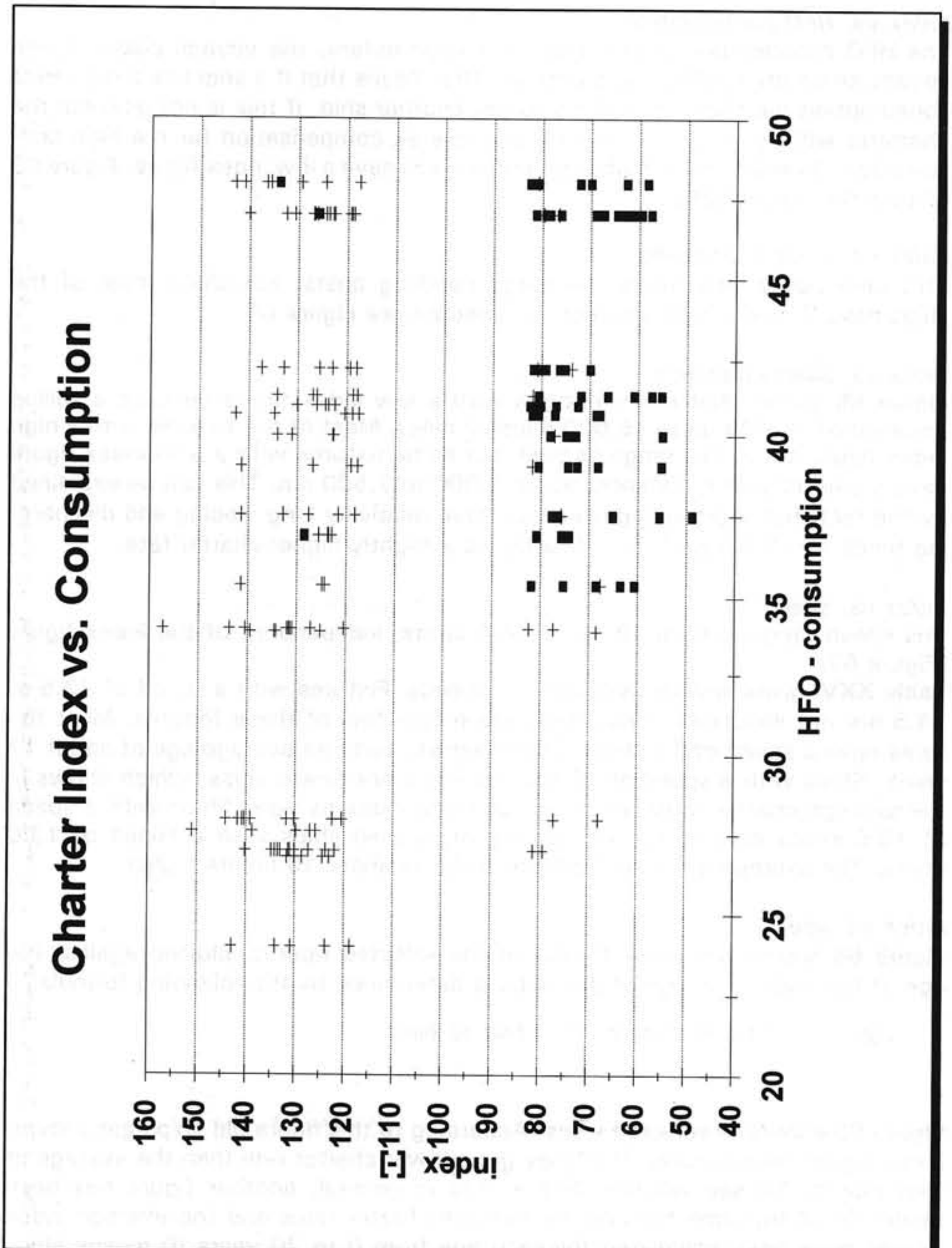


Figure 64: Index vs. HFO consumption

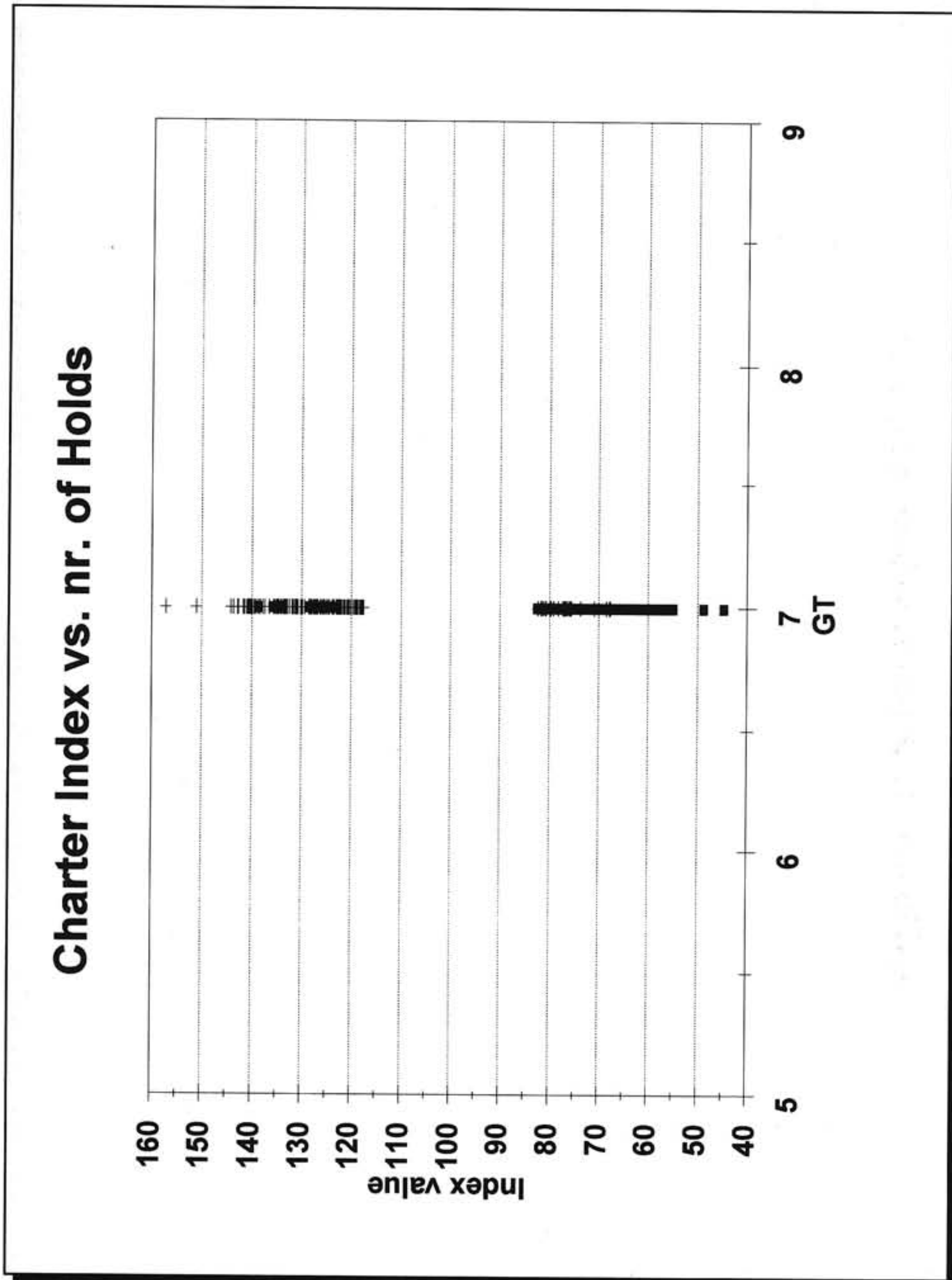


Figure 65: Index vs. number of holds

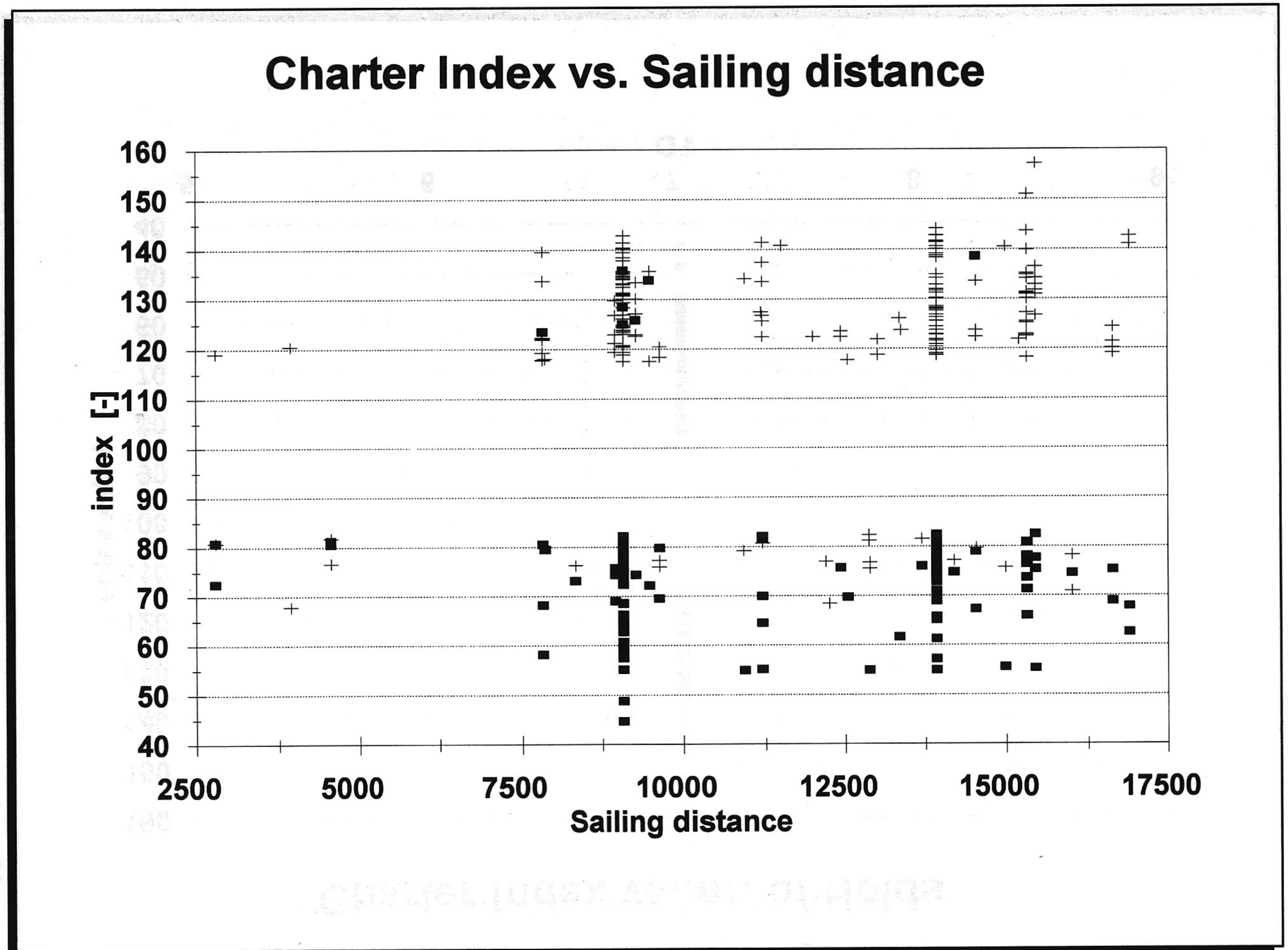


Figure 66: Index vs. sailing distance

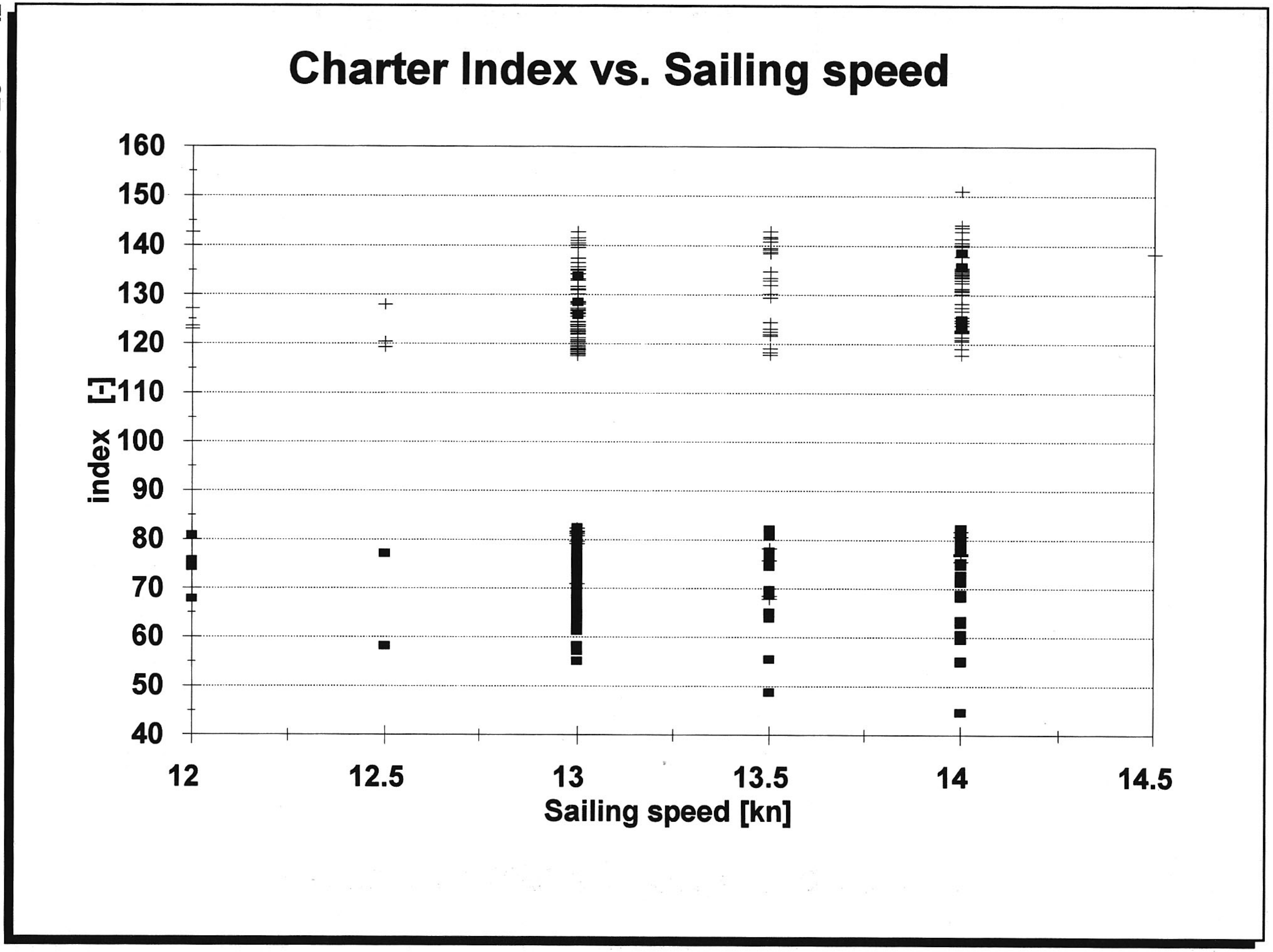


Figure 67: Index vs. sailing speed

Sailing Speed	*Total Fixtures*	*Average Rate*	*Average Index*	*Average Age*
12.0	38	$11,037	94.58	12.1
12.5	4	$15,663	115.61	4.8
13.0	437	$10,455	97.72	11.7
13.5	81	$11,391	107.84	6.2
14.0	241	$11,035	105.68	8.1
14.5	4	$11,763	108.11	5.8

Table XXVI: Sailing speed averages of all selected ships

Figure 68 shows all selected ships. According to this figure old ships get a lower index figure, which means that they get a lower charter rate than the average of that month. To see whether this is true in general, another figure has been made. Of all trip time fixtures the average charter rates and the average index figures have been calculated for each age from 0 to 20 years (0 means ships build in 1994), see **Figure 69**.

This figure clearly shows that new ships get the highest average charter rates. The first 5 years, ships get an average charter rate of about $11,750/day. Ships with an age from 5 to about 14 years get an average charter rate of about $10,500/day. Ships older than 14 years get an even lower charter rate.

For each year the ship is older the average charter rate decreases by approximatly $500/day. The difference in charter rate of a new ship (say 2 years old) and an old ship (say 18 years old) is about $3,402/day. On an annual basis this is about $1.2 million.

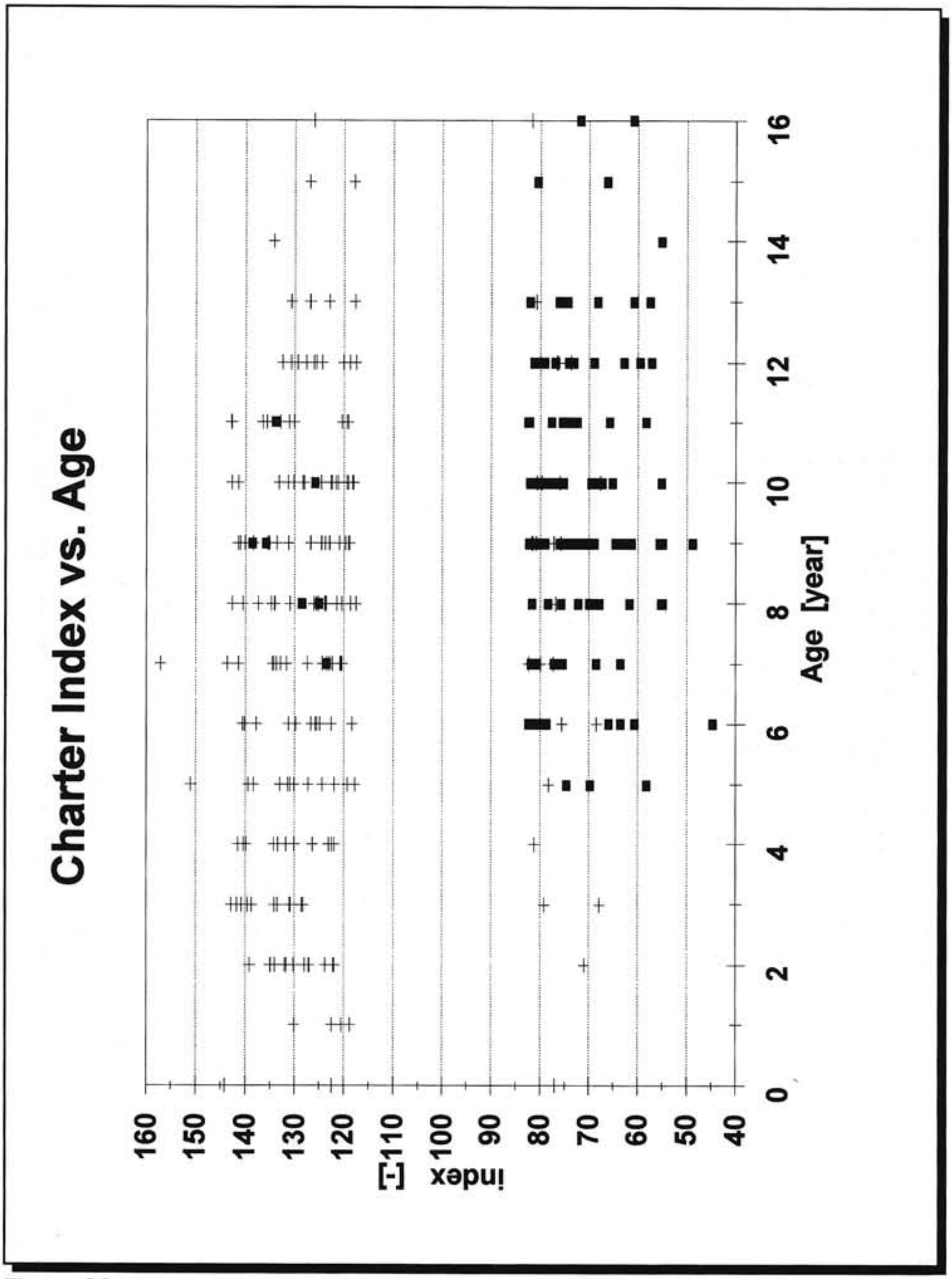


Figure 68: Index vs. age

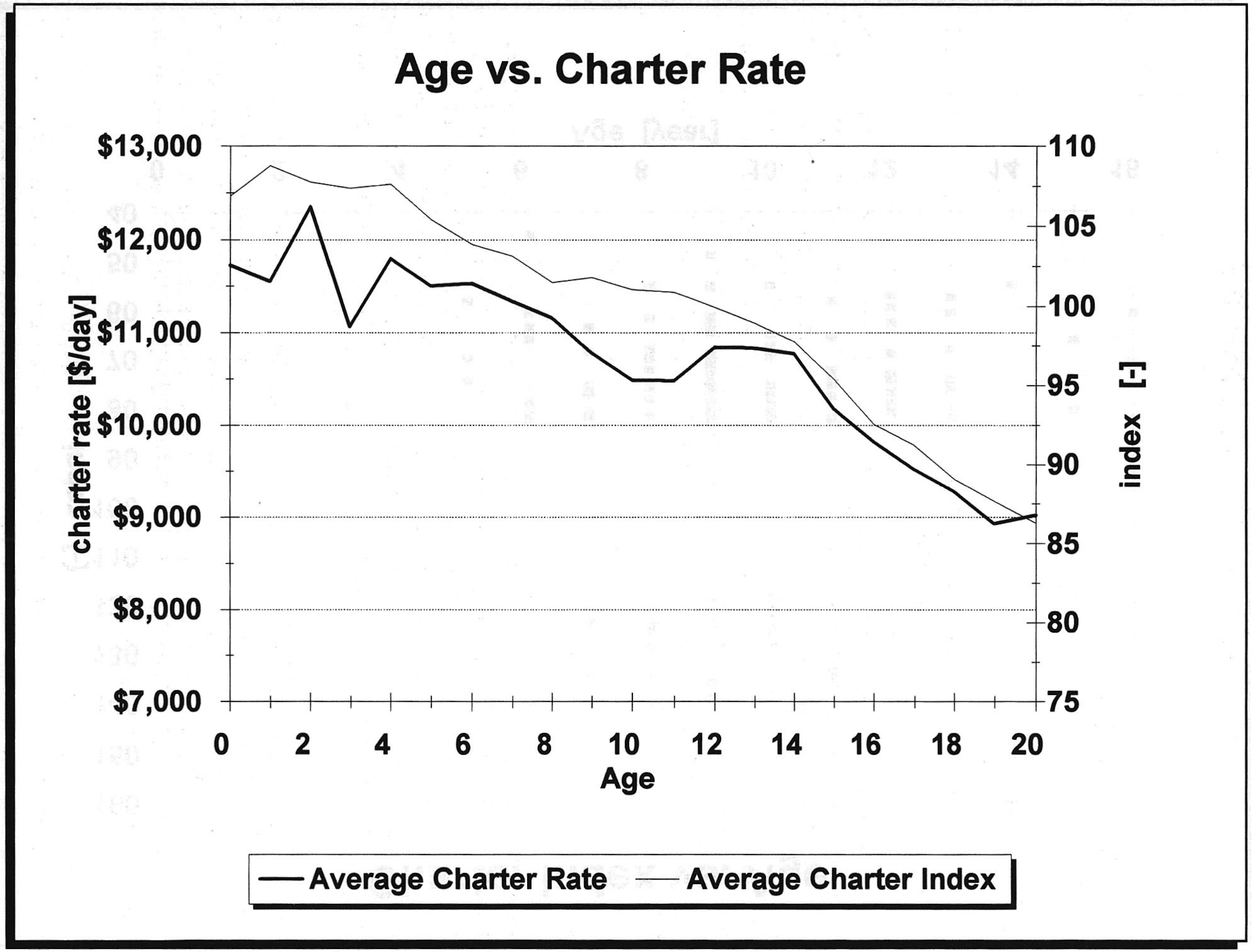


Figure 69: Age vs. average charter rate and average charter index (for all trip time fixtures)

PART 4 - CONCLUSIONS

14 CONCLUSIONS

14.1 Summary

The objective of this study was to find out whether design characteristics influence the level of the charter rates.

For this study, first an examination of the charter market has been made from the available fixtures over a six year period. Second, an analysis of the available design characteristics was made. Third, to eliminate the business cycle in the charter rates, a charter index has been made. Finally in **Part 3** with the help of the charter index, ships which outperform the market, have been identified. This charter index has been related to design and fixture characteristics. The selected outperforming ships were analysed also in respect to operators, charterers, shipyards and shipowners.

14.2 General evaluation

The panamax bulk carrier charter market is a completely transparent and open market which is self-regulating. An open market is a market where every individual vessel is free to offer its services wherever the market is. The charter rates are thus determined by the supply of and the demand for the ships. The design characteristics are only important to see if the ship is suitable for sailing on the required route. This way the characteristics determine the rates only indirectly .

The Plymouth Database represents only fixtures known to the open market. Fixtures made on private terms are not reported and have not been discussed though they represent a large part of the market especially for period time charters. The Plymouth Database does give a good representation of the complete market, though. The Clarkson Database gives an accurate representation of the available panamax bulk carriers.

Between charterers and shipowners operate the shipbrokers who will try to conclude a charter between those parties. Usually they are contacted by charterers who want to charter a ship. Shipowners give information to shipbrokers about the position of their ship(s) so the broker conclude a deal.

But how are the charter rates determined? **Figure 10** shows large fluctuations in the charter rates for period fixtures. The same goes for both other fixture types. Apart from the general demand and supply balance, the following characteristics of ships can determine the height of the charter rate as well.

Design characteristics
The purpose of chartering panamax bulk carriers is to carry the optimum amount of cargo through the Panama Canal, usually from Atlantic to the Pacific Ocean. The dimensions of the Panama Canal are rather small. The main limiting characteristics of the Panama Canal are:

* Length about 225 meter;
* Beam about 32.24 meter;
* Draught 12.40 meter.

The vessel's draught, deadweight (DWT) and other specifications will conform the charterer's requirements, allowing them to trade vessel on the routes and the ports of their choice.

The design characteristics are for shipowners of paramount importance since they determine whether a charterer is able to use the ship for the planned route. These design characteristics are usually determined in conjunction with the shipyard. The length and beam are determined by the Panama Canal but the draught is not. The draught can be divided in two categories:

* Design draught: this is the draught the ship will usually sail at.
* Scantling draught: this is the maximum draught a vessel is allowed to sail at. As an example the Mark V of Burmeister & Wain is taken. The maximum draught is 14.33 metre which is too deep for some of the traditional panamax ports, but they are still accessible at a lower draught.

Ship registration, classifcation and shipyard
According to the analysis the,se items do not or only indirectly influence the height of the charter rates. But several remarks can be made.

Registration flag of a vessel may dictate where a vessel is able or allowed to trade, the nationality of the crew, which determines to a large extent the operating costs of the owner, and the port costs, since some ports charge a premium for ships sailing with flags of convenience. Other ports offer lower or no charges for native vessels.

The yard and classifiction society do not influence the charter rates. The information a charterer may use, provides a very rough guide as to the quality of the vessel. Different classifiction societies maintain varying standards, the highest are evidently the most expensive, requiring the most rigorous maintenance.

Importance of the route
The specifications of a ship, like beam length and draught, determines whether the ship is suitable for sailing the route the charterer want it to sail.

The owner's wish is generally to have a charter as soon as the previous charter ends. But ships sail all over the world with different sailing routes. So it is impossible to continually benefit from the highest rates available at that moment. An example provided by mr. Hardcastle of H. Clarkson Ltd.:

> 'While it is possible for owners to charge $20,000 per day for an Atlantic/Pacific trip, they have to settle for $10,000 per day for a Pacific/Atlantic trip. Owners also have the option of trading within the Pacific or the Atlantic of $15,000 per day.'

Charterers can have an advantage when they specialise on one or several routes. These charterers know the route, can forecast what the demand will be at one side and can forecast what the supply at the other side of the route will be. The charterers can determine the required amount of ship capacity. Perhaps it is even possible to discuss a special port-rate, since they bring ships on a regular basis to the port.

Fuel consumption and speed
The fuel consumption effects the charter rate indirectly. If a charterer is able to choose from two ships with the only difference is the fuel consumption, he will charter the one with the least fuel consumption.

But this situation hardly ever occurs. Generally more differences between the ships occur, like a combination of differences as in DWT, age and fuel consumption. According to **Figure 34** a relation exists between the fuel consumption and the age of the vessel. Newer ships have, usually, a lower fuel consumption. Charterers pay a lower charter rate to for older vessels compensate the higher fuel consumption of the chartered vessel.

As above mentioned, the fuel consumption will determine the total costs of the transport though this differs per fixture type. For a time charter the fuel costs are to be paid by the charterer while the fuel costs for voyage charter are to be paid by the shipowner.

The amount of fuel consumed by the engine is determined by the required power. The required power is determined by the required speed. The relation between power at speed is:

$Power \cong f(v^3)$

Increasing the speed with one knot, which is an increase of about 8%, can result in an increase of fuel consumption of about 5 tons per day, which is an increase of about 16% if the fuel consumption is 30 mtons per day at the low speed.

A firm market will increase the ship's speed in order to capatalize on the high charter rates in the hope that the additional costs, incurred in bunker costs will be compensated by the extra trade generated and time saved. In a soft market the owners will decrease the speed again for the opposite result.

Holds and hatchcover operations
The number of holds plays a part in loading and discharging, however according to the analysis of the Clarkson Database most ships have 7 hold. Since abSout 90% of the panamax bulk carriers has the same number of holds, this item is not determining the charter rates. The majority of the panamax bulk carriers have side-rolling or MacGregor fore and aft folding hatches, this does not play any part in determining the rates as well.

Some old bulk carriers are provided with more than one hatchcover per hold. These ships are not popular due to the complications caused during loading and discharging the cargo, although lower charter rates could not be determined since too few ships with these kind of hatch covers exist.

Gear
Of all 834 panamax bulk carriers, 74 are provided with some kind of gear. Only a few of this small group outperform the market. The reason that only so few geared ships are mentioned in the Plymouth Database is because these ships often have long term contracts in a specialised market and according to mr.J.E. Fisk of Plymouth this kind of fixture is hardly ever reported to the open market. The geared ships usually get a premium for being geared. Usually the ports the ships visit are equipped for cargo handling, so no gear is necessary.

Forward chartering
Some long term charters in the Plymouth Database are fixed far before the start of the charter, which is not common practice. A problem is that both owner and charterer must be sure that the rates change dramatically in the future. But the shipping market in general and the bulk shipping market in particular is such a volatile market that forecasting the future rates is very difficult. The Baltic Freight Index Futures can be used for this purpose.

Usually only the charterers benefits from the difference between spot and forward charter rates. Only in extreme circumstances a period charter will be fixed at a premium to the spot rate and give the owner some benefit.

Age
The age in relation to the fuel consumption of the ships determines the height of the charter rates. This is shown in **Figure 70**. Another way to state this, is that some operators like Shipmair, who use old ships, pay lower charter rates. The average age of the chartered vessels by Shipmair is over 15 years.

Another reason to pay a lower charter rate is the high fuel consumption of the old ships. According to **Figure 70**, showing the average fuel consumptions plotted against the building year, old ships use more fuel oil than new ships. In the same figure the average charter rate has been plotted against the building year. The line shows clearly that new ships get higher charter rates than old ships. The total costs of a trip have been calculated the folowing way:

$$\textit{Total costs} = \textit{Charter rate} + \textit{Fuel costs}$$

with

$$\textit{Fuel costs} = \textit{Fuel consumption} * \textit{Fuel price}$$

The sailing time of these ships is estimated as 70% of the total time, the other 30% the ship will be in a port, loading or discharging. The total costs are for ***all*** ships about $13,000 per day. So it does not matter whether one charters an old ship with high fuel costs or a new ship with low fuel costs. The total costs are about the same. This is due to the total transparency of the bulk carrier charter market. Over 400 shipowners and over 500 charterers are playing a role in this market. And even the large owners or large charterers can hardly influence the charter rates. Although some charterers can get lower charter rates than the average but only by good timing. The same is valid for some shipowners.

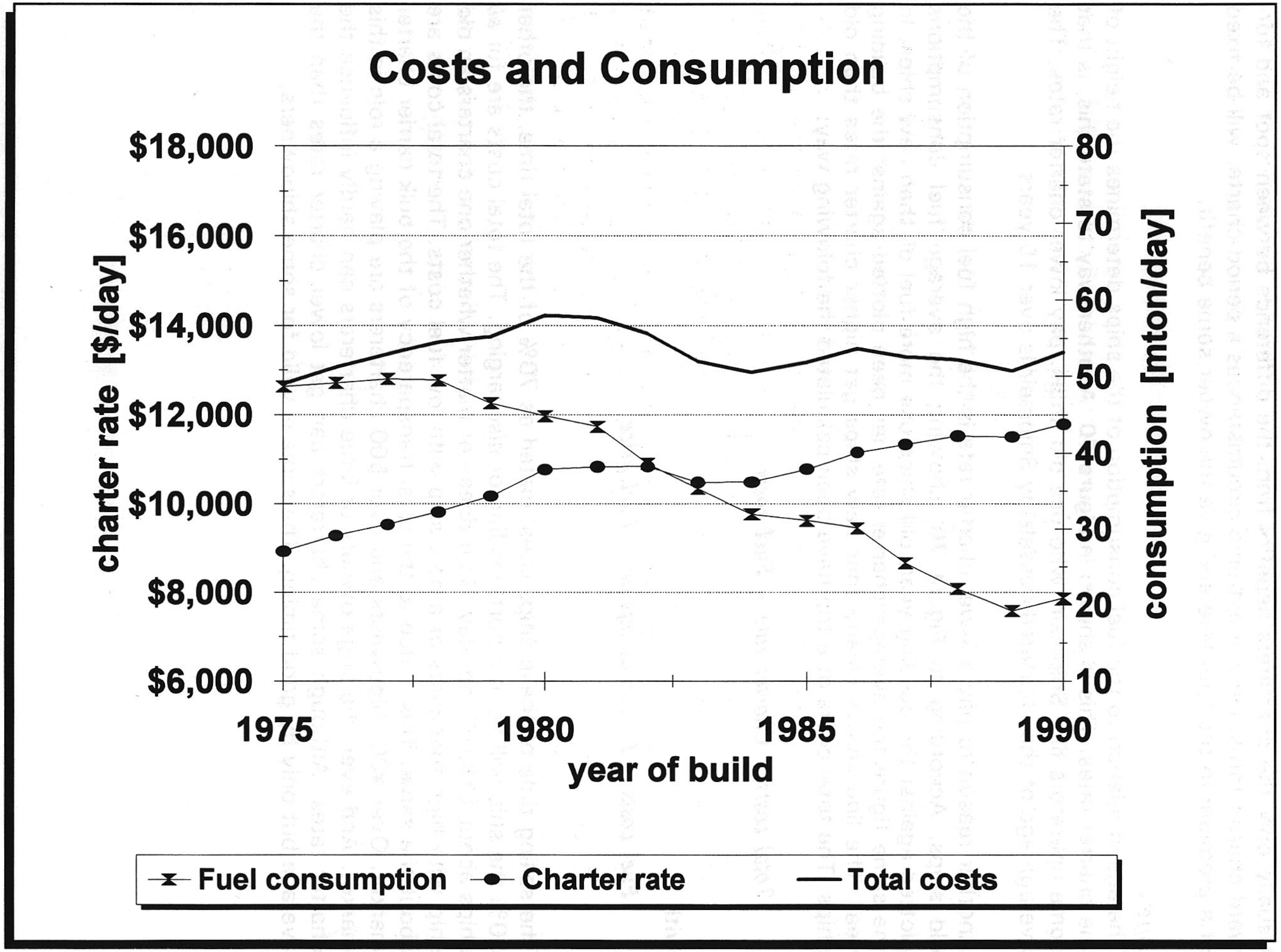


Figure 70: Cost and fuel consumption vs. year of build

If the difference between port and sailing time is smaller, (like port/sailingtime = 40/60%) then older ships are more favourable. Especially in congested ports, old ships have an advantage because of the lower charter rates.

In conclusion:

1. Analysis of the trip time fixture database over the period 1989-1994 shows that a small percentage of the panamax bulk carriers out- and underperform the martket systematically;

2. A detailed analysis of the out- and underperforming ships does not reveal common design characteristics which are at the basis of the performance, apart from one variable: fuel consumption. The more subjective factors, like the quality of the management may play an important role;

3. Fuel cost is part of the voyage cost which the charterer has to pay. The fuel consumption of older ships is significantly higher than that of new modern bulk carriers. The efficiency improvement is on average 100%, i.e. half the consumption. The difference in fuel cost is reflected in the charter rate. The higher the consumption, the lower the charter hire.

4. Over the period 1989-1994 the average charter rate has been calculated by age-groups of panamax bulk carriers. Based on a hypothetical sea-time of 70% per annum, the fuel costs have been added to this charter rate. It appears that the sum of charter hire and fuel cost, is more or less constant, around $13,000 per day for *all* the ships, irrespective of age.

5. The above leads to the conclusion that really one factor determines the average charter rate: fuel consumption, and that the charter market is almost perfect.

APPENDICES

APPENDIX A: REGIONAL DEFINITIONS

This appendix contains more detailed information on the geographical sub-divisions used in the database. All used fixtures are assigned to a particular route. Details concerning may be found in the extract listing which has been transformed into a DBase-file.

Dry Single Voyage Loading Zone, Dry Trip and Period Charter Delivery and Redelivery Zones

1.	Great Lakes	
2.	St. Lawrence	Includes Quebec, New Brunswick, Nova Scotia, Newfoundland, etc.
3.	US Atlantic	Maine to Miami, Florida (inclusive)
4	Us Gulf	Texas to Miami, Florida
5	Caribbean	Including all Caribbean Islands, east coast central america, north coast south america (excluding Brazil)
6	Brazil	
7	Argentina	
8.	W.C.South America	West coast central and south america from Mexico to Chile
9.	W.C.North America	Alaska, west coast Canada, U.S. west coast
10.	North Europe	Includes all of the Atlantic Europe west from Gibraltar, including Portugal, North Spain and North France, Holland, Belguim, Germany, Denmark, United Kingdom, Ireland and Scandinavia. Baltic Sea and Gulf of Bothnia are also included.
11.	South Europe	Includes southern Spain east of Gibraltar, French Mediterranean, Italy, Yugoslavia, Greece, Turkey, Black Sea, Malta and Cyprus.
12.	West Coast Africa	All countries from Mauretania to Angola inclusive
13.	Southern Africa	South Africa and Namibia
14.	North Africa	All countries from Morocco to Egypt inclusive
15.	Mid East	The Arabian Peninsula, Iran, Irak, Syria, Lebanon, Israel and Jordan.
16.	Australia	
17.	Far East	Includes South Asia, South East Asia, Japan, China, North and South Korea, Taiwan and ex-USSR Pacific Coast.
18.	Other	All other areas not covered. Also includes fixtures where there is more than one loading /delivery zone.

Dry Single Voyage Dischage Zones and Dry Trip via Locations

0.	Unknown	(Dry Trip time Charters only) Categorisation for those fixtures for which no specific trip via location was reported.
1.	North Europe	Includes all of the Atlantic Europe west from Gibraltar, including Portugal, North Spain and North France, Holland, Belguim, Germany, Denmark, United Kingdom, Ireland and Scandinavia. Baltic Sea and Gulf of Bothnia are also included.
2.	South Europe	Includes southern Spain east of Gibraltar, French Mediterranean, Italy, Yugoslavia, Greece, Turkey, Black Sea, Malta and Cyprus.
3.	North America East	East coast Canada, Great Lakes, St. Lawrence, US. Atlantic coast, U.S. Gulf.
4.	North America West	Alaska, west coast Canada, U.S. west coast.
5.	Japan	
6.	South Asia	Pakistan, Bangladesh, India and Sri Lanka.
7.	Far East	Includes South East Asia, China, North and South Korea, Taiwan and ex-USSR Pacific Coast.
8.	South America East	Includes Caribbean, east coast Central America, north and east coast South America.
9.	South America West	West coast Central and South America from Mexico to Chile.
10.	Mid East	The Arabian Penisula, Iran, Irak, Syria, Lebanon, Isreal and Jordan.
11.	Africa	
12.	Other	All other areas not covered. Also includes fixtures where there is more than one loading /delivery zone.
13.	Not used	
14.	Australia	Self made number since this is a large group.

APPENDIX B: COMMODITY DEFINITIONS

This appendix comprises the commodity/cargo types in the dry single voyage fixture database. For Each of the main headings details are provided of the specific commodities that have been documented

- **G** Grain, heavy grains/sorghums/soya beans, wheat, oats, barley, soya beans, sorghum, maize, corn, lentils, beans, pulses, oilseeds, sunflower seeds, palletised vegetable oil, rice, tapioca, meal, soyabean meal, pellets, soyabean pellets, feedstuffs, flour, wheat flour, citrus pelets, dried skimmed milk and agriproducts. Bagged and in bulk.

- **S** Sugar, bagged and in bulk.

- **C** Coal, coking coal, coke, metallurgical coke.

- **F** Fertilizers, potash, muriate of potash, sulphate of potash, prophate, phosphate rock, di-ammonium phosphate, sulphur and NPK. Bagged and in bulk.

- **O** Ores, iron ore, bauxite, alumina, manganese ore, copper concentrates.

- **M** Miscellaneous, scrap, including and excluding motor blocks, shredded scrap, petroleum coke, petroleum coke and coal, pipes, bulk cement, synthetic rutile, salt and bagged fish meal.

APPENDIX C: DISTANCE TABLES

The following two tables are used to determine the sailing days of each trip time fixture. Which table has been used depends on the fixture. If the ship sailed direct from the place of delivery to the place of redelivery the first table has been used. If a fixture indicated that the ship had to sail via a specified port then the second table was used. In this latter case the table had to be used twice. First, to determine the distance from the delivery port to the `via port' and second, to determine the distance from the `via port' to the port of redelivery.

C1 Distance Table

Distance Table :

World part	Port	Port Code	Great Lakes Chicago 1	St. Lawrence Quebex 2	US_Atlantic Norfolk 3	US-Gulf Mobile 4
Great Lakes	Chicago *)	1	0	1260	2860	4388
St. Lawrence	Quebex	2	1260	0	1600	3128
US_Atlantic	Norfolk	3	2860	1600	0	1705
US-Gulf	Mobile	4	4388	3128	1705	0
Caribbean	Kingston (JA)	5	3811	2551	1281	1350
Brazil	Rio de Janeiro	6	6605	5345	4723	5083
Argentina	Bahia Blanca	7	7976	6716	6101	6432
W.C.South America	Callao	8	5873	4613	3168	2758
W.C.North America	Long Beach/Seattle	9	7960	6700	5300	4900
North Europe	Rotterdam	10	4060	2800	3430	4830
South Europe	Ravena/Venice	11	5460	4200	4970	6235
West Coast Africa	Port Kamsar/Dakar	12	4790	3530	3408	4215
Southern Africa	Port Elisabeth/Capetown	13	8350	7090	6790	7237
North Africa	Alexandrie	14	6260	5000	5105	6360
Mid East	Jedda	15	7134	5874	6007	7151
Australia	Brisbane/Gladstone	16	12200	10940	9495	9086
Far East	Yokohama	17	12200	10940	9504	9095
Other	**)	18	0	0	0	0

*) Chicago is distance to Quebec + 1260 Nm.

**) All other areas not covered. Also includes fixtures where there is more than one loading/de

Distance Table :

World part	Caribbean Kingston (JA) 5	Brazil Rio de Janeiro 6	Argentina Bahia Blanca 7	W.C.South America Callao 8	W.C.North America Long Beach/Seattle 9
Great Lakes	3811	6605	7976	5873	7960
St. Lawrence	2551	5345	6716	4613	6700
US_Atlantic	1281	4723	6101	3168	5300
US-Gulf	1350	5083	6432	2758	4900
Caribbean	0	4420	5829	1933	4000
Brazil	4420	0	1423	4913	7800
Argentina	5829	1423	0	3675	9250
W.C.South America	1933	4913	3675	0	4200
W.C.North America	4000	7800	9250	4200	0
North Europe	3936	5256	6615	6177	8332
South Europe	5765	5910	7185	7415	9550
West Coast Africa	3436	2761	3700	5083	7210
Southern Africa	6278	3272	3804	7302	9980
North Africa	5765	6013	7270	7520	9650
Mid East	6576	6829	8398	8362	10660
Australia	8266	8305	7076	7050	6390
Far East	8276	11500	10279	8558	4550
Other	0	0	0	0	0

livery zone

Distance Table :

World part	North Europe Rotterdam 10	South Europe Ravena/Venice 11	West Coast Africa Port Kamsar/Dakar 12	Southern Africa Port Elisabeth/Capetown 13	North Africa Alexandrie 14
Great Lakes	4060	5460	4790	8350	6260
St. Lawrence	2800	4200	3530	7090	5000
US_Atlantic	3430	4970	3408	6790	5105
US-Gulf	4830	6235	4215	7237	6360
Caribbean	3936	5765	3436	6278	5765
Brazil	5256	5910	2761	3272	6013
Argentina	6615	7185	3700	3804	7270
W.C.South America	6177	7415	5083	7302	7520
W.C.North America	8332	9550	7210	9980	9650
North Europe	0	3065	2600	6220	3179
South Europe	3065	0	3205	6675	1200
West Coast Africa	2600	3205	0	3604	3310
Southern Africa	6220	6675	3604	0	5517
North Africa	3179	1200	3310	5517	0
Mid East	4000	2038	4125	4700	888
Australia	12080	10110	10520	6945	8960
Far East	11205	9290	11349	8320	8165
Other	0	0	0	0	0

Distance Table :

World part	Mid East	Australia	Far East	Other
	Jedda	Brisbane/Gladstone	Yokohama	
	15	16	17	18
Great Lakes	7134	12200	12200	0
St. Lawrence	5874	10940	10940	0
US_Atlantic	6007	9495	9504	0
US-Gulf	7151	9086	9095	0
Caribbean	6576	8266	8276	0
Brazil	6829	8305	11500	0
Argentina	8398	7076	10279	0
W.C.South America	8362	7050	8558	0
W.C.North America	10660	6390	4550	0
North Europe	4000	12080	11205	0
South Europe	2038	10110	9290	0
West Coast Africa	4125	10520	11349	0
Southern Africa	4700	6945	8320	0
North Africa	888	8960	8165	0
Mid East	0	8055	7200	0
Australia	8055	0	3930	0
Far East	7200	3930	0	0
Other	0	0	0	0

C2 Via-location Table

Via_Table

World part	[Nmiles] Harbor	Harbor Code	North Europe Rotterdam 1	South Europe Ravenna/Venice 2
North Europe	Rotterdam	1	0	3065
South Europe	Ravenna/Venice	2	3065	0
North America East	Norfolk	3	3430	4970
North America West	Los Angelos/Seattle	4	4830	9550
Japan	Yokohama	5	11205	9290
South Asia	Madras	6	7360	5350
Far East	Pusan	7	10853	8858
South America East	Rio de Janeiro/Bahia Blanca	8	6000	6500
South America West	Callao	9	6177	7415
Mid East	Jeddah	10	4000	2038
Africa	Capetown	11	4000	4500
Other	*)	12		
Unknown	**)	0	0	0
Australia	Gladstone/Brisbane	14	12080	10110

Via_Table

World part	North America East	North America West	Japan	South Asia	Far East
	Norfolk	Los Angelos/Seattle	Yokohama	Madras	Pusan
	3	4	5	6	7
North Europe	3430	4830	11205	7360	10853
South Europe	4970	9550	9290	5350	8858
North America East	0	5300	9504	9344	10132
North America West	5300	0	4550	9054	4926
Japan	9504	4550	0	4480	1400
South Asia	9344	9054	4480	0	4088
Far East	10132	4926	1400	4088	0
South America East	5500	8500	11000	8111	10820
South America West	3168	4200	8558	11694	8826
Mid East	6007	10660	7200	3344	6818
Africa	5000	8500	10000	4885	8244
Other					
Unknown	0	0	0	0	0
Australia	9495	4550	3930	5450	4172

Via_Table

World part	South America East	South America West	Mid East	Africa
	Rio de Janeiro/Bahia Blanca	Callao	Jeddah	Capetown
	8	9	10	11
North Europe	6000	6177	4000	4000
South Europe	6500	7415	2038	4500
North America East	5500	3168	6007	5000
North America West	8500	4200	10660	8500
Japan	11000	8558	7200	10000
South Asia	8111	11694	3344	4885
Far East	10820	8826	6818	8244
South America East	0	4300	6829	3272
South America West	4300	0	8362	7302
Mid East	6829	8362	0	4700
Africa	3272	7302	4700	0
Other				
Unknown	0	0	0	0
Australia	8305	7050	8055	6945

Via_Table

World part	Unknown	Australia
	**)	Gladstone/Brisbane
	0	14
North Europe	0	12080
South Europe	0	10110
North America East	0	9495
North America West	0	4550
Japan	0	3930
South Asia	0	5450
Far East	0	4172
South America East	0	8305
South America West	0	7050
Mid East	0	8055
Africa	0	6945
Other	0	
Unknown	0	0
Australia	0	0

APPENDIX D: PERIOD TIME CHARTERS: RATES VS. DESIGN CHARACTERISTIC

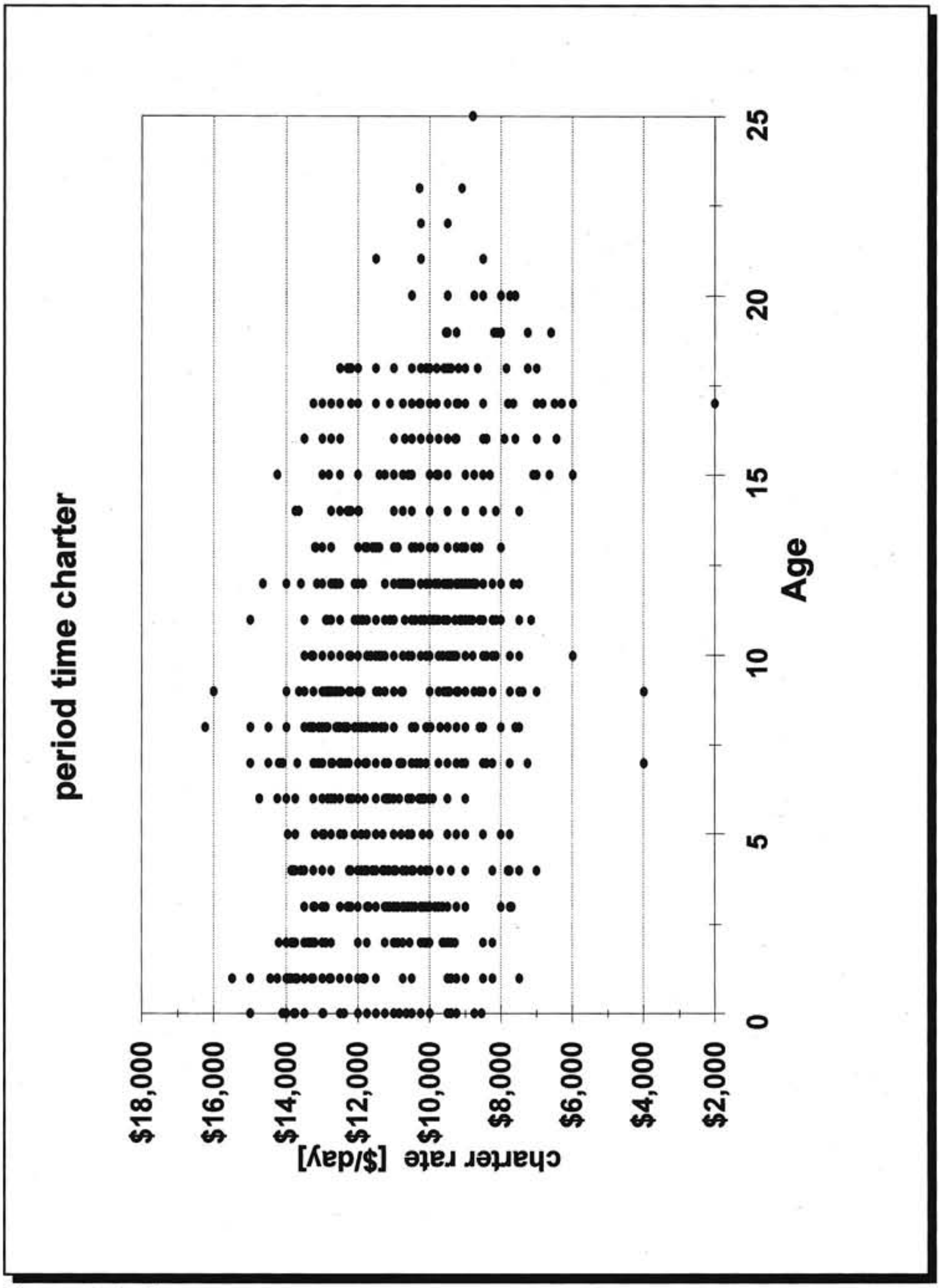


Figure D.1: Charter rate versus age

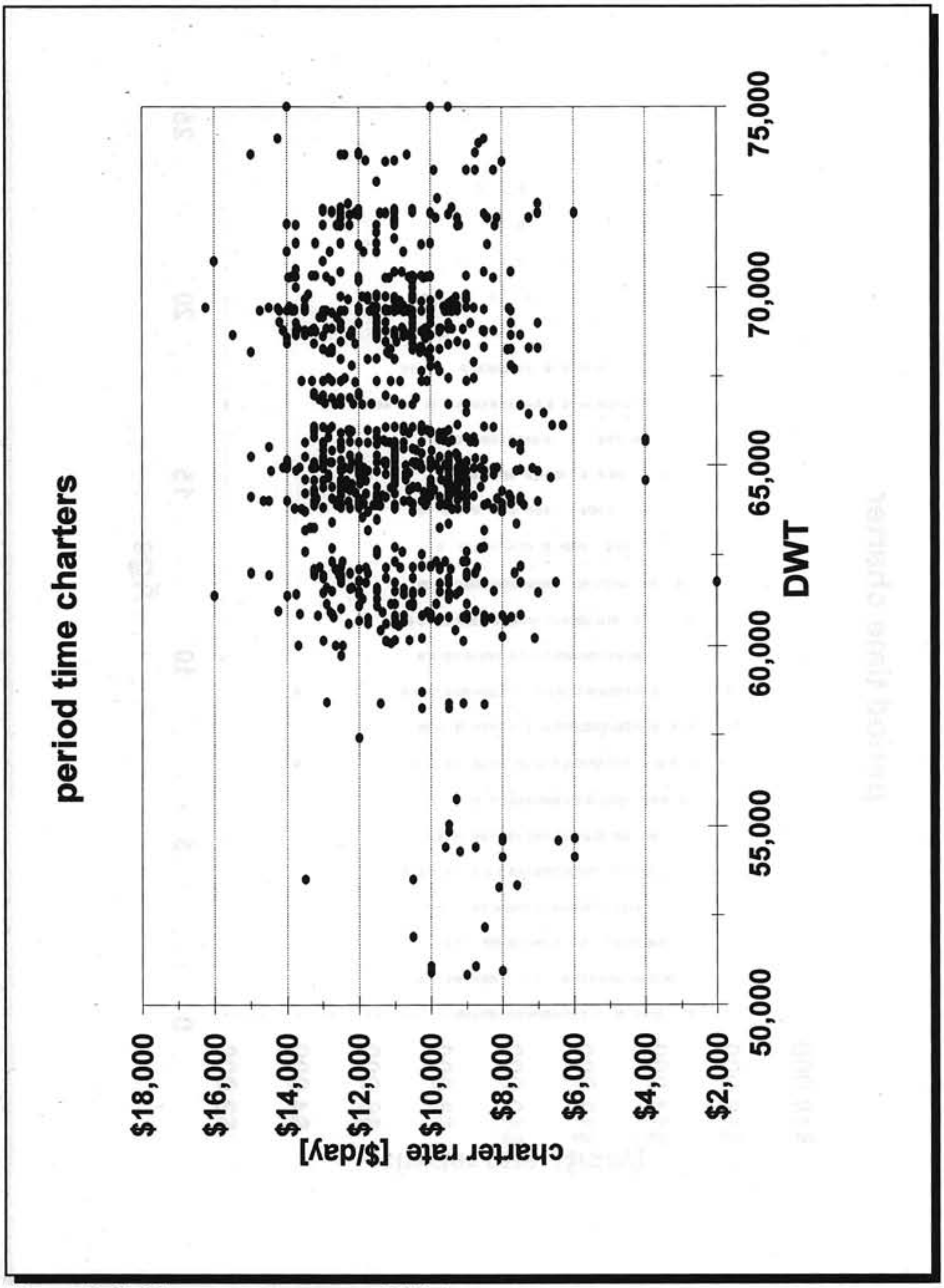


Figure D.2: Charter rates versus DWT

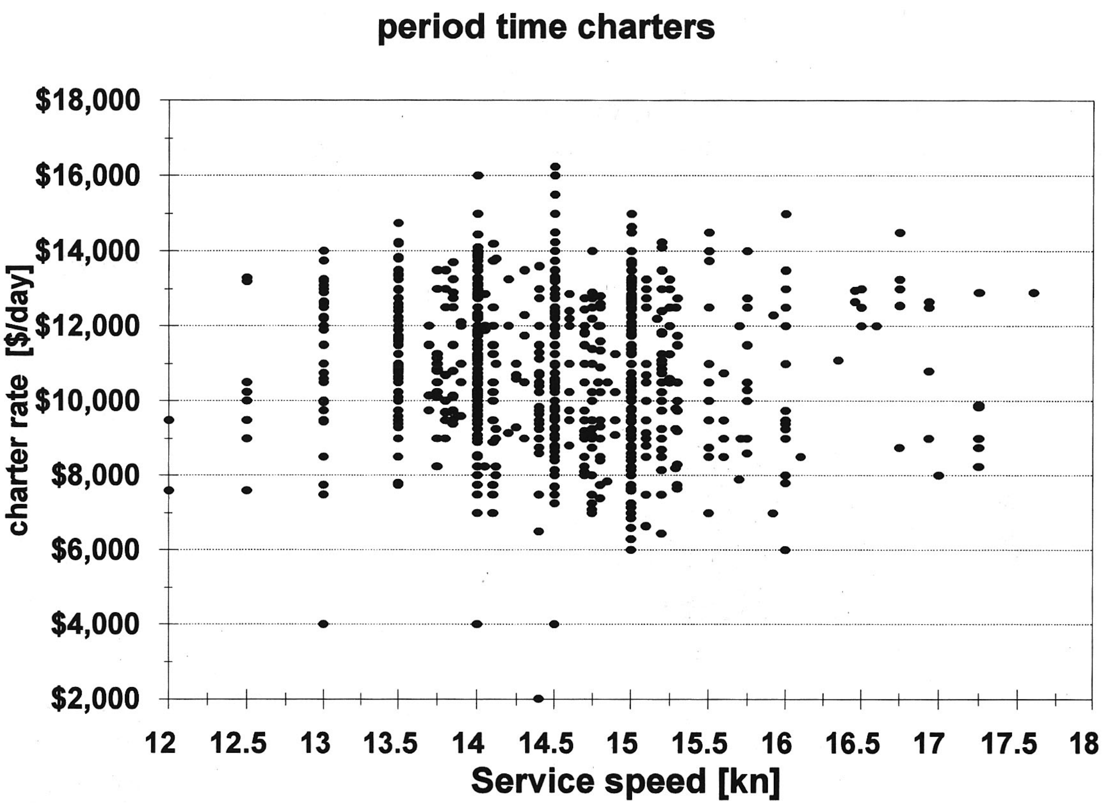


Figure D.3: Charter rate versus service speed

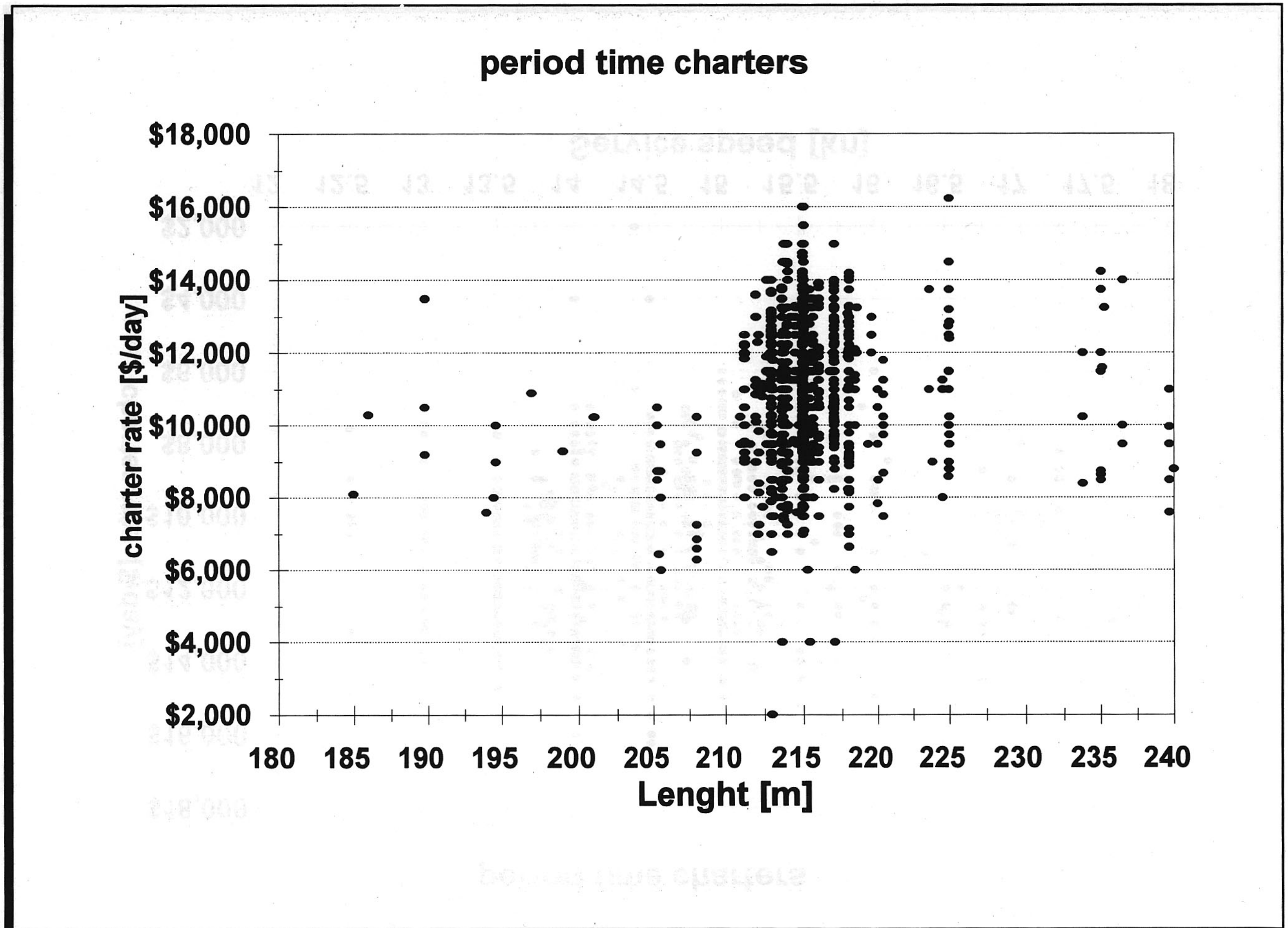


Figure D.4: Charter rate versus length

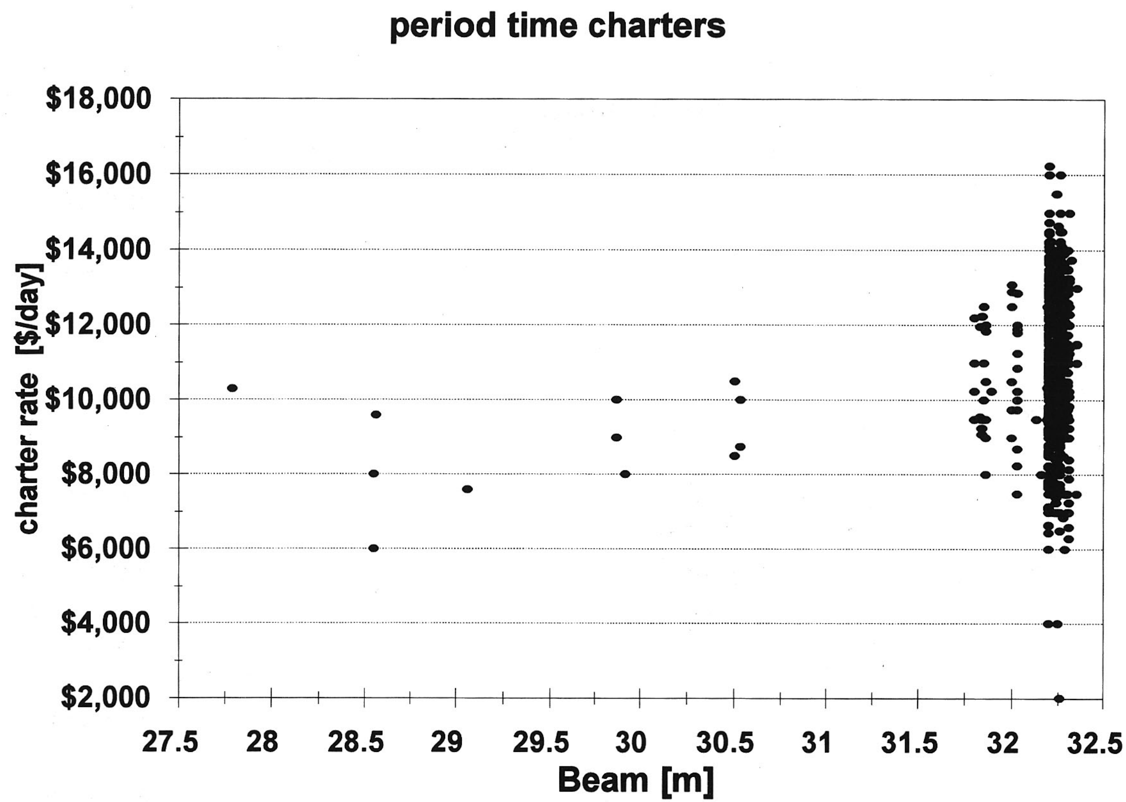


Figure D.5: Charter rate versus beam

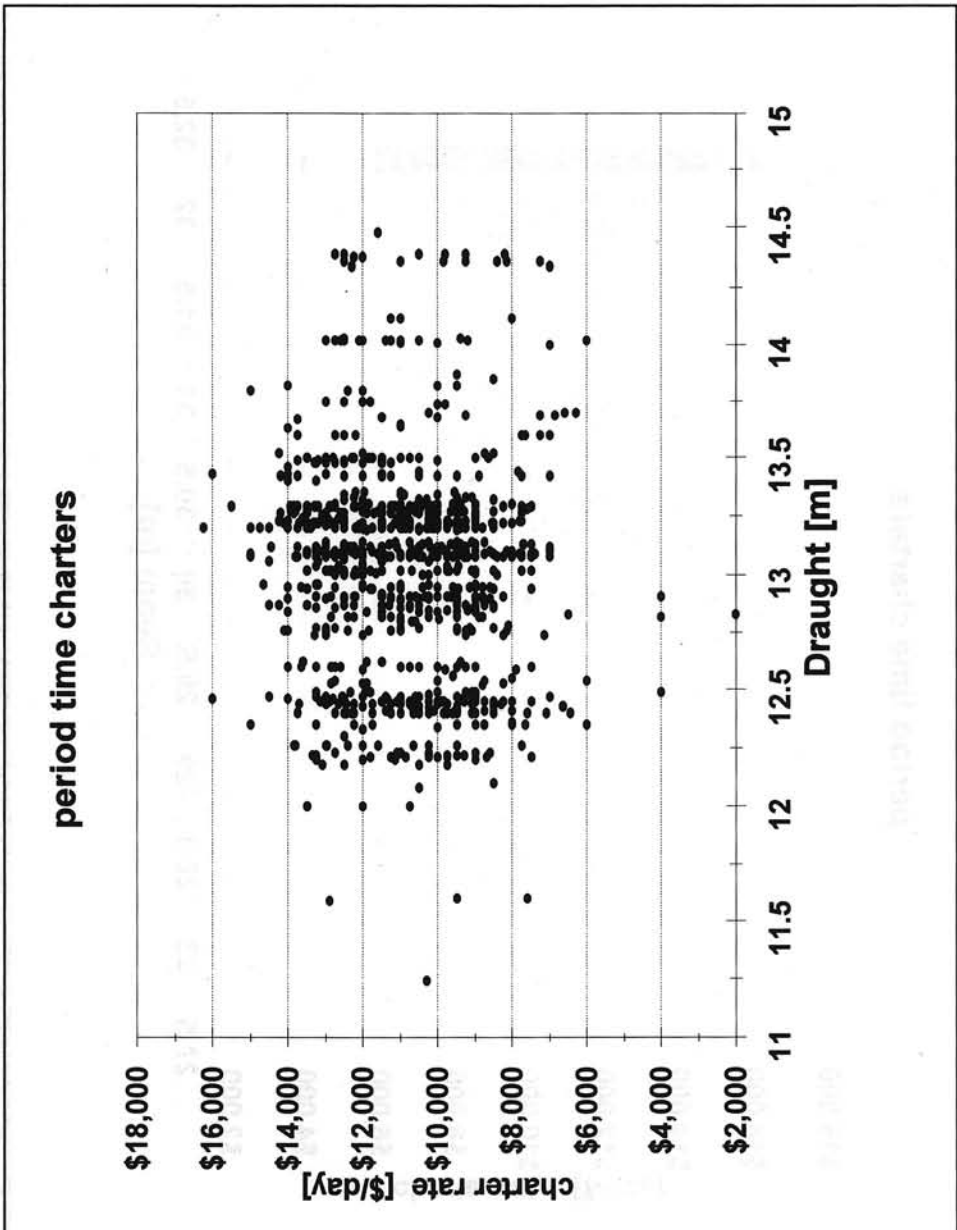


Figure D.6: Charter rate versus draught

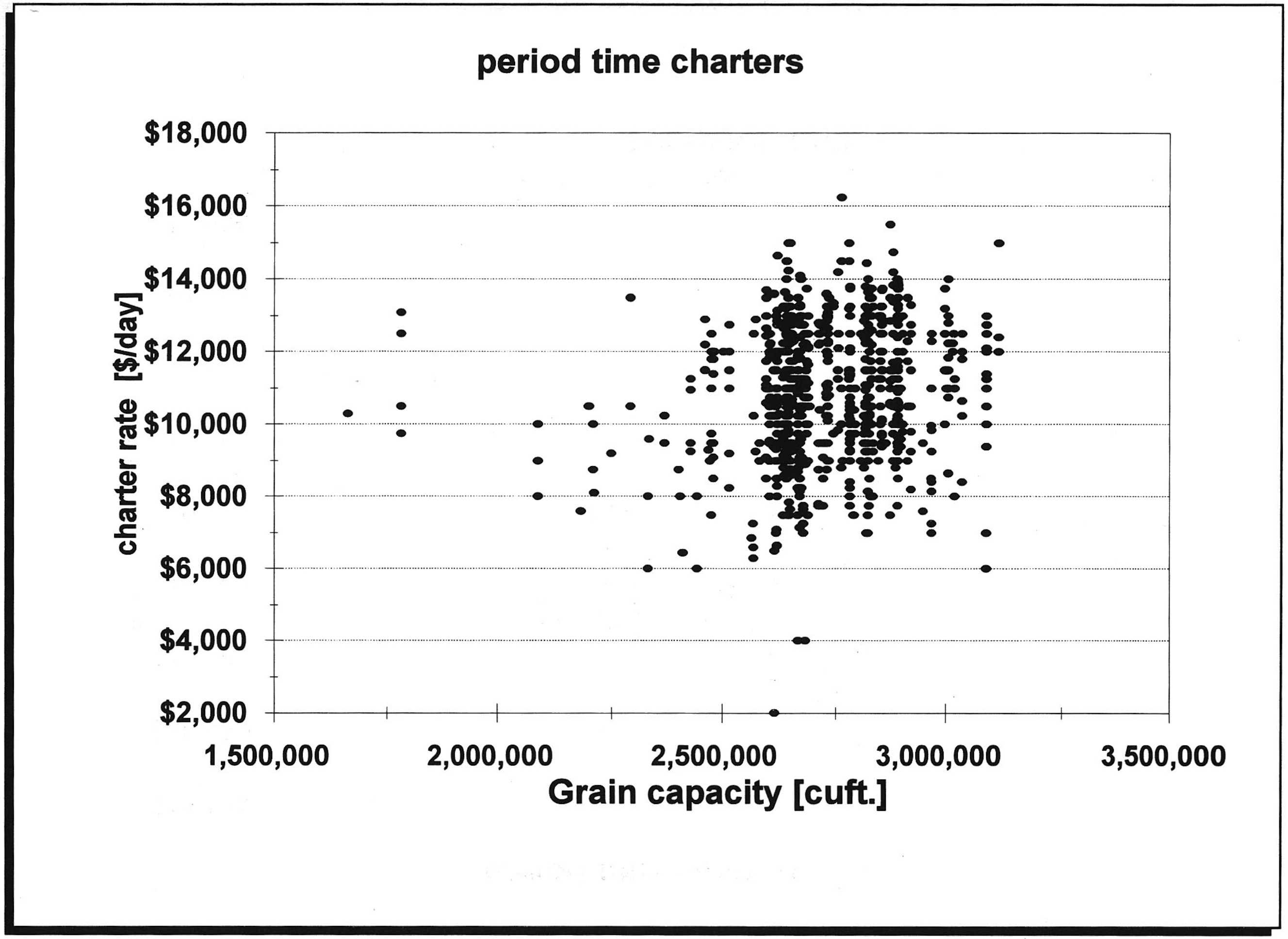


Figure D.7: Charter rate versus grain capacity

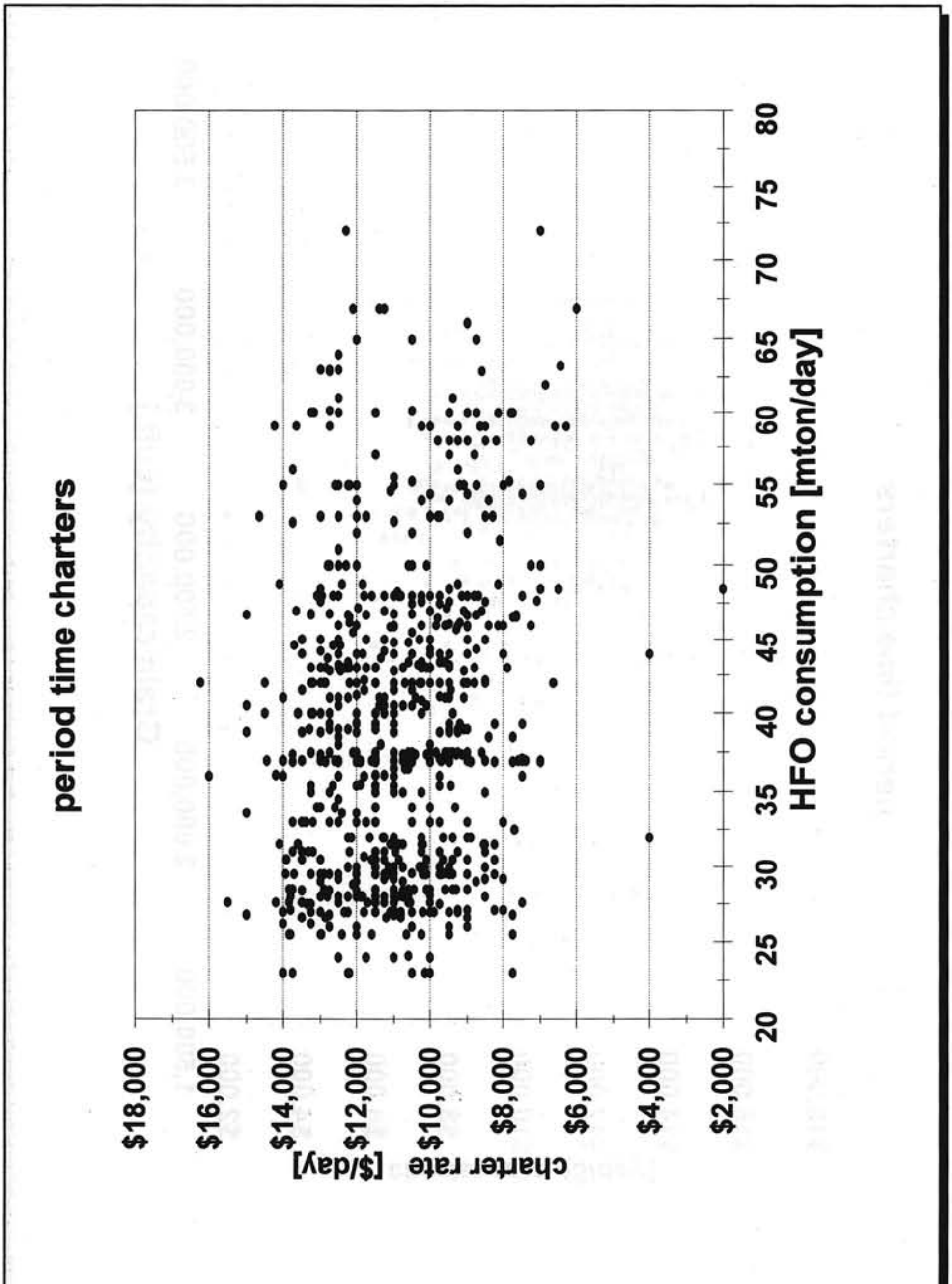


Figure D.8: Freight rate versus HFO consumption

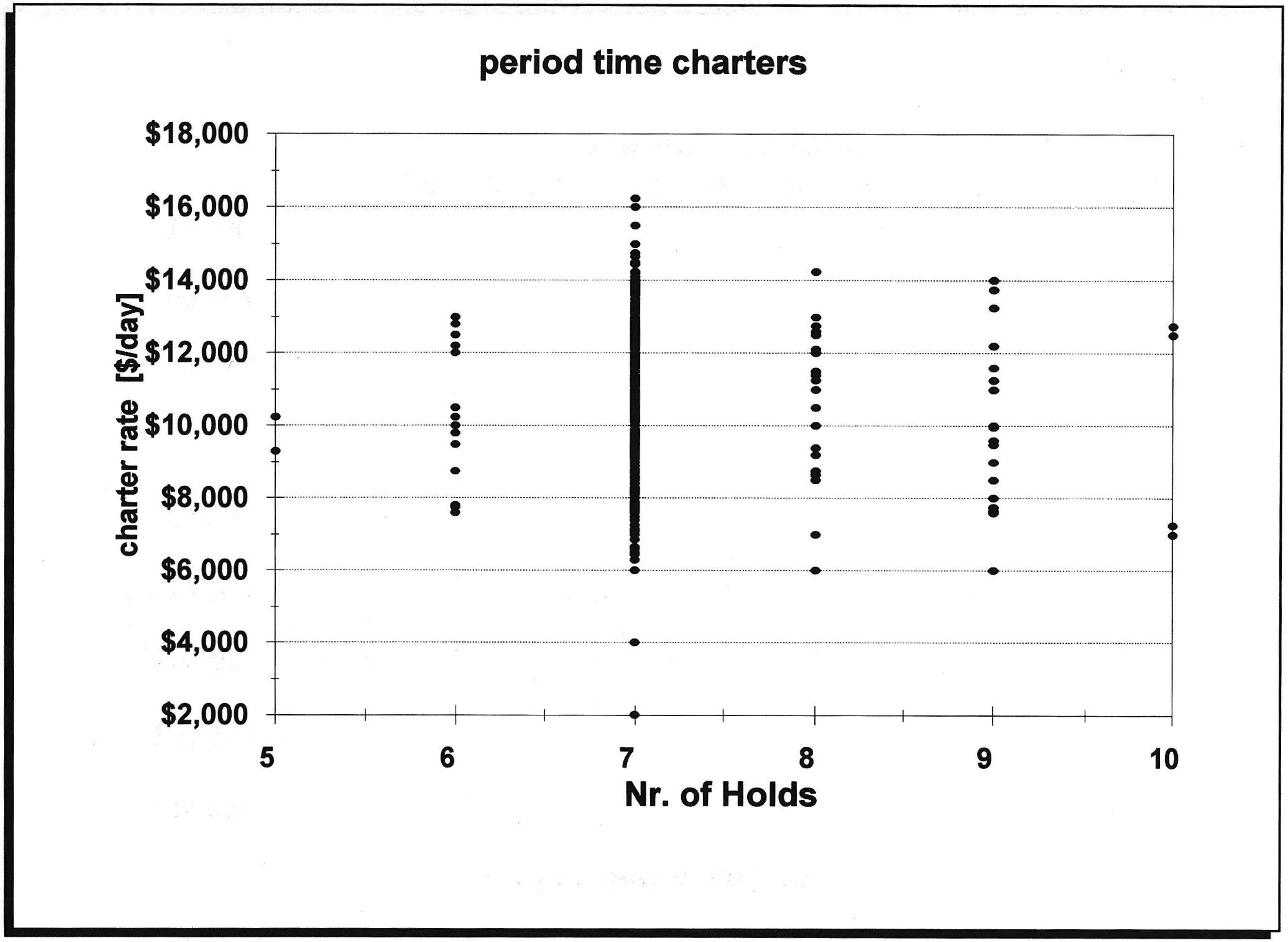


Figure D.9: Charter rate versus number of holds

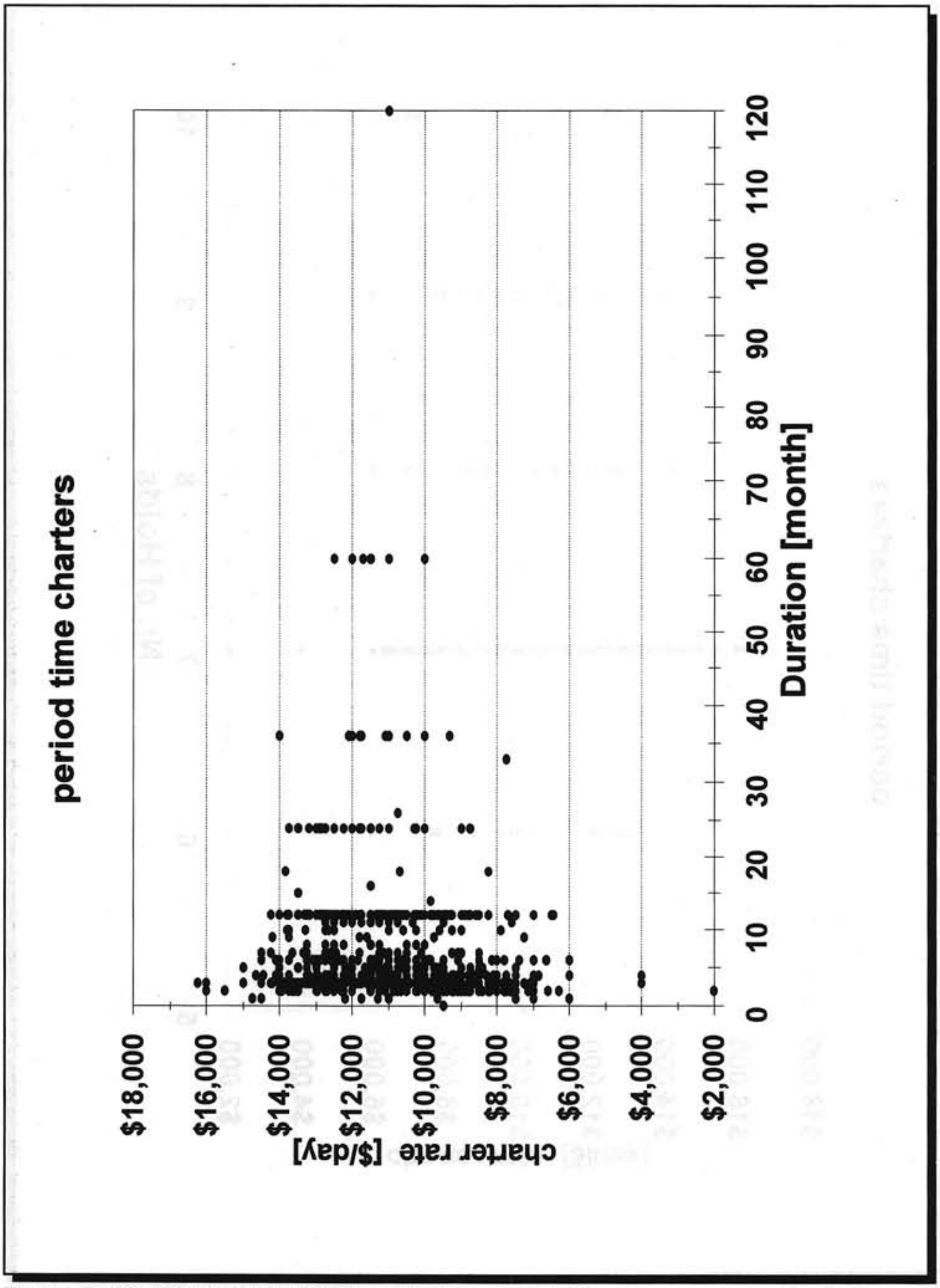


Figure D.10: Charter rate versus duration of fixtures

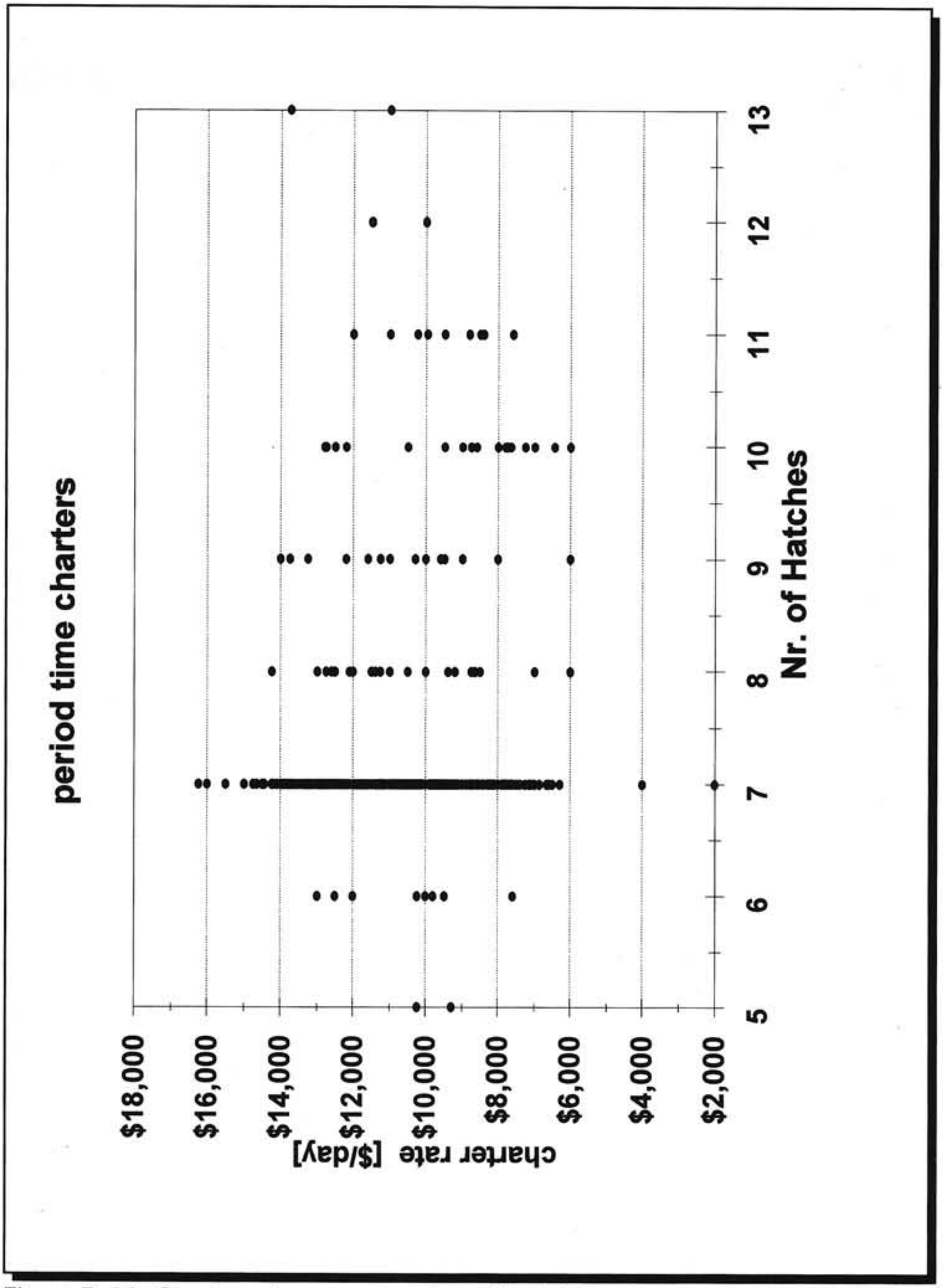


Figure D.11: Charter rate versus number of hatches

APPENDIX E: TRIP TIME CHARTERS: RATES VS. DESIGN CHARACTERISTICS

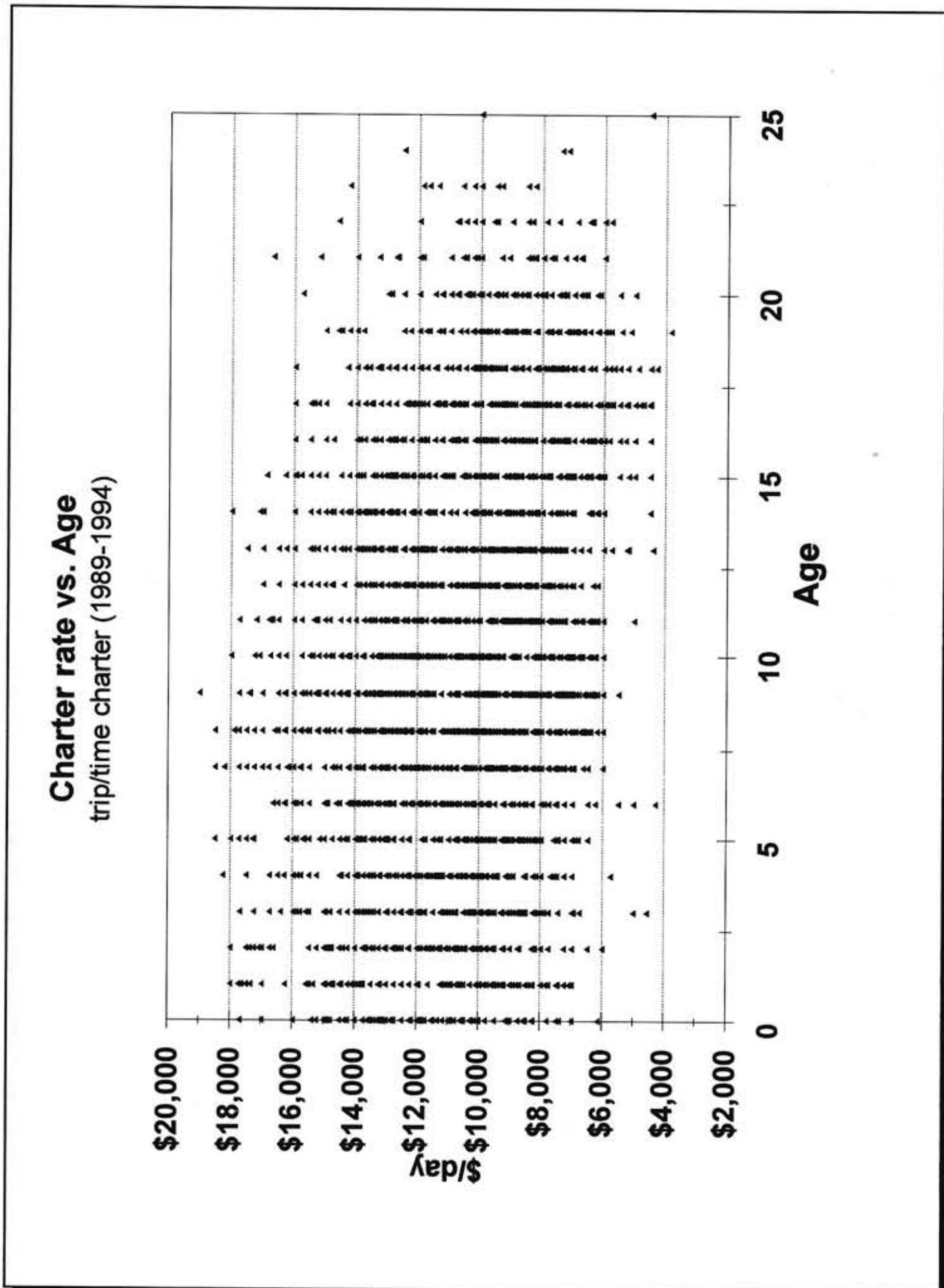


Figure E.1: Charter rate versus age

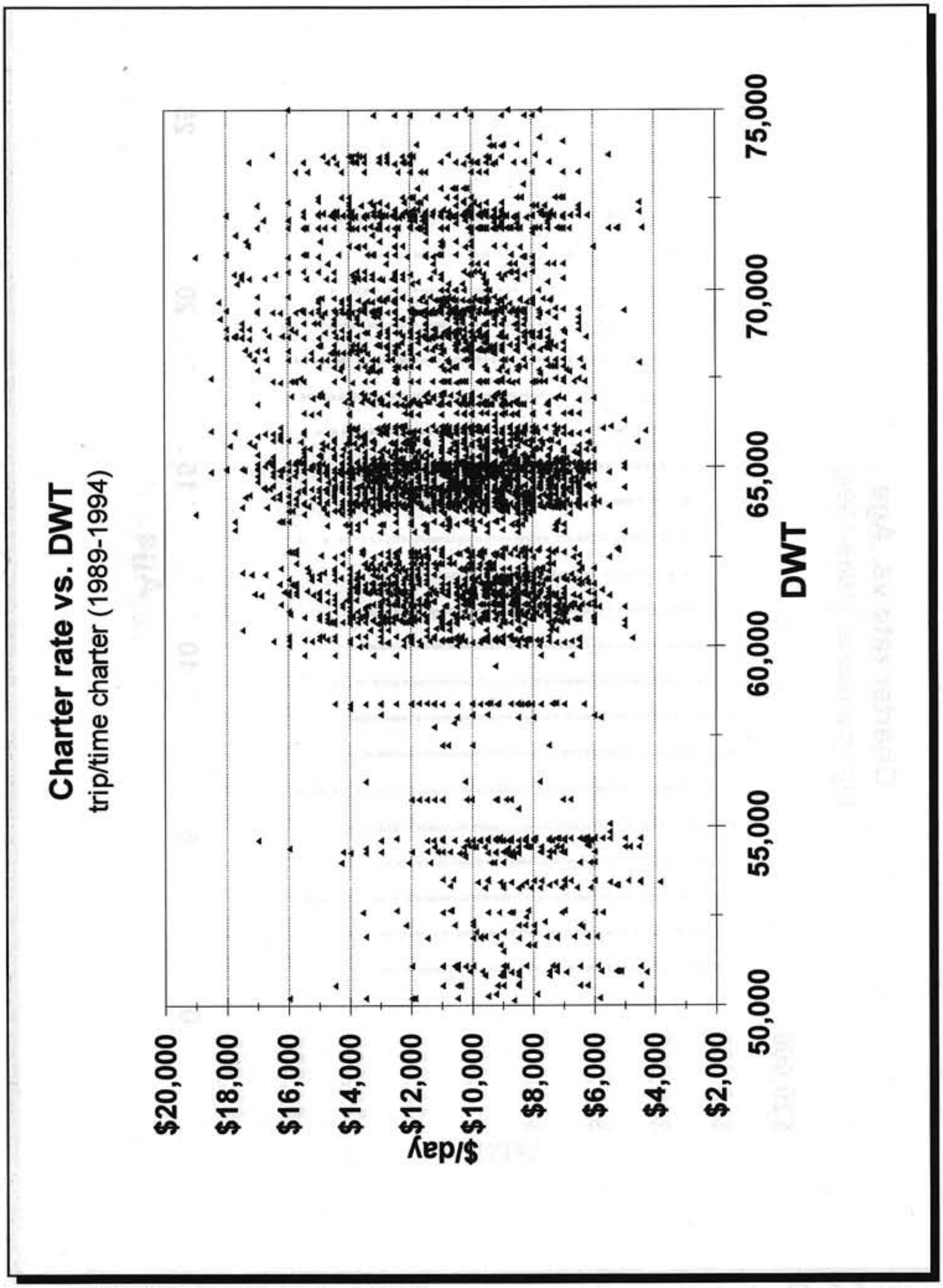


Figure E.2: Charter rate versus DWT

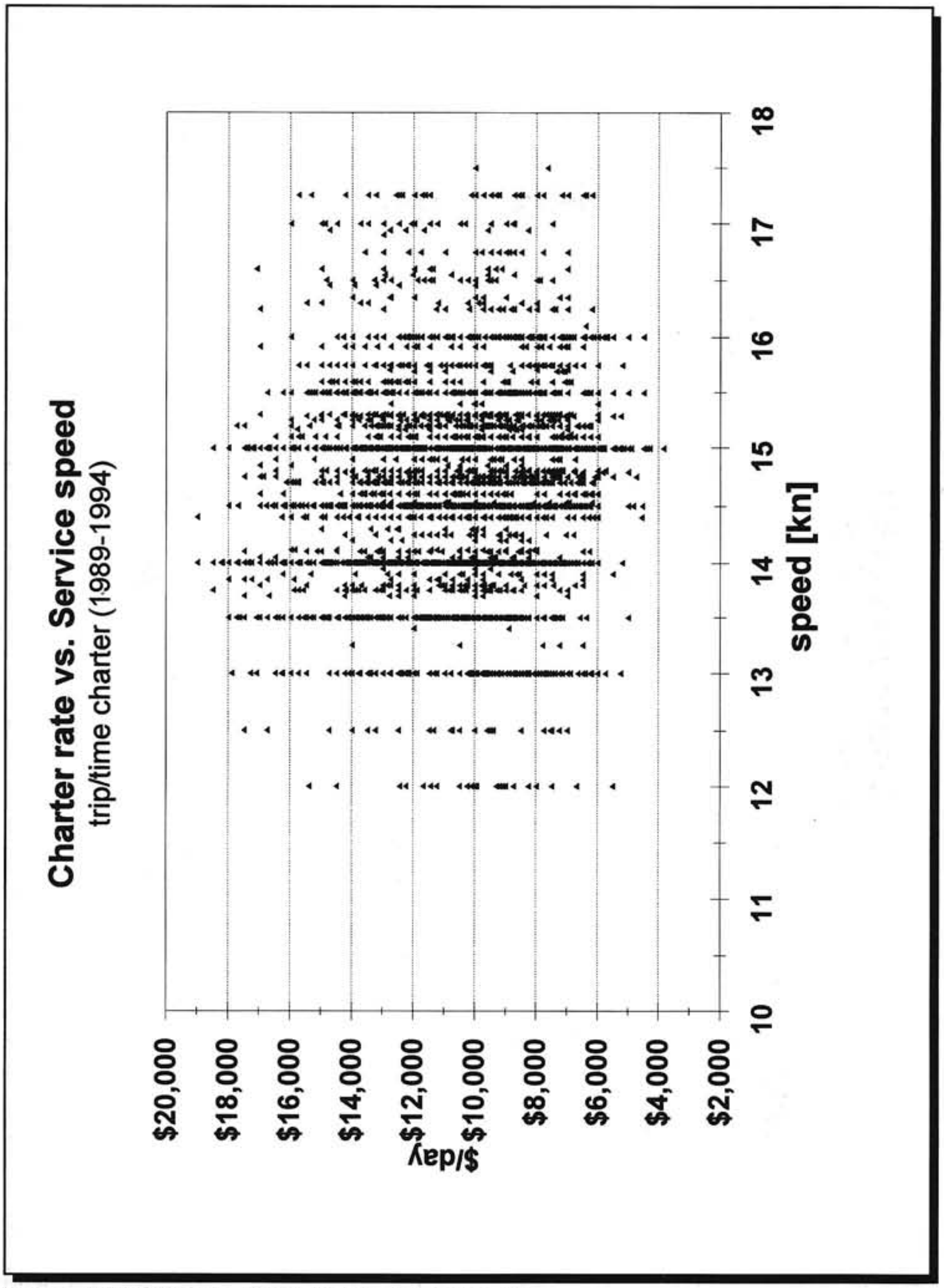


Figure E.3: Charter rate versus service speed

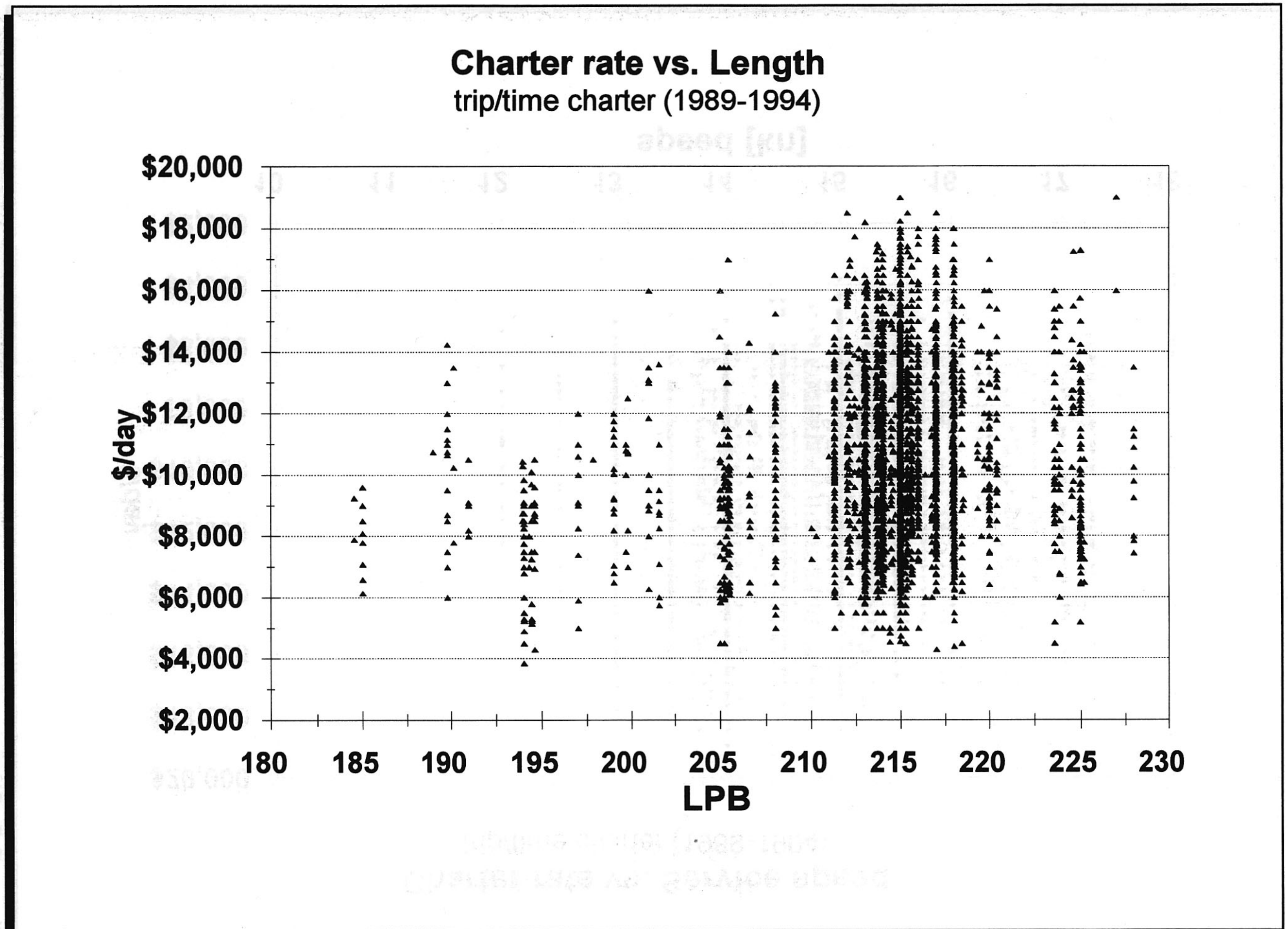


Figure E.4: Charter rate versus length

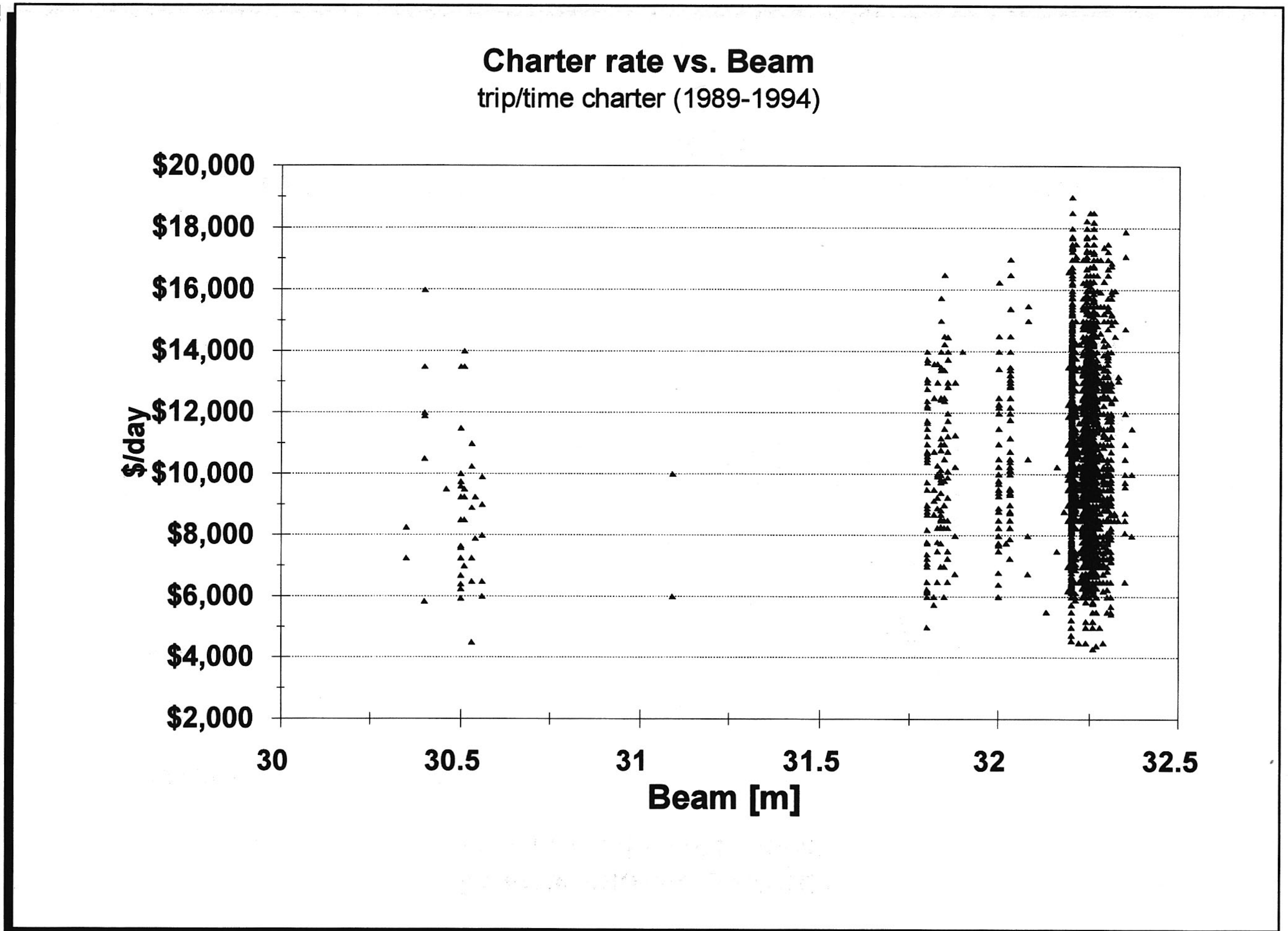


Figure E.5: Charter rate versus beam

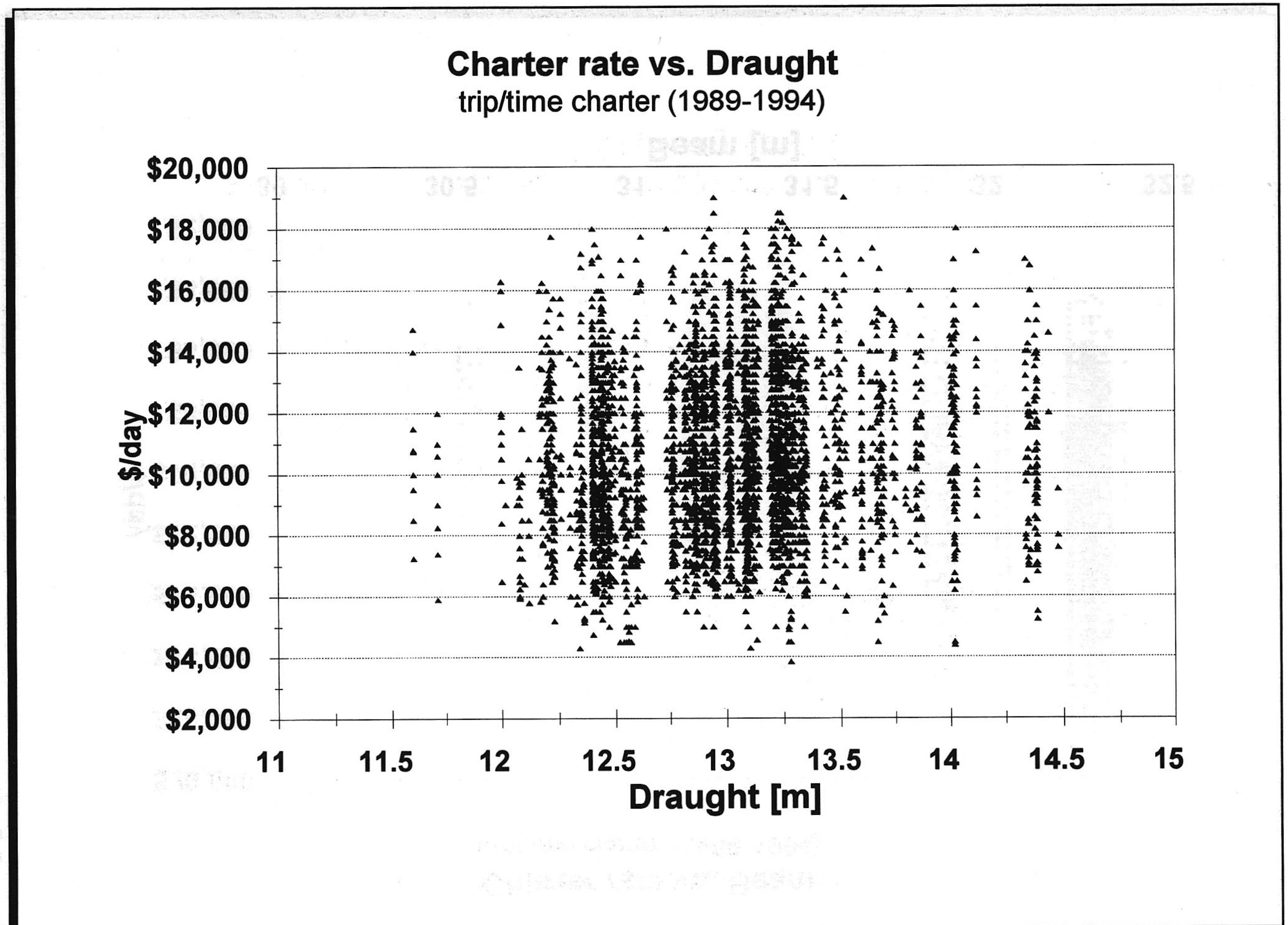


Figure E.6: Charter rate versus draught

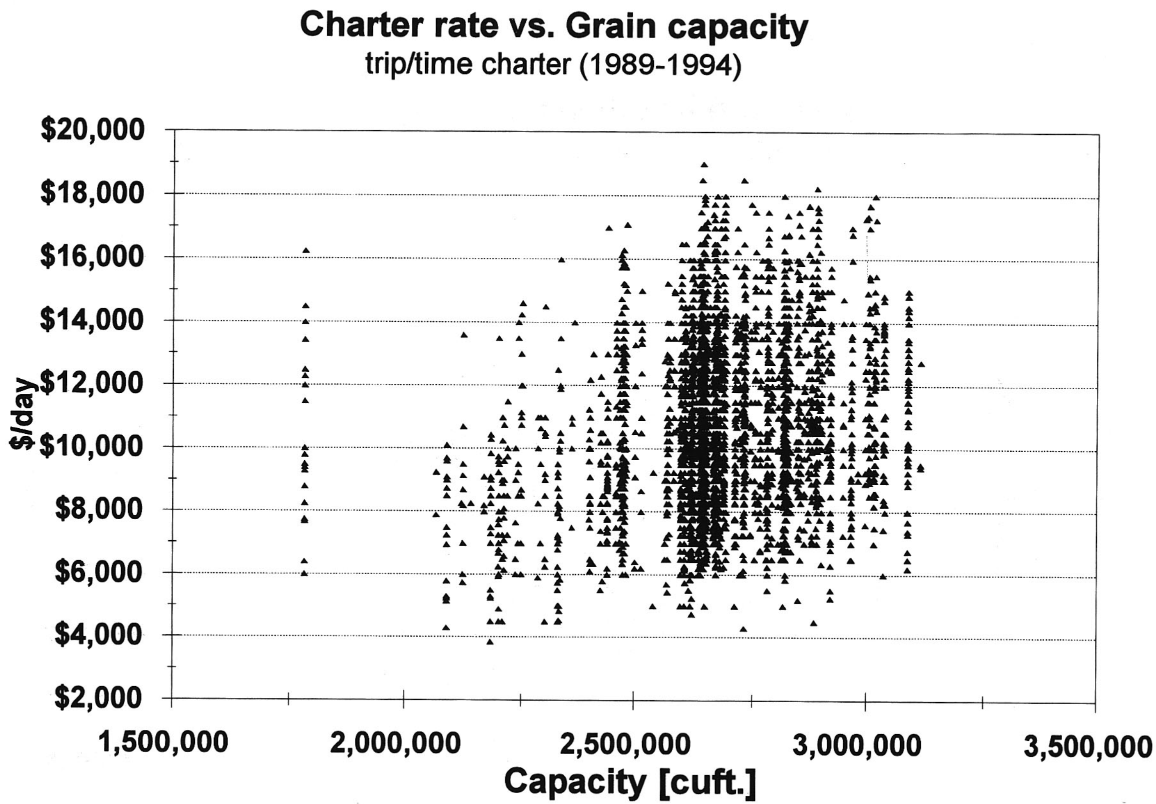


Figure E.7: Charter rate versus grain capacity

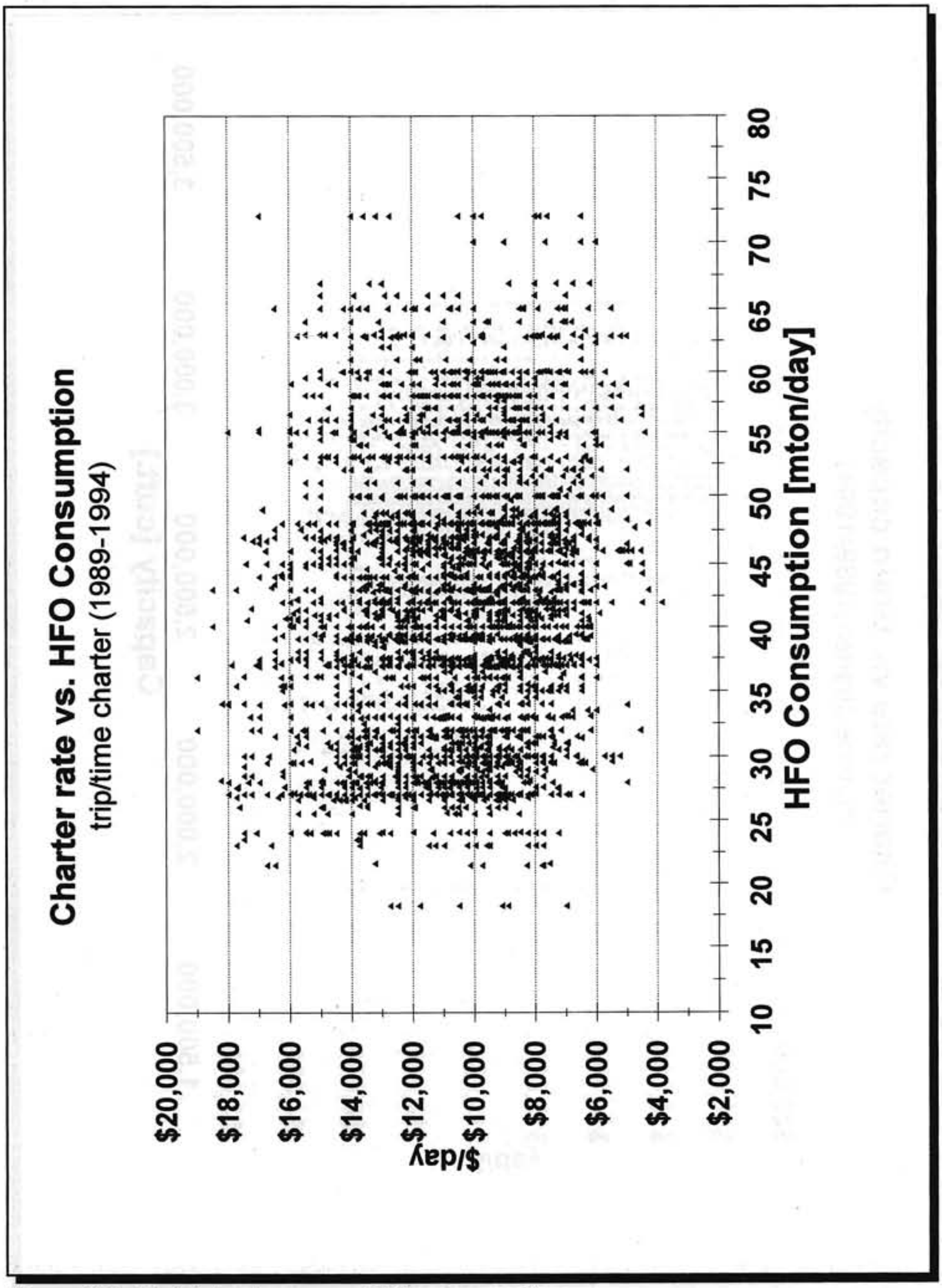


Figure E.8: Freight rate versus HFO consumption

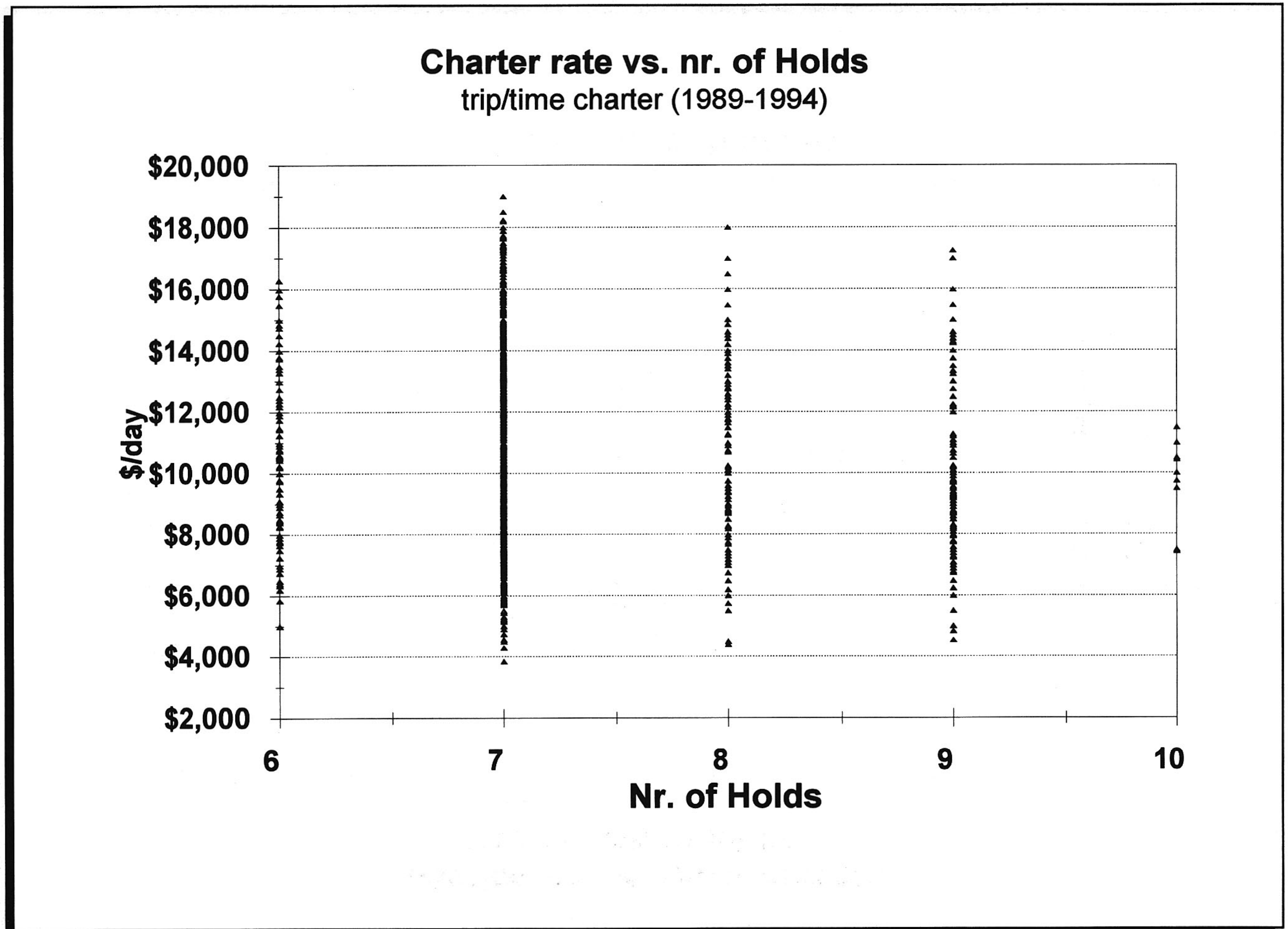


Figure E.9: Charter rate versus number of holds

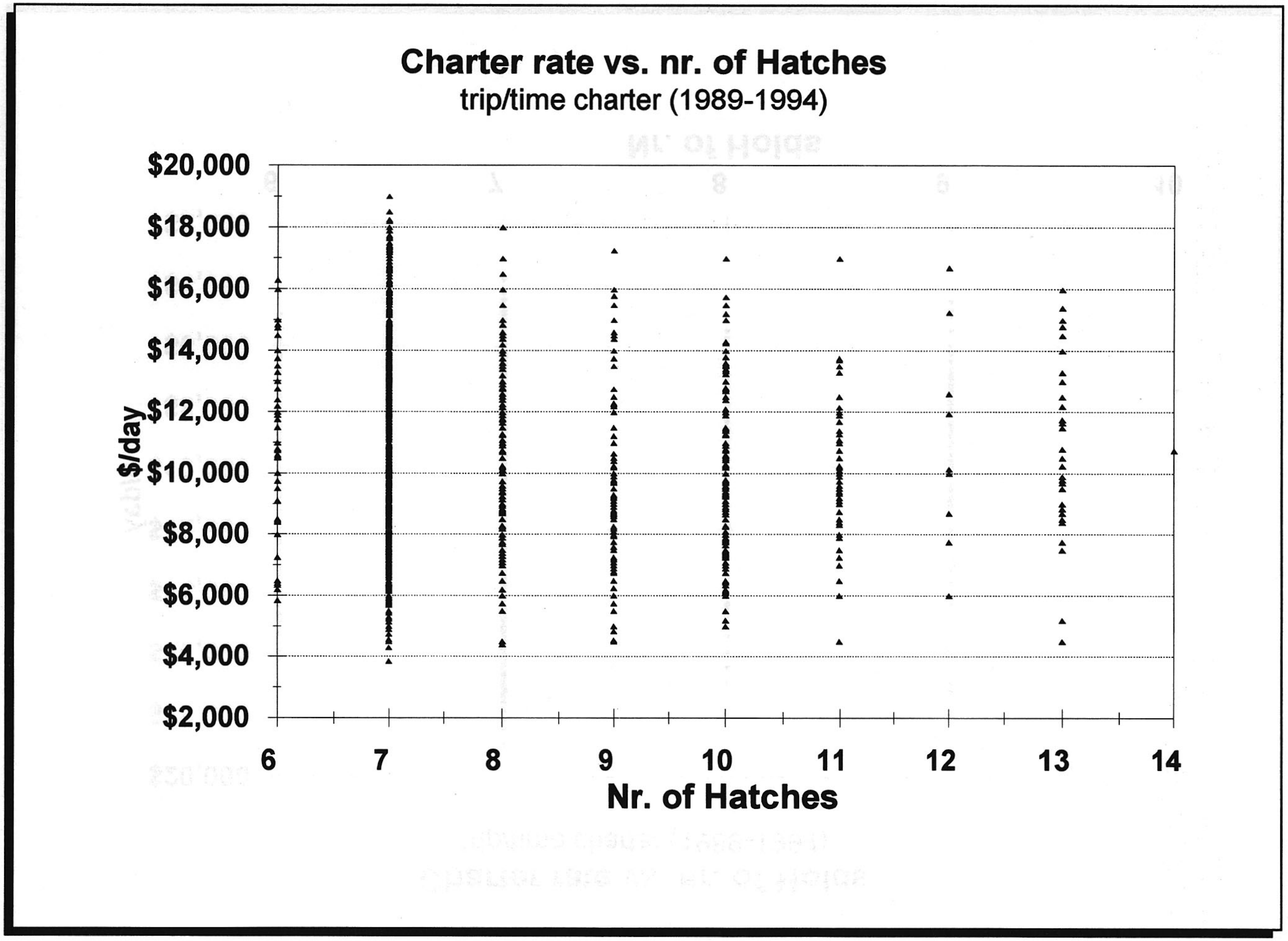


Figure E.10: Charter rate versus number of hatches

APPENDIX F: SINGLE VOYAGE CHARTERS: RATES VS. DESIGN CHARACTERISTICS

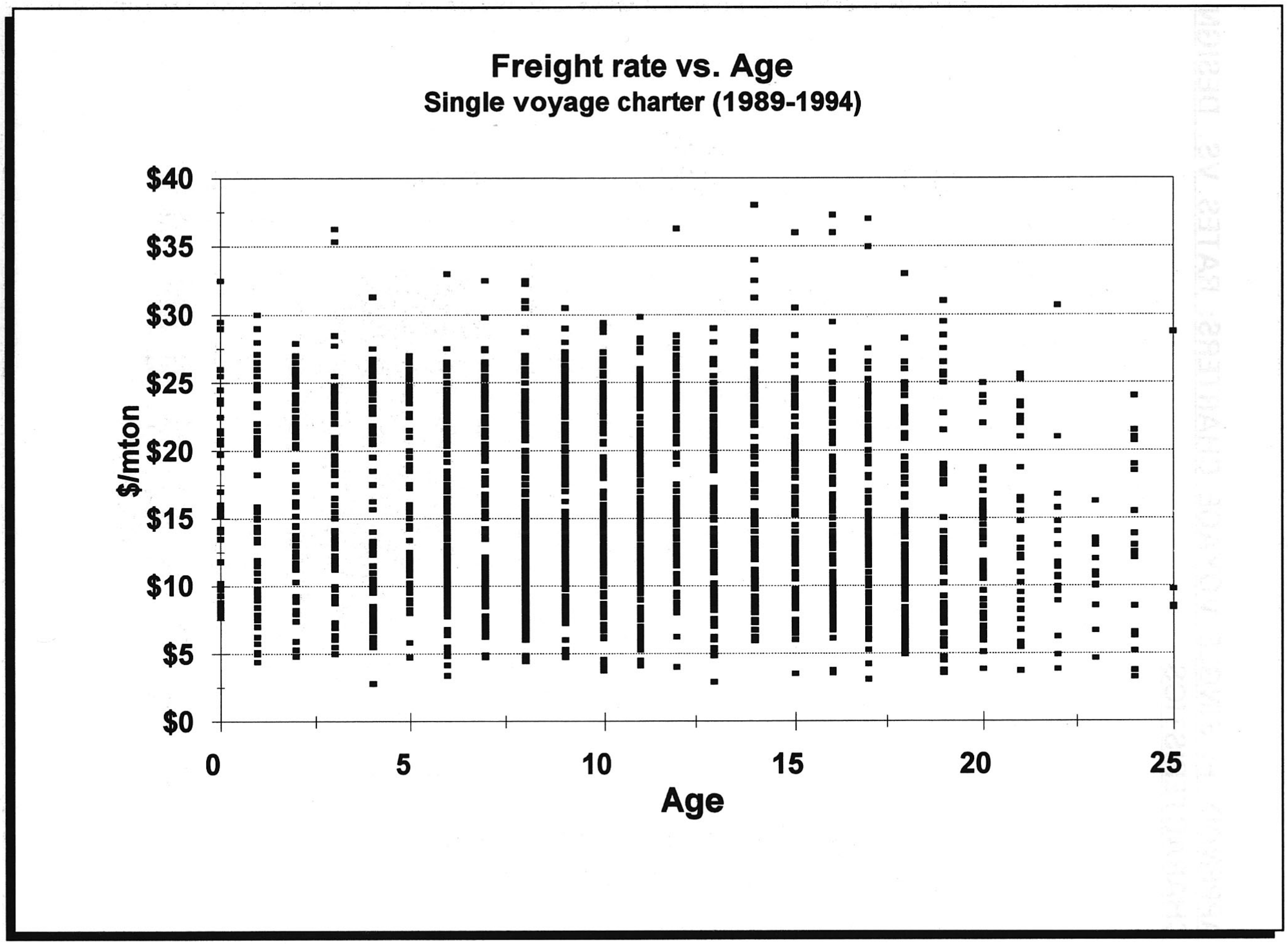


Figure F.1: Freight rate versus age

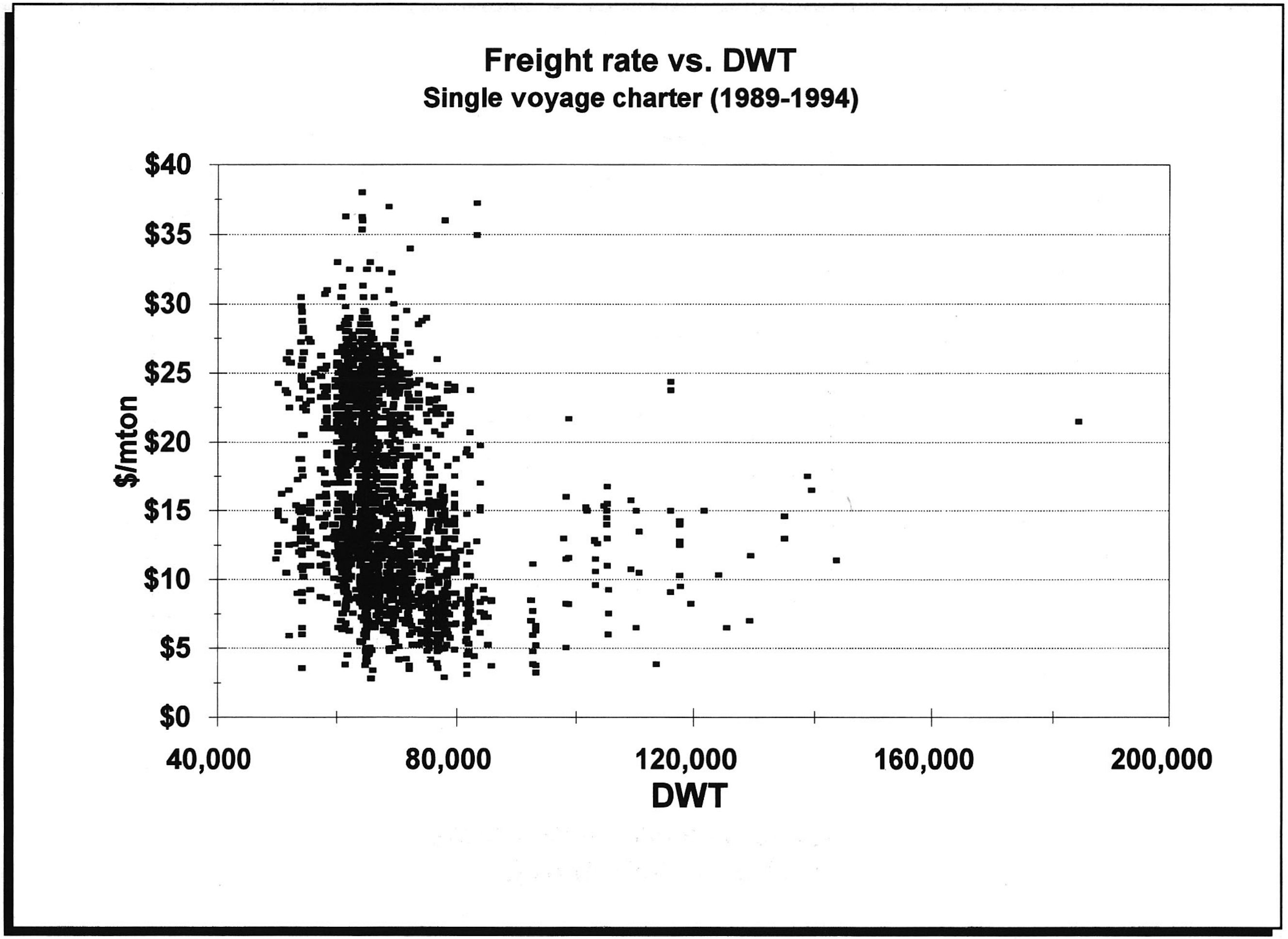


Figure F.2: Freight rates versus DWT (total range)

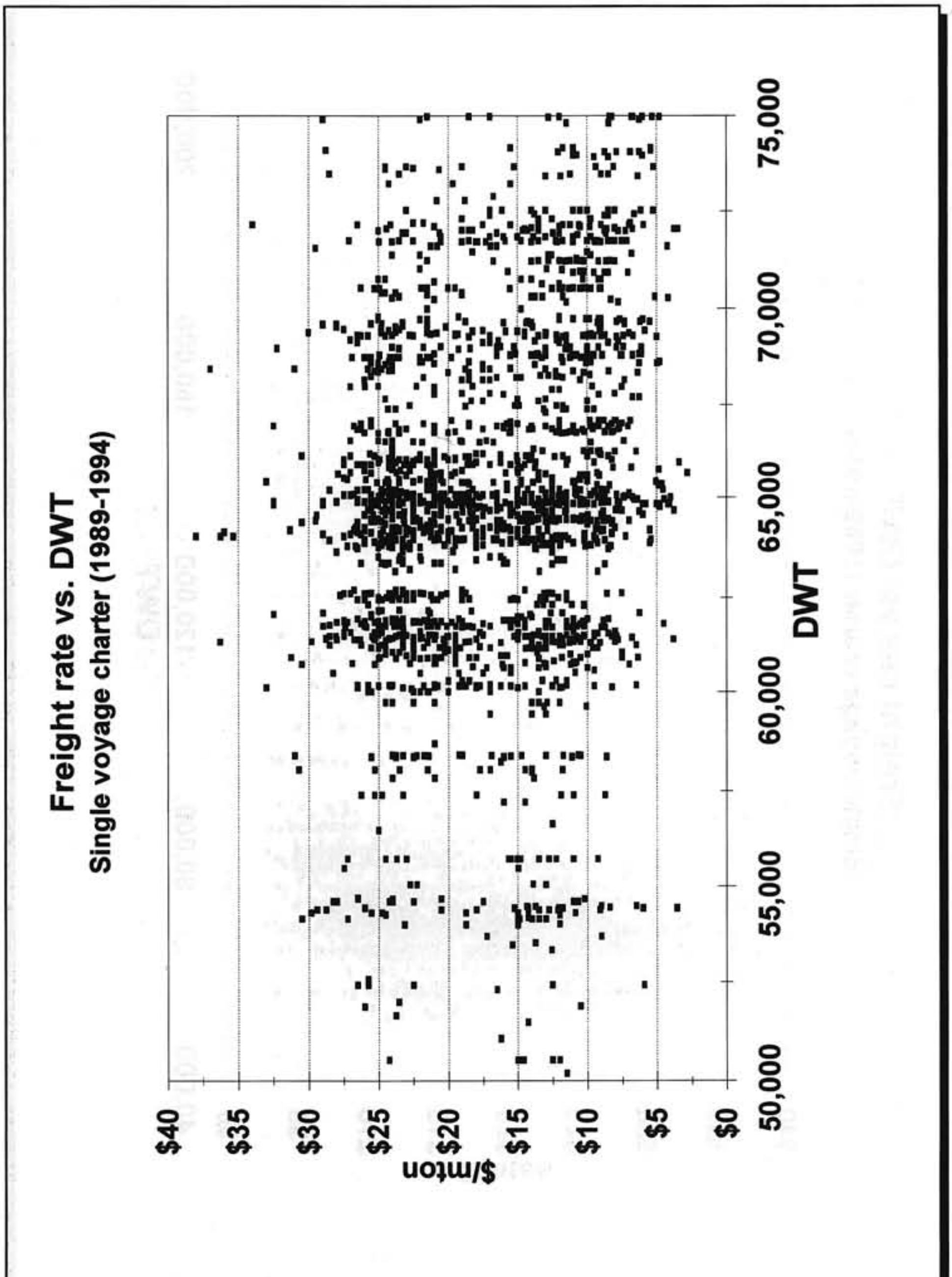


Figure F.3: Freight rates versus DWT (panamax-range)

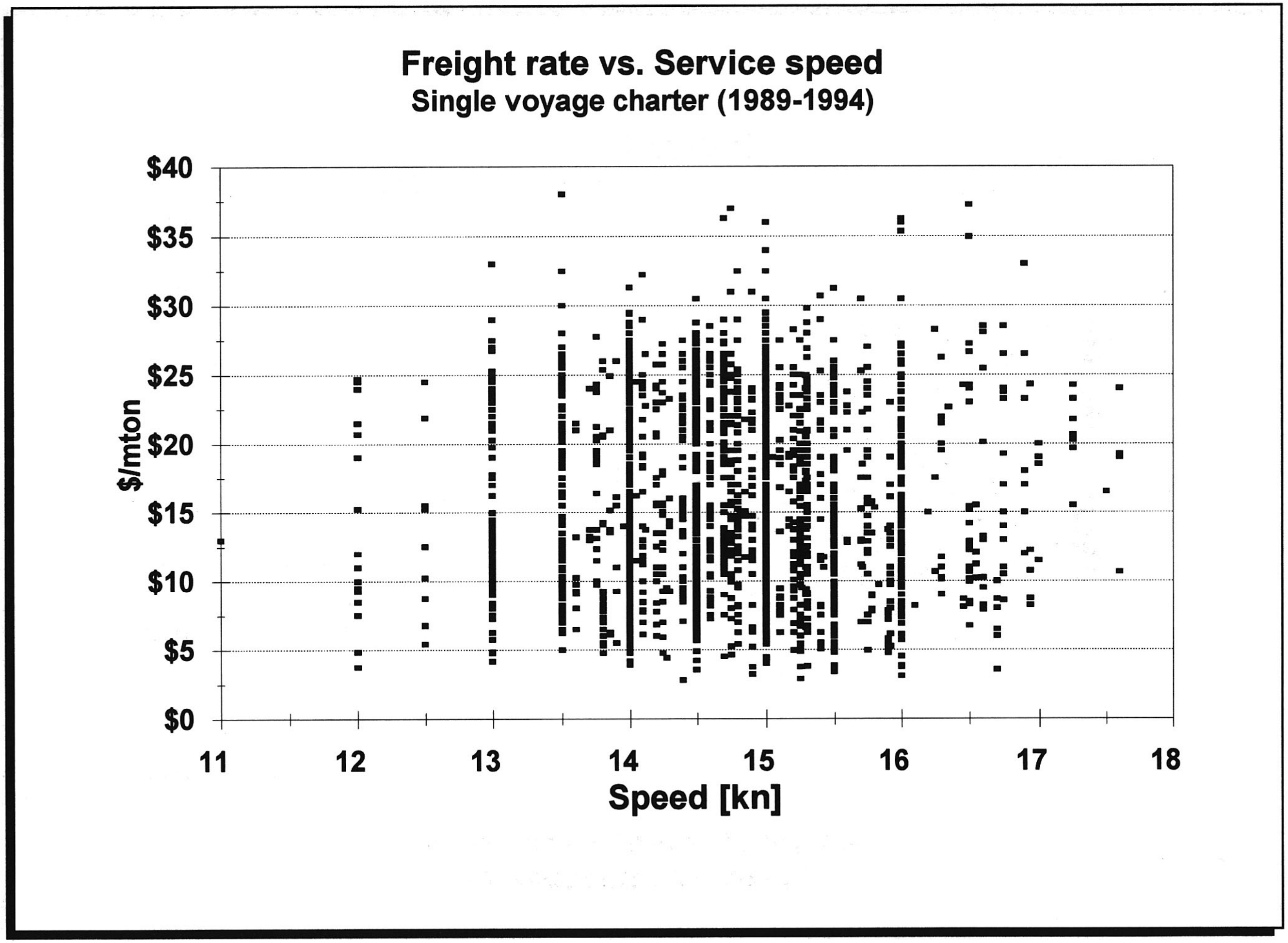


Figure F.4: Freight rate versus service speed

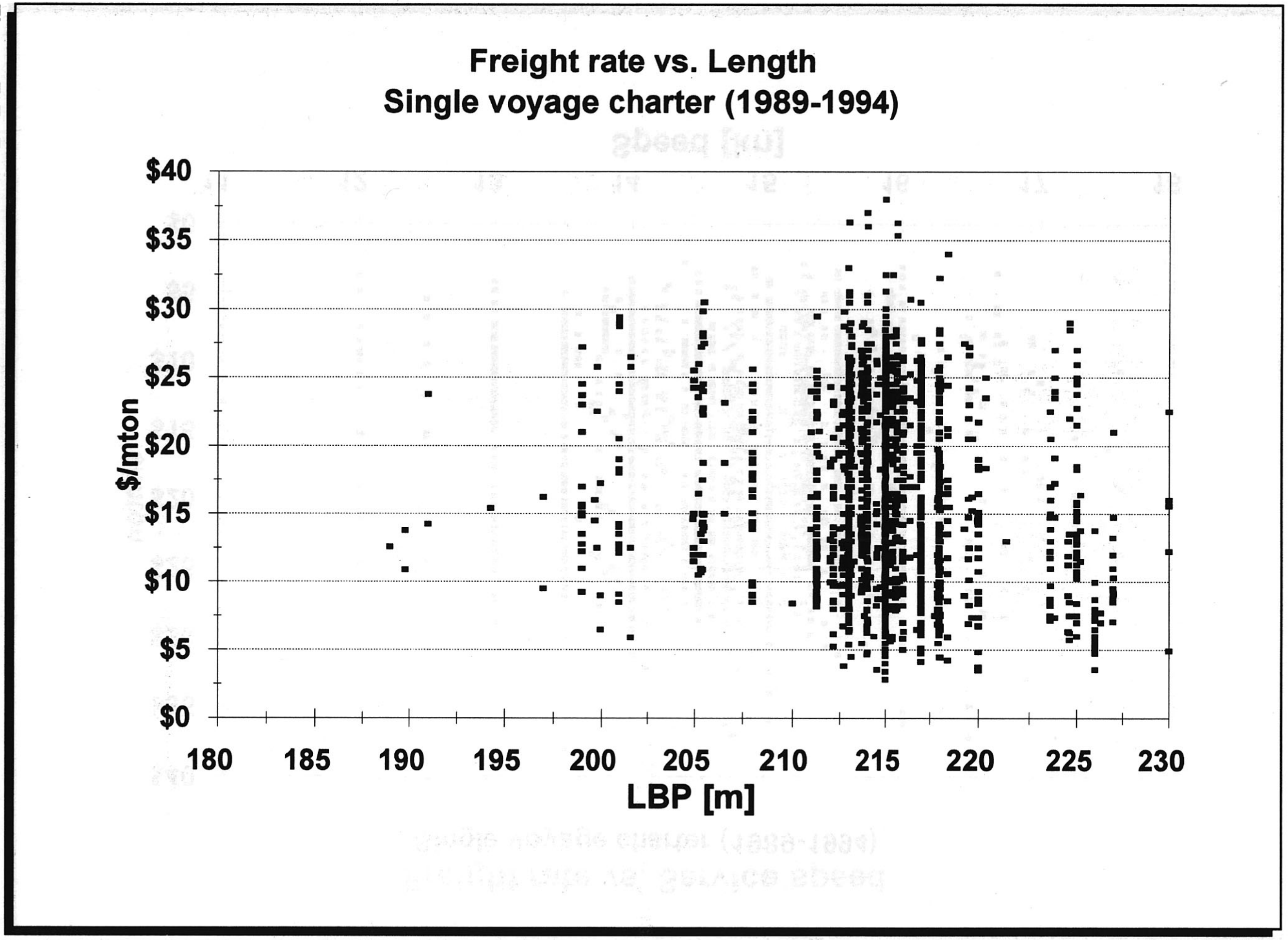


Figure F.5: Freight rate versus length

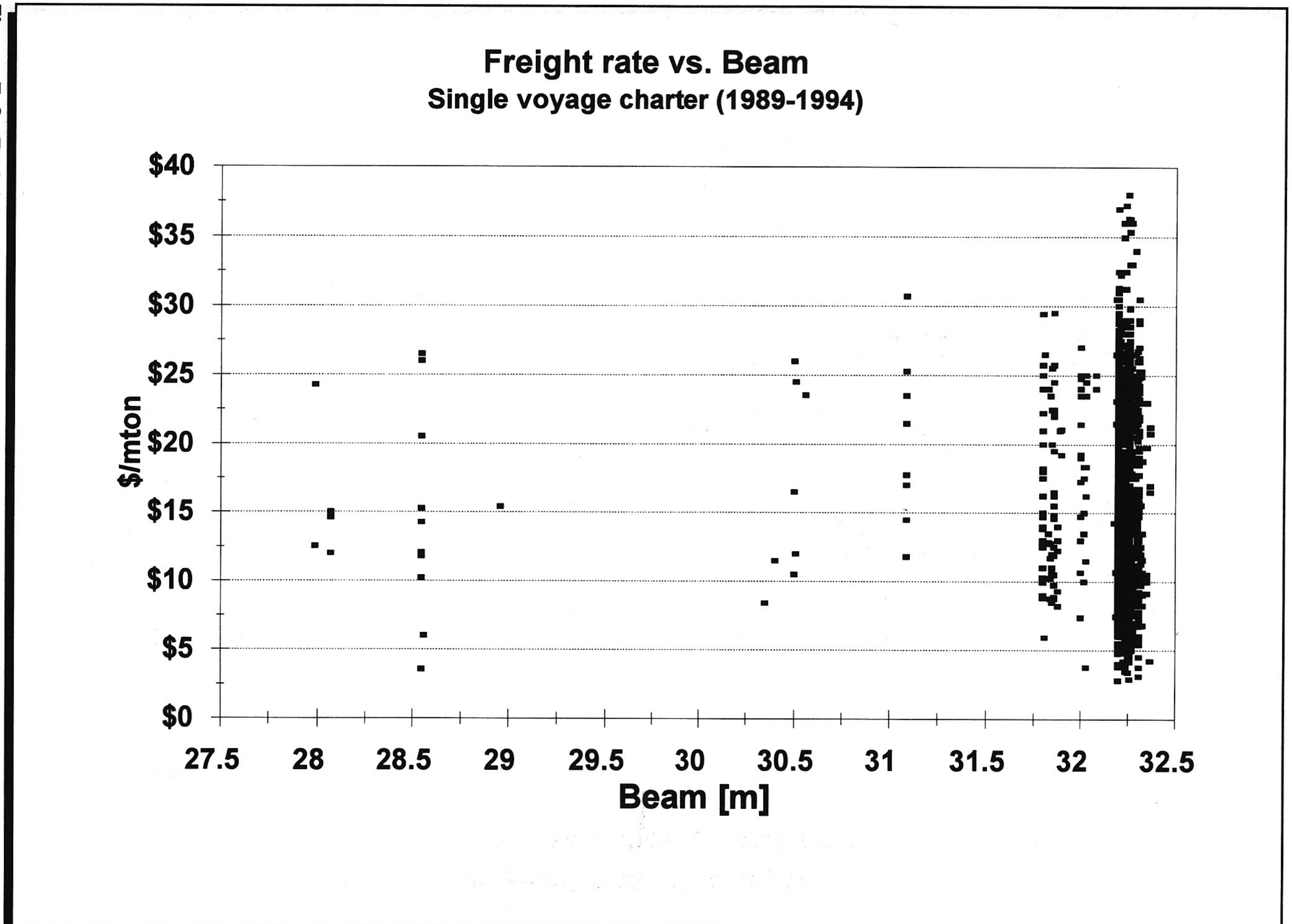


Figure F.6: Freight rate versus beam

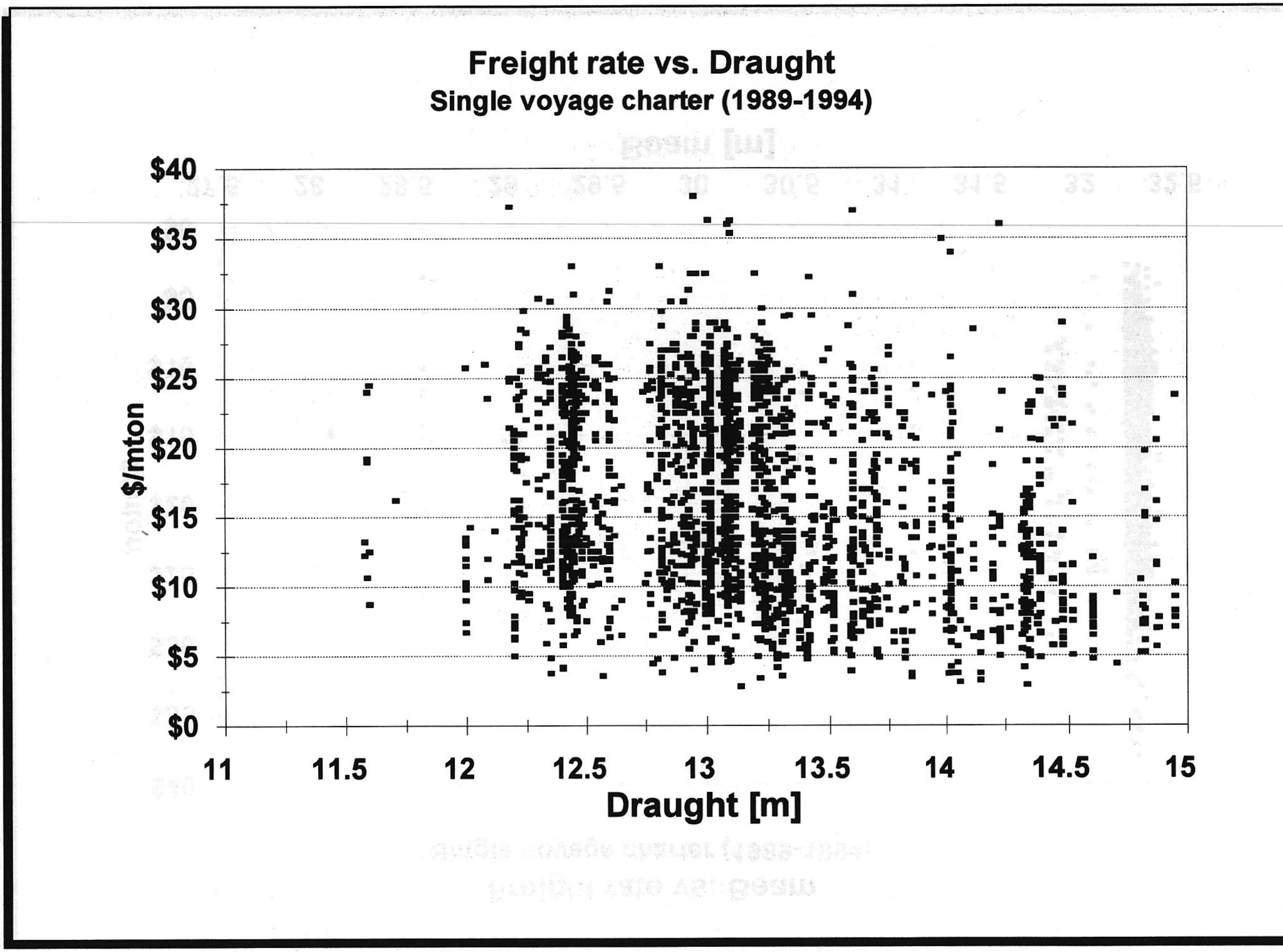


Figure F.7: Freight rate versus draught

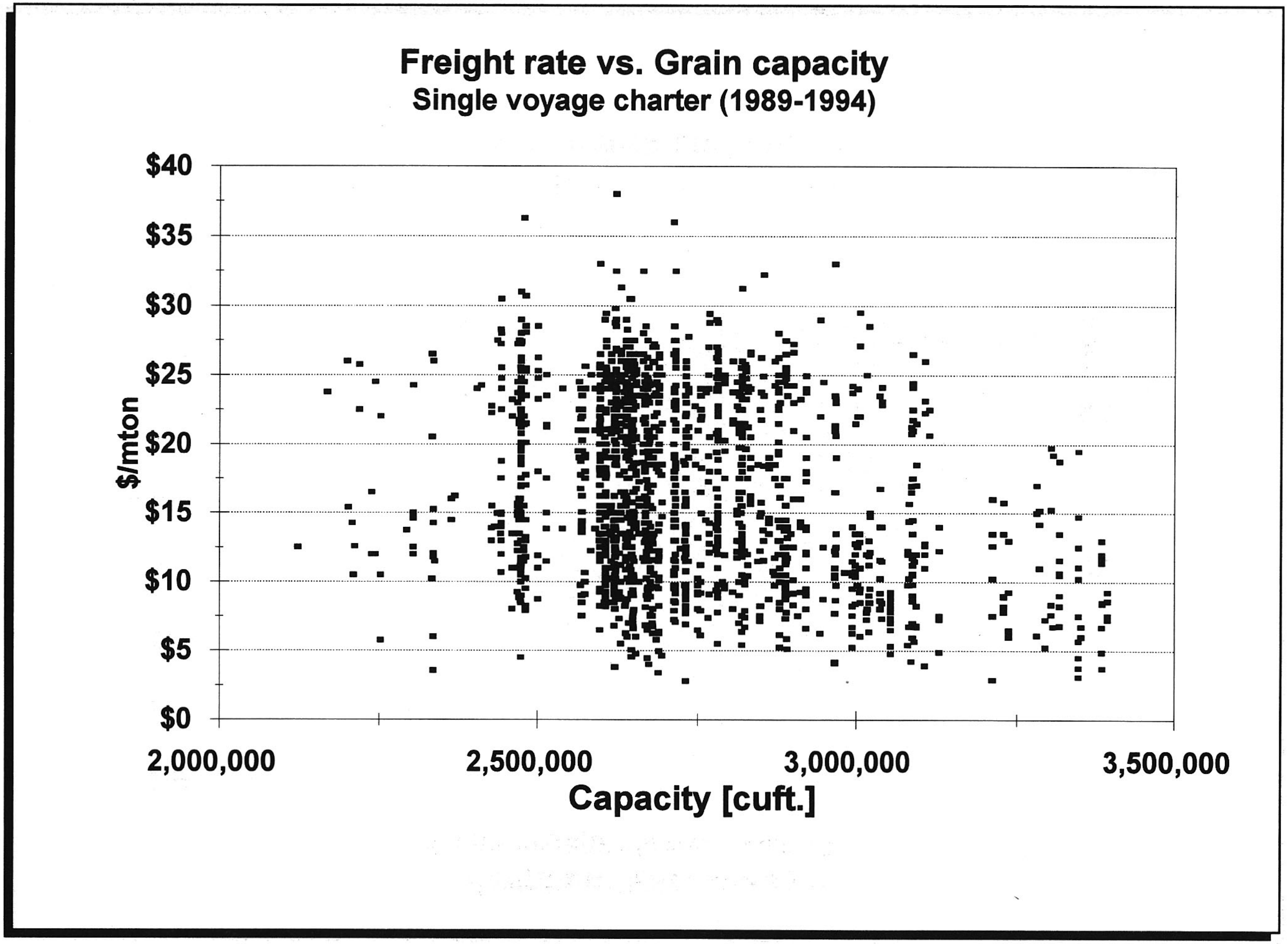


Figure F.8: Freight rate versus grain capacity

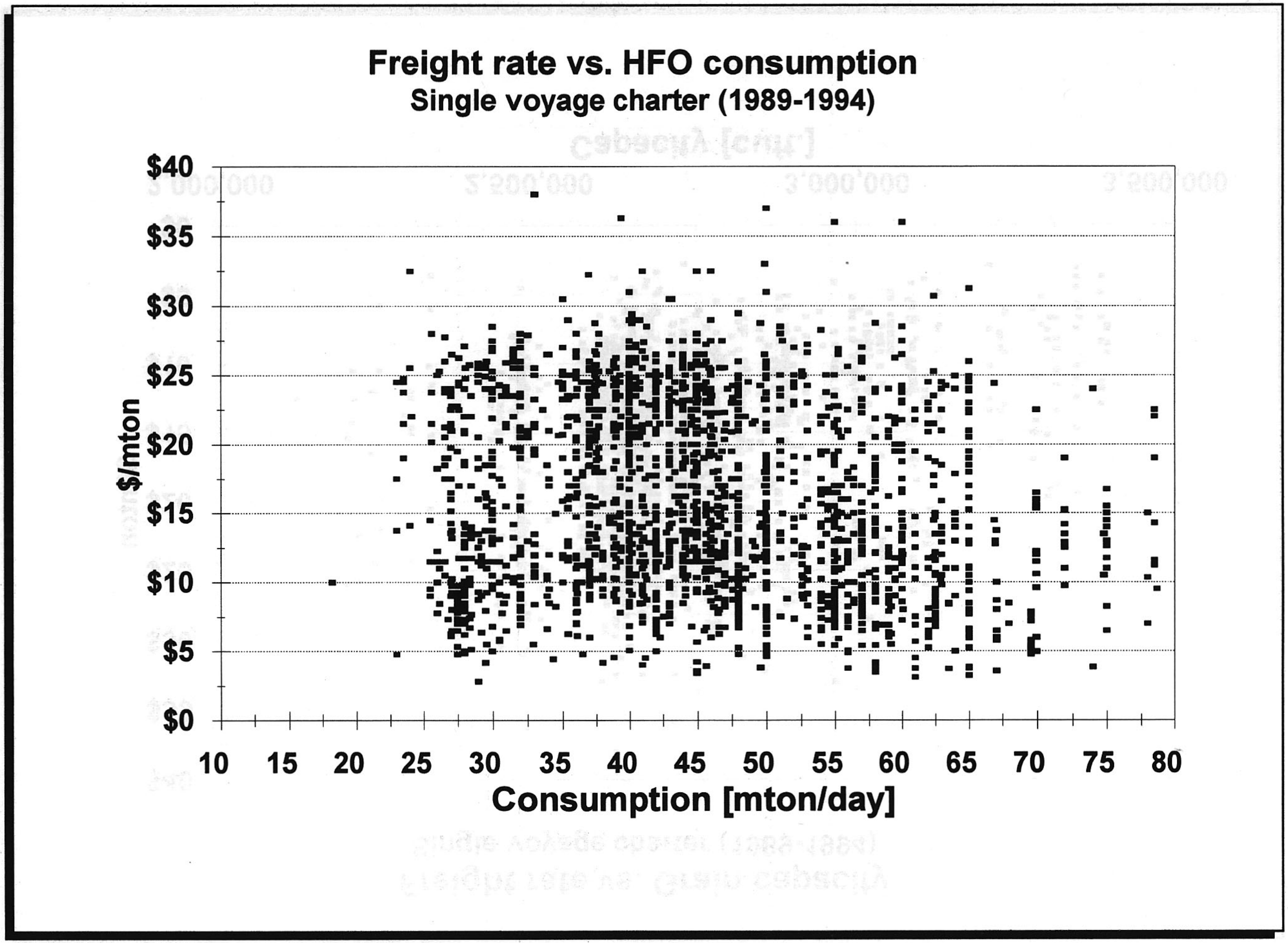


Figure F.9: Frieght rate versus HFO consumption

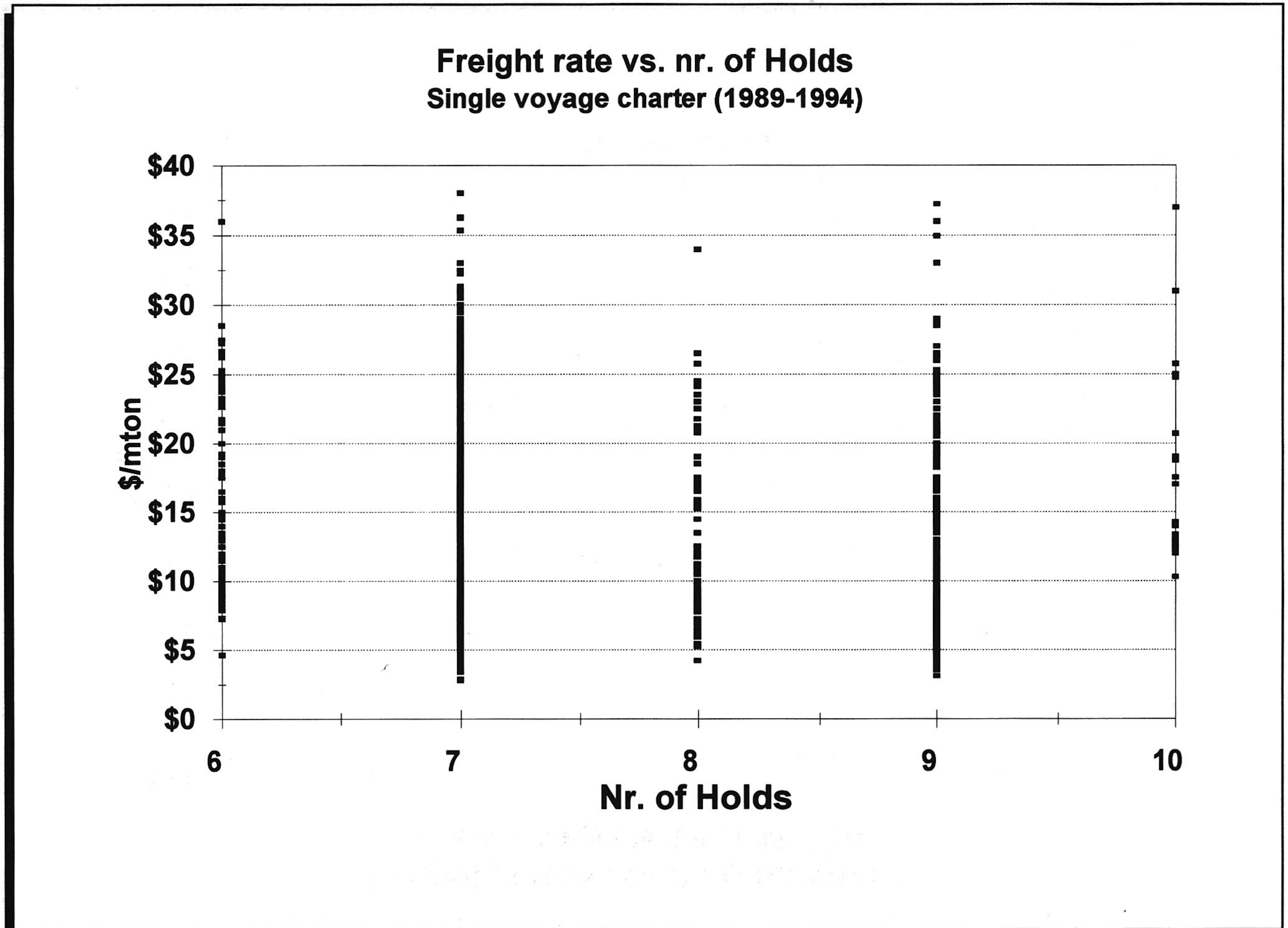


Figure F.10: Freight rate versus number of holds

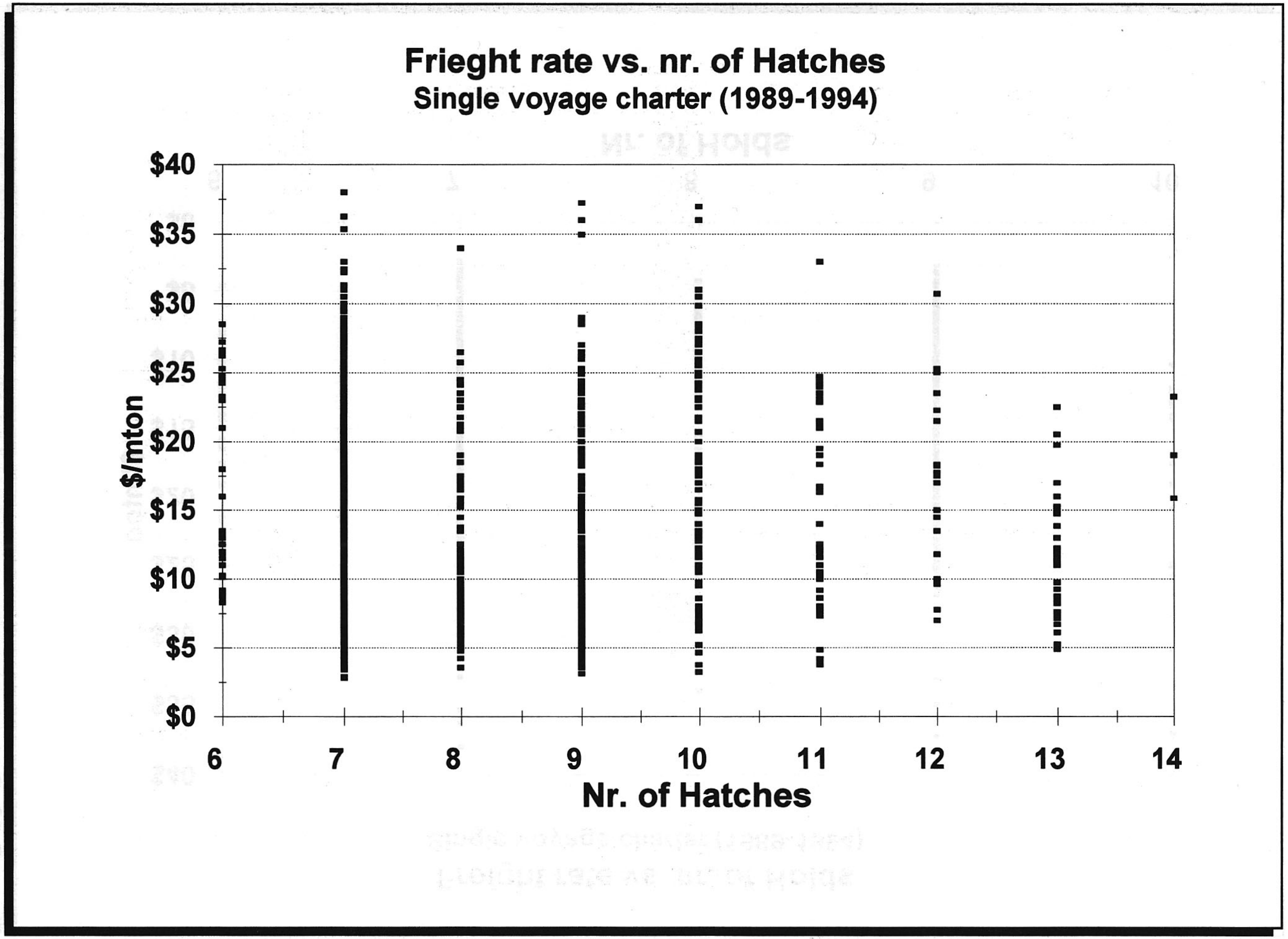


Figure F.11: Freight rate versus number of hatches

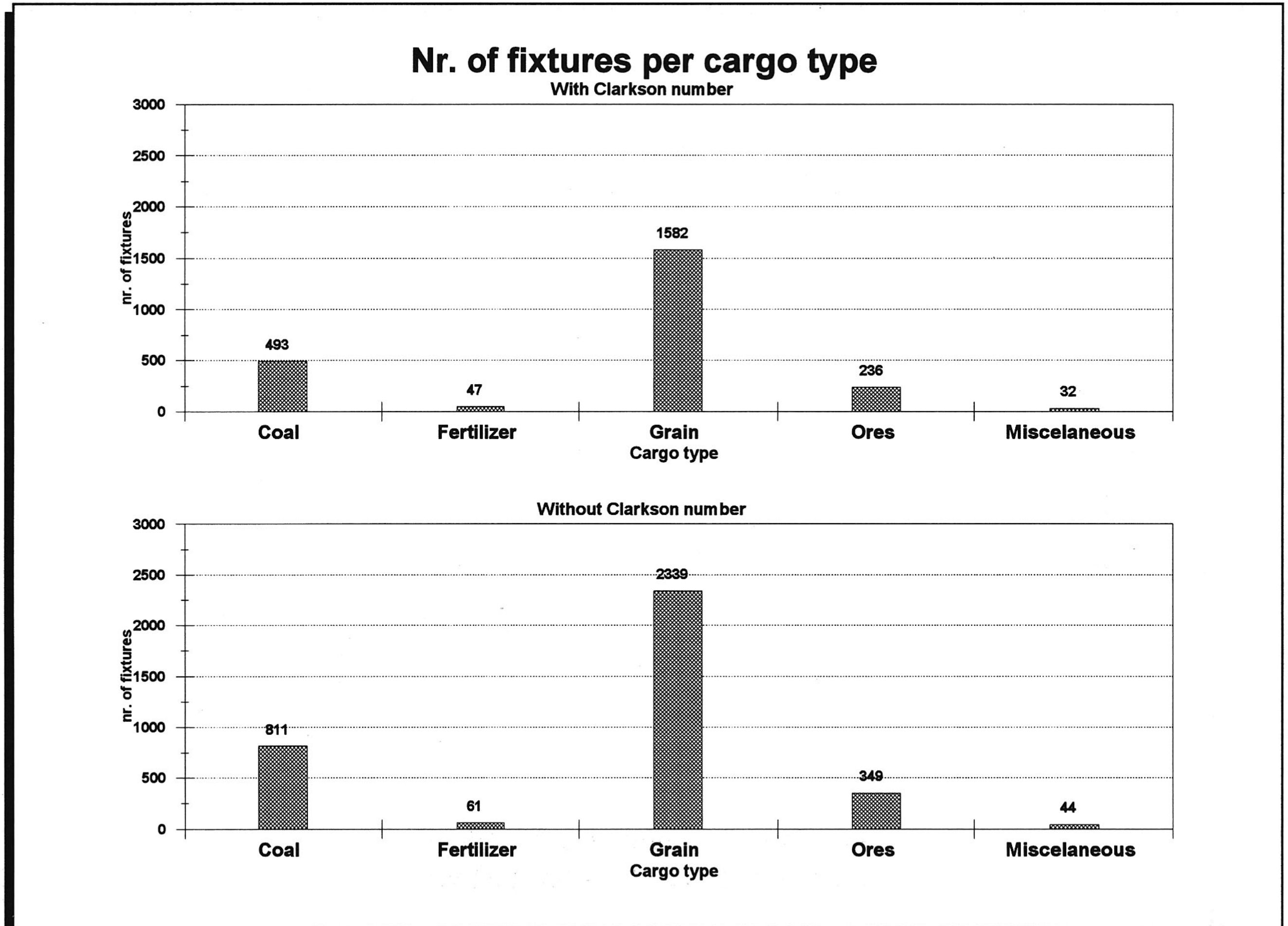
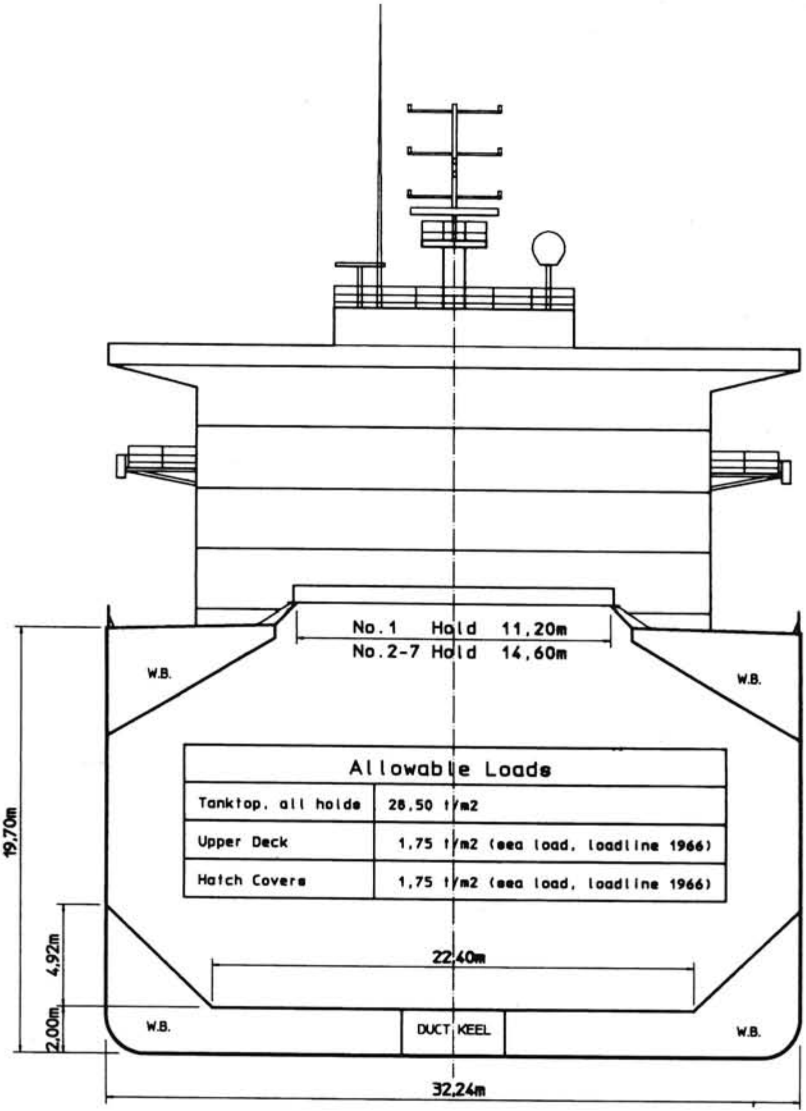
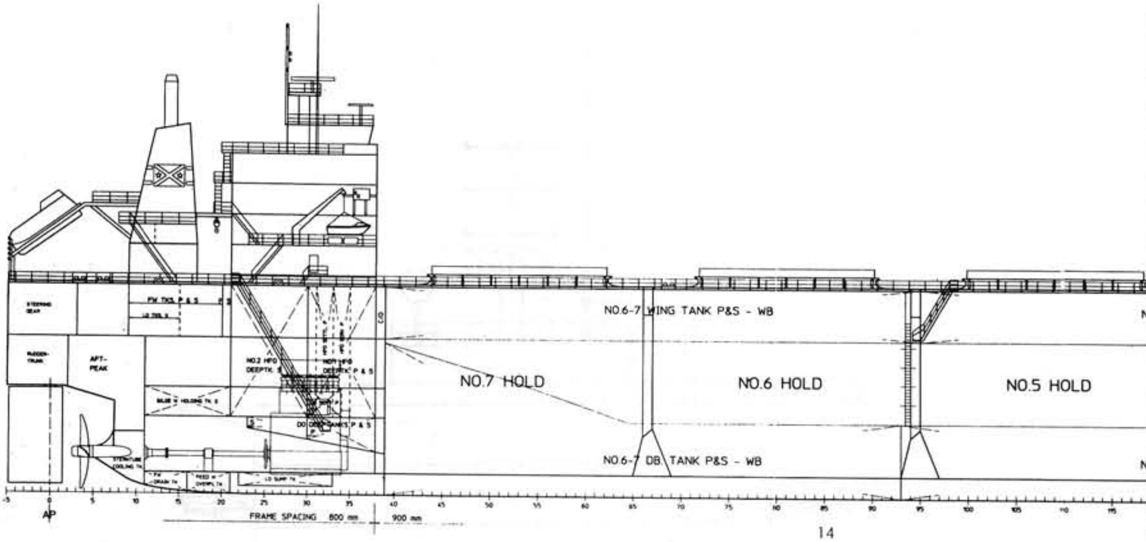


Figure F.12: Number of fixtures per cargo type

APPENDIX G: PANAMAX BULK CARRIER ROMANDIE

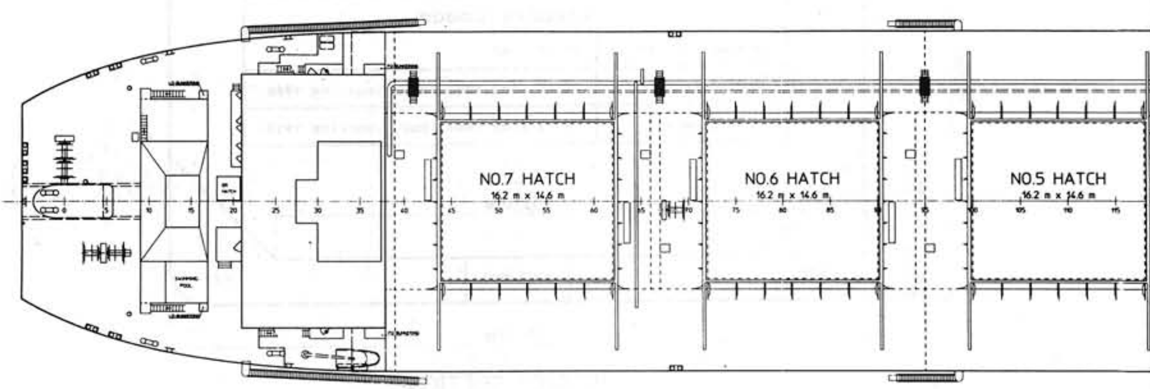


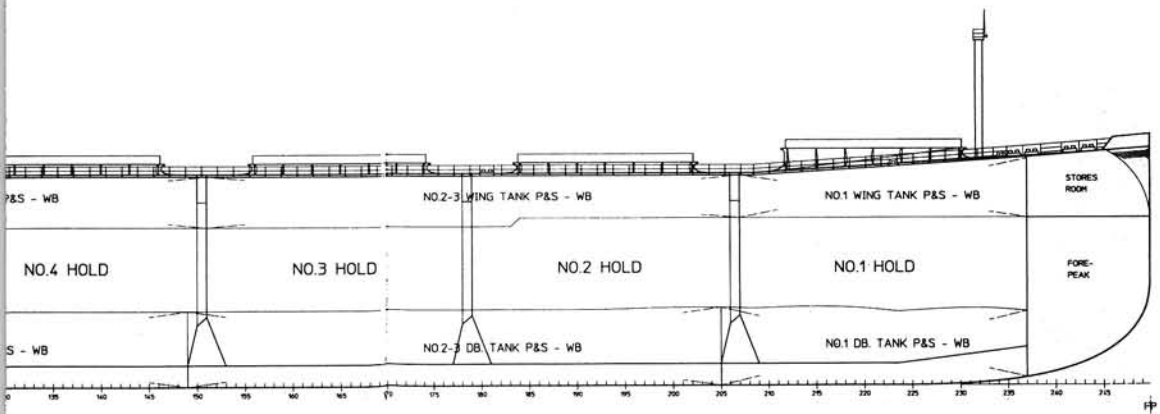
MIDSHIP SECTION

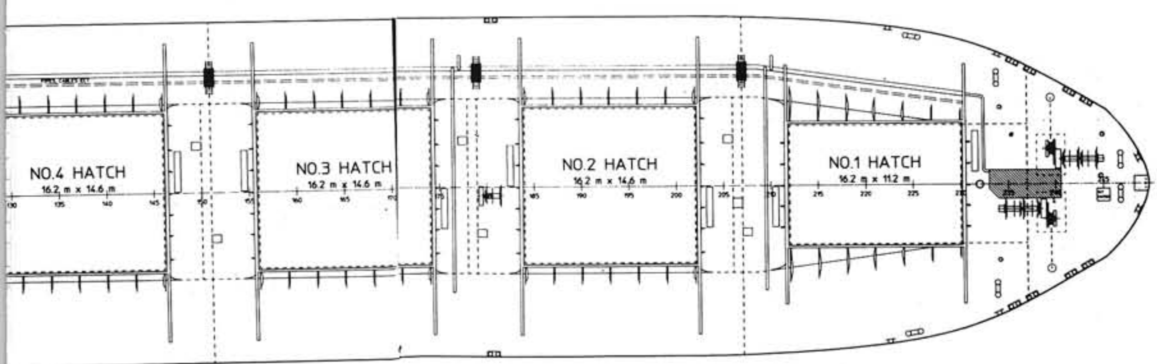


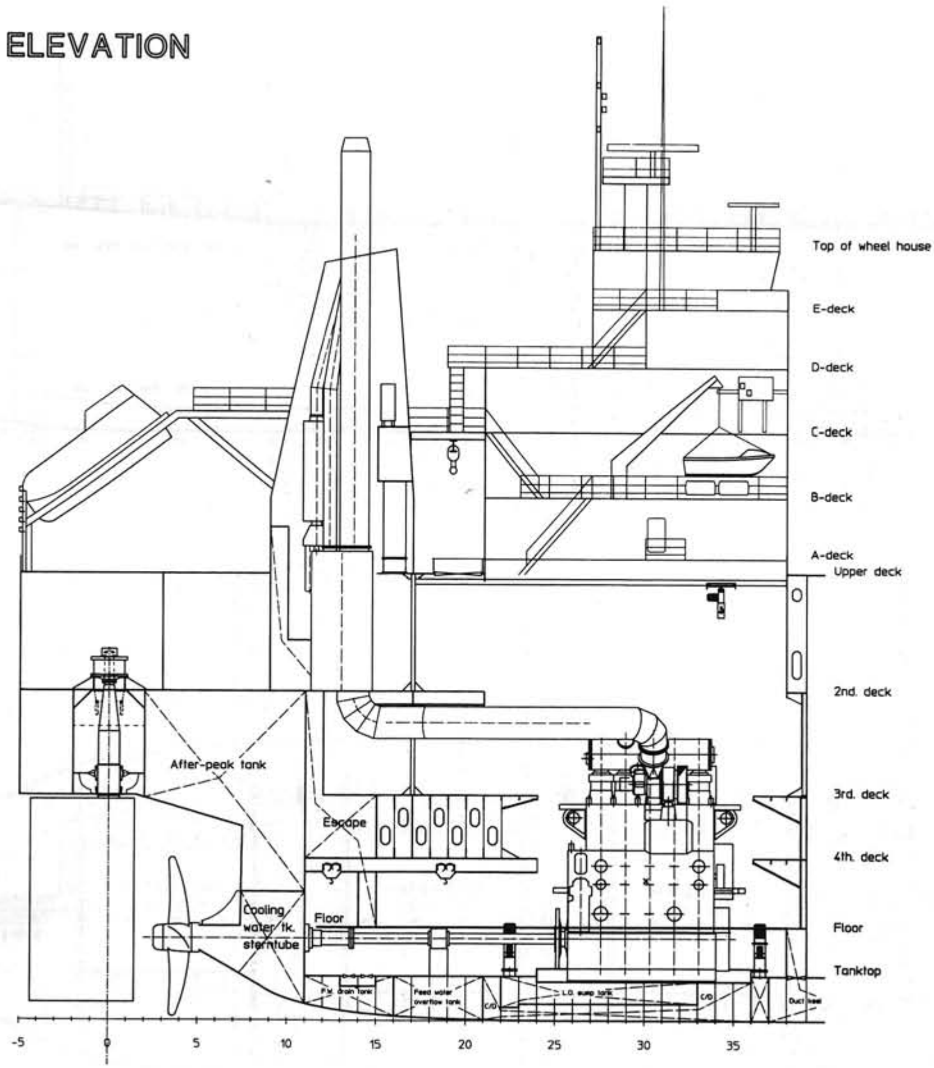
14

UPPERDECK




P&S - WB
NO.2-3 WING TANK P&S - WB
NO.1 WING TANK P&S - WB
STORES ROOM
NO.4 HOLD
NO.3 HOLD
NO.2 HOLD
NO.1 HOLD
FORE-PEAK
S - WB
NO.2-3 DB. TANK P&S - WB
NO.1 DB. TANK P&S - WB
FP


NO.4 HATCH
16.2 m x 14.6 m
NO.3 HATCH
16.2 m x 14.6 m
NO.2 HATCH
16.2 m x 14.6 m
NO.1 HATCH
16.2 m x 11.2 m


ELEVATION
Top of wheel house
E-deck
D-deck
C-deck
B-deck
A-deck
Upper deck
2nd. deck
3rd. deck
4th. deck
Floor
Tanktop
After-peak tank
Escape
Cooling water tk.
sterntube
Floor
-5
0
5
10
15
20
25
30
35

MAIN PARTICULARS (M/V "ROMANDIE")

Principal Dimensions

Length over all	738'	2 1/4"	225.00m
Length between PP	725'	3/4"	221.00m
Breadth moulded	105'	9 1/4"	32.24m
Depth moulded	64'	7 1/2"	19.70m

Tonnage

	International	Suez
Gross	39 422	39 902.98
Net	24 360	36 036.77

Class

Det norske Veritas: +1A1 Bulk Carrier HC/E, ESP, EO
ocs. ib(+), Holds 2, 4, 6 empty or Hold 4 empty

Propulsion

Main Engine: Sulzer type 5RTA62U, MCR: 10810 kW at 110rpm.
Propeller: 4-bladed, right-handed of NIKALIUM, diameter 6.30m, mean pitch 4.83m.

Auxiliary Machinery

Diesel engines:	3-off MAN-B&W/Holeby, type 5L23/30 MCR: 595kW at 720rpm.
Alternators:	3-off HEECO, type HFC6-506-14K output: 3· 440V, 60Hz, 700kVA/560kW at 720 rpm.
Emergency generator:	1-off gen-set VALMET / LEROY SOMER output: 3· 440V, 60Hz, 175kVA/140kW
Boilers:	1-off Aalborg Ciserv Int. oil/exhaustgas-fired AQ-16 output: 1200/1100kg/h at 8BAR abs.

Pumps

2-off IRON ballast pumps CVLS-1-300/315, discharge rate:	1000m3/h-27mlc.
1-off IRON fire/cargo hold cleaning pump,QVK-6/300, discharge rate:	150m3/h-125mlc.

Deck Equipment

Cargo hatch covers: MacGregor, chain-operated, side-rolling hatch covers.

Anchoring and mooring equipment:

Forward:	2-off anchor-windlasses,		
	2-off double-drum winches,	pull on drum 15t,	
Midship:	2-off single-drum winch,	pull on drum 15t,	(option)
Aft:	2-off double-drum winches,	pull on drum 15t,	

Lifting gear: 1-off gantry crane, SWL 4t.

Hold cleaning system: 14 fixed washing machines, each 75 m³/h (option)

Fire Extinguishing

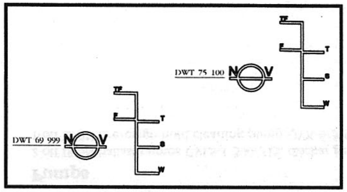
CO2-total flooding system for engineroom
CO2-total flooding system for cargoholds (option)

Radio- and Navigation Equipment

GMDSS - Communication Console	Sperry
Sat.-Comm. Std.C	T & T / Sperry
VHF-radio	SP / RT146 & RT2048/RM2042 / Sperry
EPIRB, satellite	Jotron / 30S Mk.II
SART	Jotron / Tronsart
Satellite communication, Std.A	JRC / JUE-45 MII
Reflector compass	Brøndberg & Tandrup
Gyro compass	Sperry SR-220
Auto pilot	Sperry ADG
Radar TM ARPA, S-band	Sperry 3400M-314
Radar RM ARPA, X-band	Sperry 3400M-27
Speed log	Sperry SRD-331
Loran C	Koden / LR771
Satellite navigator	Koden / KGP-931
Weather facsimile	Taiyo / TF-721
Radio direction finder	Taiyo / TD-318
Echo sounder	Honeywell Elac / LAZ50
Navtex receiver	Sperry / Shipmate RS6100

DEADWEIGHT

DUAL TONNAGE	(OPTION)
75,100 DWT AT	14.33 M DRAUGHT
69,999 DWT AT	13.58 M DRAUGHT



CAPACITIES OF CARGO HOLDS

COMPARTMENT	FRAME NOS.	CAPACITIES GRAIN (m3)
NO.1 CARGO HOLD	206-237	10749
NO.2 CARGO HOLD	178-207	12508
NO.3 CARGO HOLD	150-179	12643
NO.4 CARGO HOLD	122-151	12643
NO.5 CARGO HOLD	94-123	12643
NO.6 CARGO HOLD	66- 95	12643
NO.7 CARGO HOLD	39- 67	11329

CAPACITIES OF SUPPLY TANKS

COMPARTMENT	FRAME NOS.	CAPACITIES 100% (m3)	98% (m3)
NO.1 HFO DEEP TANK S	30- 38	769	753
NO.2 HFO DEEP TANK S	21- 30	772	757
HFO DEEP TANK P	30- 38	616	603
HFO SETTLING TANK P	31- 33	64	63
HFO SERVICE TANK P	33- 35	64	63
HFO OVERFLOW TANK P	23- 39	40	39
DO DEEP TANK S	23- 38	77	76
DO DEEP TANK P	30- 38	58	57
DO SERVICE TANK P	30- 34	25	25
DO OVERFLOW TANK S	23- 39	40	39
LO STORAGE TANK S	9- 11	39	38
LO CLEANING TANK S	11- 12	23	22
LO AUX/ENG TANK S	10- 11	7	7
CYL.O TANK S	12- 15	68	67
LO SUMP M/E TANK	24- 33	21	20

CAPACITIES OF FRESH- AND FEED WATER TANKS

COMPARTMENT	FRAME NOS.	CAPACITIES (m3)
FRESH WATER TANK S	9- 20	109
FRESH WATER TANK P	9- 21	121
FEED WATER OVERFLOW TK.	16- 21	24
FRESH WATER DRAIN TANK	11- 16	8
STERNTUBE COOLING TK.	5- 11	8

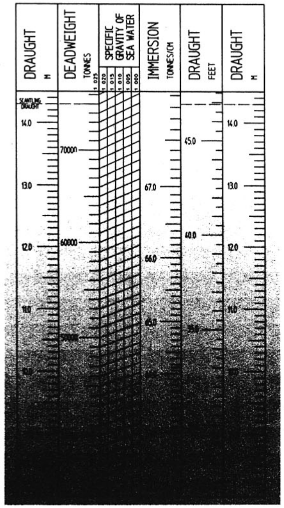
CAPACITIES OF BALLAST TANKS

COMPARTMENT	FRAME NOS.	CAPACITIES 100% (m3)	SG=1.025 (t)
FORE PEAK TANK	237- FP	1027	1053
NO.1 DB. TANK S	205-237	878	900
NO.1 DB. TANK P	205-237	878	900
NO.1 WING TANK S	207-237	755	774
NO.1 WING TANK P	207-237	755	774
NO.2-3 DB. TANK S	149-205	2154	2207
NO.2-3 DB. TANK P	149-205	2154	2207
NO.2-3 WING TANK S	151-207	1065	1092
NO.2-3 WING TANK P	151-207	1065	1092
NO.4-5 DB. TANK S	93-149	2157	2210
NO.4-5 DB. TANK P	93-149	2157	2210
NO.4-5 WING TANK S	95-151	1069	1096
NO.4-5 WING TANK P	95-151	1069	1096
NO.6-7 DB. TANK S	39- 93	1887	1934
NO.6-7 DB. TANK P	39- 93	1887	1934
NO.6-7 WING TANK S	39- 95	1069	1096
NO.6-7 WING TANK P	39- 95	1069	1096
AFT PEAK TANK	-5- 11	741	759

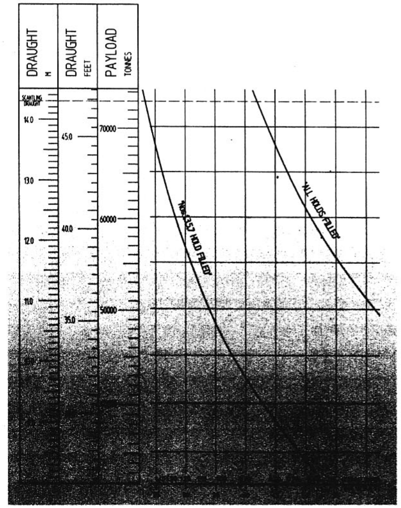
CAPACITIES OF SLUDGE- AND HOLDING TANKS

COMPARTMENT	FRAME NOS.	CAPACITIES (m3)
HFO SLUDGE TANK P	22- 26	15
LO SLUDGE TANK P	22- 24	7
DIRTY OIL DRAIN TANK P	22- 25	3
BILGE WATER HOLDING TK.S	11- 21	86

DEADWEIGHT SCALE



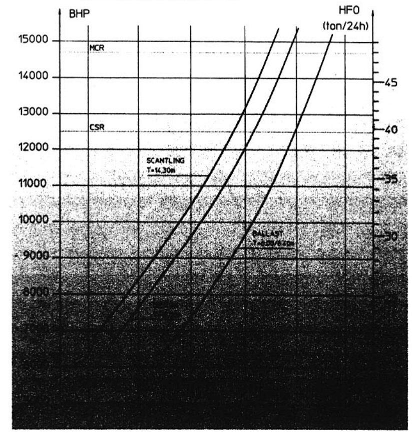
LOADING SCALE



SPEED POWER AND CONSUMPTION

MAIN ENGINE : ONE SULZER 5RTA62
14700 BHP AT 110 RPM MCR
12500 BHP AT 104 RPM CSR

15 % SEAMARGIN INCLUDED



ANALYSIS OF THE PANAMAX BULKCARRIER CHARACTERMARKET 1989-1994

IN RELATION TO THE DESIGN CHARACTERISTICS

Panamax bulk carriers form the largest homogenous shiptype-group in the world fleet. The H. Clarkson database contained in 1994, 834 of these ships, in a deadweight range of 50,000-76,000 tons.

The dimensions of panamax vessels are restricted by the dimensions of the locks of the Panama Canal, especially the beam. Shipowners and shipyards have put a lot of effort into maximizing the deadweight of the vessels within these restrictions.

The question is: Does the market honour this effort with higher charter rates? In other words: Is there a relation between the design characteristics and the charter market performance?

This study has analysed approximately 10,000 of the published fixtures over the period 1989-1994, and related the charter rates to the design characteristics of the bulk carriers.

This book is important for shipowners, shipbrokers, shipyards, naval architects, financial institutions, classification societies and all others involved in the bulk shipping industry.

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