Transport Policy 16 (2009) 259–270

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Is the container liner shipping industry an oligopoly?

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ARTICLE INFO

Available online 8 September 2009

Keywords:
Container liner shipping industry
Oligopoly
Concentration measurement
Instability index

ABSTRACT

This paper focuses on the question whether or not the container liner shipping industry is an oligopoly. Although liner shipping literature has been occupied with this question, few authors have examined the market structure of the containerised liner shipping industry. The study of the market form at trade level fills in a gap in the literature. The empirical investigation uses concentration ratios to measure the degree of concentration. The results allow us to determine the degree and type of oligopoly. The conclusion shows that the containerised shipping industry is characterised by increased concentration. Some trade lanes may be characterised as a loose oligopoly; others as a tight oligopoly.

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1. Introduction

Numerous studies in the industrial economics literature have been preoccupied with the study of the market structure of various industries (e.g. banking, agriculture, steel and car industries, etc.). A scan of the liner shipping literature reveals that there is no consensus whether or not the liner shipping industry is an oligopolistic market (For example, see Peters, 1991; Booz-Allen & Hamilton, Inc. Transportation Consulting Division, 1991; Hoffman, 1998; Japanese Shipowners' Association, 2003). In many other studies the liner shipping industry is intuitively presumed to be an example of oligopoly. Given this polemic it is interesting to determine the degree of oligopoly empirically.

In addition, with the abolishment of the anti-monopoly immunity of freight conferences (as from 18 October 2008) and given the trend towards consolidation, the question whether the container liner shipping industry is an oligopoly is yet again of current interest. It is a relevant question because the market structure under which a carrier operates will determine its behaviour. This behaviour will in turn affect the liner operators' performance: their price setting, profits, efficiency, etc.

The market structure of the container liner shipping industry (hereafter CLSI) will be examined at the following three levels: the industry, the alliances and the trade level. The following two hypotheses will be examined:

- The CLSI has become more concentrated due to consolidation.
- The market structure in which the CLSI operates is an oligopolistic market.

These hypotheses will be studied from an industrial economic viewpoint. In empirical research, seller concentration is the indicator to analyse the merger impact on concentration, to determine the degree of oligopoly (Lipczynski et al., 2005).

The paper is organised in four sections. Section 1 defines the terms 'relevant market' and 'container liner shipping industry'. Section 2 focuses on quantifying the degree of concentration in the CLSI. The empirical investigation uses the four-firm concentration ratio, the Herfindahl-Hirshman Index, the Lorenz curve and the Gini coefficient to measure the degree of concentration and the instability index to determine the magnitude of market share instability. In Section 3 the link with the degree of oligopoly is directly shown and the concentration ratios are examined at a disaggregated level, viz. the trade lane. The Section 4 summarises the main findings.

2. The industry's concentration level

Before quantifying the degree of concentration, it is important to define the terms 'market' and 'industry'.

2.1. Market definition

In theory, the definition of a market is clear-cut. Lipczynski et al. (2005) summarises theoretical definitions of a market:

- The entire territory of which parts are so united by the relations of unrestricted commerce that prices there take the same level throughout with ease and rapidity (Cournot, 1838).
- An area in which prices of the same goods tend to equality with due allowance for transportation costs (Marshall, 1920).

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doi:10.1016/j.tranpol.2009.08.003

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In practice, the definition of a market depends on the context in which it is used: in marketing literature it is commonly defined from the supply side, while in general economics, it encompasses both supply and demand. In competition law, the term 'relevant market' (or the market where the competition takes place) is used. The definition of relevant market contains both a relevant product dimension (demand side substitution, supply side substitution and potential competition) and a relevant geographic dimension. The product definition of a market should include all products and/or services that are close to substitutes for one another, both in consumption and in production (Brooks, 2000; Bikker and Haaf, 2002; Lipczynski et al., 2005). Whereas there is consensus regarding the product definition of the market, several definitions of the geographic dimension were found:

- Lipczynski et al. (2005, p. 208) interpret the geographic definition as an increase in the price of a product in one geographic location significantly affects either the demand or supply, and therefore the price, in another geographic location.
- Bikker and Haaf (2002, pp. 2192–2193) state that the geographical boundaries of a market are determined by actual and potential contacts between actual and potential market participants.
- The European Commission defines the relevant geographic market as the area in which the undertakings concerned are involved in the supply and demand of products or services, in which the conditions of competition are sufficiently homogeneous and which can be distinguished from neighbouring areas because the conditions of competition are appreciably different in those areas (European Union, 1997, 2007).

For the shipping industry, Brooks (2000) underlines the importance of market definition for the liner shipping industry in general. More specifically, for the CLSI, two definitions were found.

Firstly, Van der Ziel (1994, p. 65) defines 'market' as the total flow of containers between A and B. He proceeds that the traditional definition of liner shipping market coincides with the product itself (i.e. the carriage of a container between A and B) and the place of production of this product (i.e. the stretch between A and B). Furthermore, he also refers to the geographic location where the transportation product is sold. Under geographical location he comprehends the location of demand that may be exclusively at one end of the stretch A to B or even far away from the place of production.

Secondly, in contrast to the benchmark commercial understanding of a market, the term 'market' is more broadly defined for competition analysis. Regarding the Commission Notice on the definition of the relevant market for the purposes of Community competition law (1997), the key purpose of defining a relevant market is "to identify in a systematic way the competitive constraints faced by companies in the market(s) in which they operate". The relevant market consists of all suppliers of a container liner shipping service, including actual or potential competitors, and it has a product and a geographical dimension. In several Commission decisions and Court judgments, the container liner shipping services have been branded as the relevant product market for liner shipping. Other modes of transport have not been integrated in the same service market although in a few cases these services may be, to a marginal extent, substitutable. The reason for this is that a significant share of the goods transported by container cannot simply be switched to other modes of transport (e.g. air transport services) (http://eur-lex.europa.eu).

Should the definition of the product market be limited to a particular type of cargo transported by sea? The Commission Notice states the following:

> For example, the transport of perishable goods could be limited to reefer containers or include transport in conventional reefer vessels. While it is possible in exceptional circumstances for some substitution to take place between break bulk and container transport, there appears to be no lasting change over from container towards bulk. For the vast majority of categories of goods and users of containerised goods, break bulk does not offer a reasonable alternative to containerised liner shipping. Once cargo becomes regularly containerised it is unlikely ever to be transported again as non-containerised cargo. Containerised liner shipping is therefore mainly subject to one way substitutability.

According to the same Commission Notice, the geographical dimension of a market is determined by "the area where the services are marketed, generally a range of ports at each end of the service. As far as the European end of the service is concerned, to date the geographical market has been identified as a range of ports in Northern Europe and/or in the Mediterranean. As liner shipping services from the Mediterranean are only marginally substitutable for those from Northern European ports, these have been identified as separate markets".

Throughout this paper, the term 'relevant market for the container liner shipping industry' covers all vessel operating common carriers (VOCC's) (e.g. Maersk Line, CMA CGM, Hapag-Lloyd, Evergreen). Other suppliers of a container liner shipping service such as non-vessel operating common carriers (NVOCC's) (e.g. ECU-line, Fast Lines) and logistic/freight forwarders (Kuehne & Nagel AG, Panalpina Welttransport AG, Deutsche Post AG) are not taken into account in this study. Given the lack of data with respect to specific container liner shipping products (e.g. transport of perishable goods/dangerous goods/heavy lift/lengthy) on the one hand and the fact that substitution is highly trade dependent on the other hand, the product dimension is defined as the transport of a box. The geographical dimension of the market is considered globally (see Section 2.5) and at trade level respectively (see Section 3.2).

2.2. *Defining the container liner shipping industry*

While the term 'market' encompasses both supply/production and demand/production, Lipczynski et al. (2005) state that the term industry specifically refers to a market's supply side or productive activities. Given the complexity of defining an industry, one can fall back on specific schemes for defining and classifying the industries (Lipczynski et al., 2005). Although these classifications provide an interesting framework, in order to define the CLSI, they are not useful.

A scan of the literature yields the following definitions: in 1932 Fayle defined a liner service as a fleet of ships with common ownership or management, which provides a fixed service at regular intervals between named ports and offers transport to any goods in the catchment area served by these ports and ready for transit by their sailing dates. This definition was later updated by Stopford. He added: "A fixed itinerary, inclusion in a regular service and the obligation to accept cargo from all comers and to sail, whether filled or not, on a date fixed by published schedule are what distinguishes the liner from the tramp." (Stopford, 2004, p 343). Davies (1983) described the liner sector as that part of the ocean shipping (family of) industry(ies) which specialises in supplying scheduled cargo transport services on specified and fixed trade routes.

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Bourne (2007, personal communication) states that the liner shipping industry is best defined as those carriers of conventional general cargo (usually but not exclusively in containers these days) which carry cargo between defined ports on a regular basis.

Like the words 'industry' and 'market', the terms 'liner shipping industry' and 'container liner shipping industry' are sometimes loosely used. To the author's knowledge, no clear-cut definition of the CLSI can be found. Containerised liner shipping industry or container shipping industry can however be clearly distinguished from other industries in the water transport sector and can therefore be defined as follows:

> Container shipping industry, a major segment of the liner shipping industry, is a maritime industry, international if not global in scope. This industry operates vessels transporting containers with various but standardised dimensions/sizes, regardless of the contents. Whether filled or not, these (container) vessels are put into service on a regular basis and often according to a fixed sailing schedule, loading and discharging at specified ports.

2.3. Methodology

To determine the degree of concentration, indicators of concentration are calculated. In this section, two frequently applied indicators of concentration, viz. the *n*-firm concentration ratio Eq. (1) and the Herfindahl-Hirschman Index Eq. (2) as well as the Lorenz curve and the Gini coefficient Eq. (3) will be briefly discussed. After having identified the concentration level, the intensity of the competition will be examined by computing the Hymer–Pashigian index of market share instability Eq. (4).

2.3.1. Indicators of concentration

A prevailing method of analysing the industry is the measurement of concentration. In empirical research into industrial organisation, (seller) concentration, as a reference to the number and size distribution of firms, is an important indicator. (Seller) concentration can be measured at two levels: aggregate concentration and *industry concentration* (Lipczynski et al., 2005). This paper focuses on the second level, which reflects the importance of the largest firms in some particular industry, in this case the container shipping industry[1]. In this paper, the product is taken to be homogeneous[2], the CR4 ratio, the alternative Herfindahl-Hirschman Index, the Lorenz curve and the Gini coefficient will be applied to the containerised liner shipping industry to determine the industry's concentration level and to study whether the degree of concentration is increasing due to consolidation and/or accelerating over the period 1999–2009.

The first concentration measure is represented by the term **CRx**, which stands for the cumulative share of the *x* largest container liner operators in the market. The simplest measure of industrial concentration involves totalling up the market shares of the largest of so many firms (e.g. CR4, CR8, CR50). The four-firm concentration ratio, known as CR4, is the most typical concentration ratio for judging the degree of concentration in an industry. Technically, the four-firm concentration ratio can be written as follows:

$$CR4 = \sum_{i=1}^{4} s_i \tag{1}$$

(Lipczynski et al., 2005, p.215).

Next, the *Herfindahl-Hirschman Index* (HHI) will be calculated, since the CR4-concentration ratio is limited because it only focuses on the top liner operators in the industry and does not take into account the ranking of the remaining firms. HHI takes into account both the number of liner operators and the inequality of market shares. The HHI is calculated by squaring the market share of all liner operators in the industry, and then adding up those squares. Shepherd (1999) gives the following formula for the Herfindahl-Hirschman Index (HHI):

$$H = \sum_{i=1}^{n} s_i^2 \times 10{,}000 \tag{2}$$

where n = the number of carriers and s_i = the share of the ith carrier. It gives added weight to the biggest operators. The principle is as following: the higher the index, the more concentration and (within limits) the less open market competition. The HHI approximates 0 for a perfectly competitive industry and equals 10,000 for a monopoly. As a benchmark, a market with an HHI below 1000 is considered to be unconcentrated and unlikely to be subject to any adverse competitive effects. A value between 1000 and 1800 generally indicates moderate concentration. Any value over 1800 indicates a highly concentrated market (Shepherd, 1999).

Ultimately, the *Lorenz curve* is plotted and the *Gini coefficient* is calculated to show change in concentration over time. Although the Lorenz curve is often used to represent income distribution, this concept can easily be adapted to visualise information regarding industry concentration. The Lorenz curve shows the variation in the cumulative size of the n largest firms in an industry, as n varies from 1 to N (i.e. N equals 100) (Lipczynski et al., 2005). Subsequently, to value this concentration, the Gini coefficient can be calculated. The formula definition for the Gini coefficient is

$$G = \left\{ \frac{\sum_{n=1}^{N} \sum_{i=1}^{n} x_i}{0.5(N+1)\sum_{i=1} x_i} \right\} - 1 \tag{3}$$

(Lipczynski, 2005, p. 224). The Gini coefficient ranges from 0 if there is no concentration and it ranges to 1 if there is total concentration.

Because the indicators of concentration can mask the dynamics of change within industries, an indicator which measures the magnitude of the changes in the market shares of firms in an industry will be computed.

2.3.2. Indicator of magnitude of market share instability

Market share instability is a measure of the shift in the relative position of firms within an industry and is considered an important indicator of the intensity of the competition. A formal measure of the degree of market share instability is the "*instability index*" put forward by Hymer and Pashigan (1962). This index is the sum of the absolute value of the change between two points in time in the market share of each firm. The index is defined as:

$$II = \sum_{i=1}^{N} (|s_{i,t} - s_{i,t-1}|) \tag{4}$$

where $s_{i,t}$ equals the market share of liner operator i at time t. The value of the index ranges between zero and one. If the index is close to zero, this indicates that market share is relatively stable, and if the index is close to one, market share is relatively unstable

[1] Concentration does not only occur on a horizontal level (between carriers). Carriers also engage in vertical integration activities that cover almost all stages of the transport chain. Abstraction is made of the latter in this paper, as well as of the profound effects of the process of concentration on port development.

[2] For lack of information, the product is assumed homogeneous (read: transport of a container/box). However, when service, transit time, etc. are taken into account, one evolves towards a heterogeneous product. Although market power can be measured at the industry level, taken into account the variation due to for instance service, the question regarding concentration becomes a firm-level expression (Martin, 2002).

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(Gutiérrez de Rozas, 2007). So, the higher the instability index, the greater the level of competition. Abrupt changes have traditionally been related to the presence of competition, regardless of the concentration ratio. Hymer and Pashigan have noted that although the index might be affected by the number of firms, it is empirically not very sensitive to it because "small firms do not contribute greatly to the value of the index since they account for so small a share of the industry and since they tend to grow no faster on average than large firms" (Hymer and Pashigan, 1962, p. 86).

2.4. Data description

In liner shipping, several Commission decisions and Court judgments identify volume and/or capacity data as the basis for calculating market shares. Most studies in container liner shipping literature (Hoffman, 1998; Notteboom, 2004) use the available data of AXS-Alphaliner, more specifically the Top 100. AXS-Alphaliner deduct the market shares from the existing on board TEU (twenty equivalent unit) capacities of liner operators, compared to the fleet effectively deployed by each operator deployed on liner trades (www.alphaliner.com).

The concentration measures are computed over the period 1999–2009 using the Top 100. Although there are about 400 liner operators, an omission of the lower-ranked carriers will have no significant impact on the conclusions, as the smallest operators have a market share of less than 1% each. When these very small market shares are squared, the contribution each carrier makes to the HHI is less than 1/1000 (in other words, the HHI is affected at most in the fourth decimal place). As a result, where the container shipping industry is concerned, the liner operators ranked in the segment 101–400 can be safely omitted without affecting the picture of industry concentration.

2.5. Results at the level of the industry

The results of the CLSI's concentration level can be found in Fig. 1 (Figures refer to 1 January of each year). Fig. 1 summarises the evolution in market share of the Top 100, 50, 25, 20 and 10 compared to the total market, along with the results of the calculations of the CR4 ratio, the Herfindahl-Hirschman Index and the Gini coefficient. What conclusions can be derived from this?

First, a study of the market shares gives useful preliminary information on the degree of concentration. Appendix A shows that the Top 25 carriers currently have a market share (measured by share of total carrier capacity) of about 85.41% vs. 62% six years ago. The market share of the top-ten liner operators accounts for 60% of the total TEU capacity. Of these ten, four are Europe-based companies with 39.37% of the total and the Top 3 of these account for 34.07% of the total share (see Appendix A—Liner operators in bold are Europe-based carriers. Carriers participating alliances are shaded.). Compared with 2003 (when the Top 3 had a cumulative market share of 24.35%) and 2006 (32.37%) an increasing trend in market shares is noticeable.

Secondly, the CR4 ratio is repeatedly measured as the share of the 4 largest liner operators against the liner total, Top 100, Top 25 and Top 20. From these results one can conclude that the CLSI is becoming more concentrated. Regardless of the calculation basis, one can notice a decrease in the CR4 ratio in the years preceding such a consolidation wave. This observation indicates a stronger growth of lower-classified liner operators. A remarkably higher concentration is noticeable between 1999/2000 and 2005/2006, not coincidentally corresponding with an intense wave of consolidation.

Fig. 2 lists the number of players in the CLSI making up 50% of total capacity in service (compiled from data from AXS-Alphaliner and European Commission, 2005). In 1995, 16 members accounted for 50%, whereas in 2008 only 7 carriers have this market power, clearly indicating the trend of growing concentration.

Thirdly, over the years the HHI clearly increases, also indicating a growing concentration in the container shipping industry. Given the 1000–1800 limits, the containerised shipping industry must still be considered unconcentrated. Regardless of the calculation basis, the HHI is never higher than 1000. The decrease in the HHI, noticeable in the Top 25 from the year 2003 to 2005 generally indicates a loss of market power and an increase in competition. Furthermore, the impact of the consolidation waves on the degree of concentration is again quite observable by a remarkably higher HHI (+35%). An overview of the mergers and takeovers in the liner shipping industry is given in Appendix B (compiled from data from AXS-Alphaliner—various editions and Dynamar—various editions). Appendix B consists of two panels. The left hand side panel summarises the mergers, acquisitions and takeovers by the Top 30 liner operators (Panayides and Gong, 2002). The right-hand side panel mirrors the liner operators opting to grow organically.

Slot capacity

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Top 100			77,93%	84,73%	79,47%	88,30%	93,59%	94,16%	94,79%	94,67%	95,38%	94,50%
Top 50			71,49%	78,00%	73,66%	82,64%	88,18%	89,07%	90,51%	90,34%	91,33%	90,96%
Top 25			62,17%	68,37%	65,25%	73,90%	79,55%	81,31%	83,71%	84,25%	85,41%	84,97%
Top 20			57,21%	63,35%	60,55%	68,68%	74,23%	76,28%	80,85%	81,25%	82,38%	81,57%
Top 10			38,85%	42,32%	40,28%	46,23%	52,10%	50,00%	56,66%	60,22%	60,55%	60,01%
CR4	Liner total		23,66%	28,22%	24,66%	29,05%	31,08%	30,82%	37,60%	38,73%	39,37%	39,14%
	Top 100	25,83%	30,37%	30,94%	31,03%	32,90%	33,21%	32,84%	39,67%	40,91%	41,27%	41,42%
	Top 25	32,91%	38,06%	38,35%	37,79%	39,31%	39,07%	38,03%	44,92%	45,96%	46,09%	46,07%
	Top 20	35,51%	41,36%	41,29%	40,72%	42,29%	41,87%	40,54%	46,51%	47,66%	47,79%	47,99%
HHI	Liner total		252,21	306,96	269,87	351,87	404,91	420,13	598,33	579,16	432,05	575,15
	Top 100	336,20	415,34	427,54	427,37	451,34	462,24	473,91	665,93	646,22	640,00	644,07
	Top 25	545,81	640,21	645,80	624,77	636,75	633,87	630,60	850,51	813,12	795,56	794,05
Gini coefficient		0,6466	0,6654	0,6717	0,6829	0,7001	0,7088	0,7199	0,7569	0,7607	0,7664	0,7716
Δ			0,0188	0,0063	0,0112	0,0173	0,0087	0,0111	0,037	0,0039	0,0057	0,0052

Total turnover

CR4							42,67%	44,20%	49,70%			
							26,55%	28,88%	32,14%			

Fig. 1. Measurement of concentration.

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1995	2000	2003	2008
1 Maersk	Maersk-SL + SCL	Maersk-SL + Safmarine	APM-Maersk (*)
2 Evergreen Group	Evergreen Group	Mediterranean Shg Co	Mediterranean Shg Co
3 COSCO Container L.	P & O Nedlloyd	P & O Nedlloyd	CMA CGM Group
4 Sea-Land	Hanjin/DSR-Senator	Evergreen Group	Evergreen Group
5 NYK	Mediterranean Shg Co	Hanjin / Senator	Hapag-Lloyd (**)
6 P&O Nedlloyd	NOL / APL	APL	CSCL
7 Hanjin	COSCO Container L.	COSCO Container Lines	COSCO Container L.
8 P&O Containers	NYKCMA-	CGM Group	
9 MOL	CP Ships / Americana	NYK	
10 K Line	Mitsui-OSK L. (MOL)	CP Ships Group	
11 Zim	Zim		
12 Hapag-Lloyd			
13 NOL/APL			
14 DSR Senator			
15 MSC			(*) including P&O Nedlloyd
16 Yang Ming Line			(**) including CP Ships

Fig. 2. Liner operators making up 50% of total capacity in service.

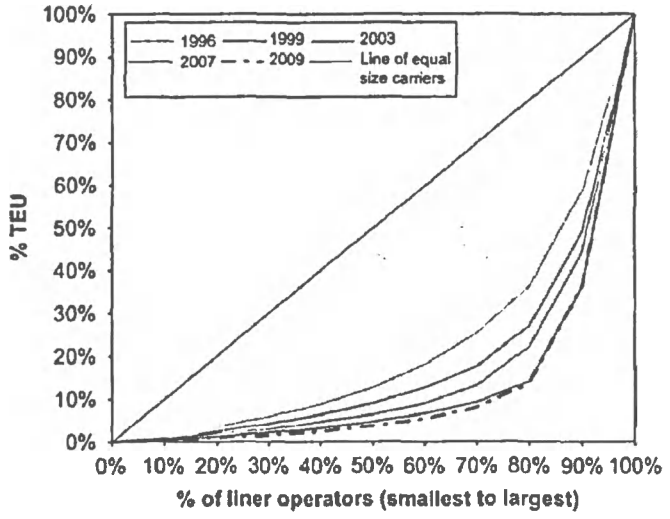

Fig. 3. Lorenz curve.

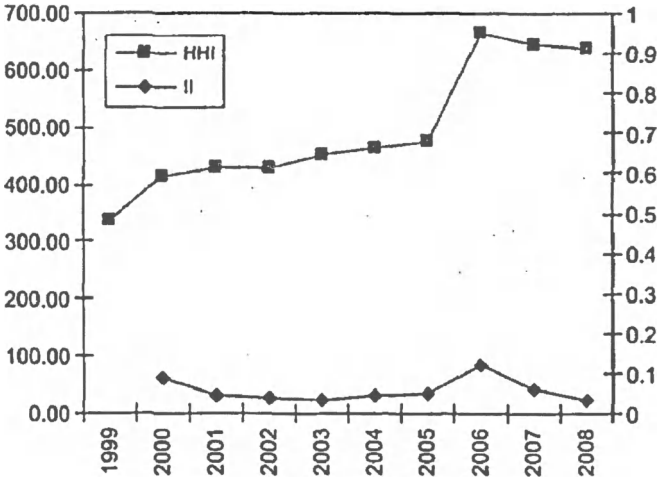

Fig. 4. Evolution of the Herfindahl-Hirschman Index and the instability index.

Next, Fig. 3 represents the Lorenz curve for the years 1996, 1999, 2003 (before the recent consolidation wave) and 2007 (after the merger movement) as well as 2009. The Lorenz curve is quite useful for graphically presenting the change in concentration over time.

The cumulative percentage of the total number of liner operators (smallest to largest) is plotted on the x-axis, the cumulative TEU percentage on the y-axis. A perfectly equal-sized industry can be depicted by the straight diagonal line $y = x$, called the line of perfect equality or the 45° line. The perfect inequality line represents a distribution in which one carrier has the total cumulative TEU percentage whereas the others have none. In practice, the Lorenz curve will be situated below the 45° line. Over a time span of 10 years the curve moved downwards away from the 45° line, suggesting a trend of growing concentration.

Ultimately, the results of the Gini coefficient to value the pace of concentration are studied. The value of G is 0.7716 vs. 0.6654 a decade ago. A rise in the coefficient value suggests, yet again, a higher market concentration. The variation (Δ) is also calculated. The merger movement (+0.037) is again observable in the results.

The concentration figures for the CLSI clearly indicate a growing concentration. In turn, it suggests a weaker competition. Even if increasing concentration implies decreased competition, fierce competition may still exist among leading firms. That is, the index of concentration ignores the shift of market shares among leading firms. Therefore, the magnitude of market share instability is calculated. Fig. 4 shows graphically the evolution of the instability index.

The value of the instability index (II) is closer to zero than to one, an indication that the CLSI is characterised by a relatively stable competition. Whereas a remarkable level of stability is achieved during 2000–2005, a peak of instability was reached in 2006.

2.6. Results at the level of alliances

After measuring concentration at the level of the liner operator, it is also interesting to analyse the market power of each alliance. Alliances group liner carriers operating on different routes around the world in order to offer a worldwide service to their clients. In addition, alliances offer a means to small- and medium-sized carriers to pool vessels in order to create sufficient capacity. The three largest alliances, viz. the Grand Alliance, the CHKY Alliance and the New World Alliance, are compared with number 1 Maersk Line over the years 2000, 2003, 2006 and 2008. After the withdrawal of P&O Nedlloyd in February 2006, the 'new' Grand Alliance was formed by Hapag-Lloyd (incl. CP Ships), MISC (still Europe–Asia only), NYK and OOCL. The members of the

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Year	Alliance	TEU	% share /liner total
2000	GRAND ALLIANCE	692.551	13,45%
	CHKY ALLIANCE	649.709	12,62%
	Maersk/Sealand	620.324	12,05%
	TNWA	446.381	8,67%
	TOTAL	2.408.965	46,78%

Year	Alliance	TEU	% share /liner total
2003	GRAND ALLIANCE	957.019	13,97%
	CHKY ALLIANCE	846.251	12,35%
	Maersk/Sealand (incl. Safmarine)	818.850	11,95%
	TNWA	536.921	7,84%
	TOTAL	3.159.041	46,12%

Year	Alliance	TEU	% share /liner total
2006	Maersk Line	1.665.272	18,23%
	CHKY ALLIANCE	1.067.198	11,68%
	GRAND ALLIANCE	989.241	10,83%
	TNWA	720.708	7,89%
	TOTAL	4.442.419	48,62%

Year	Alliance	TEU	% share /liner total
2008	Maersk Line	1.878.943	16,06%
	CHKY ALLIANCE	1.349.452	11,54%
	GRAND ALLIANCE	1.296.557	11,08%
	TNWA	927.618	7,93%
	TOTAL	5.452.570	46,61%

Fig. 5. Market share of the alliances.

New World Alliance are APL, Huyndai and MOL. The CHKY Alliance consists of Coscon, Hanjin/Senator, K-line and Yang Ming. For purposes of review, abstraction is made of the United Alliance (Hanjin and UASC). UASC, co-operating with Hanjin/Senator is presently considered as an associate member of the CHKY Alliance.

Fig. 5 shows the share of the alliances versus the liner total in 4 different years, both in absolute figures (carrying capacity—TEU) and in percentages.

Up to 2006 the Grand Alliance and the CHKY Alliance took the first and second place, respectively. In 2008 the biggest strategic cooperation, in capacity terms, is the CHKY Alliance with a share of 11.54%. Since the takeover of Royal P&O Nedlloyd by Maersk Sealand (since known as Maersk Line), the 'new' Grand Alliance saw its share diminish from 13.97% (2003) to 11.08% (2008). After acquiring P&ONL the Maersk/Sealand alliance took over the first place. Its share rose from 11.95% (2003) to 18.23% (2006). This concentration of market power illustrates that a liner operator can perfectly operate independently of alliances.

2.7. Increased concentration

After analysing the most important concentration figures, it can be conclude that the containerised shipping industry is characterised by increased concentration. All indexes support this conclusion. The use of another criterion, viz. total turnover, where the same trend is noticeable, does not contradict the conclusions (see Fig. 1).

The first hypothesis, viz. *The CLSI has become more concentrated due to consolidation* is confirmed. The impact of the consolidation waves on the degree of concentration is clearly observable in the calculations. Furthermore, the process of concentration is likely to continue, as in the future the liner shipping industry is expected to face a continued consolidation process. However, focusing on the variation of the Gini coefficient, the pace of concentration is likely to decelerate. The slope of the trend line is slightly negative (see Fig. 6.). This deceleration can also be seen in Fig. 1—Gini coefficient and Fig. 3. For the largest liner operators segment the curves 2007 and 2009 are overlapping.

Nonetheless the liner shipping industry is still a rather fragmented industry (cf. HHI values lower than 1000). In 2008 only 20 liner operators had a share of +1% (see Section 2.4 and Appendix A). The figures are modest compared with the concentration levels in other sectors (e.g. banking, media, air transport, other maritime industries), which are also undergoing a process of concentration. A comparison of the container shipping industry with other maritime industries shows us that the latter are characterised by ever-fewer suppliers accounting for an increasing share of the world total (e.g. shipyard

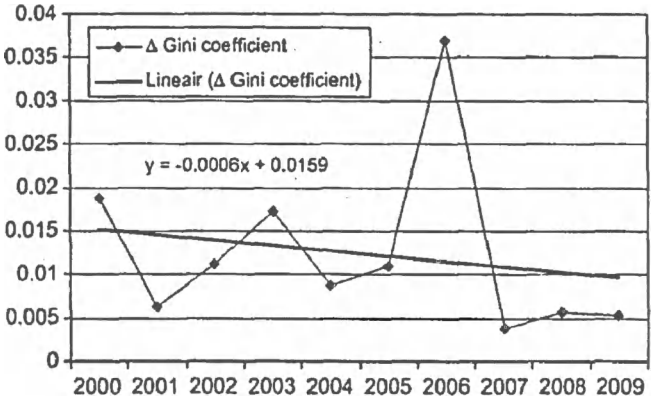

Fig. 6. Δ Gini coefficient.

(Japan and Korea), car carrying, and specialised reefer shipping sectors) (Vanelslander, 2005).

Having calculated the concentration figures, Section 3 focuses on another aspect of concentration, viz. its direct link to the degree of oligopoly. More specifically the hypothesis *'The market structure in which the container liner shipping industry operates is an oligopolistic market'* will be tested.

3. Market structure

Micro-economic theory traditionally divides industries into four categories, the two extremes of which are perfect competition and monopoly. The intermediate market structures are monopolistic competition and oligopoly. When the CR4 ratio is 40% or more, according to Martin (2002), each player must be aware of the others. Such industries are oligopolies.

In this section, the link between the CR4 and the market form will be examined at industry level (Section 3.1) and at trade level (Section 3.2).

3.1. Industry level

The previous section (Section 2—Fig. 1) shows that the CR4 has exceeded the 40% limit since the year 2000, if the Top 20 is considered. However, if the CR4 ratio is measured as the share of the 4 largest liner operators against liner total, CR4 is not higher than 40%. Considered this way, the container shipping industry would not to be an oligopolistic market.

If we assume the working hypothesis that the container shipping industry is an oligopolistic market, a detailed analysis

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Types of markets			
		market type	market condition
gradients in concentration	Shepherd	pure monopoly	one liner operator holds 100%
		dominant liner operator	one liner operator holds 40% to 99%
		tight oligopoly	four liner operators hold over 60%
			four liner operators holds 25 % to 60%
		loose oligopoly or effective competition	+ entry reasonably easy
variations in market share	Shepherd	symmetric	
		asymmetric	one dominant firm
variation in competition and collusion	Sloman	collusive oligopoly	
		formal collusive agreement (cartel)	freight conferences
		tacit collusion	operational agreements
		dominant firm price leader	
		barometric price leader	
	Markham	competitive type	
		monopolistic type	
		non-collusive oligopoly	
variations in interdepence	Machlup	pure collusion	
		uncoordinated oligopoly	
		fighting oligopoly	
		hyper-competitive oligopoly	
		chain oligopoly	
		guessing-game oligopoly	
		pure interdependent	

Fig. 7. Types of markets.

can determine what type of an oligopoly it is or negate the assumption.

Various stages along the spectrum of oligopolistic behaviour can be distinguished (see Fig. 7). Four viewpoints will be discussed.

The first viewpoint concerns 'gradients in concentration'. A CR4 of over 60% is considered a *tight oligopoly*; a CR4 between 25% and 60% a *loose oligopoly* while a CR4 below 25 is no oligopoly at all. Furthermore, a CR3 of over 90% or a CR2 of over 80% should be considered a *supertight oligopoly* (Shepherd, 1999). The term 'tight oligopoly' is understood to signify an oligopoly whose market characteristics facilitate the realisation of supernormal profits for a substantial period and where significant barriers to entry exist.

Based on these more detailed limits values, the container shipping industry can be said to be an oligopoly (regardless of the calculation method), more specifically a loose oligopoly ($25\% < CR4 < 60\%$ and a $HHI < 1000$) (see Fig. 1). A rejection of this assumption would be incorrect.

Secondly, taking the variations in market share into account, the container shipping market can neither be called a symmetric nor an asymmetric market, but is rather located in between. The first and second viewpoints together clearly show that one liner operator does not dominate the container shipping industry.

The third viewpoint focuses on variation in competition and collusion. Given the fact that in 2008 the conference system was abolished (Regulation 4056/86), and given the impact of the growing concentration, the container shipping industry may be expected to evolve from a more formal collusively orientated market towards a tacitly collusive market where operational agreements will probably become even more important.

There are two forms of tacit collusion: dominant firm price leadership and barometric firm leadership. At the level of the industry, dominant firm price leadership can be excluded; market shares of the leading liner operators (see Appendix A) show that any carrier can at most be taken as the barometer of the industry. At the level of a specific trade, however, there is likely to be a different conclusion (see Section 3.2).

At this point one can conclude that the containerised liner shipping industry is an example of a (loose) oligopolistic market.

Ultimately, the fourth viewpoint concerns variation in interdependence. Machlup (1952) distinguishes four models of oligopoly (Lipczynski, 2005, p. 119). For the CLSI, the first two categories can be excluded, viz. fighting oligopoly and hyper-competitive oligopoly. In the post-conference era, the CLSI will most likely shift from a guessing-game oligopoly towards a chain oligopoly. Of guessing-game oligopoly, Machlup writes "a small group of firms might normally be expected to collude, were it not for the presence of a few stubborn characters that refuse to play the ball". The CLSI can be classified as a chain oligopoly: the industry is competitive and each liner carrier operates within an oligopolistic sub-group or trade. This brings us to the trade level.

3.2. Some empirical evidence at trade level

Following Brooks (2000), the study should focus on the level of trade lane with port ranges at either end. In a first stage of the research, due to shortage of data, only two trades were studied. Fig. 8 lists the ranking of the largest deepsea liner operators on these trades, viz. the Black Sea—Far East trade, a growing trade and the mature US trade[3]. For the three main Black Sea countries (Romania, Russia and Ukraine) the 2006 TEU volume of all trades (import and export but excluding transhipment) is reported as starting from 10,000 TEUs. On the right-hand side are the figures

[3] For convenience of comparison the TEU totals (x 1000, rounded) of the (parent) companies mentioned have been stated as if they were in existence during the whole of all years indicated. US domestic trade has not been included in their figures. Analyses based on data sourced from PIERS US Global Container Report (Dynamar, 0907).

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Black Sea - Far East

Operator	2006	
	TEU	Share
MSC	181	23,15%
Maersk Line	159	20,33%
CMA-CGM	108	13,81%
Zim	106	13,55%
CSAV Norasia	91	11,64%
Hapag-Lloyd	39	4,99%
K Line	12	1,53%
Top 7	696	89,00%
Others	86	11,00%
Total	782	100,00%
C4		70,84%

US Trade

Operator	2006		2005		growth
	TEU	Share	TEU	Share	
Maersk Line	4 179	15,27%	4 339	17,04%	-3,69%
Evergreen (incl. Hastu and Italia Marittima)	2 098	7,67%	2 098	8,24%	0,00%
Mediterranean Shg Co	1 970	7,20%	1 575	6,18%	25,08%
Hanjin	1 789	6,54%	1 561	6,13%	14,61%
APL	1 690	6,18%	1 629	6,40%	3,74%
Hapag-Lloyd	1 656	6,05%	1 690	6,64%	-2,01%
COSCO Container Lines	1 172	4,28%	1 146	4,50%	2,27%
OOCL	1 166	4,26%	1 112	4,37%	4,86%
NYK	1 105	4,04%	1 085	4,26%	1,84%
China Shg C.L. (CSCL)	1 067	3,90%	823	3,23%	29,65%
Hyundai	1 064	3,89%	1 048	4,11%	1,53%
Yang Ming Line	1 046	3,82%	924	3,63%	13,20%
CMA-CGM (incl. ANL and MacAndrews)	1 020	3,73%	753	2,96%	35,46%
K Line	993	3,63%	892	3,50%	11,32%
Mitsui-OSK Lines	797	2,91%	755	2,96%	5,56%
Zim	536	1,96%	478	1,88%	12,13%
CSAV (Libra Br/Libra Ur and CSAV Norasia)	429	1,57%	424	1,66%	1,18%
Hamburg-Süd (incl. Aliança)	421	1,54%	346	1,36%	21,68%
Seaboard	322	1,18%	305	1,20%	5,57%
Wan Hai Lines	280	1,02%	206	0,81%	35,92%
Top 20	24 800	90,63%	23 189	91,05%	
Others	2 564	9,37%	2 279	8,95%	
Top 100	27 364	100,00%	25 468	100,00%	
C4		36,68%		38,31%	

Fig. 8. Trade analysis.

for the US full-container trade of all US ports (all destinations, all origins) over a time span of 2 years. Notice that these twenty lines carry more than 90% of the total US containerised import and export trade (www.dynamar.com).

A close analysis of these two trades reveals that the market power of each carrier differs on each trade lane. In 2006 the four-firm concentration ratio for the US trade equals 36.68% (comparable with the CR4 ratio of the total container shipping industry—see Fig. 1), whereas the degree of concentration in the Black Sea—Far East trade (only seven liner operators) is significantly higher, viz. 70.84%. The study of the degree of concentration at trade level illustrates that it can differ significantly from trade to trade.

Linking the degree of concentration with the degree of oligopoly, one can catalogue the US full-container trade as an example of a loose oligopoly, whereas the Black Sea—Far East trade is clearly an example of a tight oligopoly (CR4 >60%—see Figs. 7 and 8). Thus, at trade level, the containerised liner shipping industry remains an oligopolistic market (CR4 >25%).

For lack of data, the HHI can only be calculated using the following formula. For a given m-firm concentration ratio the HHI must lie between

$$H_{min} = \frac{(CRm)^2}{m} \text{ and } H_{max} = \begin{cases} (CRm)^2 \text{ when } CRm \geq 1/m \\ CRm/m \text{ when } CRm \leq 1/m \end{cases} \quad (5)$$

(Martin, 2002, p. 337). Only, in the case of the Black Sea—Far East trade, these liner carriers are no longer operating in an unconcentrated market structure, since the minimum HHI equals 1254.58 (>1000). The CR4 already indicated the higher degree of concentration here.

As the analysis of the two trades resulted in both types of oligopoly, additional analysis of trade lanes was required. Access to extra data made a more detailed analysis possible. Fig. 9 summarises the four-firm concentration ratio for several trade lanes. A distinction is being made between eastbound/westbound and northbound/southbound. A CR4 of over 60% is marked in bold.

First, from the perspective of 'gradients in concentration', the trade lanes can be categorised into two groups: (a) large trade lanes (e.g. transatlantic and transpacific trade; >1,000,000 TEU volume), and (b) new/growing/relatively small container trades (e.g. Mediterranean—North America, <1,000,000 TEU volume). The former group can be catalogued as a loose oligopolistic market form, while the latter trade lanes can be labelled examples of tight oligopoly. No data is available to test whether the liner operators realise supernormal profits in the trade lanes catalogued as tight oligopolistic ones.

Subsequently, notice that the transatlantic trade moves towards a tight oligopoly. This is due to economic reasons viz. the effect of a continuously sliding US dollar versus the euro, the withdrawal of liner operators from this trade, as well as the crisis in the US hindering consumer spending on expensive European imports (www.dynamar.com). The relatively small container trades leapfrogging between loose and tight oligopoly situations is due to the growth in market share of the 'others' or small players.

Next, the calculations of the CR4 show that the degree of concentration differs between east- and westbound with the latter showing a slightly higher concentration degree (see Fig. 9).

Finally, regarding the variation in competition and collusion, solely in the Mediterranean—North America trade (westbound) Maersk Line is a dominant player (2005: about 40%; 2007: about 60%).

The second hypothesis '*The market structure in which the container liner shipping industry operates is an oligopolistic market*' cannot be rejected. The container liner shipping industry operates in an oligopolistic market structure but the gradient of concentration depends clearly on the trade lane.

4. Conclusion

The current competitive environment of the container liner shipping industry is more complex and changes at a faster pace than 10 years ago. This is due to a number of factors such as the

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Trade	2003	2004	2005	2006	2007
US Trade	40.14%	38.82%	38.31%	36.68%	36.85%
Transpacific (eastbound)	44.89%	40.85%	40.93%	39.61%	37.50%
Transpacific (westbound)	43.49%	43.87%	45.83%	43.96%	46.30%
Far East to US East Coast/US Gulf ports	45.24%	47.10%	40.18%	39.92%	40.93%
US East Coast/US Gulf to the Far East	36.65%	43.17%	44.69%	38.85%	37.25%
Transatlantic (westbound)	48.41%	53.11%	53.03%	49.63%	49.23%
Transatlantic (eastbound)	44.69%	53.11%	53.52%	48.85%	60.97%
Black Sea - Far East	n/a	n/a	n/a	70.84%	n/a
Indian Sub Continent to US (all coasts)	n/a	n/a	75.88%	65.66%	63.11%
US (all coasts) to the Indian Sub Continent	n/a	n/a	72.65%	56.42%	61.94%
Mediterranean - North America (eastbound)	48.45%	57.88%	60.29%	57.14%	65.74%
Mediterranean - North America (westbound)	48.85%	56.28%	61.13%	57.06%	56.91%
North America - Latin America (northbound)	n/a	69.08%	69.54%	57.12%	58.28%
North America - Latin America (southbound)	n/a	60.97%	65.10%	58.46%	70.41%
US (all coasts) to the Middle East	n/a	n/a	69.23%	71.56%	69.41%
Middle East to US (all coasts)	n/a	n/a	48.65%	76.67%	84.21%

Fig. 9. CR4 ratio at trade level.

rapidly changing customer requirements, the deployment of ever-larger container vessels, advances in information technology, increasing competition and intense consolidation.

This paper examined the degree of concentration linked to the degree of oligopoly. Using concentration measures, first the degree of concentration was determined. From the results it can be concluded that the container shipping industry is confronted with increased concentration. In addition, the results clearly show an increase in the degree of concentration in the years marked by mergers and acquisitions. Industry observers expect more consolidation. These elements confirm the first hypothesis that the CLSI is more concentrated due to consolidation. The trend of growing concentration will most likely continue (likely in the segment of the lower-ranked carriers). Nevertheless, the containerised liner shipping industry is still a fragmented industry.

Based upon the guidelines proposed by Martin (2004) and Shepherd (1999), the following conclusions may be drawn with regard to the second hypothesis viz. that the market structure in which the container liner shipping industry operates is an oligopolistic market:

- In general, the empirical part of the paper illustrates that the container shipping industry operates in an oligopolistic market structure.
- In the spectrum of oligopoly, the containerised shipping industry moves from a formal collusively oriented market towards a tacitly collusive market.
- In a more detailed study, it was found that the degree of oligopoly depends on the trade lane. In terms of concentration, the CLSI is a loose oligopoly or a tight oligopoly depending on the trade lane.
- Over the years the Lorenz curve moves downwards, away from the 45° line, suggesting a trend of growing concentration. The pace of the concentration shows a slight deceleration. Consequently, as mergers and acquisitions continue to occur within the containerised liner shipping industry and the trend of concentration continues, the degree of oligopoly will increase.

Ultimately, the instability index provided a measurable indicator of rivals' behaviour in oligopolistic markets. It is found that the container liner shipping industry, in general, is characterised by a relatively stable competition.

Acknowledgements

The author expresses her gratitude to the members of her doctoral commission, Prof. Dr. E. Omey, Prof. Dr. E. Van de Voorde, Prof. Dr. G. Blauwens and Prof. Dr. F. Witlox for their constructive comments and helpful suggestions that contributed to the writing of this article, as well as people from the sector for their lead in her research. The author would also like to thank the anonymous referees of this journal and participants at the International Forum on Shipping, Ports and Airports (Hong Kong, May 2008) for their valuable comments. The author remains solely responsible for the article's content.

Appendix A. Market share of the Top 25

See Table A1.

Appendix B. Mergers and takeovers

See Table B1.

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Table A1

2008 rank	Company	2008 Total TEU	Market share (Top25)	Cumul. market share	Market share/ world fleet	Cumul. market share/world fleet	2006 total TEU	Market share (Top25)	Cumul. market share	Market share/ world fleet	Cumul. market share/world fleet	2003 Total TEU	Market share (Top25)	Cumul. market share	Market share/ world fleet	Cumul. market share/ world fleet
1	APM-Maersk	1,878,943	18.81%	18.81%	16.06%	16.06%	1,665,272	21.77%	21.77%	18.23%	18.23%	818,850	16.45%	16.45%	11.41%	11.41%
2	Mediterranean Shg Co	1,214,486	12.16%	30.96%	10.38%	26.45%	784,248	10.25%	32.03%	8.58%	26.81%	464,236	9.33%	25.78%	6.47%	17.88%
3	CMA CGM Group	891,803	8.93%	39.89%	7.62%	34.07%	507,954	6.64%	38.67%	5.56%	32.37%	464,236	9.33%	35.10%	6.47%	24.35%
4	Evergreen Line	619,462	6.20%	46.09%	5.30%	39.37%	477,911	6.25%	44.92%	5.23%	37.60%	394,468	7.92%	43.02%	5.50%	29.85%
5	Hapag-Lloyd	494,516	4.95%	51.04%	4.23%	43.59%	412,344	5.39%	50.31%	4.51%	42.11%	142,467	2.86%	45.89%	1.99%	31.84%
6	CSCL	432,251	4.33%	55.36%	3.70%	47.29%	346,493	4.53%	54.84%	3.79%	45.91%	152,923	3.07%	48.96%	2.13%	33.97%
7	COSCO Container L.	430,472	4.31%	59.67%	3.68%	50.97%	322,326	4.21%	59.05%	3.53%	49.43%	244,341	4.91%	53.87%	3.41%	37.37%
8	APL	401,625	4.02%	63.69%	3.43%	54.40%	331,437	4.33%	67.69%	3.63%	56.66%	239,844	4.82%	64.85%	3.34%	45.00%
9	NYK	375,925	3.76%	67.46%	3.21%	57.62%	302,213	3.95%	71.64%	3.31%	59.97%	207,040	4.16%	69.01%	2.89%	47.88%
10	OOCL	343,228	3.44%	70.89%	2.93%	60.55%	234,141	3.06%	74.70%	2.56%	62.53%	168,533	3.39%	72.40%	2.35%	50.23%
11	Hanjin/Senator	339,681	3.40%	74.29%	2.90%	63.45%	328,794	4.30%	63.35%	3.60%	53.03%	306,925	6.17%	60.03%	4.28%	41.65%
12	MOL	329,211	3.30%	77.59%	2.81%	66.27%	241,282	3.15%	77.85%	2.64%	65.17%	152,265	3.06%	75.45%	2.12%	52.35%
13	K-Line	306,486	3.07%	80.65%	2.62%	68.89%	227,872	2.98%	80.83%	2.49%	67.66%	103,213	2.07%	77.53%	1.44%	53.79%
14	Zim	276,512	2.77%	83.42%	2.36%	71.25%	201,432	2.63%	85.93%	2.20%	71.93%	163,267	3.28%	84.44%	2.28%	58.59%
15	Hamburg-Sud Group	275,691	2.76%	86.18%	2.36%	73.61%	184,438	2.41%	91.40%	2.02%	76.51%	100,971	2.03%	88.85%	1.41%	61.65%
16	Yang Ming Line	272,813	2.73%	88.91%	2.33%	75.94%	188,206	2.46%	83.30%	2.06%	69.72%	180,715	3.63%	81.16%	2.52%	56.31%
17	CSAV Group	248,987	2.49%	91.40%	2.13%	78.07%	234,002	3.06%	88.99%	2.56%	74.49%	118,767	2.39%	86.82%	1.66%	60.24%
18	Hyundai M.M.	196,782	1.97%	93.37%	1.68%	79.75%	147,989	1.93%	93.34%	1.62%	78.13%	124,047	2.49%	91.34%	1.73%	63.38%
19	PIL (Pacific Int. Line)	169,444	1.70%	95.07%	1.45%	81.20%	134,362	1.76%	95.09%	1.47%	79.60%	103,213	2.07%	93.42%	1.44%	64.82%
20	Wan Hai Lines	137,656	1.38%	96.45%	1.18%	82.38%	114,346	1.50%	96.59%	1.25%	80.85%	82,053	1.65%	95.07%	1.14%	65.96%
21	UASC	95,516	0.96%	97.40%	0.82%	83.20%	74,004	0.97%	97.55%	0.81%	81.66%	71,161	1.43%	96.49%	0.99%	66.95%
22	MISC Berhad	82,888	0.83%	98.23%	0.71%	83.90%	40,543	0.53%	98.08%	0.44%	82.10%	40,454	0.81%	97.31%	0.56%	67.52%
23	IRIS Lines	73,921	0.74%	98.97%	0.63%	84.54%	53,512	0.70%	98.78%	0.59%	82.69%	36,162	0.73%	98.03%	0.50%	68.02%
24	Grimaldi (Napoli)	53,478	0.54%	99.51%	0.46%	84.99%	44,363	0.58%	99.36%	0.49%	83.18%	49,292	0.99%	99.02%	0.69%	68.71%
25	RCL (Regional Container L.)	49,198	0.49%	100.00%	0.42%	85.41%	48,604	0.64%	100.00%	0.53%	83.71%	48,580	0.98%	100.00%	0.68%	69.38%
	Top 25	9,990,975					7,648,088					4,978,023				
	Liner total	11,697,166					9,136,632					7,174,667				

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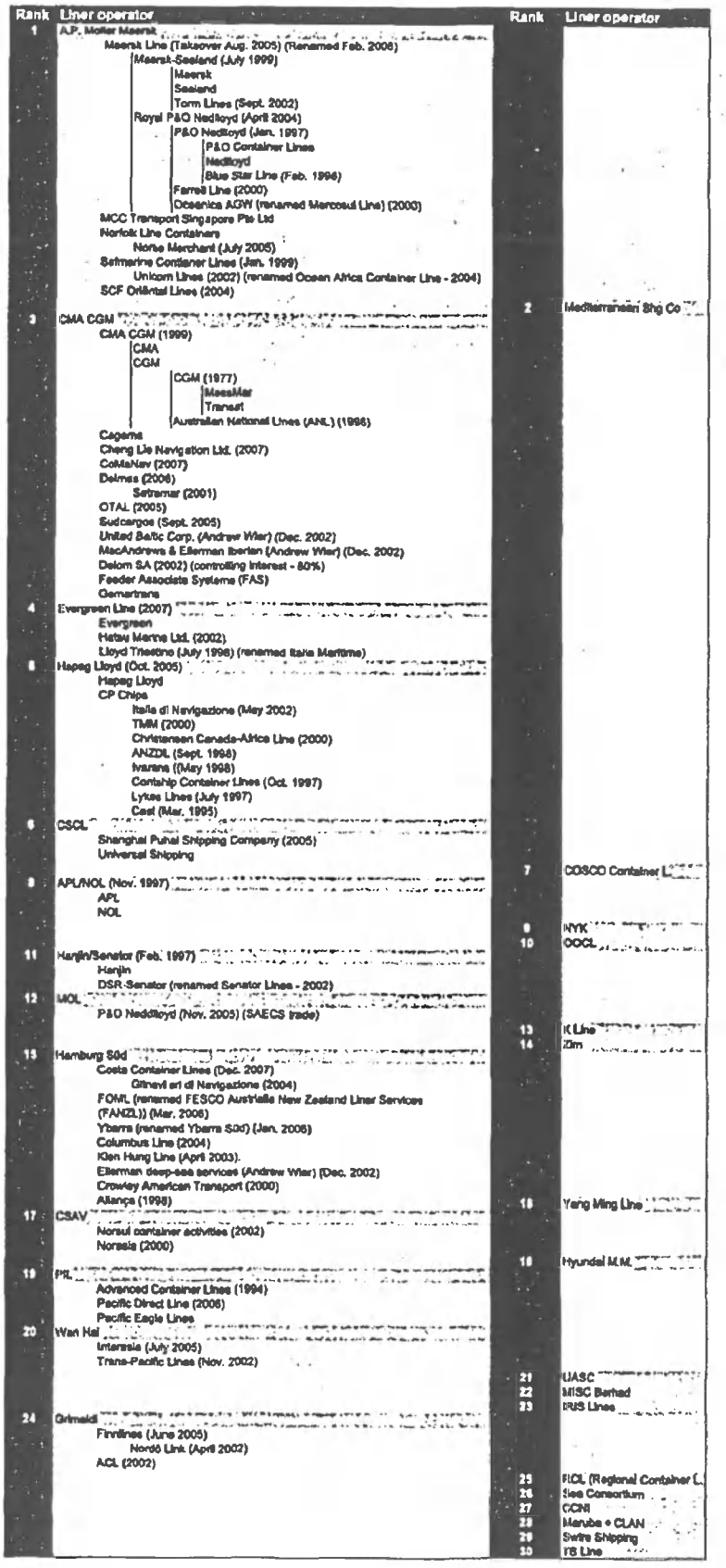
Table B1



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