



“Containership Markets”: A Comparison with Bulk Shipping and a Proposed Oligopoly Model

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Abstract

The paper unveils the market structure of container shipping, which suffers by many interpretations. Existing models regress between contestability, duopoly, monopolistic competition and game theory. This paper proposes an oligopoly model with two groups of companies: oligopolists and price-takers. The Lerner's index found equal to 0.16 excluding perfect competition for the industry; 0.46 and 0.38 found for the most successful carrier the Hyundai. We argue that carriers adjust rates *in negotiation* with big shippers based on an estimation of *supply and demand* for the year to come. Negotiations cover: a tentative emergency fee; the level of the quality of service and the bunker surcharge. In all other aspects, container shipping tends to *resemble* bulk shipping: exhibiting cycles, recessions/depressions (2002, 2009), excess ordering, and elimination of any ordering of new ships during slumps; also costly order-cancellations, *low steaming*, scrapping, and lay-ups. High concentration (using HHI and CRn indices) measured in 4 carriers and found $0.315 > 0.2$ in turnover in 2002, indicating oligopoly. The end-2008 the *crisis increased concentration*. In the 8-top-ports-range, for 10 carriers, HHI varied from 1,767 to 2,399 (2006). In 27-top-ports-range, HHI was 1,880 for KKK, 1,831 for Hanjin and 1,767 for Maersk (2006). For *alliances* HHI = 1,830 (2006) (CKHY). Seven carriers, who *invested in ports* (2005), had an *overwhelming* concentration: HHI varied from 3,035 to 6,746. Concentration helped, however, to improve companies' revenue ($R^2 = 0.79$).

JEL Classification: D21-22, L13, L91.

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1. Introduction

Liners/containerships are important for world economy as they transport products of *manufacturing* and *handcraft industries*, helping *economic development* and having higher value¹ per unit of weigh. Liner shipping earns 50%-60% of world shipping revenue². The world total number of full containers shipped^{3,4,5}, *excluding transshipments*⁶, were 78

¹ These products do not cover basic needs. Their demand is elastic. Moreover, CIF price must be set only as high as to permit consumption at destination based on elasticity of demand. *This trade is more sensitive to financial recessions/depressions like the one in end-2008.*

² McConville (1999); Stopford (2009).

³ Vessel fitted fully with fixed or portable cell guides for containers above and below weather deck.

million TEUs⁷ (2002) from 29 (1990), expected to reach 178 million (2015)...Forecasts⁸ indicate that the worldwide maritime container traffic will reach 412 million TEUs (2015).

The degree of utilization of ship's space, or the degree of *density*⁹, is a *crucial condition* for containership profit. The utilization degree was 90% eastbound and 40% westbound (Stopford, 2009). This 70% excess capacity, however, cancels part of "economies of scale"...Transpacific capacity was 83% westbound, as a percentage of eastbound leg, (2010), while the estimated income (2009) was \$17b eastbound and only \$7b westbound¹⁰.

Competition among ports led also to lower loading/unloading charges. Nowadays, carriers invest in fully- or semi- dedicated terminals¹¹ and so, not only carriers, but also ports belong now to global alliances. *Most* of the demand is *competitive*. However, very big and influential shippers, we reckon, negotiate the rates with carriers¹².

Owners of containerships must invest sufficient funds¹³ to build the expensive ships required, while one ship¹⁴ is not enough for a round service. Carriers have to provide a *round the world service and in certain days* (=quality), and therefore with appropriate *speed* (=quality implies frequency). Speed is related to operating cost given fuel prices¹⁵ and is essential given the long distances involved. Liner companies first decide *the markets to serve* (trade route), and then: the service frequency (days-hours/week for departure/arrival; vessel's capacity, fleet mix, speed), the number and order of port calls/round trip and finally the total number of vessels.

The high capital requirements on the one hand, as well extensive worldwide organization on the other hand, led to various 'groupings' to deliver services up to the *expectations of shippers* (=quality; competitive advantage). These conditions, however, prevent *free entry excluding as a result contestable markets*. Also, Marginal cost is *less than average cost* due to high fixed cost. Worth noting is that shipping in general and containerships in particular

⁴ \$63m costs a medium-sized containership of 3,500 TEU (2007); while 4,000 TEU = the average container ship on order (1st July 2008; increased to 6,368 in 2011); 12,508 TEU = the largest container ship built (2006). The larger containership in use = 6,623 TEU (in European trades) (2009), increased by 2,929 TEU since 2004 (UNCTAD, 2009). In 2013 this increased to 18,270.

⁵ Containerships are among the high priced ships depending on size. Dearer is an LNG of 138,000 cbm \$215m (2007); a 280,000 dwt double hull tanker costs \$141m; an LPG 75,000 cbm costs \$96m and a bulk carrier 170,000 dwt costs \$92m.

⁶ 524 million TEU (2008) = regional container activity; also handled by ports including empties and transshipments; 473m (2009) and 430m (2010) (the fall is due to end-2008 depression). Far East alone handled 195m TEU.

⁷ TEU = twenty feet equivalent unit.

⁸ Global industry Analysts (Google: 16/04/2010).

⁹ Economies of density (Besanko et al, 2010) are economies of scale *along a route* – the average cost is reduced as traffic volumes, *on the route*, increase; revenue-box-miles (RBM) = *traffic volume*.

¹⁰ Transpacific = 62% of income (down 9% since 2008) and transatlantic=12% (Drewry, 2010).

¹¹ Kaselimi et al (2011).

¹² Brooks (1995) wrote that 'co-operation' is a phenomenon between carriers, but also between shippers, implying shippers' size.

¹³ One small size container ship costs \$63m; Stopford (2009), in his cash-flow analysis, indicated \$184m revenue for an 11,000 TEU per year or \$70m profit per annum...

¹⁴ Maersk (top carrier) (early 2006) had 374 vessels calling at 759 ports. AP Moller-Maersk had 507 vessels (of 2,052) (in top 10 too) (2007); the top 10 had 1,903 ships (2006).

¹⁵ Carriers add surcharges on freight rates if fuel price increases applying bunker adjustment factor (BAF). Maloni et al (2013).

have a 2nd hand market minimizing this way its *sunk costs*. “Do carriers form today *monopolies or cartels*”, as used to be¹⁶ (Heaver et al, 2000)? This paper proved for not.

The sector is characterized by: ‘global partnerships’ (1996); ‘global strategic alliances’¹⁷ / ‘commercial co-operative ventures’ / ‘co-operations’ / ‘consortia’¹⁸ (1960s); ‘strategic partnerships’ (2000) - followed after consecutive generations of M&A. Carriers- as a novel phenomenon- prefer to serve container terminals to which they have invested in¹⁹ or to container terminals belonging to one of their partners. This new factor led –as we will show- to a higher port traffic concentration...

The paper is organized as follows: first, is a literature review. Then, the main characteristics of containerships are reminded like: economies of scale, logistics, globalization and alliances. Next, *containership freight rates cycles* are showed. A comparison with Bulk shipping is carried-out in turn. Moreover, M&A and strategic alliances restrictive practices are also showed. In addition, concentration, using ‘Herfindahl index’ and ‘CRn’, is measured. Next, an oligopoly model is proposed. Finally, we conclude.

2. Literature Review

Cullinane and Lee (2002) -criticizing the ‘*game*²⁰ *theoretic approach*’ adopted by Song and Panayides (2002) - argued²¹ that are adequate the so called qualitative influences for liner companies to *co-operate*²². Notteboom (2002) argued that the ‘vertical integration strategies’ of Liner shipping increasingly sought to expand ‘*door-to-door*’ services. He then used the ‘*contestable markets theory*’ (Baumol et al, 1982). But market poses barriers to entry (zero sunk costs and advanced second hand market are required). A strong threat of potential competition (Borenstein, 1989) must exist. True that companies seeking to integrate vertically, along a ‘logistics chain’, may reverse investment costs indicating this way a *contestability condition*.

Lam et al (2007) used a structure-conduct-performance-SCP model to analyze liner shipping dynamics in “transpacific”, “Europe-Far East” and “transatlantic” routes. They showed that despite concentration, *profits did not increase, which this is contra to our findings*. Notteboom and Rodrigue (2008) argued that a cumulative growth of container traffic 5%-6% p.a. (2023-2028), will lead to sufficient *concentration* in supply side, causing as a result the avoidance of measures impeding employment of larger ships (10,000+ TEUs), and thus economies of scale. Authors saw successfully 2 issues and 5 problems in action in our

¹⁶ EU issued regulation 4056 in 1986 (Roe called it ‘a major maritime policy anomaly’), exempting liner conferences (in operation in or out EU) from the Treaty of Rome. After 22 years, exemption ceased (Roe, 2009). Conferences are *illegal* for all their operations [Sys et al (2011)]. Conferences are legal monopolies or cartels.

¹⁷ Carriers serving a minimum of at least 2 of the major east/west trade routes, Europe/Asia, Asia/US or US/Europe, either by combined services, or in a round-the-world service.

¹⁸ Association of companies (2 or 3) formed for a particular purpose; for operation by bringing together the fleets of the companies. Existed about 40 consortia to and from Europe (1992) (Farthing, 1997). They involved space purchase, exchange, cost, revenue and marketing pooling.

¹⁹ Kaselimi et al (2011).

²⁰ Game theory in industrial organization theory initiated by Spence (1977) and Dixit (1979) and applied in the conduct of firms; it *became popular in all journals (by 1996)*. It *appeared also in maritime journals (2002) and repeatedly in IAME conferences (Halifax, 1999; Santiago de Chile, 2011; Taipei, 2013)* [Kaselimi et al (2011)].

²¹ Following the 1953 work of Von Neumann and Morgenstern (where utility can be measured).

²² Cullinane and Lee (2002) believed that the more important problem in maritime game theory is its inability to provide *inherently dynamic solutions*, which inevitably result from the ever-changing input values in liner economics.

opinion in 2008: more *volatile* and *costly* components of supply chain and logistics operations; delays, rising oil prices, complex security issues, labor and equipment shortages and trade imbalances.

Luo et al (2009) predicted the relationship between *fluctuations* of container freight rates and Supply and exogenous Demand (1980-2008). New orders assumed to have a 2-year lag, being proportional to profit. They predicted a fall in freight rates (2009-2013), if demand grows less than 8%. We found that the trade grew 9.1% (2006), 8.8% (2007) (est.), *but only 6.5% in 2008* (ISEL, 2008). Moreover, depression hit industry in 2009. Drewry (2010) saw a recovery by 2012. Containership-owners follow bulk shipping ones: laid up tonnage in containerships will cause a series of ups and downs (zigzag) in freight rates in adjustment to demand.

Ducruet et al (2010) argued that port and maritime studies on containerization observed a *global traffic concentration*. Liner service network aims at a best trade-off between a cost-driven exercise of *cutting operational costs* by employing larger vessels and *reducing number of calls per round trip*...Moreover, shippers need services in local markets with direct calls of mainline vessels. In the Far East-N Europe trade, the 4.9 ports of call (1989) fell to 3.35 (2009) (end), due to economies of scale. This trend led to higher concentration.

Sys et al (2011) argued that liner shipping is affected deeply by a series of recent developments like: globalization, deregulation, vertical/horizontal integration, increasing cooperation, rationalization, information technology, consolidation and increasing concentration. They investigated 18 major liner operators (1999-2008) for market structure, using the “Panzar-Rosse H statistic” of 1987. They found that *monopolistic competition holds here*. Structures like *perfect competition, sales maximization and natural monopoly (contestable markets)* are inappropriate...Bikker et al (2009) have argued that this statistic fails to infer the *degree of competition*, which this paper looks for.

Maloni et al (2013) investigated ‘slow steaming-SS practice’ of ocean container carriers facing the end-2008 depression up to 2012. The SS led to fuel efficiency and lower GHG emissions -to *the dissatisfaction* of shippers suffering longer transit times. Speed at 18 knots, instead of 24, reduced total costs by ~20%; also 43% the Carbon dioxide emissions. In \$ terms this means ~\$585m annual saving (2010; at \$700/MT fuel price; \$600 in 2013). Shippers, however, pay \$951m for pipeline inventory cost, which indirectly equals the value of the reduced level of quality of service.

Bae et al (2013) developed a 2-stage *duopoly model* of container port competition for *transshipment*. They showed -among others- that shipping lines assign more port calls to ports providing *a lower price* and *have a larger capacity*. They prefer also ports providing a *higher transshipment level*, provided congestion is eliminated.

Fan and Yin (2016) analyzed the so called dynamic interrelationships among container *new-building prices, time charter rates* and *second hand prices*. They applied the Johansen VAR co-integration model. Strangely, the econometric results did not support the existence of a long term relationship among them!

Summarizing, it is obvious that research proved unable to propose *one unique acceptable model* for the structure of containership market as shown below.

Author	Year	Theory
Cullinane & Lee	2002	Game
Notteboom	2002	Contestability
Sys et al	2011	Monopolistic competition
Bae et al	2011	Two -stage duopoly

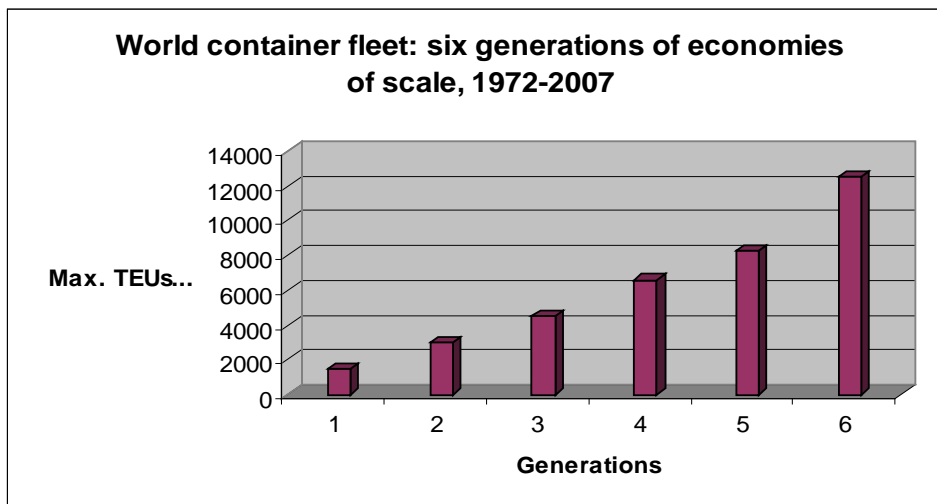
Concentration is able to increase the profits of containerships as we show. Another paper showed –indirectly- that if *transit times* are prolonged, carriers will profit about \$600m/year; environment is also benefitted by 43% lesser carbon dioxide emissions...at the expense of the *quality* of service...Surely, reality has proposed to us the best containership model to combat air pollution from vessels without IMO regulations. This is *slow steaming!*

3. The Main Characteristics of Containership Markets

3.1 Economies of scale

Over last 3½ decades containerships pursued strong economies of scale *and* especially after 1988 (Figure 1) (IAME, 1999). The maximum size of containerships²³ reached 18,270 TEUs in 2013 (Ferrari et al, 2015).

Figure 1: Maximum size of containerships over last 6 generations, 1972-2007



Source: data from ISEL, Shipping statistics yearbook (2008).

Six generations²⁴ of economies of scale showed (Figure 1) since 1972 (1st); (2nd) 1980, adding 1500 TEU to average size (lasting 8 years); (3rd) 1987, adding 1500 TEU (in 7 years); (4th) 1997, adding 2100 TEU (in 10 years); (5th) 1999, adding 1700 TEU (in 2 years) and (6th) 2007, adding 4200 TEU (in 8 years). Economies of scale *intensified heavily* since 1999, with 850 TEU additions per year (525 TEU only for 2007) and after 2005 par excellence. In 2005

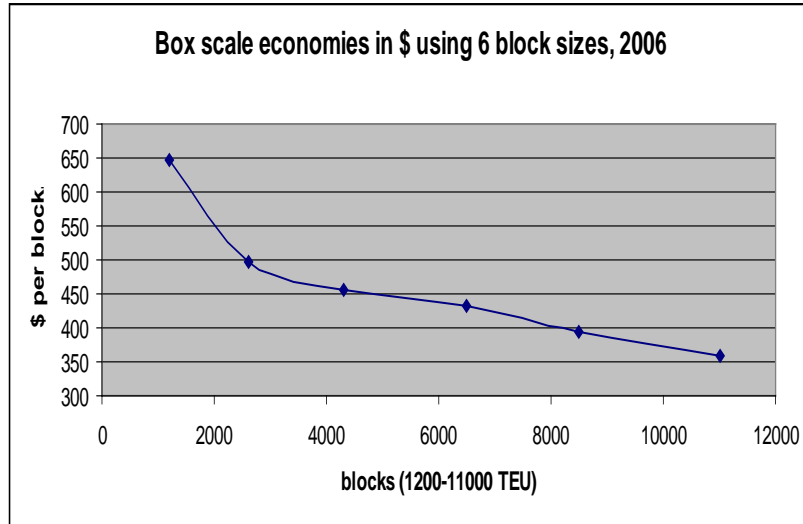
²³ Med. Shipping had a 10,442 TEU average vessel size on order-2009 Jan. (UNCTAD, 2009).

²⁴ Different authors report different generations (IAME, 1999). Above classification is based on ISEL data (2008).

the average newbuilding delivered was 9,200 and in 2006 jumped up to 15,550 and stayed there till 2011-rose to 16,020 in 2012 and 18,270 in 2013 (Ferrari et al, 2015).

Figure 2 shows the economies of scale in \$.

Figure 2: Economies of scale in Container Shipping in 6 TEU blocks in \$ (2006)



Source: data from Stopford (2009).

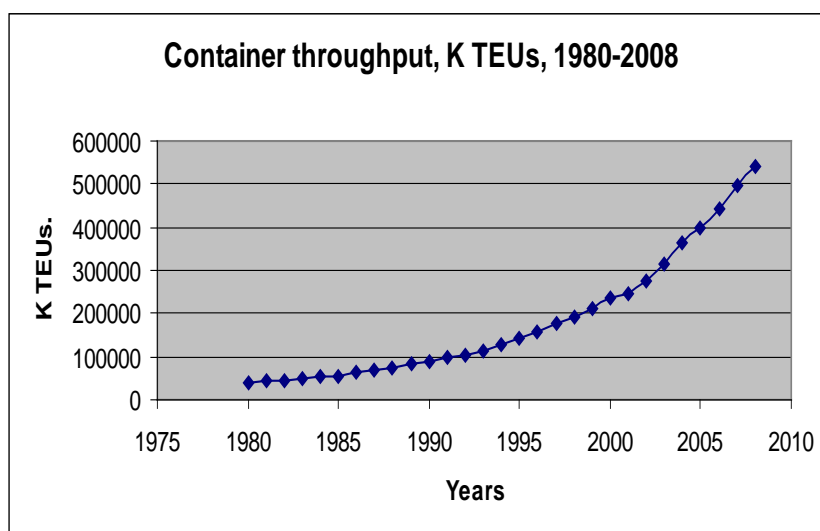
The cost ‘per box block’ p.a. fell to $\sim\frac{1}{2}$, from \$650 to \$360 (Figure 2); the block size increased 9 times: from 1,200 to 11,000 TEUs. Surely, *there²⁵ is no point in building big ships, if cannot be fully loaded.* The 11,000 TEUs containership transports 81/2 times more TEU (127,467) per year than the 1,200 TEUs one. ‘Economies of scale’ became, however, a trap (2009) for it led carriers in carrying *every* box that could be transported, albeit at unprofitable rates... (\$800 per TEU; almost $\frac{1}{2}$ during the peak of 1600+ in April 2008 Far East-Europe).

²⁵ Supported by Stopford (2009).

3.2 Unitization

A substantial reduction in ‘average liner port time’ came after *unitization*²⁶ (*containerization*) (Figure 3). *This we may say is the ‘4th*²⁷ *technological revolution’ in maritime economics.*

Figure 3: Container throughput, 1980-2008



Source: data from Luo et al (2009).

For conventional liners, *port time used to be 60% of total ship time, or even higher; and being rather common in the 1960s*²⁸. Even a much higher speed by 21 knots, i.e. 33 knots, was ineffective to raise ship’s productivity then, as it raised carrying capacity only 35% in an 8,000 miles route with 4 ports and 144 hours crossing.

“Mother ships” are loaded/unloaded fast today by ‘gantry cranes’²⁹. Noticeable is that a large 11,000 TEU container ship needs 24.1 days at sea and only 16.9 (41%) days in ports, in a 14,000 miles round trip (Stopford, 2009).

3.3 The nature of containerized goods

Containerships ‘prefer’ valuable and fine cargoes. The worldwide degree of containerization reached 75%, as recorded by ports in the ‘Hamburg-Antwerp range’. The cargoes that can be placed in containers are *expanding as time elapses* and technology advances.

²⁶ Appeared in 1956; unitization means to deal with *one unit* in loading-unloading phase.

²⁷ Revolutions in shipping took place: (1) when oil used for ships’ engines (internal combustion engine), (2) when electro-welding used in ships’ construction, (3) when cargo handling from *wider* hatch openings of dry cargo ships has been applied; also a different cover. Containerization is due to Irish McLean, who also founded Sea-Land (Stopford, 2009); he was a visionary (1956) road transport-entrepreneur in USA, who saw the possibility to transport ‘heavy objects’ *on ship’s deck*. He transported trucks on deck of a war T2 tanker. This has been used to carry airplanes and tanks on deck for the needs of the Korean War...

²⁸ OECD, Maritime Transport (1970).

²⁹ A high level structure on the deck of a ship, or on shore, to support a moving crane on rails.

3.4 Certain financial feature of containerships

An 11,000 TEU containership needs about \$13 million per round voyage (Stopford, 2009); in ports she spends \$455,000 (3.5%) and gains \$7.7million (37%) or \$700m per year. Ports also perform faster handling over time: they moved 40m TEU (1980), 75 (1990), 236 (2000), 399 (2005) and 625 (2010)...

3.5 Door- to- door, just-in-time

Containerships offer ‘door to door’ (Notteboom, 2002) and ‘just-in-time’ to serve their clients better, combining sea and ports with remaining modes of transport.

3.6 Logistics

This is a dominant concept meaning the total cost from origin to final destination (called “logistics cost”), which has to be minimized, including cost/time spent in ports; ‘supply chain’ is a synonymous. We say that logistics is a *process*, in which the carrier plans, implements and controls the efficient (cost-effective) *flow* and *storage* of (almost every transportable) cargo (raw materials, in-process inventory, finished goods), as well as of *information*, from origin to consumption points, *conforming* to customer’s requirements.

‘Logistics cost’ gave birth to 3 new concepts: “Maritime logistics” (Li, 2008; Nam and Song, 2010; 2011), “Maritime networks” (Ferrari et al, 2008) and ‘Maritime operations research’ (Sciomachen and Liu, 2009). ‘Maritime logistics’ simply involves carriers, i.e. *shipping*, *ports* and *freight forwarders* (Nam and Song, 2010; 2011); a ‘logistics center’ is no more than a ‘hub function’ (comparable with ‘distribution centers’). Sciomachen et al (2009) argued *wrongly* that the logistics term was coined first by a journal³⁰ (1998). Moreover, logistics *advances* as *independent discipline* within ‘*Operations research*’ and ‘*Management*’ science (Panayides and Song, 2013)...

3.7 Globalization

Consolidation started with globalization; the world became *one village*. Globalization (just-in-time/door to door) *can only be made true* indeed by an efficient sea-land-sea transport network, acting within the multi-modal systems (road, rail, feeder, air, canal etc.) through land gates (=ports). Just-in-time’ is well known for reducing inventory costs, a concept originated in Japan.

Globalization *led liners* to face growing demand; also, it caused an important shift of leading countries of transport *towards Asia* (since 1975) as more than 80% of container throughput (TEU) moves only in 5 areas: E. SE. NE. Asia, N. America-W & E coast, W. Med., Middle East and N. Europe. Liner shipping is really the *backbone of international trade*, having a 25% share in the market volume. Container carriers, under globalization, *grouped* to form ‘strategic alliances’, to pursue ‘economies of scope’ and ‘economies of network’³¹ in demand

³⁰ The term has been mentioned in the book of Wijnolst and Wergeland (1996).

³¹ A network is a set of *nodes* connected by *links*. In a port network (hub and spokes), the outer nodes are the smaller, or less central, ports. The central node/port is the hub (=a main port, from which containers must pass to reach peripheral ports using feeder ships). Connections with links/spokes must also exist between smaller

and supply. 'Economies of scale' led to mega-sized carriers of 16000+ TEUs³² or 18,270 in 2013. Vertical and horizontal integrations also occurred (1993-1998), while the number of carriers decreased, the size of ships *increased*, and the individual carriers became larger, using the M&A platform, and growth.

The 8 largest container carriers in EU increased their share from 36% (2000) to 50% (2007). The 9 out of 20 top carriers, operating about 40% of world's containership fleet (1st Q of 2010), had an operating income of \$51m. This means \$1/2b for industry (2010) (carriers had \$19-\$20b losses in 2009).

3.8 Alliances

Many carriers organized in alliances in trying to obtain not only *larger shares in transport capacity*, but also share (fully or partly) in *terminals*, in competition one with the other (Kaselimi et al, 2011). The important alliances (2010) were: the Grand³³, with Hapag-Lloyd (+CP Ships), NYK (+TSK), OOCL and MISC; the CYKH/CHKY³⁴, with Cosco, K line, Yang Ming and Hanjin³⁵ (+Senator) and New World³⁶, with APL, Hyundai and MOL. The largest single carrier is Maersk (+P&O and Safmarine) (1.73m TEU; 2008), (+P&O Nedlloyd); second is MSC (1.16m TEU; 2008). All carriers, but Evergreen, (+Hatsu M, Lloyd Triestino), ordered large ships of 12,000 TEU+... All carriers had 3,144 vessels of 10m TEU (Feb. 2008) (ISEL). From these ships, alliances used 437 ships of 2.3m TEU.

4. Cycles in Containership Markets

4.1 Cycles in General Cargo ships and in containerships

Average transport freight rate per ton mile for a liner (1987) was about 10 times higher than in other shipping sectors³⁷. Moreover, '*general cargo carriers*' charge *stable rates*³⁸ vis-à-vis bulk trades³⁹. The freight rate index for *general cargo* for Europe's liner trades (monthly), varied from 99 (01/2007) to 104 (08/2008), being stable since 2002⁴⁰. *General cargo showed remarkable rate stability for at least 6 years*. Freight rates for *containerships*, however, were unstable (Figure 5). After the outbreak of the end-2008 depression, container traffic *collapsed* on a worldwide basis (Tasto, 2010). The total container handlings in the 'Hamburg-Le Havre Range' (2009) declined by 16%. Europe hit more by end-2008 depression.

The index of container time-charter rates (1993-2008; Clarkson's) fell from 1993=100, 60=1999 and 50=2002. The index peaked in 2005 = 170, and fell to 115 (\$/TEU) (2008). So, the *cyclical character of the freight rate time series and the subsequent profitability are shown* (Figures 5 and 6); three peaks (1996, 2000, and 2005) and three lows (1999, 2002, and

ports and central port/hub (Economides, 1996). 'Network Economics' is a new chapter in *microeconomics* (appeared in the 1990s).

³² She transports 22-24 containers across a 60 m wide deck and 15 to 21 m draft.

³³ 144 ships of 810,400 TEUs (02/2008).

³⁴ 184 ships of 947,500 TEUs (02/2008).

³⁵ In 2016 this company has failed.

³⁶ 109 ships of 257,300 TEUs (02/2008).

³⁷ Jansson and Schneerson (1987).

³⁸ Farthing (1997).

³⁹ In conferences there is no freight rate volatility/risk, unlike bulk trades/shipping.

⁴⁰ ISEL (2008).

2007) are noted. Another index [Fairplay⁴¹] fell from 160 units (03/2008) to 85 (11/2008). So, *conferences* maintain stable freight rates, but *containerships*⁴² do not.

Containerships tried to attain rate stability copying conferences, but failed; also, they transported cargo with *delays*. They also failed to profit adequately from economies of scale: global carriers moved about 15% *more cargo*, but earned 1.2% *less revenue* (2006). The East-West main routes showed \$2.4b loss (8%), while Maersk, despite its 17% share in world container fleet (early 2008), suffered \$568m loss (2006), due to a vertical fall in container freight rates since 2005. Hanjin failed in 2016.

During high demand, over-ordering followed. By 2013, there are over 4m TEUs of containership-capacity on *delivery* (Drewry, 2010). For the *first time in the history* of containerships, *slow steaming* took place to absorb surplus capacity.

Cycles appeared too in containerships with a maximum *low* in 11/12-2009 (200th month) at ~\$5,000/month (Figure 6). In April 2008 (month 184) started a fall in rates -earlier than world depression- and lasted till 12/2009 (month 204). This was a drop from all period high of \$44,000/month (early 2005) (145-148 months). A low also appeared (end-2001) ~\$9,000/month.

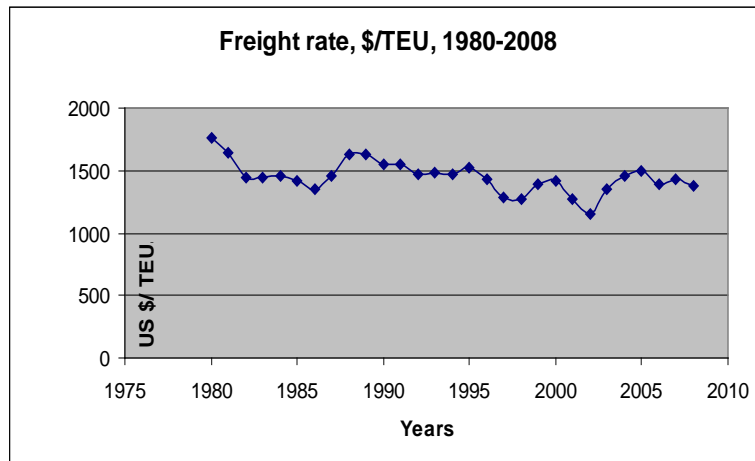
Container rates were *stable from 1993 to 1997* (1-48 months, ~\$25,000/month). Serious turbulences started in early 2001 (100th month). Charter market lags behind the spot freight market; 2009 (192nd month; \$5,000/month) was really a disaster for owners. Crisis always hits sizes and ages, which outnumber demand.

Average revenue varied over the last years: 2005 = \$1,569/TEU, 2006 = 1,452, 2007 = 1,496, 2008=1,615, 2009=1,202 (<*breakeven*) and 2010 (est.) = 1,426. *Total revenue* [(multiplying number of loaded container moves (TEU) with average revenue)] was: \$116b (2005), 127 (2006), 141 (2007), 149 (2008), 134 (2009) and 140 (est.) (2010). Gross income was: 2005 = 182b; 2006 = 185; 2007 = 212; 2008= 240; 2009= 161; 2010 (est.) = 200. End-2008 depression led to lower revenue/unit and fewer TEUs.

⁴¹ www.fairplay.co.uk (6th Nov. 2008).

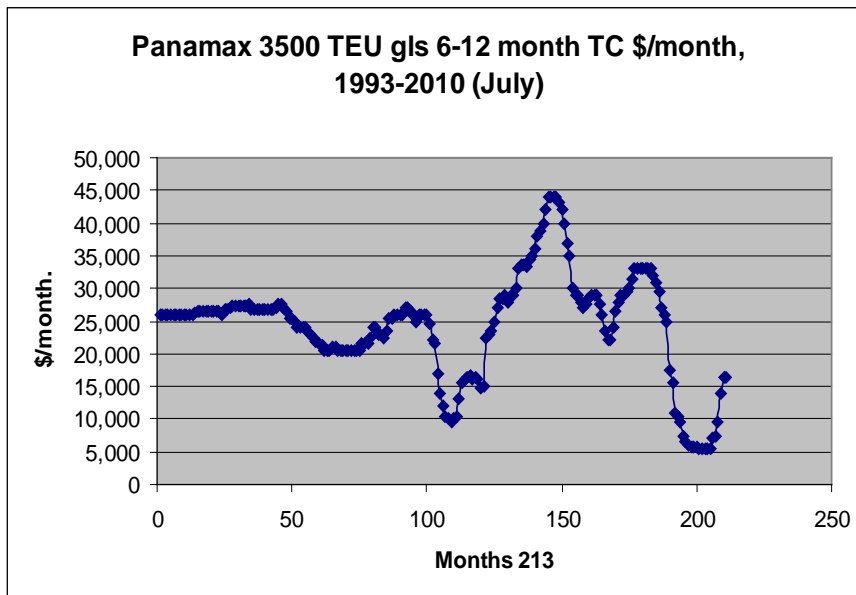
⁴² The stable 'cartel rate' was the 'price' paid by shippers for stability in rates and in capacity. Carriers avoid cut-throat competition per route (due to the high fixed cost; and also on the fact that marginal cost is less than average cost).

Figure 5: Containership Freight rates, 1980-2008



Source: Data from Luo et al (2009).

Figure 6: Container rates for Panamax (3500 TEU), 1993-2010



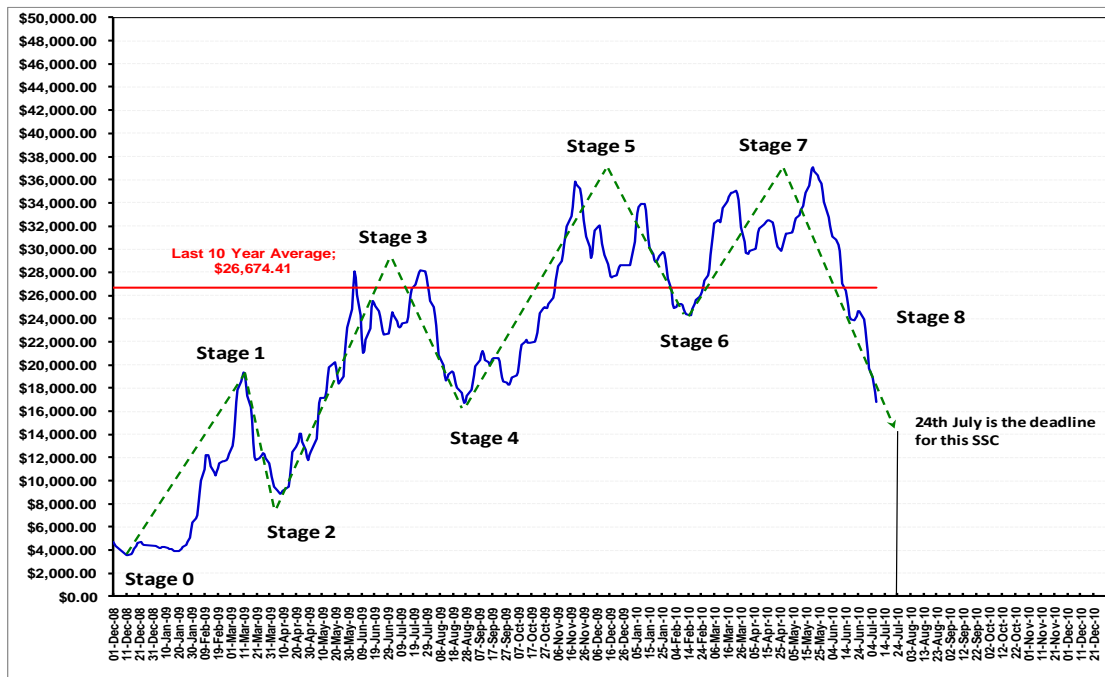
Source: Data from Clarkson's.

4.2 Comparison between dry cargo and containerships freight rate cycles

Comparing containerships' cycle with that of Panamax (4 TC routes *dry cargo*) (Figures 6 and 7), containership-owners are *luckier*, as their cycle is smoother. Also container industry earns more money in absolute terms (per company). 'The Baltic dry cargo 4 time charter routes index' manifests "the Hampton short-run shipping cycle of 3-4 years on average" (01/12/2008-07/2010) (Goulielmos, 2009). Containerization *was sensitive to economic cycles*⁴³ for at least the last 160 months (13+ years).

⁴³ 'Global Industry Analysts'/Google.

Figure 7: 4 TC routes Baltic Panamax/ten days freight rates, Dec. 2008-2010 (July).



Source: data from Clarkson’s; prepared by my student Dr M-E Psifia.

Figure 7 shows 8 ‘stages’: during 0-5, there is an upward push to freight rates; then 3 steps back; stage 7, where time series stops up-rising and shows a dramatic drop, ‘destined’ to reach stage’s 0 level! Cycle started with \$4,000 (01/12/2008) -a ‘rock bottom’ rate and returned to it after 3-4 years (Sept. 2010).

5. M&A and Alliances in Container Markets

Mergers control *markets* and *firm’s structure* (Martin, 2010). M&A *come in waves, with no specific periodicity* (Martin, 2010; Fusillo, 2009).

5.1 Waves of M&A in US Container market (1969-2006; 1993-2006)

Maritime M&A appeared in waves with a peak in 1999 (Fusillo, 2009). Three mergers took place: between P&O-Nedlloyd and P&O containers (1997), between Wallenius and Wilhemson (1999), and between CP Ships and TMM (2000). The preference of carriers was *towards acquisitions* (after 2000). Carriers sought M&A afterwards *when*: demand conditions were bad, freight rates fell, excess capacity rose, and shocks to demand were positive. Also, when regulatory reforms occurred, like OSRA⁴⁴ (1998). These disturb the co-operative relationships among suppliers. *Market concentration increased* through M&A.

⁴⁴ ‘Ocean shipping reform act’ (OSRA; 1998); it weakened the traditional conference system in US; in effect on May 1st, 1999. It did not deregulate US liner shipping services completely, but it eliminated a number of regulatory requirements of 1984 Act. It effectively replaced the common carriage system with a system of contract carriage (Shashikumar, 1999).

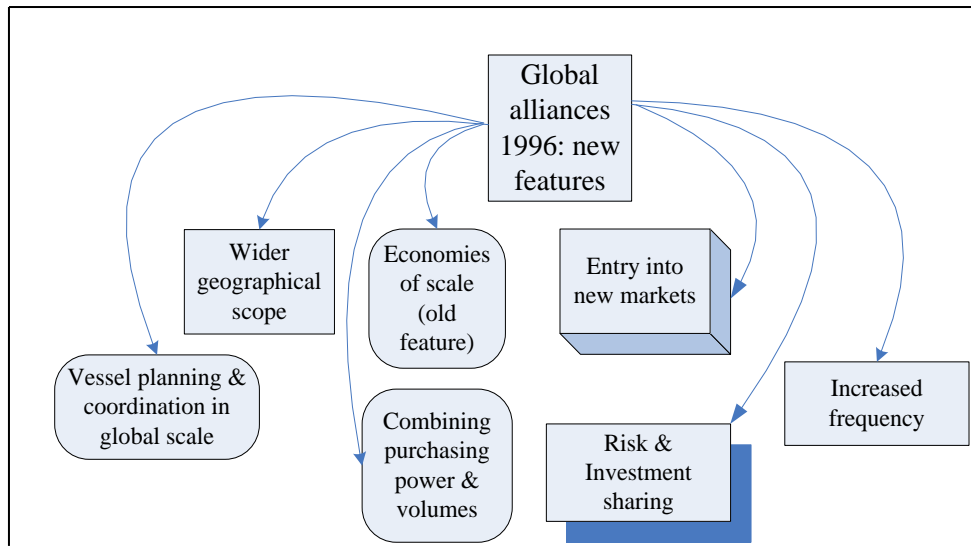
5.2 Strategic alliances

Strategic alliances in liner shipping wanted to achieve a *rate/capacity stability*⁴⁵. This target⁴⁶ was not achieved, however, due to the emerged complexity and the degree of intra-alliance *competition*⁴⁷. M&A activity in late 1998 had 2 new⁴⁸ factors on top of those in 1970s: *globalization* of world markets and *poor profitability* of most carriers (ROI from 7%-8%; 1996). Carriers tried to build a new generation⁴⁹ of ‘strategic alliances’ to pursue the long sought-after *market stability*. But as mentioned, they failed⁵⁰.

Global *partnerships* also appeared (1996). These covered *every major route*; also, a number of relevant N-S trades, regional/feeder links, a shared use of terminals, joint equipment management, inland transport/logistics and joint purchasing/procurement...Indeed, *a total control of all essential activities in container shipping*. This was due to the increasing *high capital expenditure involved*, and the subsequent *high risks have emerged* (Midoro and Pitto, 2000). Carriers wanted to remain in the scene and to provide a consistent *frequency* of services.

The *new features* of global alliances (1996) were.

Figure 10: New features in Container global alliances (1996)



Source: inspired by Midoro and Pitto (2000).

⁴⁵ Stability in capacity and in freight rates charged, were the benefits of carriers to shippers, in a way to prove that ‘conferences/cartels’ are not totally detrimental for the competition and for the common good.

⁴⁶ The characteristics were: a wide member basis, a separate marketing and sales organization, identical roles and contributions. This is a superficial reaction to strategic alliances, instead of a well-planned one.

⁴⁷ Carriers had to adopt: a smaller number of partners, a dominant carrier, differentiated roles and coordination of marketing and sales.

⁴⁸ On top of risk and investment sharing, also are economies of scale, cost-control and capability to increase service frequencies.

⁴⁹ The 1970-80 generation involved 4 strategic alliances: the global (5 companies), the Grand (four), the Maersk/ Sealand (two) and the Hanjin/Tricon (three); 318 ships; 946,000 TEU. The 1990-2000 generation (1996) involved 4 alliances with almost the same partners, but with different names; *the number of ships* increased to 435 and TEU reached 1.39m. *Alliances added power from one generation to next*. 3 alliances noted with the top 10 carriers owning 2,052 ships and 6.6m TEU (2008)! The 2001-2010 generation involved 3 alliances, which devoted 437 ships of 2.3m TEU to alliances.

⁵⁰ Expected: more future mergers and take-overs and a new generation of more efficient/more *stable* alliances.

As shown (Figure 10), demand increased its scale entering into new markets and covering wider geographical areas and providing a more appropriate frequency of service. For carriers to cope, they needed new investments, and higher risks which had to be rather shared. *This led to global alliances*. Economies of scale realized. The careful vessel planning and coordination in a global basis *was more imperative*. Carriers failed to avoid delays, and through negotiations for year rates, failed to sustain profitability (2009), achieving, however, it in 2010.

6. Monopoly or Oligopoly on Containership Markets?

The *number* of liner shipping companies providing direct services between pairs of countries *had* a strong impact on *freight rates*⁵¹ (Wilmsmeier and Hoffman, 2008). The number of carriers continued globally to increase. The more concentrated, and the less competitive liner shipping market is, the more *freight rates increased* for shippers (Caribbean; 2005), and vice versa.

The M&A created more concentration (2008), with *fewer* carriers in comparison with 1995, while the trend to *expand into new markets* continued. Empirical results support the view that the *higher* the competition between shipping lines, the *less expensive* a service is, *implying oligopoly*. The dispersed Caribbean market e.g., exhibited *diseconomies of scale* due to trade imbalances⁵².

The average number of container shipping companies (=28), providing services to and from ports of less developed countries (LDC), is 1/3 of the global average, meaning that traders have fewer choices and a lower level of competition, which *empirically is correlated with higher freight rates* (www.unctad.org/transportnews) (UNCTAD, 2009) . The global trend of M&A affected the supply of services to LDC.

The industry consists of 3 markets geographically: “transpacific”, with a share of 56% (2010), “Europe-Far East” 34% and “transatlantic” 10%. Monopoly power is measured by “Lerner’s index”. We assume the amount of \$1,295/TEU to be *the break-even rate* (based on Drewry, 2010); because at a rate of \$1,194/TEU 16 carriers (2009) had losses, and at \$1,513/TEU only 3 carriers had losses (2008). So, we take *\$1,295/TEU rate = Average cost=Marginal cost* for the industry at equilibrium. Moreover, at \$1,550/TEU (~average 2008 rate), carriers were able to *earn positive operating profits, and so we assume this to be equal to price*.

The average revenue was \$2,381/teu for Hyundai (2008). The ‘Oligopoly group’, defined above, on average charged \$1,835/TEU. The smaller group/fringe firms charged \$872/TEU on average. “Monopoly power” thus adds an extra ‘bonus’ of \$963/TEU to those possessing it...

Table 1: Measuring monopoly power in containership industry –the Lerner’s index

Lerner’s index: found LI = 0.16 (it ranges from 0 to 1)	For social efficiency LI should be equal to 0	For perfect competition optimal LI should be 0 or $e=\infty$
For monopoly LI is equal to 1.00	Monopoly power is greater, the more index approaches unity	$LI = 1/ e $

⁵¹ A factor which is stronger than ‘distance’.

⁵² Imbalances are important determinants of the transport cost.

LI is also equal to $1/e$ (e =elasticity of demand) *at equilibrium as mentioned*: so e found = 2.20 for the industry and 2.63 for Hyundai. This means that this firm *can increase profits/revenue* by lowering price/TEU (Besanko et al, 2010). It also means that *the lower the elasticity of demand, the more a profit-maximizing 'monopolist' can raise price above marginal cost*. This possibility, however, diminished (2009) for Hyundai, and for industry as a whole, due to end-2008 depression. The depression *caused a fall in company's elasticity of demand by 0.43 points (2.63-2.20)*.

In container markets profitability in *practice* does not depend *only on price and on elasticity of demand*. Rates were modified (Drewry, 2010) because carriers managed *supply* by removing capacity from market by slow-steaming, scrapping and lay-up; imposed higher fuel surcharges, and new exceptional emergency surcharges (2009); carriers did not *negotiate* heavily discounted and loss-making contract rates as in the past. They were presumably socked by the end-2008-2009 depression and their own over-investments⁵³ in *large* containerships. Moreover, carriers lost ½ of the value of their assets as ships' prices fell. The recovery will be slow with ups and downs, given slow steaming, lay-ups and ships delivered (4 million TEU) given demand.

7. Measuring Concentration in Container Markets

7.1 Concentration measures

Two concentration ratios are used here: HHI and CR_n. The concentration in a ("well-defined"⁵⁴) single *market* is a measure using market shares of all companies offering (transport) services in that market. The more companies enter into a concentration measurement, the less *monopoly power* is found. Companies included in the index should have the *same geographical characteristics*, as geography differentiates services⁵⁵.

Luo (2013) argued that market concentration can affect industry's efficiency as well as international trade. Studying the market shares of the top 20 liner shipping companies (1999-2013 May; 15 years), he found a *clear trend towards market concentration*. Three companies had an increasing market share from 33.5% to 38.9% (2010-2013). These had ~48% of the fleet of (large) containerships (>6,000 TEUs).

7.2 The Herfindahl index

Herfindahl index is given by: $\sum_{i=1}^n S_i^2 = H$ (HHI), where S_i is the market share of the i^{th} company. Table 2 presents the results in measuring concentration in 5 areas: revenue, capacity, turnover, slot capacity and port-ranges.

⁵³ CMA CGM's built-up debts were ~\$5.4b due mainly to orders of big ships. Cancellations cost \$548m. This company had also a 24% reduction in revenue/TEU in an increase in production of 22% or elasticity of demand = 0.92.

⁵⁴ For a 'well defined' market see Besanko et al (2010).

⁵⁵ Brooks (2000) argued that the industry standard for calculating the market share is the total amount of TEU throughput on a trade lane country-to-country via carriers operating in that lane. *HHI > 1000 calls for an antitrust review*. ACCOS (1992) identified a presumptive threshold of antitrust concern in liner shipping at $HHI = 1800$. For $CR_4 = 65\%$ antitrust regulators become interested, as mentioned. In Canada, a '*strategic alliance*' may be treated, by Competition Bureau = *merger* (Brooks, 1998).

Table 2: Measuring concentration (*) in Containerships, 1998-2010

Area	Sample's size	Year	Amount involved	HHI	Source
1. Revenue	29 carriers	2008	\$212b	1,132	Data from Drewry (2010); calculations by author
2. ""	38	2008	\$287b	766	As in 1.
3. ""	24	2009 (1 st Q)	\$30b	1,777.5 (i)	As in 1.
4. ""	24	2010 (1 st Q)	\$37b	1,609 (ii)	As in 1.
5. Capacity-TEU	19 leaders (iii)	2009 (Jan.)		0.04 (**)	Data from UNCTAD 2009; calculations by author
6. Charterers	10 top	2010 (1 st q)	649,000 TEU, 303 ships	1,447.5; 1,029.0 for ships (iv)	As in 1.
7. Turnover	16	2002	\$55m	0.094	As in 1.
8. ""	10 top		\$43m	0.130 (v)	As in 1.
9. ""	4 largest	2002 recession	\$25m	0.315 = <i>oligopoly</i> (vi)	As in 1.
10. Trade routes	3 routes; more than one port	2002 1998		646 (1) 703 (1) 644 (2) 577 (2) 891 (3) 674 (3)	As in 1.
11. Slot capacity	10 top	2006-7 (vii) (Aug.)		0.145 (4) 0.140 (4)	As in 1.
12. Capacity, Major port-ranges	8-top-ports-range; 10 carriers; N Europe, W Med., N America-West, East coast, M East, S E & E Asia	2006		2,030 (5) 2,051 (6) 2,182 (7) 2,101 (8) 2,399 (9) 2,098 (10) 2,260 (11) 2,173 (12) 1,917 (13) 1,767 (14)	Source: Ferrari et al (2008)
13.	27 ports range	2006		1,880 (15) 1,831 (16)	As in 12.

(*) HHI<1,000 shows no concentration; from 1,001 to 1,799 there is a moderate concentration; from 1,800 and over there is a high concentration. (**) Perfect; monopolistic competition < 0.20 (depending on product differentiation); Oligopoly= 0.20-0.599; Monopoly=0.60 and over. Shares below 1% are excluded from index for their insignificant influence when raised to square power. (i) AP Moller-Maersk-all activities=37%; AP Moller-Maersk-container shipping & related activities=16%. (ii) Top carriers=50%. (iii) Maersk 12.4, Mediterranean 10.3, CMA CGM 6.2, Evergreen 4.4, Hapag-Lloyd 3.5, COSCO 3.4, APL 3.3, China S C Line 2.9, Mitsui 2.6, Orient O C L 2.6, NYK 2.5, Hanjin 2.5, Kawasaki 2.2, Yang M M T Corp. 2.1, Zim 1.8, Hyundai 1.7, Hamburg S.D-G 1.7, Pacific 1.1 and United Arab S Co (SAG) 1.1 (=68.3%). (iv) CSAV 23, MSC 20, CMA-CGM 15, Maersk 10, Hapag-Lloyd 9, Hamburg Sud. 6, MCC 6, K Line 4, Safmarine 3.5 and HDS Lines 3.5 (=100%). (v) 79% share. (vi) Maersk=\$12m=47%=top; 46% share. (vii) AP Moller-Maersk ~ 26, MSC 17, CMA-CGM 12, Evergreen 9, Hapag-Lloyd 7, Cosco 6.7, China 6.4, APL 5.5, NYK 5.2 and Orient 5 (=99.8%). (1) Transpacific; (2) Europe-Far East-higher; (3) Transatlantic-higher. (4) Slight fall. Total fleet=5.73m TEU (1,903 ships) to 6.6m (2,052). (5-14) NYK, MSC, APL, CP ships, CMA-CGM, MOL, KKK, Hanjin, Hapag-Lloyd, and Maersk; each port range has 3-8 routes. (15) KKK; (16) Hanjin.

As shown (Table 2), *high concentration* observed in cases 3, 12 and 13; *oligopoly* found in 9. Also, *2008-9 depression raised concentration and intensified mergers (2009)*. *All container operators increased their capacity (2006-2007; in TEUs)*. *A high concentration exists in all, but one carrier in 8-top-ports-range*. For 27-top-port-range concentration *fell* below 1800 for 8 carriers, with the exception of KKK and Hanjin. When 27-port-range reduced to 8, *concentration increased*.

7.3 The CRn concentration ratio

Table 3 presents the 4-firm CR (concentration ratio):

Table 3: CRn in Containerships; comparison with Air Transport, 1998-2010

CR4 containers %	33	CR20 containers %	69	Source: author
CR4 <i>air transport</i>	34	CR20 <i>air transport</i>	73	Besanko et al (2010)
CR4 slot 2002	41	CR10 2002	72	Lam et al (2007)
CR4 slot 1998	43	CR10 1998	75	Ibid (transpacific)
CR4 2002	40	CR10 2002	73	Ibid (Europe-Far East)
CR4 1998	37	CR10 1998	68	""""
CR4 2002	52	CR10 2002	79	Ibid (transatlantic)
CR4 1998	44	CR10 1998	69	ibid

Table 3, indicates that container markets are in 6 cases (CR4) plus 2 (CR10) *more concentrated* than in air transport. Concentration increased between 1998 and 2002 in all routes. Worth noting is that the CR4 = 30% is recorded in refining petroleum (131 companies). The CR4=65% for Canada draws the antitrust interest of the state.

7.4 Concentration in alliances

The CHKY/CKHY/Ming-Hanjin (+Kawasaki and Yang) alliance had a *high concentration* (HHI=1,830). Moreover, *those not participating in any strategic alliances*, had a lower HHI

(Maersk=1,015; MSC=969). Lower *HHI* recorded also in the 27-top-port-range. *Alliances increased concentration and monopoly power.*

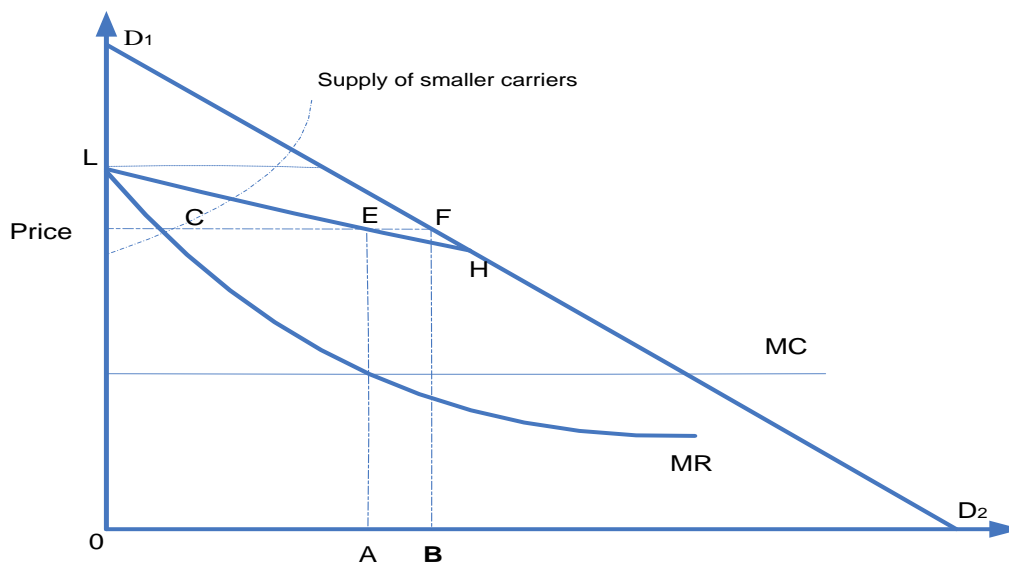
8. Our Model of Oligopoly Proposed in Containership Markets

In monopoly, it is well known in literature, that *one* firm faces *little or no competition* in its output market; this little competition now comes from ‘fringe firms’ that collectively account for no more than 30%-40% of market’s share. Moreover, these firms do not threaten monopolist’s market share (Besanko et al, 2010).

In fact we want to apply this monopoly model to containership market, but changing it into an oligopoly model. In containerships, in a metaphor, we assume that a number of firms act as oligopolies, having 60%-70% share in container markets, together with a number of other small firms acting as ‘price takers’-meaning that they face competition. This mixed oligopoly-competition model, we reckon obscures research as to what exactly is happening in container shipping.

Nine containership companies gained \$121b (2008), having an aggregate total share in fleet capacity of 64%, as mentioned above. These 9 carriers (AP Moller-Maersk, CMA CGM, Hapag-Lloyd, APL, Hyundai, Hanjin, NYK, CSAV and Zim) are oligopolies, with also a revenue share of 71% (59% share in the TEUs carried). Figure 11 presents the model diagrammatically.

Figure 11: A group of oligopolies and fringe competitive firms



Source: inspired by Besanko et al (2010).

D_1D_2 is the demand of shippers for containership services. Oligopolies produce OA , satisfying the greater part of total demand ($LEHD_2$). The smaller carriers –the fringe firms- produce AB ($EF=PriceC$). Marginal cost is assumed constant and less than AC (not shown here), due to *strong existing economies of scale*. Oligopolies maximize profits at $MR=MC$ at OA and charge $OPrice$, which is less than the *monopoly price*. This means there is no monopoly here.

The smaller carriers “charge” 0Price too, and are *price-takers*. Average revenue was \$2,381/TEU for Hyundai (2008). Oligopoly group on *average* charged \$1,835/TEU. The smaller group charged \$872 on average. “Oligopoly power” gained an extra ‘bonus’ of \$963/TEU to the leader.

9. Conclusions

Container shipping run 4,259 ships (145m TEU; 2008) to make *globalization* successful and *par excellence* in the areas of Asia (37% of all TEU handled was in Far East ports; 2008), N America, W Med, M East and N Europe. It helped economic development transporting products of *manufacturing* and *handcraft* industries, in innovative unit-boxes since 1956. China and India maintained a serious share in containership traffic and represented a persistent drive-force for recovery (after 2009), where 222m TEUs handled in the ports of Far East, SE and S Asia.

Containerization, to cope with globalization, organized network services round the world and door-to-door ones. It applied economies of scale (1972-2007)⁵⁶ building 16000 TEU ships, which have increased to 18,270 by 2013, cutting the \$ cost/TEU (\$350) almost in half (since 2006); M&A in non-periodic waves recorded in US container markets (1969-2006); M&A in US were made under the pressure of recessions/depressions and the emerging antitrust legislation.

Alliances increased sizes; formed to achieve entry into new markets, sharing risk and investment cost, increasing frequency and geographical coverage, achieving economies of scale in ships and in company’s size, and improving planning and coordination in global scale. Carriers pursued also growth and assumed higher sizes over the years, with Maersk and MSC being protagonists.

Container firms, as a conclusion, seek to *make up their deficiencies*, or *increase their competitive advantage*, by ‘acquiring’ or combining, permanently, or temporarily, what others have; their main target is to *increase economies of scale, economies of scope, and efficiency*. But there are also other targets: improved information, better marketing, higher quality, and wider market coverage. When firms do not value high their autonomy (Maersk; MSC), they turn to strategic alliances with a target of *improving* the organization of complex business transactions in a collective manner.

Maritime economists failed to determine the true model for industry, regressing from *game to contestability theories*, to *SCP*, to *duopoly*, to *Porter’s model* and to monopolistic competition, following the developments in ‘industrial organization’ theory. Monopolistic competition quite recently was proposed (2011). Contestability rejected on the grounds of high capital requirements, high sunk costs and shipping cycles. Moreover, containerships (2010) lost 50% of their 2007 value of \$60m. Depression in containerships caused \$20b loss (2009). Stable containership freight rates is a memory of the past (1993-1996); rates rose to \$44,000 per month (2005), fell to \$5,000 (2009), vis-à-vis \$25,000 (1993).

Evidence for oligopoly in container markets recorded when a lesser number of carriers, caused higher freight rates (LDC). Similarly, in the case of Caribbean market (2008). LI found for industry 0.16; this excludes perfect competition as well monopoly. One carrier (Hyundai)-the most efficient being a leader- had LI 0.38 and 0.46 (2008; 2009). Elasticities of demand for the same firm, at equilibrium, were 2.20 and 2.63. These results led us to work a ‘model of oligopoly’ for containership market. Carriers distinguished in two groups:

⁵⁶ 145 ships over 10,000 TEU will appear by 2014 on top of 42 existing in 2010 (1st April) of 1.8m TEU.

influential oligopolies (9 carriers), having 60%-70% of market share, and price-takers (8 carriers), having a 30%-40% share. Maersk and MSC were naturally in the first group being protagonists of the industry.

HHI calculated to check the degree of concentration in the market using various variables. Our general conclusion is that 'the larger the sample, the smaller the concentration'. Twenty four carriers (63%) showed a high HHI of 1,777.5~1,800 in revenue (2009). Four carriers showed *oligopoly* with $HHI=0.315>0.2$ in 2002 (a recession).

When carriers were combined with their *calling ports*, concentration rose *vertically*; "the less ports included, the higher the concentration was". For 10 carriers over 8-top-port-range (2006), HHI varied from 1,767 (Maersk) to 2,399 (MA-CGM) and in 27-top-port-range KKK had $HHI = 1,880$ and Hanjin = 1,831. Among alliances, KHY/Ming-Hanjin, Kawasaki and Yang (2006) had $HHI=1,830$. So, *alliances boost concentration*. Interesting finding was the concentration among ports, in which carriers *have invested*: seven carriers (2005) had the highest HHI from 3,035 to 6,746 in such a situation...

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