Universiteit Antwerpen
UNIVERSITEIT GENT
FACULTEIT ECONOMIE EN BEDRIJFSKUNDE

INSIDE THE BOX: ASSESSING THE COMPETITIVE CONDITIONS, THE CONCENTRATION AND THE MARKET STRUCTURE OF THE CONTAINER LINER SHIPPING INDUSTRY

DISSERTATION

Submitted at Ghent University

to the Faculty of Economics and Business Administration

in fulfillment of the requirements for the degree of Doctor in Applied Economics

and

submitted at University of Antwerp

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by

CHRISTA SYS

Supervisors:
Prof. dr. E. Omey (UGent)

Prof. dr. E. Van de Voorde (UA)

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Acknowledgement

Working on my doctoral thesis I often felt somewhat like Eliza Doolittle in *My Fair Lady*, which is based on George Bernard Shaw's *Pygmalion*. Ever so often I used to compare my supervisors with Colonel Pickering and Professor Higgins, as they made me pass a series of trials. As my first public try-out I was asked to present a paper at a national conference, viz. the BIVEC-GIBET Transport Research Day (Diepenbeek, 2005). Subsequent trials included attending the Advanced Industrial Economics and Econometrics courses as well as participating in international conferences such as the Maritime Transport III (Barcelona), the NECTAR Conference (Porto), the IFSPA (Hong Kong), and the WCTRS (Lisbon).

Now I have crested the foothill, as it were. And I must admit that it feels great. This leads me to a comparison in mountaineering terms, in particular, an expedition to the top of Mount Everest. The trek to Everest Base Camp is not unlike getting to know the (container) liner shipping industry. At the beginning of 2008, it was decided to descend back to base camp I and search for a different climbing route with state-of-the-art climbing equipment (i.e. new empirical industrial models). The trail from camp I (first publication) to camps II, III and IV was one of ups and downs and I had to pick myself up again and again. The rejection of a paper of mine was my Hilary Step, a steep spur of rock and ice that is the final obstacle above which it is comparatively easy to reach the top. Even though writing a doctoral thesis - like climbing Mount Everest - is a highly individual activity, it requires a professional team. My Mount Everest expedition was led by Prof. dr. E. Omey and Prof. dr. E. Van de Voorde, two well-experienced elite 'mountaineers' and experts in their own field. Other academic and professional experts guided and supported me throughout this process.

Enjoy your meal. In cooking I found another parallel. The widely popular reality TV cooking shows often served as a background while I was writing the thesis. Preparing a PhD is like searching for new recipes. As soon as you decide on the menu (research domain) the practicalities of cooking come into play: looking for the ingredients (data), opting for a cooking technique (methodology), selecting equipment (Ms Excel, statistical software E-views 7), consulting a cookery book to solve practical questions (*Silver Spoon* and *Ons Kookboek* are the bibles of authentic Italian and Flemish cooking respectively, the second edition of Industrial Organization - Competition, Strategy and Policy by Lipczynski, Wilson and Goddard, was my bible), but also asking specialists for advice (field research: in-depth interviews with people from the work field, viz. carriers, forwarders and liner shipping customers, associations, port authorities, and academic specialists).

First, I like to thank my two master chefs, Prof. dr. Eddy Omey, specialist in Social Economics (Supervisor Ghent University, Faculty of Economics and Business Administration, Department of Social Economics, Ghent University) and Prof. dr. Eddy Van de Voorde, internationally renowned expert in transport studies (Co-supervisor Ghent University and Supervisor University of Antwerp, Faculty of Applied Economics, Department of Transport and Regional Economics). The combination of both expertises was beyond any doubt an added value for my doctoral research. I gained a lot from their encouragement, invaluable guidance and attention throughout the study. A joint PhD degree would not have been possible without their limitless support.

Secondly, a twice yearly tasting of my research activities was organised. These doctoral commissions led to fine-tuning the recipe, looking for extra ingredients/ spices, and they provided cooking tips and hints (i.e. presenting my study in a series of lectures). Both Prof. dr. E. Omey and Prof. dr. E. Van de Voorde were members of my doctoral commission, together with two other gastronomes: Prof. dr. Gust Blauwens (University of Antwerp, Faculty of Applied Economics, Department of Transport and Regional Economics) and Prof. dr. Frank Witlox (Ghent University, Faculty of Science, Geography Department). I would like to give special thanks to them for their advice, support and helpful comments.

I would also like to express my gratitude to the external members of the Examining Committee. I wish to express my sincere respect for the helpful comments and assistance on econometric issues I was given by Prof. dr. H. Meersman. During many constructive discussions her enthusiasm reminded me why I had initially started to study applied economics and it encouraged my interest in empirical research. I thank Prof. dr. J. Bikker for his contribution to a deeper understanding of the new empirical industrial models and his constructive criticism at the final stage of preparation, and Prof. dr. N. Litinas for his knowledge and expertise in the area of international liner shipping and the special attention he gave to my research project.

Over the past few years, many people have helped me take this dissertation from idea to reality. I am in debt to liner operators, national/ international associations, port authorities, port consultants, terminal operators, forwarders and liner shipping customers as well as to national/ international journalists of the maritime press. I would like to thank these people as well as numerous academic specialists (from Belgium, Canada, Italy, The Netherlands, and the USA) for their time and their practical input. These expert interviews helped me to write this doctoral thesis and provided me with a clear view of the container liner shipping industry. Any one I have failed to mention here I shall thank personally in due time.

I would like to thank the anonymous referees of international peer reviewed journals and the participants in international conferences for their useful comments. I am also grateful for the comments received from friend-reviewers regarding the clarity and the logical line of the text.

I am obliged to the directors of the University College of Ghent as well as the heads of the Faculty of Applied Business for withdrawing my dismissal that would have jeopardised this doctoral research, for their generosity in letting me attend conferences that enriched this period even more and for the financial support, from June 2007, from the Research Fund University College of Ghent.

Many colleagues have supported me patiently during the past few years. Special appreciation is due for my coordinators, for my language-lecturer colleagues for proofreading, for my ICT colleagues for developing my website and for assisting me in practical lay-outing matters.

Thanks are also due to the staff of the library of the University of Antwerp, the Port of Antwerp, and the Faculty of Applied Business, University College of Ghent for keeping me informed about the latest publications. I would like to thank all secretarial staff (Hogent, UGent and UA/ TPR) for their administrative support.

My friends have remained close to me along the way. I thank them dearly for their encouragement. They have shared the ups and downs, they have coped with my presence and absence during the writing of this doctoral thesis.

Finally, I would like to thank my sister, brother in law and my two adorable nephews, and above all, my parents for offering me so many opportunities, for their patience, their practical help (i.e. good meals, gardening, etc), their encouragement and their endless support. It has been of incalculable value to me.

I sincerely hope that this doctoral thesis will be of some interest to the reader and constitute a significant contribution to scientific research.

Bruges, December 10th, 2010

Christa Sys

Samenvatting

CONTAINERLIJNVAART IN BEWEGING

De containerlijnvaart, een snel groeiend segment van de lijnvaart, is de afgelopen decennia sterk veranderd. Deze verandering is toe te schrijven aan de opeenvolging van fusies en overnames binnen de sector. Deze opmerkelijke fusie- en overnamegolf kan de graad van concentratie beïnvloeden. Ook ontwikkelingen zoals de recente schaalvergroting van de containerschepen, de veranderende vraagpatronen, de verhoogde verticale integratie en het toenemende belang van integrale logistieke concepten etc. hebben een grote impact gehad op de sector. Het is belangrijk om de gevolgen van deze veranderingen op het competitief gedrag van de marktspelers in kaart te brengen en te onderzoeken wat die impact precies inhoudt.

Het competitieve gedrag van marktspelers hangt af van de marktstructuur. Het kennen van de marktstructuur is een belangrijk gegeven voor bv. de prijszetting. Marktstructuren variëren tussen twee uitersten. Aan de ene kant bevindt zich de perfecte concurrentie, aan de andere kant de monopolie en daartussen zitten de monopolistische concurrentie en de oligopolie. De literatuurstudie levert voor de marktstructuur van de containerlijnvaart geen eenduidig antwoord.

Naast de introductie van stoomschepen en containers is vanuit een historisch perspectief de afschaffing van de lijnvaartconferentie een mijlpaal voor deze industrie. Sinds jaar en dag bestaan er conferenties (maritieme kartelvorming) in de maritieme sector waarvan de eerste teruggaat tot 1875. Het belangrijkste doel van deze conferenties bestond erin een einde te maken aan de moordende concurrentie door gezamenlijk de tarieven vast te leggen voor het vervoer door de deelnemende rederijen.

Op 25 september 2006 trok de Verordening (EG) nr 1419/ 2006 van de Europese Raad de generieke vrijstelling voor bepaalde mededingingsbeperkende regelingen door lijnvaart-conferenties, met name het maken van prijsafspraken en het regelen van het aanbod (nr 4056/ 86), in. Alle belanghebbende stelden zich de vraag of deze beleidsverandering het beoogde effect, met name een toename van de concurrentie, met zich zou meebrengen. Om de impact van deze beleidsverandering correct in te schatten, is het belangrijk om de concurrentiegraad vóór de beslissing te kennen.

De wetenschappelijke literatuur onderscheidt twee benaderingen, namelijk de structurele en de niet-structurele benadering. De literatuurstudie van de

containerlijnvaart toont ook aan dat het competitief gedrag van rederijen in de containerlijnvaart onvoldoende is verkend, in tegenstelling tot andere geliberaliseerde industrieën. De literatuur van andere geliberaliseerde industrieën, vooral de financiële sector, stelt zelfs een nieuwe methodologie voor om de concurrentie te meten. De evolutie van de Industriële Economie (structurele benadering) naar de Nieuw Industriële Empirische Economie (niet-structurele benadering) biedt een bijkomend instrument om de graad van de concurrentie voor de containerlijnvaart te onderzoeken.

AFBAKINGEN VAN HET ONDERZOEK

Tegen deze achtergrond richt dit onderzoek zich dan ook op de competitieve condities, de concentratiegraad en de marktstructuur van de containerlijnvaart. Dit onderzoek wil een antwoord formuleren op twee onderzoeksvragen. De eerste onderzoeksvraag gaat na *in hoeverre de concentratiegraad gevolgen heeft voor de mate van concurrentie en de marktstructuur van deze sector*. Deze vraag wordt zowel vanuit een industrieel-economische als vanuit een nieuw-industrieel-economische benadering bestudeerd. De tweede onderzoeksvraag bestudeert *in welke mate de positieve relatie tussen concentratie en winstgevendheid opgaat voor de containerlijnvaart*.

Om deze vragen te beantwoorden focust het onderzoek zich op de lijnvaart, meer specifiek op de subdivisie containerlijnvaart. De containerlijnvaart telt in 2010 ongeveer 400 rederijen. In het onderzoek ligt de focus op de 100 grootste rederijen. Het marktaandeel van de rederijen in het segment 101-400 wijzigt de concentratiegraad slechts voor het vierde cijfer na de komma. Het weglaten van deze lager gerangschikte rederijen beïnvloedt dus het beeld niet van de concentratie in de industrie.

Dit onderzoek heeft betrekking op de periode 1999-2009. De periode varieert afhankelijk van de gebruikte methodologie en de beschikbare data. Via desk- en fieldresearch (gesprekken met bevoorrechte getuigen) werden de nodige gegevens verzameld. De omvang van het onderzoek is ook beperkt tot de kernactiviteit van de rederijen, namelijk het transporteren van zeecontainers tussen zeehavens (carrier haulage), eerder dan op de logistieke activiteiten. Ondernemingen zonder schepen (non vessel operating common carrier), expediteurs (merchant haulage) en logistieke dienstverleners worden als gebruikers en niet als concurrenten beschouwd en werden buiten beschouwing gelaten. Het transport van een container wordt als een homogeen product beschouwd. Deze veronderstellingen kunnen een impact hebben op het competitieve gedrag en op de conclusies van het voorliggend onderzoek. Jammer genoeg zijn er geen gegevens beschikbaar om de impact hiervan te bestuderen. De impact van de fusie van Maersk Sealand en P&O Nedlloyd (2006), een terugkerend onderwerp, komt daarentegen wel duidelijk naar voren in de resultaten van het onderzoek.

Het proefschrift bestaat uit een bundeling van papers. De rode draad is het competitief gedrag, de concentratiegraad en de marktstructuur van de containerlijnvaart. Achtereenvolgens wordt er stilgestaan bij de gebruikte methodologie en de resultaten.

ONDERZOEKSVRAAG 1 - METHODOLOGIE

De eerste twee papers formuleren een antwoord op de eerste onderzoeksvraag. Hiertoe wordt de structurele benadering toegepast. De structurele benadering meet de invloed van de marktstructuur op de winst via het concurrentiegedrag. Voor dit onderzoek werden zowel absolute (de n-concentratie ratio (CRn) en de Herfindahl-Hirschmann Index) als relatieve (de Lorenzcurve) indicatoren van concentratie berekend en geanalyseerd.

In de eerste studie (hoofdstuk 2) zal in het kader van de eerste onderzoeksvraag de analyse op geaggregeerd niveau gebeuren, terwijl de tweede studie (hoofdstuk 3) de analyse van de marktstructuur op gedesaggregeerd niveau herhaalt. Intensieve concurrentie vertaalt zich in instabiliteit van de marktaandelen. Deze instabiliteit van de marktaandelen werd berekend aan de hand van een index voorgesteld door Hymer en Pashigan. Deze beschrijving en analyse van de marktstructuur gebeurt zowel op het niveau van de markt (over alle routes heen) als op het niveau van de deelmarkten (per route) (hoofdstuk 2 en hoofdstuk 3).

In het vierde hoofdstuk wordt de eerste onderzoeksvraag opnieuw bestudeerd. Ditmaal wordt een niet-structurele benadering toegepast die rechtstreeks de marktmacht van een sector analyseert. Deze moderne Industriële Organisatie theorieën laten toe om structurele- en gedragselementen te combineren. Zij modelleren het competitieve gedrag van ondernemingen zonder expliciete informatie over de marktstructuur te gebruiken. Zo’n benadering modelleert het competitief gedrag van containerrederijen zonder expliciete informatie over de concentratie op te nemen.

De Panzar Rossemethodologie is een empirische test die toelaat een onderscheid te maken tussen de diverse marktvormen. Met behulp van standaard econometrische methoden wordt de Panzar-Rosse H-statistiek berekend. Deze Panzar-Rosse H-statistiek, zijnde de som van de elasticiteiten van totale opbrengsten ten aanzien van de inputprijzen, laat toe om de competitieve aard van de containerlijnvaart te beoordelen. De niet-structurele modellen werken met opbrengsten- en kostendata. Deze data zijn echter niet beschikbaar voor de deelmarkten. De Panzar Rossemethodologie wordt op het niveau van de markt toegepast, dus gebaseerd op de veronderstelling dat het concurrentiegedrag hetzelfde is over alle routes heen.

ONDERZOEKSVRAAG 1 – RESULTATEN

Uit het onderzoek blijkt dat de containerlijnvaart een gefragmenteerde industrie is. De vier grootste containerrederijen, Maersk Line, MSC, CMA CMG en Evergreen hadden op 1 januari 2010 een gezamenlijk marktaandeel (CR4) van 37,56 % procent, gemeten in TEU-capaciteit (hoofdstuk 1, appendix 1-2). Afhankelijk van de bron wordt een CR4 van 40 % of een CR6 van 50 % naar voren schoven als grenswaarde tussen een monopolistische concurrentie (CR4 < 40 %) en een oligopolistische marktstructuur (CR4 > 40 %). Ongeacht de grenswaarde kan de marktstructuur van de containerlijnvaart tot 2007 omschreven worden als monopolistische concurrentie, nadien een oligopolistische marktstructuur (hoofdstuk 2). Het resultaat van de marktstudie op de deelmarkten geeft aan dat de concentratiegraad verschilt van route tot route. Routes kunnen op basis van de concentratie-indicator ingedeeld worden in ‘tight’ (CR4 > 60 %) en ‘loose’ oligopolistische deelmarkten. Kennis hiervan is belangrijk voor de prijszetting maar ook voor regelgevinginstanties (hoofdstuk 2 en hoofdstuk 3).

Alle concentratie-indicatoren wijzen op een toegenomen concentratie. Volgens de structurele benadering wordt impliciet aangenomen dat een meer geconcentreerde markt minder concurrerend is. Echter, bij agressieve interactie van de rederijen kan een positieve relatie vastgesteld worden.

Een structurele methodologie om de concurrentiegraad te meten is de Hymer-Pashigan instabiliteit index. De studie van de instabiliteit van de marktaandelen toont twee zaken aan. Ten eerste is de concurrentie op marktniveau relatief stabiel, terwijl op de deelmarkten de concurrentie duidelijk verschilt van route tot route (hoofdstuk 2 en hoofdstuk 3). Vervolgens werd de empirische relatie tussen concentratie en Hymer-Pashiganindex geanalyseerd. Onderzoek suggereert een omgekeerde U-curve. Bij lage tot gemiddelde concentratie is de relatie positief. Indien de concentratie verder stijgt, wordt het verband negatief. Het omslagpunt tussen het positieve en het negatieve verband situeert zich op ongeveer 36 %. De analyse op het niveau van de deelmarkten resulteert in een negatief lineair verband tussen concentratie en de Hymer-Pashiganindex. Verder blijkt dat groei (in volume uitgedrukt) een significante impact heeft op de dynamiek van marktaandelen (hoofdstuk 3).

Na de bespreking van de resultaten van de structurele benadering wordt vervolgens overgegaan naar de resultaten van het Panzar Rossemethodologie. Op basis van bedrijfsspecifieke data van 18 containerrederijen werd nagegaan in welke mate input- en outputprijzen gelijk opgaan (volkomen mededinging) of niet gelijk opgaan (monopolie of een perfect kartel). Een gereduceerde niet-geschaalde opbrengstvergelijking werd gebruikt om een H-statistiek voor de containerlijnvaart te berekenen. Naast de inputprijzen werden als controlevariabelen de verhouding tussen het eigen vermogen en de totale activa en de verhouding tussen TEU-capaciteit en het aantal schepen gebruikt.

De eerste controlevariabele weerspiegelt het gedrag en het risicoprofiel van de containerrederijen, de tweede controlevariabele het business profiel. Daarnaast zijn nog twee andere bedrijfsspecifieke factoren opgenomen om de impact van de fusies en overnames enerzijds en betrokkenheid in strategische allianties anderzijds op de outputprijzen in rekening te brengen. Dit kan econometrisch getoetst worden door het toevoegen van twee dummyvariabelen. De regressie leverde significante coëfficiëntschattingen met het verwachte teken op en heeft een hoge verklaringswaarde.

Verschillende regressies werden uitgevoerd. De belangrijkste bevinding van de niet-structurele benadering is dat de beduidend positieve waarde van de H-statistiek betekent dat de hypothese verworpen kan worden dat de marktstructuur van de containerlijnvaart beantwoordt aan een monopolie of collusieve coöperatie (wat de facto neerkomt op een niet-getolereerde samenwerking). De hypothese dat H gelijk is aan 1 (perfecte concurrentie) kan verworpen worden op het 0,10-significantieniveau. De resultaten suggereren dus een monopolistische concurrentie binnen de sector. Over dezelfde onderzoeksperiode wijken de resultaten van de structurele en niet-structurele benadering niet van elkaar af.

Het onderzoek levert nog enkele interessante bevindingen op. Een opmerkelijke bevinding is dat rederijen betrokken in strategische allianties als samenwerkingsvorm er niet in slagen om toegenomen kosten te vertalen in meer opbrengsten. Een andere interessante bevinding is dat het effect van fusies en overnames zich het duidelijkst manifesteert in de twee daaropvolgende jaren.

ONDERZOEKSVRAAG 2 - METHODOLOGIE

De Panzar Rossestatistiek kan de competitieve aard van de sector aanduiden maar kan de concurrentie en de efficiëntie in de sector over de tijd niet beoordelen. Verder neemt de concurrentie toe ofwel door een afname in de toetredingskosten ofwel door agressievere interactie tussen bedrijven. Agressiever gedrag wordt door de concentratie-indicatoren niet consistent gemeten.

De Boone-indicator laat echter wel toe om de concurrentie over de tijd te meten en deze ook op een consistente manier te meten. Met consistent wordt bedoeld dat een toename in concurrentie veroorzaakt door lagere toetredingskosten ofwel door agressievere interactie tussen bedrijven, altijd leidt tot een toename in de winst van een efficiënt bedrijf ten opzichte van de winst van een minder efficiënt bedrijf. De Boone-indicator onderzoekt dan ook de relatie tussen efficiëntie en prestatie. Bedrijven verschillen in efficiëntie in termen van marginale kosten. Aangezien in elke industrie een toename van de kosten zorgt voor een lagere winst, wordt een negatief verband verwacht. Het effect zal groter zijn in een meer concurrerende markt. Met andere woorden, de concurrentie zal sterker zijn in markten met efficiëntere bedrijven (dus grotere winsten en marktaandelen) dan in markten waarin deze relatie tussen efficiëntie en prestatie minder sterk of niet aanwezig is (hoofdstuk 5).

Deze nieuwe manier om concurrentie te meten laat toe een antwoord te formuleren op de tweede onderzoeksvraag.

ONDERZOEKSVRAAG 2 – RESULTATEN

Om een antwoord te formuleren op de tweede onderzoeksvraag schatte deze studie in navolging van de studie van Bikker en van Leuvensteijn (2008) de relatie tussen de prestaties (in termen van marktaandelen) en de efficiëntie (gemeten als gemiddelde kosten) op bedrijfsniveau over de periode 2000-2008. Volgens de schatting zijn bedrijfspecifieke elementen belangrijk. Om de indicator nauwkeurig te schatten werden het aantal diensten (services) en de gemiddelde scheepsgrootte (grotere schepen genieten schaalvoordelen – zie verder) als verklarende variabelen toegevoegd.

Diverse resultaten komen uit de empirische analyse te voorschijn. De Boone-indicator duidt op een procentuele daling van de winst als gevolg van één procentpunt toename van de kosten. Dus een geschatte Boone-indicator of winstelasticiteit van -0,1669 voor 2008 suggereert dat een containerrederij met 1 procentpunt hogere gemiddelde kosten dan efficiëntere rederijen 16,7 % minder winst realiseert. Tijdens de periode 2000-2008 suggereren de resultaten een (beperkte) toename van de concurrentie. De resultaten bevestigen dat de grootste rederijen in de periode 2002-2003 winsten realiseerden terwijl in de daaropvolgende periode de concurrentie versterkte. De geïntensifieerde concurrentie dwingt de concurrerende rederijen om lage prijzen te hanteren. De resultaten moeten met enige omzichtigheid benaderd worden. Een langere tijdsperiode en een onderzoek op het niveau van de deelmarkten kan nauwkeuriger resultaten opleveren. Uit een studie op het niveau van de deelmarkten kunnen ook de redenen voor de kennelijk beperkte concurrentie naar voren komen.

De bedrijfspecifieke variabelen hebben beide een beduidend positief en significant effect. Zo'n resultaat kan als volgt geïnterpreteerd worden: In tegenstelling tot inefficiënte rederijen worden efficiënte rederijen met een technologisch voordeel (lagere operationele kosten door het inzetten van grotere schepen) en een uitgebreid dienstennetwerk beloond met hogere winsten. In een concurrerende markt worden inefficiënte rederijen gedwongen om de markt te verlaten. Dat is nauwelijks het geval in de containerlijnvaart (Cho Yang, 2001, Senator Lines, 2009 en MBG Shipping, 2010). Gezien de eerder beperkte concurrentie worden inefficiënte containerrederijen nog teveel beschermd tegen de meer efficiënte rederijen.

Ten slotte werd een dummyvariabele toegevoegd om het gedrag te bestuderen van rederijen betrokken in een alliantie. De resultaten suggereren dat rederijen binnen een alliantie niet noodzakelijk efficiënter zijn in termen van winsten (e.g. te bureaucratisch?, tragere beslissingsvorming?).

Algemeen kan gezegd worden dat de sector efficiënter moet worden om hogere winsten te realiseren. Naast de rederijen en de verladers is dit onderzoek voor beleidsbepalers ook relevant. De Boone-indicator is een interessante tool voor (pro-/ re-) actief mededingingsbeleid. De onderzoeksresultaten leveren een benchmark om de impact van (toekomstige) beleidsbeslissingen te evalueren (bv. de impact van de afschaffing van lijnvaartconferenties zou aan de hand van de Boone-indicator geëvalueerd kunnen worden.

Het voorliggende onderzoek slaagt erin de onderzoeksdoelstellingen te realiseren en de onderzoeksvragen te beantwoorden. De laatste twee studies gaan een stap verder door een verklaring te zoeken voor de verkregen resultaten.

VERKLARING 1 - TOEGANGSBARRIERES

Ook toegangsbarrières bepalen voor een groot deel de structuur van de sector. Hoofdstuk 6 bestudeert de impact van zowel actuele als potentiële bedreiging van toetreding op de winst. Een dynamisch winstonderzoek houdt een tijdreeksanalyse in van de winst op bedrijfsniveau in en laat toe een idee te krijgen van de competitiviteit binnen de sector en het al of niet bestaan van toegangsbarrières. Doordat de impact van actuele en potentiële toetreding niet direct waarneembaar is, wordt de afhankelijkheid van winstgevendheid van een containerrederij geschat in functie van de winstgevendheid in het verleden.

In navolging van de 'Persistence of Profit' literatuur wordt dus ingegaan op de vraag of de winsten in de containerlijnvaart persisteren. Vijf belangrijke conclusies volgen uit deze regressieanalyse. Eerst wordt nagegaan welk percentage van de winst in elke periode voor periode *t* persisteert op korte termijn. De resultaten tonen een positief en significant verband, 'the persistence of profits above the norm', voor onafhankelijke rederijen (bv. Maersk Line, CMA CGM) terwijl de resultaten voor de CHKY alliantie[1] duiden op een gebrek aan samenhang tussen de winstgevendheid over de jaren.

Een tweede conclusie voegt hieraan toe dat de (over-)winsten van onafhankelijke rederijen trager afromen (convergeren naar de normale (gemiddelde) winst) dan die van rederijen die binnen een strategische alliantie werken. De winst van een containerrederij kan enerzijds worden afgeroomd doordat gevestigde rederijen hun productie (uitbreiding servicenetwerk, uitbreiding capaciteit) uitbreiden ofwel door de toetreding van nieuwe rederijen. Dit is een eerste aanwijzing van het bestaan van toegangsbarrières.

Vervolgens werd de hypothese getoetst of actuele en potentiële toetreding voldoende vrij is waardoor de (over-)winsten op lange termijn afbrokkelen (convergeren) naar de normale winstniveau. De hypothese wordt geaccepteerd in een winsteliminerend scenario voor alle rederijen. Voor de containerlijnvaart suggereren de resultaten dat de (over-)winsten van rederijen die buiten de allianties werken niet convergeren naar het

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[1] De regressies konden niet uitgevoerd worden voor Hapag-Lloyd en HMM. Hierdoor kan geen uitspraak geformuleerd worden voor de 'Grand Alliance' en de 'New World Alliance'.

normale winstniveau. De hypothese wordt op basis van deze resultaten verworpen. Er blijven permanente verschillen bestaan. De relatieve winstafwijking van Maersk Line en CMA CGM ten opzichte van het gemiddelde is respectievelijk 2,89 % en 3,54 %. Dit is een tweede aanwijzing dat er in de containerlijnvaart toegangsbarrières bestaan. De hoogte van de toegangsbarrière bepaalt de mate van dreiging tot toetreding. Een gedetailleerde analyse van de België-India route bevestigt het bestaan van toegangbarrières, maar deze zijn eerder laag. Verder ontwikkelde Mueller (1986) twee modellen voor de verklaring van de winstverschillen. De beschikbare data laten echter niet toe om deze modellen toe te passen.

De resultaten uit dit dynamisch onderzoek tonen ook aan dat de rangschikking op basis van 'persistence of profits' verschilt van de rangschikking op basis van marktaandeel. Dit laatste kan wijzen op een marktgerichte strategie van behoud van marktaandeel. Daarnaast suggereren de resultaten dat rederijen in strategische allianties hun winsten uit het verleden niet weten te behouden. Ten slotte duiden de resultaten op een snellere eliminatie van de (over)winst in de containerlijnvaart ten opzichte van andere industrieën. (hoofdstuk 6).

VERKLARING 2 – SCHAALVOORDELEN

De kans dat nieuwe toetreders de markt betreden hangt af van de reactie van bestaande concurrenten op de nieuwkomer en de bestaande toetredingsbarrières. Een belangrijke toegangsbarrière is de aanwezigheid van schaalvoordelen. Hoofdstuk 7 concentreert zich op een andere factor die de efficiëntie van een rederij uitmaakt, namelijk de aanwezigheid van schaalvoordelen.

Optimale schaal wordt bepaald door de vorm van de gemiddelde-kostencurve op lange termijn. Na het inventariseren van de drijfveren achter deze schaalvergroting wordt de gemiddelde kost per eenheid aan de hand van een cashflowmodel gesimuleerd bij verschillende scheepsgroottes. De resultaten van deze simulaties tonen duidelijk aan dat containerrederijen nog schaalvoordelen kunnen realiseren door het inzetten van (ultra-) grote containerschepen. Het minimum van de gemiddelde kostencurve nadert misschien maar is vooralsnog niet bereikt. In deze studie werden kosten van een feederingsysteem en de hinterlandkosten niet ingecalculeerd. Deze laatste kosten kunnen ervoor zorgen dat de gemiddelde kosten curve sneller een U-vormige curve wordt. De link met het operationele gebeuren werd ook bestudeerd. Scheepsgrootte en het operationele ontwikkelingen (bv. grotere containerkranen) evolueren hand in hand. De keuze van scheepsgrootte is duidelijk afhankelijk van het transportsegment (deepsea of short sea shipping), het type van terminal, de route en de beschikbare technologie. Met technologie wordt bedoeld het feit of 18 000 TEU of 22 000 TEU-schepen gebouwd zullen worden (hoofdstuk 7). **RELEVANTIE VAN HET ONDERZOEK**

De resultaten van het onderzoek zijn relevant voor de rederijen. Kennis van de marktstructuur is een belangrijk gegeven voor bv. de prijszetting. De resultaten duiden op monopolistische concurrentie binnen de sector. Deze uitkomst moet de rederijen aanzetten tot geheel of gedeeltelijk differentiëren van hun aanbod.

Als regulatoren en mededingingsautoriteiten een gebrek aan concurrentie vrezen, worden zij aangemoedigd de analyse over de concurrentie te baseren op de uitkomsten van meerdere concentratie-indicatoren. Het oordeel van de klant (verlader) over de prijs en de kwaliteit van de containerdiensten mag hierbij niet vergeten worden.

Op grond van het voorgaande kan gezegd worden dat de resultaten van het onderzoek een belangrijke bijdrage kunnen leveren voor beleidsvoorbereidende discussies.

Summary

THE CONTAINER LINER SHIPPING INDUSTRY IN MOTION

The container liner shipping industry has been facing comprehensive restructuring, particularly over the past decade. It has been a period of significant merger and acquisition transactions. Successive waves of such consolidation are likely to have had an impact on the degree of concentration in the industry. In addition, the industry has undergone fundamental changes (e.g. deployment of ultra large container vessels, increased containerisation and integration, and the growing importance of integrated logistic concepts) that may have affected competition. In the wake of these developments, the liner operators have found themselves challenged to offer a worldwide container service network in order to meet the rising customer expectations, and to do so under competitive conditions. It is therefore of great interest to examine the impact of these changes on the competitive behaviour of the market players.

This competitive behaviour depends on the market structure. Knowledge of this structure is relevant because it influences the behaviour of the carriers operating under it. This behaviour in turn affects the liner operator's performance: price setting, profits, efficiency, etc. Micro-economic theory traditionally divides market structures into four categories, the two extremes of which are perfect competition and monopoly. The intermediate market structures are monopolistic competition and oligopoly. A review of the scientific literature as well as of various maritime reports and discussion groups, yielded no unequivocal answer regarding the market structure in the container liner shipping industry.

History shows that the liner shipping industry has been characterised by a number of profound changes, from the advent of steamship technology, the introduction of the container box in the early 1960s, the set-up of consortia and other operational agreements (1970 - 1980), to the formation of (global) alliances in the 1990s. From a historical point of view, the abolition of the European conferences (18th October, 2008) put the liner shipping industry on the threshold of a new era. International liner shipping has been dominated by collusive agreements, called shipping conferences, which trace their origins back 135 years. These conferences were formed for the purpose of restricting competition between their members and protecting them from outside competition. It was the industry's first attempt to deal with the pricing problem. However, on 25th September, 2006 the Competitiveness Council agreed, under the

pressure of Shippers' Councils, to repeal Regulation 4056/86 as of October 2008, thus putting an end to the possibility for liner carriers to meet in conferences, fix prices and regulate capacities. The two-year transitional period allowed the shipping companies to change their mentality from that of price fixing to a competitive one. From a policy viewpoint, a next logical step is to examine whether this change has the desired impact of increased competition. Therefore, it is mandatory to establish the degree of competition that was present before the policy change took place.

The literature distinguishes a structural and a non-structural approach. A review of the (container) liner shipping literature reveals that the assessment of competition in the container liner shipping industry has remained insufficiently explored, in contrast with that in other newly liberalised service sectors. In the literature of other liberalised industries, the financial sector in particular, it is found that a new methodology to measure competition has been introduced. The evolution of industrial organisation theory (structural approach) towards the new empirical industrial organisation modelling (non-structural approach) is an extra incentive for investigating the extent of competition in the container liner shipping industry.

THE RESEARCH SET-UP

This thesis assesses the competitive conditions, the concentration, and the market structure of the container liner shipping industry in the light of the developments mentioned above. It addresses two research questions:

RQ1 ***Is there an oligopoly in the container liner shipping industry?***

RQ2 ***If the container liner shipping industry is concentrated, does the concentration affect the liner operators' performance?***

These research questions are studied from an industrial economic and from a new empirical industrial economic viewpoint.

To answer these questions, the thesis examines the competitive conditions of the liner shipping industry, more specifically the containerised liner shipping industry. At present, in 2010, the container liner shipping industry counts approximately 400 shipping companies. The research focuses on the 100 largest companies. The market shares of the liner operators ranked in the 101-400 segment affect the degree of concentration only in the fourth decimal place at most. The lower-ranked carriers can thus be safely omitted without affecting the picture of the concentration in the industry as a whole. The research covers the 1999-2009 period. The methodology used and the availability of data require varied sample periods. The necessary data were collected by means of both desk and field research (collection of primary data or information through conversations with favoured witnesses). The scope of the research was restricted to the main activity of the shipping companies, namely transporting sea containers between sea ports (carrier haulage), rather than focusing on their logistical activities. For the purpose of this thesis non vessel operating common carriers, forwarding agents (merchant haulage) and logistical service providers were regarded as users rather than as competitors. The transport of a container is taken to be homogeneous. Although these assumptions may have an impact on the study of competitive behaviour and on the conclusions of the research, a lack of data unfortunately made it impossible to study this impact. However, the impact of the merger of Royal P&O Nedlloyd and Maersk Sealand (2006), a recurrent topic, clearly shows in the results of the research.

The thesis consists of a bundled set of papers with a common theme, linked by the competition issue. In what follows, the methodology and the results are summarised per research question.

RESEARCH QUESTION 1 - METHODOLOGY

The first two papers formulate an answer to the first research question. They use the structural approach to map the competition in the container liner shipping industry. The structural approach explains profits by means of market share variables. To do so, the empirical investigation uses both absolute (i.e. the n-firm concentration ratio (CRn) and the Herfindahl-Hirshman Index) and relative (i.e. the Lorenz curve) concentration measures to compute and analyse the degree of concentration. Chapter 2 calculates and discusses a number of alternative concentration measures as the magnitude of market share instability at aggregated level. Since liner operators compete with each other not only within the total container liner shipping market but also in sub-markets (read trade lanes), Chapter 3 elaborates on this issue at a disaggregated level, viz. the trade lane, and tests an empirical model for examining the determinants of market share instability. The magnitude of market share instability is calculated with the Hymer-Pashigan or instability index.

Since concentration measurements are ambiguous measures of competition, a non-structural model is introduced to collect empirical evidence on the nature of competition in the container liner shipping industry by observing conduct directly. Non-structural models do not depend on concentration. Chapter 4 documents and estimates the Panzar and Rosse model. Panzar and Rosse (1987) propose a reduced-form approach to discriminate between monopoly, imperfect or monopolistic competition, and perfect competition. To assess the degree of competition prevailing at the market level, the H-statistic proposed by Panzar and Rosse (1987) was computed. The H-statistic (known as the revenue test) is defined as the sum of elasticities of the reduced-form revenues with respect to factor prices. Non-structural models work with revenue and cost data. These data, however, are not available at the level of the sub-markets. Consequently, the modelling focuses on the level of the global market, assuming that the competitive behaviour is the same across all routes.

RESEARCH QUESTION 1 - RESULTS

From the results it can be concluded that the container shipping industry is confronted with increased concentration and that it is found that the containerised liner shipping industry is still a highly fragmented industry. At the beginning of 2010, the four largest container shipping companies, Maersk Line, MSC, CMA CMG, and Evergreen (CR4) together had a market share of 37.56 per cent, in terms of TEU (see Chapter 1 – Appendix 1-2).

Secondly, the findings reveal that, depending on the source, a CR4 of 40 % (the top four firms have individual markets shares that average less than 10 %) or a top six lines (CR6) of 50 % serves as a benchmark for an oligopolistic market. If one accepts these cut-offs, the market structure of the container liner shipping industry up to 2007 can be labelled as monopolistic competition (CR4 < 40 %). Since 2007, the CR4 has exceeded 40 %, and as a consequence the level of competition has diminished so that the container liner shipping industry (hereafter CLSI) can be classified as an oligopoly. A more detailed study shows that the degree of oligopoly varies between trade lanes. In terms of concentration, the container liner shipping industry is either a loose or a tight oligopoly depending on the trade lane. Knowledge of the degree of oligopoly is important for price setting but also for regulating (see Chapters 2 and 3).

Thirdly, all concentration indicators point at an increase in concentration. According to the structural approach, it is implicitly accepts that a more concentrated market is less competitive. However, a positive relation between concentration and competition can be determined through more aggressive interaction between shipping companies. Therefore, the Hymer-Pashigian index of market share instability was used to indicate the degree of competitiveness at both industry and trade level. The results reveal evidence that the container liner shipping industry is characterised by a relatively stable competition. This index also allowed to measure rivals' behaviour at the trade lane level. At disaggregated level, the degree of concentration and the degree of competition differs among trade routes (see Chapters 2 and 3). In addition, the relationship between concentration and the Hymer-Pashigian index of market share instability was examined. The findings indicate the presence of an inverted U-shaped or a nonlinear relationship between concentration and market share instability at industry level. The inverted U-shaped curve is found to peak at around 36 % of the four-firm concentration ratio and then to decline. At trade level, concentration is negatively related to market share instability (see Chapter 3).

In the non-structural approach, a sample of 18 liner operators was observed to test the impact variations in the prices of production factors have on firm-level revenues. The preformed regressions were based on an unscaled revenue equation. Control variables were added to three input prices in order to capture differences in risk and business profile. The first control variable, 'equity to total assets', accounts for the leverage reflecting differences in risk preferences. The business profile is proxied by the ratio of TEU capacity to the number of ships. This variable was included to control for differences in deployed ship sizes. In addition, two dummy variables were included to capture the effect of membership of an alliance and/ or to study the impact of mergers and acquisitions on turnover.

The main finding of this study is that the significantly positive unscaled value of the H-statistic for the containerised liner shipping industry implies the rejection of the hypothesis that the market structure of the container liner shipping industry corresponds with a neoclassical monopolist, collusive oligopolist or conjectural-variations short-run oligopolist. Furthermore, perfect competition, sales maximising firms subject to break-even constraint and natural monopoly in a contestable market can be rejected at a 10% significance level. Both the structural and the non-structural approach show that up to 2007 the market structure of the container liner shipping industry could be described as a monopolistic competition (see Chapter 8).

The study also reveals some further interesting findings, notably concerning the impact of mergers and acquisitions on turnover. Their effect largely manifests itself in the two subsequent years. The results further suggest that the shipping companies involved in strategic alliances as a form of cooperation do not succeed in translating increased cost into higher revenue (see Chapter 4)

RESEARCH QUESTION 2 - METHODOLOGY

The Panzar and Rosse methodology seems well-designed to investigate the competitive nature of an industry, whereas the indicator developed by Boone (2000) relates to the change in competition over time in a certain industry by taking into account the effects of competition based on profits. Two effects can be distinguished in which competition can be intensified in a given market. The first is a fall in entry barriers. Increased entry is taken to lead to more intense competition. Secondly, competition can be intensified by more aggressive behaviour by incumbents. This increases concentration by forcing inefficient firms out of the market. The Boone indicator captures both effects.

Boone parameterises competition in terms of a negative relationship between relative efficiency and relative profits. The relative profits measure, or the Boone indicator, relies on the notion that competition enhances the performance of efficient firms (i.e. with lower marginal costs) and impairs the performance of inefficient firms, which is reflected in lower profits or smaller market shares (see Chapter 5).

RESEARCH QUESTION 2 - RESULTS

To analyse this question, the present study estimated the relation between market shares and average variable costs, adding explanatory variables for industry-specific effects (the growing number of services driven by globalisation, the introduction of larger container vessels). To determine the Boone indicator accurately it is imperative to check for quality differences and to correct for industry-specific effects.

Several findings emerge from the empirical analysis. Firstly, the Boone indicator is defined as the percentage decrease in profits due to a percentage increase in costs. So, a estimated coefficient of -0.1669 for 2008 would suggest that a liner carrier with a one percentage point average costs higher than another (more efficient) liner carrier, would have a 16.7 percent lower profit (proxied by market shares) than the more efficient liner carriers. In terms of the degree of competition, the second finding is that competition increased over the 2000-2008 period. While over the 2002-2003 period the leading liner operators enjoyed profits, competition intensified subsequently. Intensified competition forces competitors to set low prices. This finding corresponds with the analysis of the evolution of profitability. The results should be interpreted cautiously, as research over a longer time period as well as at the level of the sub-markets might produce more accurate results. A study at the level of the sub-markets might also reveal the reasons for the moderate competition. Thirdly, the other explanatory variables have a significantly positive impact on the profits (proxied by market shares). This result indicates that only efficient liner operators with a technological advantage (lower operating costs due to the deployment of larger vessels) and with the advantage of a large network of services over (inefficient) competitors, can attain any profits. In a more competitive market, liner operators are hurt more severely for being inefficient. As a consequence, inefficient liner operators are forced to exit the market. The latter, however, is hardly the case in the container liner shipping industry. Very few liner operators (e.g. Cho Yang, 2001; Senator Lines, 2009; MBG Shipping, 2010) failed and exited the market. Given the rather moderate competition, inefficient container shipping companies are still protected against the more efficient shipping companies. Finally, a dummy variable was added to study the behaviour of shipping companies involved in an alliance. The results suggest that shipping companies within an alliance are not necessarily more efficient in terms of profits.

The second research question, 'If the container liner shipping industry is concentrated, does this concentration affect the liner operators' performance?', aims at finding an explanation for the low profitability in this sector. The results relating to the second research question show that the container liner shipping industry is characterised by increased concentration. All indicators support this conclusion. Increased concentration does not immediately contribute to profitability. To understand the (low) performance, the Boone indicator measures the extent to which differences in efficiency are reflected in performance. This result indicates that only efficient liner operators with a operational advantage of lower operating costs due to the deployment of larger vessels, and of a large network of services, over (inefficient) competitors, can attain profits.The study reveals some further interesting findings. The effect on turnover of mergers and acquisitions largely manifests itself in the two consecutive years.

Our results further suggest that the shipping companies involved in strategic alliances as a form of cooperation are not more efficient in terms of profit (too bureaucratic? slower decision making?) (see Chapter 5)

In general terms, in order to realise higher profits, the sector should become more efficient. The present study assesses the degree of competition over time before the abolishment of the block exemption from 18th October, 2008, a policy change with the objective of intensifying competition, and the global downturn. The Boone indicator can be used to establish whether competition will be rising in the coming years. It allows to monitor and evaluate (anti-)competitive behaviour. Therefore, this study is particularly interesting to policy makers who wish to evaluate their decision of the abolishment (see Chapter 5).

The present research succeeds both in realising its objectives and in answering the research questions. The last two studies go one step further and search for an explanation for the obtained results.

EXPLANATION 1 – BARRIERS TO ENTRY

Barriers to entry constitute a major structural attribute of industry sectors. The importance of the (unobservable) threat of entry is recognised in this study. The persistence of profit methodology makes it possible to capture the unobservable threat of entry. This dynamic methodology observes profit outcomes over time to make interferences about the nature of competition. The central idea is that profits should persist if there are impediments to the competitive dynamic (e.g. entry barriers). Mueller (1986) shows that persistence of profits can be estimated using first order autoregressive equation for each firm's standardised profit rate. The hypothesis is that (potential and actual) entry/ exit conditions are sufficiently powerful to ensure that no firm persistently earns profits above or below the norm. The PoP-hypothesis was tested for a panel of 21 liner operators observed over the 2000-2008 period.

Five major conclusions follow from the time-series analysis on firm-level profits. First, short-run persistence refers to the percentage of a firm's standardised profit rate in any period before period *t* that remains in period *t*. The econometric results reveal a significant positive impact on profit persistence for independent carriers (e.g. CMA CGM, Maersk Line). Such result indicates that those liner operators earn returns above the competitive norm. Conversely, in the case of the CHKY alliance, the results show a low persistence of profits. In other words, the profits in year *t* of liner carriers involved in the CHKY alliance do not largely depend on profits in year *t-1*. No generalisation for all alliances can be formulated as there are no data for Hapag-Lloyd and Hyundai Merchant Marine.

Second, the values of the speed of profit adjustment parameter indicate how quickly the profit rate approaches its long-run equilibrium level. The short-run rents of CMA CGM and Maersk Line erode more slowly than those of liner operators involved in the CHKY alliance. This can be taken as an indication of the existence of entry barriers. A study of the BelgianIndia trade confirms this finding. The barriers to entry are moderately limited. Clearly, the extent of the barriers to entry differs from trade lane to trade lane. From the incumbent's viewpoint, this is a position of accommodated entry.

Third, turning to long-run persistence, the hypothesis was tested that (actual and potential) entry into and exit from any market is sufficiently free to bring any abnormal profits quickly into line with the competitive rate of return. If the permanent profitability equals zero for all liner operators, this would support the hypothesis that all long run rents are zero. Otherwise, there is long-run persistence in the sense that these liner operators earn profits which tend to differ permanently from the average profitability of liner operators in general. In the case of CMA CGM, a permanent level of profitability of 0.03536 implies that their profit to assets/ sales ratio (at container division) is on average permanently 3.5 % above the sample mean. Since the permanent level of profitability does not equal zero for all liner operators, the results imply that there is long-run persistence. Therefore, in the containerised liner shipping case, the empirical results suggest that the hypothesis can be rejected. The 'persistence of profit' approach demonstrates that independent carriers are able to preserve their profits over time. However, abnormal profit erodes at a faster pace than in other industries.

The results further suggest that the abnormal profit (if any) of shipping companies involved in strategic alliances erodes more quickly by forces of competition than those of independent carriers (see Chapter 6). Another observation is that the ranking of the liner operators differs from a ranking based on market share. This might be an indication that large operators sacrifice profit to preserve their market share. Fifth, the excess returns erode at a faster pace than in other industries (see Chapter 6).

EXPLANATION 2 – ECONOMIES OF SCALE

The entrance of newcomers depends on the response of incumbents and the existence of barriers to entry. One barrier to entry is economies of scale. After investigating and classifying the factors influencing the size of containerships, Chapter 7 concentrates on another factor that might explain the efficiency of a shipping company, namely scale advantages.

The economies of scale in deploying larger vessels are quantified by using a liner service cash flow model. The results illustrate that scale economies have been, and will continue to be, the driving force behind the deployment of larger container vessels. However, the operating cost (especially feeder cost) and the landside distribution costs should be integrated in the cost model. Adding these latter costs can raise the unit cost per TEU more rapidly and turn the economies of scale curve into a U-shaped curve.

This analysis has made it clear that (optimal) ship size and (optimal) operations cannot be studied separately. Both develop in close connection. It has been shown that the determination of the optimal ship size in relation to operations depends on transport segment (deep-sea vs. short-sea shipping, SSS), terminal type (transhipment terminals vs. other terminals), trade lane (East-West vs. North-South trades), and technology. Technology refers to the question when an 18,000 TEU or 22,000 TEU containership with an allowable draught will be built (see Chapter 7).

RELEVANCE OF THE RESEARCH

The results of our research are relevant to the liner operator, as the market structure under which a carrier operates determines its behaviour. The results suggest that the liner carriers operate in a monopolistic competitive environment. This finding should encourage liner operators to differentiate their product entirely or partially.

The findings of this study are economically highly relevant as information on the degree of competition in the container liner shipping industry is of prime importance in the light of a reflection on policy. This study presents an overall picture of the concentration-competition-profit relationship in the container division. The structural approach demonstrates that a meaningful competition analysis must be based on the outcomes of several concentration indicators. The judgment of the customer (shipper) concerning the price and the quality of container services should also be taken into account.

Finally, the results of the present study form a good starting point for a comparison and an evaluation of the effects of future changes and regulations in the container liner shipping industry. In addition, they can make an important contribution to initial policy discussions.

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Chapter 1

1 Introduction, conceptual framework and research questions

The general research topic of this study is the assessment of the competitive conditions, the concentration and the market structure of the container liner shipping industry. This introductory chapter explains the purpose and the methodology of this research. It is divided into four parts. Subsequently, the container liner shipping industry, some forms of cooperation, two anti-trust regulations as well as the conceptual framework of this study will be discussed.

1.1 The container liner shipping industry

A first step is to define and outline the container liner shipping industry. A definition of the relevant market makes it possible to identify the competitive constraints faced by the market players. The second subsection presents an overview of the largest market players. Some major developments that have been challenging those operators will be discussed in the last subsection.

1.1.1 Delineating the container liner shipping industry

In general terms, the shipping market can be regarded as a single economic unit with distinct market segments, viz. the tanker fleet, the bulk carrier fleet, the liner fleet, the fleet of ships designed for a single cargo or the specialised fleet (e.g. cement carrier, heavy lift, refrigerated), and passenger ships (Stopford, 2009).

Appendix 1-1 illustrates the relative growth of the containerised liner shipping industry. In 1990, the liner segment had a share of 16.94 % of world total (measured in 1,000 deadweight), compared with 42.53 % for the tanker segment, and 36.71 % for the bulk segment. Over the 1990-2009 period, the tanker and the bulk segments lost about 2.5 and 1 percentage points respectively, in favour of the liner segment, which rose to a 25.58 % share. As for the specialised fleet, its share in dropped from 3.24 % to 1.92 % from 1990 to 2009. The share of the passenger segment dropped from 0.62 % in 1990 to 0.55 % in 2009.

The liner segment consists of three divisions, namely containership, roll on/ roll off (ro-ro) and other (multipurpose, tweendecker, etc.). In 1990 the segment 'other' was largest with 11.72 %, followed by 'containership' with an approximate 4 %, and 'ro-ro' with 1.20 %.

Over 20 years the 'containership' division has expanded its share to 18.24 %. The increased containerisation has been largely due to dedicated purpose-built container vessels, larger vessels that present increased economies of scale (see Chapter 7), as well as its so-called 'cannibalisation' of cargo previously transported in bulk towards containers. To date, the 'container' division mainly carries finished products ready for consumption along the three major east-west liner trades: Transpacific, Asia-Europe and Transatlantic. The shares of the 'other' and the 'ro-ro' divisions have shrunk to 6.76 % and 0.58 % respectively. Although the containerised liner shipping industry dominates the liner segment, the ro-ro and other divisions will no doubt continu to exist. Because of its dimensions, weight, etc., certain cargo will never be classified as containerised cargo (e.g. out-of-box-gauge machinery, heavy lift-project cargo).

Figure 1-1 illustrates the evolution of the world full container trade (left-hand axis) versus that of the cellular fleet (right-hand axis). The structural changes that have taken place in the container liner shipping industry are illustrated in Figure 1-1 and will be discussed further in Section 1.1.3.

The container trade accounts for about 16 % of world goods loaded in volume terms (tons) (UNCTAD, 2009). Measured in twenty-foot equivalent units (TEU)[2] the world total of containerised trade was estimated at 148.9 million TEU in 2008. Mid 2010, the total seaborne container carrying fleet capacity, including fully cellular capacity stood at 14.45 million TEU. Out of a total of 5,949 active liner ships, the world fleet of fully cellular containerships stands at 4,832 cellular ships for 13.89 million TEU, 51.7 % of which are chartered. So, the cellular fleet aggregates 96.12 % of the total capacity deployed on liner trades in TEU terms (AXS-Alphaliner, 2010a). As of 2009, the capacity being added, fuelled mainly by the influx of ultra large container ships, has outstripped the growth in world full container trade.

2 Twenty Foot Equivalent Unit (containers): a measurement of cargo-carrying capacity on a container ship, referring to a common container size of 20 ft in length (Paelinck, 2008).

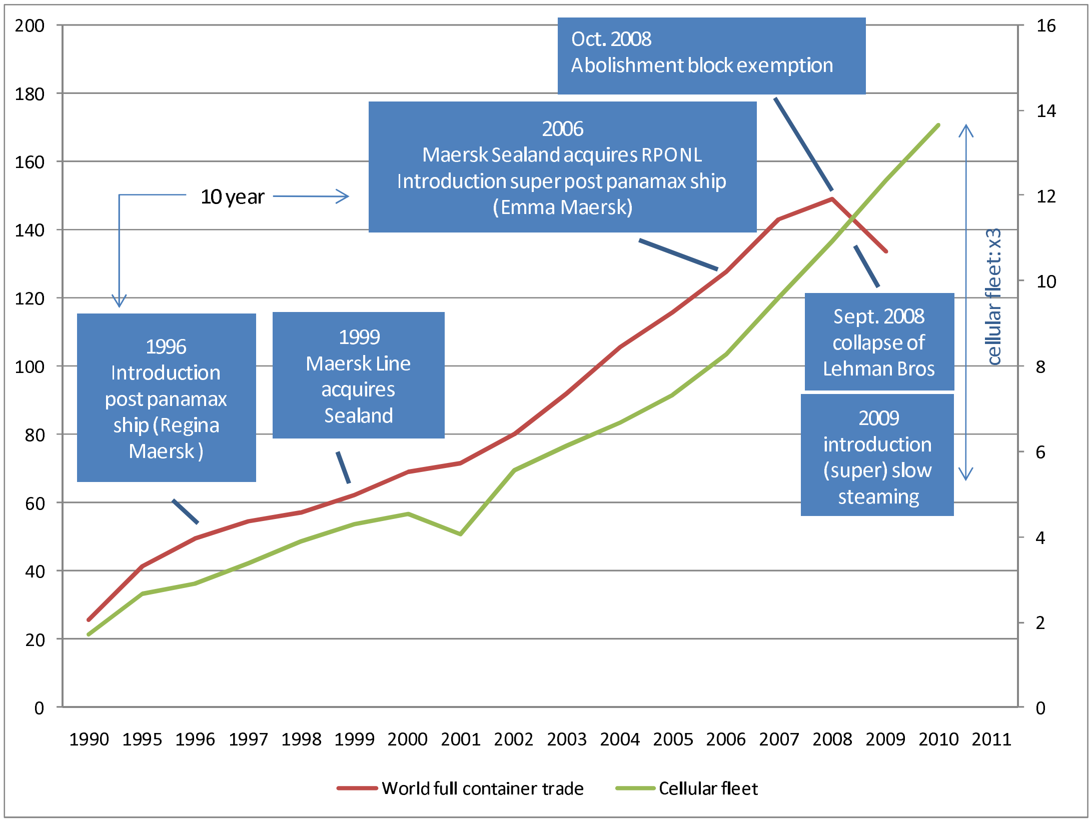

Figure 1-1: Evolution world full container trade vs. cellular fleet[3]

This research study focuses on the 'liner' market segment, more specifically the fully cellular containerised liner shipping industry.

1.1.2 Liner operators

For a better understanding of the container liner shipping market, it is necessary to have an adequate idea of the players and their trade mix of services.

First, the container liner shipping industry comprises for about 400 liner operators. A list of the largest companies is included in Appendix 1-2 which also shows the container capacity (in TEU terms and in number of ships) of the top 25 carriers and their rankings in 2000 and 2010.

The capacity of the cellular fleet amounted to 13.64 million TEU as at beginning 2010. Over the last decade, the container liner shipping industry has been characterised by a growth of + 120 %. The cellular order book suggests a continuation of this growth. The

[3] Compiled with data from Alphaliner (various editions) and Drewry (various editions). All amounts, both world full container trade and cellular fleet, are in million TEUs.

family-owned liner carriers MSC and CMA CGM are among the very few carriers with a huge order book, and clearly aim to increase their market share. To date, APM-Maersk is in a position to maintain its market share with a declared order book of not more than 352,924 TEU, unless its rivals engage in vigorous chartering activities to keep pace. It should be noted that, on January 1st, 2010, the order book of the fourth largest liner shipping company Evergreen Line, was empty. Taiwan-based carrier Evergreen Line is not only an independent carrier with an empty order book since 2008, but it is also one of the few players not ordering super post-panamax vessels, unlike several of its peers, such as the top three carriers with orders of +13,000 TEU vessels, nor does it feel a pressing need to do so. Mid 2010, this ocean carrier's policy of sticking to smaller-sized ships was confirmed with orders for 10 x 8,000 TEU and the intention to order 30 ships with a nominal capacity of 9,200 TEU. In the empirical part of this study, Evergreen Line was regrettably not included in the sample of liner operators, as it does not publish segmented figures for its container division.

The container liner operators expanded their capacity to a total of 5,392,351 TEU. Except for Evergreen and Hanjin Shipping, every liner operator at least doubled its capacity. Two independent European based liner carriers, viz. the nominal champion MSC and Maersk Line, added + 1,000,000 TEU. MSC gained size and strength through organic growth, while the expansion of Maersk Line was largely the result of mergers and acquisitions. Carriers that are accustomed to going it alone may have a slight edge in the future over those that have primarily relied on alliances. Among the top 25 liner carriers, 10 are members of alliances. This issue is addressed in this study (see Chapters 4, 5 and 6).

The top 3 carriers account for a total of 4,564,504 TEU, or about 50 % of the transported capacity of the tops 25. In terms of capacity, these three mega carriers controlled a collective share of 33.46 % of the world fleet on January 1st, 2010. Maersk Line and MSC have a double digit shares. The liner operators that do not make the top 20 have a market share of less than 1 %.

Secondly, the trade mix of services shows that the major container shipping lines have global coverage across multiple trade lanes. Appendix 1-3 depicts the liner operators' breakdown of TEU capacity deployed by trade. The radar chart compares the distribution of major liner operators across trades. Liner operators with a relatively large coverage of the Europe-Far East (EU-FE) trades are CMA CGM, Hyundai Merchant

Marine (HMM), Yang Ming and Maersk Line (in descending order of importance). In the case of the Transpacific trade, the liner carrier APL has the largest coverage followed by Hanjin, HMM and Evergreen.

Since freight rates differ across trades, the trade mix of services might affect the profitability of the liner operators. To test this, detailed data are needed at trade level. Regrettably, such information is not available. Instead, the number of services will be used as a proxy for the global coverage (see Chapter 5).

After establishing a clear idea of the market and its players, the next section elaborates on the developments that challenge the industry and links these developments have with landmark events in the container liner shipping industry. This is shown in Figure 1-1.

1.1.3 Developments in the container liner shipping industry

The introduction of containers in 1956 was an innovative landmark in the liner shipping industry. The past decade (2000-2010) has probably been the most revolutionary in this respect. For some time now the worldwide containerised liner shipping industry has been characterised by some notable developments that have challenge the liner operators (see Figure 1-2).

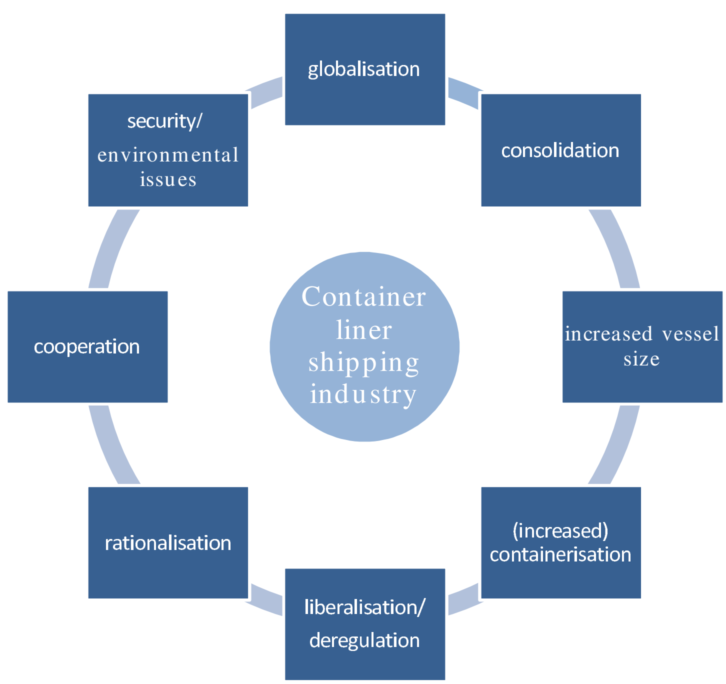

Figure 1-2: Developments in the container liner shipping industry

First, the increasing globalisation is a significant market development for the container liner shipping industry.

Second, the response to globalisation is concentration (see Chapters 2 and 3), which in turn has been driven by the need for economies of scale (see Chapter 7) and has been a response to global shippers (e.g. Wal-mart, Masterfood, Proctor & Gamble, Ikea). Concentration has been achieved through mergers and acquisitions.

The consecutive waves of consolidation have redesigned the container liner shipping industry (Sys, 2009). The first large consolidation wave in the liner shipping industry took place around 1995. Ten years later a second consolidation wave started. The most notable example of a merger in the container liner shipping sector was the takeover of Royal P&O Nedlloyd by Maersk Sealand (since then known again as Maersk Line) in 2006 (see Figure 1-1). The impact of this merger is a recurrent topic in the study (see Chapters 3, 4, 5 and 6). It also provoked other liner operators to follow suit (e.g. CMA CGM, Hapag-Lloyd, COSCO)[4]. Since the worsening of the global financial crisis and the unfolding of a worldwide economic downturn, further consolidation has been expected to achieve a financially more viable balance.

Third, the development of increased and continuing containerisation goes together with increased vessel size (Sys *et al.*, 2008). In 2006, Maersk Line created another milestone with the deployment of the Emma Maersk (see Figure 1-1). When she was launched, the Emma Maersk was the largest container ship ever built (listed capacity: 11,000 TEU versus an estimated capacity varying between 13,500 TEU and 15,200 TEU depending on the method of calculating capacity – see also Chapter 7)[5]. Following Maersk's new building programme, other liner operators such as MSC (i.e. 14,000 TEU MSC Melatilde - 2010) and CMA CGM (i.e. 13,830 TEU CMA CGM Amerigo Vespucci - 2010) have ordered similar sized series of vessels. While these liner operators are convinced of the superior economies of scale (see Chapter 7), not every liner operator is turning to the super or ultra carrying vessels. As stated before, Evergreen is going to keep to ships up to 10,000 TEU, while APL is not going for the ultra large container carrying vessels of 14,000 TEU that are being phased into service by the top three liner operators. Their strategy might be driven by the greater trading flexibility offered by 'smaller' sized vessels.

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4 For an overview: see Appendix 2-2.
5 Rumour has it that Maersk Line is considering ships of 16,000 TEU capacity.

Figure 1-3 shows the distribution by size range as well as the cellular fleet projections up to 1/1/2014[6]. Although the smallest size segments still account for the largest share, a shift towards larger ships is noticeable.

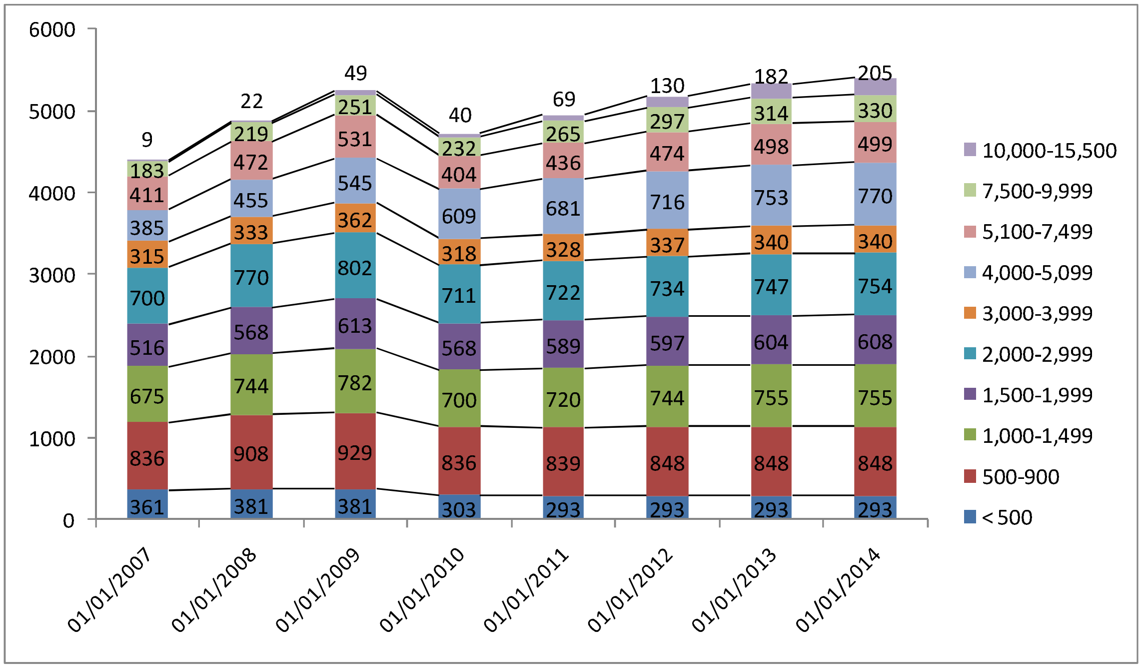

Figure 1-3: Cellular fleet forecast

This influx of large ships - driven by the expectation of significant economies of scale - is having consequences on the structure of the market. According to the present planning, a new set of larger locks will allow to transit the Panama Canal with those larger ships by 2014. This future operational opportunity might make international trading even more competitive.

A further development is the continued liberalisation (i.e. opening of trades by WTO agreements)/deregulation and consequently the resulting growth in global trade, which is of great importance for the shipping industry. This development has intensified competition on many individual trade lanes and strenghtened the incentive to cooperate.

In response to market conditions, rationalisation has further developed. It has come in the form of rescheduling (i.e. merging services, teaming up with other liner operators to launch a new service), retonnaging (i.e. cutting capacity) and restructuring. It aims to reduce the overall cost base and to ensure a more efficient service to customers. Further

6 Compiled with data from AXS-Alphaliner (2010b). AXS-Alphaliner forecasts cellular fleet based on the order book as at 1/8/2010 assuming no cancellation of orders.

rationalisation is expected, and with it (increased) cooperation. The ‘cooperation’ development will be discussed in a separate section (see Section 1.2).

Other recent developments affecting the container liner shipping industry are security at sea (increased piracy activities) and an environmental focus that grows stronger. More stringent legislative requirements, present and future, will enforce environmental developments in relation to reducing fuel consumption and emission of greenhouse gases as well as environmentally sound ship recycling programmes. Most liner operators (e.g. Evergreen, Maersk Line) set vessel-specific targets for environmental improvements.

The growing awareness in the shipping industry of climate change emissions (i.e. reduction of tons of $C0_2$ per year) in combination with the objective to save costs (i.e. annual reduction of tons of bunkers), and to trim back overcapacity triggered by the recent economic crisis, has encouraged the carriers to introduce the practice of slow and super-slow steaming[7]. Most liner operators have implemented this on the main routes. In the ‘post-crisis’ era, some form of slow steaming is expected to remain the rule, on account of environmental issues[8]. The new IMO Tier (2011) and the Tier III (NOx limits, 2016) Marpol Annex VI regulation will provide stricter new standards regarding ship emission limits. Ships operating in emission control areas (ECA) would be required to use fuel with a sulphur content that does not exceed 15,000 ppm (parts per million). To date, there are two Sulphur Emission Control Areas (SECA) designated to control the emissions of SOx : in the Baltic Sea area and in the North Sea area. Will the emission control areas be extended? How will this sustained environmental approach affect the industry? Knowing that ships are generally not designed for low speed[9], Maersk Line is the first to adjust its fleet technically to the practice of slow steaming by installing slow steaming upgrade kits.

As yet no data are available to capture the effect of these recent developments on the competitive conditions of the container liner shipping industry.

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7 Full speed steaming corresponds with 24 knots while slow steaming means a speed of 21 knots. Super slow steaming reduces speed by up to 15 knots by average. Different legs can be run at different speeds (e.g. 20-22 knots westbound and 17-19 knots average speed eastbound considered an 18 knot loop).

8 Based on Alphaliner Weekly Newsletter, various editions, 2010.

9 The industry discusses the long-term impact of super-slow steaming on diesel engines that were initially designed to operate at sustained high service speeds.

Given that the landscape of the container trade is bound to change, the liner operators that are fully aware of these challenges, should be urged to enhance efficiency and to continuously harmonise its services to order to improve its core competitiveness.

In brief, the market developments in the container liner shipping industry reflect what has been happening in the other newly liberalised sectors (e.g. telecommunication, broadcasting, banking).

1.2 Cooperation

A feature of liner shipping concerns the transport of cargo. To this end, it provides regular services to ports on a particular geographic route, generally known as a 'trade (lane)'. On strategic grounds, liner operators could opt to provide a wider scope of services. For small/ medium sized carriers, deployment of extra ships necessitates a very large amount capital outlay and might restrict the set-up of a shipping service individually. To enable liner operators to provide a wider scope of service and to increase the utilisation of vessel capacity, operational cooperation offers a solution. For major carriers, cooperation in jointly supplying a shipping service may further produce efficiencies and benefits.

Ryoo and Lee (2002) divide the liner shipping cooperation forms into two groups, according to the nature of the cooperation: cooperation on rates and operational cooperation[10]. While these authors identify merger and acquisition as operational cooperation, this present study treats merger and acquisition as a separate type of cooperation, namely full-scale cooperation. Figure 1-4 gives an overview of the liner shipping cooperations[11].

The major forms of cooperation are trade agreements, such as shipping conferences, operating agreements (consortia and strategic alliances) and mergers and acquisitions (see Figure 1-4: in italic). In the following subsections, these forms of cooperation will be described briefly.

10 Appendix 1-4 contains a list of the different forms of cooperation with a brief description.

11 Financial participation by third parties is not taken into account.

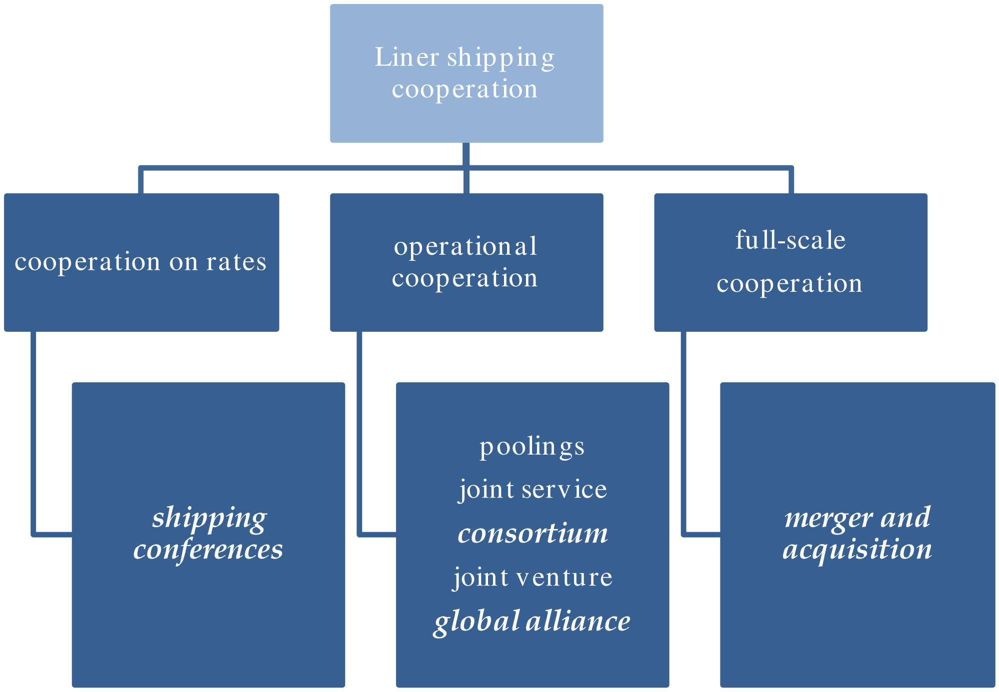

Figure 1-4: Forms of liner shipping cooperation

1.2.1 Cooperation on rates

Liner services were developed in the second half of the 19th century (mid-1870s) when reliable steam power made it possible for the first time for shipping companies to provide regularly scheduled services. The rapid growth of the liner business quickly led to fierce competition. Freight rates were forced to levels that did not cover average costs. By 1875, the first **shipping conference** was set-up to stop this instability of the liner business and to restore profitability[12].

The US adopted the Section 3(7) definition of the Ocean Shipping Reform Act (OSRA) of 1998: "*A conference means an association of ocean common carriers permitted pursuant to an approved or effective agreement, to engage in concerted activity and to utilise a common tariff: but the term does not include a joint service, consortium, pooling, sailing, or transhipment arrangement*"[13].

In the UNCTAD Code of Conduct for Liner Conferences (1975), a conference or liner conference is defined as "… *a group of two or more vessel operating carriers which provides*

[12] In August 1875, the first conference was formed by the lines trading between the United Kingdom and Calcutta (Stopford, 2009, p 556).

[13] See www.fmc.gov/ about/ shippingact.asp (assessed 10/ 08/ 2010).

international liner services for the carriage of cargo on a particular route or routes within specified geographical limits and which has an agreement or arrangement whatever its nature, within the framework of which they operate under uniform or common freight rates and any other agreed conditions with respect to the provision of liner services". The European Union adopted the definition of the UNCTAD Code of Conduct for Liner Conferences in regulation No 4056/86 of December 22th, 1986 laying down detailed rules for the application of Articles 85 and 86 of the Treaty to maritime transport[14].

Conferences were formed for the purpose of restricting competition between their members and protecting them from outside competition. It was the industry's first attempt at dealing with the pricing problem.

In the 1960s, with the advent of containerisation, this cooperation on rates was supplemented by other kinds of agreements. The role of conferences changed towards a discussion platform for analysing the market, exchanging information and evaluating the required capacity.

Mid 2010, Containerisation International online listed 46 conferences[15]. For instance, the Transpacific stabilisation agreement[16] has 15 members (APL, CSCL, CMA CGM, COSCO, Evergreen Line, Hanjin shipping, Hapag-Lloyd, HMM, K-line, Maersk Line, MSC, NYK Line, OOCL, Yang Ming Line and Zim)[17]. Its geographic scope is the USA, Japan, Korea, Taiwan, Hong Kong, China, Singapore, Malaysia, Thailand, Indonesia, the Philippines, Vietnam, Cambodia, Laos, Myanmar and the Russian Far East. The area of services of the majority of conferences is East/South Asia, Oceania, Africa and South America.

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14 See europa.eu/legislation_summaries/competition/specific_sectors/transport/l24064_en.htm, (assessed 10/08/2010).

15 By the early 1970s, there were more than 360 conferences, while thirty years later there were still 150 liner conferences. Their membership ranged from 2 to 40 shipping lines (Stopford, 2009).

16 A stabilisation agreement is a modern open sort of conference system which mainly act as a secretariat to the trades, administering rate agreements and dealing with the various regulatory bodies (Stopford, 2009, p. 558).

17 See the glossary for the liner operators' name written in full.

1.2.2 Operational cooperation

Various forms of operational cooperations are slot charters, poolings, joint services, joint ventures, consortia and alliances[18]. Only the latter two types of operational cooperation will be discussed.

In contrast to conferences, consortia[19] and alliances are technical agreements (without pricing considerations) to share fixed voyage costs (e.g. fuel consumption, wages, port dues), other fixed costs (e.g. capital cost, equipment) and operational costs.

1.2.2.1 Consortia[20]

The expansion of containerisation stimulated the development of the consortium concept.

A consortium, as defined by the Commission regulation 870/ 95, is "*an agreement between two or more vessel-operating carriers which provide international liner shipping services exclusively for the carriage of cargo, chiefly by container, relating to a particular trade and the object of which is to bring about cooperation in the joint operation of a maritime transport service, which improves the service which would be offered individually by each of its members in the absence of a consortium, in order to rationalise their operations by means of technical, operational and/or commercial arrangements, with the exception of price-fixing*" (Brooks, 2000, p. 224).

Thus, the formation of consortia allowed companies to share both the additional investment cost that containerisation entailed and the accompanying risk, with only a small number of major liner companies with adequate critical mass pursuing an independent strategy on all or some of the major routes (e.g. Two carriers can agree to set up a weekly service between port A and port B, and each carrier brings 2 ships in. This way they can offer a weekly service to their customers by a slot exchange agreement[21]). Furthermore, such agreements allow shipping lines to rationalise their

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18 The definition of the other forms is listed in Appendix 1-4, which contains an overview of the types and nature of liner shipping cooperation.

19 The first consortium agreement was the Atlantic container line (1966).

20 Liner operators have been granted conditional exemption from the competition rules when operating joint services. The Consortia Block Exemption was first adopted in 1995 by Regulation 870/ 95. Every five years, this exemption has to be reviewed. September 2009, the European Commission has decided to amend and prolong the consortia Block Exception Regulation until April 2015. Liner operators will continue to be allowed to engage in operational co-operation for the purpose of providing a joint liner service, but not for fixing prices.

21 A slot exchange agreement is an agreement between two or more carriers to exchange an equal amount of space on ships operated on each other's respective services in the same trade lane. A slot refers to an unit of space in a containership. One slot equals one TEU of capacity.

activities and achieve economies of scale and to improve the productivity and the quality of the liner shipping service, and to encourage greater utilisation of the containers and the more efficient use of vessel capacity.

To sum up, consortia can be described as purely operational agreements (e.g. joint use of vessels, port installations, marketing organisation…) within which each carrier independently determines its commercial policy, but to a very limited extent.

1.2.2.2 Alliances[22]

Early 1990s, the unprecedented demands imposed by the globalisation of world trade, began to make existing forms of agreements increasingly inadequate. Prodded by the protracted poor profitability in the 90s, medium-sized container companies started to form strategic alliances operating on different routes around the world in order to offer a worldwide service to their clients. A new generation of strategic partnerships emerged.

Das and Teng (1997) define strategic alliances as "*interfirm cooperation arrangements*[23] *aimed at pursuing mutual strategic goals*". Alliance forms included in their definition are joint ventures, joint R&D, product swap, equity investment and sharing, and licensing.

As the present study focuses on the competitive conditions of the container liner shipping industry and as 10 carriers from among the top 25 liner operators are involved in an alliance, it is worth examining these carriers' behaviour over the past years. The remainder of this subsection firstly summarises the advantages and disadvantages of an alliance membership. Secondly, it gives an overview of the process of operational agreements on one trade to the formation of alliances (see Appendices 1-5 and 6-3). Then, it addresses the question in what way alliances differ from conferences and consortia. Finally, some figures give an idea of the market power of alliances.

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[22] See also Heaver *et al.*, 2000; Midoro & Pitto, 2000 and Heaver *et al.*, 2001.

[23] These agreements cover employment and utilisation of vessels (joint vessel route assignments, itineraries, sailing schedules, type and size of vessels, ports and port relations); charters, space/ slot charters; the use of joint terminals; co-ordination of containers, pooling of containers, establishing of container stations; vessel feeder routes and co-ordination with inland services and information and procedures exchange. They do not cover joint sales, marketing, or joint maritime/ multimodal pricing; joint ownership of vessels or maintenance or assurance; joint or common bill(s) of lading; common tariffs or the sharing of profit/ losses; joint management and executive functions and revenues pools or cargo pools.

ADVANTAGES AND DISADVANTAGES

Being involved in an alliance offers to mid-sized liner operators the possibility to aggregate cargo volumes; entry in new markets without deployment of additional tonnage; increased service frequencies; scale economies of (larger) ships; improved asset utilisation through the sharing of vessels, terminals, equipment and containers and coping with the hub and spoke system[24]. Further benefits could be the employment of their collective financial strength for long-term assets and enforce a more powerful negotiating position vis-à-vis port authorities, terminal operators and inland transport firms. And finally, it is a way to deal with competition.

However, the main disadvantage is that every single partner retains its role and influence: the decision-making process can easily become lengthy and time-consuming, and eventually lead to bureaucratisation of the alliance. This aspect should not be underestimated (see Chapters 4, 5 and 6).

FORMATION OF ALLIANCES[25]

In a move aimed at reducing costs and providing more flexible service, major liner companies joined forces to share resources on a world-wide scale.

During the 90s several alliances were formed. The pivotal year in alliance formation was 1995. Overall, four periods can be distinguished: (a) 1990 - 1994, (b) 1995 – 1999, (c) 2000 – 2005, and (d) 2006 – 2010 (see Appendices 1-5 and 6-3).

Alliances were not a new phenomenon. Before 1995, these operational agreements already existed but they were of a limited scope or active on one trade only.

By the beginning of the second period, nearly all principal global containership operators had grouped themselves into alliances. The first cooperation was the Global Alliance, formed by APL, MOL, OOCL and Nedlloyd (with side arrangements with MISC). This cooperation agreement was followed by the Grand Alliance, consisting of Hapag-Lloyd, NYK, NOL and P&OCL. A third alliance was called Tricon alliance and comprised DSR-Senator and Cho Yang shipping. At that time, this alliance was more of a consortium, especially since the 75 % takeover of DSR-Senator by Hanjin (end 1996). This left Maersk, at that time the second largest carrier in the world, with the capacity to go it

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[24] A hub is the central transhipment point in a transport structure, to which traffic from many ports is directed and from where traffic is fed to other areas/ ports (referred to as spokes).

[25] The overview is confined to the biggest alliances.

alone, but it opted for a closer relationship with Sea-Land, taking into account the overwhelming economic advantages of consortia participation (Brooks, 2000). Other carriers chose to venture beyond alliances and engaged in mergers (P&O Nedlloyd) or acquisitions (NOL/ APL) that increased their size and expanded their scope of operations. P&O's joint venture with Nedlloyd forced the new company to choose between the Global and the Grand Alliances. Once P&O Nedlloyd had chosen the Grand Alliance, the newly merged NOL/ APL opted to join the restructured Global Alliance. As OOCL was not included in the new Global Alliance (subsequently renamed The New World Alliance (TNWA)), it became a participant in the Grand Alliance. OOCL's strength in the China and Southeast Asia markets created a better balance within the Grand Alliance rather than duplicating the strength of its former alliance partner, NOL/ APL (Brooks, 2000). MISC chose also to join the Grand Alliance while Hyundai Merchant Marine (HMM) opted to participate in the New World Alliance. This alliance agreement between APL/ NOL, MOL and HMM[26] was concluded in December 1997. Both the 'new' Grand Alliance (with participation of OOCL and MISC[27]) and the New World Alliance became operational in January 1998. During the formation of the Grand Alliance and the New World Alliance, Hanjin missed the opportunity to join either of these alliances. By that time a majority shareholder of DSR-Senator, Hanjin formed the Tricon alliance (later renamed into the United Alliance) with Cho Yang. This alliance entered into a loose agreement with a third member, UASC. The latter, like the carrier Cho Yang, is an independent partner and has only a restricted contribution to the alliance. This shows that market coverage and commitment to alliances can vary.

The third period started with the creation of a fourth alliance, the Sino-Japanese Alliance (renamed as CHKY-alliance), with COSCO, K-Line, Hanjin and Yang Ming, Asia's largest container shipping lines. Hanjin also represented Senator Line[28]. Their aim was to improve vessel utilisation and to rationalise their services worldwide. Cooperation through less formal vessel sharing was the forerunner of this extended partnership. During the third period, the pattern of alliances was not subjected to these previous radical changes. This period was marked as the period in which every carrier, even alliances, made operational agreements.

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26 In the empirical part of the dissertation, HMM is not included in the sample of liner operators since this carrier does not report segmented figures for its container division.
27 MISC only participated in the Europe-Far East Trade up to January 1st, 2010.
28 Senator Line went bankrupt in 2009.

Another restructuring, viz. the withdrawal of Royal P&O Nedlloyd from the Grand Alliance in February 2006 heralded the fourth period. The members of the Grand Alliance III were Hapag-Lloyd, NYK Line, OOCL and MISC Bhd. (still Europe-Far East Trade only). The other two alliances remained unchanged. Starting in early 2006, the seven carriers that belong to the Grand Alliance III and the New World Alliance started an agreement to cooperate on key East-West trade lanes. The agreement was to enable the carriers to expand their services in the face of strong competition from the newly merged Maersk Sealand and Royal P&O Nedlloyd (since then known as Maersk Line).

Initially the alliances were operating on the East-West connections, North America, Europe and the Far East, but, through agreements with other alliances, they have now gradually been covering the North-South connection and a connection with the East West container services. This period was marked by the fact that every carrier, even within alliances, made operational agreements[29]. The latter form are known as intra-alliance (e.g. the Grand Alliance had a agreement with the CHKY Alliance covering the transatlantic trades, the Grand Alliance jointly operated services with the New World Alliance). Nowadays, the overall picture is very blurry, because half of the leading operators participate in alliances with the rest of the independent services, by means of slot swapping and other operational agreements (e.g. Hapag-Lloyd with CMA CGM; the Grand Alliance with ZIM; Hamburg Süd buys slots form other carriers in the Grand Alliance; the NWA has a slot charter agreement with Evergreen, covering the US/ Asia market and cooperates with Yang Ming in the Asia/ Mediterranean trade). Moreover, independent liner carriers including Maersk Line, MSC and CMA-CGM, collaborate on the Transpacific and Asia-Europe services. Any attempt to visualise all these cooperations, would probably result in a spider's web and the picture would already require to be changed, by the time the visualisation was finished.

On May 15th, 2009, MISC Bhd, which participates solely in the Europe-Far East trades, announced that it would withdraw from the Grand Alliance effective as of January, 1st. 2010. Aware of the environmental challenge, as of April 2010, CHKY Alliance renamed itself as 'CKYH, the Green Alliance', to show its determined position on environmental protection (i.e. eco-steaming for energy-saving and emission reduction, etc.).

[29] Is it the trend of slowness shown by alliances in achieving remarkable results that has induced some of their members to find yet another way to improve their competitive positioning?

ALLIANCES VERSUS OTHER FORMS OF COOPERATION

First, alliances are not merely new versions of the old operational forms of cooperation, such as consortia. The aim of an alliance as a whole is to deliver a value that is greater than the sheer sum of its parts. Each partner may have a comparative/ complementary strength in one or more key fields of activity, which could be effectively deployed to the alliance's advantage (e.g. being active on another trade, the package of clients, specialty).

Second, alliances offer similar regular services as conferences did. But, whereas conferences provided this regularity in exchange for price agreements, the competition would largely play between alliances on the one hand and with independent carriers on the other. However, the competition is played out more subtly and has been packaged in all kinds of special contracts (like e.g. service contracts, rate contracts) in which volume, loyalty and all kind of qualitative aspects play an important role.

IN FIGURES

It is clarifying to have a notion of the rate at which carriers are adding capacity. Appendix 1-6 gives an outline of the market power of the three biggest alliances, viz. the CHKY Alliance, the Grand Alliance and the New World Alliance, in comparison with the other independent market players. It compares the capacity in TEU terms and in number of ships deployed within the alliance with the fleet capacity of the members of the alliance. The last two columns show the number of services and vessels for the Far East-Europe service. The figures in italic represent the changes between 2006 and 2009.

A first view at the data reveals that no alliance controls more than the independent family-based Maersk Line and MSC do. The biggest strategic cooperation, in fleet terms, is the CHKY alliance with a share of 12.67 %. Between 2006 and 2009, the CHKY alliance and the Grand Alliance saw their market shares diminished.

In each alliance there is a partner that dominates. In the Grand Alliance, the role and weight of NYK and Hapag-Lloyd is likely to be more significant than that of smaller partners. As stated before, MISC left the Grand Alliance on January 1st, 2010. The same situation applies to the New World Alliance where APL is the major contributor in terms of shared tonnage. While in the CHKY Alliance, Hanjin controls about 29 % of the deployed ships, COSCO dominates the CHKY alliance in TEU terms. The column 'average ship size' shows that COSCO shares larger ships.

Between 2006 and 2009, the average size of container ships, measured in terms of slot capacity, grew within each alliance.

In 2009, the CHKY alliance operated 8 loops with 8 to 9 ships on the Far East-Europe service. Except for MSC and CMA CGM, each market player cut services and removes ships from the Far East-Europe trade.

To sum up, for medium-sized liner carriers membership of an alliance is an essential way in which to compete with the major independent carriers (e.g. Maersk Line, MSC, CMA CGM).

1.2.3 Full-scale cooperation

Whereas the consortia system, which was limited to the deep-sea leg of a single trade lane, was a response to the investment pressure resulting from containerisation, modern worldwide alliances were a response to globalisation of the production and distribution processes. Another strategic response by shipping companies to globalisation in terms of management strategy side is a merger and acquisition strategy or a full-scale cooperation. The globalisation of the economy gave a new élan to consolidation. The shipping companies had no other choice but to follow this trend.

Although from an economic point of view, full-scale cooperation seems to be a logical sequel to alliances, in practice, these mergers do not grease the wheels of business (e.g. the birth pangs of P&O Nedlloyd, the difficult digestion of the acquisition of P&O Nedlloyd by Maersk Sealand) because of the different corporate cultures, the accompanying rationalisation, etc.

The statement by Brooks (2000) that "*the pattern of mergers and alliances changed dramatically between 1995 and 1998 and has, in all likelihood, not reached its final configuration*" has been confirmed during the last decade.

The empirical part of the study considers the impact of mergers and acquisitions (see Chapters 4, 5 and 6).

1.3 Competitive policy

The merger of Royal P&O Nedlloyd and Maersk Sealand (2006)[30] and the abolishment of the anti-monopoly immunity of freight conferences are two recurrent topics in this

30 See Subsection 1.1.3.

study. These two notable developments have greatly impacted liner operators and other maritime interests (e.g. shipper).

This section outlines the regulation of competition in the (container) liner shipping industry[31]. Most countries have some anti-trust regulation. Within the scope of this research, the anti-trust legislation in the US and the competition policy of the European Union (EU) are examined.

1.3.1 Federal Maritime Commission

The current American point of view on liner competition is encapsulated in the 1998 amendments to the Shipping Act of 1984, called the Ocean Shipping Reform Act (known as OSRA'98). The Shipping Act provides for a specialised competition authority, viz. the Federal Maritime Commission (FMC). This independent regulatory agency monitors and reviews almost all types of collaborations among liner operators (called agreements) for their potential impact on prices and services. The Shipping Act exempts liner operators from the generally applicable antitrust laws, if the arrangements they conclude are filed and reviewed by the FMC. If the FMC finds that a particular agreement is expected to produce an inequitable increase in transportation prices (through a reduction in competition), or an unreasonable decrease in transportation service, it may bring suit in a federal district court.

From time to time since 1998, there have been debates in the US about the pros and cons of the current American approach[32]. Presently, renewed pressure has been building among US legislators for either an end or a review of the limited anti-trust immunity granted to ocean carriers operating on US trades. The decision whether to repeal or modify the Ocean Shipping Reform Act which governs the regulatory regime remains open.

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[31] More information regarding the U.S. law and regulations and the EU competition policy can be found by consulting the FMC's website (www.fmc.gov), the webpage of the European Commission, Directorate-General for Competition (DG Comp. - ec.europa.eu/ competition/ sectors/ transport/ legislation_maritime.html) or the press releases/ studies available on the webpages of ELAA (www.elaa.net > media) and ESC (www.europeanshippers.com/ > document library). Brooks (2000) and Stopford (2009) summarise the history of regulation of competition in liner shipping. Furthermore, this debate is widely addressed by a great many authors (see Subsection 1.4.1.1).

[32] For a discussion relative to liner shipping, see govinfo.library.unt.edu/ amc/ index.html > Commission Hearings > McCarran-Ferguson Act and the Shipping Act (October 18th, 2006))

1.3.2 European Union

Until October 2008, the European Union (EU) had granted liner operators' pricing agreements a block exemption from the generally-applicable competition law (Regulation No 4056/ 86). Under pressure from shippers' lobbying efforts (e.g. European Shippers' Council, ESC) to remove anti-trust immunity from liner conferences, the EU determined in September 2006 that liner shipping should not enjoy any special immunity from the generally-applicable competition laws; rather, liner shipping should be treated as every other (non-exempt) industry and remain subject to the same prohibitions and penalties as other commercial actors. On October 18th, 2008, liner shipping operations to and from European Union countries became fully subject to EC competition law following the repeal of a regulation that had granted conferences wide-ranging anti-trust immunity[33].

What consequences does the abolition of liner conferences serving Europe, including the Far Eastern Freight Conference[34], have for the industry? Firstly, as of October 18th 2008, all EU and non-EU carriers which currently take part in conferences operating on trades to and from the EU, have to end their conference activities, in particular price-fixing and capacity regulation, on those trades. It follows that former members of liner conferences have had to establish their own tariffs and surcharges.

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33 Since liner conferences are still tolerated in other jurisdictions, pressure from Shippers' Councils is building among other legislators (e.g. United States, China) to imitate the European action or to review the limited anti-trust immunity granted to ocean carriers in non-EU trade routes and thus promote further competitive improvement of the liner shipping sector. With regard to antitrust immunity, the American competition authority, viz. the Federal Maritime Commission, is not yet persuaded of the positive impact of this abolishment. However, the idea lives to introduce legislation that would further limit antitrust immunity (i.e. eliminate rate and capacity discussions among carriers, but allow operational agreements).

34 The Far Eastern Freight Conference (FEFC) - generally accepted as the second conference to be founded, after the Calcutta Steam Traffic Conference - was formed in 1879 (Stopford, 2009).

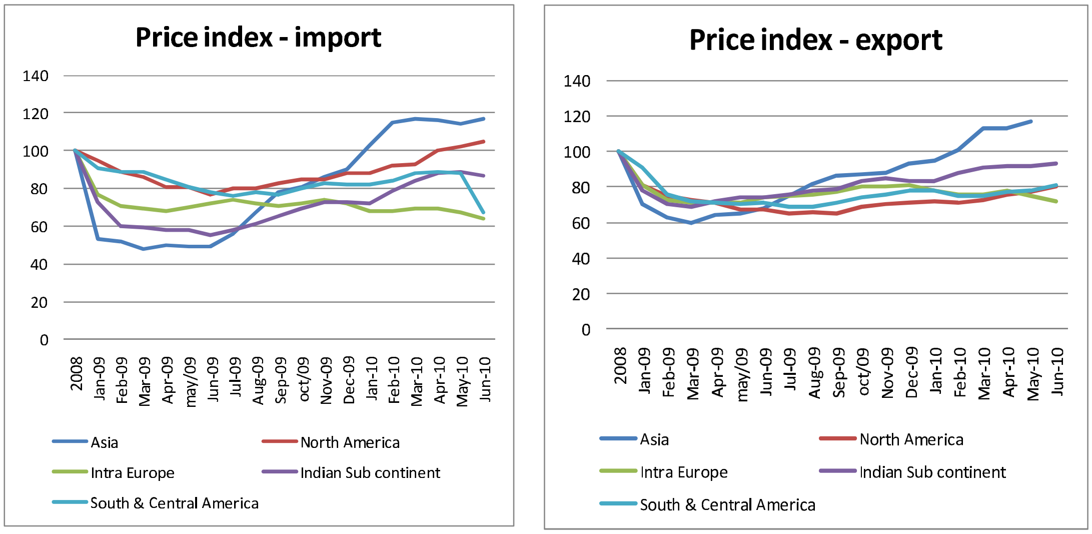

Figure 1-5 a/b: Evolution price index import/export

Freight rates have undergone enormous fluctuations in the period after the abolition of the block exemption[35]. Figure 1-5 a/ b provides evidence of this evolution by plotting the three-monthly aggregated price index by trade direction (import and export)[36]. With the average rates for 2008 as its base of 100, an initial decline can be observed in all trades. The Asia and the Indian Sub Continent/ Middle East levels about halved, while in other corridors, the decline was relatively less severe. In an effort to shore up rates after the abolition of the liner conferences, most liner operators announced an increases in their rates. Since the last quarter of 2009, the freight rates have recovered. Solely the import price index of Asia and North America exceeded the 2008 levels. The Asian export price index rose above the 2008 level. Freight rates need to rise further if the container shipping business is once again to become profitable (see also Chapter 5).

Given the decline in freight rates during the first half of 2009 to a level well below breakeven point, additionaly, the liner operators have reduced their capacity in several ways (e.g. by taking tonnage out of service, postponing delivery of new vessels and reducing speed) as well as staff cut backs (e.g. Maersk Line, Evergreen, etc.). Most liner operators re-routed their operations from Europe to Asia to transit the longer Cape of Good Hope route (+ 14 days) avoiding transit fees for the Suez Canal[37]. Apart from

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35 Note, the fluctuation of the freight rates might also be related to the financial and economic crisis.

36 The data have been compiled by Container Trade Statistics (CTS), the successor group to the European Liner Affairs Association (ELAA - www.elaa.net).

37 Container vessels pay between 50 USD – 80 USD per TEU per transit of the Suez Canal, excluding ancillary fees (www.suezcanal.gov.eg).

cost-cutting, it is also a measure that minimises the risk posed by piracy activities. In the meantime, some liner operators reversed their decision due to escalating bunker fuel prices and faster transit times.

From a shippers' perspective, the abolition resulted, consequently and not surprisingly, in different rates applied across liner operators. The multiplicity and diversity of rates applied by shipping companies are putting an extra burden on shippers, who have to make extra efforts to keep track of them all. Next, schedule reliability has also decreased since the abolition of conferences in Europe rate volatility (Drewry, 2010). Cost cutting initiatives, including the rerouting of vessels around the Cape of Good Hope, have extended transit times (average duration has been lengthened from 8-9 weeks on to 10-11 weeks) and the inventory, all of which implied higher costs for the shippers.

To sum up, rate volatility and carrier service levels have continued to deteriorate. The abolishment of the block exemption has had an impact on liner operators and other maritime interests, the on-going global economic downturn notwithstanding.

The empirical part of this study aims to provide a frame of reference regarding the degree of concentration and competition in the container liner shipping industry. There are as yet insufficient data to test the impact of the abolition of liner conferences and the financial and economic downturn on the competitive nature of the container liner shipping industry.

1.4 Conceptual framework

The conceptual framework gives an overview of the research study and puts it in perspective.

This section is divided into four parts. The first part reviews the relevant literature. The second describes the rationale of the research. The third part states the research questions and the construction of the hypotheses. Finally, a thesis outline completes the conceptual framework.

1.4.1 Literature

In setting up a theoretical framework for this doctoral study, a first step was to review the (container) liner shipping literature regarding competition, concentration and market structure.

This subsection presents the results of this review process, and then briefly outlines the developments in the Industrial Organisation (IO) literature that are relevant for this research. Finally, it focuses on some key elements of oligopoly theory.

1.4.1.1 The (container) liner shipping literature

Concentration in the (container) liner shipping literature has been reviewed. Brooks (2000, pp. 206-7) states that the four-firm concentration ratio and the Herfindahl-Hirschman Index (HHI) are interesting tools to evaluate market concentration and the potential for abuse. Additionally, she refers to a study by Davies (1990) that found a low HHI for the transatlantic trades between 1983 and 1988. Two other studies are one by Hoffman (1998) who addresses the issue of concentration and one by Notteboom (2004) who only reports the four-firm concentration ratio based on the Top 20 for the years 1980, 1995, 2000 and 2003.

A review of the liner shipping literature on assessing competition reveals that a number of studies theoretically examine competition in the liner shipping industry (e.g. Molenaar & Van de Voorde, 1994 and Brooks, 2000). Only few studies focus on modelling competition (e.g. Sjostrom, 2002). The literature focused on the (de-) regulation of the liner shipping industry for quite some time (e.g. EC DG COMP, 1997 and 2007; Heaver, 2001; OECD, 2002; ELAA, 2003; Benacchio *et al.*, 2007). Finally, Endo (2005) applies the Panzar and Rosse model to study the competitive nature of the liner shipping industry using a sample of three major Japanese liner carriers covering the 1986-2002 period. In reviewing the literature on competition for the containerised liner shipping industry, it is found that assessing competition for this shipping segment has remained insufficiently explored.

The scientific literature as well as various maritime reports and discussion groups, clearly offer no consensus regarding the market structure[38]. An oligopolistic market is

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[38] Some examples illustrating this:
In 1998, Hoffman declared that the first market structures in the majority of the shipping routes had become less oligopolistic in recent years. Secondly, he stated that “The tendency toward treating ‘a box as a box as a box’ also reflects the declining monopoly power of liner companies and their conferences”.
In a paper prepared on behalf of the Ocean Common Carrier Coalition for submission to ACCOS, industry consultants Booz-Allen & Hamilton, Inc., assert that “the liner industry is emerging as a network business” which “is almost universally regulated because their economic characteristics are such that they tend strongly to monopoly”.
In March 2003, the Japanese Shipowners' Association (JSA) stated that “A repeal of the immunity system would lead to destructive competition among carriers which may result in an oligopoly situation in liner shipping …”.

often assumed. The rationale is found in, for example, the simultaneous changes of surcharges, sharing information between liner partners with regard to a joint service, etc.

The feature of the literature revealed by review is that the terms 'liner shipping industry' and 'container liner shipping industry' are loosely used throughout. A clear-cut definition of the containerised liner shipping industry is called for (see Chapter 2[39]). Secondly, the (container) liner shipping literature on the degree of concentration and competition is fairly sparse. This can largely be attributed to data limitations, but also to the fact that competition is difficult to observe directly.

In contrast, empirically assessing the degree of competition is a recurrent topic in the literature on other newly liberalised service sectors, especially the banking industry. A review of this literature reveals methodologies to assess competition, concentration and market structure. In addition, it shows that the academic literature on the measurement of competition can be divided into two mainstreams, i.e. the structural and the non-structural approach. The former is based on the structure-conduct-performance (SCP) hypothesis, which laid the foundation for the development of industrial organisation as a separate field within economics. The non-structural approach for the measurement of competition refers to a more recent empirical framework for measuring competition: the New Empirical Industrial Organisation (NEIO) methodology. Furthermore, competition is also viewed as a dynamic process. Another strand of literature, the Persistence of Profits (PoP), includes these market dynamics. These academic lines of thought on the assessment of competitiveness will briefly be outlined in the next section.

1.4.1.2 Developments in IO literature

The Industrial Organisation (IO) literature focuses on firm behaviour in imperfectly competitive markets. In this subsection, the developments in the IO literature from traditional methods to new empirical IO approaches is broadly outlined. Figure 1-6 gives an overview of this development related to competition and the present research.

In November 2006, Chris Welsh (FTA) noted that due to the conference system the liner shipping industry had been evolving from a monopolistic structure towards an oligopolistic market structure. Mid 2010, contributors to IFW's Linkedin group believed the container shipping industry is like an oligopoly, because of the way it behaves (www.ifw-net.com).

[39] Adding 'in an environmentally sound manner (e.g. low emission, environmentally friendly technologies, etc.)' could upgrade the definition, and 'including inland transportation' could enlarge its scope.

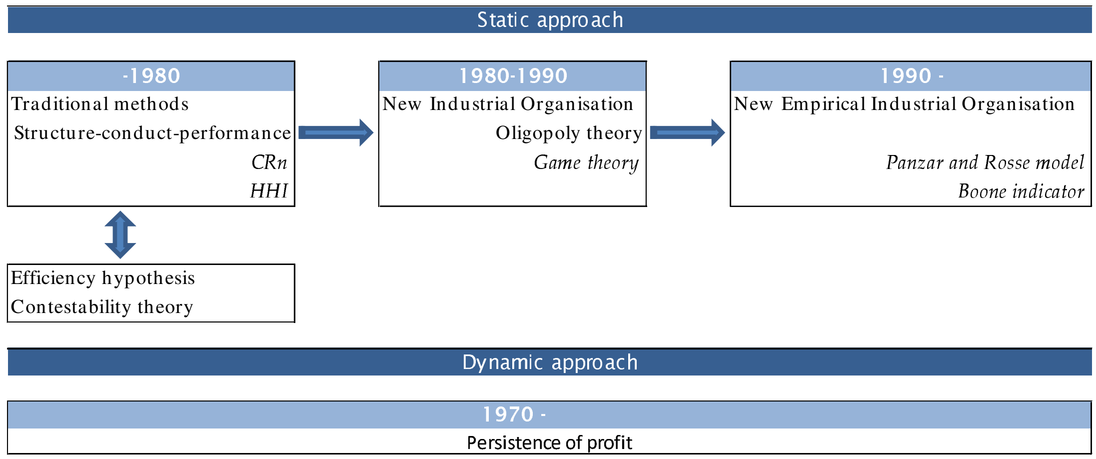

Figure 1-6: Developments in the IO literature

TRADITIONAL METHODS

Many early IO studies of market structure are based on the traditional **structure-conduct-performance (SCP) paradigm**. This SCP paradigm, which was originally developed by Bain (1956), argues that observable structural characteristics of a market determine the behaviour of firms within that market, which in turn influences the market performance of those firms. To test the SCP hypothesis, a measure of the firms' profitability is regressed on a proxy for market concentration. In empirical SCP studies, the n-firm concentration ratio (CRn) and the Herfindahl–Hirschman Index (HHI) are most frequently used as an exogenous indicator of market power or an inverse indicator of the intensity of competition (Berger, 1995). A positive relationship is expected as the basic idea of the SPC hypothesis is that the higher the concentration in a market, the lower the competition which in turn leads to a higher profitability.

A first step in the research was the testing of the SCP hypothesis for the containerised liner shipping industry covering the 1999-2010 period (see Chapters 2 and 3).

The SCP paradigm is challenged by the efficiency hypothesis and the contestability theory. Primarily, the efficiency-structure hypothesis (ES) is an alternative hypothesis to explain the expected positive relationship between concentration and competition. This hypothesis tests whether it is the efficiency of larger firms that makes for enhanced performance. According to the ES hypothesis, firms with superior efficiency improve their market shares and become more profitable (Demsetz, 1973). Both approaches focus on profitability, rather than on the deviation of output price from marginal cost, which is the correct theoretical basis for analysing competitive conditions (see below).

The second theory that challenges the SCP paradigm is the contestability theory. This theory, originally developed by Baumol *et al.* (1982) emphasises that a concentrated industry may nonetheless behave competitively when barriers to entry and exit are surmountable. If the barriers to entry and exit are low, potential entrants might enter a market and provide fresh competition to established firms. The contestability theory refers to "*a small number of incumbent firms or a single incumbent, whose market power is constrained by the threat of potential entry*" (Lipczynski *et al.* , 2009). A market is perfectly contestable when the costs of entry and exit by potential rivals are zero, and when such entry can be made very rapidly. Therefore, structural barriers, entry-deterring strategies and sunk costs are excluded. The reality, however, is that no market is perfectly contestable. In other words, virtually every market is contestable to some degree. If so, the threat of potential entry might keep the prices of liner operators already in the market low, so that they make normal profits and produce as efficiently as possible, taking advantage of any economies of scale. Criticism of the theory includes (i) that it does not sufficiently take into account the possible reaction of the incumbents and (ii) that its results are of a strictly static and equilibrium nature.

Neither competing theory has been tested for the containerised liner shipping industry. Regarding the efficiency-structure hypothesis, Berger (1995) proposes a simultaneous equation to test the impact of concentration and competition (see Chapter 5). Data limitations prevented this reduced form from being tested. The contestability theory has not been tested for different reasons. Firstly, the exclusion of structural entry barriers and sunk costs is unrealistic in general. To some extent structural barriers exist, and exit is not without cost in the case of the container liner shipping industry (see Chapter 6). Secondly, this theory is of a static nature while competition is dynamic by definition. Thirdly, the (container) liner shipping industry is often compared with air transport. Two studies (Hurdle *et al.*, 1989; Strassmann, 1990) found no evidence in favor of the contestability markets theory (Lipczynski *et al.*, 2009). Last but not least, some maritime economists (e.g. Heaver, 1993; Pearson, 1987; Jankowski, 1989) and regulators (i.e. Federal Maritime Commission, 1989; the European Commission, 1989) have extensively refuted the application of the theory of contestable markets to the liner shipping sector.

The importance of efficiency and the threat of entry is, however, recognised in the present thesis. Both issues will be addressed by new empirical IO approaches (see Chapters 5 and 6 respectively).

‘MODERN’ IO APPROACH[40]

In the late 1970s, the formal oligopoly theory replaced the non-formal framework of the SCP paradigm that had been implemented with little theoretical guidance. This coincided with the introduction of game theory, a major tool of the **New Industrial Organisation** (NIO) economists. This development pushed the literature in a theoretical direction. According to Besanko *et al.* (2004), game theory is “*the branch of economics concerned with the analysis of optimal decision making when all decisions makers are presumed to be rational, and each is attempting to anticipate the likely actions and reactions of its competitors*”.

Game theory has provided both practical insights (e.g. conduct and performance are not just functions of structural market characteristics, such as concentration, barriers to entry) into the competitive process and the basis for the new empirical industrial organisation (NEIO) literature. This latter development in the Industrial Organisation literature integrates both theory and econometrics.

Since the theoretical static game theory is not without criticism (e.g. assumption of rational players, difficult to test empirically, etc.), the present study prefers the methods proposed in the NEIO literature. This empirical literature incorporates more industry and firm-specific details in modelling.

NEW EMPIRICAL IO APPROACHES

Two new empirical IO approaches are adopted in this doctoral research.

Firstly, criticism levelled against the structural approach (e.g. too much emphasis on industry structure, one-way causality from market structure to performance, etc.)[41] has motivated a number of authors (Rosse, Panzar) to collect empirical evidence on the nature of competition by observing conduct directly. This approach has been labeled as the **New Empirical Industrial Organisation (NEIO) approach**, the next step in the stream of empirical research after the SCP literature. Unlike the empirical literature on SCP, the NEIO approaches to measuring competition do not depend on concentration but observe directly the conduct in specific industries with the aim to draw conclusions about structure. Two such approaches, the Panzar and Rosse model and the Boone indicator, are reviewed and tested in this study.

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40 A suggestion for further reading: Church & Ware, 2000, Bikker & Haaf, 2002, Lipczynski et al. 2009, etc.

41 For a checklist of criticism: see Lipczynski et al., 2009.

Panzar and Rosse (1987) propose a reduced form approach to discriminate between monopoly, monopolistic competition and perfect competition using industry or firm-level data by using an estimated indicator, the H-statistic (see Chapter 4).

The Boone indicator of competition is another way to measure competition. The central idea is that more efficient firms are expected to show better performance in terms of profits or higher market shares. The Boone indicator aims to capture both the ways in which competition in a market can be strengthened, viz. a fall in entry barriers and more aggressive conduct by established firms (Boone, 2000).

The differences between both approaches are twofold. First, the Panzar and Rosse methodology seems well designed to investigate the competitive nature of the industry and to compare competition across markets (read trade lanes), whereas the Boone indicator looks at the change in competition over time in a certain industry. Second, while the Panzar and Rosse model is based on the sum of the factor price elasticities of the reduced-form revenue equation, the Boone indicator relies on the idea of elasticity of profits towards marginal costs, i.e. profit elasticity. Hence, both approaches have different data requirements (Degrijse *et al.*, 2009). To calculate the Panzar and Rosse H-statistic, information on the input factor prices is required. Data on the input factor prices are often not accessible whereas measurement about revenue and costs may be available or can be proxied/ estimated.

From academic and policy points of view, it would be quite interesting to examine the competition at trade level. Although both NEIO methodologies require relatively moderate amounts of data, information on input factor prices, revenues and costs is hard to collect at trade level. Consequently, the analysis of competition by adopting NEIO methodologies is confined to industry level in this thesis.

BEYOND SCP AND NEIO

A caveat of the essentially static structure-conduct-performance and the NEIO framework, which is currently the preferred empirical approach[42], is the fact that both approaches focus on equilibrium, and consequently may not capture industry dynamics. In contrast, the Persistence of Profits (PoP) literature examines the dynamic structure-performance relationships, as threatened or potential entry is as important as actual

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[42] It should be noted that the SCP paradigm, which increasingly frequently uses improved econometric estimation techniques, is still applied even though to a lesser degree.

entry in determining the intensity of competition. To this end, this dynamic approach uses time series data to control for disequilibrium effects.

The main idea can be formulated as follows: if any positive relationship between concentration and profits is expected to continue to future time periods and if such findings are attributed to market power, it can be argued that incumbents are effectively isolated from potential competitors by entry barriers and that consequently their high profits will persist. Exogenous changes in cost and demand conditions, as well as competition within the market and entry from outside the market, can undermine the persistence of profits (Mueller, 1977, 1986 and 1990; Geroski, 1990).

To sum up, while the relationship between market structure and performance has been studied at length in different industries, little has been done to explore this relationship in the (container) liner shipping industry.

The contribution of the doctoral research to the literature is fourfold. Firstly, it offers a definition of the containerised liner shipping industry (see Chapter 2). Starting from an appropriate definition of the container liner shipping industry might help to delineate the relevant market for competition issues. Creusen *et al.* (2006) note that a bias in the relevant market affects all indicators (see also Chapter 5). Secondly, it contributes to the literature by applying both the traditional and the new empirical methods to the containerised liner shipping industry. The results are relevant for the ongoing debate on market structure (see Chapters 2 and 4). Thirdly, as it may take time for the effects of competition and efficiency to materialise, empirical estimations with a dynamic view complete the competition analysis (see Chapters 5 and 6). Finally, next to the impact of efficiency on performance its analysis also comprise changes in competition that may be due to developments in container liner shipping specific factors (e.g. being involved in mergers and acquisitions, being a member of an alliance). The impact of these industry specific factors is also verified, as they may affect the extent of competition as well.

1.4.1.3 Oligopoly theory

Since both the SCP and the NEIO approach are based on microeconomic (oligopoly) theory, in which optimising behaviour is assumed, it is worthwhile to elaborate on some principles of oligopoly theory.

Lipczynski *et al.* (2009) summarise the theory of oligopoly as follows: "*In the theory of oligopoly it is assumed the number of firms is small (but greater than one). The firms recognise their interdependence: changes in price or output by one firm will alter the profits of rival firms causing them to adjust their own prices and output levels. Forms of competition under oligopoly vary from vigorous price competition, which can often lead to substantial losses, through to collusion, whereby the firms take joint decisions concerning their prices and output levels*".

The fewness of the firms is the key identifying characteristic of an oligopoly. 'Fewness' can be measured by the four-firm concentration ratio (see Chapters 2 and 3).

Fewness is closely related to the nature of the product. If liner operators would produce a differentiated product (heterogeneous oligopoly), they might not see each other as competitors. However, the transportation of a container or standardised box is assumed to be a highly identical product or service across liner operators. Hence, the more homogeneous (undifferentiated) the product, the more acutely liner operators should be aware of their competitors (i.e. recognise interdependence).

Microeconomics offers many models of oligopolistic markets. These may be divided into cooperative and non-cooperative oligopolies. Here, it is assumed that liner operators behave independently or non-cooperatively. Non-cooperative oligopoly makes a distinction between quantity and price setting models. Quantity setting models are often referred to as Cournot models, which are static models of oligopoly. The Bertrand model is essentially the Cournot-Nash model except that the strategic variable is price rather than quantity. Both models describe an industry that produces homogeneous products or services[43].

Liner operators can be thought of as Cournot competitors, viz. they chose capacity (number of vessels, vessel size) without knowing their competitors choice and then compete as price setters while capacities become common knowledge. Price competition is the final stage of competition. The equilibrium outcome of this two-stage competition coincides with the Cournot equilibrium.

The standard intuition of the HHI is based on a Cournot model. Boone (2000 and 2004) has developed a broad set of theoretical models. Following the study by van Leuvensteijn *et al.* (2007), most studies rely on the Boone *et al.* (2004) model (i.e. using a

[43] A discussion of the models is beyond the scope of this research: for further reading see Martin, 2002, Besanko et al., 2004, Lipczynski et. al, 2009 and Besanko & Braeutigan, 2009.

standard Cournot model with a downward sloping linear demand function) for their application of the theory.

1.4.2 Rationale of the study

The previous sections reveal that, despite academic and policy interest, there is still no comprehensive view as to whether or not competition in the container liner shipping industry has become fiercer and why.

The general objective of the present study is twofold. The first objective is to assess the competitive conditions, the concentration and the market structure of the container liner shipping industry. The second objective is to document and estimate both (static/ dynamic) structural and non-structural measurements of competition in the containerised liner shipping industry.

After studying the developments in the CLSI, the rationale for this thesis became clear. First, the past decade was a period of significant merger and acquisition (M&A) transactions (see Chapter 2, Appendix 2-2). These successive waves of consolidation may have influenced the degree of concentration. Next, the CLSI has experienced fundamental changes which might affect competition. Knowledge of the degree of competition is important to antitrust authorities. This offers an extra incentive to examine the degree of competition. Another stimulus stems from the literature. The evolution of industrial organisation theory towards the new empirical industrial organisation modelling motivates an understanding of the degree of concentration and competition by applying both the structural and the non-structural approach.

The next step in the research process is to develop the central research question(s) and the associated hypotheses.

1.4.3 Central research questions and hypotheses

Given the developments in the container liner shipping industry, the doctoral thesis addresses two research questions:

RQ1 *Is there an oligopoly in the container liner shipping industry?*

RQ2 *If the container liner shipping industry is concentrated, does this concentration affect the performance of liner operators?*

These research questions are worth examining because the market structure under which a carrier operates will determine its behaviour. This behaviour will in turn affect the liner operators' performance: its price setting, profits, efficiency.

Subsequently, the central research question was translated into hypotheses. The following hypotheses play a central role in the testing of the structural and non-structural theories in the containerised liner shipping industry. An overview of the hypotheses is presented in Figure 1-7.

Hypotheses 1-4 propose an answer to the first research question while hypotheses 6-8 tackle the second research question. Hypotheses 8, 9 and 10 do not directly address the research questions, but complement the analysis. The last hypothesis tests whether the indicators agree on competition.

After developing the hypotheses rooted in the central research questions, calculations, estimations, testing statistical hypothesis, etc. were preformed to test whether the research hypothesis could be confirmed.

Regarding hypothesis 3, the econometric results indicate a non-linear relationship between concentration and market share instability at industry level. At trade level, concentration is negatively related to market share instability. The empirical results suggest that the both hypotheses 5 and 8 can be rejected.

Having phrased the central research questions and formulated the hypotheses, the structure of the doctoral thesis is outlined.

	Hypothesis	(Re)search information	
1	The container liner shipping industry has become more concentrated due to consolidation.	Defining the container liner shipping industry	Chapter 2
		Visualising the process of consolidation	
		Quantifying the degree of concentration in the container liner shipping industry	
2	The market structure in which the container liner shipping industry operates is an oligopolistic market.	Determining the degree of oligopoly Industry level level of alliances Trade level	
3	Concentration is positively related to market share instability	Quantifying the degree of concentration in the container liner shipping industry Industry level Trade level	Chapter 3
		Calculating the indicator of magnitude of market share instability Industry level Trade level	
		Testing the relationship between concentration and market share instability	
4	The containerised liner shipping industry market structure corresponds to a neoclassical monopolist, collusive oligopolist or conjectural-variations short-run oligopolist.	Reviewing Panzar and Rosse literature	Chapter 4
		Estimating the Panzar and Rosse H-statistic to assess the degree of competition	
		Discussing the econometric results	
5	Competition has been intensified over time	Analysing the profitability in the container liner shipping industry.	Chapter 5
		Reviewing industrial organisation literature	
		Reviewing Boone literature	
		Estimating the Boone indicator	
		Discussing the econometric results	
6	Container liner operators can freely enter/ exit the stated industry	Studying the dynamics in the containerised liner shipping	Chapter 6
		Studying the freedom of entry/ exit and entry/ exit conditions at trade level	
7	(Potential and actual) entry into and exit from any market are sufficiently free to bring any abnormal profits quickly into line with the competitive rate of return?	Testing the persistence of profit hypothesis	
8	Optimal ship size and optimal operations develop hand in hand	Defining both concepts 'optimal ship size' and 'optimal operations'	Chapter 7
		Outlining the link between both concepts	
9	The optimal ship size evolves towards the deploying of larger vessels and depends on with transport segment, terminal concept, trade lane and technology	Inventarising the driving variables behind the growth in size of the containership	
10	The split economies of scale curve turns into a U-shaped curve.	Studying the economies of scale in deploying larger vessels using a liner service cash flow model.	
11	The structural and non-structural indicators support competition	Comparing the outcomes of different measurements	Chapter 8
		Examining and discuss the coherence between the HHI and the Boone indicator	

Figure 1-7: Hypotheses

1.4.4 Outline of the thesis

The thesis consists of a bundled set of research papers that deal with a common theme. The issue competition is the connecting thread between the papers. The thesis is composed in eight chapters, each dealing with one aspect of the central theme and linked to one or more hypotheses.

The papers were written as autonomous publications. This explains some unavoidable overlap between the chapters. The reference list is be found at the end of each chapter while an index and glossary can be consulted at the end of the text.

Figure 1-8 visualises how the study is organised. It represents the relationship between the literature, the chapters and the methodologies used. The main linkages between concentration, market structure and competition are shown by the double arrows.

As for the remainder of the study, chapters two and three cover the market structure of the container liner shipping industry from the perspective of Industrial Organisation (IO) economics. Chapter two first defines the terms ‘relevant market' and ‘container liner shipping industry'. Subsequently, it calculates and discusses a number of alternative concentration measures and the magnitude of market share instability in the container liner shipping industry. Finally, the link with the degree of oligopoly is shown. Chapter three continues on this issue at an aggregated and disaggregated level and tests an empirical model for examining the determinants of market share instability.

Chapters four and five introduce two models viz. the Panzar-Rosse model and the Boone indictor in accordance with the New Empirical Industrial Organisation literature. Chapter four documents and estimates the Panzar and Rosse model, a non-structural methodology used to assess the degree of competition in the CLSI. While the Panzar-Rosse model allows to exclude certain states of competition, an increase cannot be unambiguously interpreted as more competition. Therefore, chapter five presents and applies the Jan Boone's new model-based measure of to answer the question how competition in the container liner shipping industry evolves over time.

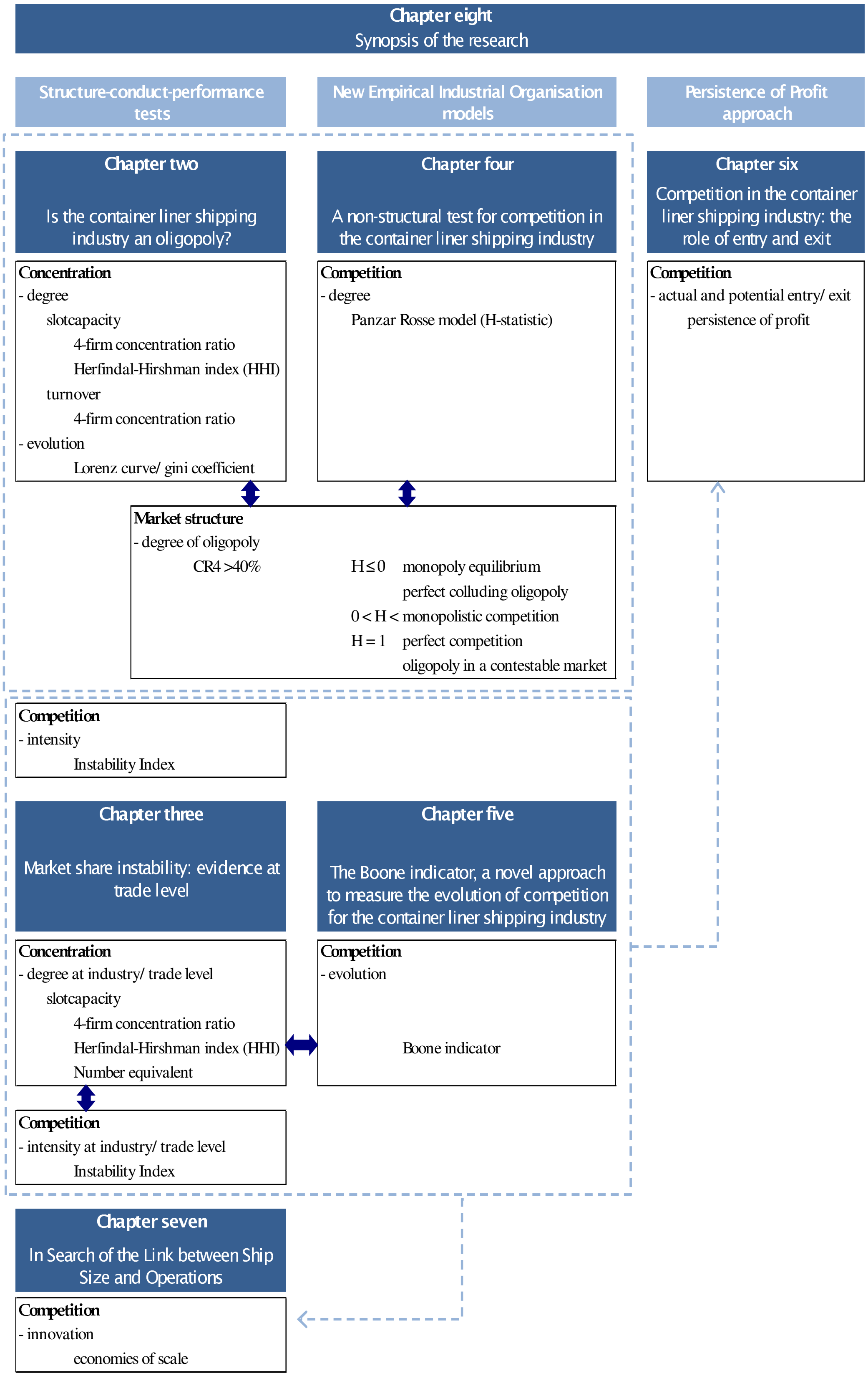

Figure 1-8: Outline of the thesis

The last two chapters go one step further and search an explanation for the obtained results. Therefore, chapters six and seven cover the actual/ potential entry and economies of scale, respectively. Chapter six examines a further important structural attribute of industries: barriers to entry. It starts with the study of the freedom of entry/ exit and entry/ exit conditions, both at industry and at trade level. Secondly, in contrast with the essentially static structure-conduct-performance and the new empirical industrial organisation frameworks, which dominate the analysis of competition in the empirical literature, chapter six is devoted to the persistence of profit methodology that captures the unobservable threat of entry. Chapter seven defines 'optimal ship size' and 'optimal operations' and outlines the link between both concepts. It does so by quantifying the economies of scale in deploying larger vessels by using a liner service cash flow model.

Finally, Chapter eight ties the other chapters together. It examines to what extent the structural and non-structural indicators agree on the competition. This analysis is reflected by the dotted lines in Figure 1-8. The analysis also links the findings with chapters 6 and 7 (see dotted arrows).

1.5 References

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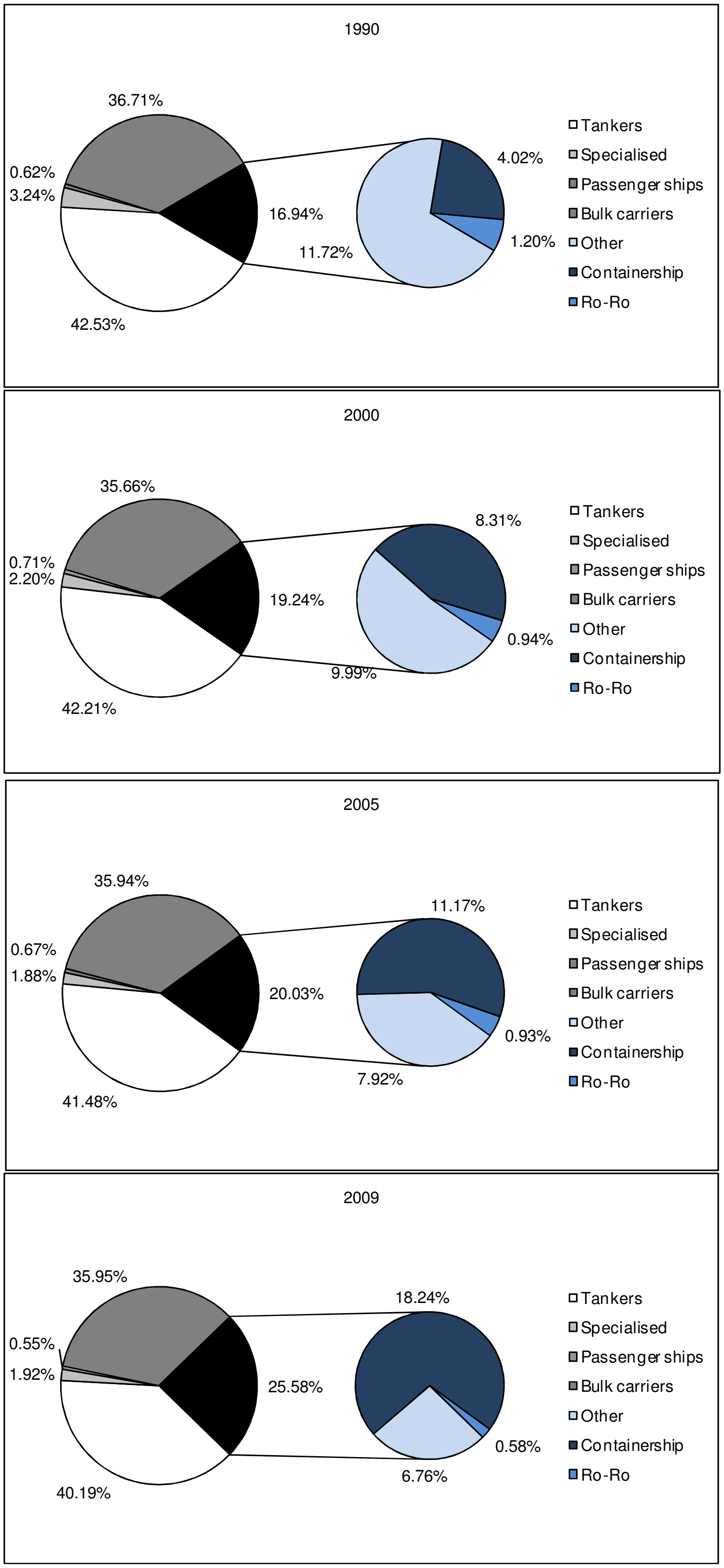
Appendix 1-1: Market segmentation 1990-2010



Source: compiled with data from ISL, 2009

Appendix 1-2: Top 25 carriers 2000-2010

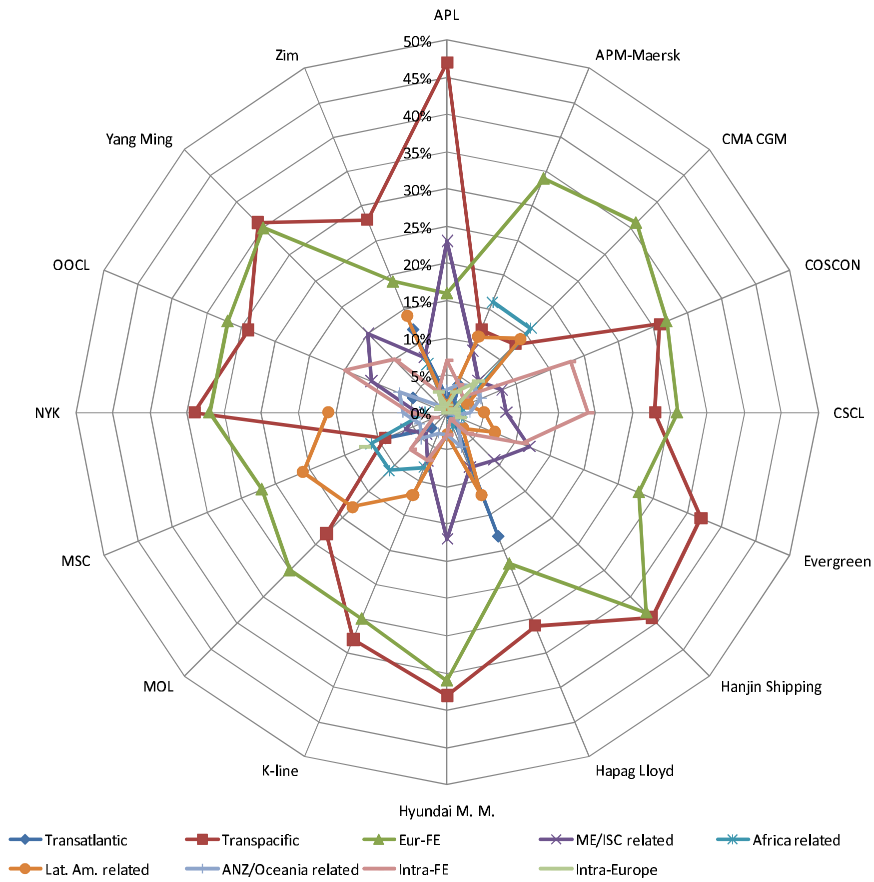
		2000			2010										
		Total			Total		Owned		Chartered				Orderbook		
Rank 2010	Operator	Rank 2000	TEU	Ships	TEU	Ships	TEU	Ships	TEU	Ships	% Chart	Market share	TEU	Ships	% existing
1	**APM-Maersk**				2,044,981	538	1,135,988	210	908,993	328	44.4%	14.99%	352,924	64	17.3%
	Maersk-SL + SCL	1	620,324	282											
	P & O Nedlloyd	3	280,794	126											
2	**Mediterranean Shg Co**	5	224,620	128	1,488,196	388	836,306	203	651,890	185	43.8%	10.91%	556,408	45	37.4%
3	**CMA CGM Group**	12	122,848	72	1,031,327	353	354,388	87	676,939	266	65.6%	7.56%	497,512	59	48.2%
4	Evergreen Line	2	317,292	137	559,023	151	319,263	87	239,760	64	42.9%	4.10%			
5	APL	6	207,992	77	549,508	139	172,289	45	377,219	94	68.6%	4.03%	137,564	18	25.0%
6	**Hapag-Lloyd**	14	102,769	43	462,288	113	258,829	58	203,459	55	44.0%	3.39%	122,500	14	26.5%
	CP Ships / Americana	9	141,419	78											
7	COSCO Container L.	7	198,841	114	453,204	134	271,897	93	181,307	41	40.0%	3.32%	409,826	53	90.4%
8	CSCL	18	86,335	72	453,009	125	250,099	71	202,910	54	44.8%	3.32%	150,400	16	33.2%
9	Hanjin Shipping	4	244,636	84	440,299	99	95,488	18	344,811	81	78.3%	3.23%	261,948	28	59.5%
10	NYK	8	166,206	79	407,300	106	312,516	61	94,784	45	23.3%	2.99%	101,944	16	25.0%
11	K Line	13	112,884	51	342,043	90	198,611	36	143,432	54	41.9%	2.51%	150,090	28	43.9%
12	MOL	10	136,075	63	341,820	91	148,706	27	193,114	64	56.5%	2.51%	150,673	27	44.1%
13	CSAV Group	20	69,745	43	328,721	96	34,821	7	293,900	89	89.4%	2.41%	109,063	18	33.2%
14	OOCL	16	101,044	43	324,209	71	224,260	39	99,949	32	30.8%	2.38%	102,164	14	31.5%
15	Yang Ming Line	17	93,348	36	312,962	77	195,437	46	117,525	31	37.6%	2.29%	141,402	22	45.2%
16	**Hamburg Süd Group**	21	68,119	39	310,477	104	136,812	37	173,665	67	55.9%	2.28%	89,400	14	28.8%
17	Zim	11	132,618	76	305,523	94	147,896	34	157,627	60	51.6%	2.24%	203,826	21	66.7%
18	Hyundai M.M.	15	102,314	29	274,529	53	74,407	12	200,122	41	72.9%	2.01%	71,810	6	26.2%
19	UASC	19	74,989	45	196,237	49	113,596	27	82,641	22	42.1%	1.44%	122,078	10	62.2%
20	PIL (Pacific Int. Line)	24	60,505	63	190,355	108	127,810	78	62,545	30	32.9%	1.40%	61,762	15	32.4%
21	MISC Berhad	26	41,738	31	125,101	39	43,894	18	81,207	21	64.9%	0.92%	34,000	4	27.2%
22	Wan Hai Lines	22	63,525	55	125,060	66	106,967	55	18,093	11	14.5%	0.92%	32,050	11	25.6%
23	HDS Lines	42	18,454	35	96,325	31	38,333	8	57,992	23	60.2%	0.71%			
24	Sea Consortium	43	17,562	27	54,751	48	3,426	2	51,325	46	93.7%	0.40%			
25	RCL (Regional Container L	28	26,355	32	53,435	39	44,700	34	8,735	5	16.3%	0.39%	2,086	2	3.9%
Total Top 25			3,833,351	+140.67%	9,225,702										
World fleet			6,182,630	+120.66%	13,642,601										

Source: compiled with data from Alphaliner-Top 100 (www.alphaliner.com/ top100/ index.php). Figures refer to January 1st of each year.

Notes: *APM-Maersk* includes Maersk Line, Safmarine, MCC, Mercosul Line and OACL; *MSC* includes WEC Lines; *CMA CGM group* includes CMA CGM, Delmas (with OTAL), ANL, US Lines, Feeder Associated system, Cagema, MacAndrews, Cheng Lie Navigation and CoMaNav; *Evergreen Line* includes Evergreen Marine Cooperation, Evergreen Marine (UK) Ltd, Evergreen Marine (HK) Ltd and Italia Marittima; *CSCL* includes Shanghai Puhai Shipping Company; *NYK Line* includes Tokyo Sepaku Kaisha; *CSAV group* includes CSAV, CSAV-Norasia, Libra (Brasil) and Libra Uruguay; *Hamburg Süd group* includes Hamburg Süd and Aliança; *ZIM* includes Gold Star Line and Laurel Navigation and *PIL* includes Advance Container Line, Pacific Eagle Line, Pacific Direct Line and Malaysia Shipping Corporation.

European liner operators are marked in bold. Liner operators involved in an alliance are shaded.

Appendix 1-3: Liner operators breakdown of TEU capacity deployed by trade



	Transatlantic	Transpacific	Eur-FE	ME/ISC related	Africa related	Lat. Am. related	ANZ/Oceania related	Intra-FE	Intra-Europe	Unassigned or idle
APL	2%	47%	16%	23%		1%	3%	7%	1%	0%
APM-Maersk	4%	12%	34%	9%	16%	11%	4%	4%	3%	3%
CMA CGM	1%	13%	36%	6%	16%	14%	5%	3%	6%	0%
COSCON	1%	31%	32%	8%	2%	3%	5%	18%	1%	-1%
CSCL		28%	31%	8%	2%	5%	3%	19%	1%	3%
Evergreen	1%	37%	28%	12%	2%	7%	1%	11%	2%	
Hanjin Shipping	1%	39%	38%	9%	1%	3%	2%	4%		3%
Hapag Lloyd	18%	31%	22%	8%	2%	12%	5%	1%	0%	1%
Hyundai M. M.		38%	36%	17%		3%	3%	3%		0%
K-line		33%	30%	7%	8%	12%	3%	7%		0%
MOL	3%	23%	30%	4%	11%	18%	5%	7%		0%
MSC	9%	9%	27%	6%	11%	21%	4%	2%	12%	-1%
NYK		34%	32%	4%	3%	16%	6%	5%		0%
OOCL	5%	29%	32%	11%			7%	15%	1%	0%
Yang Ming		36%	35%	15%			1%	10%	1%	0%
Zim	12%	28%	19%	8%	7%	14%		3%	3%	6%

Source: compiled with data from AXS-Alphaliner, 2010b.

Appendix 1-4: Types and nature of liner shipping cooperation

	Type	Author	Nature of co-operation
Cooperation on rates	Conference	Frankel (1985), Gardner (1997)	an agreement reached by shipping companies operating liner services for the purpose of regulating or restricting competition with the objectives of a relative stability of rates, regularity and realising reasonable frequency of sailings while maintaining services to less remunerative ports.
Operational cooperation	Stabilisation agreement	Canna (1992)	a voluntary agreement to reduce the level of overcapacity in order, eventually, to increase unremunarative rate levels.
	Slot charter	Jon (1986)	an agreement by which a liner service operator leases part of the slot on another's ships and markets that slot as his own
	Pooling agreement	Frankel (1985)	an agreement between shipping companies in order to increase the pool's share of the market, provide an equitable distribution of beneftis among members, limit service competition and rationalise operations.
	Joint service	Frankel (1985), Gardner (1994)	an agreement which establishes a new and separate line or service to be operated jointly by partner companies. The service fixes its own rates, publishes its own tariffs, issues its own bills of lading, and acts generally as a single carrier.
	Consortium	Koch (1975), Bras (1991)	a cooperative venture of varying degree of closeness in which shipping companies involved operate under one name by pooling all or some of their activities in a particular trade.
	Joint venture	Koch (1975), Frankel (1985)	an agreement in which each party has a share of ownership as shareholders, in one separate and legally autonomous venture and the participants jointly own or lease vessels, equipment, and terminals. The venture has its own management.
	Global alliance	Thanopoulou et al. (1997)	an agreement between container shipping companies co-operating on a global trade rout basis involving usually the provision of multimodal and logistics services as well.
	Merger and acquisition	Jones (1982)	a fusion of two companies. The assets become vested in and under the control of one company.

Source: Ryoo, D.K., 1999

Appendix 1-5: Formation of alliances

Period 1			Period 2			
1994		1995	1996	1997	1998	1999
Hapag Lloyd NYK MOL	Hapag Lloyd NYK NOL		**Grand Alliance** Hapag Lloyd NYK NOL P&OCL	**Grand Alliance** Hapag Lloyd NYK OOCL P&O Nedlloyd	**Grand Alliance II** Hapag Lloyd NYK OOCL P&O Nedlloyd MISC	**Grand Alliance II** Hapag Lloyd NYK OOCL P&O Nedlloyd MISC
			CP Ships (Cast)	CP Ships (Lykes, Contship)	CP Ships (Ivaran, ANZ)	CP Ships
Nedlloyd CGM MISC		APL MOL OOCL Nedlloyd MISC	**Global Alliance** APL MOL OOCL Nedlloyd MISC	**Global Alliance** APL MOL OOCL (P&O Nedlloyd) MISC	**New World Alliance** APL/NOL MOL HMM	**New World Alliance** APL/NOL MOL HMM
Cosco	Cosco		Cosco	Cosco		
ACE consortium K-Line NOL OOCL	MOL K-Line OOCL APL		K-Line Yang Ming Line HMM	Cosco K-Line Yang Ming Line HMM	**CKY Alliance** Cosco K-Line Yang Ming Line	**CKY Alliance** Cosco K-Line Yang Ming Line
CSAV	CSAV		CSAV	CSAV	CSAV	CSAV
CMA	CMA		CMA	CMA	CMA	
HMM Norasia Yang Ming Line	HMM Yang Ming Line		HMM Norasia MSC	HMM Norasia MSC	CMA CGM Norasia	CMA CGM Norasia[2]
MSC					MSC	MSC
Maersk P&OCL	Maersk Sea-Land	Sea-Land HMM	Maersk Sea-Land	Maersk Sea-Land	Maersk Sea-Land	Maersk Sea-Land
Sea-Land						
DSR-Senator Cho Yang	DSR-Senator Cho Yang	*Tricon-Consortium* DSR-Senator Cho Yang Hanjin	DSR-Senator Cho Yang Hanjin	DSR-Senator Cho Yang Hanjin UASC	**United Alliance** Cho Yang Hanjin-Senator UASC	**United Alliance** Cho Yang Hanjin-Senator UASC
Hanjin	Hanjin					
UASC	UASC					
Evergreen	Evergreen	Evergreen LT	Evergreen LT	Evergreen LT	Evergreen LT	Evergreen LT
LT	LT					

1 Cho Yang went bankrupt (2001)
2 CSAV acquired Norasia (June 2000)
3 Senator went bankrupt (2009)

Appendix 1-5: Formation of alliances (ctd.)

Period 3							Period 4				
2000	2001	...	2003	...	2005	...	2006	...	2007	...	2010
Grand Alliance II	**Grand Alliance II**		**Grand Alliance II**		**Grand Alliance III**		**Grand Alliance III**		**Grand Alliance III**		**Grand Alliance IV**
Hapag Lloyd	Hapag Lloyd		Hapag Lloyd		Hapag Lloyd (CP Ships)		Hapag Lloyd (CP Ships)		Hapag Lloyd		Hapag Lloyd
NYK	NYK		NYK		NYK		NYK		NYK		NYK
OOCL	OOCL		OOCL		OOCL		OOCL		OOCL		OOCL
P&O Nedlloyd	P&O Nedlloyd		P&O Nedlloyd		MISC		MISC		MISC		
MISC	MISC		MISC								MISC
CP Ships (TMM, OCA)	CP Ships		CP Ships (Italia Line)								
New World Alliance	**New World Alliance**		**New World Alliance**		**New World Alliance**		**New World Alliance**		**New World Alliance**		**New World Alliance**
APL/NOL	APL/NOL		APL/NOL		APL/NOL		APL/NOL		APL/NOL		APL/NOL
MOL	MOL		MOL		MOL		MOL		MOL		MOL
HMM	HMM		HMM		HMM		HMM		HMM		HMM
CKY Alliance	**CKHY Alliance**		**CKHY Alliance**		**CKHY Alliance**		**CKHY Alliance**		**CKHY Alliance**		**CKHY Alliance**
Cosco	Cosco		Cosco		Cosco		Cosco		Cosco		Cosco
K-line	K-Line		K-Line		K-Line		K-Line		K-Line		K-Line
Yang Ming Line	Yang Ming Line		Yang Ming Line		Yang Ming Line		Yang Ming Line		Yang Ming Line		Yang Ming Line
	Hanjin-Senator		Hanjin-Senator		Hanjin-Senator		Hanjin-Senator		Hanjin-Senator[3]		Hanjin
	UASC		UASC		UASC		UASC		UASC		UASC
CSAV (Norasia)	CSAV (Norasia)		CSAV (Norasia)		CSAV (Norasia)		CSAV (Norasia)		CSAV (Norasia)		CSAV (Norasia)
CMA CGM	CMA CGM		CMA CGM		CMA CGM		CMA CGM		CMA CGM		CMA CGM
MSC	MSC		MSC		MSC		MSC		MSC		MSC
Maersk Sea-Land	Maersk Sea-Land		Maersk Sea-Land		Maersk Sea-Land		Maersk Sea-Land		Maersk Line		Maersk Line
					P&O Nedlloyd		P&O Nedlloyd				
United Alliance											
Cho Yang[1]											
Hanjin-Senator											
UASC											
Evergreen			Evergreen/LT		Evergreen/LT		Evergreen/LT		Evergreen Line		Evergreen line
LT											

Appendix 1-6: Major alliances vs. independent carriers, comparison 2009 with 2006

	deployed in alliances						fleet capacity										Far East-Europe services			
Alliance	n° of ships		1000 TEU		av. ship size (in TEU)		n° of ships		1000 TEU		operator % of total		av. ship size (in TEU)		max. ship (in TEU)		n° of services		vessels in service	
CHKY Alliance	**178**	***-15***	**1,002.4**	***134.9***	**5,631**	**1,136**	**332**	***26***	**1,371.2**	***300.9***	**12.67%**	**-1.13%**	**4,130**	**632**			**8**	**-3**	**66**	**-20**
Hanjin	51	*-5*	278.4	*-3.7*	5,458	420	79	*-1*	352.6	*23.4*			4,464	349	5,620	*-2,560*				
K-Line	37	-3	205.0	22.3	5,539	971	78	*9*	292.6	*61.4*			3,751	400	10,060	*4,440*				
Cosco	49	*-4*	308.4	*58.8*	6,293	1,584	99	*10*	439.0	*120.9*			4,435	861	8,180	*-1,200*				
Yang Ming Line	41	-3	210.6	*57.5*	5,135	1,655	76	*8*	287.0	*95.2*			3,777	956	5,500	*0*				
Grand Alliance	**138**	***18***	**826.5**	***198.7***	**5,976**	**744**	**324**	***30***	**1,310.7**	***320.7***	**12.11%**	**-0.65%**	**3,815**	**448**			**5**	**0**	**46**	**7**
NYK	45	*7*	280.4	*93.5*	6,231	1,313	110	*11*	421.0	*128.1*			3,827	868	6,260	*0*				
Hapag Lloyd	49	2	270.9	*31.8*	5,528	441	122	*-5*	471.6	*46.8*			3,865	520	8,750	*0*				
OOCL	37	*6*	233.8	*47.5*	6,319	309	72	*18*	341.0	*102.7*			4,736	323	8,060	*0*				
MISC	7	*3*	41.4	*25.9*	5,915	2,040	20	*6*	77.1	*43.1*			3,853	1424	4,469	*0*				
New World Alliance	**105**	**7**	**580.4**	***90.9***	**5,271**	**276**	**253**	***67***	**1,023.4**	***328.3***	**9.45%**	**0.49%**	**3,586**	**-151**			**3**	**-1**	**27**	**-4**
APL	40	-3	215.6	*3.0*	5,390	446	104	32	430.1	*142.4*			4,135	139	8,110	*2,348*				
HMM	29	2	166.0	*32.7*	5,725	788	48	*10*	231.5	*77.4*			4,823	768	7,471	*711*				
MOL	36	*8*	198.8	*55.2*	5,522	393	101	*25*	361.8	*108.5*			3,582	249	6,800	*400*				
Maersk Line							466	*35*	1,894.1	*433.6*	17.50%	-1.33%	4,065	676	12,508	*4,058*	7	-2	67	-4
MSC							369	*140*	1,387.2	*612.8*	12.81%	2.83%	3,759	377	9,178	*0*	6	3	57	27
CMA CGM							282	*125*	895.4	*426.8*	8.27%	2.23%	3,175	190	9,415	*1,015*	8	3	62	26
Others							1,188	*217*	2,943.2	*643.6*	27.19%	-2.45%	2,973	173	8,914	*630*	37	-14	83	-35
Total fleet							3,214	*640*	10,825.2	*3,066.7*	100.00%		3,332	318						

Source: compiled with data from ISL (2009).

Notes: N° of ships refers to fully cellular container ships of 1,000 TEU and over. *Maersk Line* incl. Royal P&O Nedlloyd and Safmarine; *CMA CGM* incl. ANL-CL; *Hanjin* incl. Senator Line and *Hapag-Lloyd* incl. CP Ships.

Chapter 2

2 Is the container liner shipping industry an oligopoly? [44]

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.

Keywords:

Container liner shipping industry, oligopoly, concentration measurement

[44] The paper is published in Transport Policy, 16, pp. 259-270. 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.

2.1 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, 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 October 18th, 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 and 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.

2.2 The industry's concentration level

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

2.2.1 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).

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, p. 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 and 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) (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 Line) 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 2.2.5) and at trade level respectively (see Section 2.3.2).

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. 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.

2.2.3 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).

2.2.3.1 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[45]. In this paper, the product is taken to be homogeneous[46], 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 1999-2009 period.

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:

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

(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 summing the squared market share of all liner operators in the

45 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.

46 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).

industry, and then adding up those squares. Shepherd (1999) gives the following formula for the Herfindahl-Hirschman Index (HHI):

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

where n = the number of carriers and s_i = the share of the i^{th} 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 1,000 is considered to be unconcentrated and unlikely to be subject to any adverse competitive effects. A value between 1,000 and 1,800 generally indicates moderate concentration. Any value over 1,800 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

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

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

2.2.3.2 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:

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

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 (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).

2.2.4 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 1999-2009 period 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/ 1,000 (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.

2.2.5 Results at the level of the industry

The results of the CLSI's concentration level can be found in Figure 2-1 (Figures refer to January 1st of each year). Figure 2-1 shows 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?

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%	26.22%	24.66%	29.05%	31.08%	30.92%	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	0.66537	0.6717	0.68286	0.70012	0.70881	0.71989	0.75685	0.76071	0.7664	0.7716
Δ			0.01875	0.00632	0.01117	0.01726	0.00868	0.01108	0.03696	0.00386	0.0057	0.0052
Total turnover												
CR4							42.67%	44.20%	49.70%			
							26.55%	28.88%	32.14%			

Figure 2-1: Measurement of concentration

First, a study of the market shares gives useful preliminary information on the degree of concentration. Appendix 2-1 shows that the Top 25 carriers had a market share (measured by share of total carrier capacity) of about 69.38 % in 2003 to 85.41 % in 2008. The market share of the top-ten liner operators accounts for 60 percent of the total TEU capacity. Of these ten, four are Europe-based companies with 38.29 % of the total and the Top 3 of these account for 34.07 % of the total share[47]. Compared with 2003 (when the top three 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 (see Figure 2-1). From these

[47] See Appendix 2-1. Liner operators in bold are Europe-based carriers. Carriers participating in alliances are shaded.

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.

	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	COSCO Container L.
8	P&O Containers	NYK	CMA-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

Figure 2-2: Liner operators making up 50 % of total capacity in service

Figure 2-2 lists the number of players in the CLSI making up 50 % of total capacity in service (compiled from data from AXS-Alphaliner). 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 1,000 – 1,800 limits, the containerised shipping industry must still be considered unconcentrated. Regardless of the calculation basis, the HHI is never higher than 1,000. 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 2-2 (compiled from data from AXS-Alphaliner and Dynamar - various editions). Appendix 2-2 consists of two panels. The left-hand side panel summarises the mergers, acquisitions and takeovers by the Top 30 liner operators. The right-hand side panel mirrors the liner operators opting to grow organically.

Next, Figure 2-3 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.

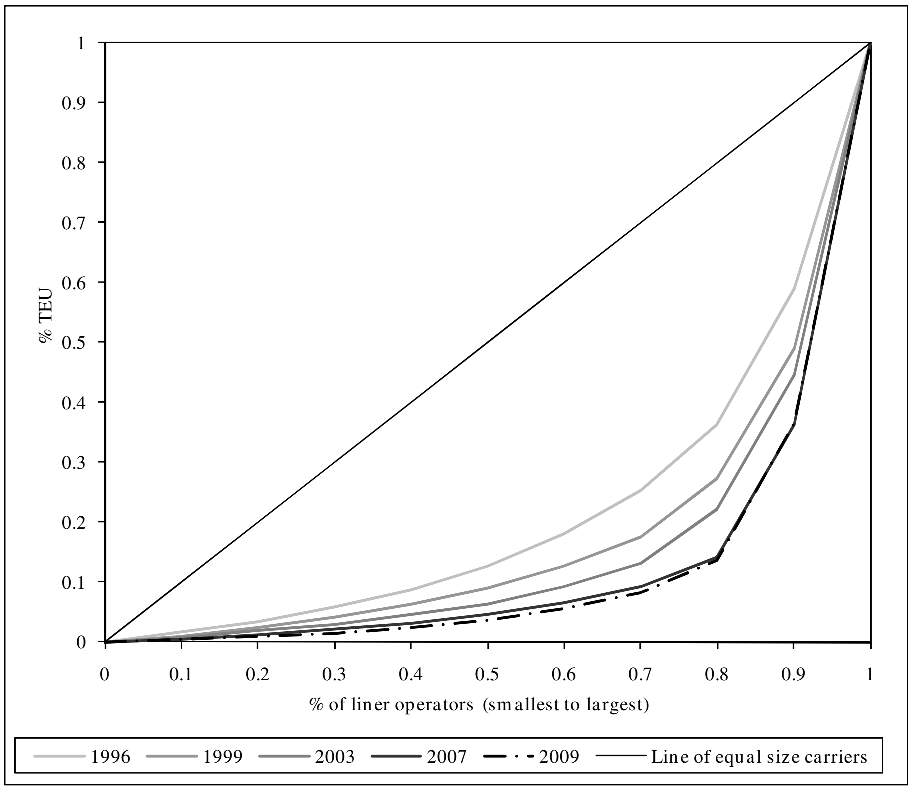


Figure 2-3: Lorenz curve

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 that 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. Figure 2-4 shows graphically the evolution of the instability index on a yearly base.

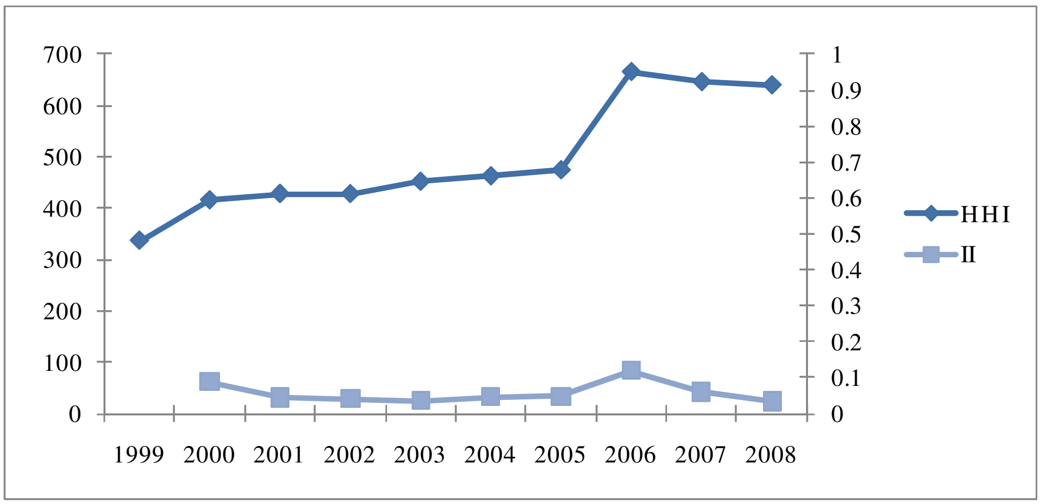


Figure 2-4: Evolution of the Herfindahl-Hirschman Index and the instability index

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.

2.2.6 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 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.

Figure 2- 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.

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	16.60%
	CHKY ALLIANCE	1,264,640	11.93%
	GRAND ALLIANCE	1,251,016	11.80%
	TNWA	927,618	7.46%
	TOTAL	5,322,217	47.79%

Figure 2-5: Market share of the alliances

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 11.93 %. Since the takeover of Royal P&O Nedlloyd by Maersk Sealand (since then known as Maersk Line), the 'new' Grand Alliance saw its share diminish from 13.97 % (2003) to 11.80 % (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.

2.2.7 Increased concentration

After analysing the most important concentration figures, it can be concluded 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 Figure 2-1).

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 Figure 2-6). This deceleration can also be seen in Figure 2-1 – Gini coefficient and Figure 2-3. For the largest liner operators segment the curves 2007 and 2009 are overlapping.

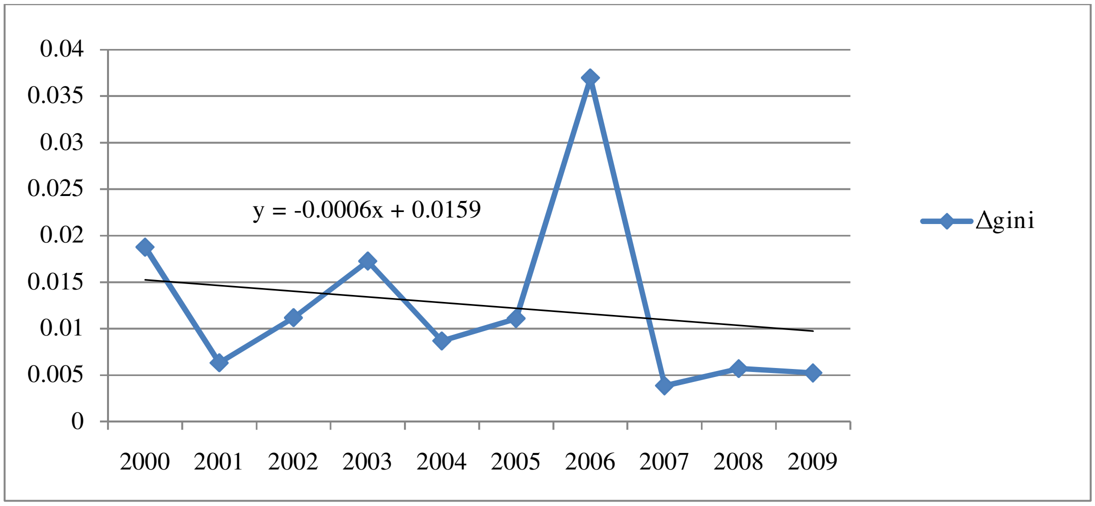


Figure 2-6: Δ Gini coefficient

Nonetheless the liner shipping industry is still a very highly fragmented industry (cf. HHI values lower than 1,000). In 2008 only 20 liner operators had a share of +1 % (see Section Appendix 2-1). 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 (Japan and Korea), car carrying, and specialised reefer shipping sectors) (Vanelslander, 2005).

Having calculated the concentration figures, Section 2 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.

2.3 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 per cent 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 2.3.1) and at trade level (Section 2.3.2).

2.3.1 Industry level

The previous section (Section 2 – Figure 2-1) 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 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 Figure 2-7). 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 < 1,000) (see Figure 2-1). A rejection of this assumption would be incorrect.

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%
		loose oligopoly or effective competition	four liner operators holds 25 % to 60% + 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	

Figure 2-7: Types of markets

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 2-1) 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 2.3.2).

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.

2.3.2 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 present research, due to shortage of data, only two trades were studied. Figure 2-8 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[48]. 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 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).

[48] For convenience of comparison the TEU totals (*1,000, 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 U.S. Global Container Report (Dynamar, 0907).

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%
Crowley LS					
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%	

Figure 2-8: Trade analysis

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 Figure 2-1), 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 Figures 2-7 and 2-8). 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

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

(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 1,254.58 (> 1,000). 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. Figure 2-9 shows 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.

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%**

Figure 2-9: C4 ratio at trade level

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 Figure 2-9).

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.

2.4 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 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 since 2007.
- 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.

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Appendix 2-1: Market share of the Top 25

2008 Rank	Company	2008 Total TEU	Market share (top 25)	Cumul. market share	Market share /world fleet	Cumul. market share/ world fleet	2006 Total TEU	Market share (top 25)	Cumul. market share	Market share /world fleet	Cumul. market share/ world fleet	2003 Total TEU	Market share (top 25)	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				

Appendix 2-2: Mergers and takeovers

Rank	Liner operator	Rank	Liner operator
1	A.P. Moller Maersk		
	Maersk Line (Takeover Aug. 2005) (Renamed Feb. 2006)		
	Maersk-Sealand (July 1999)		
	Maersk		
	Sealand		
	Torm Lines (Sept. 2002)		
	Royal P&O Nedlloyd (April 2004)		
	P&O Nedlloyd (Jan. 1997)		
	P&O Container Lines		
	Nedlloyd		
	Blue Star Line (Feb. 1998)		
	Farrell Line (2000)		
	Oceanica AGW (renamed Mercosul Line) (2000)		
	MCC Transport Singapore Pte Ltd		
	Norfolk Line Containers		
	Norse Merchant (July 2005)		
	Safmarine Contianer Lines (Jan. 1999)		
	Unicorn Lines (2002) (renamed Ocean Africa Container Line - 2004)		
	SCF Oriëntal Lines (2004)		
		2	Mediterranean Shg Co
3	CMA CGM		
	CMA CGM (1999)		
	CMA		
	CGM		
	CGM (1977)		
	MessMar		
	Transat		
	Australian National Lines (ANL) (1998)		
	Cagema		
	Cheng Lie Navigation Ltd. (2007)		
	CoMaNav (2007)		
	Delmas (2006)		
	Setramar (2001)		
	OTAL (2005)		
	Sudcargos (Sept. 2005)		
	United Baltic Corp. (Andrew Wier) (Dec. 2002)		
	MacAndrews & Ellerman Iberian (Andrew Wier) (Dec. 2002)		
	Delom SA (2002) (controlling interest - 80%)		
	Feeder Associate Systems (FAS)		
	Gemartrans		
4	Evergreen Line (2007)		
	Evergreen		
	Hatsu Marine Ltd. (2002)		
	Lloyd Triestino (July 1998) (renamed Italia Maritima)		
5	Hapag Lloyd (Oct. 2005)		
	Hapag Lloyd		
	CP Chips		
	Italia di Navigazione (May 2002)		
	TMM (2000)		
	Christensen Canada-Africa Line (2000)		
	ANZDL (Sept. 1998)		
	Ivarans ((May 1998)		
	Contship Container Lines (Oct. 1997)		
	Lykes Lines (July 1997)		
	Cast (Mar. 1995)		

Appendix 2-2: Mergers and takeovers (ctd.)

Rank	Liner operator	Rank	Liner operator
6	CSCL		
	Shanghai Puhai Shipping Company (2005)		
	Universal Shipping		
		7	COSCO Container L.
8	APL/NOL (Nov. 1997)		
	APL		
	NOL		
		9	NYK
		10	OOCL
11	Hanjin/Senator (Feb. 1997)		
	Hanjin		
	DSR-Senator (renamed Senator Lines - 2002)		
12	MOL		
	P&O Neddlloyd (Nov. 2005) (SAECS trade)		
		13	K Line
		14	Zim
15	Hamburg Süd		
	Costa Container Lines (Dec. 2007)		
	Gilnavi srl di Navigazione (2004)		
	FOML (renamed FESCO Austrialia New Zealand Liner Services (FANZL)) (Mar. 2006)		
	Ybarra (renamed Ybarra Süd) (Jan. 2006)		
	Columbus Line (2004)		
	Kien Hung Line (April 2003).		
	Ellerman deep-sea services (Andrew Wier) (Dec. 2002)		
	Crowley American Transport (2000)		
	Aliança (1998)		
		16	Yang Ming Line
17	CSAV		
	Norsul container activities (2002)		
	Norasia (2000)		
		18	Hyundai M.M.
19	PIL		
	Advanced Container Lines (1994)		
	Pacific Direct Line (2006)		
	Pacific Eagle Lines		
20	Wan Hai		
	Interasia (July 2005)		
	Trans-Pacific Lines (Nov. 2002)		
		21	UASC
		22	MISC Berhad
		23	IRIS Lines
24	Grimaldi		
	Finnlines (June 2005)		
	Nordö Link (April 2002)		
	ACL (2002)		
		25	RCL (Regional Container L.)
		26	Sea Consortium
		27	CCNI
		28	Maruba + CLAN
		29	Swire Shipping
		30	TS Line

Chapter 3

3 Market share instability: evidence at trade level

Abstract[49]

The aim of this paper is to study how the intensity of competition in the container liner shipping industry evolves over time. Therefore, the Hymer-Pashigian index of market share instability has been used to indicate the level of competitiveness at both industry and trade level. In addition, the relationship between concentration and the Hymer-Pashigian index of market share instability is examined. The findings indicate the presence of an inverted U-shaped relationship between concentration and market share instability at industry level. At trade level, concentration is negatively related to market share instability and evidence is provided that the variable ‘growth’ (in terms of volume) plays a major role in affecting the dynamics of market share. In the policy context, regulators should focus on trade level since the effects are more clearly identified when working at the disaggregated level rather then at aggregated industry level.

Keywords:

Container liner shipping industry, competition, instability index, market share, concentration

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[49] Thanks are due to Prof. dr. H. Meersman and Prof. dr. G. Blauwens for comments and Prof. dr. E. Van de Voorde for inspiration.

3.1 Introduction

When the European Commission banned liner conferences in October 2008[50], shippers hoped for a better service and lower freight rates as a result of more competition. In contrast to service and freight rates, competition is not directly perceptible. Therefore, an indirect measurement, viz. the Hymer Pashigian index of market share instability will be used to determine whether competition increased.

The aim of this paper is to explore the dynamics of competition in the container liner shipping industry (hereafter abbreviated as CLSI). Since, liner operators compete with each other not only within the total container liner shipping market but rather within sub-markets (read trade lanes), this paper focuses on the degree of competition both at industry (Section 3.2) and trade level (Section 3.3). It contributes to the CLSI competition literature in applying the market instability index next to the static concentration measures. Static measures include the four-firm concentration ratio and the Herfindahl-Hirshman Index[51].

The remainder of the paper is organised in two main sections. Successively, the indicator of concentration and the indicator of magnitude of market share instability are calculated and discussed both at industry (Section 3.2.2 and 3.2.3) and trade level (Section 3.3.2 and 3.3.3). Next to it, an empirical model is presented to examine the determinants of market share instability followed by the empirical results (Section 3.2.4: industry level and Section 3.3.4: trade level). Finally, conclusions will be drawn about the competitiveness at both industry and trade level.

3.2 Container liner shipping industry

This section firstly presents the used data. Subsequently, the indicators of concentration and the intensity of competition are computed and discussed. Finally, the relationship between concentration and the market share instability is examined.

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50 "…[T]he European Commission has granted a block exemption from the competition rules for conference liner operators since 1986. A Block Exemption Regulation defines certain categories of agreements which are compatible with EU competition rules provided that the agreements meet the conditions laid down in the Regulation. In March 2003, the European Commission's Directorate General for Competition announced a review of Regulation 4056/ 86. On September 25th, 2006, the Council agreed to repeal Regulation 4056/ 86. By consequence, it puts an end to the coordination of prices, charges and surcharges as well as coordinated capacity management in European Union trades as of October 2008. Since that date, liner operators have to fix their own freight rates and any surcharge (European Commission, 1997 and 2007; ELAA, 2003)" (Sys *et al.*, 2010).

51 Appendix 3-1 summarises the calculation of the concentration measures used in this paper.

3.2.1 Data

To calculate the indicators of concentration and the indicator of magnitude of market share instability, one needs individual data of the top 4 liner operators, together with the data for the entire containerised liner shipping industry. Therefore, the Top 100 of Alphaliner has been annually surveyed (AXS-Alphaliner, various editions).

Capacity data is the basis for calculating market shares at industry level rather than turnover. According to Hymer and Pashigan (1962) and Sakakibara and Porter (2001), a turnover measure is inappropriate as it is responsive to the dispersion of firm sizes within a market. So, the n-firm concentration ratio (CRn) is computed as the existing on board TEU (twenty equivalent unit) capacities of n liner operators compared to the fleet effectively deployed by each operator (see also Sys, 2009).

The value of the absolute changes in liner operators' market shares forms the basis for the calculation of the instability index. When calculating the instability index, it is sufficient to restrict attention to liner operators with market shares of 0.01 or larger. As the contribution of liner operators with smaller market shares do not affect the instability index significantly. To study the determinants of market share instability, data regarding industry growth, price of secondhand ships, etc. is collected from Drewry Container market annual review and forecast (Drewry, various editions).

3.2.2 Indicators of concentration

A reasonable accurate assessment of the likely nature of competition in a market is to look whether the market is concentrated or not. Figure 3-1 gives an overview of the measures of concentration at industry level.

First, a common measure of market structure is the n-firm concentration ratio. Figure 3-1 shows that the largest liner operator (CR1) doubled its market share over the period 1999-2010. This is the result of mergers. Since the takeover of Royal P&O Nedlloyd by Maersk Sealand (since then known as Maersk Line), the world biggest liner operator saw its share diminishing from 19.23 % in 2006 to 16.44 % in 2010.

The top four liner operators (i.e. Maersk Line (before takeover of Sea-land), Evergreen/ Uniglory, P&O Nedlloyd and Hanjin/ DSR-Senator) held 25.83 % of the market in 1999. By January 1st, 2010, the leaders (i.e. Maersk Line (after several mergers and acquistions – e.g. Sealand, P&O Nedlloyd), MSC, CMA CGM group and Evergreen) controlled 41.18 % of the containerised liner shipping market. A CR4 of 40 % serves as a benchmark for an oligopolistic market (Martin, 2002). Hence, the market structure in which the CLSI operates would be an oligopolistic market since 2007 (in bold).

The market share of the top-ten liner operators (CR10) accounts for 63.41 % in 2010, up from about 50 % in 1999. The results reveal that the CLSI is becoming more concentrated (see also Sys, 2009).

Industry level												
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CR1	8.34%	12.88%	13.25%	12.63%	12.93%	13.13%	13.21%	19.23%	17.53%	16.84%	16.49%	16.44%
CR4	25.83%	30.37%	30.94%	31.03%	32.90%	33.21%	32.84%	39.67%	**40.91%**	**41.27%**	**41.42%**	**41.18%**
CR10	50.90%	52.68%	52.66%	53.54%	55.39%	55.67%	56.40%	63.26%	63.61%	63.48%	63.50%	63.41%
HHI	336.20	415.34	427.54	427.37	451.34	462.24	473.91	665.93	646.22	640.00	644.07	647.26
NE	30	24	23	23	22	22	21	15	15	16	16	15

Figure 3-1: Degree of concentration at industry level[52]

Secondly, another commonly used measure of market structure is the Herfindahl-Hirschman Index (HHI). The HHI conveys more information than the n-firm concentration ratio. Over the studied period, the HHI clearly increases, also indicating a growing concentration in the container shipping industry. However, HHI never exceeds the 1,000 – 1,800 limits (see Appendix 3-1). Comparing with other industries, the container liner shipping industry must still be considered to be unconcentrated (Sys, 2009).

Thirdly, the reciprocal of the HHI is referred to as the numbers-equivalent (NE). Thus, a market whose HHI is 647.26 has a number equivalent of 15 or the market structure is equivalent to having 15 firms of the same size. Over the 1999-2010 period, the NE halved. This would suggest less competitive behaviour.

To sum up, one can conclude that the container shipping industry is confronted with increased concentration. Even if theoretically increasing concentration should result in decreased competition, in practise, fierce competition may still exist among leading carriers. That is the index of concentration ignores the shift of market shares among leading firms.

3.2.3 Indicator of magnitude of market share instability

In general, fueled by liberalisation/ deregulation, many studies have been conducted in an effort to understand competition. Many of these studies regress profitability or price

52 Figures refer to January 1st of each year.

on concentration. The results of these studies are similar but the interpretation of the results is very different. Therefore, Bresnahan (1982) developed a test that involves estimating a structural model incorporating demand and cost equations, linked with the profit-maximising condition that marginal revenue equals marginal cost. The main drawback of this methodology is its data-intensive requirements. An alternative measure of the degree of rivalry is the 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. The instability index, devised by Hymer and Pashigan (1962), sums up the absolute value of the change between two points in time in the market share of each firm. The index is calculated as follows:

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

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.

This index is based on the variation in ranking or market shares reflecting competitive pressure in the industry that is not observable in indicators of concentration. In other words, this index provides an indication of interfirm rivalry. The higher the value of this index, the less stable market shares are, indicating more competitive pressure in the industry (Hymer & Pashigan, 1962, p. 86 and Gutiérrez de Rozas, 2007).

According to Caves and Porter (1978), the instability index captures the effects of both price and non-price competition. Like the airline industry (Barla, 1999), liner operators also compete on other levels (i.e. quality of the service, frequency,…) than price[53].

Industry level												
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
II		0.162767	0.129300	0.114580	0.117452	0.121033	0.101599	0.249227	0.127077	0.074869	0.075962	0.102112

Figure 3-2: Evolution of the instability index at industry level

[53] See Staiger and Wolak (1992) for the theoretical justification of using the instability index as an indicator of intensity of competition.

The evolution of the instability index (II) is reported in Figure 3-2. At aggregated level, the value of the instability index is closer to zero than to one, an indication that the CLSI is characterised by a relatively stable competition.

3.2.4 Relationship concentration – instability index

Economic theory suggests that higher concentration leads to less competition. To investigate this theoretical link, the analysis starts with a visual plot of both indicators followed by a correlation analysis. Finally, an empirical model is described to estimate the determinants of market share instability.

First, Figure 3-3 plots the Herfindahl-Hirschman Index[54] (left-hand axis) and the Instability Index (right-hand axis). Whereas a remarkable level of stability is achieved during the 2000-2005 period, a peak of instability was reached in 2006. This change in intensity of competition coincides with the acquisition of Royal P&O Nedlloyd by the Danish A.P. Moller-Maersk Group. Abrupt changes have traditionally been related to the presence of competition, regardless of the concentration ratio (Hymer & Pashigan, 1962). The impact of the financial and economic downturn is also observable in Figure 3-3.

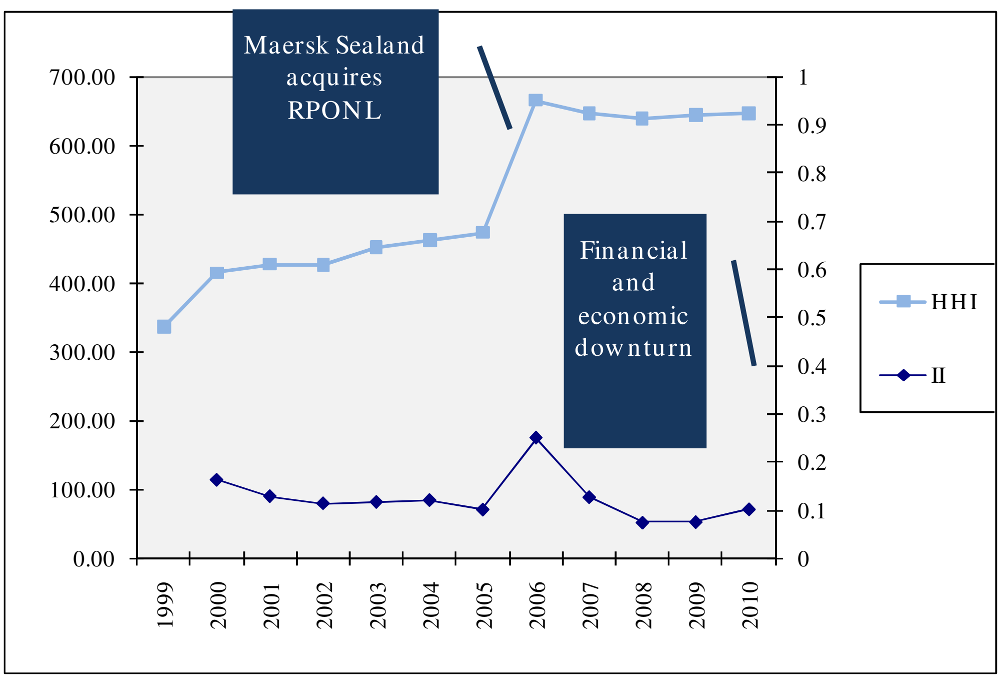

Figure 3-3: Relationship concentration and competition

[54] Given that the relative size of the largest liner operator's is an important determinant of conduct and performance, as economy theory suggest, consequently the HHI is likely to be more informative.

A scatter diagram is another visual display of both indicators. In Figures 3-4 a/ b, the HHI and the CR4 (on the horizontal axis) were plotted as a scatter diagram against the instability index (on the vertical axis). Even though a scatter diagram does not determine the exact relationship between the two variables, it does indicate whether they are correlated or not. The scatter plot quickly identifies the merger between AP Moller-Maersk and Royal P&O Nedlloyd (2006). A simple regression line can be used to statistically describe the trend of the points in the scatter plot. Discarding the outlier, the data pairs are exhibiting a negative correlation[55].

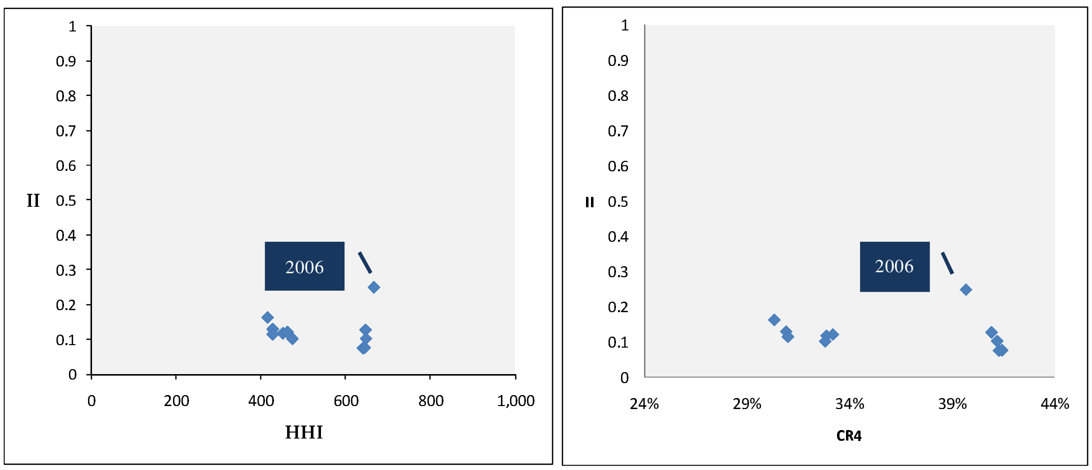

Figure 3-4 a/b: Scatter diagram HHI/CR4

Secondly, the question arises how the different observed indicators coincide mutually? Figure 3-5 summarises the correlation coefficients between the used measures (t-statistics in parentheses). From Figure 3-5, it can be observed that the CR4 and HHI provide similar indications of the competitiveness of the industry. The correlation coefficient between the two approximates 1. Over the 2000-2010 period, the correlation between CR4 and II is negatively while the correlation between HHI and II is positive. However, both outcomes are insignificant. Discarding the observation of 2006, the association between both concentration measurements and the instability index turns to inverse, meaning that concentration increases the intensity of competition decreases. The intensity of this inverse association is moderate and significant. Note, a correlation analyses cannot be interpreted as establishing cause-and-effect relationships between concentration and competition.

[55] Based on a simple regression, the result should be threated with caution. Adding several independent variables might have an impact on the correlation coefficient (see below).

Period	Indicator	CR4	HHI	II
Period 2000-2010	CR4	1		

	HHI	0.986579	1	
		(18.12605)	-----	
	II	-0.111237	0.034494	1
		(-0.335795)	(0.103543)	-----
Period 2000-2010 (excl. 2006)	CR4	1		

	HHI	0.997156	1	
		(37.41982)	-----	
	II	-0.662976	-0.642539	1
		(-2.504776)	(-2.371767)	-----

Figure 3-5: Correlation matrix

Last, from these simple correlation coefficients, one cannot infer whether there may be a nonlinear relationship between concentration and market share instability. In addition, other variables may also affect market share instability. Following earlier studies (Caves & Porter, 1978; Barla, 1999; Kato & Honjo, 2006 and Masathoshi & Yuji, 2006), a similar empirical model will be estimated to examine the determinants of market share instability. The empirical model takes the following form:

$$II_t = \alpha_0 + \alpha_1 CR4_t + \alpha_2 CR4_t^2 + \alpha_j \sum_{j=3}^{m} ISF_t + \mu_t \qquad (2)$$

The variables are defined as follows: II_t denotes the market share instability. To identify whether concentration has a negative effect on market share instability, the four-firm concentration index, $CR4_t$ is used[56]. This variable is introduced in a quadratic form to allow for a nonlinear relationship between II and CR4. Caves and Porter (1978) and Sakakibara and Porter (2001) suggested that the instability index initially increases with the level of concentration, then declines as concentration becomes more significant. Next, ISF_t represents industry specific exogenous factors and μ_t denotes an error term.

To control industry-specific factors, firstly, industry growth (IGR_t) is included in the model. Industry growth is expected to affect competition. The impact is twofold: a growing industry is most attractive for new entrants and is likely to trigger rivalries' behaviour amongst industry's incumbents (e.g. uncertainty regarding scale of production: will liner operator *i* put an extra/ a larger ship into service?). Previous

56 The alternative measure, HHI was also tested. The results were similar.

studies have found that industry growth increases market share instability (Hymer and Pashigian, 1962; Caves & Porter, 1978; Papadogonas & Droucopoulos, 2006; Kato & Honjo, 2006). Here, industry growth is defined as the differences between the value of world container traffic in period *t+1* and *t*, divided by the value of world container traffic in period *t* (Drewry, various editions). Since, Davies & Geroski (1997) stated that both positive and negative industry growth brings larger uncertainty to leading firms, the squared term, IGR_t^2 is included in the model to verify a nonlinear relationship between market share instability and industry growth. It is expected that the effect of this squared term (IGR_t^2) on market share instability is positive.

Secondly, market shares are redistributed due to entry into a trade or exit from it. Here, entry/ exit is proxied by the variable $SECONDHAND_t$. This independent variable reflects the price of second hand ships. New entrants weighing up opportunities in both the new building and second hand markets as well as charter markets. Separate regressions were run using new build ($R^2 = 0.79$) and charter price ($R^2 = 0.75$) as independent variables. In the case of second hand price, R-squared (0.81) was slightly higher. A large fraction of the variation in the determinants of market share instability can be explained.

Last, in 2005, Maersk Sealand acquired Royal P&O Nedlloyd. This event lead to a redistribution of market shares and to a change in the intensity of competition (see Figure 3-3). This effect will be controlled by the dummy variable, *MERGER* in the regression. This dummy equals 1 in the year+1 of the merger, otherwise zero.

The parameters α_0, α_1,... are the parameters to be estimated. Equation 2 is estimated using least squares regression methods (OLS)[57]. The OLS estimates of Eq. 2 are reported in Figure 3-6. Figure 3-6 summarises the determinants of the market share instability of three regressions (RE1/ 2/ 3 – including t-values between parentheses). In the last column, R-squared is reported.

	CR4		CR4^2		IGR		IGR^2		SECONDHAND		MERGER		C		R-squared	Adj. R-squared
RE1	0.709	*(1.882)*			0.5577	*(2.101)*			-0.002	*(-1.427)*	0.0509	*(1.483)*	-0.053	*(-0.485)*	0.54	0.23
RE2	10.796	*(2.401)*	-14.699	*(-2.248)*	0.2662	*(1.097)*			-0.002	*(-1.335)*	0.1012	*(2.916)*	-1.762	*(-2.304)*	0.77	0.54
RE3	11.270	*(2.459)*	-15.260	*(-2.295)*	0.4020	*(1.407)*	-1,976	*(-0.932)*	-0.002	*(-1.536)*	0.0968	*(2.731)*	-1.826	*(-2.346)*	0.81	0.53

Figure 3-6: Estimated results at industry level

In the first regression (RE1), the squared term of concentration (CR4^2) and industry growth (IGR^2) are excluded from the model while in RE2 only the latter independent

57 Estimation is carried out with EViews.

variable is excluded. The coefficients of concentration (CR4) are positive and statistically significant in RE2 and RE3. In addition, the coefficients of its squared term (CR4^2) are significantly negative. The results suggest a nonlinear relationship between concentration and market share instability, which is consistent with the studies of Caves & Porter (1978) and Sakakibara & Porter (2001). The inverted U-shaped curve appears to peak at about 36 % of the four-firm concentration ratio and then declines.

With respect to the variable industry growth (IGR), the coefficient is positive but only statistically significant in the first regression. The effect of its squared term (IGR^2) is found to be negative while the coefficient is not statistically significant. The results for the container liner shipping industry differ from those of other industries (see Davies and Geroski, 1997).

In all equations, the effect of second hand prices was found to be negative but not significant.

Turning now to the effect of the dummy variable merger, the regression coefficient has a positive effect on market share instability conform to a priori expectation. It clearly suggests a redistribution of market shares and a change in the intensity of competition.

Liner operators compete with each other not only within the total container liner shipping market but rather within sub-markets (read trade lanes). The next section provides evidence of the degree of concentration and the intensity of competition at trade level.

3.3 Evidence at trade level

What is the nature of the trade lanes in which the liner operator competes and the nature of competitive interactions among liner operators in these markets? These are the questions that will be addressed in this section.

3.3.1 Data

To address the dynamics of competition at trade level, a newly constructed panel data set has been constructed. This panel data set is the result of combining the annual trade routes analyses of Dynamar (various editions, 2007-10). These analyses contain rankings of top carriers by volume measured in TEUs. Hence, these total TEUs carried are the basis for calculating market shares at trade level. This unbalanced panel covers the 2003-2009 period. It allows computing the four-firm concentration ratio and the market share instability index as well as testing the relationship between both indicators at disaggregated level. Successively the results are commented.

3.3.2 Indicators of concentration

The four-firm concentration ratio and the Herfindahl-Hirschman Index are calculated to proxy the extent of concentration at trade level. Figure 3-7 reports the four-firm concentration ratio at trade level (in alphabetical order). A distinction is being made between eastbound/ westbound and northbound/ southbound legs respectively. For comparison reasons, the four-firm concentration ratio at industry level is added.

Trade level								
Trade lane	Indicator	2003	2004	2005	2006	2007	2008	2009
Black Sea - Far East	CR4				**70.84%**			
Central America - US	CR4					52.46%	50.56%	49.88%
EU-Africa	CR4						**76.56%**	**77.63%**
EU-Indian Sub Continent	CR4						**79.49%**	**71.45%**
EU-Latin America	CR4							**93.12%**
Far East -Africa	CR4						**80.35%**	**82.19%**
Far East to US East Coast/ US Gulf ports	CR4	45.24%	47.10%	40.18%	39.92%	40.93%	40.51%	36.14%
Indian Sub Continent to US (all coasts)	CR4			**75.88%**	**65.66%**	**63.11%**	**68.00%**	**64.59%**
Mediterranean - North America (eastbound)	CR4	48.45%	57.88%	**60.29%**	57.14%	**65.74%**	**65.26%**	**80.91%**
Mediterranean - North America (westbound)	CR4	48.85%	56.28%	**61.13%**	57.06%	56.91%	**65.61%**	50.49%
Middle East to US (all coasts)	CR4			48.65%	**76.67%**	**84.21%**	**84.48%**	**85.86%**
North America - Latin America (all coasts) (northbound)	CR4					**84.84%**	**74.47%**	**63.16%**
North America - Latin America (all coasts) (southbound)	CR4					**62.84%**	**61.59%**	**62.13%**
North America - Latin America (northbound)	CR4		**69.08%**	**69.54%**	57.12%	58.28%		
North America - Latin America (southbound)	CR4		**60.97%**	**65.10%**	58.46%	**70.41%**		
Transatlantic (eastbound)	CR4	44.69%	53.11%	53.52%	48.85%	**60.97%**	58.62%	56.90%
Transatlantic (westbound)	CR4	48.41%	53.11%	53.03%	49.63%	50.00%	50.80%	52.01%
Transpacific (eastbound)	CR4	44.89%	40.85%	40.93%	39.61%	37.97%	39.89%	38.76%
Transpacific (westbound)	CR4	43.49%	43.87%	45.83%	43.96%	39.84%	36.72%	36.97%
US - Central America	CR4					37.43%	34.16%	35.64%
US (all coasts) to the Indian Sub Continent	CR4			**72.65%**	56.42%	**61.94%**	**66.45%**	**67.16%**
US (all coasts) to the Middle East	CR4			**69.23%**	**71.56%**	**69.41%**	**65.86%**	**66.90%**
US East Coast/ US Gulf to the Far East	CR4	36.65%	43.17%	44.69%	38.85%	37.25%	33.16%	38.38%
US Trade	CR4	40.14%	38.82%	38.31%	36.68%	36.85%	36.62%	33.02%
Industry level	CR4	32.90%	33.21%	32.84%	39.67%	**40.91%**	**41.27%**	**41.42%**

Figure 3-7: Four-firm concentration ratio at trade level

Given the lack of data, the HHI cannot be calculated for each trade lane. However, minima and maxima values can be computed by using the following formula of Sleuwaegen and Dehandschutter (1986) whom proved that for a given m-firm concentration ratio the HHI must lie between

$$H_{min} = \frac{(CR_m)^2}{m} \text{ and } H_{max} = \begin{cases} (CR_m)^2 \text{ when } CR_m \geq 1/m \\ CR_m/m \text{ when } CR_m \leq 1/m \end{cases} \quad (3)$$

Figure 3-8 gives an overview of the decision rules of Benitez and Estache (2005) which allows us to classify the different trade lanes.

HHImin	HHImax	decision
< 1,000	< 1,000	unconcentrated
< 1,000	1,000 - 1,800	inconclusive => presumption: unconcentrated
< 1,000	> 1,800	inconclusive
1,000 - 1,800	> 1,800	inconclusive => presumption: concentrated
> 1,800	> 1,800	highly concentrated

Figure 3-8: HHI decision rule

The CR4 and the derived HHI_{min} and HHI_{max} for 2009 are reported in Figure 3-9[58]. The multiple sort conditions of Figure 3-9 are the degree of concentration followed by alphabetical order.

Measurement of concentration at trade level (2009)				
Trade lane	CR4	HHImin	HHImax	
EU-Latin America	**93.12%**	2,168	8,671	highly concentrated
Middle East to US (all coasts)	**85.86%**	1,843	7,372	highly concentrated
EU-Africa	**77.63%**	1,507	6,026	concentrated
EU-Indian Sub Continent	**71.45%**	1,276	5,105	concentrated
Far East -Africa	**82.19%**	1,689	6,756	concentrated
Indian Sub Continent to US (all coasts)	**64.59%**	1,043	4,172	concentrated
Mediterranean - North America (eastbound)	**80.91%**	1,637	6,546	concentrated
US (all coasts) to the Indian Sub Continent	**67.16%**	1,128	4,510	concentrated
US (all coasts) to the Middle East	**66.90%**	1,119	4,476	concentrated
North America - Latin America (all coasts) (northb	**63.16%**	997	3,990	
North America - Latin America (all coasts) (southb	**62.13%**	965	3,860	
Transatlantic (eastbound)	56.90%	809	3,238	
Mediterranean - North America (westbound)	50.49%	637	2,549	
Transatlantic (westbound)	52.01%	676	2,705	
Central America - US	49.88%	622	2,488	
Far East to US East Coast/ US Gulf ports	36.14%	327	1,306	unconcentrated
Transpacific (eastbound)	38.76%	376	1,502	unconcentrated
Transpacific (westbound)	36.97%	342	1,367	unconcentrated
US - Central America	35.64%	318	1,270	unconcentrated
US East Coast/ US Gulf to the Far East	38.38%	368	1,473	unconcentrated
US Trade	33.02%	273	1,090	unconcentrated
Industry level	41.42%			

Figure 3-9: Degree of concentration at trade level

What conclusions can be derived from Figures 3-7 and 3-9? First, the analysis of the four-firm concentration ratio shows that the degree of concentration differs from trade lane to trade lane.

[58] Note: to calculate the HHI range, one need to multiply by 10,000.

Secondly, some trade lanes (e.g. Transpacific eastbound/ westbound, US Trade) show a trend of decreasing concentration while other trade lanes are characterised by a trend of increasing concentration.

Thirdly, the calculations allow us to link the degree of concentration with the degree of oligopoly. A trade lane with a CR4 between 25 % and 60 % is labelled a loose oligopoly while a CR4 below 25 % is no oligopoly at all. A CR4 of over 60 % is considered a tight oligopoly. 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 (Shepherd, 1999). In Figure 3-7 and 3-9, a CR4 of over 60 % is marked in bold. Figure 3-10 catalogues the studied trade lanes. Clearly, the container liner shipping industry appears to be a series of oligopolistic sub-markets.

Degree of oligopoly		
CR4 < 25%	25% < CR4 < 60%	CR4 > 60%
no oligopoly	**loose oligopoly**	**tight oligopoly**
	Transatlantic (eastbound)	EU-Africa
	Transatlantic (westbound)	EU-Indian Sub Continent
	Transpacific (eastbound)	EU-Latin America
	Transpacific (westbound)	Far East -Africa
	US - Central America	Indian Sub Continent to US (all coasts)
	US East Coast/ US Gulf to the Far East	Mediterranean - North America (eastbound)
	US Trade	Middle East to US (all coasts)
	Far East to US East Coast/ US Gulf ports	North America - Latin America (all coasts) (northbound)
	Mediterranean - North America (westbound)	North America - Latin America (all coasts) (southbound)
		US (all coasts) to the Indian Sub Continent
		US (all coasts) to the Middle East

Figure 3-10: Degree of oligopoly

Analysing the associated volumes reveals that the loose oligopolistic sub-markets are large trade lanes with a volume of + 1,000,000 TEU while the tight oligopolistic sub-markets corresponds with < 1,000,000 TEU volume. Tight oligopoly corresponds with concentrated/ highly concentrated trade lanes[59]. In addition, the nature of the submarkets could also explain some differences (e.g. the Latin America trade lane: served by regional carriers, the U.S. import trade: served by proprietary carriers like Dole).

[59] For the U.S. airline industry, Barla (1999) states that "Concentrated routes usually have lower traffic density and, therefore, higher costs". The former also applies for the CLSI.

Figure 3-11 gives a rough idea of where the loose versus tight oligopolistic trade lanes are located. The dashed black lines in Figure 3-11 shows the routes that correspond with tight oligopolistic while the grey lines mark the loose oligopolistic sub-markets. To keep the mapping simple, if both east- and westbound or north- and southbound are catalogued as the same degree of oligopoly, it is depicted by a left-right arrow.

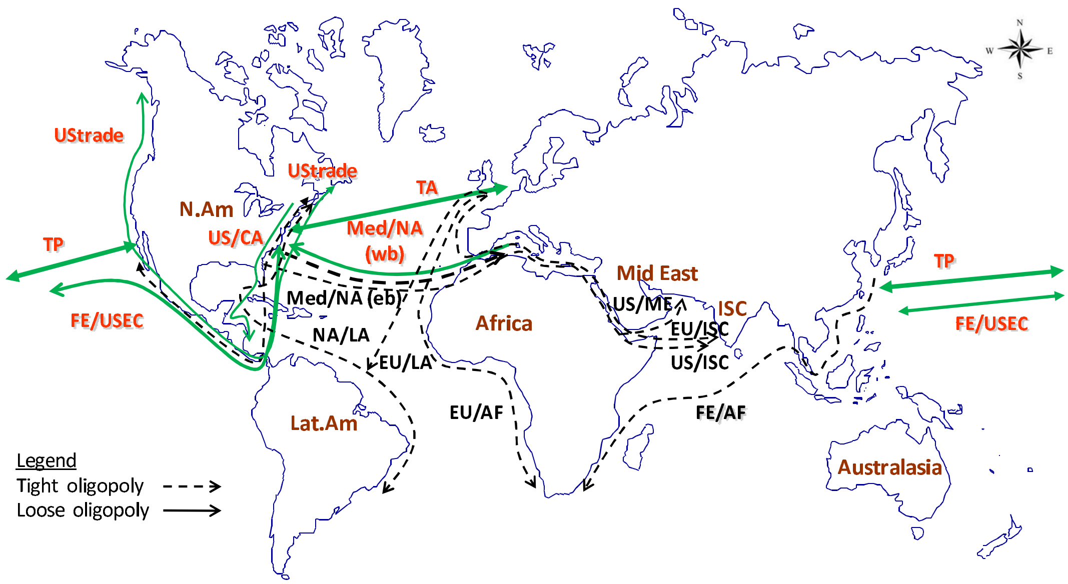

Figure 3-11: Tight versus loose shipping routes

Figure 3-11 shows no special patterns. The difference between tight and loose oligopolistic sub-markets is not restricted to geographic patterns.

Fourthly, Sleuwaegen and Dehandschutter (1986) indicate the use of the HHI as a superior measure. Applying the formulae given in (3) yields HHI ranges corresponding with CR4 for the studied trade lanes (see Figure 3-9). From policy perspective, trade lanes labelled 'unconcentrated' generally do not require further analysis. Trade lanes in which $1{,}000 < HHI_{min} < 1{,}800$ and HHI_{max} exceeds 1,800 are considered 'concentrated'. If both the lower and upper bound of the HHI exceeds 1,800, the trade lane is labelled 'highly concentrated'. In the latter two cases, antitrust authorities need to analyse whether competition is threatened in the case of a new merger.

Finally, another question arises whether the top 4 liner operators do dominate any sub-market and hence have greater monopolistic control than might be evident from looking at their total market share? As a benchmark, a dominant position corresponds with a CR1 > 40 %. A close analysis reveals - not surprisingly - that the market shares of the liner operators differ from trade lane to trade lane. Maersk Line is the number one in the US-Indian Subcontinent trade (ISC) on the outward and return leg, US Trade, North America-Middle East trade. Solely in the Mediterranean - North America trade (westbound) Maersk Line is a dominant player (CR1 > 40 % since 2005). In contrast, this carrier was never the number 1 liner operator in Transatlantic (eastbound), North America – Los Angeles, South America – US on the outward and return leg, Europe-Africa, Europe-Latin America and Far East-Africa during the 2005-2009 period. CMA CGM is the leader in the latter three trade lines while MSC leads the South America – US trade route. For the remaining trade lanes, Maersk Line was the number 1 up to 2005 but lost its position to MSC, Hapag-Lloyd, Evergreen, Hamburg Süd respectively. For most of those trades, Maersk Line started in 2009 jostling for market share again and regained its statue of maritime industry leader.

3.4 Indicator of magnitude of market share instability

The Hymer-Pashigan instability index was applied to each sub-market and the results are given in Figure 3-12.

Trade level								
Trade lane	Indicator	2003	2004	2005	2006	2007	2008	2009
Central America - US	II						0.06124	0.09670
EU-Africa	II							0.23119
EU-Indian Sub Continent	II							0.68570
Far East -Africa	II							0.25573
Far East to US East Coast/ US Gulf ports	II		0.33598	0.14386	0.11031	0.09634	0.19044	0.12305
Indian Sub Continent to US (all coasts)	II				0.30571	0.23824	0.30744	0.10337
Mediterranean - North America (eastbound)	II		0.30335	0.13832	0.22516	0.25230	0.21701	0.39904
Mediterranean - North America (westbound)	II		0.27079	0.18445	0.23437	0.15315	0.24568	0.38682
Middle East to US (all coasts)	II				0.58018	0.18772	0.23525	0.28282
North America - Latin America (all coasts) (northbound)	II						0.18484	0.21676
North America - Latin America (all coasts) (southbound)	II						0.08385	0.10923
North America - Latin America (northbound)	II			0.08868	0.39426	0.19892		
North America - Latin America (southbound)	II			0.24583	0.33198	0.31738		
Transatlantic (eastbound)	II		0.16833	0.24642	0.21451	0.20410	0.29120	0.28124
Transatlantic (westbound)	II		0.23248	0.06005	0.16991	0.21176	0.18838	0.17892
Transpacific (eastbound)	II		0.09592	0.04208	0.06447	0.16758	0.24202	0.15222
Transpacific (westbound)	II		0.21406	0.19783	0.09710	0.36782	0.13012	0.29359
US - Central America	II						0.09530	0.05981
US (all coasts) to the Indian Sub Continent	II				0.40069	0.32240	0.34983	0.32143
US (all coasts) to the Middle East	II				0.30095	0.14904	0.23525	0.28282
US East Coast/ US Gulf to the Far East	II		0.12184	0.11663	0.14079	0.12842	0.25589	0.19682
US Trade	II		0.07232	0.07412	0.08160	0.12075	0.06233	0.24040
Industry level	II	0.11745	0.12103	0.10160	0.24923	0.12708	0.07487	0.07596

Figure 3-12: Instability Index at trade level

Conforms a priori expectations, the instability index differs from trade lane to trade lane and also from the leg studied. This indicator fluctuates between 0.04 and 0.64 over the studied period. At disaggregated level, the value of the instability index is also closer to zero than to one. Figure 3-13 shows the dynamics of competition over time.

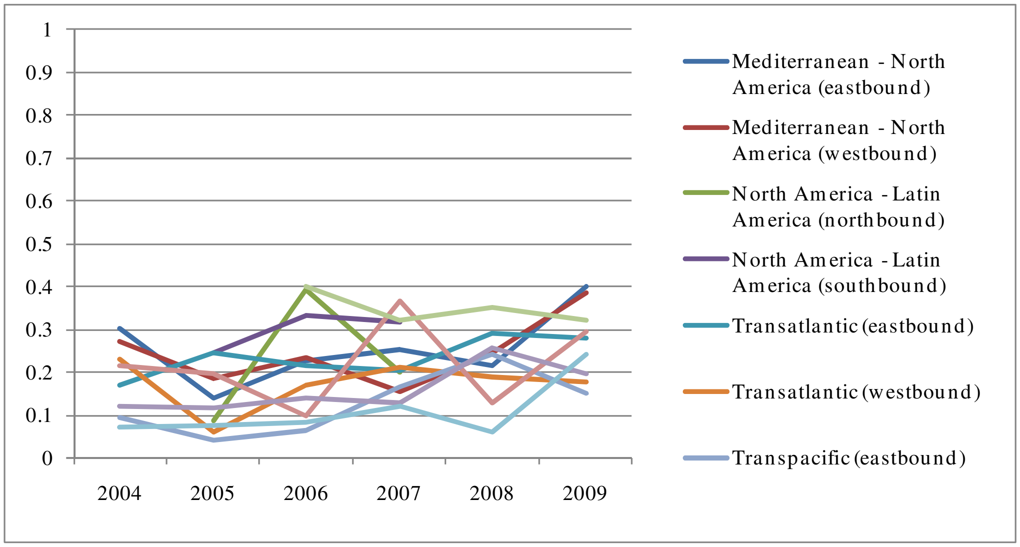

Figure 3-13: Evolution of the instability index

Combining Figure 3-7, 3-9 and 3-12 firstly reveals that the market share instability index seems not to be lower in highly/ concentrated trade lanes. Secondly, the presence of a dominant liner operator in the Mediterranean-North America trade lane increases the market share instability index. Thirdly, in trade lanes where Maersk Line lost its leading position, the market share instability index increased significantly between 2006 and 2007 (e.g. Transpacific, east-/ westbound; Transatlantic, east-/ westbound). Last, the market share instability index appears to fluctuate more in trade lanes labelled 'loose oligopoly'.

3.5 Relationship concentration – instability index

Although competitiveness of an industry cannot be measured by market structure alone, such as Herfindahl-Hirschman Index and other concentration ratios, it is interesting to look at the relationship between concentration and market share instability at trade level.

To explain variations in the market share instability index (II) across trade lanes (i) and time periods (t), Eq. 2 was re-estimated now including trade specific factors ($TFS_{i,t}$) in the empirical specification.

$$II_{i,t} = \alpha_0 + \alpha_1 CR4_{i,t} + \alpha_2 CR4_{i,t}^2 + \alpha_j \sum_{j=3}^{m} TSF_{i,t} + \mu_{i,t} \qquad (4)$$

$TFS_{i,t}$ stands for a k-vector control variables that may affect market share instability at trade level. Analogous to the estimated model at industry level (see 3.2.4), trade growth ($TGR_{i,t}$), its squared term ($TGR^{2}_{i,t}$), second hand prices ($SECONDHAND_t$) and the dummy variable *MERGER* are included to control trade specific factors.

To account for trade specific elements, Eq. 4 is estimated by using pooled least squares method corrected for fixed effects in the cross-section dimensions. The standard errors are corrected for heteroskedasticity using the White procedure. Both the estimates of the coefficients and the fixed effects are given in Figure 3-14.

	II	
	Coefficient	t-statistic
CR4	-0.2628	-1.7074
TGR	-1.1969	3.7757
TGR^2	0.6331	7.8327
SECONDHAND	-0.0003	-0.4388
MERGER	0.0068	0.6143
C	0.3567	4.3369
fixed effects (cross)		
US-Central America--C	-0.188005	
US-trade--C	-0.134911	
Central America-US--C	-0.133018	
Transpacific (EB)--C	-0.116089	
North America - Los Angeles, all coasts (SB)--C	-0.104081	
US, East coast - Far East--C	-0.066609	
Far East - US East coast--C	-0.063735	
Transatlantic (WB)--C	-0.040466	
Transpacific (WB)--C	-0.010274	
North America - Los Angeles, all coasts (NB)--C	0.007890	
Transatlantic (EB)--C	0.031041	
North America - Los Angeles (NB)--C	0.036408	
Mediterrean-North America (WB)--C	0.042617	
Mediterrean-North America (EB)--C	0.060797	
Middle East - US--C	0.061315	
Indian Subcontinent-US--C	0.061922	
US-Middle East--C	0.061941	
Far East - Africa--C	0.078587	
Europe-Africa--C	0.105072	
North America - Los Angeles (SB)--C	0.137282	
US- Indian Subcontinent--C	0.160004	
Europe-Indian Subcontinent--C	0.534745	
R-squared	0.70	

Figure 3-14: Estimated results at trade level[60]

[60] Eastbound and Westbound is abbreviated to EB and WB respectively. NB and SB stands for Northbound and Southbound.

Firstly, in contrast to RE3 (see Figure 3-6), the squared term of concentration (CR4^2) is no longer significant. So, a negative linear relationship between concentration and market share instability is found at trade level. Secondly, growth at trade level (TGR) is important in the model due to its disturbance effect on competition (Kato & Honjo, 2006). In contrast to the estimated results at industry level, the coefficient of trade lane growth (TGR) is significantly negative while its squared term (TGR^2) shows a significant and positive growth. This result indicates the presence of a U-shaped relationship between instability index and trade lane growth. So, the instability index initially decreases and then increases as growth increases from negative to positive levels. The outcome of this quadratic effect for trade lane growth concurs with the study of Davies and Geroski (1997). The minimum occurs at a TGR value of 0.15545 %. Davies and Geroski (1997) state that a value so close to zero implies that both positive and negative growth bring greater uncertainty.

The question becomes whether this quadratic effect at trade level can be explained. A first explanation might be found in the commonly used volume (service) contracts with large shippers. Such volume (service) contracts establish freight rates, assured space, service levels, etc. for a predetermined period. A change in demand can be captured within the terms of the contract. So, volume (service) contracts might delay the destabilisation of market shares as long as the liner carrier is not brought up against capacity constraints. This leads us towards the deployed capacity (e.g. on the Transatlantic trade, Maersk Line deploys ships with a capacity varying between 2,890 – 5,040 TEUs, MSC runs this trade with vessels of 3,876 up to 6,732 TEUs while CMA CGM put into service vessels of about 2,556 TEUs). Given fixed liner shipping capacity in the short-run and mostly a capacity utilisation of less than 100 %, market shares are expected to be stable at low levels of trade lane growth. Stability should fall or instability should increase when some competitors are brought up against capacity and add extra vessels and/ or upgrade scale. Next, according to Caves & Porter (1978), a fast growth could destabilise shares by widening the errors in firms' planned capacities. Last, a growing trade lane is attractive for new entrants. Here, the results suggest that entry is only attractive as from a certain level of growth in the trade lane.

Thirdly, the regression coefficient of the $SECONDHAND_{i,t}$ variable remains negative and insignificant.

Last, the impact of the dummy variable *MERGER* at trade level is positive but not significant.

3.6 Concluding remarks

The objective of this paper was to study how the degree of concentration and the degree of competition changes over time for the container liner shipping industry, both at aggregated and disaggregated level. This study contributes to the CLSI literature.

Two absolute indicators of concentration (i.e. the four-firm concentration ratio and the Herfindahl-Hirschman Index) and one relative concentration measure (i.e. numbers equivalent) were calculated to assess the degree of concentration. The Hymer-Pashigan index of market share instability was employed to determine the degree of competition. Calculations were done both at industry and trade level. The assessment of market share instability by means of time-series method may contribute to the characterisation of trade lane rivalry.

This paper firstly presents evidence that the container liner shipping industry is becoming as a whole more concentrated. Regarding the degree of competition over time, the value of the instability index is closer to zero than to one. This result indicates that the container liner shipping industry is characterised by a relatively stable competition. This index also allowed to measure rivals' behaviour at the level of trade lane. At disaggregated level, the degree of concentration and degree of competition differs from trade route to trade route. Not surprisingly, the competition is in some trades stronger. From policy perspective, regulators should analyse the impact of a further merger at trade level.

Secondly, linking the degree of concentration to the degree of oligopoly allows to catalogue the different trade lanes in no, loose or tight oligopolistic submarkets. This analysis is useful for policymakers who want to enhance competition. In the case of a new merger, the trade lane portfolio of the newly merged shipping company should be screened to ascertain that the degree of competition does not diminish. This is certainly the case if the involved trade lanes are labelled 'concentrated' or 'highly concentrated'.

Finally, the relationship between concentration and market share instability was analysed. Besides a graphical and correlation analysis, an empirical model for the determinants of liner operators' market share instability was estimated. The findings indicate the presence of an inverted U-shaped relationship between concentration and market share instability at industry level. At trade level, concentration is negatively related to market share instability and evidence is provided that the variable ‘growth’ (in terms of volume) plays a major role in affecting the dynamics of market share.

Future research is suggested in testing the relationships concentration – instability index over a longer time period and in analysing the effect of cooperation between liner operators by re-computing the market share instability index using combined market shares.

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Appendix 3-1: Concentration measures

Many ways to measure concentration exist. For the purpose of this paper, Appendix 3-1 briefly describes two absolute indicators of concentration, viz. the n-firm concentration ratio (A1) and the Herfindahl-Hirschman Index (A2)[61] and one relative concentration measure, viz. the reciprocal measure, numbers equivalent[62]:

Regardless the concentration measure, the market share of liner operator i is denoted as s_i. There are n firms in the industry. The container liner operators are ordered according to market share. Liner operator 1 has the largest market share, liner operator 2 has the second-largest market share and so on ($s_1 \geq s_2 \geq s_3 \ldots \geq s_n$).

1 CRn

In early empirical studies, the n-firm concentration ratio, denoted as CR_n, was the most common measure of concentration. The n-firm concentration ratio is the cumulative share of the n-largest container liner operators to the market. The formula for the n-firm concentration ratio is as follows:

$$CR_n = \sum_{i=1}^{n} s_i \qquad \text{(A1)}$$

The number of liner operators included in the concentration is not determined by underlying principles. The four-firm concentration ratio, known as CR_4, is the most typical concentration ratio for judging the degree of concentration in an industry.

2 HHI

HHI stands for Herfindahl-Hirschman Index. HHI takes into account both the number of liner operators and the inequality of market shares. HHI is the sum of squares of all liner operators' percentage of market shares, according to the existing on board TEU (twenty equivalent unit) capacities of liner operators, and ranges from 0 (a perfectly competitive industry) to 10,000 (a monopoly).

The HHI is a concentration measure based on the sum of squares of market shares of all liner operators in the industry. The HHI is calculated as follows

61 See also Sys, 2009.
62 For an overview, see Lipczynski et al., 2005.

$$HHI = \sum_{i=1}^{n} s_i^2 \text{ x } 10{,}000 \qquad (A2)$$

This measure gives added weight to the biggest operators. The principle is: the higher the index, the more concentration and (within limits) the less open market competition. As a benchmark, a market with an HHI below 1,000 is considered to be unconcentrated and unlikely to be subject to any adverse competitive effects. A value between 1,000 and 1,800 generally indicates moderate concentration. Any value over 1,800 indicates a highly concentrated market (Shepherd, 1999 and Brooks, 2000).

3 NE

The numbers-equivalent (NE) is computed by dividing the theoretical maximum HHI (10,000) by the calculated HHI. This reciprocal measure translates the measure of concentration, as reported by the HHI, into the hypothetical equivalent number of equally-sized firms constituting the same level of concentration. In other words: into a number to indicate how many "effective" competitors exist in a sector (Lipczynski *et al.*, 2005 and Gutiérrez, 2007).

Chapter 4

4 A non-structural test for competition in the container liner shipping industry[63]

Abstract

This paper examines the competitive conditions of the containerised liner shipping industry. The degree of competition prevailing in this industry will be assessed using the H-statistic proposed by Panzar and Rosse (1987). The properties of this non-structural methodology (e.g. using firm level data, robustness in small samples, no need to specify a relevant market, etc.) make it an excellent framework for assessing the degree of competition in the containerised liner shipping industry. The empirical specifications are based on an unbalanced panel of data regarding a sample of 18 major liner operators covering the 1999-2008 period. A significantly positive unscaled value of the H-statistic has been found. This means that the hypothesis can be rejected that the containerized liner shipping industry market structure corresponds to a neoclassical monopoly, a collusive oligopoly or a conjectural variations short run oligopoly.

Keywords:

Container liner shipping industry, competition, Panzar-Rosse model

[63] The paper is under review for publication in the journal Maritime Management and Policy. This chapter is joint work with Prof. dr. H. Meersman and Prof. dr. E. Van de Voorde. The authors wish to thank Prof. dr. R. Vander Vennet for bringing the Panzar-Rosse methodology to their attention and Prof. dr. G. Everaert and Prof. dr. J. A. Bikker for their assistance in econometric issues. The authors remain solely responsible for the article's content.

4.1 Introduction

The liner shipping industry has experienced fundamental changes in recent years due to globalisation, deregulation, horizontal/ vertical integration, (increased) co-operation, rationalisation, developments in information technology, consolidation and increased concentration. These developments may affect competition. As in other industries, competition in the (containerised) liner shipping industry matters for a number of reasons: it encourages the level of innovation (e.g. vessel size, low emission ships, tracking and tracing of cargo, etc.) and the quality and efficiency of services rendered in the sector.

Besides these changes, the liner shipping industry was under the spell of the question whether the block exemption would be abolished. As from October 18th, 2008 this abolishment is a fact (EEC Regulation n° 4056/ 86)[64]. The liner carrier association, European Liner Affairs Association, expects the liner shipping market to become even more competitive as soon as conferences and in particular conference surcharges[65] and ancillary charges[66] will disappear.

Remarkably, in publicly available reports of the European Commission - Directorate General of Competition (DG Comp - ec.europa.eu/ comm/ competition/ antitrust/ overview_en.html), the European Shipper Council (ESC - www.europeanshippers.com) and the European Liner Affairs Association (ELAA - www.elaa.net), the degree of competition has never been established neither by applying the structural nor the non-structural approach. Knowledge of the degree of competition is important for antitrust authorities. This offers an extra incentive to examine the degree of competition.

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64 Since 1986, the European Commission has granted a block exemption from the competition rules for conference liner operators. A Block Exemption Regulation defines certain categories of agreements which are compatible with EU competition rules provided that the agreements meet the conditions laid down in the Regulation. In March 2003, the European Commission's Directorate General for Competition announced a review of Regulation 4056/ 86. On September 25th, 2006, the Council agreed to repeal Regulation 4056/ 86. By consequence, it puts an end to the coordination of prices, charges and surcharges as well as coordinated capacity management in European Union trades as of October 2008. Since that date, liner operators have to fix their own freight rates and any surcharge (European Commission, 1997 and 2007; ELAA, 2003).

65 Surcharges relate to charges that are meant to cover uncertainties, such as the Bunker Adjustment Factor (BAF), Currency Adjustment Factor (CAF), Congestion Surcharges (CSC) and War Risk Surcharge (WRS) (Competition Commission of Singapore, 2006).

66 Ancillary charges – such as terminal handling charges, demurrage costs, change of destination, special equipment and charges based on the nature of the cargo (dangerous, noxious, refrigerated etc.), … – cover the supplementary increase in charges that are triggered by or linked with the operation of moving containers, i.e. they are ancillary to the service provided by liner operators (Competition Commission of Singapore, 2006).

The main emphasis of the present paper is to examine the competitive conditions of the liner shipping industry, more specifically, the containerised liner shipping industry (hereafter CLSI). To do this, a non-structural measurement of competition is documented and estimated at the level of CLSI. For this purpose, and in function of data availability, a panel data set of 18 major liner operators with a global presence was set up. The evolution of the competitive structure of the CLSI will be studied over the 1999-2008 period.

The paper will be structured as follows: Section 4-2 provides a brief overview of the literature. Section 4-3 is devoted to the non-structural methodology used to assess the degree of competition in the CLSI. Section 4-4 presents the data and selection criteria. Section 4-5 reports and discusses the econometric results. Ultimately, section 4-6 summarises and draws conclusions.

4.2 Literature review

A scan of shipping literature reveals that a number of studies theoretically examined the issue of competition in the liner shipping industry (e.g. Molenaar. & Van de Voorde, 1994; Brooks, 2000; …). Few of these studies focused on modelling competition (e.g. Sjostrom, 2002). Additionally, literature has long focused on the regulation/ deregulation of the liner shipping industry (for example: see EC DG COMP, 1997 and 2007; Heaver, 2001; OECD, 2002; ELAA, 2003; Benacchio *et al.*, 2007).

In contrast, assessing empirically the degree of competition is a recurrent topic in the literature of other newly liberalised service sectors, such as banking industry, telecommunication, broadcasting, etc.. This literature shows two major approaches, viz. the structural and the non-structural approach. The structural approach is based on the structure-conduct-performance (SCP) hypothesis. It is assumed that observable structural characteristics of a market determine the conduct of firms operating in that market which in turn influences measurable aspects of market performance. In contrast, the non-structural approach attempts to draw inferences about market structure and competitive conditions from direct observations of conduct at firm level (Martin, 2002; Lipcynski *et al.*, 2005).

As a reaction to the theoretical and empirical shortcomings attributed to the structural stream, namely recognition of the need to endogenise market structure and the neglect of potential competition (Gischer and Stiele, 2009), non-structural models of competitive behaviour have been developed. These 'New Empirical Industrial Organisation (NEIO)' approaches, such as the Iwata-model (1974), Bresnahan (1982) and Lau (1982) mark-up model, and Panzar and Rosse (1987) model measure competition and analyse the competitive conduct of firms without using explicit information about the structure of the market.

As the first two models are very data-intensive, the majority of the studies have investigated competition using the non-structural methodology put forward by Panzar and Rosse - the so-called H-statistic - (*Newspaper industry*: Panzar & Rosse, 1987; *Banking* [67]: Shaffer, 1993; Vesala, 1995; Bikker & Groeneveld, 2000; De Bandt & Davis, 2000; Bikker & Haaf, 2002; Bikker, 2004; Claessens & Laeven, 2004; Bikker, Spierdijk, & Finnie, 2006 and 2008; Al-Muharrami *et al.*, 2006; Matthews, Murinde & Zhao, 2007; Chan et al, 2007; Goddard & Wilson, 2007; Gutiérrez, 2007; Gischer and Stiele (2008); Bikker, Shaffer and Spierdijk (2009); *Life insurance*: Bikker & Leuvensteijn, 2008; *Physician services industry*: Wong, 1995; *Cigarette industry*: Sullivan, 1985; Ashenfelter and Sullivan, 1987; *Security sector*: Tsutsui and Kamesakab, 2005).

In the field of transport, two studies were found applying this methodology. First, Fischer and Kamerschen (2003) applied the Panzar-Rosse test to assess market performance in selected airport-pairs originating from Atlanta. Secondly, Endo (2005) studied the competitive nature of the liner shipping industry estimating Panzar-Rosse H-statistic based on panel data of three major Japanese shipping companies between 1986 and 2002. He concluded: "*Panzar-Rosse H-statistic indicates that the three major Japanese liner carriers*[68] *do not behave as forming perfect collusion. This result is consistent with monopolistic competition. It seems that competition has been intensified following the introduction of competition promotion policy.*" (Endo, 2005).

An extra advantage of the Panzar-Rosse model (hereafter, abbreviated to the P-R model), as well as other non-structural models, is that there is no need to specify a relevant

[67] The booming of papers in the banking industry is fuelled by recent developments in the European banking industry (e.g. financial liberalisation, ongoing economic and regulatory integration, introduction of the Euro, developments in information technology, etc.).

[68] Endo most likely studied the behaviour of Mitsui O.S.K Lines (MOL), Nippon Yusen Kaisha (NYK) and Kawasaki Kisen Kaisha (K-line). Their shipping business is wide-ranging, covering container, car, bulk and energy resources transport.

market[69], since the behaviour of individual firms provides an indication of their market power. Furthermore, the P-R approach works well with firm-specific data on revenues and factor prices, and does not require information about equilibrium output prices and quantities for the firm and/ or industry. In addition, the P-R approach is robust in small samples, while the Bresnahan-Lau model tends to exhibit an anticompetitive bias in small samples (Shaffer, 2004).

The fact that the P-R methodology uses firm-level data on revenues and factor prices, is robust in small samples and does not need the specification of the relevant market makes it an excellent framework for assessing the degree of competition for the CLSI.

4.3 Methodology

This section presents the theoretical background of the P-R model, the interpretation of the *H*-statistic, the debate regarding the dependent variable and subsequently focuses on the empirical implementation of the model.

4.3.1 Theoretical background of the P-R model

Rosse & Panzar (1977) and Panzar & Rosse (1987) developed a non-structural estimation technique to discriminate between oligopolistic, monopolistically competitive and perfectly competitive markets. For this purpose, the P-R model derives a competition indicator also referred to as the H-statistic or revenue test. The H-statistic provides a quantitative assessment of the competitive nature of a market. This statistic is calculated from reduced-form revenue equations and measures the elasticity of total revenues with respect to changes in factor input prices.

The P-R model starts from a number of assumptions. Firstly, firms are treated as profit-maximising, single product firms. The single product firm assumption is consistent with the intermediation approach. The intermediation approach which describes liner operators as profit-maximising firms that transport boxes (standardized twenty feet equivalent units, TEU's) by using physical capital (assets i.e. ships), human labour and financial capital as input is adopted. Secondly, higher input prices must not be correlated

[69] Although the Guidelines on the application of Article 81 of the EC Treaty to Maritime Transport Services (OJ C 245, 26.09.2008) state that it is necessary to define the relevant product and geographic market(s), it is not possible to use data at product level and/ or geographical markets level due to a shortage in data of input factor prices with respect to specific trades (e.g. the eastbound market differs from the westbound market), to products (niche products (dangerous goods, reefer,...) versus transportation of a box), etc. Applying the Panzar Rosse model solves this problem.

with higher quality services that generate higher revenues because such a correlation would bias the calculated H-statistic. A final crucial assumption is that the firm must be in long-run equilibrium (Panzar & Rosse, 1987; De Bandt & Davis, 2000)[70].

Given these assumptions Panzar and Rosse [21] start their analysis with the firm's profit function. A firm *i* wants to produce the output level x_i which maximizes

$$\Pi_i = R_i - C_i = \Pi\,(x_i, z_i, w_i, t_i) \qquad (1)$$

where x_i, refers to the output of firm *i*, z_i and t_i denote resp. a vector of exogenous variables that shift the firm's revenue function, w_i is a vector of m factor prices of firm *i*. The vectors z_i and t_i may or may not have variables in common. Hereafter subscripts referring to firm i are dropped.

Next, they consider an equi-proportionate increase in all factor input prices, from w to (1+h) w. Let x° be the argument that maximises profit function (1) and x^1 the output that maximises Π (x, z, (1+h) w, t) with the scalar $h \geq 0$. Then, let $R^\circ = R(x^\circ, z) \equiv R^*(z,w,t)$ and $R^1 = R(x^1, z) \equiv R^*(z,(1+h)\,w, t)$. R* denotes the firm's reduced form revenue function. By definition

$$R^1 - C(x^1, (1+h)\,w, t) \geq R^\circ - C(x^\circ, (1+h)\,w, t) \qquad (2)$$

Costs are linearly homogeneous in factor input prices, so (2) can be rewritten as

$$R^1 - (1+h)C(x^1, w, t) \geq R^\circ - (1+h)C(x^\circ, w, t) \qquad (3)$$

which subsequently results in

$$(R^1 - R^\circ)/\,h = [R^*(z, (1+h)\,w, t) - R^*(z, w, t)]/\,h \leq 0 \qquad (4)$$

Assuming that the reduced-form revenue equation is differentiable, taking the limit of (4) for h → 0 and dividing by R* yields

$$H = \sum_{j=1}^{m} \frac{\partial R^*}{\partial w_{j_i}} \cdot \frac{w_{j_i}}{R^*} \qquad (5)$$

Market power is measured by the amount to which a change in *m* factor input prices (∂w_{j_i}) is mirrored in the equilibrium revenues (∂R_i^*) realised by firm i.

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70 The Panzar Rosse methodology has been largely applied in the banking industry. Although to provide banking services, a bank license is a condition for a financial institution under most jurisdictions, every study accepted the assumption of free entry and/ or exit. In contrast, the containerized liner shipping industry is not regulated. We also accept this assumption.

In order to calculate the H-statistic, the following linear regression is used[71]:

$$\text{Ln } R_{i,t} = \beta_0 + \beta_1 \ln (w_{1,i,,t}) + \beta_2 \ln (w_{2,i,,t}) + \beta_3 \ln (w_{3,i,,t}) + \sum_{j=4}^{m} \beta_{3+j} FSF_{j,i,t} + \varepsilon_{i,t} \qquad (6)$$

The notation is as follows: the subscript i and t values represent firm i at time t. $R_{i,t}$ denotes the revenue of firm i in year t and $w_{j,i,,t}$ represents the price of factor input j paid by firm i in year t. If the price of factor inputs cannot be observed directly, they are usually imputed using the ratio of quantity of each factor employed to the level of expenditure on the same factor (Lipczynski *et al.*, 2005). FSF_j stand for firm specific exogenous factors and $\varepsilon_{i,t}$ denotes an error term. With three factor inputs in the notation of Eq. 6, the Panzar-Rosse H-statistic is defined as $H = \beta_1 + \beta_2 + \beta_3$. Thus, Panzar and Rosse define a measure of competition H as the sum of elasticities of the reduced-form revenues with respect to factor prices.

4.3.2 Empirical implementation of the P-R model

The P-R revenue test is implemented by estimating the following linear regression using container division level data, in line with Equation 6:

$$\begin{aligned} \ln TURN_{i,t} &= \beta_0 + \beta_1 \ln(PO_{i,t}) + \beta_2 \ln(PL_{i,t}) + \beta_3 \ln(PCE_{i,t}) + \\ &\gamma_1 \ln(EQTA_{i,t}) + \gamma_2 \ln(CAPVESSEL_{i,t}) + \gamma_3 \ln(DUMMY\_AL_{i,t}) + \gamma_4 \ln(DUMMY\_MA_{i,t}) + \varepsilon_{i,t} \end{aligned} \qquad (7)$$

where $TURN_{i,t}$ denotes the turnover at container division level; $PO_{i,t}$ is a proxy for the input price of operation and calculated as the ratio of operating expenses to transported TEU; $PL_{i,t}$ is a proxy for the input price of labour and calculated as the ratio of staff expenses to the number of employees and $PCE_{i,t}$ is a proxy for input price of capital stock and obtained by dividing the non-operating expenses by total assets for the business segment container shipping.

Next, a set of CLSI-specific variables are added in essence to catch differences in risk and business profile. The first control variable, $EQTA_{i,t}$ (Equity to Total Assets) accounts for the leverage reflecting differences in risk preferences. Secondly, the business profile is proxied by the ratio of TEU capacity to the number of ships ($CAPVESSEL_{i,t}$). This

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[71] See Panzar & Rosse, 1987 and Bikker et al., 2006 for the translation of the theoretical P-R model into an empirical specification by using a simple single product monopoly model with a demand curve of constant price elasticity and a constant return to scale Cobb-Douglas technology.

variable is included to control for differences in deployed ship sizes. A positive coefficient value is expected since larger ship size should provide economies of scale, hence a higher return. In addition, two dummy variables taking on the values 1 and 0 are included to capture the effect of being a member of an alliance (*DUMMY_AL*) and/ or to study the impact of mergers and acquisitions (*DUMMY_MA*) on turnover.

Ultimately, $\varepsilon_{i,t}$ is a stochastic disturbance term which is assumed to follow a normal distribution ($\varepsilon_{i,t} \sim N(0, \sigma^2)$). The subscript i denotes liner operator i and the subscript t denotes year t. All variables are taken in natural logarithms.

4.3.3 Equilibrium test

A key assumption underlying the P-R model is that the H-test must be undertaken on observations that are in long-run equilibrium. In long-run equilibrium, rates of return should be uncorrelated with input prices. The equilibrium test is based on a regression in which the dependent variable TURN in Eq. 7 is replaced by a measure of profitability such as return on assets (ROA). Since ROA can take on small negative values, following Claessens and Laeven (2004), the dependent variable is calculated as ln(1 + ROA) where ROA is the unadjusted return on assets. The data set allows for the estimation of the equilibrium test as shown in the following equation:

$$\begin{aligned} \ln(1+ROA)_{i,t} &= \beta_0 + \beta_1 \ln(PO_{i,t}) + \beta_2 \ln(PL_{i,t}) + \beta_3 \ln(PCE_{i,t}) + \\ &\gamma_1 \ln(EQTA_{i,t}) + \gamma_2 \ln(CAPVESSEL_{i,t}) + \gamma_3 \ln(DUMMY\_AL_{i,t}) + \gamma_4 \ln(DUMMY\_MA_{i,t}) + u_{i,t} \end{aligned} \quad (8)$$

The long-run equilibrium test measures the sum of the elasticity of return on assets with respect to input prices ($E = \beta_1 + \beta_2 + \beta_3$). If the E-statistic equals zero, it implies that the CLSI is in long-run equilibrium[72]. If rejected, the market is assumed not to be in equilibrium. Figure 4-1 gives an overview of the tests (equilibrium test and competitive environment test) and the relation with the market structure.

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[72] It should be noted that equilibrium does not mean that competitive conditions are not allowed to change during the sample period. It only implies that changes are to be taken as gradual (Shaffer, 1982; Claessens and Laeven, 2004).

Assumption		long-run equilibrium		
E-statistic		E < 0 disequilibrium	E = 0 equilibrium	
H-statistic		H ≤ 0	0 < H < 1	H = 1
Property		without threat of entry	free entry and exit result in zero profits in equilibrium	
Assumption	profit maximising firm			
H-statistic	H ≤ 0		H > 0	
Market structure	monopoly collusive oligopoly	short-run conjectural variation oligopoly	other cases	perfect competition Natural monopoly in a contestable market Sales maximising firm subject to a breakeven constraint
Property	revenu of the firm is independent of decision of rivals, actual or potential	revenu of the firm is affected by the actions of others		

Figure 4-1: Interpretation of E-statistic and H-statistic

4.3.4 Interpretation of the H-statistic

The H-statistic ranges from minus infinity to unity. Until the publication of a recent contribution by Bikker, Shaffer and Spierdijk (2009) the following conclusions were reached on the relation between H and market structure:

If firms pricing policies are consistent with the model of monopoly or a perfect colluding oligopoly, H is negative. In long-run equilibrium, the market structure is characterized by monopolistic competition, if H is positive but less than unity and by perfect competition if the H-statistic equals unity (Panzar and Rosse, 1977). Shaffer (1982) proved that a monopoly operating in a perfectly contestable market and a sales maximising firm subject to a break even constraint also are consistent with an H-statistic of unity. In 1983, Shaffer (1993) showed that a short-run conjectural variations oligopoly corresponds with $H \leq 0$. The numerical value of the H-statistic is interpreted as a continuous measure of the level of competition (Shaffer, 1993). So, an H-value closer to unity indicates a stronger competition than lower values (Vesala, 1995, p. 56, Bikker and Haaf, 2002, p. 2203).

Figure 4-1 summarises the interpretation of the H-statistic. To assure a valid interpretation of the PR model, the market has to be in a long-run equilibrium. The long-run equilibrium test or E-statistic (see section 4.3.3) is already integrated in this overview. For either monopoly or collusive oligopoly, the assumption of profit maximisation is sufficient (See Panzar & Rosse, 1987, p. 446).

Turning to the new interpretation of the H-statistic, Bikker *et al.* (2009) link the properties of the H-statistic with the shape of the average cost function (i.e. u-shaped versus constant average cost function) to allow meaningful interpretations. Figure 4-4 sums up the properties of the H-statistic according to Bikker *et al.* (2009).

Assumption	average cost curve	
	U-shaped	Constant
Market structure		
Monopoly	Rosse and Panzar (1977): H < 0	H < 0
Oligopoly	Rosse and Panzar (1977): H < 0	H < 0
Long-run competition	Rosse and Panzar (1977): H = 1	H < 0 or 0 < H < 1
Short-run competition	Shaffer (1982, 1983): H < 0 possible Rosse and Panzar (1977): 0 < H < 1 possible	
Monopolistic competition	Rosse and Panzar (1977): 0 < H < 1 under conditions, but H < 0 possible	

Figure 4-2: Properties of the H-statistic[73]

In the same study, they also show that the equilibrium test is a joint test for competitive conduct and long-run structural equilibrium, and the unscaled P-R test is a one-tail test of conduct. So, according to their findings, a positive unscaled value of the H-statistic is inconsistent with any form of imperfect competition, while a negative value may arise under various conditions, including short-run competition or even long-run competition with constant average cost (Bikker *et al.*, 2009). In other words, a negative unscaled H-value cannot by itself discriminate between perfect and imperfect competition without information about the shape of the cost function.

For the containerised liner shipping industry, a U-shaped average cost curve is assumed. While the presence of large and small liner operators might suggest that scale effects are not important, increased concentration (e.g. Hoffman, 1998; Sys, 2009), explosion in containership size (e.g. Cullinane & Khanna, 2000; Sys *et al.*, 2008), etc. are indications that scale effects are important in this industry.

Ultimately, Bikker *et al.* (2009) also concluded that the numerical value of H is not a reliable indicator of the strength of competition.

[73] Source: Bikker *et al.*, 2009.

4.4 Data description

Data has been obtained from Liner Intelligence financial analysis (www.ci-online.co.uk) and from investor/ annual reports published on the publicly available internet websites of the selected liner carriers[74]. In the notes to financial statement as well as fact books, Powerpoint presentations, etc. more information at the level of the container shipping division was available. Subsequently, extra data (e.g. number of staff, staff costs, etc.) also has been obtained from these complementary files. The resulting panel of container-related financial results (in millions of USD) is unbalanced as (for a variety of reasons) not all liner operators submit information for all the variables throughout the entire period.

First, adjustments to the resulting panel were made excluding all observations where liner operators reported missing values for operating income and net profit (e.g. Hamburg Süd, Pacific International Line, United Arab Shipping Company). Next, some liner operators were deleted as segmented figures for container division were not available (e.g. Evergreen, Hyundai Merchant Marine). Ultimately, because the test for the nature of competitive conditions is based on the properties of a reduced form log-linear revenue equation and logarithms of negative values do not exist, observations with negative values were dropped.

Despite the above modifications, the small sample should be regarded as fairly representative and comprehensive.

In sum, the empirical specifications at container division level are based on an unbalanced panel data for a sample of 18 major liner operators covering the 1999-2008 period.

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[74] Data incurred in currencies other than US dollars were translated into US dollar using the currency convertor www.oanda.com/ currency/ convertor at the currency exchange rate prevailing at the balance sheet data (End of March or December).

Ranked 2010	Liner operator	Webpage	TEU 01/01/2010	MS100	Total revenu at container level (2008-USD	Alliances	M&A
5	APL/ NOL	www.nol.com.sg	549,508	4.41%	7,945	NWA	
29	CCNI	www.ccni.cl	36,712	0.30%	972		
8	China Shg C.L. (CSCL)	www.cscl.com.cn	453,009	3.64%	5,070		☑
3	**CMA CGM**	www.cma-cgm.com	1,031,327	8.29%	13,393		☑
7	COSCO Container L.	www.coscon.com	453,204	3.64%	6,391	CHKY	
13	CSAV	www.csav.com	328,721	2.64%	4,887		
9	Hanjin Shipping	www.hanjin.com	440,299	3.54%	6,559	CHKY	☑
6	**Hapag Lloyd**	www.hapag-lloyd.com	462,288	3.72%	8,767	GA	☑
11	K-Line	www.kline.com	342,043	2.75%	11,421	CHKY	
1	**Maersk Line**	www.maerskline.com	2,044,981	16.44%	28,666		☑
36	Matson	www.matson.com	29,074	0.23%	1,024		
21	MISC Berhad	www.misc.com.my	125,101	1.01%	3,727	GA	
12	Mitsui-OSK L. (MOL)	www.mol.co.jp	341,820	2.75%	6,529	NWA	☑
10	NYK	www.nykline.com	375,925	3.37%	6,061	GA	
14	OOCL	www.oocl.com	324,209	2.61%	6,502	GA	
25	RCL	www.rclgroup.com	53,435	0.43%	584		
15	Yang Ming Line	www.yml.com.tw	312,962	2.52%	3,573	CHKY	
17	ZIM	www.zim.co.il	305,523	2.46%	4,325		
CHKY	CHKY Alliance						
GA	Grand Alliance						
NWA	New World Alliance						
MS100	market share based on TOP100						
Liner operators in bold are Europe-based carriers							

Figure 4-3: Sample of selected liner operators

Figure 4-5 lists the selected ocean carriers. As the study uses firm-level data aggregated from raw balance sheet data, it is noteworthy that the second largest liner operator, Mediterranean Shipping Company (MSC) is not integrated in the sample.

4.5 Empirical results

In this section, the econometric results are reported and discussed. The reduced-form revenue function expressed in equation 7 is linear in its unknown parameters and, therefore, amenable to estimation by least squares regression methods (OLS).

Figure 4-6 summarises the results of the E-statistic (RE1: ROA) and the estimated values of H-statistic of three regressions (RE2/ 3/ 4: TURN) (including t-values and p-values). The reported standard errors are based on White's heteroskedasticity robust covariance matrix. The test results for the hypothesis H = 0 and 1 are also reported.

	RE1a: ROA			RE1b: TURN			RE2a: ROA			RE2b: TURN			RE3a: ROA			RE3b: TURN		
	coefficient	t-value	p-value	coefficient	t-value	p-value	coefficient	t-value	p-value	coefficient	t-value	p-value	coefficient	t-value	p-value	coefficient	t-value	p-value
Intercept	0.1646	0.4675	0.6416	0.9481	0.4053	0.6865	5.2452	0.9003	0.3716	0.7771	0.2910	0.7719	2.0031	0.3560	0.7230	1.0083	0.4370	0.6635
lnPO	-0.0206	-1.3051	0.1963	0.4757	3.7910	0.0003	-0.1406	-0.5221	0.6035	0.3783	2.9430	0.0045	-0.1829	-0.6816	0.4979	0.4034	3.7053	0.0004
lnPL	0.0033	0.3087	0.7585	0.2046	3.9849	0.0002	0.1321	0.7544	0.4536	0.1559	2.4864	0.0154	0.1447	0.8299	0.4097	0.1611	2.7854	0.0069
lnPCE	0.0002	0.0294	0.9766	0.1899	3.1127	0.0027	0.0752	0.5747	0.5677	0.1486	2.5172	0.0142	0.1131	0.8526	0.3971	0.1639	2.4366	0.0173
lnEQTA	0.0288	1.9615	0.0539	0.2130	5.6220	0.0000	0.3314	1.2793	0.2057	0.1638	3.9435	0.0002	0.5702	2.2730	0.0264	0.1826	5.5712	0.0000
lnCAPVESSEL	-0.0287	-0.7946	0.4296	1.5616	7.3504	0.0000	-1.0839	-1.7792	0.0803	1.4140	6.0141	0.0000	-0.6325	-1.0570	0.2945	1.4204	6.5167	0.0000
DUMMY_AL	0.0499	2.3516	0.0216	-0.5211	-3.4714	0.0009	0.7544	1.7880	0.0788	-0.1475	-0.8861	0.3787	0.3664	0.8495	0.3987	-0.1843	-1.1261	0.2639
DUMMY_MA	0.0170	0.5020	0.6173	0.4920	3.5161	0.0008	0.2890	0.5283	0.5992	0.4642	3.7745	0.0003	-0.3229	-1.5124	0.1354			
DUMMY_MA(-1)							-0.4536	-0.8029	0.4252	0.7904	4.0800	0.0001						
DUMMY_MA(-2)							-0.3957	-0.6458	0.5209	0.7056	4.7507	0.0000						
DUMMY_MAb																0.7671	3.9950	0.0002
E-value	-0.0171						0.0667						0.07485					
H-value				0.87029						0.68281						0.72838		
Wald test (F-statistic) for testing E = 0	0.68678		0.4102				0.03601		0.8501				0.04560		0.8316			
Wald test (F-statistic) for testing H = 0				45.1944		0.0000				16.2784		0.0001				30.5243		0.0000
Wald test (F-statistic) for testing H = 1				1.00401		0.3197				3.51281		0.0653				4.24458		0.0430
R²				0.74127						0.80939						0.78236		
Adj. R²				0.71576						0.78378						0.7609		
N° of observations	76			79			70			77			72			79		

Figure 4-4: Panel estimation results of the P-R model

We experimented with different coding of the variable *dummyMA*. In the regressions 1 and 2, the dummy variable, *dummyMA* is set equal to one in the year of the merger and zero in other years. In regression 2 the merger activity is assumed to last a number of years. The best results were obtained with a lag of two years. In regression 3, the dummy variable, *dummyMAb* was coded one for liner operators involved in a merger and acquisition in the year of the merger and all consecutive years, zero otherwise (i.e. before mergers and for liner operators not involved in mergers). This means that it is assumed that a merger has a permanent impact on turnover. This is a too strong assumption given the results for regression 3. Although for all regressions, the R-squared is high (>70%) and they are able to explain a large fraction of the variation in turnover, it is clear that the results for RE2 give the best fit in terms of the adjusted R^2.

Over the regressions, the H-statistic varies for the containerized liner shipping industry from 0.68 to 0.87 but is in all cases largely driven by the price of operations. The assumption that mergers may have a lasting or permanent character as is the case in RE2 and RE3, reduces the significance of the impact of membership of an alliance. The estimation results show a positive value for *lnEQTA* or equity to total assets which accounts for the leverage reflecting differences in risk preferences [62]. A possible explanation may be that capital buffers encourage risk-taking (i.e. to order larger ship sizes).

4.5.1 Interpretation of the H-statistic

Firstly, we interpret the *H*-statistic in accordance with the traditional approach summarized in Table 1. Prior to estimating the *H*-statistic, an equilibrium test was conducted to verify the long-run equilibrium assumption of the P-R model. The test for long-run equilibrium based on equation 8 and the estimates reported in column RE1a of Table 4 yields an *E*-statistic that is close enough to zero. According to the results of a Wald test the null hypothesis of long-run equilibrium cannot be rejected at a 5% significance level. Consequently, the *H*-statistic can be interpreted for all the market models. The equilibrium test was also conducted for the regressions 2 and 3 (see columns RE2a and RE3a). In each scenario the null hypothesis of long-run equilibrium cannot be rejected at a 5% significance level.

According to Table 1, the P-R model shows that the *H*-statistic can be used to identify the market structure in which a carrier operates. For equation RE2b, an unscaled *H*-statistic of 0.68 would suggest that the CLSI could be described as displaying monopolistic competitive behaviour. Or, an increase in costs causes turnover to increase at a lower rate ($0 < H < 1$).

The usual statistical framework is applied to test the value of H. Following Bikker *et al.* (2006), a t-test for the one-sided hypotheses and a Wald-test for the two-sided ones are used. The one-sided test for monopoly (H_0: $H \leq 0$ versus H_1: $H > 0$) rejects the null hypothesis. To test whether or not the calculated H-statistic is statistically different from zero and unity, the Wald test (F-statistics) was conducted. The null hypothesis of the two-sided test for the value of H (H_0: $H = 0$ versus H_1: $H \neq 0$) can clearly be rejected. The *F*-statistic of 3.51 implies that the hypothesis that $H = 1$ can be rejected at the 10% significance level.

So, the *H*-statistic suggests that the CLSI operates in a monopolistic competitive environment. Furthermore perfect competition, sales maximising firms subject to breakeven constraint and natural monopoly in a contestable market can be rejected at a 10% significance level, even at a 5% significance level if RE4 is considered.

Secondly, following Bikker *et al.* (2009), the interpretation of the H-statistic deviates from prior studies. The estimate of the H-statistic based on an unscaled revenue equation is significantly positive in all regressions (RE1/ 2/ 3a). According to Figure 4-4, a significantly positive unscaled value of H is inconsistent with any form of monopoly or collusive oligopoly but under certain conditions, it is consistent with monopolistic competition. Based on the unscaled PR model, we reject the null hypothesis (H < 0) based on a one-sided t-test. Then, according to the study of Bikker *et al.* (2009), no further tests are required to rule out the possibility of neoclassical monopolist, collusive oligopolist or short-run conjectural variation oligopolist.

4.5.2 Other regressions

We also ran several regressions to test alternative variables (e.g. non-operating expenses to transported TEU, dummy variable indicating liner operators quoted on the stock exchange, etc.). Neither of these tests had any significant effect. Next, macro data (e.g. GDP, world container traffic to GDP,...) was included in the P-R model (Bikker *et al.*, 2008). The outcomes were not statistically significant.

In addition, we worked with a time-dependent coefficient since liberalisation, deregulation, etc. may cause changes in the competitive structure of a market over time. For that reason, Bikker and Haaf (2002) add a time-dependent coefficient, assuming that the long-run equilibrium market structure changes gradually over time. The reduced form revenue equation is then written as

$$\ln TURN_{i,t} = \beta_0 + \left[\beta_1 \ln(PO_{i,t}) + \beta_2 \ln(PL_{i,t}) + \beta_3 \ln(PCE_{i,t})\right] e^{\delta \mathrm{TIME}} + \gamma_1 \ln(EQTA_{i,t}) + \gamma_2 \ln(CAPVESSEL_{i,t}) + \gamma_3 \ln(DUMMY\_AL_{i,t}) + \gamma_4 \ln(DUMMY\_MA_{i,t}) + \varepsilon_{i,t} \quad (9)$$

The time-dependent *H*-statistic can be written as $H(TIME)=(\beta_1+\beta_2+\beta_3)e^{\delta\ TIME}$. For a situation where the competitive structure is constant over time δ will be equal to zero. For the CLSI, the test yields a not significant δ, indicating no significant changes in competitive conditions.

Ultimately, to identify whether individual liner operators' features have a significant effect on the competitive structure, a series of specification tests were run between pooled OLS, fixed effects and random effects. It comes as no surprise that the fit of the P-R model with fixed effects (measured by $\bar{R}^2$) is higher. Based on the Hausman test, the random effects model was rejected in favour of fixed effects. However, fixed effects estimation of a static revenue equation results in an upward bias of the unscaled H-statistic (see also Goddard & Wilson, 2007). Goddard and Wilson suggest a dynamic panel estimation method. In this stage of the research, the small number of observations does not allow the estimation of a dynamic revenue equation.

4.6 Concluding remarks

This paper investigates in detail the competitive conditions of the containerised liner shipping industry for the period 1999 to 2008, viz. the period before the abolishment of the conferences in liner shipping industry and the financial and economic crisis.

To assess the degree of competition at the level of the container liner shipping industry, a modern empirical analysis based on the non-structural method developed by Panzar and Rosse (1987) was conducted. This method is also known as the H-statistic or revenue test. It examines whether the conduct of a liner operator is in accordance with the models of perfect competition, imperfect or monopolistic competition, or monopoly. A new study of Bikker, Shaffer & Spierdijk (2009) adds that only an unscaled revenue equation yields a valid measure for competitive conduct. The methodology has been applied to several sectors ranging from banking systems to airline industries. To test the impact on firm-level revenues of variations in the prices of factors of production, a sample of 18 liner operators was observed.

The main finding of the study is that the significantly positive unscaled value of the H-statistic for the containerised liner shipping industry means that the hypothesis can be rejected that the CLSI market structure corresponds with a neoclassical monopolist, collusive oligopolist or conjectural-variations short-run oligopolist. An equilibrium test was also conducted to satisfy the long-run equilibrium assumption of the P-R model. Noteworthy is the impact of mergers and acquisitions on turnover. The results show that the liner operators involved in mergers and acquisitions have higher revenues in later years

From a policy viewpoint, the findings of this study have a high economic relevance since it is important to have information on the degree of competition in the container liner shipping industry. The results of the present study form a good starting point to compare and to evaluate the effects of future changes and regulations in the stated industry. The findings are also interesting for the liner operators since the market structure under which a carrier operates determines its behaviour.

An interesting avenue for future research might be to focus on applying the Panzar-Rosse model between port pairs to assess the nature of the trade lanes in which the liner operator competes. In this stage of the research, due to a shortage of data, these aspects could not be examined.

The Panzar Rosse model might also be applied on other business segments of the liner shipping industry (e.g. bulk transport, tanker segment as well as terminal operations) or other transport modes.

4.7 References

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Chapter 5

5 The Boone indicator, a new approach to measure the evolution of competition for the container liner shipping industry

Abstract[75]

How does competition in the container liner shipping industry evolve over time? To answer this question, the present paper examines a new model-based measure of competition. This measure of competition based on Boone's theoretical work quantifies the impact of marginal costs on performance, measured in terms of profits or market shares. Boone (2000 and 2004) shows that when profit differences are increasingly determined by marginal cost differences, this indicates increased competition. The evolution of competition will be calculated using a pooled data set of 20 liner operators. The sample period covers the years from 2000 to 2008. The analysis is carried out at industry level. After correcting for industry-specific effects (i.e. number of services, average ship size), the findings suggest that over the 2000-2008 period the competition has intensified.

Keywords:

Competition, Container liner shipping industry, Boone indicator, Efficiency, Market structure

[75] I would like to thank Jan Boone for valuable comments as well as Matthew Beddow and Jane Degerlund (Containerisation International) for assistance with data regarding the number of services. I much appreciated the advice and assistance of Prof. dr. H. Meersman on econometric issues as well as the helpful suggestions of Prof. dr. E. Van de Voorde. Finally, I would like to thank the members of my 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. The author remains solely responsible for the article's content.

5.1 Introduction

According to economic theory, firms under monopolistic competition and oligopoly earn supernormal profits in the short-run while profits will tend towards a normal level for all firms in the industry in the long-run. Sys *et al.* (2010) state that the containerised liner shipping industry (hereafter abbreviated, CLSI) operates in a monopolistic competitive environment and that the market structures, viz. perfect competition, sales maximising firm subject to breakeven constraint and natural monopoly in a contestable market can be rejected at a 10 % significance level. This points in the direction of the opportunity to earn supernormal profits. On the other hand, the transport sector generally is known for its small profit margins. Thus, the CLSI might be characterised by small profit margins. Two opposite findings.

Maritime advisor, Drewry (2009, p. 1) observes that "*Running a global container business is no different from being a small manufacturer of textiles – the ultimate aim must be to remain profitable, not to be the biggest. Collective ocean carrier strategy has certainly never resulted in the former, at least for any sustained period.*" Given the quote by Drewry, the scenario of small profit margins is expected.

The aim of the present paper is to better comprehend the performance of the liner operators. To do this, this paper uses the Boone indicator. The Boone indicator measures the effect of efficiency on performance.

The remainder of this paper is structured as follows. Section 5-2 first analyses the profitability of the container liner shipping industry. Section 5-3 provides a brief overview of empirical studies which concentrate on the causes and effects of market performance. The Boone indicator is introduced in Section 5-4. This section also contains a brief survey of the literature on this particular methodology. The data is described in the following section. Using firm-level data, Section 5-6 presents the empirical results. Finally, Section 5-7 ends with concluding remarks, sets a few challenges for further economic research and derives implications for policy makers.

5.2 Profitability of the container liner shipping industry

As background for the empirical part of this paper, this section provides an overview of the profitability of the container liner shipping industry from 2000 to mid 2010.

To study the profitability of the CLSI, the evolution of three profitability measures will be examined[76]. First, Appendix 5-1 gives an overview of the evolution of the operating profit or earnings before interest, tax, depreciation and amortisation (EBITDA)[77] in absolute values (upper panel) and year-on-year percent change (lower panel). Secondly, a barometer of long-term industry profitability viz. the evolution of return on sales (ROS)[78] is shown in Appendix 5-2. Thirdly, Appendix 5-3 lists both in absolute values and year-on-year percent change the evolution of the bottom line performance or net profit for the selected firms engaged in the container liner shipping industry.

The sample selection process is driven by those liner operators that publish accounts at the level of the container shipping division and resulted in a sample of 20 liner operators covering the 2000-2008 period[79]. Figure 5-1 provides a short description of the selected carriers.

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76 Data was collected from Liner Intelligence financial analysis (www.ci-online.co.uk), annual reports, the notes to financial statements as well as fact books and Powerpoint presentations. Data in currencies other than US dollars were converted into US dollar using the currency convertor www.oanda.com/ currency/ convertor at the currency exchange rate prevailing at the balance sheet data (End of March or December). All figures in Appendix 5-1, 5-2 and 5-3 are in US dollar million except % changes.

77 Not all liner operators have the same accounting rules on vessel depreciation. Therefore, EBITDA is preferred above EBIT.

78 Return on sales is defined as EBITA divided by sales revenue and measures the ability to extract operating profit out of every dollar earned before financial items and tax.

79 Note: some Top 20 liner operators are not included in the sample. Due to missing data for operating income and net profit, for instance, Hamburg Süd and Pacific International Line are not included in the sample. Furthermore, some liner operators are excluded as segmented figures for container division were not available (e.g. Evergreen, Hyundai Merchant Marine). Boone *et al.* (2007) state that "… *we need not have the data on all firms in the market. Clearly, more data is always better, but we can still estimate the relationship reliably when we only have a sample of firms in the market*".

Rank	Liner operator	Webpage	TEU	Ships	Number of services	Market share	Alliances
4	APL/ NOL	www.nol.com.sg	549,508	139	70	4.41%	☑
29	CCNI	www.ccni.cl	36,712	16	10	0.30%	
8	China Shg C.L. (CSCL)	www.cscl.com.cn	453,009	125	46	3.64%	
3	CMA CGM	www.cma-cgm.com	1,031,327	353	91	8.29%	
7	COSCO Container L.	www.coscon.com	453,204	134	88	3.64%	☑
13	CSAV	www.csav.com	328,721	96	22	2.64%	
9	Hanjin Shipping	www.hanjin.com	440,299	99	52	3.54%	☑
6	Hapag Lloyd	www.hapag-lloyd.com	462,288	113	68	3.72%	☑
11	K-Line	www.kline.com	342,043	90	66	2.75%	☑
1	Maersk Line	www.maerskline.com	2,044,981	538	104	16.44%	
36	Matson	www.matson.com	29,074	15	5	0.23%	
21	MISC Berhad	www.misc.com.my	125,101	39	22	1.01%	
12	Mitsui-OSK L. (MOL)	www.mol.co.jp	341,820	91	85	2.75%	☑
10	NYK	www.nykline.com	407,300	106	41	3.27%	☑
14	OOCL	www.oocl.com	324,209	71	69	2.61%	☑
25	RCL	www.rclgroup.com	53,435	39	36	0.43%	
19	UASC	www.uasc.net	196,237	49	15	1.58%	
22	Wan Hai Lines	www.wanhai.com	125,060	66	34	1.01%	
15	Yang Ming Line	www.yml.com.tw	312,962	77	51	2.52%	☑
17	ZIM	www.zim.co.il	305,523	94	47	2.46%	

Figure 5-1: Sample of liner operators

As shown in Appendices 5-1, 5-2 and 5-3, the financial results for the year 2000 were generally good. Focusing on the operating results of the liner operators, the year 2003 was a much better year than either 2001 (i.e. influence of currency exchange factors on liner operators' bottom line performance) and 2002 (i.e. weaker results posted in 2001 continued in 2002). The most impressive improvements were witnessed by Asian-based carriers (e.g. CSCL, COSCO Container line). The improved financial performance posted by liner operators in 2003 continued into the year 2004. By comparison, the number of liner operators realising a ROS above 10 %, doubled (see Appendix 5-2). During the latter two years, the container market improved due to a combination of factors (e.g. general freight rate recovery programs, network optimisation, (tight) cost control, better performance and a strong demand on all main trade routes even faster than the increase in available vessel capacity). However, the improvement in the container market was tempered by the adverse impact of continuous increases in rates for chartered tonnage, high fuel prices, high land operations costs and increased costs relating to the repositioning of empty containers.

The last year of strong profitability was the year 2005. Increased costs, especially those relating to bunkering and chartered tonnage yet again neutralised the freight rates which were on average above the level of 2004. Higher bunker recoveries were introduced. The optimistic expectations for continued economic growth led to extra contracts for new and larger container vessel tonnage. One year later, looking at the % change (lower panel of Appendices 5-1 and 5-3), a reduction in profit levels is clearly observable. Operating profits plummeted by an average of 30 % (see sample average, Appendix 5-1) and some liner operators even slipped into the red at net level (see Appendix 5-3). Excepting some liner operators, Beddow and Ajala (2007) note that diversified groups better maintain their profit than pure container liner operators. Following the dramatic decrease seen in 2006, liner operators’ profits increased again in 2007. The recovery experienced in 2007 was only temporary since the container vessel capacity increased more than the volumes transported causing freight rates to develop negatively.

A reversing trend is noticeable starting in the last quarter of 2008 as global demand slows drastically following the global financial and economic crisis. The period end 2008 - beginning 2009 is characterised by a downswing in demand and freight rates across all trade lanes caused by the global downturn, higher operating costs caused by escalating bunker fuel prices and costs associated with the restructuring process. Some financially challenged liner operators stopped reporting net profit at container division[80].

By the end of 2009, most liner operators’ financial results have reached negative results. Focusing on the container division results, some examples illustrate the impact of the new market downturn on liner carriers' ongoing profitability. First, AP Moller-Maersk posted a post-tax loss of USD 373 million, dragged down by the segment result after tax for Maersk Line of USD -555 million. Next, Hapag-Lloyd posted a USD 300 million operating loss for the first quarter of 2009. Hapag-Lloyd as well as other carriers (e.g. CMA CGM,…) applied for state aid. Furthermore, Taiwan's duo of ocean carriers - Yang Ming and Wan Hai Line - as well as the Japanese ocean carriers NYK Line, MOL and K-Line have all seen their 2009 financial results falling. Their net profit sank into the red compared to previous years’ profit. The list of carriers posting substantially lower financial results in 2009 grew, such as Hanjin Shipping's container division, China Cosco Holdings' container shipping arm COSCON and fellow Chinese ocean carrier China Shipping Container Lines (CSCL) as well as the Malaysian transport group, MISC Berhad. Furthermore, the Chilean shipping line, CSAV and the Intra-Asia feeder and domestic carrier, Regional Container Lines (RCL) also reported considerable losses in

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80 Based on Containerisation International (www.ci-online.co.uk), the evolution of the profitability can further be described in broad outlines up to the reporting of interim results of the first quarter of 2010.

2009. In fighting to keep their cost base in check, both carriers trimmed operating costs (i.e. a lower fuel bill and renegotiated charter rates).

For the first quarter of 2010, Maersk Line, CMA CGM, Hapag-Lloyd, China Cosco Holdings turned back into operating profits. Even with a significant improvement in carryings and turnover, Singapore's leading liner shipping and logistics group, APL still reported heavy losses. An explanation might be found in its much smaller share of the Asia-Europe trade and its heavier reliance on the transpacific than other Top 10 liner operators. Other carriers forecast a return to profit.

Mid 2010, most liner operators expect to make a much bigger profit in 2010 than previously forecast, assuming that freight rates, oil prices and exchange rates remain stable over the remainder of the year. Once again, the shipping companies experience a ongoing shortage of sea container equipment in many areas, which drives up operational costs (Beddow & Ajala, 2006-8; Beddow, 2009 and 2010; Drewry, 2000-9).

Summing up, the containerised liner shipping industry suffers from the current economic downturn like most other industries. Knowing that the liner operators have taken action to cut costs (e.g. reduced number of sailings, introducing bigger cost effective tonnage, slow-steaming to save fuel, sailing via the Cape of Good Hope to save on Suez canal transit fees, off-hiring vessels, scrapping vessels, cutting overhead, selling some of their profitable terminal operations (e.g. Hanjin, Hapag-Lloyd Maersk Line, OOCL), one might conclude that there is no indication of earning supernormal profits at current profitability levels. Moreover, it was financially a grim five years' period for liner operators.

Like stated before, the aim of the present paper is to better understand the performance of the liner operators. Is it a matter of buying of market share activity (e.g. Maersk Line, APL), facing competition from non-vessel common operating carriers (e.g. Ecu-Line) and global forwarders (e.g. DHL, K&N, Panalpina, DB Schenker), artificial competition, a lack of competition or inefficient behaviour?

Many empirical studies, using different methodologies, have attempted to explain the variations in performance between firms, most commonly measured by profitability. The next section provides a selective overview of the recent developments in Industrial Organisation literature.

5.3 Evolution in Industrial Organisation literature

In the tradition of the Industrial Organisation (IO) literature, an explanation for the variations in performance would be found in regressing the profit-concentration relationship. Since the seminal study by Bain (1956), a large number of IO-studies have been preoccupied with this relationship. Some studies therefore used a single-equation approach (i.e. regressing a measure of firms' profitability on a proxy for market concentration, such as the n-firm concentration ratio (CRn) or the Herfindahl–Hirschman Index (HHI) as an exogenous indicator of market power or an inverse indicator of the intensity of competition). A positive coefficient is expected as higher concentration goes hand in hand with higher market power. Many studies found a positive statistical relationship between profit (i.e. an index of performance) and concentration (an index of market structure) while other studies were often quite weak in their statistical significance and/or found an adverse relationship[81]. Applying this single-equation approach for the CLSI resulted in a negative statistical relationship.

Besides to the conflicting evidence, the single-equation approach is subject to a number of statistical reflections[82]. For instance, the assumption of the existence of a unidirectional causality among structure-performance variables may result in biased and inconsistent estimates of the parameters. Meanwhile, some studies refute this critique and state that the simultaneity bias is not so important and that the results of the single-equation are reliable (see Bhattacharya & Bloch, 1997). This debate led eventually to a two-way causality. Round (1980) was the first to use a simultaneous equation approach to explain industry performance. Berger (1995) introduced a reduced form, which nests four hypotheses that are typically postulated as potential drivers of a positive relationship between structure and performance. Earlier studies failed to consider the four hypotheses simultaneously. The four hypotheses are two market-power theories (i.e. structure-conduct-performance hypothesis, SCP and relative-market power hypothesis, RMP)[83] as well as two efficiency explanations of the positive relationship, viz. the

[81] For a comprehensive review see Berger, 1995 and De Jonghe & vander Vennet, 2008.

[82] See Lipczynski *et al.*, 2005, pp. 14-16.

[83] The SCP–hypothesis suggests that the performance of a firm depends upon its conduct which, in turn, depends upon the market in which it operates. In other words, the SCP-hypothesis investigates whether a highly concentrated market (as measured by four-firm concentration ratio or Herfindahl-Hirschman Index) causes collusive behaviour among larger firms resulting in greater market performance whereas the RMP-hypothesis asserts that only firms with large market shares have the power to set prices and thus to earn supernormal profits (Berger, 1995).

efficient-structure hypothesis, ESX and the efficient-structure-scale hypothesis, ESS[84]. Berger estimates a translog cost function to derive both efficiency measures. A translog cost function could not be estimated for the CLSI due to data limitations. An in-depth analysis of studies applying this reduced form therefore is beyond the scope of this paper.

As of the early 1990s, there has been a shift in literature from 'traditional' methods employed in industrial organisation (e.g. SCP-analyses, studies of scale and scope economies) towards 'new' empirical methods (New Industrial Organisation, NIO: game theory and New Empirical Industrial Organisation, NEIO: Bresnahan, Panzar and Rosse[85]). Empirical research in the NEIO stream is based on microeconomic theory in which optimising behaviour is assumed and makes direct observations of the conduct in specific industries. Regarding the measure of conduct, the focus moved from firms prices/ profitability to efficiency, service quality, etc. with the advent of New Empirical Industrial Organisation. Regarding empirical models, there is a shift from static cross section short-run towards dynamic effects over time (Berger *et al.*, 2004).

Another question arises as to how efficiency can be measured? First, a straightforward measure is the popular empirical measure of competition, namely price cost margin (PCM). Price cost margin is equal to the output price minus the marginal costs, divided by the output price. A disadvantage of this measure is that in many industries as well as in the CLSI competition cannot be measured directly, as costs and often also price data of single products are usually unavailable. Moreover, a second disadvantage observed by Boone and Weigand (2004) is the fact that PCM does not capture the notion of increased competition through more aggressive interaction between firms. Secondly, an alternative indirect measurement technique has been proposed in the line of NEIO-literature. A new approach to measure the effects of competition is the so-called Boone indicator. The Boone indicator (synonym: relative profit difference, RPB; relative profits measure, RPM or profit elasticity, PE) measures the effect of efficiency on performance in terms of profits or market shares. To do this, an empirical specification will be estimated to explain profits through market structure variables and measures of efficiency using firm-level panel data.

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84 The ESX-hypothesis states that firms are able to realise higher profits as a result of superior management while the ESS-hypothesis claims that the difference in profitability between firms is caused by differences in the level of scale efficiency at which a firm is operating (Berger, 1995).

85 Sys *et al.* (2010) have applied the Panzar and Rosse model for the containerised liner shipping industry.

Against the backdrop of both academic and political interest in competition and its measurement, it is somewhat surprising to observe that little is known about the evolution of competition in the CLSI (see also Sys *et al.*, 2010). The Boone indicator is an interesting tool to estimate how (the intensity of) competition in the CLSI evolves over time.

5.4 The Boone indicator model

This section presents the Boone indicator and discusses the literature on this topic.

5.4.1 The theory

Boone (2000) has developed an indicator to measure the effects of competition based on firms' profits. Two effects can be distinguished in which competition can be intensified within a market. The first effect is a fall in entry barriers. Consequently, increased entry leads to more intense competition. Secondly, competition can be intensified by more aggressive behaviour by incumbents. This forces inefficient firms out of the market and increases concentration. The Boone indicator captures both effects.

To do so, Boone parameterises competition in terms of a negative relationship between relative efficiency and relative profits. (Boone, 2000 and 2004; Griffith *et al.*, 2005). The relative profits measure or the Boone indicator relies on the notion that competition enhances the performance of efficient firms (i.e. with lower marginal costs) and impairs the performance of inefficient firms, which is reflected in lower profits or smaller market shares (van Leuvensteijn *et al.*, 2007). This effect of efficiency on profits or market shares will be greater in a more competitive environment, since firms are punished more harshly for being inefficient (Boone, 2004). This approach is related to the efficiency hypothesis[86], which also explains firms' performances by differences in efficiency (van Leuvensteijn *et al.*, 2007)[87].

The advantages of the Boone indicator are threefold. First, the Boone indicator is shown to be more robust theoretically than the price cost margin (Boone, 2004). Secondly, the Boone indicator is able to measure competition at disaggregated level. Thirdly, as mentioned in van Leuvensteijn *et al.* (2007), the indicator requires relatively little data compared to many other approaches (e.g. the Bresnahan model) which are very data

[86] See section 5.3, footnote 90.

[87] Measuring efficiency using a production/ cost frontier analysis was impossible due to a lack of data.

intensive. The Boone indicator does not require to have data for all firms in the market all years.

The indicator relies on two key assumptions. First, Boone (2000) assumes that firms generally pass on at least part of their efficiency gains to their clients (read: shippers). Secondly, the Boone indicator ignores differences in product quality and design across firms, as well as the attractiveness of innovations (van Leuvensteijn *et al.*, 2007). This might be a caveat with regard to the Boone indicator.

5.4.2 The model

Following Boone *et al.* (2004), van Leuvensteijn *et al.* (2007) and van Leuvensteijn (2008), the mathematical derivation starts from the assumption that firm i faces a demand curve of the form

$$p(q_i, q_{j\neq i}) = a - bq_i - d\sum_{j\neq i} q_j \tag{1}$$

whereby each firm has a constant marginal cost, mc_i. To maximise profits, firm i chooses the optimal output level q_i to solve

$$\pi_i = (p_i - mc_i)q_i \tag{2}$$

or

$$\max\left\{(a - bq_i - d\sum_{j\neq i} q_j - mc_i)q_i\right\} \tag{3}$$

Two key assumptions are imposed. First, the intercept a has to exceed the marginal cost ($a > mc_i > 0$). Secondly, the parameter d which can be interpreted as the measurement of the degree of substitution of this product between firms is positive and less than or equal to the parameter b ($0 < d \leq b$). The first order condition for a Cournot-Nash equilibrium is then given by

$$a - 2bq_i - d\sum_{j\neq i} q_j - mc_i = 0 \tag{4}$$

Let there be N firms producing positive output levels, one can solve the N first order condition yielding

$$q_i(mc_i) = \frac{(2\,{}^{b}\!/_{d} - 1)a - (2\,{}^{b}\!/_{d} + N - 1)mc_i + \sum_j mc_j}{(2b + d(N-1))(2\,{}^{b}\!/_{d} - 1)} \tag{5}$$

If profits, π_i are defined as variable profits excluding entry costs, E a firm with marginal costs mc_i enters the market if, and only if, $\pi_i(mc_i) \geq E$ in equilibrium. Combining the profit function (Eq. 2) with Eq. 5 which relates output with marginal costs, it can be shown that profits depend on marginal costs in a quadratic way

$$\pi_i(mc_i) = b[q(mc_i)]^2 \tag{6}$$

Based on these properties, Boone *et al.* (2004) considered two ways in which competition in a market can be intensified through (i) an increase of d (keeping d below b) and/ or (ii) the effect of a reduction in the entry cost, E. In the former regime, the products offered by different firms become closer substitutes. In the second regime, the lower the entry barriers, the more firms should enter and the more competitive the industry should be. The Boone indicator picks up both forms of changes in competition correctly (Boone *et al.* 2004).

In order to calculate the Boone indicator, Boone (2004), Griffith *et al.* (2005), Boone *et al.* (2007), van Leuvensteijn *et al.* (2007) postulate the following linear specification between profits ($ln\ \pi_{i,t}$) and marginal costs ($ln\ mc_{i,t}$) which can be viewed as a first order Taylor approximation

$$ln\ \pi_{i,t} = a + \beta\ ln\ mc_{i,t} + \mu_{i,t} \tag{7}$$

The notation is as follows: the subscript i and t values represent firm i at time t. The parameter of interest is the absolute value of the slope coefficient, β. The Boone indicator or β is expected to have a negative sign. It represents the percentage decrease (increase) in profits of firm i as a result of one percentage point increase (decrease) in marginal costs. The larger β, the more intense the competition. The parameter a is the constant term and $\mu_{i,t}$ is an error term following the classical assumption, namely, $E(\mu_{i,t}) \sim N(0,\sigma^2)$. In order to deal with heteroskedasticity, Eq. (7) has been specified in log-linear terms.

As data on marginal costs cannot be observed directly, most studies used a proxy. In the next section, the Boone literature will be reviewed in order to inventarise the used proxies used.

5.4.3 Literature review

This subsection provides a brief review of the growing literature that has applied the Boone indicator and elaborates on the choice of the dependent and independent variables. A summary of this strand of literature is given in Appendix 5-4[88].

In the first study, Boone (2000) investigates the conceptual differences between competition measures for a broad set of economic models and proves that intensifying competition entails more emphasis on rewarding efficiency advantages.

After developing the theoretical framework, Boone and Weigand (2000) and Boone (2004)[89] have tested their model using data from different manufacturing industries. As dependent variable, Boone and Weigand (2000) used the relative values of profits where Boone (2004) selected the absolute values of profits. Given that the marginal costs cannot be observed directly, both papers approximated the independent variable by the ratio of variable costs and revenues.

Since then, several articles have applied the Boone indicator for different industries. Following Boone & Weigand (2004), Creusen *et al.* (2006a) apply the Boone indicator to measure the intensity of competition for a number of sectors of the Dutch economy (i.e. manufacturing industry, construction sector and service sector). Griffith *et al.* (2005) concentrated on the UK market whereas Creusen *et al.* (2006b) investigated the Dutch market sector using four competition indicators (i.e. price-cost margin, Herfindahl-Hirschman index, labour-income ratio and the Boone indicator). Covering the 1993-2001 period, Creusen *et al.* (2006b) found elasticities between average variable costs and profits of about -5.7 and -2.5 respectively. Maliranta *et al.* (2007) tested various relatively well-known competitiveness indicators across the Finnish manufacturing and service sectors at a relatively disaggregated level. Out of nine different indicators, these authors state that the Boone indicator is preferred for both analytical/ theoretical and empirical reasons. All the above-mentioned studies estimated the firm's marginal cost by the ratio of variables costs and revenues. Maliranta *et al.* (2007) used different functional forms.

van Leuvensteijn *et al.* (2007) is the first to apply the Boone indicator to the banking sector covering the 1994-2004 period. For six major EU countries and two non-EU

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88 Appendix 5-4 lists the papers according to the year of publication. The next two columns report the sample period and the industries studied. The fourth column provides an overview of the chosen dependent variable while the last column summarises the independent variable used.

89 In the meantime, this study has been published in Economic Journal, 188, pp. 1245-1261. In the literature review, here, Boone (2008) is not mentioned as it concerns a revised version of Boone (2004).

countries (i.e. the US and Japan), van Leuvensteijn *et al.* (2007) measures the level of competition in the lending markets, a separate product market as well as among specific types of banks. In contrast to previous studies, van Leuvensteijn *et al.* (2007) measures the impact of marginal cost on performance in terms of market shares and calculates the marginal cost (i.e. employing a translog function) instead of using average variable costs as a proxy for marginal cost.

Whereas most studies estimate the cross-sectional relationship between marginal costs and profits of different firms at a given time, van Leuvensteijn (2008) applied the Boone indicator to identify different regimes of competition for one firm, viz. the American Sugar Refining Company during different periods of time (1890-1914). In this study, van Leuvensteijn again uses information on market shares as a proxy for the profits.

Another study of Bikker & van Leuvensteijn (2008) applies the Boone model to the Dutch life insurance industry over 1995–2003. The Boone indicator of this industry is around -0.45. They estimated the Boone indicator in three ways. First, Bikker & van Leuvensteijn consider marginal cost derived from a translog cost function (TCF). Secondly, they test the model using an adjusted marginal cost (i.e. marginal costs adjusted for scale economies). Last, marginal costs are represented by average variable cost. Bikker & van Leuvensteijn (2008) found that average variable costs and model-based marginal costs result in similar estimates.

Tarryn (2008) regresses absolute values of profit on marginal cost to determine the effectiveness of measuring the degree of competition within the electricity markets. According to Tarryn (2008), the Boone Indicator may not be an adequate measure to use within the electricity sector due to intricacies of the electricity market (e.g. hourly fluctuating demand).

Maslovyck (2009) adopts the Boone indicator approach in estimating the level of competition in the Ukrainian loan market. This study estimated the Boone indicator, using both the average cost and the translog cost function approach. The author found that the translog cost function approach is more robust and reliable in estimating the level of competition.

Schaeck & Cihák (2010) estimate a modified version of the Boone model. To estimate the Boone indicator, these authors opt for a lin-log specification and use return on assets

(ROA) as a dependent variable instead of lnROA. The independent variable is proxied by average variable costs.

Applying a similar concept as van Leuvensteijn *et al.* (2007), Roengpitya (2010) measures the level of competition in the loan market of the Thai and U.S. banks. In contrast to the study of van Leuvensteijn *et al.* (2007), this author estimated the translog cost function including the states' fixed effects and calculated the marginal cost differently.

Braila *et al.* (2010) estimate the Boone indicator from firm-level data to describe product market competition in the Belgian economy covering the 1997-2004 period. Here, the dependent variable is defined as the difference between a firm's revenue and its variable cost. The marginal cost is approximated by the ratio of variable cost and operating revenue (or turnover).

The study of Schiersch & Schmidt-Ehmcke (2010) is the first to question the applicability of the Boone indicator. These authors conclude that "*the Boone-Indicator, although theoretically superior, is, at least at this stage, not an empirically robust indicator. The Lerner-Index on the other hand indicates changes in competition as expected. However, the results of the RPD (Relative Profit Differences) based Boone-Indicator are promising*".

Summing up, this compilation of articles does not seem to offer a consensus regarding the choice of dependent and independent variables. Furthermore, this body of literature can be applied to all kind of industries except for network industries (i.e. media, electronic communication, railways), ICT-industries as well as very knowledge-intensive industries (i.e. pharmacy) (see Creusen *et al.*, 2006a). This paper adds to this literature by using the Boone-indicator for the CLSI.

5.5 Variables/data used

This section discusses the variables used and required data used.

First, the key variables to calculate the Boone indicator are measures of efficiency and profitability. Following van Leuvensteijn (2008) and Bikker & van Leuvensteijn (2008), as a left-hand variable in Eq. 7, market share ($s_{i,t}$) is used instead of profits or relative profits. For the purpose of this study, market share is defined as $s_{i,t} = \frac{x_{i,t}}{X_{i,t}}$ where $x_{i,t}$ equals the market share of liner operator i for year t and $X_{i,t} = \sum_{i=1}^{100} x_{i,t}$ for Top 100 liner operators.

van Leuvensteijn *et al.* 2007 and Bikker and van Leuvensteijn (2008) state that working with market share has two advantages. The first advantage is the fact that a market share model will be more precise since the impact of efficiency on market share and its relation with competition is theoretically known. Another advantage of working with market share is the ever positive value of this variable. Given that logarithms of negative values do not exist, observations with negative values (read: negative profits) would be dropped. Consequently, the estimation results would be distorted by sample bias as it would ignore inefficient, loss-making liner carriers.

A lack of data prohibits the estimation of a translog function in order to determine the marginal costs. So, as an explanatory variable, average variable cost ($avc_{i,t}$)[90] is used as an approximation of the marginal costs (the relationship is in fact exact, if the marginal cost is constant). The choice for the right-hand variable is based upon the study of Bikker & van Leuvensteijn (2008). These authors found that average variable costs and model-based marginal costs result in similar estimates. Here, the average cost is calculated as the ratio of operating expenses to transported twenty feet equivalent unit (TEU).

Secondly, to estimate the Boone model, data was obtained from investor/ annual reports (see Section 5.2). It resulted in an unbalanced firm-level panel of data[91] for a sample of 20 liner operators (see Figure 5.1). Figure 5.1 lists the sample of liner operators and shows the market share as well as other variables (number of TEU capacity, ships and offered services) to explain competition. The paper focuses on the 2000-2008 period. The next section discusses and analyses the estimates of the Boone indicator.

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90 Bikker and van Leuvensteijn (2008) state that "*[A]verage variable costs have the advantage of being less complex, since they are not model-based, but they are less accurate because we cannot distinguish between variable and fixed costs*". Boone (2004, p. 18) discusses the definitions of fixed and variable costs and states that only variable costs and no fixed costs should enter the calculation.

91 The Boone indicator requires data of fairly homogeneous products (Creusen *et al.*, 2005; van Leuvensteijn *et al.* 2007). Although some heterogeneity (i.e. service, transit time, etc.) exists, the product is assumed highly homogeneous (read: transport of a container/ box) in the containerised liner shipping industry.

5.6 Empirical results

Boone and Weigand (2000) made several transformations and adjustments to the basic equation (i.e. control for firm-specific effects, control for time-specific effects, etc.) (see also Creusen *et al.*, 2006a). In this section, some of these transformations and adjustments are tested for the CLSI.

The regressions divide this section in two parts. In the first part, the Boone indicator is calculated by estimating the basic equation, in line with Eq. 7. In the second part, the measure of efficiency is corrected for industry effects by adding control variables. So, an extended version of Eq. 7 is estimated. The analysis is embedded in each section.

5.6.1 Basic equation

Estimation of the basic equation (Eq. 7) depends on the assumptions about the intercept (a), the slope coefficients (β) and the error term ($\mu_{i,t}$). Several scenarios are possible.

Firstly, the intercept and the slope coefficient are constant across time and space. In this scenario, the error term captures differences over time and among liner operators. So, the first regression estimates the relation between profitability, measured by market shares and average variable costs disregarding space and time dimensions of the pooled data (both variables are in logarithms). This OLS regression suggests a significant positive slope coefficient where a negative sign is expected by theory (see Section 5.4).

Secondly, the intercept is allowed to vary over time. Taking into account a common intercept and 9 year dummies, the slope coefficient again does not attain the appropriate sign. The R^2 value is very low.

Since the aim of the paper is to detect how competition evolves over time, in the third regression, β is estimated separately for every year (hence β_t) while the intercept is constant. The results from the basic equation for estimating the year-by-year Boone indicator are summarised in Figure 5.2. The slope coefficient or Boone indicator is shown in the middle column with the standard errors in the last column.

Basic equation		
Year	Slope coefficient	Std. Error
2000	0.046740	0.025041
2001	0.480321	0.028892
2002	0.700170	0.010968
2003	0.572652	0.004674
2004	0.257424	0.003487
2005	0.044714	0.010948
2006	0.132858	0.017484
2007	0.203862	0.020101
2008	-0.094747	0.018361

Figure 5-2: Estimated Boone indicator

In all years, the slope coefficients are significantly different from zero. Yet, the slope coefficients do not have the expected negative signs except for the year 2008. An estimated β of – 0.094747 for 2008 would suggest that a liner carrier with one percentage point higher average costs than another (more efficient) liner carrier would have 9.47 percent lower profit (proxied by market shares) than the more efficient liner carriers (Griffith *et al.*, 2005). Figure 5-3[92] and Figure 5-4 plot log market share (ln ms) against log average variable cost (ln avc) for the years 2005 and 2008 with the individual liner operators labeled (Griffith *et al.*, 2005). The slope of the regression line shows the estimated beta.

Comparing the latter two figures, a first observation is the turning of the slope of the regression line from positive into negative between 2005 and 2008. This suggests an increase in competition over the period. A second observation is the shift of CMA CGM and Hapag-Lloyd (HL) from the third quadrant to the second quadrant. These liner carriers appear to become less efficient. Thirdly, RCL, a liner operator that does not have the economy of scale (fleet size from 500 TEU to 2,600 TEU) of the rest of the sample has the lowest average variable costs in both years while Matson has twice the highest average variable costs. These regional niche players are not really comparable with the other liner operators. Fourthly, interesting to note is the nearly unchanged situation for liner operators involved in an alliance (marked in bold italic), except for Hapag-Lloyd. Following the completion of the acquisition of CP Ships (2005) by TUI AG, parent of Hapag-Lloyd, the carrier entered a difficult period of changing ownership.

92 Data regarding the average variable costs of COSCO and UASC for the year 2008 was not yet available at the time of the writing of this paper.

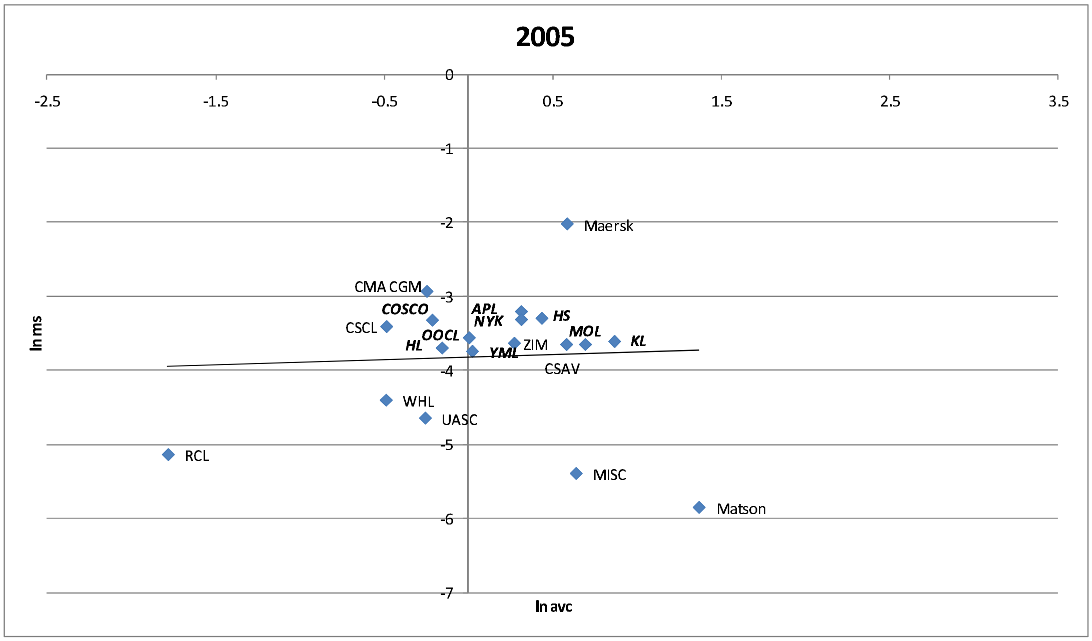

Figure 5-3: Container liner carriers, 2005

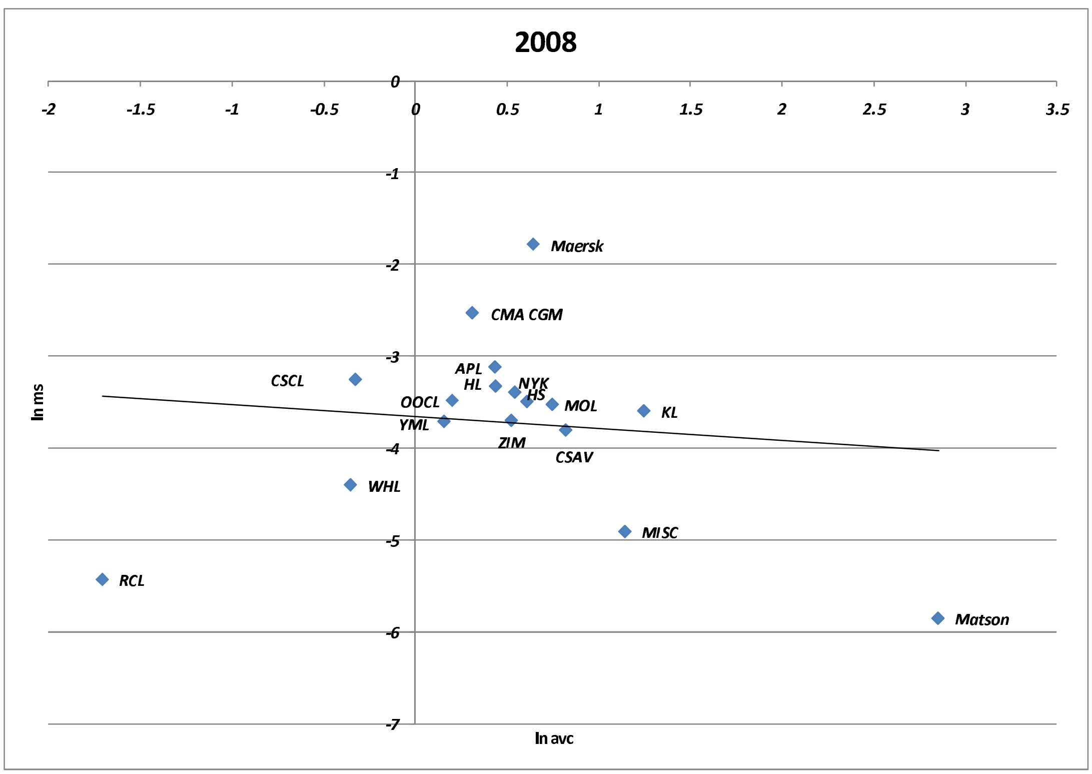

Figure 5-4: Container liner carriers, 2008

Finally, the intercept as well as the slope coefficients are allowed to vary over time to estimate the Boone indicator more accurately. Time-specific intercepts capture unobserved effects (i.e. control for business cycles, removing the effects of any macroeconomic fluctuations) common to all liner operators (Boone, 2004; Creusen *et al.*, 2006a; Bikker and van Leuvensteijn, 2008). Adding fixed period effects does not alter the signs to negative. The slope coefficient for 2008 becomes slightly more negative (i.e. -0.131577) or efficiency becomes more rewarded. Both the statistical significance of the estimated coefficients and the R^2 value have increased.

How can positive profit elasticities (i.e. an increase in market share due to a one percent increase in marginal cost) in the other years be explained?

A first explanation for these positive profit elasticities concerns the issue of the relevant market or the market where the competition takes place (Boone, 2000; Boone and Weigand, 2000; Creusen *et al.*, 2006b). In theory, the definition of a market is clear-cut while in practice, it is known to be a difficult problem. The question is whether the relevant market has been correctly defined? If not, it consequently may affect the outcome of the Boone indicator. Boone (2000) states that if the market is defined too broadly (narrowly) then concentration is too low (high) and will overestimate (underestimate) the degree of competition. In this paper, the relevant market consists of suppliers of fully cellular container liner shipping services. These services have been branded as the relevant product market. The geographical dimension is considered globally (Sys, 2009). Due to a lack of detailed information, the present study cannot take into account that liner operators compete at trade level and neglect the possible interrelationship between trade lanes. In order to match with the relevant market, data for the empirical investigation has solely been collected at container division level assuming that all liner operators compete globally.

Sample problems could be a second explanation. The results would also be inaccurate if the sample is uneven in favour of the more efficient firms. Re-estimating the above scenarios without the leading liner carrier, Maersk Line did not alter the results except for the last scenario. Next to the year 2008, the sign for the year 2005 turns to negative (-0,035344). This indication of increased competition might be linked with the statement of Maersk Sealand (since then known as Maersk Line) in May 2005 regarding its plans to buy P&O Nedlloyd. Next, the smallest players in the sample (i.e. CCNI and Matson) were left out. This experiment again did not change the signs of the slope coefficients.

Thirdly, the Boone indicator measures to which extent the market maps efficiency differences into profit differences. Marginal costs and profits are not directly observable. Mis-measurement within these variables and/ or working with proxies – a common practice (see Appendix 5-4) - may bias the result (Boone, 2000; van Leuvensteijn *et al.*, 2007). Boone and Weigand (2000) note that approximating marginal costs with average variable costs is only correct if production is characterised by constant returns to scale technology[93]. The latter holds for the containerised liner shipping industry.

Last, the Boone indicator is based on two assumptions (see Subsection 5.4.1). Most studies accept the assumption regarding the ignorance of the differences in product quality and design across firms. However, Boone and Weigand (2000) state that *"[P]roducing higher quality products is usually more expensive in terms of inputs, but clearly these higher costs (as such) do not indicate a lack of efficiency. To take this into account, a firm's costs should be corrected for the quality of its goods*." Not correcting for quality might explain the outcome of positive profit elasticities for the container liner shipping industry. This aspect will be analysed and tested in the next section.

5.6.2 Extended model

To test whether a liner operator's costs should be corrected for the quality of its products, firstly, the product should be defined. The product or service can be defined as the transportation of a box/ container between A and B (door to door, port to port, etc.). Liner carriers are assumed to be single product firms.

Does the container liner shipping industry produce higher quality products?[94] In other words, is there a quality difference between the transportation of a box/ container by liner operator x and y both offering – for instance - a door-to-door service? From the viewpoint of the shipper, the answer is positive. Transit time, schedule reliability, etc. differs from liner carrier to liner carrier. Assuming a quality difference, another question arises namely whether it is more expensive in terms of inputs for the liner operator? Due to a lack of data at trade level, the latter is unobservable.

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93 Boone and Weigand (2000) discuss in detail the limitations of the Boone indicator with respect to an unobservability of marginal costs, an (unobserved) unlevel playing field and problems with defining the relevant market. These authors use excellent examples to illustrate the limitations.

94 From June 1st, 2010, Maersk Line is the first carrier that launched a 'Priority Product'-upgrade on selected services (that is apart from those that are prohibited by Federal Maritime Commission (FMC) regulations or are otherwise restricted). This new product (precedence loading of cargo, reduced risk of costly delays, etc.) seeks to give priority to shippers in an increasingly common overbooked situation. As the sample period ends in 2008, this fact is not yet captured in the results of this empirical research.

Is it possible that long hauls are both more expensive and more profitable than short hauls? Put differently, should one take the portfolio of services into account? Due to the practices of "double/ triple dipping"[95] as well as transhipment combinations on long hauls, it is very difficult to get insight in costs and revenues per trade lane and to conclude that long hauls are both more expensive and more profitable. But then, these practise are introduced to cut costs and wring greater efficiencies from their networks. The Boone indicator should turn out to attain the appropriate sign.

Creusen *et al.* (2006a) suggest to adjust the basis equation for industry-specific effects. For the CLSI, industry-specific effects might be like differences in technology (ship size), the wide range of services, being a member of an alliance, etc. A look at Figure 5-1 shows that the dataset is very heterogeneous regarding the number of services offered and the average ship size (TEU capacity divided by number of ships). Given this observation on the one hand and the suggestion Creusen *et al.* (2006a) on the other hand, the year-by-year Boone indicator is re-estimated based on

$$\ln s_{i,t} = \alpha + \sum_{t=1,\dots T-1} \gamma_t d_t + \sum_{t=1,\dots,T} \beta_t d_t \ln avc_t + service_{i,t} + avteu_{i,t} + \mu_{i,t} \tag{8}$$

where d_t is the year t dummy variables and t = 2000…2008. In order to estimate the Boone indicator more accurately, the variables number of services ($service_{i,t}$) and average TEU ($avteu_{i,t}$) were added as explaining variables to the basic equation. A wider range of services and the deployment of larger ship sizes might affect profit. The parameters α, γ and β can be estimated by ordinary least squares (OLS)[96].

Figure 5-5 presents the heteroskedasticity-robust OLS estimates of the Boone indicator based on Eq. 8 with market shares and average variable costs in logarithms. The middle column shows the annual estimates of beta while the last column shows the t-statistics.

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95 The practice of double/ triple dipping is often used on long-haul routes. It means that other vessels also load containers for other trade lanes using intermediate wayports or hubs along the route to unload them. This logistic pattern ensures that, wherever is practical, empty slots are filled and/ or that a slot is used more than once on a given leg, which produces opportunities to earn additional revenue.

96 van Leuvensteijn *et al.*, 2007; Schaeck and Cihák, 2010 and Roengpitya, 2010 have applied a Generalised Method of Moments (GMM) estimator whereby one-year lagged values of the explanatory variables are used as instruments. Statistical tests (for overidentification of the instruments, Hansen J-test and for relevance of excluded instruments, Anderson canonical correlation likelihood ratio) and variance estimation (kernel-based heteroskedastic and autocorrelation consistent) are performed in these studies. The GMM-style estimator with as instruments the one-year lagged values of the explanatory variable, average cost (in logarithms) is also tested for the containerised liner shipping industry. When fitting a model by GMM, one should check whether the instruments used are uncorrelated with the errors. The test statistic has a $\chi 2$ distribution under the null hypothesis that the instruments are valid. The significant statistic (557.2609; Hansen J-test p value: 0) indicates a decisive rejection of the null hypothesis that the model is correctly specified.

Year dummy coefficients are not reported separately since the key parameter of interest is the slope coefficient, β.

Extended model			
Variable	Coefficient	t-Statistic	
SERVICE?	0.018289	19.1554	**
AVTEU?	0.000412	4.9372	**
C	-5.609487	-28.8473	**
LNAVC?--2000	0.233333	210.3799	**
LNAVC?--2001	-0.135650	-1.8942	*
LNAVC?--2002	0.192068	2.5820	*
LNAVC?--2003	0.160307	2.9221	**
LNAVC?--2004	-0.166424	-3.4781	**
LNAVC?--2005	-0.200081	-7.9306	**
LNAVC?--2006	-0.159378	-5.6320	**
LNAVC?--2007	-0.110895	-3.5568	**
LNAVC?--2008	-0.166986	-12.0238	**

Adjusted R^2	0.530435

Figure 5-5: Time fixed effects estimates of the Boone model[97]

From the regression results obtained, the slope coefficients are significant in all years and fluctuate between 0.23 and -0.20. The annual estimates of beta are negative in the years 2001, 2004 to 2008. The impact of the announcement of the takeover of Royal P&O Nedlloyd is again observable in the negative peak in beta in 2005. Subsequently, competition weakens till the year 2008. During that year the container liner shipping industry was under the spell of the question whether the block exemption would be abolished. As from October 18th, 2008 this abolishment is a fact (EEC Regulation n° 4056/ 86)(see Sys *et al.*, 2010). This might explain the further increase in competition.

Turning to the added variables, both the number of services and the average ship size are positive and significant. Incorporating these explanatory variables impacts profits.

In another experiment, a dummy variable was added to capture the effect on efficiency of being a member of an alliance. This dummy variable was coded one for liner operator member of an alliance and zero otherwise. The impact on market shares is negative and significantly. Regarding market shares, this might indicate that alliances are not

97 The asterisks indicate the statistical significance at 1 percent (**) and 5 percent (*) respectively.

necessary more efficient (see also Sys *et al.*, 2010). The adjusted R-squared increased to 0.53.

Next, to visualise how the competition in the CLSI has been evolving over time, Figure 5-6 plots the estimated beta over time (see solid line). Figure 5-6 relates the absolute value of the slope coefficient β on the vertical axis to the years of the sample period on the horizontal axis. The dashed line running from 2000 to 2008 depicts the regression of this estimated beta over time.

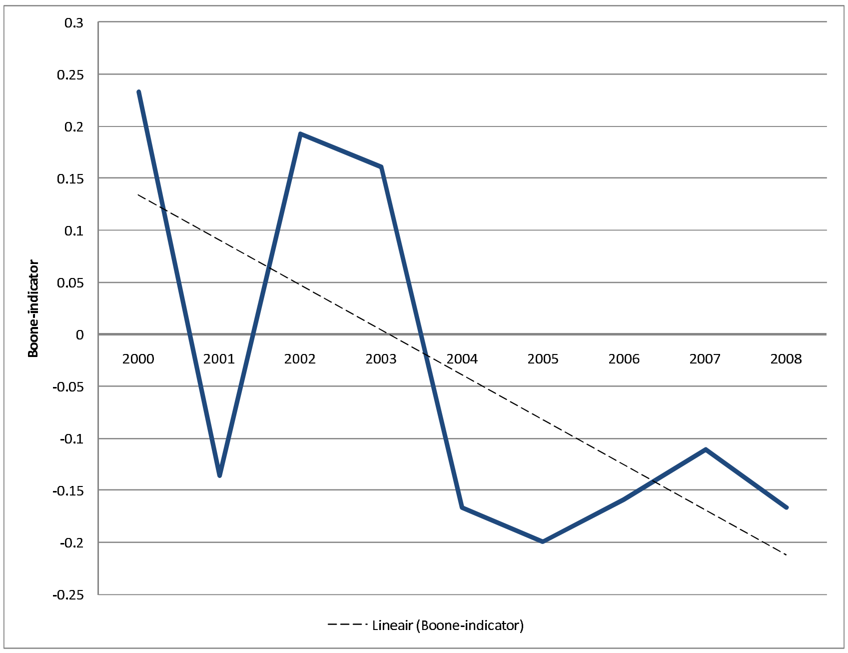

Figure 5-6: Boone-indicator over time

The regression line clearly slopes downward. This suggests an increase in competition over the years observed.

5.7 Conclusion

This paper started with an analysis of the profitability in the container liner shipping industry. No supernormal profits have been observed. In search for an explanation, the review of the Industrial Organisation literature over the past decade clearly showed a shift from ‘profit’ to ‘efficiency’, as a measure of conduct.

In the present paper, efficiency is measured for the containerised liner shipping industry based on Boone’s theoretical work. The basic idea of the Boone indicator is that the (cost) advantage of each firm to its competitors in terms of lower marginal costs translates into (relatively) higher profitability (Boone, 2000 and 2004; Boone & Weigand, 2000). This indicator allows one to measure how competition in the containerised liner shipping industry evolves over time. Therefore, a firm-level panel dataset of 20 liner operators was compiled. The analysis involves the period from 2000 to 2008. The present study estimates the relation between market shares and average variable costs (both in logarithms) adding explanatory variables for industry-specific effects (the growing number of services driven by globalisation, the introduction of larger container vessels).

The contribution of the present paper to the debate of competition in the container liner shipping industry is fourfold. First, it documents and estimates a consistent indicator to measure competition over time in the container liner shipping industry. Secondly, the paper shows that the Boone indicator helps to understand the effects of competition and efficiency on the liner operators' behaviour. Thirdly, it also controls for industry-specific effects on the change in competition. Correcting for industry-specific effects appears to be very important to attain the appropriate sign. Finally, the Boone indicator is interesting for policy makers who want to enhance competition or for regulators to see whether competition indeed increases over time after a policy change.

Several findings emerge from the empirical analysis. In terms of the degree of competition, the first finding is that competition increased over the 2000-2008 period. Over the 2002-2003 period, the leading liner operators enjoyed profits while subsequently competition has intensified. This finding corresponds with the analysis of the evolution of the profitability in the first part of the paper. Intensified competition forces the competitors to set low prices. Only efficient firms with a technological advantage (lower operating costs due to the deployment of larger vessels) as well as having a large network of services over (inefficient) competitors can attain profits. In a more competitive market, liner operators are hurt more severely for being inefficient. By theory, inefficient liner operators are forced to exit the market. The latter is hardly the case in the container liner shipping industry. Very few liner operators (e.g. Cho Yang, 2001, Senator Lines, 2009 and MBG Shipping, 2010) failed and exited the market. Secondly, the other explanatory variables have a significantly positive impact on the profits (proxied by market shares). Adding a dummy variable indicates that alliances are not necessary more efficient in terms of profits. Finally, it is very important to check for quality differences and industry-specific effects in order to estimate the Boone indicator accurately.

What can liner operators learn from this empirical analysis of the evolution of competition for the CLSI?. First, to realise higher profits, the focus should be on becoming more efficient. Secondly, liner operators involved in an alliance should wonder what the reason(s) is/ are for the negative impact on profit.

For policy makers, this research is especially relevant. As far as the author knows, no study has put forward the overall picture on the degree of competition at container division level. This paper contributes to the lack of such research.

First, it introduces in the CLSI an new way to measure competition over time which stands in the tradition of the New Empirical Industrial Organisation approach.

Second, this research has assessed the degree of competition over time just before the abolishment of the block excemption as of October 18th, 2008 - a policy change with the objective of intensifying competition - (EEC Regulation n° 4056/ 86) and the global downturn. A suggestion for further research is to check what the effect is on competition of both events.

Thirdly, it introduces a framework to discuss competition in the CLSI.

Last, the present empirical evidence is based on the container liner shipping industry. The indicator can also be used for separate submarkets (read trade lines), in other segments of the (liner) shipping industry as well as in other transport modes. Data availability often limits research at disaggregated level. Here, lack of data on average costs makes estimating competition at trade level impossible.

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Appendix 5-1: Evolution operational result at container division

EBITDA	2000	2001	2002	2003	2004	2005	2006	2007	2008
APL	284.00	189.00	134.00	406.00	892.00	845.00	566.90	766.00	299.00
CCNI				-5.00	19.00	38.00	-20.00	-14.00	4.70
CSCL		130.81	-27.34	224.93	629.19	694.94	365.96	764.17	
CMA CGM	109.28	36.33	110.00	328.00	620.00	819.69	823.09	1284.00	1260.00
COSCO Container L.			-17.62	328.91	610.38	1114.28	1912.36	3835.01	
CSAV			34.69	66.53	145.35	188.73	-197.00	93.00	
Hanjin Shipping	317.09	193.30	9.00	362.00	792.77	615.77	325.66	481.72	
Hapag Lloyd	86.67	287.95	238.01	456.00	392.88	537.78	267.22	851.08	
K-Line				273.33	649.31	1099.84	991.72	1023.17	1837.74
Maersk	1091.84	1356.42	1480.77	2082.22	2805.84	3419.66	1539.97	2407.98	2262.00
Matson				145.00	166.00	189.00	164.00	190.00	
MISC Berhad		455.00	435.23	379.93	661.52	1680.86	1320.36	1393.52	774.33
Mitsui-OSK L. (MOL)				173.00	555.00	383.00	75.20	150.00	
NYK				215.00	445.00	188.00		211.00	
OOCL			90.85	359.38	729.01	744.93	805.41	867.53	610.00
RCL			61.00	57.00	128.00	160.00	116.70	107.00	57.00
UASC			0.28	56.17	117.64	136.43	79.31		
Wan Hai Lines			21.00	48.00	187.00	202.00	153.00	252.00	
Yang Ming Line			460.00	232.00	497.00	455.00	50.00	187.00	
ZIM			28.00	99.00	251.00	261.00	189.00	142.00	
average	**342.1**	**331.5**	**181.23**	**312.972**	**573.8**	**687.7**	**475.94**	**778.3**	**836.4**
Δ EBITDA		2001	2002	2003	2004	2005	2006	2007	2008
APL		-33.45%	-29.10%	202.99%	119.70%	-5.27%	-32.91%	35.12%	-60.97%
CCNI					480.00%	100.00%	-152.63%	-30.00%	133.57%
CSCL			-120.90%	922.67%	179.72%	10.45%	-47.34%	108.81%	
CMA CGM		-66.76%	202.81%	198.18%	89.02%	32.21%	0.41%	56.00%	-1.87%
COSCO Container L.				1966.50%	85.58%	82.56%	71.62%	100.54%	
CSAV				91.78%	118.47%	29.85%	-204.38%	147.21%	
Hanjin Shipping		-39.04%	-95.34%	3922.22%	119.00%	-22.33%	-47.11%	47.92%	
Hapag Lloyd		232.22%	-17.34%	91.59%	-13.84%	36.88%	-50.31%	218.49%	
K-Line					137.55%	69.39%	-9.83%	3.17%	79.61%
Maersk		24.23%	9.17%	40.62%	34.75%	21.88%	-54.97%	56.37%	-6.06%
Matson					14.48%	13.86%	-13.23%	15.85%	
MISC Berhad			-4.34%	-12.71%	74.12%	154.09%	-21.45%	5.54%	-44.43%
Mitsui-OSK L. (MOL)					220.81%	-30.99%	-80.37%	99.47%	
NYK					106.98%	-57.75%			
OOCL				295.60%	102.85%	2.18%	8.12%	7.71%	-29.69%
RCL				-6.56%	124.56%	25.00%	-27.06%	-8.31%	-46.73%
UASC				19962.14%	109.42%	15.97%	-41.87%		
Wan Hai Lines				128.57%	289.58%	8.02%	-24.26%	64.71%	
Yang Ming Line				-49.57%	114.22%	-8.45%	-89.01%	274.00%	
ZIM				253.57%	153.54%	3.98%	-27.59%	-24.87%	

Appendix 5-2: Evolution of return on sales at container division

ROS	2000	2001	2002	2003	2004	2005	2006	2007	2008
APL	0.07452	0.05262	0.03912	0.09713	0.16814	0.14173	0.09533	0.11515	0.03763
CCNI				-0.0127	0.03619	0.06333	-0.0471	-0.0191	0.00483
CSCL			-0.0215	0.1217	0.26913	0.19761	0.09354	0.14353	
CMA CGM	0.05745	0.01832	0.04178	0.08611	0.11328	0.13657	0.09775	0.10881	0.08344
COSCO Container L.			-0.007	0.10517	0.15675	0.1874	0.18909	0.25901	
CSAV			0.02071	0.03115	0.05412	0.04846	-0.0513	0.02241	
Hanjin Shipping	0.09385	0.05501	0.00238	0.0775	0.16448	0.12744	0.05787	0.06499	
Hapag Lloyd	0.09246	0.08355	0.06012	0.15136	0.10702	0.11841	0.0339	0.10013	
K-Line				0.04628	0.09733	0.16016	0.12393	0.08627	0.12472
Maersk	0.11474	0.13305	0.12715	0.15409	0.1776	0.15888	0.06093	0.09029	0.07891
Matson				0.18686	0.19529	0.21526	0.17336	0.18868	
MISC Berhad		0.29549	0.30011	0.26505	0.32987	0.59694	0.43342	0.41218	0.20776
Mitsui-OSK L. (MOL)				0.04968	0.14903	0.09189	0.01553	0.02161	
NYK				0.05531	0.10468	0.04099	-0.0053	0.03172	
OOCL			0.03696	0.11088	0.17607	0.15862	0.17472	0.15352	0.0932
RCL			0.20199	0.16864	0.27766	0.2974	0.21126	0.18739	0.10307
UASC			0.0004	0.0685	0.1198	0.13068	0.07663		
Wan Hai Lines			0.02331	0.04336	0.12995	0.13369	0.09462	0.13447	
Yang Ming Line			0.35088	0.10861	0.17936	0.15274	0.01518	0.04542	
ZIM			0.01689	0.0487	0.09929	0.08893	0.06181	0.03728	
average	0.085	0.094	0.071	0.091	0.148	0.153	0.084	0.108	0.09

Note: By way of comparison, the A.P. Møller Maersk Group improved its financial performance between 2007 and 2008 increasing its ROS from 23.3 % to 26.9 % while it only gained 18.94 US cents out of every dollar in 2009. Drilling down towards two other of its business segments, the annual reports reveal that the ROS of the business segment, A.P.M. terminal continuously grew (2007: 16.27 %, 2008: 18.37 % and 2009: 24.09 %) (cross-subsidisation?) while the business segment Maersk Tankers saw its ROS drop to 25,76 % after maintaining its ROS at about 30 % for the 2007-2008 period. As a bench-mark, a look at other industries shows that Audi achieved a ROS of 8.1 % in 2008 and 5.4 % in 2009. The ROS of Nippon Steel continuously diminished (2006: 13.9 %, 2007: 11.7 % and 2008: 7 %) while the ROS of Proctor & Gamble slightly grew (2006: 19.42 %, 2007: 20.20 % and 2008: 20.46 %).

Appendix 5-3: Evolution of net profit at container division

Net profit	2000	2001	2002	2003	2004	2005	2006	2007	2008
APL	284.00	19.00	-73.00	406.00	892.00	845.00	344.00	523.00	83.00
CCNI				9.00	17.00	35.00	-19.50	-13.80	0.60
CSCL		161.91	-72.22	167.29	486.35	444.41	110.90	440.87	
CMA CGM	100.81	24.81	49.00	255.00	566.00	553.00	611.00	966.00	111.00
COSCO Container L.			-144.69	210.76	599.71	861.03	1215.11	2907.30	
CSAV				72.00	206.00	132.00	-58.20		
Hanjin Shipping	-58.96	-59.66	15.54	247.67	501.81	390.35	403.78	155.72	
Hapag Lloyd	73.48	203.78	149.94	455.00	386.00	328.00	107.30	268.80	
K-Line				96.83	305.00	620.00	382.40	562.00	918.94
Maersk	518.47	151.60	59.15	586.33	1512.42	1278.01	2249.08	106.00	205.00
Matson				93.00					
MISC Berhad		443.68	353.88	345.89	603.78	1259.46	813.81	874.58	730.03
Mitsui-OSK Line				56.00	517.00	965.00	26.70	69.40	
NYK				44.00		149.00	-82.00	114.00	
OOCL			51.79	329.04	670.60	651.29	581.14	2548.40	275.53
RCL			28.00	20.00	95.00	119.00	80.00	100.00	-24.00
UASC			4.00	70.00	135.00	115.00	54.00		
Wan Hai Lines			98.00	130.00	212.00	165.00	95.50	193.20	
Yang Ming Line			32.00	195.00	307.00	282.00	35.90	186.60	
ZIM			-9.00	47.00	172.00	187.00	80.00	28.20	
average			**42.89**	**183.18**	**449.13**	**483.26**	**341.26**	**555.63**	**276.68**
Δ Net profit		**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
APL		-93.31%	-484.21%	-656.16%	119.70%	-5.27%	-59.29%	52.03%	-84.13%
CCNI					88.89%	105.88%	-155.71%	-29.23%	104.35%
CSCL			-144.61%	331.62%	190.73%	-8.62%	-75.05%	297.54%	
CMA CGM		-75.39%	97.52%	420.41%	121.96%	-2.30%	10.49%	58.10%	-88.51%
COSCO Container L.				245.66%	184.55%	43.57%	41.12%	139.26%	
CSAV					186.11%	-35.92%	-144.09%		
Hanjin Shipping		-1.19%	126.05%	1493.85%	102.61%	-22.21%	3.44%	-61.44%	
Hapag Lloyd		177.31%	-26.42%	203.46%	-15.16%	-15.03%	-67.29%	150.51%	
K-Line					215.00%	103.28%	-38.32%	46.97%	63.51%
Maersk		-70.76%	-60.98%	891.33%	157.95%	-15.50%	75.98%	-95.29%	93.40%
Matson									
MISC Berhad			-20.24%	-2.26%	74.56%	108.60%	-35.38%	7.47%	-16.53%
Mitsui-OSK Line					823.21%	86.65%	-97.23%	159.93%	
NYK							-155.03%	239.02%	
OOCL				535.37%	103.80%	-2.88%	-10.77%	338.52%	-89.19%
RCL				-28.57%	375.00%	25.26%	-32.77%	25.00%	-124.00%
UASC				1650.00%	92.86%	-14.81%	-53.04%		
Wan Hai Lines				32.65%	63.08%	-22.17%	-42.12%	102.30%	
Yang Ming Line				509.38%	57.44%	-8.14%	-87.27%	419.78%	
ZIM				622.22%	265.96%	8.72%	-57.22%	-64.75%	

Appendix 5-4: Overview literature

Study (in chronological order)	sample characteristics	industry	dependent variable	independent variable
2000 | Boone, J.				
2000 | Boone, J. & J. Weigand	1978-1992	manufacturing industries	relative values of profit	proxy: average variable cost/ revenu
2004 | Boone, J.		manufacturing industries	absolute values of profit	proxy: average variable cost/ revenu
2004 | Creusen, H., B. Minne & H. van der Wiel	manufacturing, 1978-1999 construction, 1982-1999 market services, 1987/ 93-1999	manufacturing construction market services	relative values of profit	proxy: average variable cost/ revenu
2005 | Griffith, R., J. Boone & R. Harrison	UK, 1986-1999	pharmaceutical industry supermarkets	absolute values of profit	proxy: average variable cost/ revenu
2006 | Creusen, H., B. Minne & H. van der Wiel	1993-2001	Dutch manufacturing industry and service sector	absolute values of profit	proxy: average variable cost/ revenu
2007 | Boone, J., J. van Ours & H. van der Wiel	1993-2002	Dutch market	absolute values of profit	average variable costs
2007 | Maliranta, M., M. Pajarinen, P. Rouvinen & P. Ylä-Anttila	1994-2004	business sectors	operating profits (different functional form)	average variable costs (different functional forms)
2007 | van Leuvensteijn, M., J. Bikker, A. van Rixtel & C. Sørensen	EU countries + UK, US and Japan 1994-2004	banking industry: loan markets	market share	estimate of marginal cost (MC)
2008 | van Leuvensteijn, M.	1890-1914	sugar industry	market share	MC
2008 | Bikker, J. & M. van Leuvensteijn	1995-2003	life insurance industry	relative values of profit or market shares	estimate of MC or proxy: average cost
2008 | Roos, T.	2006-2007	electricity sector	absolute values of profit	MC
2009 | Maslovych, M.	2005-2008	Loan market in Ukraine	market share	estimate of MC or proxy: average cost
2010 | Schaeck, K. & M. Cihák	European banks: 1995-2005 U.S. banks: 2005	banking industry	ROA	proxy: average cost
2010 | Roengpitya, R.	1994-2004	banking industry: loan markets	market share	estimate of MC (fixed effects)
2010 | Braila, C., G. Rayp & S. Sanyal	1997-2004	manufacturing and non-manufacturing industries	difference between a firm's revenue and its variable cost	proxy: ratio of variable cost and operating revenue (or turnover)
2010 | Schiersch, A. & J. Schmidt-Ehmcke	1995-2006	German manufacturing firms	absolute values of profit	proxy: average variable cost/ revenu

Chapter 6

6 Competition in the container liner shipping industry: the role of entry and exit

Abstract[98]

Oligopolistic firms are often thought to generate larger economic profits, and whenever there are profits there is an inducement to entry. While the role of entry and exit has been dealt with in shipping literature in general and with regard to liner conferences, the study of entry and exit conditions was ignored for the container liner shipping industry. An analysis of entry/ exit conditions for the containerised liner shipping industry is an interesting issue.

Firstly, this paper investigates how freely container liner operators can enter/ exit the industry, alliances and a trade. Secondly, entry conditions also determine the extent to which incumbent firms need to fear competition from potential entrants. This paper adopts the persistence of profit methodology to capture this unobservable threat. Mueller's (1977, 1986) persistence of profit hypothesis will be tested for a sample of container liner operators between 2000 and 2008. To this end, a time-series analysis on firm-level profits is used to estimate the short-run and long-run persistence. The hypothesis is that (actual and potential) entry into and exit from any market are sufficiently free to bring any abnormal profits quickly into line with the competitive rate of return (Lipczynski *et al.*, 2005). In the containerised liner shipping case, the empirical results suggest that the hypothesis can be rejected.

Keywords:

Competition, barriers to entry, container liner shipping industry, persistence of profits

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[98] The author is grateful to Prof. dr; H. meersman and Prof. dr. E; van de Voorde for their valuable comments and suggestions which contributed to the writing of this article. The author remains solely responsible for the article's content.

6.1 Introduction

In analysing competition in a particular industry, the conditions for entry and exit cannot be overlooked. Since the seminal work of Bain (Barriers to New Competition – 1956) and Baumol (Theory of Contestability[99] - 1982), a vast amount of literature has studied the entry/ exit conditions for various industries to determine the extent to which established firms or incumbents need to fear competition from outside the market. While the role of entry and exit has been dealt with in shipping literature in general (e.g. Brooks, 2000; Cullinane & Khanna, 2000) and with regard to liner conferences[100] (e.g. Heaver, 1973; Davies, 1983a and 1986), the study of entry and exit conditions has been ignored for the containerised liner shipping industry. This offers an incentive to analyse the entry/ exit conditions for the containerised liner shipping industry.

The main emphasis of the paper is to answer the following research questions:

RQ1 How freely can container liner operators enter/ exit the containerised liner shipping industry?;

RQ2 Are the competitive forces in the containerised liner shipping industry sufficiently powerful to bring any abnormal profits (positive or negative) into line with the competitive rate of return?

In studying the dynamics of entry/ exit conditions for the containerised liner shipping industry[101] (hereafter CLSI), the relevant market[102] is the first element to be considered. Although the importance of non vessel operating common carriers (NVOCC) and global forwarders is growing, here, the relevant market consists of all vessel operating common carriers (e.g. Maersk Line, MSC, CMA CGM) offering container liner shipping services, including actual or potential competitors. The transportation of a box is the product

[99] A perfectly contestable market is characterised by two properties: (a) there are no barriers to entry in the market and exit is costless and (b) incumbent operators will not react (through pricing) to new entry (Davies, 1986 and Haralambides, 2007). Since some maritime economists (e.g. Heaver, 1993; Pearson, 1987; Jankowski, 1989) and regulators (i.e. Federal Maritime Commission, 1989 and the European Commission, 1989) have extensively refuted the application of the theory of contestable markets to the liner shipping sector, the present paper focuses on barriers to entry/ exit.

[100] Since the promulgation of the US Shipping Act of 1984, the ability of conferences to raise barriers to entry has eroded. Starting 18/ 10/ 2008, liner conferences are abolished on trade to/ from ports of the European Union.

[101] 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 (Sys, 2009).

[102] See also Van der Ziel (1994), Brooks (2000), European Union (1997 and 2007) and Sys (2009).

dimension. The relevant geographical dimension of the market is defined globally and at trade level respectively.

The remainder of this paper is structured as follows: To answer the first research question, Section 6.2 first focuses on the dynamics in the containerised liner shipping industry. Subsequently, the freedom of entry/exit and entry/exit conditions will be studied at trade level, viz. the case study Belgium-India (6.2.2) as well as at the level of alliances (6.2.3). Section 6.3 deals with the second research question. The persistence of profit hypothesis will be tested for a sample of container liner operators between 2000 and 2008. The hypothesis is that (potential and actual) entry/exit from any market are sufficiently free to bring any abnormal profits quickly into line with the competitive return (Mueller, 1977, 1986 and 1990). To this end, a time-series analysis on firm-level profits is used to estimate the short-run and long-run persistence. Subsection 6.3.1 presents the sample and data. The methodology is explained in Subsection 6.3.2. Subsection 6.3.3 reports and discusses the econometric results. Finally, Section 6.4 gives concluding remarks.

6.2 Entry/exit conditions for the containerised liner shipping industry

Entry may take many forms. First, a firm can enter the CLSI by buying an established liner operator. Secondly, an entirely new liner operator can start deploying fully cellular or non cellular containerships. Thirdly, an established liner operator active in other shipping divisions may expand its activities to the containerised liner shipping industry i.e. pursuing strategies of diversification. Finally, an entrant also may be an established container liner operator diversifying its portfolio of services, that is, the carrier enters a trade route where it was not previously active or re-enters a trade route. Exit is the reverse of entry, viz. a liner operator withdrawing from a trade route or discontinuing its activities completely (Besanko *et al.*, 2004).

Entry and exit conditions refer to barriers to entry and exit. Bain (1956, p. 10) defined the condition of entry to an industry as "… *advantages which established firms in an industry have over established entrant firms, ... evaluated in general by measures of the heights of entry inducing prices relative to defined competitive levels*". Since then, there has been a considerable debate in the economic literature about a precise definition of 'barriers to entry' (OECD, 2002). For example, Bain's definition has been criticised by Stigler (1968,

p. 67) who restricted the term 'entry barrier' to differentially higher costs faced by entrants but not by incumbents. Stigler states that economies of scale are not an entry barrier if the same cost conditions are available to entrants and established firms at any given output level. Von Weizsäcker (1980) extends Stigler's approach to include welfare effects in the definition of barriers to entry (Lipczysnki *et al.*, 2005).

A more recent debate focuses on the relevance of a fixed definition of barriers to entry for competition policy. Pragmatics argue that it is more important to answer the more practical questions of whether, when, and to what extent entry is likely to occur. This pragmatic view is largely accepted by most competition agencies in OECD countries (OECD, 2002 and 2007).

This section aims to answer these practical questions for the containerised liner shipping industry.

6.2.1 Industry dynamics

Before studying how freely liner operators can enter/exit the CLSI, the industry dynamics will be analysed. To this end, an interesting tool is the classification of the 100 largest container liner operators sourced by Alphaliner. Since 1996[103], the Top 100 consists of the ranking of the container liner operator, their TEU capacity and number of ships deployed, their market share as well as their total order book. The consolidation of the Top 100s over the 1996-2010 period allows the change in ranking, market share, etc. to be observed.

To start, the analysis of the dynamics of the industry focuses on the first tier of the Top 100s, viz. the segment + 20. Furthermore, the impact of the financial and economic downturn is examined (6.2.1.1). Next, the change in ranking and market share are analysed for the segment 21-100 (6.2.1.2). Finally, a look at new ventures completes the analysis of the dynamics of the CLSI.

6.2.1.1 Segment 1-20

Appendix 6-1 summarises the liner operators in alphabetical order, showing their ranking and their market share (in italic – percentage represents the liner operator's

103 Note: Alphaliner published a Top 65 for the years 1997 and 1998.

share of the Top 100 liner fleet in TEU terms) covering the 1996-2010 period[104]. The Top 20 carriers on January 1st, 2010 are shaded.

Firstly, Appendix 6-1 highlights the rise and fall of world largest liner operators. A total of 30 different names[105] occurred in the segment 1-20 during those 15 years. Of them, 15 liner operators[106] remained in this segment during the whole period. UASC, Wan Hai Lines (2010 – ranked 22) and PIL constantly flirt with the rank 20 limit. CSAV and CSCL have been in the segment 1-20 since 2000. CSAV's financial difficulties brought along the temporary departure of the segment 1-20 (October 2008). Hamburg Süd appeared in this segment in 2001 a first time and returned in 2004. There were seven mergers (1997: P&OCL; 1998: DSR-Senator; 1999: Nedlloyd, Sealand Services and Safmarine; 2005: P&O Nedlloyd and CP Ships), one acquisition (NOL/ APL, 1998) and one liquidation (Cho Yang, 2001).

Secondly, Appendix 6-1 also reports the evolution of the ranking. Maersk Line, MSC, CMA CGM and Evergreen retained their ranking during the last five years. The evolution in ranking of the other carriers is more volatile. Climbing in rank is the result of the occasion of mergers (e.g. in 2005 TUI AG, former parent company of Hapag-Lloyd took over the 16th-ranked transatlantic carrier CP Ships, causing Hapag-Lloyd to climb from 17th to 5th rank) as well as organic growth (e.g. CMA CGM, MSC, CSLS climbed in ranking largely through organic growth, although CMA CGM bought a few niche carriers). Conversely, the decrease in ranking is due to the lack of investment in TEU capacity. Except for K-line, the carriers NYK and MOL lost rank. All three Japanese liner operators are no longer as expansive in the container liner shipping industry as they used to be.

Finally, a look at the evolution of the market shares also shows quite some dynamics in this segment. Between January 1996 and January 2010, the TEU capacity deployed on liner trades has continuously risen from 3,194,896 TEU to 12,440,630 TEU. To retain their market shares, liner operators had to increase their TEU capacities at the same pace. The world's top 20 carriers represent a combined global market share of 86.94 % in 2010, up from 65.04 % in 1996. Only Maersk Line controls more than 15 % of the market share. Although the Maersk Line's capacity has grown from 1,665,272 TEU to 2,044,981 TEU

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104 Figures refer to 1 January of each year - www1.axsmarine.com.

105 Maersk Line and its predecessors are taken as one name.

106 In alphabetical order: APL/ NOL, CMA CGM, COSCO, Evergreen, Hanjin, Hapag-Lloyd, HMM, K-Line, NYK, Maersk Line, MOL, MSC, OOCL, Yang Ming Line and ZIM.

(+ 22.80 %), the market share of the world's number one container carrier has slid from 19.23 % to 16.44 % during the last five years (2005: A.P. Møller-Maersk bought P&O Nedlloyd). Both MSC, ranked second, and CMA CGM, ranked third, have strengthened their position at the expense of rivals. Evergreen, world's fourth biggest line after sliding from second place in 1999, saw it market share shrank to 4.49 % in 2010. Given its empty order book, Evergreen will continue to go backwards. The levels of market share controlled by the Japanese carriers, NYK and MOL decreased and will continue to decrease given their post-global downturn corporate strategies to restructure their containership sectors. As reflected in Appendix 6-1, the post-1997 financial crisis affected the Korean liner operators Hanjin-Senator and Hyundai Merchant Marine. As a result, the new building programs of both carriers were slowed down at that time. The notion of global market share for smaller carriers (e.g. PIL, Wan Hai, etc.) with a regional focus is of low significance. As market shares differ from trade to trade, their regional market shares are more important.

What is the impact of the economic downturn on this segment? Figure 6-1 compares the ranking, the number of ships and the TEU capacity of the top league of liner operators on January 1st, 2010 with October 1st, 2008[107] (compiled with data from www1.axsmarine.com). A first observation is the return of CSAV in the segment 1-20 at the expense of Wan Hai Lines. Secondly, concerning the ranking, various liner operators changed position in the ranking in the chaotic year 2009. This change in ranking is clearly observable since July 2009. The liner operators Hapag-Lloyd, MOL, OOCL, PIL and ZIM lost rank while APL, CSAV, Hamburg Süd, Hanjin, NYK, K-Line and YML gained rank. For the latter 4 liner operators, the number of ships dropped while their TEU capacity increased. This increase is driven by the delivery of larger new vessels. The rest of the liner operators succeeded to keep their rank unchanged. Another observation is the growth of the global cellular ship capacity both in TEU capacity and number of ships. This trend is only followed by CSAV, Hanjin, and NYK. As a result of the market conditions, the majority of the liner operators has taken vessels out of service as part of their capacity rationalisation program (e.g. redelivery of chartered vessels, scrapping programs, idling of operated vessels,…).

[107] Except in the case of CSAV, January 1st, 2009 was compared with January 1st, 2010.

	Rank												TEUcapacity					
	Oct. 2008	Jan. 2009	July 2009	Oct. 2009	Jan. 2010	ΔRank Oct. 2008 - Jan. 2010	Oct. 2008	Jan. 2009	July 2009	Oct. 2009	Jan. 2010	ΔShips Oct. 2008 - Jan. 2010	Oct. 2008	Jan. 2009	July 2009	Oct. 2009	Jan. 2010	ΔTEUcap Oct. 2008 - Jan. 2010
World Fleet							9,321	9,406	9,525	9,480	9,535	↑ 214	13,898,349	14,143,656	14,705,773	14,806,337	14,951,771	↑ 1,053,422
Maersk	1	1	1	1	1	→ 0	452	437	439	420	427	↓ -25	1,791,124	1,770,223	1,780,821	1,734,937	1,746,639	↓ -44,485
MSC	2	2	2	2	2	→ 0	405	421	416	399	394	↓ -11	1,351,550	1,421,975	1,510,842	1,495,023	1,507,843	↑ 156,293
CMA CGM	3	3	3	3	3	→ 0	271	284	265	274	289	↑ 18	810,247	849,857	886,981	916,174	944,690	↑ 134,443
Evergreen Line	4	4	4	4	4	→ 0	181	181	178	172	167	↓ -14	628,993	631,216	623,111	609,180	592,732	↓ -36,261
Hapag-Lloyd	5	5	6	7	7	↓ -2	135	131	129	123	129	↓ -6	496,927	492,097	491,603	482,291	470,171	↓ -26,756
COSCON	6	6	7	6	6	→ 0	151	154	143	144	143	↓ -8	483,073	491,481	480,703	495,512	495,936	↑ 12,863
APL	7	7	5	5	5	↑ 2	125	128	130	129	116	↓ -9	447,560	473,157	497,187	526,054	524,710	↑ 77,150
CSCL	8	8	8	8	8	→ 0	120	118	122	123	120	→ 0	409,155	412,002	438,471	456,355	457,126	↑ 47,971
MOL	9	9	10	11	11	↓ -2	111	106	98	93	89	↓ -22	374,376	366,871	360,091	351,017	348,353	↓ -26,023
OOCL	10	10	12	14	14	↓ -4	92	93	84	70	77	↓ -15	362,944	365,240	351,066	306,545	290,350	↓ -72,594
Hanjin	11	11	9	9	9	↑ 2	76	78	87	88	90	↑ 14	344,949	350,274	385,990	388,826	400,033	↑ 55,084
NYK	12	12	11	10	10	↑ 2	78	81	81	82	89	↑ 11	334,854	349,040	351,916	360,460	359,608	↑ 24,754
K Line	13	13	13	13	12	↑ 1	102	101	104	92	80	↓ -22	310,004	312,721	33,587	321,068	325,280	↑ 15,276
YML	14	14	14	12	13	↑ 1	86	84	83	83	63	↓ -23	298,718	302,365	316,683	326,879	317,304	↑ 18,586
Zim	15	15	17	17	17	↓ -2	91	83	80	62	88	↓ -3	274,291	252,735	253,887	210,376	215,726	↓ -58,565
HMM	16	16	15	16	16	→ 0	57	56	62	57	53	↓ -4	249,065	238,332	289,488	273,319	259,941	↑ 10,876
Hamburg Sud	17	17	16	15	15	↑ 2	79	77	83	88	64	↓ -15	221,547	232,594	268,472	281,870	283,897	↑ 62,350
PIL	18	18	20	20	20	↓ -2	80	80	76	77	66	↓ -14	158,915	159,337	152,541	160,105	173,989	↑ 15,074
UASC	19	19	19	19	19	→ 0	45	47	42	42	45	→ 0	137,958	152,864	153,384	165,572	176,578	↑ 38,620
Wan Hai	20						74						129,581					
CSAV		20	18	18	18	↑ 2		55	59	65	84	↑ 29		139,587	167,680	190,672	195,884	↑ 56,297

Figure 6-1: Impact of economic downturn on segment 1-20

Maersk Line has suffered the largest drop in vessels. In contrast, MSC's active fleet grew significantly despite its aggressive scrapping campaign (see July 2009 – January 2010). The growth in TEU capacity was due to delivery of a series of owned 11,000-14,000 TEU vessels and to its well known strategy of scooping up the market for cheap charter tonnage. After the return of chartered tonnage (January-July 2009), CMA CGM's active fleet also grew significantly. The world's third largest container line, CMA CGM continues to take delivery of ordered +11,000 TEU ships. In contrast, some Asian liner operators also trimmed their owned containership fleet but their disposals are not compensated by the delivery of newbuildings or through chartering-in.

6.2.1.2 Segment 21-100

There is a gap between the leading Top 20 liner operator's and the carriers ranking after them. First, the share of the carriers located in the segment 21-100 does not pass the 1 % mark each. Secondly, over the 1996-2010 period, more than 50 mergers and acquisitions took place. It is interesting to note that most liner operators that were taken over were located in segment 30 - 50 before merger/ takeover. Thirdly, in a normally competitive market, firms that are unsuccessful fail. Over those 15 years, all bankruptcies/ liquidations were located within this segment. As a consequence, new names appeared.

6.2.1.3 New ventures

While established liner operators wrestle with cash flow problems and heavy expansion-induced debt burdens, new competitors enter the market. Hereafter, the focus is on two recent new ventures, viz. MBG Shipping and The Containership Company. These entrepreneurs seek new opportunities in the current difficult economic climate. Both new competitors are helped by the current market conditions, which enable them to pick up the vessels and containers at highly competitive daily charter/ rental rates.

First, Cape Town-based MBG Shipping[108] planned to enter the South Africa/ Europe fruit trade in December 2009 with a regular reefer container liner service. MBG Shipping intended to charter seven 1,000 TEU-class ships with high reefer capacity (+300-plug points per vessel). For the South African fruit exporters, this newcomer offered a competitive and effective alternative to the reefer services between South Africa and Europe (Fossey, 2009a). MBG Shipping had to compete against liner operator MSC (ships deployed ranged between 4,850 TEU and 6,742 TEU) and the SAECS consortium. The members of the South Africa Europe Container Service (SAECS) which comprise Deutsche Afrika Linien (DAL), MOL and liner heavyweights Maersk Line and Safmarine - both part of the AP Moller-Maersk Group - deploy 1 x 4,500/ 2 x 4,931/ 1 x 4,258 and 2 x 4,035 TEU-class ships respectively. The question will be whether this 'new' carrier will be able to compete against those established players that have much larger economies of scale.

The launch of the weekly sailing (i.e. nine weeks after planned departure date) was not only very difficult but seems to have failed even before completing its first voyage. Firstly, the venture was not easy. The South Africa fruit season was already under contract by that time and the potatoes and onions season was underperforming due to the September drought. In addition, the freight rates for these commodities are remarkably lower than other products. Secondly, the launch was not easy either due to the previous record of MBG Shipping initiator Ian Wicks, the resignation and withdrawal of Carl van der Westhuizen after one week from shareholding in the operations, the pending payment of harbour dues, the delayed departure of the chartered 1,347 TEU vessel Alioth and the consequent affected confidence. Finally, the new carrier MBG Shipping only offered one sailing. In the meantime, the chartered ship

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108 The management and the rotation of this service strongly resemble those of the shipping company SAILS which ended its activities previous year.

has been transferred to the ship owner with the cargo (i.e. one full (reefer) 40 ft and 20 empty containers) still onboard. Immediately, the market reacted. The SAECS consortium has reintroduced the Reefer Express or REX service and phases into operation additional capacity to help satisfy the increased seasonal demand of South Africa's fruit exporters.

Starting a liner shipping company from scratch was rarely successful. For instance, the German shipyard Bremer Vulkan had access to low-priced ships. Therefore, in 1987, they began with a 14-day round-the-world service under the name Senator Lines. Senator Lines later merged with the shipping-line division of Deutsche Seereederei Rostock. Since 1997, Hanjin Shipping has been their principal shareholder. Early 2009, Senator Lines ceased business (www.senatorlines.com). Other predators e.g. Blue Anchor Line, Great Western Shipping and US Lines (bought up by CMA CGM, 2007) also assumed that the availability of vessels when container charter rates were low was a sufficient factor for setting up a successful liner service. To be successful, a liner operator requires besides ships, good management, a global network, human resources, customer relations, (IT) systems, preferably a track record, and sufficient cargo coverage. Will the venture of the carrier-to-be, The Containership Company be successful?

The business model of The Containership Company (TCC) announces to be quite different from established players. Given that enough funding is found, the liner carrier's services will be run along the lines of a budget airline, offering only port-to-port bill of ladings (B/ Ls)[109] and not always on mainstream ports (Fossey, 2009a).

Can such business model be successful in the liner shipping industry? Possibly, but some side-notes are required: firstly, a look at air transport shows us that favourable leasing, secondary airport strategy and subsidies allow starting from scratch. But then, even low cost airlines do not sell belly hold capacity (i.e. freight capacity supplied by passenger airlines in the bellies of passenger or combi aircrafts) on short-haul routes. It complicates the operation and jeopardises turnaround times. On long-haul, low cost airlines putting aircrafts with large cargo capacity into service are pressed towards the traditional operating model (i.e. the importance of cargo capacity from revenue

[109] A bill of lading is a shipping document by which the master of a ship acknowledges having received in good order and condition (or the reverse) certain specified goods consigned to him by some particular shipper and binds himself to deliver them in similar conditions to the consignees of the shipper at the point of loading (Paelinck, 2008). There are several forms of B/ Ls. A port-to-port or the classic ocean B/ L covers ocean port to ocean port carriage of cargo on a single ocean going vessel and no other stage or form of carriage.

perspective). Secondly, offering port-to-port B/L s only works in such trades where freight forwarders are powerful (merchant haulage[110]), such as the European continent, Asia, Indian Sub Continent to name a few. The USA market is a different situation. A liner carrier cannot enter this market offering a port-to-port B/L. Here, the freight forwarders are not involved. The liner carrier does inland trucking (carrier haulage[111]). Thirdly, the business model is not quite new. The established liner operators have a global footprint to serve secondary ports via transhipment. Finally, it needs to be seen if the business model of TCC will be successful. Its first service between Taicang (near Shanghai) and Los Angeles is expected to start in the middle of April 2010. TCC will enter the CLSI also through chartering-in of smaller ship sizes (i.e. ranging in size between 2,500TEU and 3,000TEU capacity).

Clearly, the analysis of the industry dynamics suggests that the industry is not stable. This can be interpreted as an indication of actual entry and exit.

6.2.2 Actual entry and exit: a case study[112]

In this subsection, following Brooks (2000), the freedom of entry/exit will be studied at trade level. Therefore, the growing Europe – Indian Subcontinent trade has been (connection to present) selected. India, becoming an authoritative economy in Asia has been chosen for its growing demand for containerised services (at 12.2 per cent to reach 12.7 million TEU of import and export trade in 2015 – www.imf.org). The Indian Subcontinent (ISC) covers India, Pakistan, Sri Lanka and Bangladesh. After introducing this trade, barriers to entry/exit will be analysed in detail for the market Belgium – Indian Subcontinent.

6.2.2.1 Introduction

Following the EU's abolition of anti-trust immunity for operators on European trade routes (as from 18 October 2008), European Liner Affairs Association (ELAA) trade association publishes monthly historical data regarding aggregated trade volumes and

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110 Merchant haulage refers to the inland transport of shipping containers arranged by the merchant/freight forwarders. This includes empty container moves to and from handover points in respect of containers released by the carrier to merchants.

111 Under the term 'Carrier haulage' or liner's haulage is understood the inland transport service which is performed by the sea-carrier under the terms and conditions of the tariff and of the relevant transport document.

112 The empirical observations are based on data from AXSLiner, Dynamar, CI Online and various volumes of the Containerisation Yearbook.

freight rates for all trades to and from Europe gathered from its 25 members. The ISC trade is included in the statistics Europe - ISC & Middle East (hereafter ICS & ME). Figure 6-2 shows the evolution of the westbound and eastbound volume (in TEU) over the period January 2008 - January 2010 (compiled with data from www.elaa.net). The impact of the worldwide financial and economic downturn (October 2008) is clearly observable. Since Aug. 2009, Europe's ISC & ME containerised import volume has picked up to the same volume as January 2008. In the same month, the market from Europe to the ISC increased with 23.84 basis points (i.e. January 2008 = 100). The ELAA's statistics show that westbound trade grew by 12.97 % in January 2010, compared to the same month of 2009, with eastbound traffic ahead by 20.53 %. While, the year on year comparison January 2008 - January 2009 showed a decrease of 12 % for both legs.

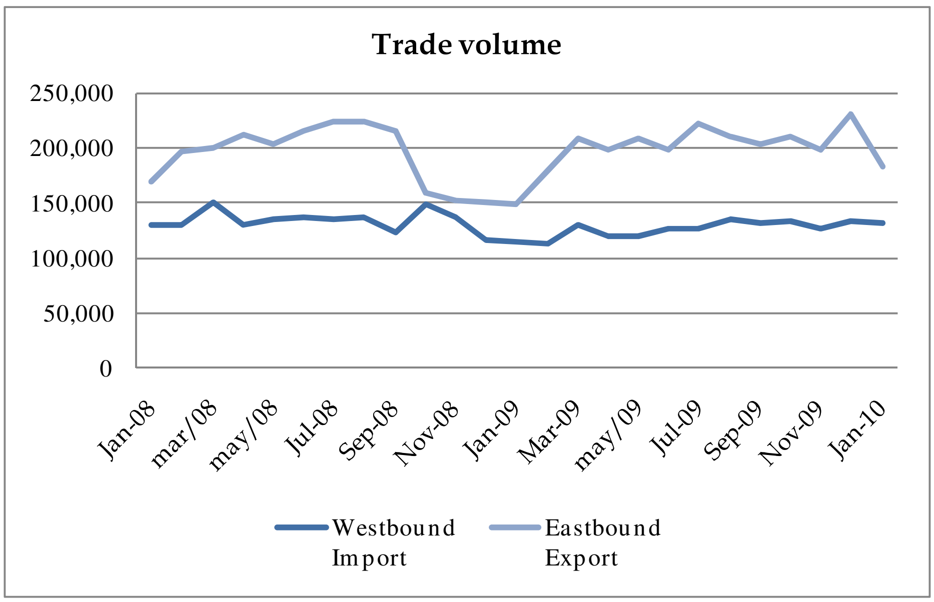

Figure 6-2: Trade Volumes Estimated TEU Dry & Reefer 2009

Secondly, Indian Subcontinent is delineated from the ISC & ME statistics. Focusing on the entry/ exit of liner operators over the 1985-2008 period, it can be recorded that entry/ exit on the stated trade is not restricted. As shown in Figure 6-3, the number of players evolved from 14 in 1985 up to 28 liner operators in 2008 with a minimum of 12 liner operators in 1997 and a maximum of 30 in 2004 (compiled with various editions of Containerisation Yearbook).

CI Yearbool	1985	1986	:	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
N° of players	14	19		27		22		16	12	29		27	26		26	30	28	28		28
IN		7		13		1		2	0	18		6	4		8	5	1	1		8
OUT		2		5		6		8	4	1		8	5		8	1	3	1		8

Figure 6-3: Entry/exit ISC

Some liner operators left the trade and returned a few years later (e.g. Yang Ming, K-Line, Rickmers Linie, MSC...). An explanation can be found in the fluctuations of volume (see Figure 6-2). Again mergers and acquisitions, new entry and exit of liner operators unravel the changing number of players.

The evolution of the fleet deployment (right-hand axis) and volume (left-hand axis) for the Europe – ISC trade is summarised in Figure 6-4 (compiled with data from www.ci-online.co.uk).

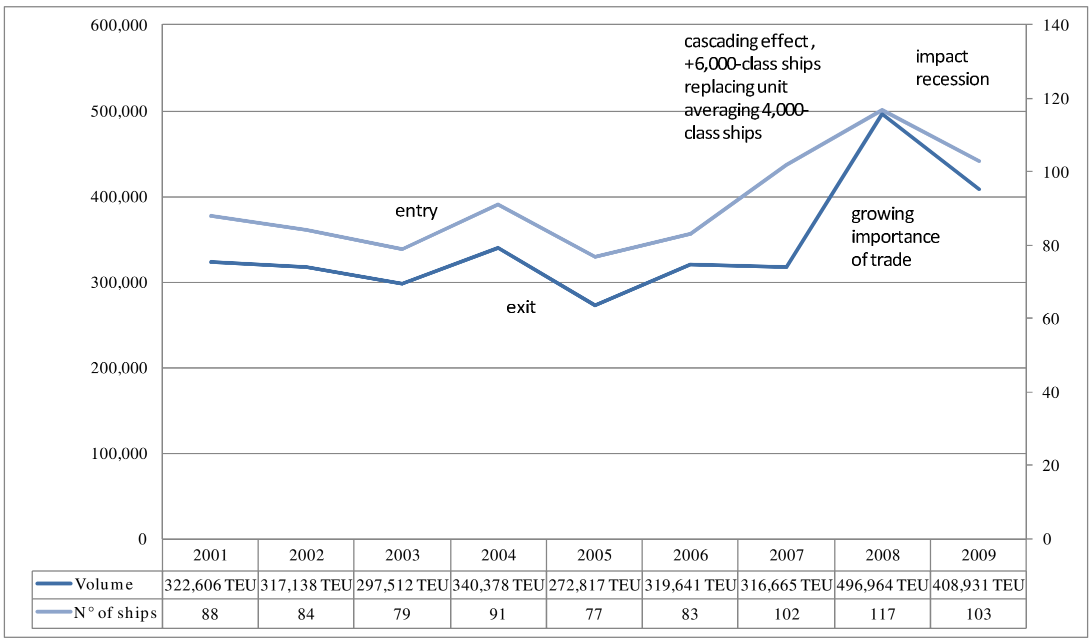

Figure 6-4: Evolution fleet deployment ISC

While the fleet deployment grew by a factor of 1.17, the TEU deployed (volume) increased at a rate of 1.2 during the 2001-2009 period. Entry and exit movements influence both graphs. The line graph of n° of ships rises gradually to a peak in 2008 due to the cascading effect as a result of the deployment of ultra large container ships in the Europe-Far East trade. The Europe - Indian Subcontinent trade also felt the global economic down turn. Ocean carriers have cut capacity by 14 vessels or 88,033 TEUs (year-on-year comparison 2008-2009).

Finally, Indian major seaports are marked out from the Indian Subcontinent trade. The major ports/ terminals in India are Chennai, Kandla, Cochin, Kolkata, Mumbai, JNPT, NSICT, Mundra, New Mangalore, Pipavav, Tuticorin, and Visakhapatanam. Figure 6-5 lists the number of liner operators calling at these major Indian ports over the 1985-2008 period (compiled with various editions of Containerisation Yearbook).

CI Yearbook	1985	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Chennai								27		25	24		21	21	21	13		11
Kandla		5		4		4	4	4		4	4		3	3	3	2		3
Kochi	7	12		24		25	25	24		24	22		20	20	15	15		14
Kolkata	10	9				35	35	34		32	31		10	10	10	10		10
Mumbai						7	30	37		23	25		23	23	23	23		22
Jawaharlal Nehru Port (JNP) Container Terminal		9				16	16	16		12	11		10	24	33	34		24
Nhava Sheva International Container Terminal (NSICT)											8		10	4	16	16		14
Mundra															13	13		15
New Mangalore													3	3	7	7		7
Pipavav													2	2	2	2		12
Titicorin													11	22	22	22		15
Visakhapatnam		1		0		1	1	1		1	1		16	16	8	9		9
Number of liner operators	17	36		28		88	111	143		121	126		129	148	173	166		156

Figure 6-5: Entry/exit ISC at terminal level

Jawaharlal Nehru Port Container Terminal is the biggest container port called in India. It was called at by 24 liner operators in 2008 followed by Mumbai (22), Mundra and Titicorin (15), Kochi and Nhava Sheva International Container Terminal (14), Pipavav (12), Chennai (11) and Kolkata (10). In comparison with 2006, Pipavav won +10 liner operators, while the majority of ports/ terminals lost players (see Figure 6-5). An analysis of the top 3 liner carriers, shows a clear shift from the ports of Kochi and Kolkata to new and/ or larger ports is. Figure 6-6 summarises the calls at Indian ports for the three largest liner operators over the 1995-2008 period.

Yearbook	APM-Maersk										
1995		JNP		Kochi							
1996		JNP		Kochi	Kolkata					Visakhapatnam	
1997		JNP		Kochi	Kolkata	Mumbai				Visakhapatnam	
1998		JNP		Kochi	Kolkata	Mumbai				Visakhapatnam	
1999		JNP		Kochi	Kolkata					Visakhapatnam	
2000		JNP	NSICT	Kochi	Kolkata					Visakhapatnam	
2001			NSICT	Kochi				Pipavav		Visakhapatnam	
2002		JNP	NSICT	Kochi				Pipavav	PSA Sica	Visakhapatnam	
2003		JNP	NSICT				New Mangalor	Pipavav	PSA Sical		
2004	Chennai	JNP	NSICT				New Mangalor	Pipavav	PSA Sical		
2005	Chennai	JNP	NSICT				New Mangalor	Pipavav	PSA Sical		
2006	Chennai	JNP	NSICT				New Mangalor	Pipavav	PSA Sical		
...											
2008	Chennai	JNP	NSICT				New Mangalor	Pipavav	PSA Sical		
	MSC										
2004		JNP				Mumbai					
2005		JNP				Mumbai					Mundra (March 2004)
2006		JNP				Mumbai					Mundra
...		JNP	NSICT			Mumbai					Mundra
2008		JNP				Mumbai			PSA Sical		Mundra
	CMA CGM Group										
1995		JNP		Kochi							
1996		JNP		Kochi	Kolkata						
1997		JNP		Kochi	Kolkata	Mumbai					
1998	Chennai	JNP		Kochi	Kolkata	Mumbai					
1999	Chennai	JNP		Kochi	Kolkata						
2000	Chennai	JNP		Kochi	Kolkata						
2001	Chennai	JNP		Kochi					PSA Sical		
2002	Chennai	JNP		Kochi					PSA Sical		
2003	Chennai	JNP	NSICT				New Mangalore		PSA Sical		Mundra (mid dec 2003)
2004		JNP	NSICT				New Mangalore		PSA Sical		Mundra
2005		JNP	NSICT				New Mangalore				Mundra
2006		JNP	NSICT				New Mangalore				Mundra
...											
2008		JNP	NSICT				New Mangalore				

Figure 6-6: Overview Indian port calls by Maersk Line, MSC and CMA CGM

At this point in the study, all figures indicate that container liner operators can freely enter/ exit the industry, a trade and a port/ terminal. However, linking up with terminal concessions, entry might be restricted. If some carriers (such as Maersk Line, MSC, CMA CGM) govern the exploitation of terminals, they can deny access to this infrastructure to potential rivals. This leads us to barriers of entry/ exit. To analyse this, from the Europe - Indian Subcontinent trade the direct calls between Belgian ports and major Indian ports/ terminals served by fully cellular ships were singled out. This market is chosen because India is one of the fastest growing economies of the world in the fields of IT, medical technology, biotechnology and telecommunication, the importance of the economic relations between both countries is increasing (i.e. India is the fifth non-European exporter to Belgium and the second non-European importer of Belgian products, www.flanderstrade.com) and the market is surveyable.

6.2.2.2 Belgian-India trade

Since mid-2007, the Belgian-India trade has been monitored. From all European ports to India there are 19 services, of which 12 serve the trade route between Belgium and India. 10 services depart from Antwerp and 2 from the port of Zeebrugge (ME1 Maersk Line/ IEC2 (ME1) UASC). For this study, 5 direct cellular container services departing from the port of Antwerp (IMEX, IPAK, ISES, EPIC and IOS) were marked out the departure list.

Appendix 6-2 gives an overview of the fully cellular services departing from Belgium, viz. the number of deployed vessels, the size of the vessels, the partners, the number of ports, the transit time and the day of sailing. Given the fact that only the Belgium-India trade is studied and taking into account that Appendix 6-2 is a snapshot of the situation at the moment of time of writing of the paper, only a limited number of observations can be formulated.

6.2.2.3 Entry and exit

First, the main players in the trade study are CMA CGM, CSAV Norasia, Maersk Line, MSC, Hapag-Lloyd and Hamburg Süd. The majority of services from European ports to Indian ports are dedicated links which are joint service offerings[113]. An example of such joint service is the Europe Pakistan India Consortium or EPIC service. CMA CGM is the founding partner of the original EPIC service in 1997. Partner Hamburg Süd participated in January 2003 and Hapag-Lloyd got involved in 2005. As of May 2008, CMA CGM, Hapag-Lloyd and Hamburg Süd disbanded their established 2-sling Europe Pakistan India Consortium (EPIC). CMA CGM continued with a single weekly service (www.cmacgm.com). The amended EPIC-service of Hapag-Lloyd (IOS) and Hamburg Süd (EPIC) was launched in the same month. MSC entered in March 2001 with the NEur-India & Pakistan service while CSAV launched its service in December 2006. As a part of the new Maersk Line network following the merger of the Maersk Sealand and P&O Nedlloyd services (2005), the ME-1 services of the tandem Maersk Line/ Safmarine

[113] The analysis does not take into account the dry ports (for instance Coimbatore, Bangalore, …) as operations serving India by transhipment via Colombo (e.g. APL, SCX service; CMA CGM, FAL8 (SCX) and FAL9 (AE9); Evergreen, UAE service; Maersk, AE9 service and MSC, NEur-IndOC-ANZ service) or elsewhere (e.g The Grand Alliance serves the region via Singapore, The New World Alliance makes calls at the hub of Salalah, Singapore and a westbound call in Colombo, The members of the CKHY-alliance work via the hubs of Singapore, Port Kelang, Khor Fakkan and Colombo, The carrier IRISL feeders from and to Dubai, etc.). Nor does the analysis take into account the phenomenon of 'double dipping' where cargo for India on for instance Australia services are doubled dip over Singapore to India.

supersedes the former ME-1 as of May-June 2006. The most recent new entrant is UASC as slot partner. Starting from September 2009, UASC serves the trade through a slot charter agreement with Maersk Line.

On the topic of exit, CSAV-Norasia announced in March 2009 a port change for the IMEX Service (or India-Middle East-Europe service - launched in December 2006) from Antwerp to Rotterdam. After an absence of less than one year, CSAV re-entered the Belgium – India trade by again adding Antwerp to the schedule of CSAV Norasia's India-Middle East-Europe Express. Antwerp is the last European port of call before heading to Port Said, Jebel Ali, Karachi, Nhava Sheva and Mundra. In December 2009, Antwerp replaced Rotterdam in the ISES service organised by MSC and S.C. India, returning for this latter carrier to the original ISES service. An extra service is offered (www1.axsmarine.com). To sum up, the Belgium-India trade lane is in principle open to everyone with some cargo to ship. Due to credibility, an exiting firm easily enters another trade.

Next, regarding the deployment of vessels, Maersk Line successively upgraded the ship size replacing units with capacities ranging from 4,026-4,822 TEU to a more homogenous fleet of 6,250 TEU (October 2006) towards 6,978 TEU ships (February 2010). In this trade lane the shipboard capacity of Maersk Line largely exceeds the deployed capacity of the other players. A study of the name of Maersks' ships shows that the majority of the ships stayed in operation in this trade. In contrast, MSC's fleet is a rather non-homogenous fleet varying from 2,258 TEU to 3,268 TEU units in the period Aug. 2007 - Aug. 2008 (except for the 5,100 TEU vessel 'MSC Benedetta' which suggested at that time the upgrading of the fleet in succession of Maersk Line). In the period March-May 2009, MSC doubled the capacity of the service to approximately 5,500-6,000 weekly TEU. Furthermore, MSC quite often replaces its ships (corresponding with seventeen different vessels) and changes the day of sailing mostly in the port of departure. A clear indication that barriers to entry between markets are particularly low as vessels deployed on one trade can be redeployed on another trade as a function of supply and demand as well as ending the charter.

In general, the increase in scale is largely due to the cascading effect since the introduction of ultra large container vessels in the Europe-Far East trade and the growing volume (see Figure 6-4). The increase in the number of ships is linked with the introduction of slow-steaming programs[114] of most liner operators. The latter clearly has an impact on the transit-time (from min. 42 days up to max. 56 days). Notable is the re-entry of CSAV which was accompanied with an injection of larger ships on its IMEX service. The carrier has replaced the previous 3,100 TEU units with larger tonnage of up to an average weekly capacity of 4,452 TEU (www.csav.com).

Finally, regarding port selection, the services of liner operators MSC, CMA CGM (with partner Hapag-Lloyd and Hamburg Süd) depart from Antwerp and call Mundra and Jawaharlal Nehru. North/ West Indian ports (see Figure 6-5) serve as entry point for European shipments. These ports are preferred over South/ East ports for their shorter transit times, their draught and accessibility, their customs' policy, their hinterland connectivity (to New Delhi, to distribution centres, etc.) and improving logistical services. More specifically, Mundra is chosen as a preferred alternative for the heavily congested and still much-preferred Nhava Sheva container terminal in Jawaharlal Nehru Port Trust (JNPT) on the one hand and for the development of a container freight station (CFS) at its Dadri inland container depot (ICD) complex) on the other hand. Jawaharlal Nehru Port Trust (JNPT), the (hub) container port of Mumbai is most likely called for its 'memorandum of understanding' with the port of Antwerp[115]. In the restructuring of the new EPIC service, CMA CGM and Hapag-Lloyd/ Hamburg Süd keep calling at the Nhava Sheva International Container Terminal (Mumbai). Leaving from the port of Zeebrugge, Maersk Line calls before Jawaharlal Nehru at the port of Pipavav on the Gujarat coast driven by the booming cargo volumes from the north-western Indian hinterland. CSAV opted for a different port rotation, viz. starting in the south and coming up to the north and back.

The number of port calls varies between 8 (MSC – Aug. 2007) and 16 (CMA CGM – February 2010). Every service calls at two ports in India. MSC often changes ports. E.g. in 2005, the IPAK service first called at India followed by Pakistan. At the beginning of 2006 MSC switched the direction. Till November 24th, 2005 Nhava Sheva was the first port of call. Since then, MSC has frequently reshuffled the port rotation. Twice such a reshuffle coincided with a restructuring of the EPIC service. This suggests that obtaining an

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114 Leading liner operator, Maersk Line, pioneered the present trend for slow and super slow steaming. Most liner operators are in the process of, or have already adopted this strategy. Slow and super-slow steaming programs aim to save costs (i.e. annual reduction of tonnes of bunkers), trim back overcapacity and with it environmental concerns (i.e. reduction of tonnes of C02 per year).

115 The port of Zeebrugge has a 'memorandum of understanding' with Ennore, sister port of Chennai (Madras).

interesting berth window is not an impediment. Obtaining an interesting berth window is very important since a berth window in one port might not be compatible with a berth window in another port (i.e. Mundra might have a window on Tuesday morning and Cochin Tuesday evening).

To sum up, the analysis of the Belgium-India trade indicates that entry/ exit is sufficiently free. Free access of shipping companies as well as their flexibility in port choice are a clear proof of this. Is this an indication of low/ surmountable barriers to entry/ exit?

6.2.2.4 Barriers to entry/exit[116]

A liner operator will enter the industry if it expects that the net present value of post-entry profits exceeds the sunk cost (i.e. costs that cannot be recovered if the liner operator decides to exit the industry) of entry (Besanko *et al.*, 2004). The likelihood of entry can be reduced through entry barriers as well as barriers to exit.

Barriers to entry are circumstances particular to a given market or industry that create disadvantages for new competitors attempting to enter the market. Figure 6-7 classifies the barriers to entry/ exit.

BARRIERS TO ENTRY		
INDUSTRY LEVEL		FIRM LEVEL
Structural barriers to entry	Strategic barriers to entry	
- economies of scale	- pricing strategies	- capital requirement
- absolute cost advantage	- limit pricing	- time
- product differentiation	- predatory pricing	- management
- legal entry barriers	- strategic product differentiation	
- monopoly rights	- signalling commitment	
- registration, certification and licensing of businesses and products		
- patents		
- government policies		
- geographic entry barriers		
- tariffs, quotas, subsidies to domestics producers		
- physical barriers		
- technical barriers		
- fiscal barriers		
- preferential public procurement policies		
- language and cultural barriers		

Figure 6-7: Overview barriers to entry

[116] The focus is on sellers entry barriers since buyers entry barriers are non existent in this industry.

Entry barriers may be grouped into three categories. The first category groups structural barriers or entry barriers over which neither incumbent nor entrant have direct control (Lipczynski *et al.*, 2005). Under this heading, five types of entry barriers will be discussed: economies of large scale, product differentiation, and absolute cost advantages of incumbent firms compared with entrants (Bain, 1956, pp. 15-16), legal barriers and geographical barriers (Lipczynski *et al.*, 2005, pp. 277-315). In CLSI, the most important barriers to entry are the traditional 'Bain' barriers. The second category is the strategic barriers to entry, which are those created or raised by incumbents through their own entry-deterring strategies. Entry-deterring strategies may include limit pricing, predatory pricing, strategic product differentiation and signalling commitment. The third category is formed by firm-level specific barriers. Each category will be discussed in turn.

To assess entry conditions, the **structural entry barriers** must be understood (Besanko *et al.*, 2004).

Firstly, Lipczynski et al (2005, p. 280) state that economies of scale can act as a barrier to entry in two ways. First, economies of scale are an entry barrier if the minimum efficient scale of production is large relative to the total size of the market. Secondly, there is an entry barrier when average costs associated with a production level below the minimum efficient scale are substantially greater than average costs at the minimum efficient scale.

Are there economies of scale in the CLSI? Literature proves that economies of scale do exit in liner shipping industry (see e.g. Jansson & Shneerson, 1987; Davies, 1983a/b; Brooks, 2000). Economies of scale are based on the firm size (number of vessels) or on the size of one vessel. The latter (i.e. the ability to operate larger ship sizes) is a classical example of economies of scale (see Cullinane & Khanna, 2000; Sys *et al.*, 2008). Following Stigler (1968), Davies (1983a, p. 91) concludes for the liner shipping industry that economies of scale do not constitute a barrier to entry.

However, is this still correct for the containerised liner shipping industry? In the CLSI, the minimum efficient scale of production differs from trade route to trade route and is determined by the level of service (i.e. transit time, reliability, etc.) a carrier aims to provide. So, the number of vessels to set up a service and the accompanied huge investments can act as a barrier to entry. In order to provide a weekly service, liner operators need to deploy more than one ship. Vessel speed, distance, ports served, etc.

determine the number of vessels in a string. The need to maintain fixed day weekly services as the minimum acceptable quality of service requires 5 ships on the Transatlantic trade, 6 on the Indian-Subcontinent (see Appendix 6-2) and 8 on the Far East trade. The slow steaming program of the main carriers adds 1 or 2 ships.

On the topic of average costs, either a new liner operator faces high risks by entering at a large scale to avoid the penalty of higher average costs, or the newcomer enters at a smaller scale (e.g. see 6.2.1.3), which would mean that it incurs the penalty of higher average costs. Additional, the significant economies of multi-plant operations and distribution network will increase the barrier. To compete with the existing firms in the first case, the entrant would be forced to enter as a horizontally integrated firm. In the second case the firm would have to be vertically integrated. The containerised liner shipping industry has become dominated by large carriers, which through economies of scale and the majority shareholder or ownership of terminal operations (so, vertical integrated), can effectively keep out potential entrants. If some carriers (like Maersk Line, MSC, …) govern the exploitation of dedicated terminals, they can deny access to this infrastructure to potential rivals or ask for phenomenal fees[117]. Another possible strategy could be to block deliberately the access to non-dedicated terminals with the aim to discourage the new player whose ships have to wait several days before entering the small port. So, it will be very difficult for an entrant to compete on equal terms with the established companies and to be able to start up on a very large scale. Unless the entrant is already established in another shipping segment (e.g. bulk industry) it will be hard to survive this competition. Consequently, these economies of scale will reinforce the next two main barriers.

Secondly, Lipczynski *et al.* (2005) indicate that an established player has an absolute cost advantage over an entrant if the long-run average cost function of the entrant lies above that of the existing firm. The absence of a global network, a track record, sufficient cargo coverage, the existence of vertically integrated operations; the dominant position on certain trades; etc. explains why entrants might face higher absolute costs in the stated industry. So, new carriers would find it again hard to compete.

The third main barrier Bain distinguishes is product differentiation. What is the product in the CLSI? The 'product' equals the transportation of a box (read: container). But, a

[117] In the current economic situation, other liner operators are welcomed. A source of revenue.

broader look tells us that in the containerised liner shipping industry, it isn't just the movement of a container but also the services that surround it (e.g. frequency, port of call, combination of arrival and departure, etc.). Product differentiation is not yet a common feature in the CLSI. It exists in some degree in the services offered. For instance, the Marseille-based carrier, CMA CGM offers two alternatives in transporting goods towards Malta. The first alternative is the fast services from Antwerp to Marseille via train. Subsequently, the goods are feedered to Malta. The second alternative is the direct service (FAL) to Malta (Antwerp-Zeebrugge: 1 day and Zeebrugge – Malta: 7 days). On long distances, the same carrier offers more possibilities. For instance, on the route Belgium-Australia, the shipper can choose between the services EPIC (via Le Havre), NEMO and PAD service via Panama canal. The transit time is respectively 51 days, 40 days and 44 days not including the barging from Antwerp to Rotterdam. Advertising is a proxy for the extent of product differentiation. In theory, entrants will have to spend more on advertising than incumbents. Launching advertising in the CLSI largely differs from other sectors. Large-scale advertising is not common in this business segment. Each major liner operator advertises in maritime journals (e.g. Containerisation International, Lloyd's shipping economist). A good idea would be to advertise in the specialised journals of their major clients (e.g. chemical, pharmaceutical,… sector). If the liner operator MSC would publish accounting data, the cost of advertising would largely be attributed to the business segment 'cruises'. For entrants, this structural entry barrier only exists if shippers are loyal to their carrier.

Other types of structural barriers are legal barriers and geographic barriers. The most effective of all entry barriers are legal barriers to entry. In the containerised liner shipping industry regulatory barriers are low. No license, patents, etc. are required. Maybe countries (e.g. West Africa, Syria, …) can raise 'legal' barriers to call at a port? Geographic barriers may take the form of tariffs (e.g. since cargo is the driving force, for instance, WTO- agreements might have an influence), quotas, subsidies, physical and technical barriers (i.e. access to ports), fiscal barriers, preferential public requirement policies and language (language of communication is English) and cultural barriers.

Besides the magnitude of structural entry barriers, an entrant also must consider the strategic behaviour of the established firms against (potential) market entry. Three entry conditions can be distinguished, viz. blockaded, accommodated and deterred entry. The first entry condition corresponds with high structural barriers so that established carriers need do nothing to discourage entry. The latter also applies for the accommodated entry, where, the structural entry barriers are low. The incumbent's costs of deterring entry are higher than the benefits it could gain from repelling the entrant. If the incumbent can keep the entrant out by employing an entry-deterring strategy and doing so boost its profit, entry is deterred. Only in the latter case, the incumbent should take on a predatory act.

To sum up, the analysis of the structural entry barriers indicates that there are some barriers to entry. The extent of the barriers to entry is moderate. Clearly, the extent of the barriers to entry differ from trade lane to trade lane. This does not imply that barriers are permanent. For instance, the building a new terminal can eliminate physical and technical barriers. From the incumbent viewpoint, this is a position of accommodated entry.

Subsequently, whereas structural barriers focus on basic industry conditions such as demand and cost, **strategic barriers** are intentionally created by established firms with the aim of deterring entry. These barriers may arise as a result of limit pricing, predatory pricing, strategic product differentiation and creating and signaling commitment. Limit pricing refers to the practice whereby an incumbent firm discourages entry by charging a low price before entry occurs, whereas predatory pricing refers to the practice of setting a low price in order to drive other firms out of business. Both pricing strategies can succeed only if the entrant is uncertain about the nature of post-entry competition (Besanko *et al.*, 2004; Lipczynski *et al.* 2005). In the studied relatively new trade route, there are no indications of such strategic barriers. Given the growing volume (see Figures 6-2 and 6-4), strategic product differentiation is not yet of importance. Furthermore, no established liner operator signals a commitment to fight entry by engaging the entrant in a price war. However, it is not excluded that such strategic barriers do occur on other trades.

Other entry-deterring actions might be changes in production level (read: increase of deployed TEU capacity) or price level. A threat that such changes might occur can act as a barrier to entry. Mid 2009, the re-entry of CSAV, ISES-service calling Antwerp, etc. did not significantly alter the deployed TEU capacity of the other players.

In general, on the topic of price level, the three-monthly aggregated price index by trade direction compiled by ELAA is an interesting tool to check whether the general level of prices is rising or falling. Figure 6-8 shows the evolution of the price index of ELAA from Europe to and from the Indian Subcontinent & Middle East (ISC&ME). The index for eastbound rates stood at 83 % of 2008 levels in January 2010. On the westbound leg, the price index shows rates down about 25 per cent compared to the price level of January 2008 (= 100).

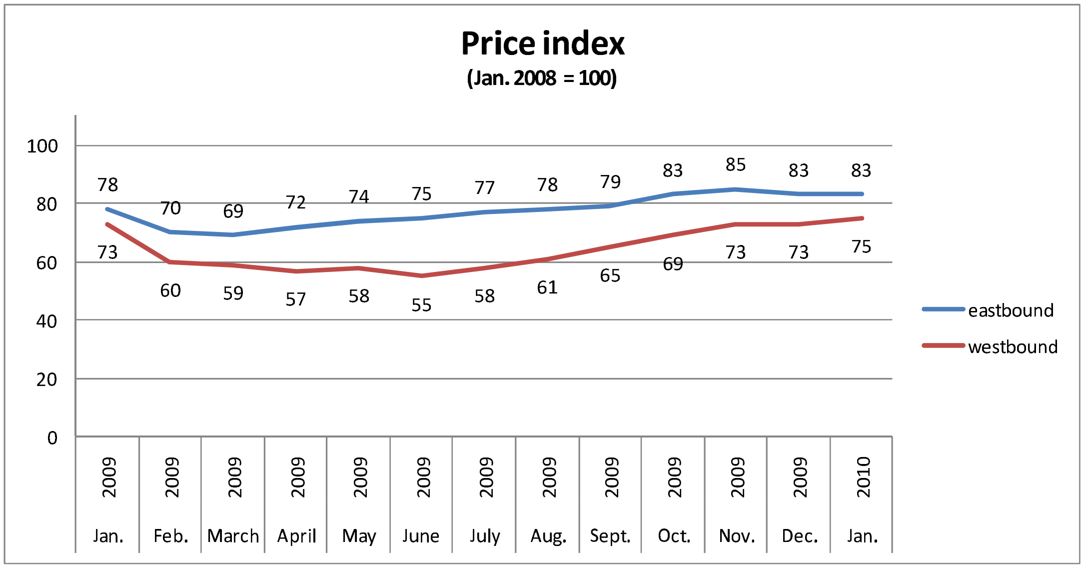

Figure 6-8: Evolution Price Index[118]

On the eastbound leg, the decrease in price level continued throughout the months January until March 2009. Since then the prices steadily continued to increase. For the Westbound leg the price decrease shows a more distinct decrease which remained for the entire duration of February until July below 60 % of the 2008 price level. In August 2009 a first rise above 60 % was noted.

Figure 6-9 depicts the evolution of volume and freight rate indexes (January 2008 = 100) on the Belgium-India trade lane[119] covering a two-year period. Quarterly westbound freight data per 40-foot container was obtained from two liner operators (LO). End 2008, freight rates plummeted, in part due to reduced demand precipitated by the current global economic crisis. An improvement in freight rates occurred over the second half of the year 2009. The increase/ decrease of the freight rate index follows two months after a

[118] Compiled with data from www.elaa.net.

[119] In February 1998, the rates were around USD 850/ 20' and USD 1,000/ 40' eastbound and westbound rates amounted USD 700/ 20' and USD 900/ 40'. At the end of 2006, Eastbound to India west coast ports, base rates for general cargo reportedly dropped to around USD 500/ 20' and USD 700/ 40' or even lower. The westbound freights reached levels of USD 600 and 1,200 respectively (excluding THC and surcharges) (Dynamar).

collapse in/ signs of a pick up of cargo volume. Clearly, no indications of limit/ predatory pricing were observed in the trade study.

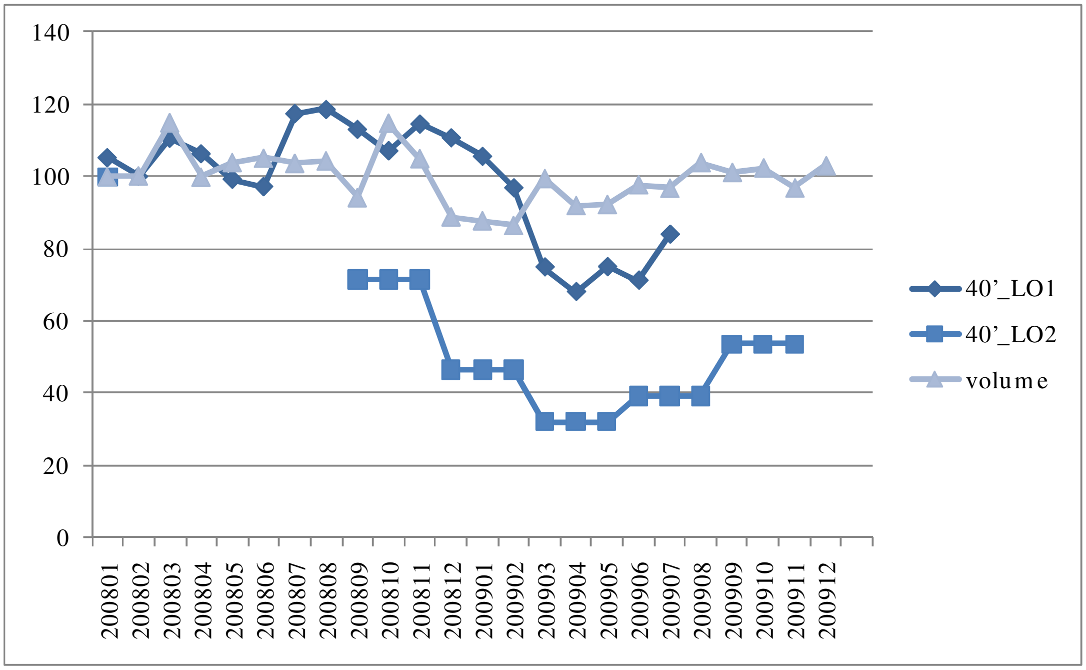

Figure 6-9: Evolution volume and freight rate indexes

Besides structural and strategic barriers, there are **firm-level barriers** or other operating barriers (i.e. capital, time and management) to complete the analysis of barriers to entry. Firstly, the cost of entry into the CLSI with sufficient and additionally matching or nearly matching vessels to provide regular fixed services is substantial. The small scale entry of MBG Shipping and The Containership Company (TCC) calls for USD 70 million and USD 50 million capital respectively. Even in times of recession there was plenty of interest to subscribe TCC's USD 50 million share issue. Is it, therefore, right to assume that the finance market lightens this barrier to entry? To mount a credible service on the European – Far East trade lane, nine or ten similar or matched ships offering a capacity of between 11,000 TEU and 14,000 TEU are required or an investment of between 1 billion USD and 1,5 billion USD (Fossey, 2009b). What is more, given that one aims to compete with global operators in each relevant market requires even more vessels. Despite the fact that new and second-hand vessels as well as the other adjoined investments (e.g. terminals and/ or cargo handling facilities, containers, inland facilities and an agency network) cost several billion USD, finance was generally available. So, capital requirements do not represent insurmountable barrier to investment in new equipment.

Secondly, time might be a potential barrier as building a new ship takes after all several years. But then, if there is a second hand market, this barrier is low. For the CLSI an active second hand market is in place.

Management (including knowledge) could be a third operating barrier[120] (Brooks, 2000; Clarkson Research Studies, 2004; Haralambides, 2007). Where in other segments of shipping both the technical and commercial management of the vessel are easily outsourced, this is hardly the case in the CLSI.

The final consideration in understanding a new entrants' incentive to enter a market paradoxically is the firm's ability to exit the market. The size of barriers to exit may be an important element in determining the incentive for new entrants. If it is costly to exit a market, the incentives to enter are reduced (Besanko *et al.* 2004; Lipczynski *et al.*, 2005).

In the case of the CLSI, is it costly to exit the market? Negatively, if a liner operator decides to exit a trade, the liner operator will opt to redeploy its assets in other trades. Conversely, If the carrier decides to exit the industry (e.g. MBG Shipping), the carrier sells off its assets or returns the chartered tonnage to the owner. In the latter scenario, there will be some sunk costs (e.g. advertising, redundancy payments, financial penalty clause, …) that cannot be recovered if the liner operator decides to exit the industry. Consequently, there are barriers to exit but the extent of these barriers is not significant. MBG Shipping exited the industry with loss.

6.2.3 Alliances

Caves and Porter (1977) suggest entry barriers apply not only to entrants, but also between different groups of established firms within industries. The three largest alliances, CHKY Alliance, the Grand Alliance and the New World Alliance may be defined as groups in the CLSI. In a study conducted by Das and Teng (1997), strategic alliances are defined along similar lines as '*interfirm cooperation arrangements aimed at pursuing mutual strategic goals*'. So, alliances allow a liner operator to enter a trade even

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[120] Irrespective of the shipping division, finding officers and good/ specialised crew is rather a hindrance than a barrier, since established firms also are confronted with this issue.

without the deployment of additional tonnage, simply by using slots on its partners' existing services (Midoro, 2000)[121].

An overview of the process of operational agreements on one trade to the formation of alliances is provided in the left-hand side panel of Appendix 6-3. The right-hand side panel reports the milestones during the 1994–2010 period. What conclusions can be derived from Appendix 6-3?

First, very quickly after the creation, most of the alliances were restructured, modified or re-named. Since, no new members entered an alliance. Secondly, regarding exit, the process of transition is largely driven by mergers and takeovers (e.g. the merging of P&O and Nedlloyd ended the first most important alliances). Subsequently, entry/ exit in/ out of the Top 100 had no impact on the alliances since solely major liner operators (ranked in the segment 1-25) are involved in these operational agreements. In addition, the impact on the alliance of the bankruptcy of Cho Yang (2001: ranked 25) and Senator Line is negligible. Finally, one 'pure' exit is reported. MISC withdrawing its participation from the European and Mediterranean trade lanes (as of January 1st, 2010) fits within a portfolio restructuring due to the global economic downturn. Since, MISC solely participated in the Europe-Far East trades the withdrawal will not affect the Grand Alliance's services.

6.2.4 Synopsis

To sum up, as in most industries, while liner operators enter, other carriers exit simultaneously. Martin (2002) compares this process with the picture of a revolving door. He proceeds by saying that few firms make it into the lobby and manage to maintain an enduring presence in the industry. This picture also fits for the CLSI. Small liner operators (of which the majority exit the CLSI in less than a year after entrance) have little influence on the industry. Survivors do grow precipitously (e.g. on the Europe/ Asia trade, CSCL has entered the market in 1999 (ranked 46; 2010: ranked 8). The economic downturn as yet has only a small impact on the Top 20. Regarding entrance, a lot of attempts are to be expected as a lot of assets are available. On the other hand, there is a growing number of liner operators requiring fresh capital from their shareholders, and even government help and/ or disposal of assets in an attempt to

[121] Other alliance forms are joint ventures, joint R&D, product swap, equity investment and sharing, and licensing.

survive, some liner operators are expected to fail and disappear from the scene. It could be one of the top league players, smaller niche liner operators, …

At the level of alliances, it appears that the alliances are in a position to retain their members. The detailed study of the Belgium-Indian trade lane indicates that there are barriers to entry/ exit. However, the extent of the barriers is not significant[122].

In this part, the focus was solely on actual entry. Entry conditions should also determine the extent to which established liner operators need to fear competition from potential entrants. The threat of entry cannot be neglected[123]. Geroski (1988) stated that "*entry does not need to occur in order to have effect on the behaviour of firms in markets, the mere threat of large scale imitation may lead incumbent firms to take pre-emptive actions which both lower their current period profit and discourage potential entrants from actually entering*". The next part observes patterns in time-series variation of firm-level profit rate data which allows to draw interferences about the nature of competition (i.e. actual and potential entry/ exit).

6.3 Persistence of profit

The threat of entry determines in a fundamental way the market performance. From econometric view, assessing the likelihood of potential entry is a problem since the threat of entry is an unobservable variable. In addition, Martin (2002) states that even actual entry of the kind that affects the performance of established firms is an unobservable variable. To deal with this issue, a body of literature, known as Persistence of Profit (PoP) approach, observes profit outcomes over time to make interferences about the nature of competition.

The literature distinguishes two representations of the competitive processes, viz. the static and dynamic view. The static view is based on the Structure-Conduct-Performance (SCP) model. According to SCP, the structure of the market (reflected in characteristics, such as the number and size distribution of firms, the extent of product differentiation

[122] This observation corresponds with the business segments tanker and dry bulk market. Here the barriers of entry also are low due to the presence of an active second hand market. Conversely, there are substantial barriers to entry in the capital intensive LNG market and the Pure Car Carrier market for immediate entries. In addition, the LNG market also requires a specially trained crew (Clarkson Research Studies, 2004).

[123] Davies (1983a and 1986) has studied the entry and exit of liner operators into/ from liner conferences serving Canada covering the period 1975-1982 as well as the actual entries and exits of ships into/ from Canadian liner trades between 1977 and 1979 to validate the contestability theory. On the basis of this empirical analysis, the conclusions were that entry/ exit happen a lot and that liner shipping markets can accurately be described as being contestable. In their critique on contestability, both Pearson (1987) and Jankowski (1989) argued that the focus solely was on actual entry and neglected the threat of entry.

and the strength of entry and exit barriers) affects the conduct of the firms operating in that market which in turn influences their performances. Competition among an existing set of firms suffices to produce zero profits at each point in time. This static view does little to explain the dynamics of competition[124]. The dynamic view owes its origin to J. Schumpeter. Under the dynamic view, the entry and exit of firms drives profits to zero in the long run, and is thus consistent with there being non-zero economic profits at different points in time. This Schumpeterian perspective on the competitive process is adopted in PoP-studies[125] (Mueller, 1977 and 1986; Geroski, 1990; Lipczynski *et al.*, 2005).

In this section, the persistence of profits will be studied for the CLSI. To this end, Mueller's (1977, 1986) Persistence of Profit hypothesis will be tested for a sample of container liner operators between 2000 and 2008. A time-series analysis on firm-level profits is used to estimate the short-run and long-run persistence. Persistence should be interpreted as the percentage of a firm's rent in any period before period t that systematically remains in period t (Waring, 1996). The hypothesis is that (potential and actual) entry/ exit conditions are sufficiently powerful to ensure that no firm persistently earns profits above or below the norm (Lipczynski *et al.*, 2005).

6.3.1 Sample, variable and data

The persistence of profit approach analyses time-series data on firm-level profit rates. A time-series study requires time series as long as possible. In contrast to other industries, the containerised liner shipping industry suffers from a lack of long time-series data. Consequently, it puts a restriction on the number of liner operators that may be included in the sample. For this purpose, and in function of data availability, the empirical specifications at container division level are based on an unbalanced panel data set for a sample of 21 major liner operators covering the period from 2000 to 2008 inclusive[126].

To control for business cycles and to remove the effects of any macroeconomic fluctuations, the PoP literature concentrates on the persistence of a firm's standardised profit rate denoted $\pi_{i,t}^{s}$. The persistence of a liner operator's standardised profit rate is

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124 Contestability theory is an example of static model.

125 Overview of firm-level PoP-studies: see Lipczynski *et al.*, 2005; Gschwandter, 2009.

126 The data set comprises the following 21 liner operators in alphabetical order: APL (5), CCNI (29), CMA CGM (3), COSCO (7), CSAV (13), CSCL (8), Hapag-Lloyd (6), Horizon Line (30), Hanjin (9), K-Line (11), Maersk Line (1), Matson (36), MISC (21), MOL (12), NYK (10), OOCL (14), RCL (25), UASC (19), Wan Hai Line (22), Yang Ming Line (15) and ZIM (17). The number in parentheses denotes their ranking at January 1st, 2010.

defined as $\pi^s_{i,t} = \pi_{i,t} - \overline{\pi_t}$ where $\pi_{i,t}$ is firms *i*'s actual profit rate at time *t* and $\overline{\pi_t} = \sum_{i=1}^{n} \frac{\pi_{i,t}}{n}$ the average profitability of the industry profit rate in year *t*. In other words, $\pi^s_{i,t}$ represents the deviation of the profitability of liner operator *i* at time *t* from the average profitability of all liner operators in the sample at a given time.

Most PoP-studies measure profit as the firm's return on assets (ROA). The interpretation of this main variable however varies. Firstly, some studies define the profit rate as the ratio of *before* taxes to total assets (e.g. Mueller, 1977 and 1990; Geroski & Jacquemin, 1998; Glen *et al.*, 2001; Yurtoglu, 2004; Eklund & Wiberg, 2007). Mueller (1977) argues that before-tax profits were used to avoid noise as a result of differences in tax treatment. In the same study, Mueller tested all of the models using an after-tax definition of profits. He obtained the same qualitative results. Secondly, other studies used net profit *after* tax plus interest payments (e.g. Goddard, 1996; Waring, 1996; Goddard & Wilson, 1999; Maruyama & Odagiri, 2002; Bektas, 2007; Gschwandtner, 2009). On the topic 'after-tax', Maruyama & Odagiri (2002) reason that entrants should make their entry decisions based on after-tax profits if effective tax rates differ across industries. In addition, they argue that interest should be included because total assets in the denominator include those financed by debt and, so, the numerator should also take account of the returns to debt. Another viewpoint is offered by Mueller (1990), the author defined company's return on capital as its profits net of taxes and *gross* of interest divided by total assets. The line of reasoning is based on the assumption that the convergence of profits to the competitive return is driven by exit and entry of other firms and that this entry and exit respond to after tax profit levels. Finally, Stephan & Tsapin (2008) used two measures of profit rate: price-cost margin (or revenue minus costs relative to revenue) and return on assets, which is defined as operating profits divided by the assets of the firm.

A study of the persistence of profit for the CLSI differs from other PoP-studies where the persistence of profit is investigated across industries or across firms located in a specific country (e.g. *Japan*: Maruyama & Odagiri, 2002; *Spain*: Bou & Santorra, 2007; *Turkey*: Bektas, 2007, Yurtogli, 2004; *United Kingdom*: Goddard & Wilson, 1996, Cubbin & Geroski, 1990; *United States*: Mueller, 1990). The CLSI is a global industry with liner operators having their headquarters all over the world. Different accounting methods are used. Leasing and/ or chartering of ships is common practice, certainly of carriers-to-be (see 6.2.1.3). In addition, this study focuses on the business segment of container liner shipping. Therefore, assuming that entry into and exit from the container liner shipping industry is driven by operational profit, this PoP-study measures profit as the return on sales (ROS or EBITDA[127] to turnover, where the denominator equals a proxy for total assets)[128]. EBITDA is a useful parameter for an entrant in evaluating the operating performance as it removes depreciation and amortisation which can vary depending upon accounting methods as well as interest and taxes.

To test/ confirm the validity of this assumption, regressions were run using return on assets (ROA or net income to total assets at container level division) and return on capital employed (ROCE or EBITDA to total assets). In the case of 100 % liner operators, the results of these three profitability measures do not differ significantly. In the case of liner operators with diversified operations portfolio, the results of ROA differ from the other results. This difference can largely be attributed to the fact that not all liner operators report net income at container division (e.g. Evergreen, Hamburg Süd, Hyundai Merchant Marine) or stopped reporting it (e.g. Hapag-Lloyd). The above arguments argue in favor of the profitability measure, return on sales[129].

The data for the empirical investigation were collected from Liner Intelligence financial analysis (www.ci-online.co.uk) and from investor/ annual reports published on the publicly available internet websites of the selected liner operators.

6.3.2 Model

This paper applies the well established profit persistence methodology pioneered by Mueller (1977, 1986) and extended in contributions by Geroski and Jacquemin (1988) and Geroski (1990) in modelling variations in company profitability over time.

Firstly, Mueller (1986) shows that persistence of profits can be estimated using first order autoregressive (AR(1)) equation for each firm's standardised profit rate as follows

$$\pi^s_{i,t} = (1-\lambda_i)\pi_{i,p} + \lambda_i \pi^s_{i,t-1} + \mu_{i,t} \qquad (1)$$

[127] Reconciliation from Earnings before interest, taxes, depreciation and amortization (EBITDA) to Net income: subtract non-cash chargers (i.e. depreciation and amortisation expenses), non-operating expenses (such as interest and "other" non-core expenses) as well as income tax from EBITDA.

[128] Maritime consultancy bureaus also opt to work with return on sales in their studies.

[129] Neglecting the ratio owned versus chartered ships might obtain biased results.

where λ_i and $\pi_{i,p}$ are the key parameters. These parameters of interest describe the impact of the previous years' firm-specific profits to the current year's profit rates by regressing $\pi^s_{i,t-1}$ on $\pi^s_{i,t}$, and reflect the strength of persistence of profit in both the short and the long run (Lipczynski *et al.*, 2005). The measure of persistence is the slope coefficient, λ_i. The value of λ_i predicts the intensity of competition or the speed with which profits converge on $\pi_{i,p}$. For convergence, λ_i must lie between zero and one (Cable & Mueller, 2008). $\pi_{i,p}$ represents the permanent profitability level of firm *i*. The permanent component $\pi_{i,p}$ can itself be partitioned into two terms as $\pi_{i,p} = c + r_i$ where *c* is the competitive rate of return common to all firms and r_i equals a permanent rent specific to firm *i*. The cost of entry/ exit into/ from the industry is assumed to be reflected by the latter term. The error term, $\mu_{i,t}$ captures the effect of random shocks to these profits which is assumed to satisfy the usual conditions for OLS.

Letting $\hat{\alpha}_i$ and $\hat{\lambda}_i$ be the estimates of the autoregressive equation, this reduces Eq. 1 to the following testable empirically model:

$$\pi^s_{i,t} = \hat{\alpha}_i + \hat{\lambda}_i \pi^s_{i,t-1} + \mu_{i,t} \tag{2}$$

where $\hat{\alpha}_i = (1-\hat{\lambda}_i)\pi_{i,p}$. If $\hat{\alpha}_i$ and $\hat{\lambda}_i$ are the generalised least squares estimators of α_i en λ_i, then the permanent profitability level of firm i, $\pi_{i,p}$ can be derived and estimated as

$$\pi_{i,p} = \frac{\hat{\alpha}_i}{1-\hat{\lambda}_i} \tag{3}$$

An overview of the interpretation of short-run and long-run persistence and with it the link to barriers to entry is given in Figure 6-10.

Short-run persistence		Barriers to entry
λ_i		
$\lambda_i = 0$	Year-on-year variation in $\pi^s_{i,t}$ is random	No
	No association between $\pi^s_{i,t-1}$ and $\pi^s_{i,t}$	
$0 < \lambda_i < 1$	If $\pi^s_{i,t-1}$ is above (below) zero, it is likely that $\pi^s_{i,t}$ will also be above (below)	Yes
	Positive association between $\pi^s_{i,t-1}$ and $\pi^s_{i,t}$	
Long-run persistence		
α_i		
Positive	Firm i's actual long-run average profit rate is above average for all firms	
Negative	Firm i's actual long-run average profit rate is below average for all firms	
$\pi_{i,p}$		
$\pi_{i,p} = 0$	Standardised profit rates of all firms tend to fluctuate around the same long-run convergence	No or surmountable
$\pi_{i,p} \neq 0$	Standardised profit rates of all firms tend to fluctuate around different long-run average	Yes
	No convergence	

Figure 6-10: Interpretation of persistence

Secondly, Geroski and Jacquemin (1988) and Geroski (1990) have shown that equation 1 is a reduced form of a more elaborate two equation structural model which makes explicit the role of actual and potential entry (and exit) in the model, but which do not affect the specification of the reduced form. The central idea is that profits can be expected to attract entry, and entry drives profits down.

In the first structural equation, profits are assumed to depend on the threat of entry in the market, $E_{i,t}$.

$$\pi^s_{i,t} = \gamma_{i0} + \gamma_{i1} E_{i,t} + \gamma_{i2} \pi^s_{i,t-1} + \mu_{i,t} \tag{4}$$

where $\gamma_{i1} < 0$, $0 < \gamma_{i2} < 1$ and γ_{i0} may take any value. The parameter γ_{i1} measures the direct impact through actual entry or indirectly by forcing established firms to undertake pre-emptive actions, and varies inversely with the level of entry barriers protecting firm *i*, while γ_{i2} describes the effect of entry on $\pi^{s}_{i,t}$. The error term, $\mu_{i,t}$ is characterised as a normally distributed i.i.d. (independently and identically distributed) stochastic process with mean, E($\mu_{i,t}$) = 0 and variance, E($\mu^{s}_{i,t}$) = constant (Geroski, 1990).

Next, the threat of (actual and potential) entry and exit is assumed to depend on the standardised profits observed in the last period. The second structural equation can be written as follows:

$$E_{i,t} = \gamma_{i3}(\pi^{s}_{i,t-1} - \gamma_{i4}) + \varepsilon_{i,t} \qquad (5)$$

where $\gamma_{i3}, \gamma_{i4} > 0$.

The amount of entry attracted by a unit increase in excess profit (i.e. those profits that can be bid away) is measured by the parameter, γ_{i3}. According to Geroski (1990), this parameter reflects the number of potential entrants. The exogenous flow of entry or exit is captured in the white noise error term, $\varepsilon_{i,t}$ which is assumed to be independent of $\mu_{i,t}$.

Equations 4 and 5 cannot be estimated directly since the variable $E_{i,t}$ cannot be quantified. This unobservable variable can be eliminated by solving for the reduced form. Substituting Eq. 5 into Eq. 4, and rearranging yields again equation 2 where $\hat{\alpha}_i = (\gamma_{i0} - \gamma_{i1}\gamma_{i3}\gamma_{i4})$, $\hat{\lambda}_i = (\gamma_{i2} + \gamma_{i1}\gamma_{i3})$ and $\mu_{i,t} = (\mu_{i,t} + \gamma_{i1}\varepsilon_{i,t})$. Despite the fact that the model is built around an unobservable variable called 'threat of entry', Eq. 2 can be estimated with observable data, viz. firm level profit rates.

6.3.3 Empirical results and discussion

This section will firstly test the admissibility of the data. Secondly, the empirical results are reported and discussed.

6.3.3.1 Admissibility of data set

This study works with a relatively short time dimension of the data (see also Glen *et al.*, 2001). This is a disadvantage of time series with a short time dimension. Conversely, an advantage of a short time series is that the time series is less likely to be subject to the kinds of shocks that would change the profits dynamics of a firm (Cable & Mueller, 2008).

However, some econometric issues can arise. So, it is necessary to test the admissibility of the data. The analysis starts with the test whether the time series are stationary or not, then the lag structure of the equation is investigated and finally, the serial correlation of the disturbances in Eq. 2 are checked.

A first econometric issue in estimating Eq. 2 is stationarity. Empirical work based on times series data as in the analysis of the speed of adjustment of profitability assumes that the underlying time series is stationary. The existence of non-stationarity (or unit root) in the firm-level profitability series would indicate that shocks to profitability persist indefinitely and that competitive pressures never erode differences in profitability (Yurtoglu, 2004).

Studies testing for unit root mostly used the augmented Dickey-Fuller (ADF) test and the Phillips-Perron test (e.g. Glen *et al.*, 2001; Yurtoglu, 2004; Bektas, 2007). Both tests have a null hypothesis of a unit root process. Cable & Mueller (2008) concluded that the right null hypothesis for profits times series should be one of stationarity. Following these authors, here, stationarity is tested by using the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) procedure. The KPSS-test is an inverse of the Phillips-Peron test, so, it reverses the null (stationary) and alternative (non-stationary) hypothesis. An extra advantage of

this procedure is its robustness in small samples. The results of the KPSS test show that the times series were stationary[130].

The second econometric issue concerns the introduction of more lagged dependent variables to the right-hand side of Eq. 2. To decide on the appropriate lag structure, the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) were computed. Both criterion favored Eq. 2 above alternative higher order autoregressive models.

Testing for the presence of serial correlation is a third econometric issue. Before using an estimated equation for statistical inference (e.g. hypothesis tests), it is essential to examine the residuals for evidence of serial correlation. The Breusch-Godfrey LM test

[130] This study also applied a unit root test provided by Im et al. (2003) to the panel data which has time and cross-section dimension. The test is based on the average value of the Augmented Dickey–Fuller (ADF) statistics obtained for each of the individual firms' data. The result is equal to -2.7084 for the sample of 21 liner operators observed over the 2000 tot 2008 period. Since the calculated t-statistics is lower than the critical value of the standardised t-bar test at 5%level, the null hypothesis of non-stationary is rejected.

and the Ljung-Box Q-statistic were performed[131]. Both tests for serial correlation indicate that the residuals are not serially correlated and Eq. 2 should not be re-specified before using it for hypothesis tests.

6.3.3.2 Empirical results[132]

A point of interest during studying the empirical results is the different behaviour of independent carriers and liner operators involved in an alliance. Mediterranean Shipping Company (MSC – ranked 2nd), Hyundai Merchant Marine (HMM, member of The New World Alliance) and Evergreen[133] are not integrated in the sample. MSC does not report its financial results and the latter two carriers publish no disaggregated data (i.e. for their business segment 'container'). In addition, in the annual report 2008 the TUI group, former parent of Hapag-Lloyd (participate in the Grand Alliance) stopped to report disaggregated data. Therefore, the present study compares the empirical results of two independent Top 3 liner operators (i.e. CMA CGM and Maersk Line) with the CHKY alliance formed by COSCO, K-Line, Hanjin and Yang Ming Line.

A visual plot of data is usually the first step in the analysis of any time series. Appendix 6-4 sets out plots of the excess profit, $\pi_{i,t}^{s}$ for Maersk Line (ranked 1st) and CMA CGM (ranked 3rd) against time (left-hand panel). The right-hand panel of Appendix 6-4 plots their associated phase diagrams with $\pi_{i,t-1}^{s}$ on the horizontal axis and $\pi_{i,t}^{s}$ on the vertical axis. Both carriers are European-based and family-owned companies. Their growth is driven by mergers and acquisitions; and partly by organic growth (Sys, 2009). Maersk Line is part of the A.P. Møller-Maersk group which is engaged in a multitude of activities (e.g. liner shipping; tanker, offshore and other shipping operations; oil and gas activities, APM terminals). CMA CGM dates from the merger of CMA and CGM. Two separate entities in 1999. Maersk Line account for 52 % of group turnover whereas the container liner shipping division of CMA CGM accounts for +90 %.

The phase diagrams give a visual impression of the persistence category (Cable & Mueller, 2008). With two exceptions, Maersk's data points are situated in the first

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131 If there are lagged dependent variables on the right-hand side of the regression, the DW test is no longer valid.

132 The complete analysis is available from the author upon request.

133 Studying the behaviour of Evergreen would have been most interesting as this liner operator decided not to follow the trend of buying/ chartering ultra large container ships. Evergreen is now the only large operator with an empty order book. Will the present economic slowdown and the difficult situation of the liner business contributed to Evergreen's corporate strategy?

quadrant. The first quadrant corresponds with the scenario “profits are consistently above the norm”. The discomfort from PONL integration (2005) is observable in both graphs. Since, Maersk Line no longer has to absorb extra costs associated with the integration of P&O Nedlloyd, they turned back in the first quadrant. In the case of CMA CMG, the phase diagram indicates an evolution from below the norm (third quadrant) to above the norm. This might suggest that the acquisitions of CMA CGM were more successfully. In order to preserve space, the graphs of the members of the CHKY alliance are not reported. Except for Hanjin which strays occasionally into the other quadrants, the observations of the other members are located in the third quadrant, i.e. profits below the norm[134].

Turning to the formal analysis, separate regressions for each liner operator were estimated following Eq. 2. Estimation is carried out with the aid of E-views. The OLS estimates of Eq. 2 for CMA CGM, Maersk Line and the CHKY alliance are reported in Figure 6-11 (t-statistics in parentheses). Figure 6-11 is sorted in descending order of estimated $\hat{\lambda}_i$.

rank	liner operator	α_i	λ_i	$1-\lambda_i$	$\pi_{i,p}$
Top 3 liner operators					
3	CMACGM	0.01124	0.68231	0.31769	0.03536
		(0,8134)	(2,2579)	(1,0513)	(1,4964)
1	Maersk	0.01120	0.61205	0.38795	0.02886
		(0,9495)	(2,7154)	(1,7211)	(1,4525)
CHKY - alliance					
11	Kline	-0.01769	0.08035	0.91965	-0.01923
		(-1,0426)	(0,2551)		
7	COSCO	-0.02007	0.07100	0.92900	-0.02160
		(-0,4718)	(0,0545)		
15	YML	-0.06819	0.06179	0.93821	-0.07268
		(-2,6326)	(0,2447)		
9	Hanjin	-0.02491	-0.09550	1.09550	-0.02274
		(-3,1155)	(-0,4647)		
	average		0.02941		
Sample					
	strenght of persistence		0.19775		

Figure 6-11: Empirical results

[134] The observations of CCNI, COSCO, CSAV, NYK, Wan Hai Line and ZIM are located in the third quadrant. In contrast, the observations of MISC, RCL, OOCL (with one exception) and Matson (with two exceptions) are situated in the first quadrant. The other liner operators stray occasionally into the other quadrants.

Firm level PoP literature examines two forms of persistence, viz. short-run and long-run persistence (see Figure 6-10).

First, short-run persistence refers to the percentage of firm's standardised profit rate in any period before period *t* that remains in period *t*. The first order autocorrelation coefficient, $\hat{\lambda}_i$ can be interpreted as a measure of short run persistence of profit[135]. As reflected in Figure 6-11, the estimated $\hat{\lambda}_i$s are positive and significant for CMA CGM and Maersk Line. The closer $\hat{\lambda}_i$ is to one, the more rapidly liner operators' profits converge to their long-run level. In the case of CHKY, $\hat{\lambda}_i$ is close to zero, there is low persistence of profits. In other words, profits in year t do not depend largely on profits in year *t-1*. Regarding the low average value (i.e. 0.02941), no generalisation for all alliances can be formulated since there is no data for Hyundai Merchant Marine. Another thing to note is that the ranking of the liner operators (see column 2) differs from ranking based on market share (see column 1). Sorting for long-run persistence leads to another hierarchisation, viz. MISC, RCL, OOCL, CMA CGM and Maersk Line. This might be an indication that large operators give up profit to preserve their market share. Next, the $\hat{\lambda}_i$ s of the independent carriers are significantly larger than those of the members of the CHKY alliance. This leads us to the values of the speed of profit adjustment parameter, (1 - $\hat{\lambda}_i$) (see column 5). The expression (1 - $\hat{\lambda}_i$) is an estimate of the speed of erosion of short-run rents and indicates how quickly the profit rate $\pi_{i,}$ approaches its long-run equilibrium level $\pi_{i,p}$. On a longer time series, the lower value of (1- $\lambda_{i,t}$) for CMA CGM and Maersk Line would be interpreted as if it is more than likely that both carriers will earn abnormal profit the following year (Lipczynski *et al.*, 2005). Now it is difficult to formulate such statement, the financial and economic downturn might be indicated in future research as a structural break since some liner operators wrestle with cash flow problems and heavy expansion-induced debt burdens and announce substantially poorer financial results for 2009. Certainly and not surprisingly, the short-run rents of CMA CGM and Maersk Line erode slower. Conversely, if (1-$\hat{\lambda}_i$) is high, then the degree of persistence of past profits is also small and consequently short-run rents are quickly

[135] One side note urges: since the sample size is small, some caution is required for interpreting the estimated $\hat{\lambda}_i$ and accordingly, the estimated long-run profit rate. From theory, the least-squares estimate of an autoregressive model is known to be biased downward, when the sample size is small (Patterson, 2000). Adjusting for this bias, the mean of $\hat{\lambda}_i$ equals 0.2636. The adjusted $\hat{\lambda}_i$ still corresponds with low persistence.

eroded. Literature states that quick erosion is a sign of increased competition (Gschwandter, 2009). Another indication of quick erosion can be found, in common with previous studies, in the explanatory power of the regressions for $\hat{\lambda}_i$ which is quite low with a mean R^2 value of 0.15. Thus the transitory component of a firm's profit rate would not seem to require more than a year to be eliminated (Mueller,1986).

Secondly, the degree of variation in the long-run average standardised profit rates between liner operators is known as long-run persistence. $\pi_{i,p}$ is a measure of permanent rents which are not eroded by competitive forces. The long-run $\pi_{i,p}$ is calculated as $\hat{\alpha}_i / (1-\hat{\lambda}_i)$ (see Eq. 3). In the case of CMA CGM, a $\pi_{i,p}$ of 0.03536 implies that CMA CMG's profit to assets/ sales ratio (at container division) is on average permanently 3.5 % above the sample mean. In the left-hand panel of Appendix 6-4, the dashed horizontal line corresponds with the average of equilibrium value of $\pi_{i,p}$.

The sign of the parameter $\hat{\alpha}_i$ determines whether firm i's long-run averaged standardised profits is positive or negative. Together with Figure 6-10, the positive value of $\hat{\alpha}_i$ for CMA CGM and Maersk Line indicates that those liner operators earn returns above the competitive norm[136]. In the case of the CHKY alliance, there is an indication that the members earn returns below the competitive norm. This corresponds with the observations of the informal method. Except for APL and OOCL, a look at the sample teaches us that all liner operators participating in an alliance earn returns below the competitive norm. An interesting topic for future research.

To formally test the hypothesis that (potential and actual) entry into and exit from any market are sufficiently free to bring abnormal profits quickly into line with the competitive rate of return, would be to test whether $\pi_{i,p}$ differs significantly across firms. If $\pi_{i,p}$ equals zero for all i, one would accept the hypothesis that all long run rents are zero (Mueller, 1990; Lipzcynski *et al.*, 2005). If $\pi_{i,p} \neq 0$ for some liner operators, there is long run persistence, in the sense that these liner operators earn profits which tend to differ permanently from the average profitability of liner operators in general (see Figure 6-10). The Wald test is applied to test the significance of estimated 'permanent' profits or

136 The estimated value of $\hat{\alpha}_i$ is also positive for APL, CSCL, Horizon Line, Matson, MISC, OOCL and RCL.

'long-run projected profits', $\pi_{i,p}$. As reflected in Figure 6-11, $\pi_{i,p}$ is > 0 for CMA CGM and Maersk Line[137]; and $\pi_{i,p} < 0$ for the CHKY alliance. In the containerised liner shipping case, the empirical results suggest that the hypothesis can be rejected.

The aim of observing patterns in the times series variation of firm-level profit rate data was to draw interferences about entry and exit as well as whether barriers to entry exits. Goddard and Wilson (1996) state that "$\hat{\lambda}_i$ *summarises information on the extent to which high profits in the previous time period induces entry in the current period, the extent to which such entry affects profit in the current period and the extent to which such the firm would have be able to maintain its advantages in absence of entry*". The quick erosion of the short-run persistence indicates the existence of entry. The fact that some liner operators do earn long-run rents implies that barriers to entry and exit do exist (see Figure 6-10).

Finally, for the sample, the estimated $\hat{\lambda}_i$'s range from 0.68 to - 0.39 around a mean of 0.19775 (see bottom line of Figure 6-11). The values of $\hat{\lambda}_i$ are negative in 5 cases but of these none are statistically significant at the 5 % level. The average estimated value of $\hat{\lambda}_i$ of 0.19775 suggests relatively low persistence of profit. This result is significant lower than those obtained in other industries (see Lipczynski *et al.*, 2005; Gschwandtner, 2009).

6.4 Concluding remarks

Liner operators should know the entry and exit conditions of their industry, since both are powerful forces because they strongly influence behaviour. To this end, this paper studied both the (actual and potential) entry and exit.

This issue was translated into two research questions. First, the study addressed the question whether container liner operators can freely enter/ exit the containerised liner shipping industry. Secondly, the paper dealt with the question whether the competitive forces in the containerised liner shipping industry are sufficiently powerful to bring any abnormal profits (positive or negative) into line with the competitive rate of return. These two questions divided the paper in two parts.

In the opening part, firstly the industry dynamics were firstly examined. Next, the exit and entry as well as the entry and exit conditions were analysed for the selected trade

[137] This outcome also applies for APL, CSCL, Horizon Line, Matson and UASC. The remaining carriers know a $\pi_{i,p} < 0$.

route Belgium-India. Finally the dynamics at alliance level were observed at the three levels: the industry, the alliances and the trade level indicate the existence of actual entry/ exit. The trade study indicates that structural barriers exists but the extent of these barriers is moderate. Furthermore, the analysis reveals that established carriers need do nothing to discourage entry. No generalisation can be formulated for other trade routes.

Secondly, to model both actual and potential entry, this study adopted the growing persistence of profits literature. This literature observes firm-level profit outcomes over time to draw interferences about the nature of competition as both actual and potential entry are unobservable variables. In other words, the central idea is that profits should persist if there are impediments to the competitive dynamic (e.g. entry barriers). This methodology is applied to a panel of 21 liner operators observed over the period 2000-2008.

Estimation of the persistence of profits for the CLSI firstly reveals that the short-run persistence is significant higher for large independent carriers than liner operators involved in alliances. Secondly, it showed that the ranking short-run/ long-run persistence does not correspond with the ranking based on market shares. This finding might suggest that large carriers give up profit to preserve their market share. Thirdly, the hypothesis that (actual and potential) entry into and exit from any market are sufficiently free to bring any abnormal profits quickly into line with the competitive rate of return was tested. Since $\hat{\pi}_{i,p}$ does not equal zero for all liner operators i, the results for the CLSI imply that there is long-run persistence. In the containerised liner shipping case, the empirical results suggest that the hypothesis can be rejected. Last, the excess returns erode at a faster pace than other industries.

Finally, liner operators that persistently earn profits above the norm today should continue to do so in subsequent periods. An interesting suggestion for future research might be to examine whether the ‘persistence of profits’ would persist and to identify the determinants of the speed of profit adjustment.

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Appendix 6-1: Ranking and market shares

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
APL	10 2.64%	11 2.65%	7 4.58%	7 4.37%	6 4.32%	6 4.28%	6 4.04%	6 3.86%	7 3.96%	6 4.04%	7 3.83%	9 3.41%	8 3.60%	7 3.92%	5 4.42%
APM-Maersk	2 5.80%	1 6.67%	1 7.18%	1 8.34%	1 12.88%	1 13.25%	1 12.63%	1 12.93%	1 13.13%	1 13.21%	1 19.23%	1 17.53%	1 16.84%	1 16.49%	1 16.44%
China Shg C.L. (CSCL)					18 1.79%	17 2.10%	15 2.43%	14 2.41%	11 2.74%	10 3.30%	6 4.00%	6 4.04%	6 3.87%	8 3.63%	8 3.64%
Cho Yang			19 1.55%												
CMA CGM Group	20 1.46%	15 2.51%	14 2.42%	12 2.55%	12 2.55%	10 2.71%	8 3.41%	8 3.71%	5 4.56%	5 5.31%	3 5.87%	3 7.34%	3 7.99%	3 8.03%	3 8.29%
COSCO Container Lines	4 5.31%	5 5.42%	4 5.79%	5 5.01%	7 4.13%	7 3.93%	7 4.03%	7 3.79%	9 3.37%	9 3.60%	9 3.72%	7 3.89%	7 3.86%	6 3.98%	6 3.64%
CP Ships			18 2.24%	10 3.07%	9 2.94%	9 2.83%	11 2.72%	10 3.02%	12 2.70%	16 2.51%					
CSAV Group					20 1.45%	19 1.85%	19 1.60%	19 1.78%	17 2.13%	15 2.59%	13 2.70%	16 2.42%	17 2.23%	16 2.39%	18 2.64%
DSR-Senator	16 2.21%	19 2.04%													
Evergreen	3 5.74%	3 6.24%	2 6.04%	2 6.55%	3 6.59%	3 6.21%	3 6.21%	4 6.23%	3 6.49%	3 5.77%	4 5.52%	4 5.53%	4 5.55%	4 5.06%	4 4.49%
Hamburg-Süd Group						20 1.53%			18 2.03%	19 1.99%	17 2.13%	17 2.09%	15 2.47%	14 2.56%	15 2.50%
Hanjin	9 3.05%	7 3.73%	3 5.86%	4 5.14%	4 5.08%	4 4.93%	5 5.11%	5 4.84%	6 4.07%	7 3.69%	8 3.80%	8 3.48%	11 3.04%	11 3.00%	9 3.54%
Hapag-Lloyd	15 2.22%	14 2.61%	15 2.41%	17 2.21%	14 2.13%	15 2.22%	17 2.25%	16 2.25%	16 2.35%	17 2.47%	5 4.76%	5 4.57%	5 4.43%	5 4.03%	7 3.72%
Hyundai M.M.	19 1.82%	10 3.00%	11 2.79%	14 2.41%	15 2.12%	18 2.03%	14 2.49%	17 1.96%	20 1.85%	20 1.93%	18 1.71%	18 1.68%	18 1.76%	18 2.02%	16 2.21%
K Line	13 2.35%	17 2.25%	16 2.38%	15 2.33%	13 2.34%	12 2.60%	10 2.85%	11 2.85%	10 2.91%	12 2.70%	14 2.63%	13 2.69%	13 2.75%	13 2.58%	12 2.75%
Mediterranean Shg Co	12 2.43%	9 3.35%	9 4.00%	7 4.39%	5 4.66%	5 4.71%	4 5.41%	2 7.33%	2 7.65%	2 8.29%	2 9.06%	2 10.50%	2 10.89%	2 11.84%	2 11.96%
Mitsui-OSK L. (MOL)	6 3.88%	8 3.64%	10 3.11%	11 2.85%	10 2.82%	11 2.65%	13 2.55%	12 2.66%	13 2.69%	14 2.59%	11 2.79%	12 2.79%	12 2.95%	10 3.08%	11 2.75%
Nedlloyd	7 3.64%														
Neptune Orient Lines	18 2.00%	18 2.22%													
NYK	5 4.57%	6 4.06%	8 4.04%	9 3.62%	8 3.45%	8 3.26%	9 3.07%	9 3.27%	8 3.59%	8 3.63%	10 3.49%	10 3.31%	9 3.37%	9 3.45%	10 3.27%
OOCL	17 2.18%	16 2.35%	13 2.44%	18 2.01%	16 2.10%	14 2.46%	12 2.58%	15 2.40%	14 2.61%	11 2.84%	12 2.70%	11 2.97%	10 3.08%	12 2.93%	14 2.61%
P & O Nedlloyd		2 6.24%	5 5.59%	3 5.80%	3 5.83%	2 6.56%	2 6.79%	3 6.42%	4 5.94%	4 5.57%					
P & OCL	8 3.11%														
PIL (Pacific Int'l Line)							20 1.40%	20 1.55%			19 1.55%	19 1.43%	19 1.52%	19 1.52%	20 1.53%
SafMarine		20 1.60%	20 1.36%												
Sea-Land Service	1 5.90%	4 6.13%	6 5.50%	6 4.61%											
UASC			19 1.13%	19 1.51%										20 1.25%	19 1.58%
Wan Hai Lines			20 1.35%								20 1.32%	20 1.16%	20 1.23%		
Yang Ming Line	11 2.45%	12 2.64%	17 2.33%	16 2.23%	17 1.94%	16 2.15%	18 2.17%	18 1.87%	19 2.01%	18 2.36%	16 2.17%	14 2.53%	16 2.45%	15 2.43%	13 2.52%
Zim	14 2.29%	13 2.64%	12 2.65%	13 2.51%	11 2.75%	13 2.52%	16 2.32%	13 2.58%	15 2.53%	13 2.63%	15 2.33%	15 2.43%	14 2.48%	17 2.13%	17 2.46%

Appendix 6-2: Overview Belgium-India trade (1/6)

	ME-1			IPAK Europe-Indian subcontinent service			ISES Europe-Indian subcontinent service
Liner operator	Maerks Line			MSC			MSC
Type	FC			FC			FC
Antwerp				x			x
Zeebruges	x						
Trade Route	Eur-ME-IndSub-ME-Med-Eur			Eur-ME-IndSub-ME-Eur			
Type of Service	Mainline service			Mainline service			
Frequency	1 sailing a week			1 sailing a week			
Fixed Day	Yes			Yes			
Aug. 2007							
n° of ships	6			6			
	SEA-LAND NEW YORK	6252 TEU		MSC LUGANO	3032 TEU		
	SAFMARINE HIMALAYA	6252 TEU		MSC CARINA	3029 TEU		
	SEA-LAND WASHINGTON	6252 TEU		MSC BRIANNA	3014 TEU		
	SEA-LAND ILLINOIS	6252 TEU		MSC DYMPHNA	2918 TEU		
	MAERSK KOLKATA	6252 TEU		MSC NIKITA	2686 TEU		
	MAERSK KALAMATA	6252 TEU		MSC SOCOTRA	2258 TEU		
Shipboard Capacity		37512 TEU			16937 TEU		
av. speed	25,5			21			
av. dwt	81000			42500			
av. TEU	6252 TEU			2822 TEU			
rotation	42			42			
March 2008							
n° of ships	6			5			
	SEA-LAND NEW YORK	6420 TEU		MSC BENEDETTA	5060 TEU		
	MAERSK KOBE	6420 TEU		MSC BRIANNA	3268 TEU		
	SEA-LAND WASHINGTON	6420 TEU		MSC CARINA	3029 TEU		
	SEA-LAND ILLINOIS	6420 TEU		MSC LUGANO	3032 TEU		
	MAERSK KOLKATA	6416 TEU		MSC SOCOTRA	2258 TEU		
	MAERSK KALAMATA	6416 TEU					
Shipboard Capacity		38512 TEU			16647 TEU		
av. speed							
av. dwt	81094						
av. TEU	6418			3329			
rotation	42			42			
Service Partners	Slots-charter Safmarine						
Port/Transittime	**Port**	**Transit Time**		**Port**	**Transit Time**		
	Felixstowe	0	Fri	Felixstowe	0	Wed	
	Zeebrugge	2	Sun	Antwerp	2	Fri	
	Bremerhaven	4	Tue	Suez	10	Sat	
	Rotterdam	5	Wed	Port Mohammad Bin Qasim	18	Sun	
	Salalah	16	Sun	Mundra	20	Tue	
	Jebel Ali (Dubai)	19	Wed	Jawaharlal Nehru	23	Fri	
	Pipavav	22	Sat	Jeddah	28	Wed	
	Jawaharlal Nehru	25	Tue	Felixstowe	42	Wed	
	Jeddah	31	Mon				
	Malaga	38	Mon				
	Algeciras	39	Tue				
	Felixstowe	42	Fri				
N° of ports	12			8			
May 2008							
n° of ships	6			6			
	SEA-LAND NEW YORK*	6420 TEU		MSC DYMPHNA	2880 TEU		
	MAERSK KOBE*	6420 TEU		MSC BRIANNA	3268 TEU		
	SEA-LAND WASHINGTON*	6420 TEU		MSC CARINA	3029 TEU		
	SEA-LAND ILLINOIS*	6420 TEU		MSC LUGANO*	3032 TEU		
	MAERSK KOLKATA*	6416 TEU		MSC SOCOTRA*	2258 TEU		
	MAERSK KALAMATA*	6416 TEU		MSC NIKITA	2472 TEU		
Shipboard Capacity		38512 TEU			16939 TEU		
av. dwt	81094						
av. TEU	6418 TEU			2823 TEU			
rotation	42			42			
Service Partners	Slots-charter Safmarine						
Port/Transittime	**Port**	**Transit Time**		**Port**	**Transit Time**		
	Felixstowe	0	Fri	Felixstowe	0	Wed	
	Zeebrugge	2	Sun	Antwerp	2	Fri	
	Bremerhaven	4	Tue	Suez	10	Sat	
	Rotterdam	5	Wed	Port Mohammad Bin Qasim	18	Sun	
	Salalah	16	Sun	Mundra	20	Tue	
	Jebel Ali (Dubai)	19	Wed	Jawaharlal Nehru	23	Fri	
	Pipavav	22	Sat	Jeddah	28	Wed	
	Jawaharlal Nehru	25	Tue	Felixstowe	42	Wed	
	Jeddah	31	Mon				
	Malaga	38	Mon				
	Algeciras	39	Tue				
	Felixstowe	42	Fri				
N° of ports	12			8			

Appendix 6-2: Overview Belgium-India trade (2/6)

	MAERSK ME-1			MSC IPAK Europe-Indian subcontinent service			MSC ISES Europe-Indian subcontinent service
Aug. 2009							
n° of ships	7			6			
	MAERSK KALMAR	6990 TEU		MSC CAROUGE	4860 TEU		
	MAERSK KAMPALA	6802 TEU		MSC CATANIA	4741 TEU		
	MAERSK KIEL	6930 TEU		MSC INDEPENDENCE	5551 TEU		
	MAERSK KIMI	6990 TEU		MSC LIBERTY	5551 TEU		
	MAERSK KITHIRA	6802 TEU		MSC MARINA	6742 TEU		
	MAERSK KLAIPEDA	6990 TEU		MSC MICHAELA	6724 TEU		
	MAERSK KUSHIRO	6200 TEU					
Shipboard Capacity		47704 TEU			34169 TEU		
av. dwt							
av. TEU	6815 TEU			5695 TEU			
rotation	49			49			
Service Partners							
Port/Transittime	**Port**	**Transit Time**		**Port**	**Transit Time**		
	Felixstowe, GB	0	Sat	Felixstowe, GB	0	Thu	
	Zeebrugge, BE	1	Sun	Antwerp, BE	3	Sun	
	Bremerhaven, DE	2	Tue	Jeddah, SA	17	Sun	
	Rotterdam, NL	4	Thu	Salalah, OM	22	Fri	
	Aqaba, JO	14	Sun	Mundra, IN	26	Tue	
	Jebel Ali, AE	21	Sun	Nhava Sheva Jawaharlal Nehru, IN	29	Fri	
	Bandar Abbas, IQ	22	Tue	Gioia Tauro, IT	39	Mon	
	Jebel Ali, AE	25	Thu	Valencia, SP	42	Thu	
	Nhava Sheva Jawaharlal Nehru, IN	29	Mon	Felixstowe, GB	49	Thu	
	Pipavav, IN	31	Wed				
	Salalah, OM	34	Sat				
	Jeddah, SA	37	Tue				
	Algeciras, SP	44	Tue				
	Felixstowe, GB	49	Fri				
N° of ports	14			9			
Nov. 2009							
n° of ships	7			6			
	MAERSK KALMAR	6990 TEU		MSC CAROUGE	4860 TEU		
	MAERSK KAMPALA	6802 TEU		MSC CATANIA	4741 TEU		
	MAERSK KIEL	6930 TEU		MSC INDEPENDENCE	5551 TEU		
	MAERSK KIMI	6990 TEU		MSC LIBERTY	5551 TEU		
	MAERSK KITHIRA	6802 TEU		MSC MARINA	6742 TEU		
	MAERSK KLAIPEDA	6990 TEU		MSC MICHAELA	6724 TEU		
	MAERSK KUSHIRO	6200 TEU					
Shipboard Capacity		47704 TEU			34169 TEU		
av. dwt							
av. TEU	6815 TEU			5695 TEU			
rotation	49			49			
Service Partners	Safmarine						
	UASC (Sep 2009)						
Port/Transittime	**Port**	**Transit Time**		**Port**	**Transit Time**		
	Felixstowe, GB	0	Sat	Felixstowe, GB	0	Thu	
	Zeebrugge, BE	1	Sun	Antwerp, BE	3	Sun	
	Bremerhaven, DE	2	Tue	Jeddah, SA	17	Sun	
	Rotterdam, NL	4	Thu	Salalah, OM	22	Fri	
	Gioia Tauro,	14	Sun	Mundra, IN	26	Tue	
	Port Said	21	Sun	Nhava Sheva Jawaharlal Nehru, IN	29	Fri	
	Jebel Ali, AE	22	Tue	Gioia Tauro, IT	39	Mon	
	Nhava Sheva Jawaharlal Nehru, IN	25	Thu	Valencia, SP	42	Thu	
	Pipavav, IN	29	Mon	Felixstowe, GB	49	Thu	
	Salalah, OM	31	Wed				
	Jeddah, SA	34	Sat				
	Port Said	37	Tue				
	Algeciras, SP	44	Tue				
	Felixstowe, GB	49	Fri				
N° of ports	14			9			

Appendix 6-2: Overview Belgium-India trade (3/6)

	MAERSK ME-1			MSC IPAK Europe-Indian subcontinent service			MSC ISES Europe-Indian subcontinent service		
Feb. 2010									
n° of ships	7			6			7		
	MAERSK KALMAR	6990 TEU		MSC DISCOVERY	5711 TEU		HS LIVINGSTONE	4992 TEU	
	MAERSK KAMPALA	6788 TEU		MSC HIGHNESS	5711 TEU		SCI CHENNAI	4400 TEU	
	MAERSK KIEL	6673 TEU		MSC INDEPENDENCE	5711 TEU		SCI MUMBAI	4400 TEU	
	MAERSK KIMI	6673 TEU		MSC CONFIDENCE	5443 TEU		MSC MATILDE	4396 TEU	
	MAERSK KITHIRA	6788 TEU		MSC ELA	5050 TEU		MSC ANTWERP	3808 TEU	
	MAERSK KLAIPEDA	6788 TEU		MSC CATANIA	4953 TEU		MSC NORA	3014 TEU	
	MAERSK KUSHIRO	6478 TEU					SCI NEW DELHI	3534 TEU	
Shipboard Capacity		47178 TEU			32579 TEU			28544 TEU	
av. dwt	88203			67442			53695		
av. TEU	6740 TEU			5430 TEU			4078 TEU		
rotation	49			49			49		
Service Partners	Safmarine (slots)						S.C. India		
	UASC (slots)						K-Line (slots)		
Port/Transittime	**Port**	**Transit Time**		**Port**	**Transit Time**				
	Felixstowe, GB	0	Sun	Antwerp, BE	0	Sun	Hamburg, DE	0	Sun
	Zeebrugge, BE	1	Mon	Felixstowe, GB	2	Tue	Antwerp, BE	2	Thu
	Bremerhaven, DE	3	Wed	Jeddah, SA	12	Fri	Felixstowe, GB	3	Wed
	Rotterdam, NL	5	Fri	Salalah, OM	17	Wed	Port Said, EG	11	Thu
	Gioia Tauro, IT	12	Fri	Nhava Sheva Jawaharlal Nehru, IN	22	Mon	Jeddah, SA	14	Sun
	Port Said, EG	15	Mon	Mundra, IN	24	Wed	Colombo	22	Mon
	Jebel Ali, AE	17	Wed	Salalah, OM	28	Sun	Nhava Sheva Jawaharlal Nehru, IN	25	Thu
	Nhava Sheva Jawaharlal Nehru, IN	25	Thu	Jeddah, SA	33	Fri	Mundra, IN	28	Sun
	Pipavav, IN	29	Mon	Gioia Tauro, IT	39	Thu	Salalah, OM	31	Wed
	Salalah, OM	31	Wed	Valencia, SP	41	Sat	Port Said, EG	36	Mon
	Jeddah, SA	37	Tue	Antwerp, BE	49	Sun	Barcelona, SP	41	Sat
	Port Said, EG	40	Fri				Hamburg, DE	49	Sun
	Algeciras, SP	45	Wed						
	Felixstowe, GB	49	Sun						
N° of ports	14			11			12		

Appendix 6-2: Overview Belgium-India trade (4/6)

	EPIC Loop 1 (Europe Pakistan India Consortium)			IOS-1 Europe-Middle East-Pakistan-India service			IMEX (India-Middle East-Europe service)		
Liner operator	CMA CGM			Hapag Lloyd			CSAV-Norasia		
Type	FC			FC			FC		
Antwerp	x			x			x		
Zeebruges									
Trade Route	Eur-Med-ME-IndSub-Med-Eur			Eur-Med-ME-IndSub-Med-Eur			ME-IndSub-Med-Eur-Med-ME		
Type of Service	Mainline service			Mainline service			Mainline service		
Frequency	1 sailing a week			1 sailing a week			1 sailing a week		
Fixed Day	Yes			Yes			Yes		
Aug. 2007									
n° of ships	6						4		
	BAVARIA EXPRESS	4252 TEU					NORASIA BALKANS	3108 TEU	
	THURINGIA EXPRESS	4252 TEU					NORASIA TEGESOS	2890 TEU	
	CMA CGM NILGAI	4252 TEU					CSAV RIO MAIPO	2732 TEU	
	CMA CGM KINGSTON	4252 TEU					CSAV RIO LOA	2732 TEU	
	CMA CGM SAMBHAR	4043 TEU							
	MUMBAI EXPRESS	3987 TEU							
Shipboard Capacity		25038 TEU						11462 TEU	
av. speed	24,5						22		
av. dwt	51150						39500		
av. TEU	4173 TEU						2865 TEU		
rotation	42						42		
March 2008									
n° of ships	3			3			5		
	CMA CGM NILGAI	4253 TEU		BAVARIA EXPRESS	4051 TEU		CSAV TENO	2741 TEU	
	CMA CGM KINGSTON	4253 TEU		THURINGIA EXPRESS	4051 TEU		CSAV TUBUL	2741 TEU	
	CMA CGM SAMBHAR	4043 TEU		SAIGON EXPRESS	4253 TEU		NORASIA BALKANS	3108 TEU	
							NORASIA TEGESOS	2890 TEU	
							WADI ALRAYAN	3011 TEU	
Shipboard Capacity		12549 TEU			12355 TEU			14491 TEU	
av. speed	24,5								
av. dwt	51421						38988		
av. TEU	4183			4118			2898		
rotation	42			42			42		
Service Partners	Slot-charter ANL Container Line Pty Ltd								
	Partner CMA CGM SA			Partner CMA CGM SA					
	Partner Hamburg Süd			Partner Hamburg Süd					
	Partner Hapag-Lloyd AG			Partner Hapag-Lloyd AG					
	Partner MacAndrews & Co Ltd			Partner MacAndrews & Co Ltd					
Port/Transittime	**Port**	**Transit Time**		**Port**	**Transit Time**		**Port**	**Transit Time**	
	Tilbury	0	Tue	Tilbury	0	Tue	Jebel Ali (Dubai)	0	Wed
	Hamburg	2	Thu	Hamburg	2	Thu	Mundra	3	Sat
	Antwerp	4	Sat	Antwerp	4	Sat	Jawaharlal Nehru	5	Mon
	Malta	10	Fri	Marsaxlokk	10	Fri	Port Said	13	Tue
	Port Said	12	Sun	Port Said	12	Sun	Antwerp	21	Wed
	Jebel Ali (Dubai)	19	Sun	Jebel Ali (Dubai)	19	Sun	Hamburg	23	Fri
	Mundra	22	Wed	Mundra	22	Wed	Felixstowe	25	Mon
	Jawaharlal Nehru	24	Fri	Jawaharlal Nehru	24	Fri	Port Said	34	Thu
	Damietta	33	Sun	Damietta	33	Sun	Jebel Ali (Dubai)	42	Wed
	Malta	36	Wed	Marsaxlokk	36	Wed			
	Tilbury	42	Tue	Tilbury	42	Tue			
N° of ports	11			11			9		
May 2008									
n° of ships	3			4			4		
	CMA CGM NILGAI*	4253 TEU		BAVARIA EXPRESS	4051 TEU		CSAV TENO*	2741 TEU	
	CMA CGM KINGSTON*	4253 TEU		THURINGIA EXPRESS	4051 TEU		CSAV TUBUL*	2741 TEU	
	CMA CGM SAMBHAR*	4043 TEU		LIVERPOOL EXPRESS*	4253 TEU		NORASIA BALKANS*	3108 TEU	
				MUMBAI EXPRESS*	4038 TEU		NORASIA TEGESOS*	2890 TEU	
Shipboard Capacity		12549 TEU			16393 TEU			11480 TEU	
av. dwt	51421								
av. TEU	4183						2870 TEU		
rotation	42			42			42		
Service Partners	Slot-charter ANL Container Line Pty Ltd			Partner Hamburg Süd					
	Partner CMA CGM SA			Partner Hapag-Lloyd AG					
	Partner MacAndrews & Co Ltd								
Port/Transittime	**Port**	**Transit Time**		**Port**	**Transit Time**		**Port**	**Transit Time**	
	Tilbury	0	Tue	Tilbury	0	Tue	Jebel Ali (Dubai)	0	Wed
	Hamburg	2	Thu	Hamburg	2	Thu	Mundra	3	Sat
	Antwerp	4	Sat	Antwerp	4	Sat	Jawaharlal Nehru	5	Mon
	Malta	10	Fri	Marsaxlokk	10	Fri	Port Said	13	Tue
	Port Said	12	Sun	Port Said	12	Sun	Antwerp	21	Wed
	Jebel Ali (Dubai)	19	Sun	Jebel Ali (Dubai)	19	Sun	Hamburg	23	Fri
	Mundra	22	Wed	Mundra	22	Wed	Felixstowe	25	Mon
	Jawaharlal Nehru	24	Fri	Jawaharlal Nehru	24	Fri	Port Said	34	Thu
	Damietta	33	Sun	Damietta	33	Sun	Jebel Ali (Dubai)	42	Wed
	Malta	36	Wed	Marsaxlokk	36	Wed			
	Tilbury	42	Tue	Tilbury	42	Tue			
N° of ports	11			11			9		

Appendix 6-2: Overview Belgium-India trade (5/6)

	EPIC Loop 1 (Europe Pakistan India Consortium)		IOS-1 Europe-Middle East-Pakistan-India service		IMEX (India-Middle East-Europe service)	
Aug. 2009						
n° of ships	8		6			
	CMA CGM AZURE	4250 TEU	BAVARIA EXPRESS	4051 TEU		
	CMA CGM CORAL	4300 TEU	THURINGIA EXPRESS	4051 TEU		
	CMA CGM JADE	4250 TEU	JAKARTA EXPRESS	4253 TEU		
	CMA CGM ONYX	4250 TEU	SAIGON EXPRESS	4253 TEU		
	CMA CGM QUARTZ	4300 TEU	Cap Gabriel (Hamburg Süd)	4294 TEU		
	CMA CGM TURQUOISE	4300 TEU	Cap George (Hamburg Süd)	4294 TEU		
	HANJIN LISBON	5752 TEU				
	Ville d'Orion	3961 TEU				
Shipboard Capacity		35363 TEU		25196 TEU		
av. dwt	51421					
av. TEU	4183 TEU					
rotation	42		42			
Service Partners	Slot-charter ANL Container Line Pty Ltd		Partner Hamburg Süd			
	Partner CMA CGM SA		Partner Hapag-Lloyd AG			
Port/Transittime	**Port**	**Transit Time**	**Port**	**Transit Time**	**Port**	**Transit Time**
	Southampton, GB	0 Fri	Hamburg, DE	0 Fri		
	Hamburg, DE	2 Sun	Tilbury, GB	2 Sun		
	Rotterdam, NL	4 Mon	Antwerp, BE	4 Tue		
	Antwerp, BE	5 Wed	Cagliari, IT	10 Mon		
	Le Havre, FR	8 Thu	Jebel Ali, AE	19 Wed		
	Port Said, EG	17 Sat	Port Muhammad Bin Qasim Karachi, PK	22 Sat		
	Djibouti, DJ	22 Sun	Mundra, IN	24 Mon	March 2009: Rotterdam replaces Antwerp	
	Jebel Ali, AE	27 Mon	Nhava Sheva Jawaharlal Nehru, IN	26 Wed		
	Port Muhammad Bin Qasim Karachi, PK	30 Wed	Cagliari, IT	36 Sat		
	Nhava Sheva Jawaharlal Nehru, IN	32 Sat	Hamburg, DE	42 Fri		
	Mundra, IN	35 Wed				
	Djibouti, DJ	40 Fri				
	Jeddah, SA	44				
	Malta - Marsaxlokk, MT	48				
	Tangier Med, MA	52				
	Southampton, GB	55				
N° of ports	16		10			
Nov. 2009						
n° of ships	8		6			
	CMA CGM AZURE	4250 TEU	BAVARIA EXPRESS	4051 TEU		
	CMA CGM CORAL	4300 TEU	THURINGIA EXPRESS	4051 TEU		
	CMA CGM JADE	4250 TEU	JAKARTA EXPRESS	4253 TEU		
	CMA CGM ONYX	4250 TEU	SAIGON EXPRESS	4253 TEU		
	CMA CGM QUARTZ	4300 TEU	Cap Gabriel (Hamburg Süd)	4294 TEU		
	CMA CGM TURQUOISE	4300 TEU	Cap George (Hamburg Süd)	4294 TEU		
	HANJIN LISBON	5752 TEU				
	Ville d'Orion	3961 TEU				
Shipboard Capacity		35363 TEU		25196 TEU		
av. dwt	51421					
av. TEU	4183 TEU		4199 TEU			
rotation	42		42			
Service Partners	Slot-charter ANL Container Line Pty Ltd		Partner Hamburg Süd			
	Partner CMA CGM SA		Partner Hapag-Lloyd AG			
Port/Transittime	**Port**	**Transit Time**	**Port**	**Transit Time**	**Port**	**Transit Time**
	Southampton, GB	0 Fri	Hamburg, DE	0 Fri		
	Hamburg, DE	2 Sun	Tilbury, GB	2 Sun		
	Rotterdam, NL	4 Mon	Antwerp, BE	4 Tue		
	Antwerp, BE	5 Wed	Cagliari, IT	10 Mon		
	Le Havre, FR	8 Thu	Jebel Ali, AE	19 Wed		
	Port Said, EG	17 Sat	Port Muhammad Bin Qasim Karachi, PK	22 Sat		
	Djibouti, DJ	22 Sun	Mundra, IN	24 Mon		
	Jebel Ali, AE	27 Mon	Nhava Sheva Jawaharlal Nehru, IN	26 Wed		
	Port Muhammad Bin Qasim Karachi, PK	30 Wed	Cagliari, IT	36 Sat		
	Nhava Sheva Jawaharlal Nehru, IN	32 Sat	Hamburg, DE	42 Fri		
	Mundra, IN	35 Wed				
	Djibouti, DJ	40 Fri				
	Jeddah, SA	44				
	Malta - Marsaxlokk, MT	48				
	Tangier Med, MA	52				
	Southampton, GB	55				
N° of ports	16		10			

Appendix 6-2: Overview Belgium-India trade (6/6)

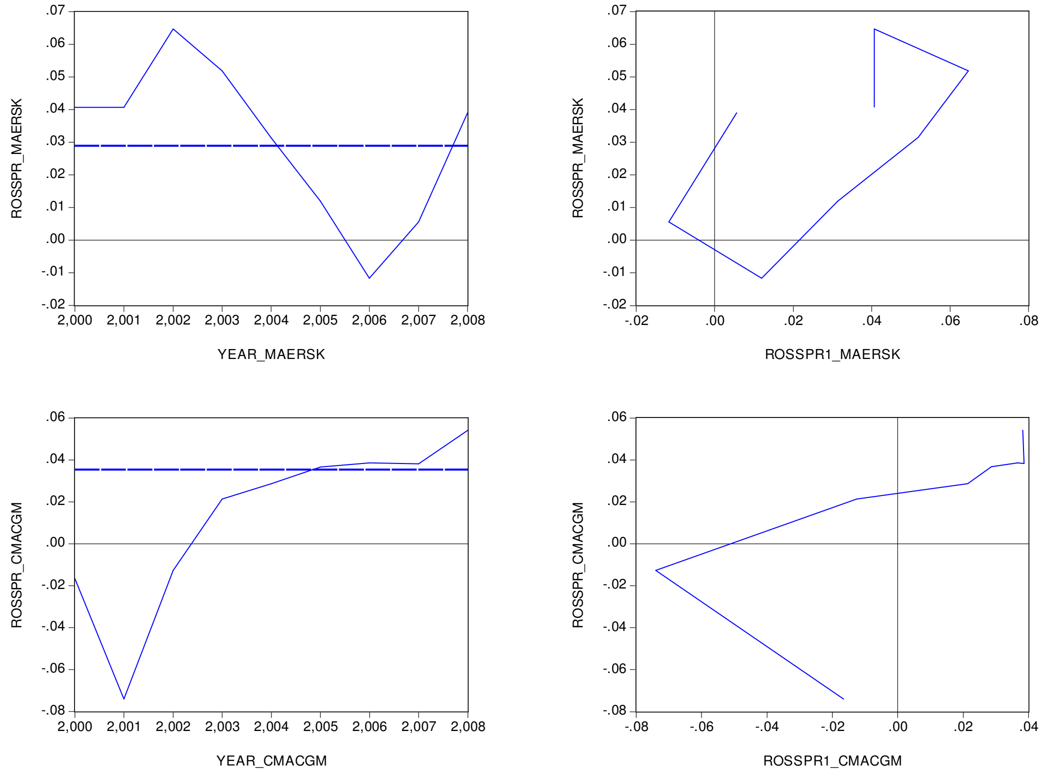
	EPIC Loop 1 (Europe Pakistan India Consortium)		IOS-1 Europe-Middle East-Pakistan-India service		IMEX (India-Middle East-Europe service)	
Feb. 2010						
n° of ships	8		7		7 TEU	
	CMA CGM AZURE	4250 TEU	BAVARIA EXPRESS	4252 TEU	CSAV APPENNINI	4800 TEU
	CMA CGM CORAL	4308 TEU	THURINGIA EXPRESS	4252 TEU	CSAV PYRENEES	4800 TEU
	CMA CGM JADE	4250 TEU	JAKARTA EXPRESS	4250 TEU	CSAV JURA	4800 TEU
	CMA CGM ONYX	4250 TEU	SAIGON EXPRESS	4250 TEU	CSAV CANTABRIAN	4800 TEU
	CMA CGM QUARTZ	4308 TEU	MANILA EXPRESS	4250 TEU	HS BEETHOVEN	4389 TEU
	CMA CGM TURQUOISE	4308 TEU	Cap Gabriel (Hamburg Süd)	4298 TEU	MARE PHOENICIUM	4038 TEU
	CMA CGM JAMAICA	4298 TEU	Cap George (Hamburg Süd)	4298 TEU	PAGO	3534 TEU
	Ville d'Orion	3961 TEU				
Shipboard Capacity		33933 TEU		29850 TEU		31161 TEU
av. dwt	51421				58159 TEU	
av. TEU	4242 TEU		4264 TEU		4452 TEU	
rotation	56		42		49	
Service Partners			Partner Hamburg Süd UASC (slots)			
Port/Transittime	**Port**	**Transit Time**	**Port**	**Transit Time**	**Port**	**Transit Time**
	Southampton, GB	0 Sun	Hamburg, DE		Rotterdam, NL	
	Rotterdam, NL	1 Mon	Tilbury, GB		Hamburg, DE	
	Hamburg, DE	2 Wed	Antwerp, BE		Felixstowe, GB	
	Antwerp, BE	5 Fri	Tangier		Antwerp, BE	
	Le Havre, FR	8 Mon	Cagliari, IT		Port Said, EG	
	Port Said, EG	17 Thu	Jebel Ali, AE		Jebel Ali, AE	
	Salalah, OM	24 Thu	Port Muhammad Bin Qasim Karachi, PK		Karachi, PK	
	Jebel Ali, AE	27 Sun	Mundra, IN		Mundra, IN	
	Port Muhammad Bin Qasim Karachi, PK	30 Wed	Nhava Sheva Jawaharlal Nehru, IN		Mumbai-Nhava Sheva, IN	
	Nhava Sheva Jawaharlal Nehru, IN	32 Fri	Cagliari, IT		Port Said, EG	
	Mundra, IN	35 Mon	Hamburg, DE		Barcelona, SP	
	Salalah, OM	38 Thu			Rotterdam, NL	
	Djibouti, DJ	41 Sun				
	Malta - Marsaxlokk, MT	48 Sun				
	Tangier Med, MA	52 Wed				
	Southampton, GB	55 Sat				
N° of ports	16		11		12	

Appendix 6-3: Formation of alliances

Period 1/Operational agreements on one trade					
1994	Hapag Lloyd	Nedlloyd	Cosco	DSR-Senator	Alliances were not a new phenomenon. Before 1995, these operational agreements already existed but they were of a limited scope or only active on one trade (indicated by different colours).
	NYK	CGM		Cho Yang	
	MOL	MISC	*ACE consortium*		
			K-Line	Hanjin	
	Hapag Lloyd	OOCL	NOL		
	NYK	APL	OOCL	DSR-Senator	
	NOL			Cho Yang	
			Cosco		
				Hanjin	
			MOL		
			K-Line		
			HMM		
			Norasia		
			Yang Ming Line		
			HMM		
			Yang Ming Line		
Period 2/Formation of alliances					
1996	**Grand Alliance**	**Global Alliance**		**Tricon consortium**	
	Hapag Lloyd	APL	Cosco	DSR-Senator	The first cooperation was the Global Alliance, formed by APL, MOL, OOCL and Nedlloyd (with side arrangements with MISC).
	NYK	MOL		Cho Yang	
	NOL	OOCL		Hanjin	
	P&OCL	Nedlloyd	K-Line		
		MISC	Yang Ming Line		
			HMM		
1997	**Grand Alliance**	**Global Alliance**		**Tricon consortium**	
	Hapag Lloyd	APL	Cosco	DSR-Senator	Merger to form P&O Nedlloyd. P&O Nedlloyd choses for the Grand Alliance
	NYK	MOL	K-Line	Cho Yang	
	OOCL	OOCL	Yang Ming Line	Hanjin	
	P&O Nedlloyd	(P&O Nedlloyd)	HMM	UASC	
		MISC			Tricon consortium renamed in United Alliance (incl. loose agreement with UASC)
1998	**Grand Alliance II**	**New World Alliance**	**CKY Alliance**	**United Alliance**	Newly merged NOL/ APL opt to join the restructured Global Alliance.
	Hapag Lloyd	APL/ NOL	Cosco		
	NYK	MOL	K-Line	Cho Yang	As OOCL was not included in the new Global Alliance (later on renamed into The New World Alliance (TNWA)), it became a participant in the Grand Alliance (GA).
	OOCL	HMM	Yang Ming Line	Hanjin-Senator	
	P&O Nedlloyd			UASC	
	MISC[(1)]				MISC chose also to join the GA while Hyundai Merchant Marine (HMM) opted to participate in TNWA.
Period 3					
2001	**Grand Alliance II**	**New World Alliance**	**CKHY Alliance**	**United Alliance**	Creation of a fourth alliance, the Sino-Japanese Alliance (nowadays know as the CHKY-
	Hapag Lloyd	APL/ NOL	Cosco		
	NYK	MOL	K-Line	Cho Yang	Cho Yang went bankrupt
	OOCL	HMM	Yang Ming Line	Hanjin-Senator	
	P&O Nedlloyd		Hanjin-Senator	UASC	Hanjin also represents Senator Line [(2)]
	MISC				
2003	**Grand Alliance II**	**New World Alliance**	**CKHY Alliance**		
	Hapag Lloyd	APL/ NOL	Cosco		
	NYK	MOL	K-Line		
	OOCL	HMM	Yang Ming Line		
	P&O Nedlloyd		Hanjin-Senator		
	MISC		UASC		
2005	**Grand Alliance III**	**New World Alliance**	**CKHY Alliance**		May 2005: merger of Maersk Sealand and P&O Nedlloyd
	Hapag Lloyd (CP Ships)	APL/ NOL	Cosco		
	NYK	MOL	K-Line		
	OOCL	HMM	Yang Ming Line		August 2005: acquisition of CP Ships by Hapag-Lloyd
	MISC		Hanjin-Senator		
Period 4					
2007	**Grand Alliance III**	**New World Alliance**	**CKHY Alliance**		Name CP Ships dropped
	Hapag Lloyd (5)	APL/ NOL (9)	Cosco (7)		
	NYK (10)	MOL (12)	K-Line (13)		
	OOCL (11)	HMM (18)	Yang Ming Line (14)		
	MISC (22)		Hanjin-Senator (8)		
2010	**Grand Alliance IV**	**New World Alliance**	**CKHY Alliance**		A new period will start on January 1, 2010. On 15 May 2009 MISC Bhd, participating solely in the Europe-Far East trades, announced that it would withdraw from the Grand Alliance
	Hapag Lloyd	APL/ NOL	Cosco		
	NYK	MOL	K-Line		
	OOCL	HMM	Yang Ming Line		
			Hanjin		
	MISC				

(1) MISC only participate in the Europe-Far East Trade
(2) Senator Line went bankrupt in 2009

Appendix 6-4: Profit time series



Chapter 7

7 In search of the link between ship size and operations

Abstract[138]

Since the 1990s the liner shipping industry has faced a period of restructuring and consolidation, and been confronted with a continuing increase in the container vessel scale. The impact of these changes is noticeable in trade patterns, cargo handling methods and shipping routes, in short ‘operations’. After listing the factors influencing size, growth in container ship size is explained by the economies of scale in deploying larger vessels. In order to quantify the economies of scale, this paper uses the liner service cash flow model. A novelty in the model is the inclusion of +6,000-20-foot Equivalent Unit (TEU) vessels and the distinction in costs between single and twin propeller units on ships. The results illustrate that scale economies have been - and will continue to be - the driving force behind the deployment of larger container vessels. The paper then assesses the link between ship size and operations, given the current discussion about the increase in container vessel scale. It is found that (a) ship size and operations are linked; (b) optimal ship size depends on transport segment (deep-sea vs. short-sea shipping, SSS), terminal type (transhipment terminals vs. other terminals), trade lane (East-West vs. North-South trades) and technology; and (c) a ship optimal for one trade can be suboptimal for another.

Keywords:

Container liner shipping, containership size, container operations, economies of scale

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[138] The paper is published in Transportation Planning and Technology, 2008, 31(4), 435 – 463.This chapter is joint work with Prof.dr. E. Omey, Prof. dr. E. Van de Voorde, Prof. dr. G. Blauwens and Prof. dr. F. Witlox. The authors wish to thank the editor-in-chief for his comments, and acknowledge the anonymous referees for their constructive criticism and helpful suggestions that contributed to the overall quality of this paper. All remaining errors are the responsibility of the authors.

7.1 Introduction

History tells us that the liner shipping industry has been characterised by a number of profound changes, starting from the introduction of the container box in the early 1960s, the set-up of consortia and other operational agreements (1970 - 1980), and in the 1990s, the formation of (global) alliances. These alliances have made it financially possible to deploy bigger ships which, in turn, allow the economies of scale associated with such vessels (Ham, 2004; Stopford, 2004; European Commission, 2005; UNCTAD, various editions). The planned abolition of the European conferences in October 2008 puts the liner shipping industry on the threshold of a new era.

The maritime landscape, which plays a vital role in the industrial and economic development, was redesigned by successive waves of consolidation. The first consolidation in the liner shipping industry took place around 1995. Ten years later a second consolidation round started. In Mid-June 2005 the liner shipping industry was shaken up by the takeover of Royal P&O Nedlloyd by Maersk Sealand (since then known as Maersk Line). No doubt this merger will redesign the liner shipping industry and inevitably provoke others to follow, as can already be noted (Fossey, 1990; Brooks, 2000; Containerisation International, various editions). After all, liner shipping is an example of the oligopolistic market where interdependence is a key feature (Lipczynski et al, 2005). The question becomes: 'Will the trend towards mega concerns affect the operations of liner shipping companies? If so, how?'.

The focus of this paper is to examine from an economic point of view the way ship size is linked with operations. The paper is divided into four sections. In Section 7.1 the market configuration is explained. The next two Sections focus on the concept 'Optimal ship size' and 'Optimal operations' respectively. Section 7.4 outlines the link between both concepts. Finally, conclusions are drawn in Section 7.5.

7.2 Market configuration

Firstly, the world's pure cellular fleet capacity (or the capacity of container ships fitted throughout with fixed or portable cell guides for the carriage of containers, OECD Glossary of Statistical Terms) as at January 1st, 2008 was assessed at 4,312 vessels with a total nominal capacity of about 11 million 20-foot Equivalent Unit (TEU) (BRS, 2008). Assuming all vessels are delivered as contracted and with the sustained minimum scrapping taking place, this carrying capacity is forecasted to increase by another 15.18 %

during 2009, 14.00 % during 2010, 13.71 % during 2011 and by 8.59 % by 2012 (see Figure 7-1, Figures refer to January 1st of each year. The figures for the period 2009 to 2012 have been derived from the order book. As liner operators can still book orders for delivery in 2010, the figures for the period 2010 to 2012 are not definitive yet). The 10 million-TEU barrier was overstepped in 2007.

year	number of ships	index	carrying capacity (TEU)	index	growth %	average ship size
1988	1,151	100	1,503,244	100		1,306
…						
1998	2,332	203	3,875,130	258		1,662
1999	2,512	218	4,296,511	286	10.87%	1,710
2000	2,611	227	4,525,919	301	5.34%	1,733
2001	2,735	238	4,936,737	328	9.08%	1,805
2002	2,892	251	5,540,085	369	12.22%	1,916
2003	3,033	264	6,125,493	407	10.57%	2,020
2004	3,174	276	6,667,758	444	8.85%	2,101
2005	3,347	291	7,318,184	487	9.75%	2,186
2006	3,606	313	8,258,608	549	12.85%	2,290
2007	3,943	343	9,587,306	638	16.09%	2,431
2008	4,312	375	10,921,474	727	13.92%	2,533
2009	4,798	417	12,579,049	837	15.18%	2,622
2010	5,240	455	14,340,308	954	14.00%	2,737
2011	5,600	487	16,306,339	1085	13.71%	2,912
2012	5,788	503	17,706,885	1178	8.59%	3,059

Figure 7-1: Evolution of the cellular fleet 1988-2010

Secondly, we zoom in on the evolution of the world container fleet over two decades (see Figure 7-1 - compiled with data from BRS, 2008 and Drewry Shipping Consultants, 2005). While the number of ships grew by a factor of five, the carrying capacity (TEU) increased at twice that rate. In combination these two aspects show that the average ship size increased from about 1,306 TEUs at the end of the 1980s up to 2,533 TEUs (2008). Consultancy reports confirm that this trend of increased average ship size will continue. The trend forecast suggests that the average size will move to about 3,300 TEUs in ten years' time (Drewry Shipping Consultants, 2005).

Cellular ships deliveries				
Range \ Year	2008	2009	2010	2011
<1,000	97	53	11	0
1,000 - 2,999	208	150	101	40
3,000 - 5,099	103	138	98	44
5,100 - 7,499	48	44	47	12
7,500 - 10,499	46	35	66	33
> 10,500	6	22	37	59
TOTAL	508	442	360	188

Figure 7-2: Number of ships newly deployed

In detail, Figure 7-2 illustrates the distribution by size range of the newly delivered ships in the respective years (BRS, 2008). While in 1995, nine new vessels were deployed with a capacity in the size range of 5,001-6,000 TEUs, a decade later, 76 vessels were delivered with a capacity of over 5,000 TEUs. Although the smallest size segments still account for the largest share, a shift towards larger ships is noticeable. Looking at the cellular ship deliveries for the period 2008 to 2011, one can conclude that this trend will continue (see Figure 7-3) (BRS, 2008).

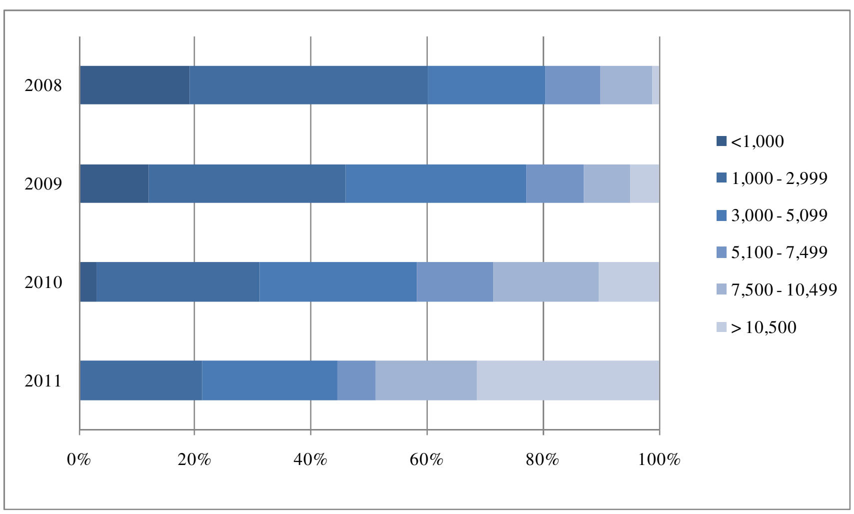

Figure 7-3: Cellular ship deliveries

Ultimately, the container liner shipping industry is currently undergoing a period of unprecedented structural growth, in terms of both volume and ship size. Figure 7-4 shows the evolution of the biggest ships (listed by TEU) in the world, the information about the owner and the characteristics of the ship (i.e. length over all (length o.a.), beam, draught, TEU, Gross Register Ton (GRT), and Deadweight Tonnage (DWT) (Compiled with data from www.answer.com and information from liner operators).

Built	Name	Length o.a	Beam (m)	Beam (TEU)	Draught	TEU	GRT	DWT	Owners
2006	Emma Maersk	394,00 m	56,40 m	17 (22)	16.00 m	11,000 (13,460)	n.n.	173000	Maersk Line/ Denmark
2006	COSCO Guangzhou	350,00 m	45,60 m	17	15.00 m	9,580	105,000	115,000	China Shipping Container Lines/ China
2005	MSC Pamela	336.70 m	45.60 m	18	15.00 m	9,200	107,849	109,600	MSC/ Switzerland
2004	CSCL Europe	334.00 m	42.80 m	17	14.50 m	8,468	90,465	101,612	China Shipping Container Lines/ China
2003	OOCL Shenzhen	322.97 m	42.80 m	17	14.50 m	8,063	89,097	99,518	OOCL/ Hongkong
2003	Axel Maersk	352.10 m	42.80 m	17	15.02 m	7,226 (8,650)	93,496	109,000	Maersk Sealand/ Denmark
1997	Sovereign Maersk	346.98 m	42.80 m	17	14.50 m	6,600 (8,050)	91,500	104,690	Maersk Line/ Denmark
1996	Regina Maersk	318.24 m	42.80 m	17	14.00 m	6,000 (7,048)	81,488	82,135	Maersk Line/ Denmark
1995	OOCL Hongkong	276.02 m	40.00 m	16	14.00 m	5,344	66,046	67,637	OOCL/ Hongkong
1991	Hannover Express	294.00 m	32.30 m	13	13.50 m	4,639	53,783	67,686	Hapag-Lloyd/ Germany
1988	Marchen Maersk	294.12 m	32.22 m	13	11.00 m	4,300	53,600	60,639	Maersk Line/ Denmark
1984	Louis Maersk	270.00 m	32.30 m	13	11.00 m	3,390 (3,700)	43,392	53,395	Maersk Line/ Denmark
1981	Frankfurt Express	287.73 m	32.28 m	13	13.06 m	3,430	57,540	51,540	Hapag-Lloyd/ Germany
1972	Hamburg Express	287.70 m	32.20 m	13	12.04 m	3,010	58,088	47,995	Hapag-Lloyd/ Germany
1972	Tokyo Bay	289.32 m	32.26 m	13	13.00 m	2,961	58,889	47,462	OCL then P&O/ GB
1971	Kamakura Maru	261.00 m	32.20 m	13	12.00 m	2,500	51,069	35,737	NYK/ Japan
1970	Sydney Express	217.00 m	30.58 m	12	11.58 m	1,665	27,407	33,350	Hapag-Lloyd/ Germany
1969	Encounter Bay	227.31 m	30.56 m	12	9.00 m	1,572	28,800	28,794	OCL then P&O/ GB
1968	Hakone Maru	187.00 m	26.00 m	10	9.00 m	752	10,423	14,745	NYK/ Japan

Figure 7-4: The biggest ships (listed by TEU) in the world

The impressive size growth – particularly during the last decade - is astonishing, especially when compared with the preceding period of 25 years. In the latter period (1970-1995) the vessel size tripled, while during the last 10 years it almost doubled.

The official number of TEU is not necessarily the same as the nominal number of TEU the ship can carry. In the column of the TEU characteristics in Figure 7-4, the nominal values between brackets can be noted. Maersk Line for instance does not quote the TEU capacity of its ships in the same way as the other liner shipping operators do. Maersk Line quotes the maximum load capacity of their ships in terms of filled TEUs with a 14 tonne load (tare weight included). This will always result in a smaller TEU capacity than the true TEU capacity (i.e. the ship MS 'Axel Maersk' most likely has a capacity of 8,650 TEU instead of the reported 7,226 TEU).

Assuming that a 13,500-TEU vessel is soon to be deployed, how does this reflect on the problematic nature of draught and accessibility of ports (see Section 7.3)? Further research yields the following explanation: a containership cannot transport its nominal capacity, even if we are talking about empty containers. A hypothetical example illustrates this point: suppose all 20-foot containers are filled with sand, and each container loaded up to a weight of 18t + 2t (weight of the container) or 20t. Multiplying the weight by the number of slots, viz. 9,580 TEUs, equals 191,600t, which exceeds the deadweight of the ship (115,000t - see Figure 7-4). Starting from its deadweight and using the Maersk Line rule of thumb, a 9,580 vessel could transport about 8,214 TEUs loaded (115,000t/ 14t).

Linking weight with trade lane, vessels on the Far East/ Europe trade lane are fully loaded by TEU and not by weight. On the contrary, the African trade lane is characterised by heavy cargo (e.g. chemicals,...), so here the vessels are fully loaded by weight and not on slot capacity.

Besides the characteristics of cargo, the commercial aspect also plays an important role. In a very competitive environment on the one hand and with the forecasted risk of overcapacity on the other, it will become hard to sell all slots of these larger vessels. We can cautiously conclude that the problem of accessibility of ports is not an issue yet, as vessels are seldom fully loaded by weight and, in addition, main ports respond largely by intensive dredging investments (see Section 7.3).

The shift towards larger ships seems to continue, possibly even up to 18,000 TEUs (known as the Malacca-max vessels which refers to the maximum size and draught to transit the Strait of Malacca, a vital part of the Asia trade route). Although it is not clear if and when an 18,000-TEU containership with an allowable draught will be built, it is fairly certain that the recent surge in vessel size will not stop at the barrier of 11,000 TEUs. Technically there seem to be no limitations.

7.3 Optimal ship size

Wijnolst *et al.* (1999) state that: "*the driving force is the creation of a competitive advantage through economies of scale. The Malacca-max design has an overall lower cost level of approximately 16 % over the current largest container ships of 8,000 TEUs. In a world of cutthroat competition, 16 % can make a decisive difference*". From a technological point of view, 18,000 TEUs can be considered as the maximal ship design, but it is not the optimal ship size.

7.3.1 Factors Influencing Size

Various technical studies have shown that the deployment of larger container ships is feasible and that there are neither technical limitations nor market obstacles to introducing them (Wijnolst *et al.*, 1999; Akiyama *et al.*, 2002; Ham, 2004). Currently, further engineering is still needed regarding future Panamax vessels and new logistical concepts are required. The tremendous growth in ship size makes it necessary to look for a systematic explanation of the factors influencing the size of ships.

The driving variables were obtained by reviewing the relevant literature and from interviews with liner carriers and shippers. After listing the variables, it became clear that the criterion for cataloguing the driving key factors would be a synthesis of the different points of view of all players involved. In clockwise order this includes the shipper, the (port) authorities, technology, the terminal operators, the carrier and finally, though not least important, market-driven forces. The result of the driving variables pushing the vessel scale is summarised in Figure 7-5.

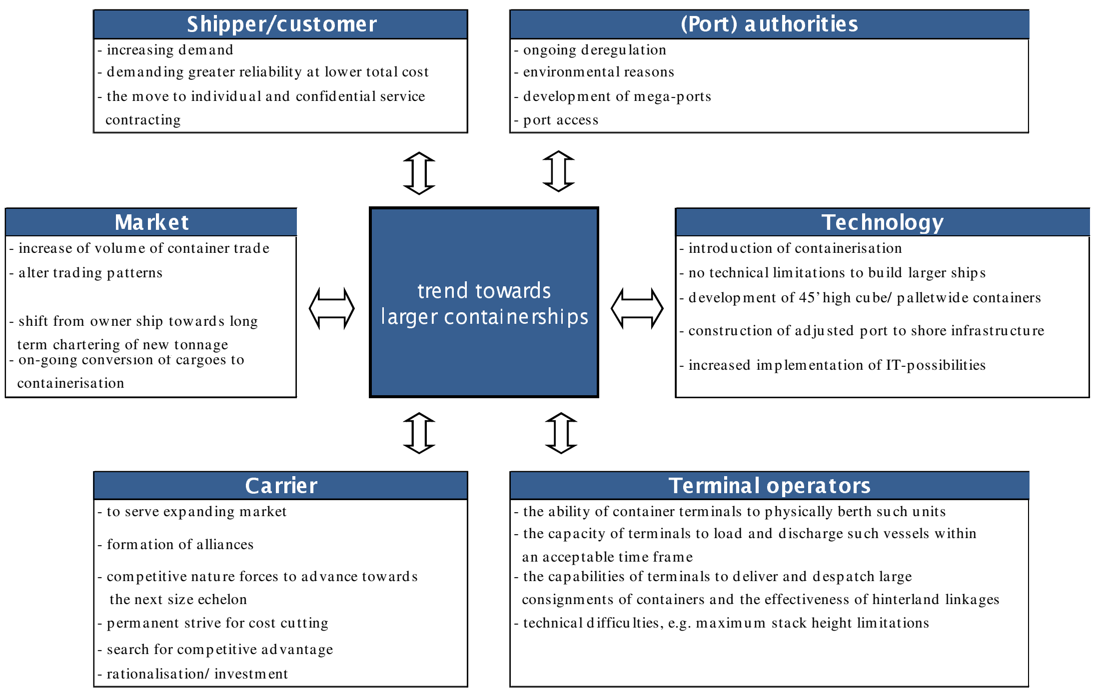

Figure 7-5: Influencing key factors

From the viewpoint of the carrier the response to the expanding market, the permanent strive for cost cutting, the formation of strategic cooperations, and most particularly the (global) alliances have fuelled the upsizing trend. Economies of scale, the engine that drives the scale of the container ship, exist when the unit costs of operating a ship decrease as the size of containerships increases. In a very competitive market new building orders for bigger ships provoke others to follow. These orders have not been solely placed by alliance members. In an attempt to maintain their market share by keeping pace with this level and type of investment, most major independent liner operators have also placed orders for such vessels.

In addition, other variables such as the increase in the worldwide demand for liner shipping, technological evolution (e.g. the development of the 45' high cube/ pallet wide containers), ongoing conversion of cargoes to containerisation,… have also contributed to the increase in the container vessel scale. The economies of scale definitely form the main variable. But, without any doubt, the interaction between all factors plays a very important role in this upsizing movement.

7.3.2 Optimal (Ship) Size

In general, micro-economic theory links the size of a company to efficiency; that is to say, a size that minimises the average long-run costs. Furthermore, the size of a business depends on the market that it is in. If the demand is not sufficiently great, it is not possible to produce at the minimum efficiency level, even if it were technologically possible to take advantage of the economies of size.

Another approach refers to economies of scale, which are predominantly of a technical nature and which determine the optimal size of the firm (Baumol, 1982). However, organisational factors also have an influence on the optimal size, possibly creating diseconomies of scale, and thus changing the optimal size of the firm. Consequently the balance between the predominance of economies of scale and the predominance of diseconomies of scale determines the optimum size of a company.

Size, a common denominator for ships expressing type as well as capacity (TEU), is singled out as the most important design variable or analytical tool for liner service optimisation.

Before the 1970s the theory was to use the largest ship possible that could be accommodated at both origin and destination ports (Heaver, 1968; Van de Voorde, 2005). Since then, the subject of optimal ship size has received a lot of attention from transport economists (Heaver, 1968; Goss, 1971; Kendall, 1972; Jansson *et al.*, 1982 and 1987; Talley, 1990; McLellan, 1997; Lim, 1998; Cullinane *et al.*, 1999 and 2000; Stopford, 2004; Imai *et al.*, 2006). Nowadays we know that other determinants, such as volume of trade, length of route, sailing frequency, the number of port calls, etc., also influence ship size. Regarding the number of port calls, an interesting question is: 'Is the reduction in the number of ports due to the dimensions of the ships or do liner operators in some cases decide to tailor their ship size to a port/ region?'. The right answer probably lies somewhere in between.

A scan of the literature yields the following definitions: Kendall (1972) describes the optimum size of a ship used on a particular route as the size which minimises the total transport costs. By 'total transport costs' he does not only mean those costs incurred by the ship at sea, but also the related cost of the terminals at either end of the voyage (port costs - dredging, berthing, … -, handling costs, storage costs). This definition already refers to the link with operations, which will be explored in Section 7.4.

According to Jansson and Shneerson (1982), optimal ship size is obtained by trading off economies of size in the hauling operations with diseconomies of size in the handling operations. In port, handling costs per ton increase with ship size, while hauling costs per ton at sea, on the other hand, decline with size.

Talley (1990) defines optimal ship size as the containership size that minimises the cost per TEU moved per voyage leg (between two port calls) on a given route.

Cullinane and Khanna (1999 and 2000) and Stopford (2004) refer in their studies regarding optimal ship size to economies of scale as the determinant for optimal ship size.

Previous maritime studies provide an insight into the concept 'optimal ship size' but exclude from their model the costs linked with cargo handling, shore infrastructure etc. (Heaver, 1968; Jansson *et al.*, 1987; Cullinane *et al.*, 1999 and 2000). Given the current expansion towards door-to-door transportation systems, recognition of these costs and their impact on logistic decisions (regarding waiting time, inventory, etc.) must be considered.

From the point of view of a profit-maximising liner operator, the notion 'optimal' is determined by minimising costs per TEU, given the current and forecasted demand. In the next section, it will become clear that the optimum is rather a segment than a point estimation. Currently, due to technological advances and specialisation, optimal ship size on a particular route is equal to the number of containers a line can capture between port A and port B on a weekly fixed-day basis by minimising cost per TEU, at sea, in the port and hinterland connection, while still offering the greatest flexibility to liner operators in their movement toward logistic providers.

There are many different factors (e.g. number of ports, time in port, distance,...) that might determine optimal ship size and many different points of view of what optimal ship size really is. The fact is that minimising costs per TEU recurs as a crucial element. This point leads to the question: 'How can we identify the optimal containership?'

The optimal containership size can be found by studying the economies of scale in deploying larger vessels. In order to quantify the economies of scale, this paper uses the liner service cash flow model of Stopford (2004). This model is based on a transatlantic round-trip voyage, assuming a hypothetical weekly-service frequency, an 8,500-mile distance , an average operating speed of 19 knots, 7 port calls and a capacity utilisation of 80 % outward and 90 % return. The model consists of two levels. Level one constructs the six components of liner service costs (viz. service schedule, ship costs, port charges, container operations, container costs and administration costs). In the second stage the calculated costs are used in a cash flow model. The model was later updated by Notteboom (2000). In addition, he linked the days/ portcall with ship size. Stopford's and Notteboom's calculations are limited to ships up to 6,500 TEUs.

For an impact analysis of economies of scale, we focus on ship costs, more specific on the unit cost per TEU (expressed in terms of USD/ day) by comparing different ship sizes. The unit cost per TEU (USD/ day) is defined in the following way:

$$\begin{aligned}&\textit{Unit cost per TEU (USD/day)}\\&=\frac{\textit{operating cost (USD/day)} + \textit{capital cost (USD/day)} + \textit{bunker cost (USD/day)}}{\textit{ship size (TEU)}}\end{aligned}$$

Given the increase in container vessel scale, it is most interesting to enlarge the model with +6,500-TEU vessels. In this paper the model has been expanded to include ship sizes up to the hypothetical 18,000 TEUs. Another novelty in the model is the distinction in costs between single and twin propeller units on ships. The use of single-propeller units on ships larger than 10,000 TEUs would require progressively longer engine rooms to accommodate such installations. Given the current structural implications it has been assumed, in our model, that ultra large containerships are equipped with a twin-propeller configuration. Ship owners opting for a twin configuration would have to be assured that operating costs would more than compensate for higher capital costs.

Two scenarios were computed. In the cost assessment of containerships exceeding current sizes, the assumptions of Stopford's model were, in a first stage, maintained and extrapolated (s1). Subsequently the cost calculation (s2) was repeated taking into account that:

- By the end of 2005, on the transatlantic trade, the outward capacity utilisation was 68 % and the return capacity utilisation was 80 % instead of respectively 80 % and 90 % (Drewry Shipping Consultants, 2005);
- the average speed for vessels larger than 4,500 is 21.5 knots rather than 19 knots;
- the moves per hour/ crane are for the first 3 categories 30 moves/ hour/ crane, for the next 3 ship sizes 45 moves/ hour/ crane and for the remaining sizes 50 moves/ hour/ crane as the productivity of new cranes improves;
- the number of cranes increases gradually. In this calculation it is assumed that 4 cranes will be used for a 6,500 TEU vessel, 5 cranes for the next two sizes and up to 6 cranes for the ultra large container ships (ULCSs); and
- the capital cost is updated.

The data, processed in a standard spreadsheet application, are obtained from The Drewry Annual Container Market Review and Forecast (DSC, various editions) and from interviews with sales managers of top 10 liner carriers. The results of both calculations are shown in Figure 7-6.

Ship size	Unit cost per TEU (USD/day)			
	calculation 1		calculation 2	
1,200 TEU single propeller	16.59		15.10	
2,600 TEU single propeller	11.06	-33.33%	10.10	-33.11%
4,000 TEU single propeller	9.50	-14.10%	8.34	-17.43%
6,500 TEU single propeller	7.45	-21.58%	6.63	-20.50%
7,500 TEU single propeller	7.20	-3.36%	6.25	-5.73%
8,500 TEU single propeller	7.02	-2.50%	5.97	-4.48%
10,000 TEU single propeller	6.52	-7.12%	5.63	-5.70%
12,500 TEU single propeller	6.02	-7.67%	5.45	-3.20%
10,000 TEU twin propeller	7.70		6.63	
12,500 TEU twin propeller	6.75	-12.34%	6.04	-8.90%
15,000 TEU twin propeller	5.97	-11.56%	5.73	-5.13%
18,000 TEU twin propeller	5.35	-10.39%	5.35	-6.63%

Figure 7-6: Results of cost calculation – 2005

On closer analysis of the results of the first calculation (s1), we notice - not surprisingly - that savings are achieved by using bigger ships. The unit cost per TEU drops from 16.59 $/ TEU/ day for a 1,200-TEU ship to about 6 $/ TEU/ day for a ship whose carrying capacity is ten times bigger (see Figure 7-6). The rationale for this conclusion is that the unit cost generally falls as the ship size increases, because capital, operating and cargo handling costs - key elements in the economies of scale calculation - do not increase proportionally with the capacity. For example, a 12,500-TEU ship only costs twice as much as a 5,000-TEU ship, but carries more than two and a half times as many containers. Further increases in vessel size provide only limited unit cost reductions. Once the 7,500-TEU barrier is exceeded, the economies of scale diminish very rapidly, which is in line with the results of the Malacca report (Wijnolst *et al.*, 1999).

Figure 7-7: Economies of scale curve –s1

Graphically, the economies of scale curve relates the unit cost per TEU (USD/ day) on the vertical axis to the ship size (TEU) on the horizontal axis (see Figure 7-7). Introducing the distinction between single versus twin-propeller configuration results in a split economies of scale curve (see the dotted line in Figure 7-7).

Comparing the results of the size bracket [10,000 TEUs - 12,500 TEUs] from a cost perspective, a liner operator will rather opt for a single-propeller than a twin-propeller configuration. It goes without saying a twin-propeller configuration is more costly (initial cost, maintenance, etc.). But then again, it also has some advantages: (a) the second propeller serves as a spare part, (b) increased manoeuvrability, (c) it economises on the number of tug boats, etc.

In the second scenario (s2), Stopford's assumptions were altered (as above). The results are also shown in Figure 7-6 (second calculation - s2). The conclusion of the adjusted calculation does not diverge from the conclusion of the first calculation. For the majority of vessel sizes the unit cost per TEU is lower. Again, the cost falls sharply when sizing up towards 4,000 TEUs, and in the larger categories the marginal return levels off. The results of both calculations are shown graphically in Figure 7-8.

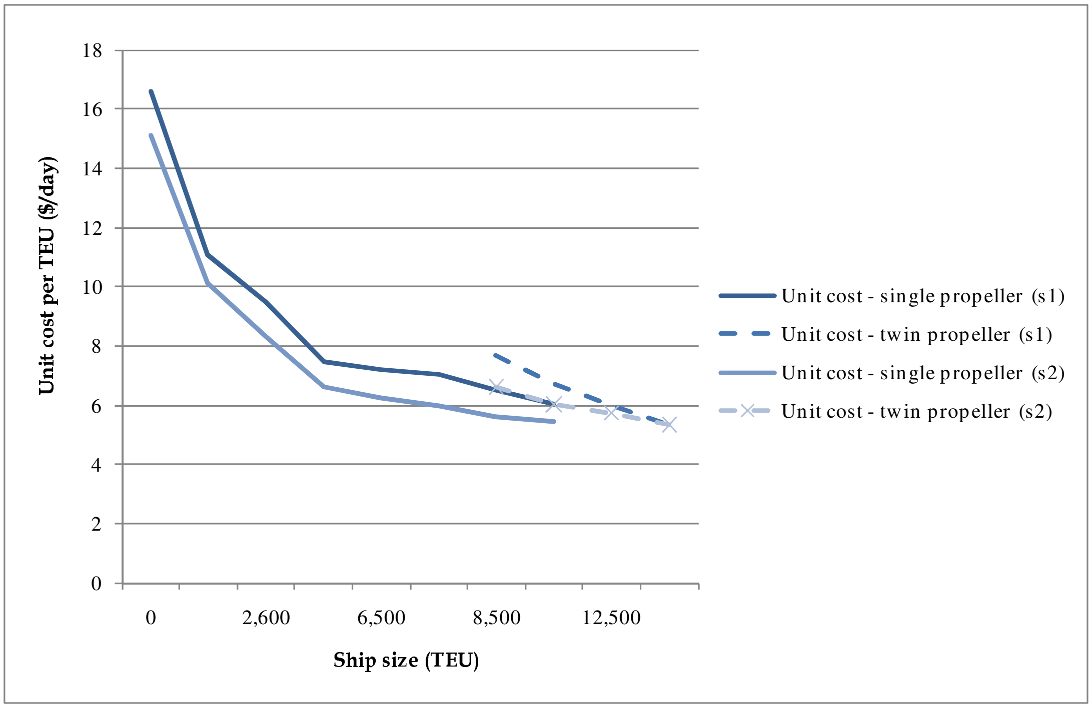

Figure 7-8: Economies of scale curve – s1 & s2

The cost curve of the second calculation is situated below the curves of the first calculation. The marked full line corresponds with ship sizes fitted with a single propeller (i.e. 1,200 TEUs - 12,500 TEUs), while the marked dotted line shows the cost curve for ships equipped with a twin propeller (i.e. 10,000 TEUs - 18,000 TEUs). The black colour illustrates the economies of scale curve of the first calculation (s1), while the grey curves show the results of the second calculation (s2) for both single (marked full line) and twin propeller (marked dotted line). By coincidence the latter curve overlaps and continues the economies of scale curve of the first calculation (full black line), giving the false impression that +12,500-TEU ships will be equipped with a single propeller. Again the curve becomes very flat and the optimal ship size seems to become very large.

When looking to minimise costs, a liner operator should opt for the largest ship available. But there is far more than this to take into consideration.

First, the determination of optimal ship size is undeniably linked to operational occurrence (see Sections 7.3 and 7.4). Secondly, the port-to-port cost saving will only be achieved if the vessel is fully utilised. Poor slot utilisation can have an impact on carriers' revenues and lead to lower profitability.

Furthermore, the deployment of larger ships will also increase an operator's cost base as additional sales and marketing staff may have to be employed, particularly if new trades are targeted to provide the additional cargo necessary to load the vessels and if operations are reconfigured.

Eventually, if the additional feeder, transhipment and landside distribution costs are taken into account, the cost per TEU will hypothetically increase for 12,500-TEU, 15,000-TEU and 18,000-TEU vessels. The shape of the economies of scale curve (see Figure 4) is likely to change into a U-shaped curve (see Figure 7-9). If this proves to be the case, the size bracket [10,000 TEU - 12,500 TEU] appears to be the optimum, under the assumptions that the carrier operates efficiently and that there is sufficient volume on a particular trade.

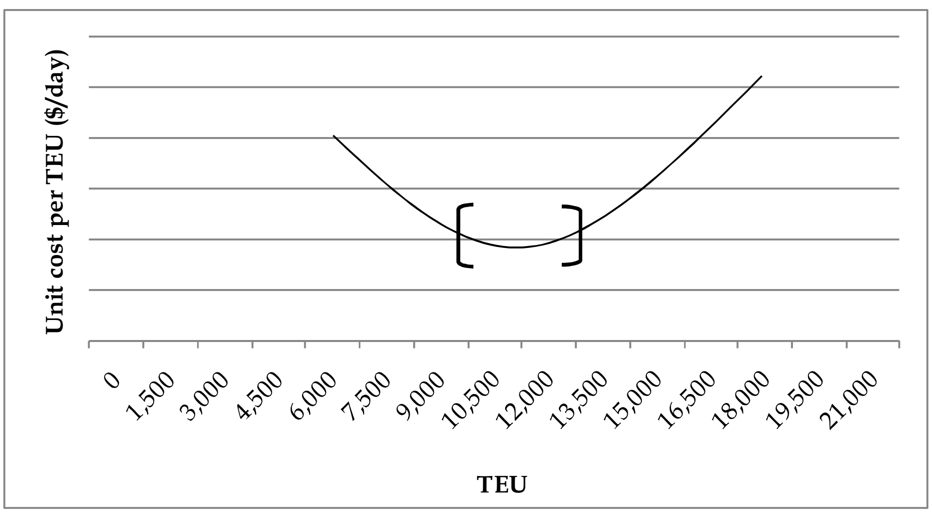

Figure 7-9: Interval estimation of optimal ship size

This latter assumption cannot be ignored. Returning to the starting point, the cost calculation is based on a transatlantic round-trip voyage. The long-term prognosis for this trade,_according to Drewry Shipping Consultants, is not very promising, with growth in both directions forecasted to be in the 2 % to 2.5 % range for the foreseeable future (Drewry Shipping Consultants, 2005). Even though a liner operator wants to reduce unit costs (i.e. to achieve economies of scale) and to increase his income (i.e. to gain greater market power), on the transatlantic trade lane smaller ships will be put in service compared with the other major line routes (see Section 7.4). Thus features, such as demand, space for future volume growth and cargo imbalances also need to be examined.

Another important issue is the infrastructure needed at ports to accommodate large ships. The trend toward increased size of containerships presents challenges not only for liner operators, owners, designers and classification societies…, but especially for operational managers. This brings us to a discussion of the impact of vessel scale increase on operations.

7.4 Optimal ship operations

Optimal ship operations should be interpreted in a broader sense than ship operational management. Optimal operations include:

- linking economic centres by choosing the right route with the best number of port calls, taking into account the possibilities of feeder and hinterland connections;
- a reasonable frequency; this should be interpreted for the liner operator as e.g. offering a weekly fixed-day service with the smallest number of ships employed. Setting up a weekly service on the Europe-Far East line will require the deployment of 7 to 8 ships; for the Transpacific 5 vessels employed is sufficient;
- an efficient agency network;
- a sufficient number of stevedores providing a reliable service;
- good logistical support; and
- acceptable port conditions (i.e. port entry charges - port and canal dues, frequency reduction, pilotage, etc., if applicable, acceptable time-windows, etc.).

In other words, optimal operations involve all aspects geared towards minimising cost. The impact of previously listed aspects should be integrated into the outline of costs (e.g. the impact of frequency on waiting time cost, inventory cost, etc.) (Witlox & Vandaele, 2005; Blauwens *et al.*, 2006).

Clearly, the central question regarding optimal ship size cannot be studied without reference to operations. In the decision process liner operators take into account potential implications on ports by deploying ever-larger vessels.

In the past ports and terminals have responded to size increases by making large and rapid investments in infrastructure in order to cope with these new vessel sizes. Until now they could provide whatever capacity to ensure that the vessel only stayed in port for a brief period. But the movement to the next size echelon has struck terror into the hearts of terminal operators (Stopford, 2002).

Opting for minimisation of the number of port calls (see Section 7.4), container shipping alliances, as well as independent lines, put pressure on domestic ports to keep skylines. Moreover, the movement towards larger ships confronts the port authorities with a number of pressing issues with regard to investing in stronger tugs; deepening and/ or widening approach channels, port and turning basins; environmental and regulatory constraints; expansion projects; organising traffic (deepsea - shortsea - barges); etc.

At present, the limiting factor is water depth in ports and navigable waterways. Rumour has it that in future the limiting factor will no longer be vessel draught but rather vessel length (i.e. turning circle). An indication can be found in the expansion plans of the Bremerhaven Basin. Extra limiting factors will be air draft, bending moment and torsion of the vessel.

Returning to water depth, the current 14m-scantling design draught of +6,000-TEU ships already poses problems. Figure 7-4 shows that since containerisation vessel draught has climbed gradually from 9m up to 16m. It also clearly shows the changes in design, concentrating on length, followed by beam and design draught. As ships get deeper, a number of ports will be faced with restrictions on their capacity to handle them (e.g. East Coast U.S. ports). Figure 7-10 shows draughts of the top 20 container ports and some secondary ports in alphabetical order. Note that the maximum draught should be taken with a pinch of salt. In practice the draught is smaller (i.e. Antwerp: 14m). In addition, Figure 7-10 does not take into account the sequence of the port in a loop. The draught criterion is maybe less determined for the fifth port of the loop.

Port	Draught	Port	Draught	Port	Draught
Amsterdam	14m - 15m	Hong Kong	12.2m - 15m	Rotterdam	10.65m - 13.5m
Antwerp	7,5 - 16,7m	Kaoshiung	12m - 15m(*)	Seatle	9m - 15m
Bremerhaven	14.6m	Laem Chabang	14m	Shanghai	9.4m - 12.5m
Busan	11m - 15m	Long Beach	11m - 15.2m	Shenzhen	6.5m - 14m
Dubai	14m	Los Angeles	n/ a	Singapore	8.9m - 15.3m
Dunkirk	12.5m	Marseille	14.5m	Tacoma	15.24m
Felixstowe	9.75m - 15m	New York	11m - 13.5m	Tanjung Pelepas	15m
Gioia Tauro	12.5m - 14m	Port Kelang	10.5m - 13m	Tokyo	12m - 15m(**)
Hamburg	14.5m	Quingdao	7.2m - 14.5m	Zeebruges	15m - 16m
(*) 4 terminals with a draught of 12m, 1 of 13m, 14 of 14m and 3 of 15m					
(**) >5 terminals with a draught of 15m					

Figure 7-10: Draught of container ports – 2005

Bearing in mind that Figure 7-10 is just a snapshot, two scenarios are possible: (a) for future ULCS's the list becomes more limited. This, in its turn, will encourage the further development of a selected number of big transhipment hubs for containerships, which will cause fierce competition between ports and terminals wishing to become one of these few gigahubs (i.e. Tanjung Pelepas vs. Singapore); or (b) main ports/ terminals will remain the focus of large-scale major dredging and port infrastructure developments to cater to them, while other ports/ terminals will need to focus on niches.

The latter scenario suggests that port and terminal operators must take action and, moreover, continue to respond by investing in terminals and in larger ship-to-shore handling equipment. Taking into account that the next generation of quay cranes with their ever greater outreach (± 65m) and lift capacity will cause higher loads on the wheels, quay walls must be stronger, and this has implications on quay wall construction methods, a serious concern for all container ports.

In addition to investment decisions about ship-to-shore equipment, terminal operators are also confronted with an increased quantity of TEU handling, partly due to their clients' enormous growth in tonnage. As their clients grew - in tonnage as well as in market power -, terminal operators had to follow, if they wanted to carry on independently from any shipping line. Terminal operators have to be extremely cost-conscious, as the handling rate remains the principal factor for the liner operator when selecting a port and an operator. From this point of view, the advent of ever-larger container vessels necessitates port decisions regarding the container yard area, higher yard stacking, terminal automation, improved gate system, reduced container dwell times, security and safety issues, environmental aspects (e.g. the EU-habitat directive), the depth of berth, etc.

Berth time is an ever more critical aspect. A lot of equipment and work force are required when such a mega-vessel arrives. Can a terminal handle these ships cost-effectively? Will the handling cost remain relatively constant? Over time as vessel size increased, berth productivity (moves/ vessel/ hour) became ever more important to guarantee that vessels could adhere to their sailing schedule. The operating system enabling these high productivities is the so-called "direct straddle carrier system". A fully automated yard management and operation planning system is necessary to exploit the potential of the straddle carrier. Terminal operators also need to consider decisions regarding new IT and communication systems, Internet applications, etc. with regard to this operating system.

Another question emerges: 'Is the handling a 12,500-TEU vessel comparable to the handling of two 6,000-TEU ones?' To answer this question, one needs to know what is required to cater to an ULCS or vessels with a nominal capacity in excess of 10,000 TEU. Figure 7-11 compares the requirements concerning berth length, depth alongside,… for both ship sizes (revealed from interviews (2005) and Rizvi, 2003).

	6,000 TEU	12,500 TEU
berth length	350m	450 m
depth alongside	14m	15.5 - 16.0m
approach channel depth	14m	18.0-19.0m
terminal area	16.0 ha per berth	22.5 ha per berth
gantry cranes	40 - 45m outreach/ 45 cycles per hour	60 - 63m outreach/ 45 cycles per hour

Figure 7-11: Terminal requirements

Besides longer/ deeper berth dimensions and a bigger terminal area, wider vessels will require container terminals to invest in longer cranes that can handle +20-container-wide vessels. The main aspect is rather the number of gantries (or port cranes used to load and discharge containers from vessels able to be positioned by moving along rail track) and straddle carriers (or wheeled vehicle designed for loading containers onto or unloading them from a trailer, and carrying them to and from a stacking area, Port Glossary) a terminal operator must have at its disposal when a large ship arrives. An excess of terminal handling equipment will jeopardise the overall cost-effectiveness. Furthermore, practise teaches us that the capacity/ crane is not the constraining factor; it is rather the systems bringing the containers under the gantry crane that play a key role in the productivity of handling a ship. Depending on the clauses stipulated in the terminal contract, 3 to 5 container cranes are used simultaneously for one 6,000-TEU vessel. Up to 6 cranes have to be put into action to load/ unload a +12,500-TEU ship. These vessels have to be served in the shortest possible time (typically less than 24 hours, depending on the volume of the cargo). At the same time operations on other vessels must not be hampered by a lack of equipment due to the operations on the ULCS. More and faster container handling is necessary just to keep up with vessel upsizing; otherwise extended port time will destroy the rationale for bigger ships. Thus ship size has a number of effects on container operations.

Whereas the beam, or the number of rows of containers affects the outreach of cranes, the length of ships influences the quay length. Given a quay length of 1,000m, two ships of 6,000 TEUs can be catered to at the same time. In future a 12,500-TEU ship and, say a 6,000-TEU ship can easily be put into action alongside such quay length. Consequently, this will require a significant increase in productivity of terminals.

When dimensions and capacities of the equipment are considered, the impact of the ULCS on the terminal is rather minor. Vessel size has no influence on terminal transport equipment and stacking area design. But what about the size of the terminal? The parameter 'size' is less important, because a containership hardly unloads all its containers in one port. The impact difference between 2 x 6,000-TEU vessel deployment and a 12,500-TEU will be determined by the hinterland (offtake of the containers) and whether or not the terminal is a dedicated terminal, rather than by the size of the terminal. Port operations will not be a bottleneck for their deployment, provided large terminals are called at. However, it seems likely that hinterland connections are becoming a significant factor, as a consequence of the move towards a door-to-door transportation system.

In order to maintain acceptable container line schedules and to compete successfully with smaller container ships, main liner operators are becoming more and more involved in extended partnerships with terminal operators. The huge scale of investment required for container handling operations favours these closer relationships. Besides infrastructure, operational managers are confronted with other issues, such as:

- the lobby of environmental groups against competitiveness and growth of large terminals;
- the containership loading problem;
- lack of qualified people;
- 24/ 5 or 24/ 7 availability of the customs office depending on the country;
- hinterland transportation operations; and
- direct service versus the trend towards hub-and-spoke operations. A hub is the central transhipment point in a transport structure, to which traffic from many ports is directed and from where traffic is fed to other areas/ ports (referred as spokes). Given the growing importance of transhipment, 12,000 TEU capacity will most likely be deployed between hubs. Note that the trend towards hub-and-spoke operations is located in the East-West trade, and less in the North-South trade. Moreover, it does not exist in the African trade.

Until now the trend in the East-West Transpacific trade has been to call direct at as many ports as possible in different loops. In Europe the biggest ships generally call at two or three Mediterranean ports and around four in the North-West of the continent. The advantages are threefold, keeping transit times and roundtrips as short as possible, limiting expensive feeder operations only to outports and finally, allowing the shipper the advantage of direct port calls. As ship size continues to increase, various studies (Cullinane *et al.*, 2000; Rijsenbrij, 2001; Ham, 2004) forecast that liner shipping companies in search of cost reduction and faster transit times will reduce the number of port calls in favour hub-and-spoke global networks, with mother and feeder services integrated to serve the container trade. This upsizing movement in the main trades creates a corresponding increase in both number and size of feeder vessels. This cascading effect is probably the most important application of scale economies in the container business (Stopford, 2004). However, other questions arise: will the lower slot cost outweigh the higher feeder cost for ships above 10,000 TEUs? Have we already reached the point at which additional feeder and inventory costs outweigh any further savings in slot costs on main line vessels? Tariffs diverge strongly, depending on the destination variables such as distance, degree of competition, expensive/ cheap ports and surcharges like bunkering adjustment factor (BAF), International Ship and Port Security (ISPS),… One thing is certain: what matters is the total cost of the network.

Finally, the logistics of the container flow itself will become more important. Are these flows large enough to maintain container-shipping services with very large ships with a reasonable frequency, knowing that each container transported requires two others, one in the port of origin and one in the port of destination?

7.5 The link between ship size and operations

It is obvious that ship size and operations are linked, but to what extent? After expounding the experience of the sector through interviews, considering the cost price of bigger vessels - chartered or owned - and taking into account the operational process, cost-effectiveness will probably not increase by deploying such ships. There are three arguments to consider:

First, various studies (Cullinane *et al.*, 1999; Ham, 2004) state that larger ships will have access to fewer ports due to the limited draught of the ports (see Section 7.3). The number of port calls by the post-Panamax vessel will be reduced as long as the additional costs for feeder and intermodal connections are lower than the savings from fewer port calls. However, currently this is hardly the case for ship sizes up to 9,700 TEUs calling at North European ports. For example, an analysis of the CMA CGM's French Asia Line (FAL) tells us that in 2006 this liner operator gradually replaced the 6,500-TEU ships by new ships with a capacity of 8,450 TEUs with the same port rotation (Shanghai, Ningbo, Yantian, Hong Kong, Port Kelang, Suez, before calling at Malta and continuing to Le Havre, Rotterdam, Hamburg, Zeebrugge and Southampton) (see Figure 12) (Compagnie Maritime d'Affrètement - Compagnie Générale Maritime abbreviates to CMA CGM). Starting of July 2007, the number of port calls in this service increased (+4).

French Asia Line								
Service name		FAL1			FAL2	FAL3	FAL4	FAL5
Year		jan/06	jul/06	jul/07	aug/06		July 2008	Oct. 2009
Vessel Type		6,500 TEU	8,450 TEU	8,450 TEU	9,400/9,600 TEU	6,400/6,700 TEU	9,700 TEU	11,000 TEU
Port call	Beirut					×		
	Chiwan			×		×		
	Dalian			×				
	Hamburg	×	×	×	×	×	×	
	Hong Kong	×	×	×	×			
	Jeddah					×		
	Khor Al Fakkan			×				
	Le Havre	×	×	×	×	×		
	Malta	×	×	×				
	Nansha						×	
	Ningbo	×	×	×	×	×		
	Port Kelang	×	×	×	×		×	
	Qingdao					×		
	Rotterdam	×	×	×	×	×	×	
	Shanghai	×	×	×	×		×	
	Southampton	×	×	×		×		
	Suez	×	×	×	×			
	Tiajin Xingang			×				
	Xiamen					×	×	
	Yantian	×	×	×	×	×	×	
	Zeebrugge	×	×	×	×	×	×	
N° of ports		12	12	16	10	11	8	
Cooperation					50-50 China Shipping Container Line (CSCL)		50-50 China Shipping Container Line (CSCL)	

Figure 7-12: Overview French Asia Line (FAL)

Since August 2006, 8 vessels of 9,400-9,600-TEU capacity have been deployed on the Far East liner service (FAL2) with the liner operator China Shipping Container Line (CSCL). The port rotation is Ningbo, Shanghai, Yantian, Hong Kong, Port Kelang, Le Havre, Rotterdam, Hamburg, Zeebrugge, Port Kelang and back to Ningbo. With the launch of the FAL2 Malta (12m average draught), Southampton (with a 12.6m channel depth) and the ports in the Arabic Gulf were excluded from this rotation. Under the denominator of providing optimum port coverage, FAL 4 (July 2008) and FAL 5 (October 2009 - 11,000 TEUs) are added to the existing FAL network, linking Asia and Europe (FAL1, FAL 2 & FAL3). The launch of the new service, FAL5 will coincide with the process of enlargement, since CMA CGM will in the same year take entities of 11,000 TEUs into service.

Knowing that on the world's densest maritime routes nearly all main ports are considering expansion plans, we assume that for the deployment of + 10,000-TEU ships a revision of major loops will result in a reduction in the number of port calls. This trend by no means complies with the preferences of shippers who favour more ports, more routes, shorter transits, greater frequency and all this with a lower freight rate. Economies of scale are the driving force behind the trend of containerships calling at a limited number of big ports. This policy will, therefore, increase transhipment costs as well as the risk of longer transit time for containers that have to be transhipped and relayed, whether by feeder vessel or overland. But how long will carriers be able to follow a strategy of restricting the number of entry ports into Europe to provide opportunity for consolidated freight flows? And what about the impact on service levels? Or are shippers pleased with a lower freight rate for slow moving containers?

Second, not all terminals are dedicated terminals. To unload such large ships three to five gantry cranes are required. Dedicated terminals will organise the process of unloading so that a ship can leave the port as quickly as possible. But will other terminals have the same strategy? Will they only concentrate on the big ships or not?

Third, containerships with higher container capacities have to sail at higher speeds than those with lower capacity, because they need more port time. This is the reason why ship speed is of such enormous importance to large container ships. An hour's time loss in port would require on average a four-knot increase in transit speed to meet the scheduled arrival time. The very large single-propeller containerships cannot reach the required service speed with their current main engines. Large ships, certainly those above 12,000 TEUs, will need twin propellers, and this will logically increase maintenance and fuel consumption. Fuel consumption rises exponentially with increased speed. A rule of thumb: a 10 % increase in speed results in about a 30 % increase in fuel consumption (www.prads2004.de).

Furthermore, there are financial implications. A ship with a capacity of 10,000 TEUs only has a reduced slot cost with the assumption that the capacity is fully utilised. It is clear that these ships will be deployed on the Far East trade (Far East - Europe route and Far East - USA route). Knowing that to exploit a route on the Far East, a liner operator needs seven to eight ships for a weekly service and the capital cost of a 10,000-TEU ship is about US$ 130 million (end 2005), it is quite obvious that only the main liner operators will be able to finance such ships.

Nor can the loading problem be ignored. A liner operator cannot operate a loop with one loading port and one discharging port. If this were the case, a weekly service would be impossible because the presence of more than one ship at the terminal would hinder operational speed. Imagine a loop with three loading ports and three discharging ports. Will it be possible to load a ship with a huge number of containers in each loading port and to discharge the containers in the right discharging port without repositioning containers on the ship or by way of the quay? And what will be the projected cost of repositioning? Moreover, how will a liner operator fill ULCS not once but with a reasonable frequency, preferably weekly? And will the ship in that first discharging port be expected to take in additional cargo for the next destination in order to keep it at full charging capacity?

These arguments confirm the link between ship size and operations and confirm that ship size influences operations, creating diseconomies of scale (e.g. increased cost of transhipment,…). It is obvious that (optimal) ship size goes hand in hand with (optimal) operations. This brings us to the question 'Is there an optimal ship size?'

Until the mid-80s, size was limited by the dimensional constraints of the Panama Canal (length 294 m and width 32 m), which strongly influenced the development in containership size. For a long time the market levelled off at the maximum ship size of 4,500 TEUs. This was undoubtedly the reason why this was labelled as 'optimal ship size' for more than a decade. Note, due to technological reconfiguration, the capacity of new Panamax vessels is pushed above 4,500 TEU - the so-called high capacity Panamax vessels. In future the planned expansion of the Panama locks will definitely cause another revolution in the global liner shipping industry and eliminate the distinction between Panamax and wider-than-Panamax vessels.

The 2003-2006 ordering craze has fuelled speculations on future ship size. CEOs of big carriers give different statements. CMA CGM indicates 9,500 TEUs as the optimal ship size. According to them deploying such ships is the best strategy without reducing the number of ports (www.cmacgm.com). This trend towards ever-larger vessels is not followed by all top 25-carriers. APL, CSAV/ Norasia, PIL, Wan Hai and ZIM do not (yet) have ships larger than 7,500-TEU vessels on order. Will this be the optimal strategy or will they jump immediately towards +10,000-TEU vessels?

Clearly 'the' optimal ship size does not exist. It evolves with **transport segment** (deep-sea vs. short-sea shipping (SSS)), **terminal concept, trade lane** and **technology**. These parameters - or four T's - are taken into account. First, a distinction is made between terminals which operate solely as transhipment hubs (e.g. Gioia Tauro, Algéciras,…) and other terminals, where hinterland throughput plays an important role (e.g. Antwerp, Rotterdam, Hamburg,…). Hub terminals will be marked by operational activities focused on the quayside area, whereas other terminals will focus more on backyard area or even both. Second, the determination of optimal ship size cannot be studied separately from a trade route (volume, port accessibility). Container business covers a spectrum of different trades. There are about 1,500 liner routes. The industry divides the trade routes into three groups: East-West trades, North-South trades and intraregional cargo. The different routes are marked by a different volume and therefore the global liner operator requires a portfolio of different ship sizes. Ultimately, as larger ships enter the market, a shift towards these ships can be expected, as they are more cost-effective with reference to the routes.

Figure 7-13 gives an overview of the optimal ship size with the parameters of transport segment, type of terminal, trade lane, and phasing-up of larger ships. This overview is based on the results of section 7.2.2 and on extrapolation of the demand, cost and technology parameters. At present neither 15,000-TEU nor 18,000-TEU ships have been built, but for the purpose of the present study we are already simulating the consequences of their existence. Since preparations to widen the Suez Canal have already begun, the arrival of those ships in the next 10 years is a serious possibility. Undoubtedly, this ship size will be the minority in the fleet portfolio of the main liner operators.

Transport segment / Terminal type / Trade lanes / Technology	Deepsea					SSS
Terminal type	Hub + hinterland				Hub	
Trade lanes	Main trades			Other		
Technology	Eu/Asia/Eu	Transatlantic	Transpacific	North/South		
2005 - up to 10,000 TEU	7,500 - 9,500	3,000-5,500	7,500 - 9,500	3.000	7,500 - 12,500	1.500
2012 - up to 15,000 TEU	12.500	5,500-7,500	12.500	4.500	7,500 - 15,000	3.000
> 2012 - up to 18,000 TEU	15.000	5,500-7,500	15.000	5,500-6,500	7,500 - 18,000	4.500

Figure 7-13: Optimal ship size linked to optimal operations

Assuming that the main liner companies will continue to invest in larger tonnage, the size of a typical container ship on the *Europe-Asia* trade lane will shift first towards vessel sizes varying between 7,500 TEUs and 12,500 TEUs. Within the portfolio of the fleet, one expects that the number of vessels varying between 7,500 - 9,500 TEUs will form the majority (read: be the optimal ship size segment). The vessels will be powered by a single propeller and will offer operators, compared to a 4,500-TEU ship, potential cost savings of about 35 % (see Section 7.2). It is likely that the upcoming giant container ships will be single-propeller vessels. Due to economic reasons twin-propeller vessels are currently not competitive (i.e. increased maintenance, fuel consumption,…). By 2012 the largest ships on the Europe/ Asia/ Europe and the transpacific trade lanes will be 15,000-TEU twin-propeller, rising to 18,000 TEUs. Few vessels of the future Panamax size, which will be able to load at least 22 containers across the weather deck, will enter service during the latter part of this decade, once the ports/ terminals operating companies have made the necessary investments in new equipment (cranes,…), berths, etc. to handle them. Ever-larger vessels will most likely constitute a minority within the fleet portfolio.

The optimal ship size will be found around 12,500-TEU capacity. This vessel does not only offer economies of scale, but also environmental benefits (reduced emissions, improved fuel consumption, etc.). In the long run, optimal ship size will probably shift towards the 12,500-15,000-TEU segment, taking into account the expected growth of China and India. The same trend is expected for the *transpacific trade*. The last main trade, though not the least important, is the Intra-Asia trade. The smaller ports in this region are fed with vessels up to a capacity of 1,500 TEUs. Given the increased volume, optimal ship size will gradually increase. A noticeable trend is the takeover of this trade by the main liner operators. Recently two feeder operators have filed a petition of bankruptcy.

The *transatlantic trade* is quite another story. Most of the reflections concerning future seaport development depend heavily on estimations of future demand for freight transport, a major element. Generally, the demand is expected to grow continuously. But, as cargo volumes on the transatlantic route evolve at a slower pace and no real durable growth margin is noticeable, the optimal ship size is currently situated in the range between 3,000 - 5,500 TEUs, according to the deployed ship sizes. In line with the trend on the other two major trade lanes and under the assumption of sufficient volume, the optimal ship size for the transatlantic route is expected to be located in the 4,500-6,500-TEU segment by 2012.

Other trades will be served with smaller ship sizes. The main constraints here are trade volume and port accessibility. On the *North-South routes*, the optimal ship size today is about 3,000 TEUs. Hamburg Süd, a major player on these routes, started deploying ships with a capacity of 5,500 TEUs. According to them this capacity is the optimal ship size for this trade, taking into account the volume of trade and especially the accessibility of ports in South America. These 'true giants' (e.g. the Monte Rosa, a 5,500-TEU container freighter with the largest reefer capacity) represent the beginning of a new era for the South American trade. +10,000-TEU freighters cannot/ will not be handled in, for instance, South American ports. Ports on the North-South trade lanes are advised not to invest in large facilities. These ports are facing pressure to upgrade, as vessel sizes on these routes are also growing due to a cascade effect. The optimal ship size will steadily rise to 4,500 TEUs followed by a shift to the 5,500-6,500-TEU segment after 2012.

The capacity of a terminal solely operating as a hub port needs to evolve hand in hand with the growth of container ship size. Here the feeder network gains importance. Consequently the focus of the optimal ship size in deep-sea operations will shift towards the optimal ship size in short sea operations (SSS or Short Sea Shipping).

The existing range of vessels deployed on the *intraregional routes* diverges between 1,000 TEUs and 3,500 TEUs. Here the optimal ship size is expected to increase repeatedly with +1,500 TEUs largely due to the cascading effect, but also because of the development of hub-and-spoke systems (see Section 3).

7.6 Conclusions

The liner shipping industry is an increasingly important and attractive transport market segment. Nowadays this industry is marked by (increased) containerisation, globalisation, consolidation, deregulation, rationalisation and (intensified) competition. These have radically changed the liner shipping industry and helped to fuel progress towards larger ships.

The central question of this paper was to analyse the link between ship size and container operations.

Firstly this paper dealt with the question of the driving variables behind the growth in size of the containership. Evidently, the deployment of the new generation of container vessels is largely due to economies of scale which are based on the assumption that a good utilisation of the larger vessels can be achieved. Scale economies have been - and will continue to be - the driving force behind the deployment of larger container vessels.

Neither the desire to maximise profit nor the impact of the other variables can be ignored.

Secondly, the economic analysis of the concept of 'optimal containership size' was studied, allowing the following conclusions to be drawn:

- the economies of scale curve is rather a split curve (single propeller vs. twin propeller);
- for a long time the market levelled off at the maximum/ optimal ship size of 4,500 TEUs, while nowadays a shift of the optimal ship size towards larger vessel scale is noticeable: economies of scale still exist for +8,000 TEUs (see Figure 7-7 – Section 7.2);
- the operating cost (especially feeder cost) and the landside distribution costs should be integrated in the cost model; and
- consequently, the split economies of scale curve will likely turn into a U-shaped curve.

Thirdly the size of the future post-Panamax ships challenges not only the liner shipping companies, but also the ports and terminals businesses. Ports and terminals have responded and still respond to size increases by making large investment plans. This is the case because the main limiting factor is the water depth in ports and navigable waterways besides the length of the vessel, the airdraft, etc. Furthermore it is quite obvious that the operation of bigger vessels raises terminal, intermodal and commercial issues.

Finally throughout this paper it has become clear that (optimal) ship size and (optimal) operations cannot be studied separately. Both concepts develop hand in hand. It has been shown that the determination of the optimal ship size in relation to operations depends on **T**ransport segment; **T**erminal type; **T**rade lane and **T**echnology.

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Chapter 8

8 Synopsis of the research

The present thesis has employed both Structure-Conduct-Performance (SCP) tests and 'New Empirical Industrial organisation' (NEIO) models to assess the competition, the concentration and the market structure of the container liner shipping industry. Next to these two static methodological frameworks for empirical IO, a dynamic view of competition, known as the 'Persistence of Profit' (PoP) approach, has also been applied.

This chapter is divided into two parts. The first part compares the results of the research on the level of competition. The second part offers some critical reflections and suggests some directions for further research.

8.1 Bilateral comparison of the different approaches

This section compares the outcomes of the different approaches. Section 8.1.1 discusses and compares the results of the structural (i.e. concentration measurements) and non-structural (i.e. Panzar Rosse model) approaches in order to determine the degree of concentration and its direct link to the market structure. Regarding the change in competition intensity, the Section 8.1.2 investigates whether the results of the instability index equate with the outcomes of the Boone indicator. The last subsection examines and discusses the coherence between the HHI and the Boone indicator.

The comparison is limited to the results at industry level. Because of a lack of sufficient disaggregated data, a comprehensive analysis of competition at trade level using NEIO models was not possible. Since the study could benefit from longer time-series, the coherence between the different indicators should be interpreted with caution.

8.1.1 Degree of concentration

Market structure refers to the number and distribution of firms in a market. Observing the number of liner operators can be an first indication of how competitive the container liner shipping industry (hereafter CLSI) is.

Another approach to measuring the degree of competition is to focus on the level of concentration of the industry. A common measure of market structure is the n-firm concentration ratio, described by the cumulative distribution of market shares. For the present research, the four-firm concentration ratio (CR4) has been calculated. One critique of the CR4-concentration ratio is that it fails to take into account the distribution of market share across all firms in an industry. Since, the Herfindahl-Hirschman Index (HHI) does not share this weakness, this measure, which a more comprehensive and revealing measure of industry concentration, is also computed for the CLSI. The lower the HHI, the more competitive the market, and under perfect competition the HHI approaches zero. However, the HHI ignores a number of factors that contribute to the potential exercise of market power, such as demand conditions, strategic behaviour, and overcapacity. Nonetheless, both indices[139] are effective as a primary screening tool in the long-run (see Chapters 2 and 3). Furthermore, these measurements of concentration are used by policy makers (i.e. Department of Justice[140], Federal Trade Commission[141] and European Community) as market concentration is a useful indicator of the likely potential competitive effect of a merger.

According to Shepherd (1999), a CR4 of 40 % (the top four firms have individual market shares averaging less than 10 %) serves as a benchmark for an oligopolistic market. If one accepts this cut-off, the market structure of the CLSI would be labelled as monopolistic competition up to 2007. Since 2007, the CR4 has exceeded 40 %, and as a consequence the level of competition has dropped and the CLSI can be classified as an oligopoly (see Chapters 2 and 3).

Next, given that the CR4 and the HHI are concentration indices in the tradition of the SCP-approach, the criticism leveled against the SCP approach (see Lipczynski *et al.*, 2005, pp. 14-16) and the cut-off of 40 %, which can be challenged (i.e. the delineation may vary by industry), in accordance with the NEIO literature, the Panzar-Rosse approach is used to verify the outcome. This non-structural estimation technique allows a more accurate distinction between oligopolistic, monopolistically competitive and perfectly competitive markets (see Chapter 4). Unlike the SCP-approaches, which depend on concentration to

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[139] Other indicators could have been used to measure competition. For further explanation see Lipczynski *et al.*, 2005, and Bikker & Haaf, 2000.

[140] For instance, in measuring market concentration, the current United States Department of Justice (DOJ) guidelines apply the HHI in assessing whether a merger is likely to lessen competition. The DOJ may attempt to block mergers in markets in which the HHI exceeds 1,800. The soon to be revised guidelines will still rely on the Herfindahl-Hirschman Index (www.ftc.gov/ bc/ docs/ horizmer.htm).

[141] The Federal Trade Commission (FTC) uses both the CR and the HHI to assess the extent to which a proposed merger will affect competition in an industry.

measure competition, the calculation of the Panzar and Rosse H-statistic is based on factor input prices.

The results show that the Panzar and Rosse H-statistic is a significantly positive unscaled value. It means that the hypothesis can be rejected that the containerised liner shipping industry market structure corresponds with a neoclassical monopolist, collusive oligopolist or conjectural-variations short-run oligopolist. In other words, a significantly positive unscaled value of H is inconsistent with any form of monopoly or collusive oligopoly, but under certain conditions, it is consistent with monopolistic competition.

To sum up, the SCP-tests and the NEIO model match for the 1999-2008 sample period. The NEIO model is arguably preferred over the previously available alternatives for both theoretical and empirical reasons. For instance, when calculating the concentration indices, the definition of the relevant market presents a notorious problem. The latter does not go to the Panzar Rosse model. But then, data on input factor prices are often not available. The matching results allow to fall back on the concentration indices as a screening tool for the degree of competition.

8.1.2 Degree of competition

The Panzar-Rosse H-statistic makes it possible to exclude certain states of competition, but an increase must not be unambiguously interpreted as evidence of more competition. In this section, the results on how competition evolves over time are compared.

Starting from the result of the SPC-tests, both the absolute concentration indicators as well as the number equivalent (see Chapter 3) point to similar outcomes: the containerised shipping industry is characterised by increasing concentration. Other measures of market concentration has been used to detect the change and pace of concentration over time. As far as the change of concentration is concerned, the Lorenz curve indicates a trend of growing concentration. The results of the Gini coefficient, which value the pace of concentration, suggest yet again, a higher market concentration as well as a likely deceleration of concentration.

Traditional concentration measurements have the disadvantage of failing to take into consideration strategic behavioural incentives of firms. In addition, evidence from the literature suggests that aggregate concentration measurements are not a sufficient indicator of competitive behaviour, because the indicators of concentration can mask the dynamics of change within industries (i.e. concentration may also be due to consolidation forced by severe competition). Therefore, an indicator that measures **the magnitude of the changes in the market shares** in an industry was firstly computed both at industry level and at trade level (see Chapters 2 and 3). The result indicates that the container liner shipping industry is characterised by a relatively stable competition and suggests a nonlinear relationship between concentration and market share instability.

Secondly, the HHI has been increasing till the year 2007 (see Figure 8-1). However, it never exceeded the value of 1,000. According to the theory, the latter suggests a competitive market. But, Boone (2000 and 2004), Griffith *et al.* (2005), Creusen *et al.* (2004 and 2006) and van Leuvensteijn *et al.* (2007) state that the HHI fails as a reliable competition indicator since its relation with competition is not always straightforward. Competition can be intensified in two ways: (i) more firms in a market as a consequence of a fall in entry barriers and (ii) more aggressive conduct by incumbent firms. Analysis of the effects of both these ways of intensifying competition on the HHI explains why a widely applied measure such as the HHI is less efficient. Regarding the first way, the standard intuition of the HHI is based on a Cournot model with symmetric firms. A fall in entry barriers is an exogenous shock that intensifies competition and consequently lowers the HHI. The effect is correctly measured by the HHI. The problem with the HHI as an indicator of competition concerns the second way. More aggressive behaviour by established firms may force inefficient firms out of the market (selection effect of competition). This increase in concentration incorrectly indicates a decrease in competition. Boone (2000 and 2004) suggests an alternative measure, based on relative profits, which is monotone in competition both when competition becomes more intense through a fall in entry barriers and when there is more aggressive interaction between firms.

After correcting for industry-specific effects (i.e. number of services, average ship size), the **Boone indicator** suggest that over the 2000-2008 period the competition had (slightly) intensified. In detail, the period before 2006 suggests intensified competition. The subsequent years point at a weakening of competition. The turning point coincides with the year when CR4 exceeds 40 % (see Chapters 2 and 3).

Since concentration measurements yield ambiguous measures, the Boone indicator is preferred to establish how competition involves over time.

8.1.3 Relation between the Boone indicator and the HHI

This section focuses on the relation between the Boone indicator and the HHI. It also briefly elaborates on the differences in underlying economic determinants (Boone, 2000 and 2004, and Creusen *et al.,* 2006).

The relation between the Boone indicator (right-hand axis) and the HHI (left-hand axis) is plotted in Figure 8-1. In the bilateral comparison, the HHI and the Boone indicator contradict each other on the direction of change in competition at the industry level. On the one hand, the Boone indicator suggests intensified competition over the 2000-2008 sample period. On the other hand, following the traditional interpretation, the HHI increased over the same period. In general, increases in the HHI indicate a gain of market power and a decrease in competition, while decreases imply the opposite.

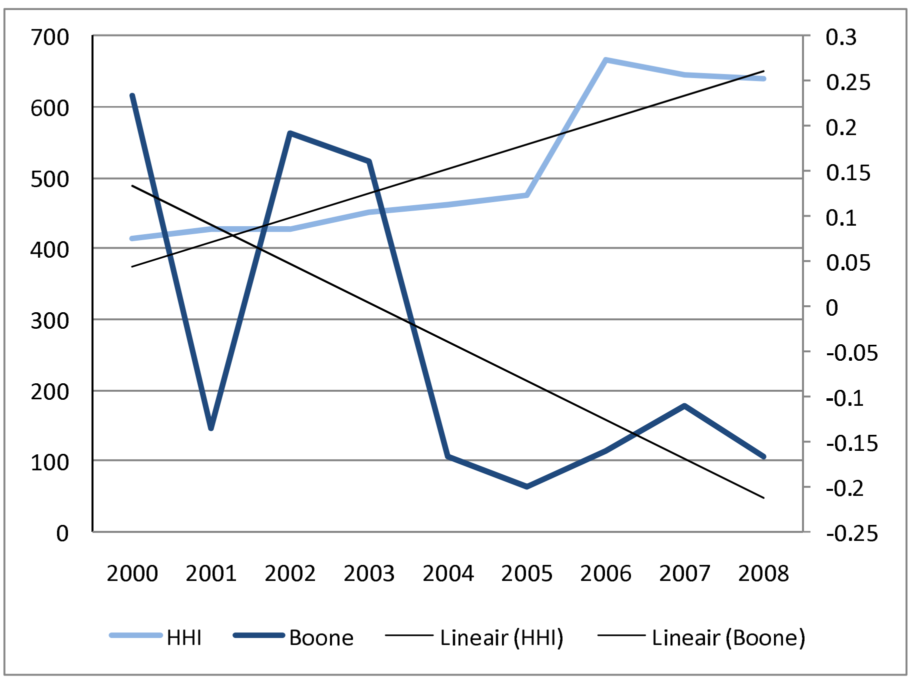

Figure 8-1: Relationship HHI – Boone indicator

However, according to the theory, a negative relationship between the Boone indicator and the HHI is expected. Two analyses test the relationship between both variables. Given the sample period, one must remain cautious about strong inferences from the correlation coefficient and results of the simple regression.

First, the correlation between both variables is calculated. The two indicators should be negatively correlated in order to agree on the direction of the change of competition. Comparing the change of the estimates of the Boone indicator with the change of the HHI statistic (in terms of percentage), both variables are correlated (Pearson correlation) with a coefficient of 0.1828, which is statistically insignificant.

Secondly, Figure 8-2 relates the change of the estimates of the Boone indicator to the change of the HHI statistic (both in terms of percentage) over the period 2000-2008. The plot indicates a weakly positive relationship. The outlier corresponds with the year 2006. Again the impact of the merger of Royal P&O Nedlloyd and Maersk Sealand is observable. Discarding the observation of 2006, the relationship between both variables turns negative.

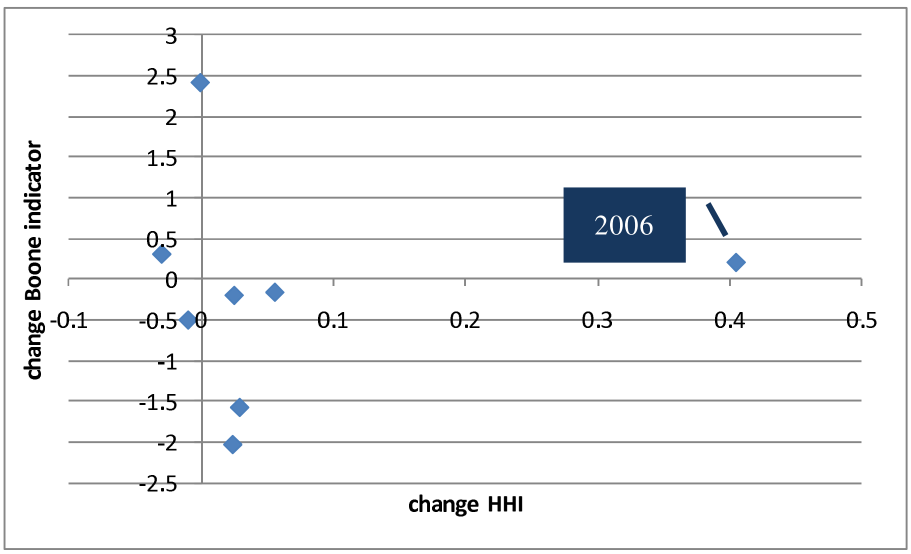

Figure 8-2: Change HHI versus change Boone indicator

Next, the conceptual difference between the competition measurements is analysed from a theoretical point of view. A first explanation for the poor coherence might be found in the fact that the Boone indicator and the HHI enclose different information, which may lead to contradictory changes in competition. Secondly, the observed differences in competition development between the indicators at the industry level can to a degree be traced back to differences in their economic concepts. For instance, a reduction of the coherence between the indicators and the change in competition may be due to more dispersion in efficiency among firms (Creusen *et al.*, 2006). The latter might be the case in the CLSI (see Chapter 6). Another explanation for an opposite direction of change in competition might be found in the cost reducing objective of liner operators by deploying larger vessels (see Chapter 7). This objective has a non-monotone impact on the HHI, but raises the Boone indicator. Last, if aggressive conduct affects in any way the market shares of inefficient firms (reallocation effect), this effect may bias the HHI (Boone, 2000; Griffith *et al.,* 2005). At the level of the industry, aggressive conduct is not directly observable.

Given that the change in the concentration indicator for the CLSI is positive, Figure 8-3 summarises the impact of underlying determinants across the indicators (compiled from Creusen *et al.*, 2006).

<table>
<tr><th colspan="3">Change in concentration indicator: positive</th></tr>
<tr><td rowspan="3">Change in Boone indicator</td><td colspan="2">Change in competition is caused by</td></tr>
<tr><td>positive
(efficiency more rewarded)</td><td>intensifying competition is caused by
- more strategic interaction
- more product substitutability</td></tr>
<tr><td>negative
(efficiency less rewarded)</td><td>weakening competition is caused by
- less entry, due to higher fixed costs (more emphasis on scale economies)</td></tr>
</table>

Figure 8-3: Economic implications

The change in the Boone indicator is positive in the 2003-2005 period. According to Creusen *et al.* (2006), the change in competition might be caused by more strategic interaction and/or more product substitutability (i.e. more liner carriers offering more services to the Far East).

In contrast, the subsequent two years point to a weakening in competition. Then, the explanation could be found in less entry. The latter finding is easily linked with the results of the modelling of both actual and potential entry. Chapter 6 applies the growing persistence of profits literature, an approach beyond the SCP tests and NEIO models. The persistence of profit approach is based on empirical investigation of the dynamics of firm-level profits. The main conclusion is that the quick erosion of the short-run persistence indicates the existence of entry but the fact that some liner operators do earn long-run rents implies that barriers to entry and exit do exist. A study of the Belgian-India trade confirms this finding and finds that the extent of the barriers to entry is moderate.

For the year 2008, the change in the Boone indicator is again positive, while the concentration ratio is slightly decreasing. More entry is the economic implication when the change in the Boone indicator is positive (efficiency more rewarded) (see Figure 8-3).

Since end 2009, this phenomenon is observable. New competitors (e.g. MBG Shipping[142], December 2009; The Containership Company, April 2010; Cyprus-registered Rasiacon, July 2010; Hainan Pan Ocean, Aug. 2010) seek new opportunities. These new ventures are helped by the market conditions, which enable them to pick up the vessels and containers at highly competitive daily charter/ rental rates. This might announce the start of a new period with more competition. If so, the policy change searched for by shippers with the objective of intensifying competition (i.e. abolishment of block exemption) will be achieved.

Further research is needed to understand the effect of the policy change, the financial and economic downturn as well as the recent new ventures.

8.2 Critical reflection and future research

In the light of a policy reflection, this study is especially relevant. It aims to put forward an overall picture of the concentration-competition-profit relationship in the container division. Hence, it contains to understand the effects of competition and efficiency on the liner operators' behaviour.

Secondly, the results suggest that regulators should focus on the trade level since the effects are more clearly identified when working at the disaggregated level than at aggregated industry level (see Chapter 3). Trade lanes labelled 'unconcentrated' do not in general require further analyses from a policy perspective. Conversely, antitrust authorities need to establish whether, in the case of a new merger, competition is threatened. The service portfolio of the shipping companies involved in merger and acquisition transactions may require further action.

Thirdly, given that competition measurements act as barometers only and in view of theoretical and statistical shortcomings of all applied competition indicators, it is advised to use more than one indicator to obtain an accurate impression of competition in the containerised liner shipping industry.

In addition, the study may serve as a benchmark when monitoring and evaluating the effects of changes in competition due to mergers and acquisition, policy changes, the global crisis as well as new entries and exits. For instance, a competition indicator such as the Boone indicator is interesting for policy makers who want to enhance competition

142 January 2010, MBG Shipping failed and exited the market.

or for regulators to find out whether competition indeed increases over time after a policy change (see Chapter 5).

Regarding future research, monitoring and evaluating the effect of changes in competition is a first direction for future research. In addition, further research is needed to check whether the results also stand for a longer sample period. A critical reflection might concern the short time horizon of the research. In general, the containerised liner shipping industry suffers from a lack of long time-series data.

Another topic for future research is a similar analysis for other shipping segments (i.e. tanker, bulk, roll on/ roll of, as well as terminal operations)[143] or other transport modes.

The results of the study should also encourage future empirical studies in the containerised liner shipping industry to avoid assumptions regarding the market structure and the loose use of the terms 'liner shipping industry' and 'containerised liner shipping industry'.

A challenge for future economic research concerns the data (sources). Liner carriers, government institutions, maritime consultancy bureaus, etc. should be encouraged to avoid changes and cutback in data. More data would allow enlarging the sample period and the sample of liner operators. As a consequence, it would also make it possible to compare results over time, to estimate the marginal cost instead of approximating it (see Chapter 5), to examine whether the 'persistence of profits' would persist as well as to identify the determinants of the speed of profit adjustment (see Chapter 6).

More detailed information at trade level would help to better delineate the relevant market. The future repetition of the analysis in chapters 4, 5 and 6 would allow to model the non-structural approaches at trade level. To date, the research has been confronted with the limits of analysing firm-level data at trade level.

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[143] Note: the Boone indicator cannot be used to compare the intensity of competitionbetween industries (Boone and Weigand, 2000).

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Glossary

ACL (liner operator) Atlantic Container Line

Ancillary charges cover the supplementary increase in charges – such as terminal handling charges, demurrage costs, change of destination, special equipment and charges based on the nature of the cargo (dangerous, noxious, refrigerated etc.), … – that are triggered by or linked with the operation of moving containers, i.e. they are ancillary to the service provided by liner operators

ANL (liner operator) ANL Container Line

ANZDL (liner operator) Australia New Zealand Direct Line

APL (liner operator) American President Lines

Average cost (variable) the ratio of total cost to output

AWS (liner operator) Andrew Weir Shipping

BAF (surcharge) Bunkering Adjustment Factor, used to compensate for fluctuating fuel costs.

Barrier to exit◆or any cost incurred by an incumbent wishing to exit from an industry

Barriers to entry◆ or any factor which makes the average cost of a would-be entrant higher than that of an incumbent or which impedes entry in any other way

B/L* A bill of lading is a shipping document by which the master of a ship acknowledges having received in good order and condition (or the reverse) certain specified goods consigned to him by some particular shipper and binds himself to deliver them in similar conditions to the consignees of the shipper at the point of loading

CAF (surcharge) Currency Adjustment Factor

Carrier haulage' or liner's haulage is understood the inland transport service which is performed by the sea-carrier under the terms and conditions of the tariff and of the relevant transport document.

CCNI (liner operator) Compania Chilena de Navegación

CEC (liner operator) Clipper Elite Carriers Lines

Chipolbrok (liner operator) Chinese-Polish Joint Stock Shipping Company

CHKY (alliance) Coscon, Hanjin, K-line, Yang Ming

CLAN (liner operator) Compania Latin Americana de Navegacion

CLSI or container liner shipping industry

CMA CGM (liner operator) Companie Maritime d'Affrètement - Companie Générale Maritime

CNC (liner operator) China Navigation Company

CNC Line (liner operator) Cheng Lie Navigation Company

Conference*, an affiliation of ship owners or operators over the same regional route(s) who agree to charge uniform rates, sailing schedules and other terms of carriage

Container ship*, a ship constructed in such a way that she can easily stack containers near and on top of each other under as well as on deck.

Container*, a large rectangular or square container/ box of a strong structure that can withstand continuous rough handling from ship to shore and back. Typical containers may be 20 feet or 40 feet in length, 8 feet or 8.6 feet in width and 8.6 feet or 9.6 feet in height.

Contestable market◆ or a market with free entry and exit conditions. An outside firm can enter temporarily, and cover its costs when it subsequent exists. Consequently, the behaviour of incumbents is constrained not only by actual competition, but also by potential competition.

COSCO (liner operator) China Ocean Shipping Company

CRn or n-firm concentration ratio (concentration measure), the combined market share of the N largest firms in the market, usually reported as four-firm concentration ratio (CR4)

CSAV (liner operator) Compania Sud America de Vapores

CSCL (liner operator) China Shipping Container Lines

CTE (liner operator) Compania Transatlantica Espanola

D2D or door-to-door, through transportation of a container and its contents from consignor's premises to consignee's premises

DAL (liner operator) Deutsche Afrika Linien

Double dipping The practice of double/ triple dipping is often used on long-haul routes. It means that other vessels also load containers for other trade lanes using intermediate wayports or hubs along the route to unload them.

DSR (liner operator) Deutsche Seereederei Rostock

DWT or deadweight tonnage, the load capacity of a ship measured in tonnes. With container ships, the number of TEUs (Twenty Foot Equivalent Units) is used as a unit of capacity. That is the maximum number of containers measured in TEUs that the ship can transport. Since an empty container takes up as much space as a loaded one, DWT is not used with container ships.

EBIT or Earnings before Interests and Taxis

EBITDA or Earnings before Interests, Taxes, Depreciation and Amortisation

Economies of scale◆ long-run average cost is decreasing with respect to an increase in output

ELAA or European Liner Affairs Association

Elasticity◆ a measure of the responsiveness of one economic variable to a small change in another variable

ESC or European Shippers' Council

EWL (liner operator) Europe West Indies Lines

FCL or full container load

FEU or forty foot equivalent unit

FMC or Federal Maritime Commission, US Government Agency responsible for regulatory aspects of all maritime activities.

GA or Grand Alliance (Hapag-Lloyd, MISC, NYK, OOCL)

Gini coefficient◆ a measure of inequality based on the Lorenz curve, which can be applied to data on firm sizes or market shares

HHI or Herfindahl-Hirschman Index (concentration measure). It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers

HL (liner operator) Hapag-Lloyd or Hamburg-Amerikanische Packetfahrt-Actien-Gesellschaft

HMM (liner operator) Hyundai merchant Marine Co

Hub is the central transhipment point in a transport structure, to which traffic from many ports is directed and from where traffic is fed to other areas/ ports (referred to as spokes)

ICL (liner operator), Independent Container Line

Imperfect competition◆ market structures that fall between the polar cases of perfect competition and monopoly

Industry◆ a group of firms producing a similar product using similar technology

II or instability index, a measure of the degree of market share instability

IRISL (liner operator), Islamic Republic of Iran Shipping Lines (renamed to HUB line)

ISC or Indian Subcontinent

KL (liner operator) K-line or Kawasaki Kisen Kaish Ltd

KMTC (liner operator) Korea Marine Transport Company

LCL or Less than container load

LOA, length o.a. or length over all meaning the overall

Lorenz curve◆ when plotted using firm size or market share data, shows the cumulative sizes or market shares of all firms up to firm n

LT (liner operator) Lloyd Triestino

M&A, mergers and acquisition

Marginal cost◆ the additional cost of producing one extra unit of output

Merchant haulage refers to the inland transport of shipping containers arranged by the merchant/ freight forwarders. This includes empty container moves to and from handover points in respect of containers released by the carrier to merchants

MISC (liner operator) Malaysia International Shipping Corp Bhd

MOL (liner operator) Malaysia International Shipping Corp Bhd

Monopolistic competition◆ a market structure with a large number of firms producing similar but not identical products, and with free entry

Monopoly◆ a market structure with a single firm, producing a unique product and protected from competition by insurmountable entry barriers

MSC (liner operator) Mediterranean Shipping Co sa

Navibulgar (liner operator) Navigation Maritime Bulgare

NDS (liner operator) Nile Dutch Shipping

NE or number equivalent◆ an inverse measure of concentration, which compares the structure of an observed N-firm industry to a hypothetical industry comprising N equal-sized firms.

NEIO or New Empirical Industrial Organisation◆ an approach which attempts to draw interferences about market structure and competitive conditions form direct observation of conduct at firm level.

NIO or New Industrial Organisation◆ theories of industrial organisation which focus primarily on strategy and conduct at firm level, rather than on market or industry structure

NOL (liner operator) Neptune Orient Lines

NPX or New Panamax Ship

NSCSA (liner operator) National Shipping Co. of Saudi Arabia

NVOCC or Non Vessel Owning/Operating Common Carrier - (a) A cargo consolidator of small shipments in ocean trade, generally soliciting business and arranging for or performing containerization functions at the port. (b) A carrier issuing Bs/L for carriage of goods on vessel which he neither owns nor operates.

NWA (alliance) New World Alliance (APL, Hyundai, MOL)

NYK (liner operator) Nippon Yusen Kaisha

Oligopoly◆ a market structure with a small number of firms, whose products may be identical or differentiated, and where there are barriers to entry. The firms recognize their interdepence

OOCL (liner operator) Orient Overseas Container Line Ltd

OTAL (liner operator) OT Africa Line

PIL (liner operator) Pacific International Lines

PNSC (liner operator) Pakistan Nat'l Shg Corp.

POCL (liner operator) P&Ocean Container Lines

RCL (liner operator) Regional Container Line

Revenue test or a test proposed by Rosse and Panzar, which examines whether firm conduct is in accordance with the models of perfect competition, imperfect competition or monopoly, based on observation of the impact of variations in factor prices on profit-maximising firm-level revenues.

ROA (variable) return on assets, net income divided by average earning assets

ROE (variable) return on equity

ROS (variable) return on sales

RPONL (liner operator) Royal P&O Nedlloyd Line

SAECS South Africa Europe Container Service

SAILS (liner operator) South Africa Independent Liner Services

SCI (liner operator) Shipping Corporation of India

SCP or Structure-Conduct-Performance◆ an methodological approach for research in industrial organisation, in which the structural characteristics of industries are assumed to influence or dictate the conduct and performance of the industry's member firms.

SICT (liner operator) Shandong International Transportation Corp.

Slot refers to an unit of space in a containership. One slot equals one TEU of capacity

Slot exchange agreement is an agreement between two or more carriers to exchange an equal amount of space on ships operated on each other's respective services in the same trade lane.

Sunk cost◆ expenditure on items, such as advertising and research and development that is non-recoverable in the event that the firm exits formt he industry

Surcharges relate to charges that are meant to cover uncertainties, such as the Bunker Adjustment Factor (BAF), Currency Adjustment Factor (CAF), Congestion Surcharges (CSC) and War Risk Surcharge (WRS)

SYMS (liner operator) Shandong Yantai International Maritime Shipping Company

TEU* Twenty-foot equivalent unit or a measurement of cargo-carrying capacity on a containership, referring to a common container size of 20 ft in length

THC (surcharge) Terminal handling charges

TOL (liner operator) Tasman Orient Line

TPL (liner operator) Trans Pacific Line

UAL (liner operator) Universal Africa Line

UASC (liner operator) United Arab Shipping Company

UCS Ultimate Container Ship (18,000 TEU Malacca-Max)

UFS (liner operator) United Feeder Services

ULCS or Ultra Large Container Ship (+ 10,000 TEU)

USL (liner operator) United States Lines

VLCS or Very Large Container Ship (between 7,500 - 10,000 TEU)

VOCC or Vessel Operating Common Carrier

VSA or Vessel Sharing Agreement

WHL ((liner operator) Wan Hai Line

YML (liner operator) Yang Ming Line

ZIM (liner operator) is an acrostic for the Hebrew words for Israel Merchant Navy. The Hebrew word “Zim” is used to refer to “large vessels” (www.zim.co.il)

WTO or World Trade Organisation isis the only international body dealing with the rules of trade between nations

Terminology, abbreviations,... denoted by an asterisk refer to Paelinck, 2010 while a diamond refers to Lipczynski et al., 2009.