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Changes of concentration patterns in European container ports during and after the crisis

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Contents

CHAPTER 1

Introduction

1.1 Background

Over the last 40 years, there have been significant changes to international trade and maritime industry, concerning not only the volume of products transported, but also the technological advancements of this period. One of the most significant changes was the adoption of container as the primal mean of transportation of goods, something that changed the route of history for both shipping lines and ports. Especially, Containerization era resulted in a series of changes concerning port development during the years, from an initial unorganized port system serving regional markets, to a vast network of seaports characterized by inter-port competition for container volumes and hinterland expansion. The present period, is characterized by two trends in port evolution already studied by some academics (Notteboom (1997), Wang (2002)) and in some cases for seed as a coming trend (Hayuth 1981), the so-called concentration and deconcentration of container cargo in ports.

Concentration is generally considered as the accumulation of container traffic in the large load centers, leaving the medium-sized and smaller ports in a 'traffic starvation''. On the other side, Deconcentration is regarded as loss of an amount of cargo traffic from the load centers which is shifted to the medium and small sized ports. There is a slight diversification in the exact definition of the concentration-deconcentration phenomenon by the academic literature; so, an executive analysis is going to be implemented in a later chapter.

1.2 Purpose of study

Concentration/deconcentration tendency in ports is a phenomenon, which constantly changes during the years as shown by previous researchers (Notteboom 2010), Wank (2002) attributed to a variety of reasons. The methods used by previous authors to study the phenomenon had been either qualitative (investigating through case studies) or quantitative (by using mathematical models)**.** There a few attempts for a combination of both qualitative and quantitative approach of this phenomenon (Notteboom 1997, 2006) most of them targeting in a small amount of ports. This research tries to close this gap, making a combination of case studies and statistical analysis for the period 2007-2012 with a great amount of container ports (157 ports while the previous higher amount of ports was 76). The study becomes even more interesting because it searches the current phenomenon during the years of economic recession in Europe (2008 and on). Accordingly, the main research question in this analysis is:

Research question:

How and why did concentration-deconcentration patterns change in European container ports during the period

2007-2012?

Contribution to the academic society. The study is important in order to explain whether the forecasts of previous authors about the results of financial crisis in container ports are confirmed. Except for that, it is important to see whether recent conclusions of researchers about concentration during the crisis are confirmed by studying a wider number of ports in this period of years that has not be studied yet with mathematical models.

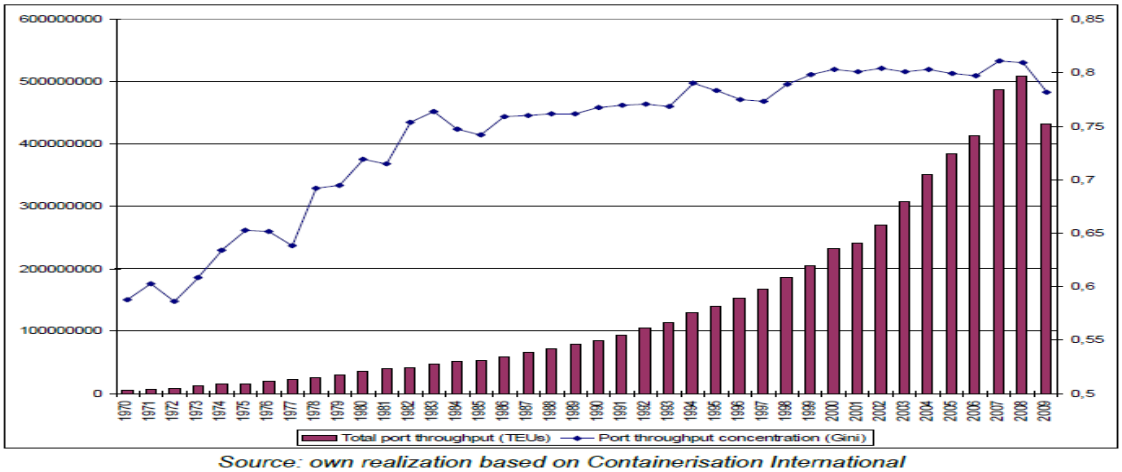
Contribution to maritime industry. Through the analysis, the results indicate the policies of ports and shipping lines that resulted in the change of patterns of concentration/deconcentration. The conclusions produced may be a helpful guidance for the shipping lines and private terminal operators concerning the reasons for the present trends. Moreover, the outcomes can be helpful for port authorities (either the ones targeting to concentration or the ones targeting to deconcentration) in order to realize whether the strategies they stressed are towards the right direction or not.

Importance of studying the phenomenon in this particular period. The great economic recession that started in 2008 resulted in great damage to the maritime industry. According to statistics, the major downfall in traffic was inflicted during the years 2008 and especially 2009.However the results cannot be attributed and studied in this particular period only, but also for the years to come. This is indicated by a series of authors studying the phenomenon. Ducruet and Notteboom (2012) during their research for linear shipping Networks, demonstrate the concentration in port from 1970 to 2009 mentioning two important results for the periods studied:

- The crisis was the reason why their results indicate a downward tendency from the ports for the year 2009.
- There is a constant fluctuation in concentration/deconcentration levels indicating that the results may change annually.

  Notteboom and Ducruet (2012) show these results in their analysis for the years the studied in the following table.

Figure 1: World port throughput and concentration, 1970-2009



Source: own realization based on Containerisation International

Notteboom and Ducruet (2012)

1.3 Methodology and Empirical analysis

In order to see the factors driving to (de)concentration tendencies, a review of the previous studies (qualitative and quantitative ones) will be made. In this part, the definition of the phenomenon is going to be given by the different authors. Except for that, the empirical approaches of the authors will be analyzed (quantitative and qualitative ones) along with the results that were generated.

Moving forward, the empirical analysis of this study is going to be based on four main steps:
The first one is the construction of the database that is going to be used for the analysis by combining a variety of online databases. The second step is the separation of the different port ranges where the phenomenon is going to be studied. The third step includes the quantitative part, where a set of indicators (N-HHI and Gini coefficient) will be used in order to identify how concentration/ deconcentration changes during the years of crisis .However, in order to be able to make a proper comparison, the year 2007 is also going to be analyzed in order to see how was the situation just before the recession. Finally, the fourth step includes the qualitative approach that searches the factors that explain the results produced and whether they are similar with the findings of previous authors.

CHAPTER 2

Evolution of concentration

In order to better understand the phenomenon and define what is concentration and deconcentration, an extensive analysis of studies of previous authors has to be conducted.

2.1The first studies on concentration patterns

Taffee (1963) was the first who introduces a five-phase model concerning port development. In his model's final phase, he outlines the concentration tendency of polarizing huge amounts of cargo in load centers. He also mentions that concentration may result in the disappearance of the smaller ports in the network. Barke (1986) extended Taaffee's model, introducing deconcentration phase According to his approach, the constantly growing port areas begin to face congestion problems. This results to the transport of some port activities in more peripheral sites. An alternative version of deconcentration considered by Barke is the extension of existing ports to peripheral sites or even the creation of new port terminals in order to satisfy the traffic. It has to be said that the latter was a favorable method until the 90's.After 90's the most favorable port locations for new facilities have been already captured, so there was no space for Greenfield investments.

Rimmer (1961) presented a five-phase model of Australian ports development .He once again mentions a phenomenon where the bigger ports gain ground at the expense of the smaller ones. During his five phase model, he identifies concentration (phase 3) as a tendency outlined from the 19th century where the bigger ports gained cargo in the expense of the smaller ones. The main difference with him and the rest of the authors is the fact that between concentration and deconcentration phase the centralization phase is intervened that could be characterized as an intermediate level. The author believes that despite the early existence of deconcentration, a full concentration era will be applied by the introduction of containerization (through the standardization of the cargo units).

Kenyon (1970) during his research on American ports identifies reasons for the concentration of general cargo in New York port. He mentions that a mix of industrial activities concentrating in large city centers along with the new technological achievements (increase of ship size) led to further concentration of cargo in bigger ports at the expense of the smaller ones. He also is the first one mentioning proximity as important element in the traffic distribution especially for continental routes (connection America-Europe).Despite the fact that during this period, containerization was not yet fully established, he foresees that with the upcoming inland infrastructure and the challenge of achieving economies of scale, containers will result in a concentration tendency living out of the game the smaller ports. The ones that were going to have full benefit of containerization will be the ones that are going to be the first users of the new technology.

Hilling (1977) also agreed with Kenyon for the future of containerization. He provides a four-phase model (primitive surf-ports, Lighterage and surf ports, Deep-water and surf ports and deep-water ports) in the port system of Ghana. Despite the lack of accurate database, he identifies concentration-deconcentration tendencies according to the above mentioned port development phases from 1400 until 1970. Fluctuations between diffusion of port traffic (deconcentration) to concentration tendencies are identified by the author until a stabilized concentration situation where traffic continuously gathers in the big ports.

Until now, the majority of the authors mentioned a concentration tendency in the ports as the years go by. However, the authors did not include container ports in their studies because this technology was still in a primitive phase. Some of them mention though that an even more concentrated tendency is the most obvious thing to happen by the introduction of container.

2.2 Container technology dominates.

2.2.1 Hayuth's Peripheral port challenge

The first author who exclusively studied the phenomenon in container port level was Hayuth (1981) in his five-phase model. He stated that concentration-deconcentration of port traffic was the natural consequence of port evolution that was a result of many factors. The first stage can be characterized as the pre-container era, moving to the second period (introduction of containers), to the third one where the boost of containerization in the world economy is obvious. The most important periods during his analysis are considered the fourth and fifth. More specifically, Phase 4 includes the load center concept where concentration tendency occurs. The use of intermodal transportation along with the rapid growth of container use create the concentration of container traffic in a small number of ports .During this phase, there are two tendencies that should be mentioned. First, the bigger ports concentrate most of the cargo at the expense of the smaller ports. Secondly, in this phase there is a clear distinction concerning the competitors: The top ports that compete for the lion's share, and the smaller ports that compete with each other for what it has left. Hayuth identifies four reasons for this concentration tendency: hinterland connection, proximity to strong markets, reduction of ports of call by the shipping lines for reduction of cost and the attempt of shipping lines to achieve economies of scale during the final phase (Phase 5) load centers are still the dominant ports in port traffic. However the challenge of the so-called '*peripheral ports*' is the new concept. According to the author, the small port in its attempt to attract more cargo creates conditions (lowering charging fees or other incentives) in order to attract the shipping lines and turn traffic to them instead of the big load centers. Except for that, the long distances inside the huge load centers create also time-cost problems that may result in the deconcentration to smaller ports. The phenomenon is also followed by a significant penetration of the small port to the hinterland that was once captive by the load centers seeing a deconcentration tendency in American ports.

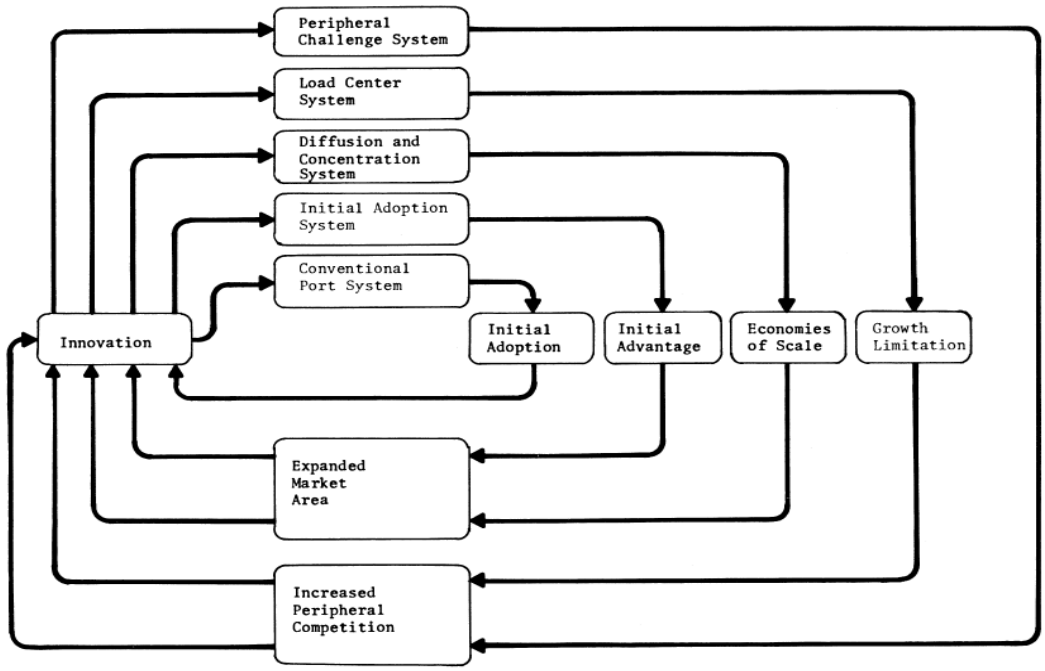


Fig. 2. The Dynamics of the U.S. Container Port System.

Hayuth's five-phase model (1981)

Kuby and Reid (1992) tried to see whether Hayuth's results were also applicable in general cargo for period 1970-1988.Their results indicated a concentration of general cargo for that period, in contrast with Hayuth's results. The interpretation was that, the tendency was different in containers from in general cargo because of the use of new technology. Especially, the standardization of technology, making it available in more ports (not only the large ports who were the initial adopters in the first years) was the result of deconcentration observed and for seed by Hayuth in containers in contrast with the concentration tendency observed in general cargo.

Until now, the majority of the reports regarded (de)concentration as phenomenon that steamed out by reasons such as, the creation of economies of scale, reduction of cost by the shipping lines and strong hinterland connection.

However, another school of thought gives more emphasis in other reasons, far away from the obvious cost depending factors. The managerial role of port authorities and terminal operators, the governmental decisions are reasons explained by the some authors as the motives for change in concentration patterns. Ducruet(2009),Studying the phenomenon in North Korea, he mentioned that the changes in trade patterns were mainly a result of geopolitical change and not as a result of economies of scale policy. Especially, in an economic and port system constantly losing ground, Nampo, the biggest gateway port in containerization and general cargo in North Korea, manages to increase its share .The reasons were the good political relationships with China. China was allowed by North Korea to create their own terminal in

the port. It has to be mentioned that previous similar attempt by South Korea was rejected. This particular case study indicated that the positive political relationships of Pyongyang with China, along with the negative relations with the West, resulted in a positive concentration on specific ports in Korea, at the expense of the rest of the ports. Except of that, an important observation is that a concentration tendency occurs when on the same time the region studied is not in a positive economic growth, something not shown in previous researches.

2.2.2 Concentration factors are not the same for every region.

However, even the governmental and managerial issues were not enough to explain completely the reasoning behind concentration. Some authors mentioned that changes occurred in port concentration are an outcome of a dynamic environment that is different for every country or port range. This dynamic environment may change by a variety of reasons which was mentioned above, from cost factors, to government decisions and management of port authorities. However, there is not a standardized combination for all the ports and all the cases.

Le and Ieda (2010) studied the phenomenon in a country level with a GEO-economic concentration index between Japan, Korea and China. The results indicate different outcomes among the three countries. The writers consider the different results generated as outcome of different port governance and port development policies. Their main conclusion is that differences in concentration between countries cannot be based only on geographical or economic reasons but also in the socioeconomic background of the region studied.Wang (1998) who studied that containerization path of Hong Kong from 1960 to 1995 supported this:'' *the development paths of container port systems may vary with regional circumstances''* (Wang 1998).

Being the biggest port in China, Hong Kong enjoyed a monopolistic status until the mid-80's.However, its dominance ended in during the 90's were a number of smaller ports (Yantian, Dalian) started to gain ground. However, as Slack and Wang (2002) mentioned, Hong Kong does not match in any of the criteria that could explain the deconcentration tendency. Record of container moves per hour, efficient technological equipment and lack of congestion are Hong Kong's characteristics. So, the question is how is it possible such a successful load center facing the peripheral port challenge? Wang (1998) gave the answer already. The small ports were supported and funded by the state in order to accommodate larger vessels and even more traffic from the west. This change (influenced by the government) along with the rise of some intermediate ports like Pusan (driven by global terminal operators), resulted in a diffusion of traffic for Hong Kong. Except for that, Despite seeing a lot of evidence of peripheral port challenge, as smaller ports started to gain ground, in the case of China, this was not attributed in a high extend to lack of space or reasons of congestion as mentioned by Hauyth in American ports. The main reason was the policy of government and private hub operators established in the smaller ports.

Figure 1. Hong Kong and the Pearl River Delta.

Peripheral port challenge in China (Slack and Wang 2002)

However, government and terminal operator's role is different in every case. An example is the case of Singapore as studied by Slack and Wank (2002). When MAERSK shipping line demanded the reduction of port charges by PSA (government owned company handling the port), PSA refused, in the fear of similar demands by other companies. The result was the mitigation of MAERSK's operations in the small port of Pelepas. Despite the costs and time needed for the port to become operational for MAERSK'S needs, it finally came to operation in 2000. The result was a heavy loss for Singapore, not only because they lost their greater customer, but also because other shipping lines followed the reallocation (Evergreen).

Figure 2. The Port of Singapore and the Straits of Malacca.

Peripheral port challenge in Singapore and the mitigation of Maersk from Singapore to Pelepas (Slack and Wang 2002)

On the same study, Slack and Wank (2002) studied port of Shanghai. The port did not handle the same amounts of cargo such as Singapore and Hong Kong. However, being a very important port handling approximately 6 million TEUS in 2000 was the port that had to face the dredging costs that created a

drawback for the increase of traffic. However, the government, instead of developing the dredging operations in Shanghai, preferred the development of Nimbo and Yang Shan port, ports located near Shanghai, being able to host the bigger vessels under further development and much closer to shipping lanes. In this case, a combination of government policy with dredging costs are the result of deconcentration in a port region, something that was not observed in previous cases.

Concluding their study, Slack and Wank (2002) mentioned that the main drivers of deconcentration process are a combination of the role of the global terminal operators, port authorities' management, and their contracts and relationships with the shipping lines. These reasons themselves show that every port case is different and the deconcentration cannot be attributed only in one reason.

2.2.3 Concentration of container ports in Europe

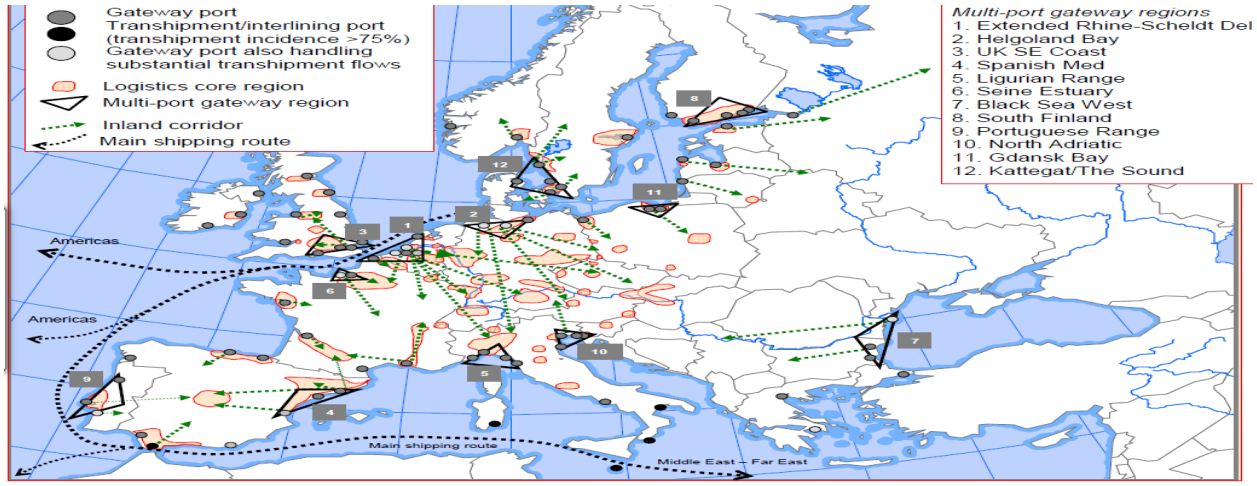
Until now, the authors mentioned described concentration in a global scale. It is important to study also the phenomenon in European range level. Notteboom(1997) was one of the first authors who studied the concentration/deconcentration tendency so extensively in European ports for the period 1980-1994 with various statistical methods for three different port ranges in Europe(Atlantic, Mediterranean and Hamburg –La Havre range), trying also to make a comparison with the results of authors concerning the US container system. One of the main differences with previous authors, is the fact that he regards deconcentration as a tendency that occurs not only in the peripheral port challenge introduced by Hayuth(small ports taking considerable traffic share by the small ones) but as the general change in port traffic from load centers to small and medium sized ports. Except for that, he mentioned that RTW (Round The World) routes has been one of the main reasons for the changes in concentration and not congestion in port areas as mentioned in previous authors. Seeing his research on a time basis, his results indicated a great fluctuation in the container port system. In the early 80's the results were different in each port range (deconcentration in Mediterranean, concentration in Atlantic and not specific results for Hamburg Le Havre range). Moving forward, in the mid 80's there was clear concentration in all ranges, coming to the end of 80's and early 90's were deconcentration is the result. He also concluded that the results towards deconcentration were not attributed to the peripheral port challenge as indicated by Hayut in Us but by the fact that transshipment hubs in Europe were the ones gaining ground absorbing more cargo than before.

The transition to a not only cost- depending theory came later on also in Europe. Brunt(2000) during his research concerning Irish ports mentioned reasons such as the inclusion of Ireland in EU and the governmental plan to forward a trade in its four biggest ports (Cork, Dublin, Roeselare and Waterfront) by huge subsidies in order to increase the European trade with Ireland, reducing on the same time the investments used for smaller ports.

Monios and Wilmsmeier (2010) studied concentration in English ports. They mention that the last four decades were characterized by a shift of concentration traffic from the north and central ports to the south, close to the English Channel that has closer proximity. According to their point of view, the deconcentration pattern is still blur among the authors. They believe that until now there can be no clear

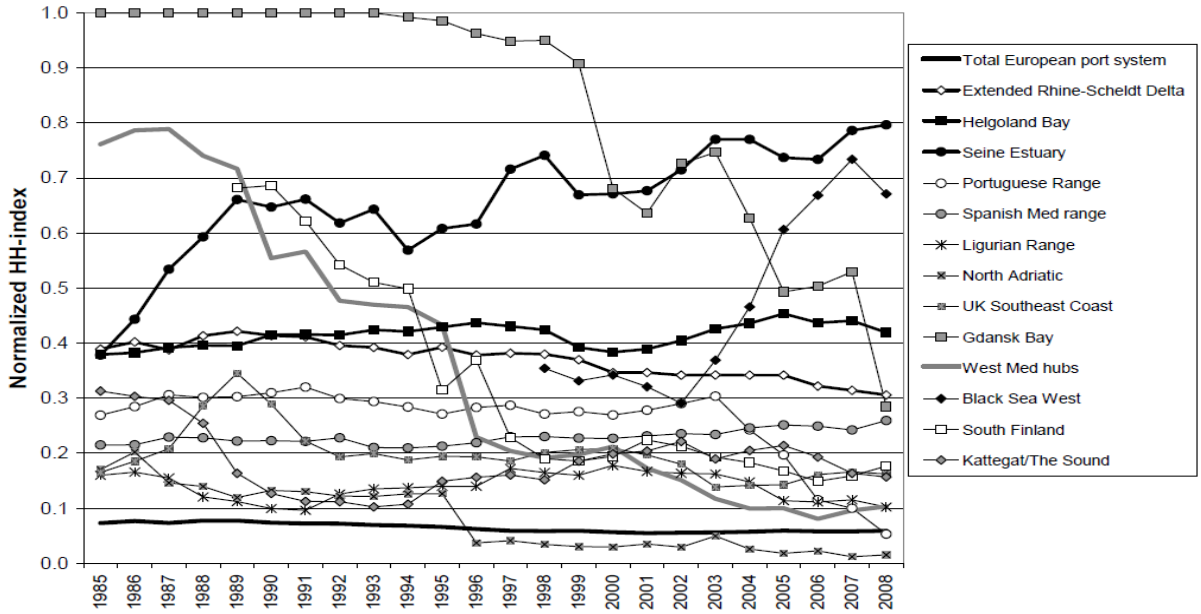
definition whether deconcentration occurs because of false strategic choices in the port system operation or it is a systematic approach by government and port authorities that targets to cargo diffusion. They also mention that deconcentration tendency is not only a result of port system operation but also is determined by the hinterland transport system along with the economic system in terms of logistics operations. Their analysis indicates that concentration is a phenomenon that has to be studied and analyzed in a combination of factors and this is the reason it cannot be attributed only in one reason.

When Notteboom revisited this phenomenon (2010), he had discovered new results. He concluded that there was a shift in container traffic. It is also the first study that he mentions the political influence as a reason for change in concentration patterns.



Notteboom (2010) the European container port system

According to his study, the power once gained Mediterranean ports by the transshipment incident was reduced due to the direct shipping routes of the shipping lines to specific ports depending on the demand of the shipper. Using mathematical models (HHI) he identifies great fluctuations in (de)concentration patterns from his initial year of study (1985) to the final one (2008) as seen in the following graph:



HHI results Notteboom (2010)

He concludes that the results indicate a deconcentration tendency in the whole European range. Container cargo seems to be much more concentrated than other segments. Writing the article in the late 2009 he was not able identify the results of the crisis; however he mentions that the first signs indicate that larger ports are in favor in comparison with the smaller ones.

2.3 Defining Concentration

By studying the previous authors, it is made clear that there have been some differences between the between them on how they see and interpret concentration tendencies. The following table indicates some of the most notable approaches by writers concerning concentration/deconcentration.

WRITER	DEFINITION ON CONCENTRATION	COMMENT OF THE WRITER FOR THE PHENOMENON
Hayuth(1981)	'Concentration is the phenomenon of polarizing container traffic in the big load centers in the expense of the smaller ports.'	the reallocation of port activity from the load centers to smaller, more peripheral ports , taking advantage congestion and diseconomies of scale created in the load centers
Barke(1986)		large ports that face congestion due to the rapid growth of containers , forcing the mitigation of port activities in more peripheral or new areas

Slack and Wang(2002)		*'The relocation of facilities, from older confined berths to more extensive sites that may also offer deep water access, or the construction of new ports, built to relieve congestion at the established centers, the concentrating tendencies of scale economies are mitigated'*(Slack and Wang(2002)
Ducruet(2009)	Phenomenon that 'stems the path-dependency of large agglomerations and the resilience of large load centers implementing efficient urban and port planning policies avoiding congestion' *Ducruet(2009)*	'Occurs due to new port development, carrier selection, global operation strategies, Governmental policies, congestion, and lack of space at main load centers.' *Ducruet(2009)*
Liu Wang and Yip(2012)		They see decentralization process the mitigation of cargo traffic from Hong Kong to two more ports Shenzhen and Ghouanzout
United Nations (1998)	*Concentration in the field of maritime transport means that relatively larger ports, shipping companies and their alliances are increasing their market share at the expense of the remaining smaller players(UN 1998)*	
Monios and Wilmsmeier(2010)	➢ Geographical concentration: South English ports concentrate 85% of container traffic ➢ Container traffic: concentration of cargo in a specific port or specific ports generally in England.	
Le and Ieda (2010)		*''The construction of new ports with better geographical location, as well as the ambition of small ports to become the regional load centers , due to congestion and diseconomies of scale at established in load centers'' Le and Ieda 2010*

The above-mentioned Table indicates the fact that there is not a clear agreement. As it can be seen, there is a general agreement that concentration is the tendency of focalizing the cargo traffic to the big load centers. On the other hand, deconcentration is considered the tendency of dispersing the container traffic in a larger number of ports.

Apart of this agreement, the ideas for the phenomenon vary. Some authors explain concentration as the traffic gained the load centers by the smaller ports. Others explain it as the concentration of traffic in a small amount of ports no matter whether it came from smaller or bigger ports. There are also authors who claim concentration in a more clearly geographical perspective indicating the geographical position of a number of ports in a close proximity to each other.

This is the same for deconcentration. Deconcentration by some is considered as the phenomenon of diffusion of cargo from the big load centers to smaller ports or even new ones. Others consider it as the disperse of cargo from bigger number of ports the rest of the port range, no matter the size of the port that takes the cargo. However, in recent years there have been researchers (Notteboom) who regarded concentration tendency as the ability of a small number of ports to increase its cargo traffic , no matter if it was by attracting cargo at the expense of other ports or due to just better financial situation that increased demand in the market. From the moment, that this research tries to identify the fluctuations of concentration and the factors that caused it during the crisis an approach towards Notteboom's point of view is going to be given. Accordingly:

Concentration is the phenomenon of polarization of container traffic in a few numbers of ports.

Deconcentration is the phenomenon of diffusion of container traffic from a small number of ports to a wider set of ports.

Accordingly form now on:

- **Concentrated range is the range that polarizes the container traffic to a small number of ports.**
- **Deconcentrated is the range that disperses the traffic in a wider number of ports**
- **(De)concentration tendency/trend is the up/down warding fluctuation of concentration levels of a port range during the years of study(2007-2012)**

CHAPTER 3

Factors driving to (De) concentration

This part is going to summarize the factors that according to the literature review drive to concentration and deconcentration tendencies.

3.1 Factors driving to concentration

Early adoption of the container function.

Hayuth(1981) supported that ports that were the first ones establishing the container function before the third period(boost of containerization)were the ones that managed to have the precedence in the process ,managing to polarize the cargo in their operations.

Technological improvements

The rapid growth of container traffic resulted in the need for new technological advances for both the shipping lines (as means of transportation) but also for ports. Accordingly, a rapid change in costs function happened. The fixed and variable costs for the equipment skyrocketed and only the big load centers were able at least in the first years to bear them.

Cost reduction that favors concentration

Not long before Hayuth's model (1981), there was the belief that the concentration tendency was the struggle between ports for dominance (inter-port competition). However, he was the first one to acknowledge that one of the main reasons was the need for reduction of costs.

Some of the costs mentioned are described below:

- *Turnaround time, of ships in ports*
- *Total voyage time of the ships in terms of time.*
- *Charges in order to enter the harbor*

Such costs could be more easily faced by the reduction of ports of call by the shipping lines. It was obvious that the shipping lines would prefer to reduce the calls in the smaller ports and on the same time maintaining the bigger ones, resulting in this way to the concentration tendency.

Economies of scale.

From the moment that operating scale increases, the extraordinary fixed costs are dispersed in more movement units (containers).Consequently, the cost reduction of unit per cargo is achieved. The big load centers that were able to offer loading and unloading processes to the shipping lines of such extend, were the ones that would be preferred in comparison with the smaller ones that did not have this ability.

Maintenance of the main shipping routes by the shipping lines.
Through the reduction of ports of call, shipping lines have the ability of cost reduction. On the other hand there was still the need for customer satisfaction so, shipping lines had to maintain the traffic routes that passed through the major service channels that (at least for Hauyth's period) were locations dominated by the load centers, and leave the smaller ports 'out of the schedule'.

Negative economic situation of the region studied.
Ducruet (2009) proved that concentration tendency occurs when the region that is studied is not in a positive economic growth.

The continuously growing traffic of the transshipment centers located near the main shipping routes.
United Nations (1998) mentioned the importance of transshipment centers for the concentration pattern. The fact that transshipment centers had not significant gateway and hinterland operations made them focus and specialize in the transshipment of cargo, giving the ability to the shipping lines transport huge amounts of cargo in the near port region. Except for that, their favorable locations near the most important (translantic shipping routes) made them polarized centers of container traffic. Transshipment hubs were mentioned also by Hayuth (1981) who mentions that transshipment hubs in Europe were the main reason for concentration of cargo in.

Hinterland connection.
The concentration concept is also boosted by the fact that the load centers had developed a strong captive hinterland network through specialized equipment and transportation means, creating more efficient movement of the cargo.

Strong local market.
Hanelt and Smith (1987) research indicated that imports tend to be much more concentrated than exports. To be more specific, when importers and exporters were asked which are the most important factors on choosing the ports of call, importers mentioned the size of the local market for the port selection. A nearby strong local market that has the ability to consume most of the products, the port is selected from the moment that the transshipment costs are avoided. On the other hand, exporters mentioned other reasons such as transit time, or direct/indirect port costs as important (the standard cost-concerns implied in the whole literature) seeing ports as 'another part in the supply chain''. Rimmer (1967) also observed the above tendency concerning general cargo.

RTW services:
Round The world Services (RTW) are services that result in cargo polarization. This is because these kind of services make an one point direction trip .This is the reason why shipping lines prefer load centers that are able to accommodate big amounts of cargo, excluding the smaller ports .The RTW routes are so important, that a lot of new ports emerge mainly in order to be able to take advantage of the RTW routes (Notteboom 1997) .So, in RTW there cannot only attributed concentration tendencies but also and the emergence of smaller ports leading to deconcentration.

The role of global terminal operators.

Some ports (case of China studied by Ieda and Le (2010)) indicated an increasing degree of concentration levels from the moment that global terminal operators operated in specific ports that had advantages concerning the favorable location or the captive hinterland. According to the research, ports having terminals given by concession in terminal operators or shipping lines may develop greater degree of concentration, absorbing cargo at the expense of the smaller ports in the specific port range. Except for that UN (1998) research mentions that the concessions occurred in some ports from private operators is in favor of the governments since they are able to avoid costs concerning the construction of facilities or dredging costs that demand enormous budgets.

Costs of transition to a new port

In some cases, shipping lines (and consequently the shippers) do not change the selection of their port of call despite the fact that they do not consider it as the most efficient one. This is because the transition costs from one port to another may be even higher for the shipping line.

Governmental intervention and type of governance

The type of port governance may have different outcomes in the concentration and deconcentration of ports. This distinction is made in the next page:

- *Decentralized port governance leads to concentration of ports.*

It is important to see the study of Ieda and Le (2010) about China's dual governance. The general port strategy is operated by the maritime government agency; however, the local governments and port authorities can have their own policy referring on how they are going to obtain funds. This resulted to the participation of foreign funds in specific ports selected by global terminal operators (given by concession) and gave a great boost in a these specific ports traffic activity. As a result ,ports that were not in the plans of global operators had decreasing values from the moment that the shipping lines had as port of call only their selected 'dedicated' ports an terminals polarizing the container traffic in specific places.

- *Centralized port governance and concentrated port development*.

An example of the above-mentioned strategy was Korea.

With a centralized policy concerning the port management, according to government program, some ports (Busan) were selected as the ports that were going to be funded in order to be developed as great hubs. Except for that, they increased their transshipment operations in order to be able to attract even more traffic.

3.2 Factors driving to deconcentration

Congestion and lack of space in the load centers

Load centers are incapable of handling the continuously growing container traffic because of the unavailability of further expansion that results in congestion. Diseconomies of scale start to appear resulting in the loss of the main advantages that the load centers had during this period.

Favorable location

Hayuth (1981) was the first having acknowledged the importance of hinterland and foreland access for the increase of cargo traffic in a port. The ability of the smaller ports or the new ones to create railway infrastructure that connected them to emerging markets was one of the reasons for the immediate growth of smaller ports at the expense of the load centers. Hayuth (1981) concerning the Port of Oakland demonstrated an example. The ability of the port to construct container facilities near the terminals made it acquire container traffic from Port of San Francisco that was unable for urban expansion. Except for that, Baird (1996) was the one who proved that ports that have deep-water access or are located in ocean shipping routes are more attractive to the shipping lines because they can use their largest vessels in order to achieve the economies of scale. Moreover, of Zohil and Prijon (1999) proved the significant relationship of traffic growth with the deviation from the shipping routes confirms favorable location as a reason for deconcentration tendency. However, the fact that some upstream ports continue their success all these years (Hamburg and Antwerp) indicate that the site location is not the only factor that may lead to deconcentration tendency and it is another evidence that the reasons resulting to (de)concentration patterns vary depending the socioeconomic background of the region studied something notified by a series of researchers Slank and Wank (2002), Ieda and Le (2010).

Long distances inside port areas.

Great load centers that had the area in order to be extended and host huge amounts of container traffic, created many costs because of the equipment costs needed for handling the cargo along with the longer times for covering the long distances inside the port.

Involvement of private investors (terminal operators, shipping lines) in peripheral port's management/investment.

Global operators are mentioned before as a significant reason for the concentration tendency. However, evidence depict that the global operators result also in deconcentration of a specific port range. According to Wang (1998), the rise of the peripheral ports (Shenzhen ports) was a result of lower labor costs and land costs in comparison with Hong Kong's charges. However, the most important reason for deconcentration was the involvement of Hong Kong's TOCs (Terminal Operator Companies) in the management of Shenzhen's terminals. This also holds true for cases in Europe. Ducruet and Notteboom (2012) in their study for the linear shipping networks, they indicate that the establishment of dedicated terminals by the shipping lines does not imply cargo concentration in specific ports. Even in cases when

shipping lines may take in their possession a whole hub, still the shipping lines choose to have a diffusion strategy in order to have more choices in terms of ports of call for the shipper.

Shipping lines conflicts with load center's port Authorities.

When MAERSK shipping line demanded the reduction of port charges in Singapore port, PSA (state owned company that operates the port) refused. PSA thought that accepting such demands would have a domino effect in the also for the other shipping lines. The result was the shift of MAERSK's operations in the small port of Pelepas. Despite the costs and time needed for the port to become operational for MAERSK'S needs, it finally came to operation in 2000. The result was a heavy loss for Singapore, not only referring to their greatest customer, but also because other shipping lines followed this reallocation (Evergreen).

Weather conditions.

Ducruet (2009) mentions that deconcentration process can be also forwarded by a different set of parameters such as weather conditions. The example of North Korea's ports that were not vulnerable in extreme ice weather as China and Russia's ports is an indicative result of how good weather can affect concentration process.

Metropolitan power of port cities.

As mentioned by Kenyon (1970) the proximity to a metropolitan area, is an important reason for concentration. This can be steamed out by the fact that labor cost is less expensive. Except for that, there are always bigger markets in proximity of a large city. Ducruet and Lee (2006) made also an important observation concerning the latter. Studying the connection between ports and port cities, they came out with the result that the close proximity in a metropolitan region may have two different outcomes depending on the level of the economy (advanced or developing). He mentions that in developing countries the increase of urban territories resulted in increase of port concentration while in the advanced economies had the opposite result because of congestion and lack of space, forcing the construction of new terminals outside the urban core.

Close proximity between the large ports.

A reason may be the close proximity of the big ports. An indicative example is the case of Japan where Tokyo Yokohama and Osaka operate in the very close region something that indicates that the extreme competition creates low results of concentration levels.

Cost reduction of smaller ports.

Hayuth (1981) mentioned that the small port in its attempt to attract even more cargo, decides to reduce the costs and charging fees, in order to be able to attract the shipping lines. This is one of the 'competitive weapons' smaller ports have in comparison with the bigger ones.

Governmental intervention and type of port governance

However, port governance is not a reason observed only as concentration-driven factor.

- *Decentralized governance that leads to decentralization of ports*

Ieda and Le (2010) mentioned the case of Japan where the governance program aimed in a balanced distribution of traffic in as many ports as possible. As a result, the subsidies were equally balanced among the port authorities, who were also responsible for the port management's significant change regarding to the previous years, were the ports were controlled by the Ministry of Land and infrastructure. This is the reason why the authors consider that concentration cannot be applicable in Japan container ports.

Other examples (China) the decentralized governance lead to deconcentration of port traffic. The so-called dual governance (the government makes port planning for the whole country but the management is in the hands of the respective port Authority) Slack and Wang (2002) mentioned the case of Shanghai concerning government's decision that lead to diffusion pattern. Shanghai, was a port that suffered by low quality dredging. Instead of developing the dredging operations in Shanghai, the government preferred the development of Nimbo and Yang Shan ports, ports located near Shanghai, being able to host the bigger vessels under further development and much closer to shipping lanes.

So far, the research indeed shows that concentration is something that cannot be justified by only one factor, but by a combination of the factors studied.

CHAPTER 4

Methodology

This chapter is going to analyze the methods used in the past by different authors in order to study the phenomenon from a quantitative perspective. After this analysis, the most useful tools are going to be used in order to investigate the situation in Europe for the years studied.

4.1 Methods measuring concentration tendency

Hilling's concentration index

Hilling (1977) was one of the first researchers who tried to represent the concentration/deconcentration tendency through a statistical model, giving a concentration index that represented a ranking of the ports depending on the tonnage handled by the sampled ports diachronically. Despite the lack of accurate databases, it was still an effective measure for the time being. The model presented was

$$I = \sqrt{(P_1^2 + P_2^2 + \ldots + Pn^2)}$$

Where I is the index for concentration and P is the percentage of share of trade for ports 1 to n. When I reached the value of 100, there was an indication for full concentration in the port system. On the other hand, a value closing to 0 indicates a deconcentration, or diffusion of the port system.

Geo-Economic Concentration Index (GECI)

Most of the studies use Lorenz Curve and Herfindahl-Hirschman Index (HHI).However according to the *Yiping LE a, Hitoshi IEDA(2010)* writers the above-mentioned methods are not suitable during the comparison of countries but only in port system regions. This is the reason why they used the Economic Concentration index (GECI).

GECI index tries to identify the level of competition between two ports in terms of the degree of *''overlapping hinterland of the two ports'' (Le and Ieda (2010))***.** Having as an input the distance among the ports and incorporating elements such as geographical scale and economical scale of the country concerned, the result is the GECI index. GECI is defined as:

$$GECI = \sum \frac{s_i^2}{\sum w_{ij} s_j}$$

Where si and sj are the shares of the ith and jth port respectively and wij the weight of port j for the port i.

Normalized Hirshmann-Herfindahl Index (N-HHI)

HHI and its variation (Normalized HHI) is a commonly used index that identifies the level of concentration in a particular industry. Referring the port industry, authors such as Notteboom (1997, 2006, and 2009) and also Ieda and Lee (2010) used the index in order to mention the concentration/deconcentration tendencies. It is by far the most used index in estimating the concentration levels. However, Ieda and Lee (2010) were the ones proved that the concentration index is not appropriate when comparing port ranges. This is because HHI index takes into consideration the traffic and the number of ports, in real numbers and not in percentages. A port region like Black sea(3 ports), may indicate extremely high amount of HHI results in comparison with a port region like Hamburg-La Havre(15ports) something that is not true at least before 2007. In these terms, they mention that HHI and N-HHI are indicators that should be used in order to estimate concentration levels of the ports located in the same range. Except for that, in their example in China, they mention that HHI is not accurate enough when comparing ports of a whole country or continent. In this way, all ports are considered to be in the same market and as a result, the competition levels decrease.

The main difference between Normalized HHI (N-HHI) and HHI is the fact the N-HHI is measured from 1/n to 1 while the HHI is measured from 0 to 1. However, the NHHI is by its nature a more realistic index because it is almost impossible to have perfectly evenly matched ports. Next, the N-HHI equation and scales of concentration levels are given according to Notteboom's research (2009).

Level of concentration	N-HHI
Deconcentrated port system	>0-0.1
Moderate concentration in the port system	0.1-0.18
Highly concentrated port system	>0.18

Levels of concentration in N-HHI(Notteboom 2009)

$$H^* = \frac{\frac{\sum_{i=1}^{n} TEU_i^2}{\left(\sum_{i=1}^{n} TEU_i\right)^2} - \frac{1}{N}}{1 - \frac{1}{n}} \qquad and \quad 0 \le H^* \le 1$$

Normalized HHI(Notteboom (2009))

IN N-HHI model, TEUi is the container throughput of port I and n is the number of ports in the container ports system.

Lorenz Curve and Gini coefficient

As already explained N-HHI was described in order to measure the concentration/ deconcentration tendency for the different port ranges. In this part, the Gini coefficient will be analyzed and used later on in order to see the results by a different indicator, but also to be able to cover the gap of N-HHI usage, which is the incompetence of using it for comparing the ranges.

Lorenz Curve

''A cumulative frequency curve that compares the distribution of a specific variable with the uniform distribution that represents Equality''. (Notteboom2006). Lorenz curve could be considered as a visualization method that depicts how the different firms (in this case ports) deviate from an equal distribution. The more the curve deviates from the equality line, the more deconcentrated the port range becomes during the years. However, despite the fact that it is a way of visualization, in order to fully understand and comprehend the differences concerning concentration patterns, the results of the Lorenz Curve have to be quantified. This problem was solved by the use of the Gini coefficient.

Gini coefficient

Gini coefficient is an indicator that (a descriptive statistic as called by Notteboom(2006)) which makes the comparison of the distribution of each variable of the sample with the equality distribution line. There are different ways of calculating the Gini coefficient. One of the most usual measurement for the port systems case, is the use of a variant of Gini coefficient, the so-called dissimilarity index that is '' the summation of vertical deviations between the Lorenz curve and the line of perfect equality'' (Notteboom 2006).

$$G = 0.5\sum_{i=1}^{N} |X_i - Y_i|$$

The above equation is the Gini coefficient where ''the Xi is the cumulative percentage of the number of ports up to the ith port and Yi is the cumulative percentage of market shares of all ports up to the ith container port. N is the number of ports in the port system''(Notteboom 1997). The above-mentioned equation was used from a variety of authors for calculating the Gini coefficient from Notteboom (1997) to Kuby and Reid (1992). According to Pocsai (2011) through Gini coefficient, the different concentration levels can be identified.

In this respect, the author mentions the following concentration scales:

Level of concentration	Gini Coefficient
Very low concentration	>0.3
Low concentration	0.30-0.40
Moderate concentration	0.40-0.60
High concentration	0.60-0.90

Shift share analysis

Shift share analysis is separated in two parts:

The share effect: expected growth of container traffic in a port as it would have the same growth pattern as the port range.

$$SHARE_i = \left(\frac{\sum_{i=1}^{n} TEU_{it_1}}{\sum_{i=1}^{n} TEU_{it_0}} - 1 \right) . TEU_{it_0}$$

$$SHFT_i = TEU_{it_1} - \frac{\sum_{i=1}^{n} TEU_{it_1}}{\sum_{i=1}^{n} TEU_{it_0}} . TEU_{it_0}$$

Total shift: Total number of TEUS that a port has lost or won by the ports in the same range. SHFT, *is the total shift of port* ***i*** *for the period t,-t, expressed in TEU.TEU, is the container traffic of port* ***i*** *expressed in TEU, and* ***n*** *is the number of ports in the container port system. (Notteboom 1997)*

As seen in this chapter, there were many tools and ways that the different researchers tried to use in order to come to a result referring to which port concentrates the most traffic, either by direct study of the concentration measures(GINI,GECI,HHI) or with more indirect (Shift share analysis).

4.2 Methods used in the current study

In this research, the tools that are going to be used in order to see the changes in concentration in Europe are N-HHI, GINI coefficient and Lorenz Curve .The selection was made by chance. N-HHi is a useful tool in order to depict the concentration levels on a specific range of ports. On the other hand, Gini coefficient makes also feasible the comparison of the ranges. Consequently, the combination of both indexes in a study shows a clear overview of the situation in Europe. It was not feasible to select only one index and this is because authors in the past have proved that in some cases the indexes are inaccurate. Therefore, the use of both of them will be able to show the best possible conclusion on the results.

Differences between N-HHI and Gini

During their findings, Notteboom (1997, 2006) and also Ieda and Lea (2010) proved that the different concentration indexes might have diversified results and outcomes that sometimes are almost diverse and difficult to comprehend. Clear examples are Notteboom's search (2006) where he found through N-HHI that West coast of US evolves clearly towards concentration, and on the same time Gini coefficient

indicate strong deconcentration tendency in northwest coast, and a concentration tendency referring to south west coast. Furthermore, Notteboom(1997) studying the two indexes for European port range during the 80's, he mentions that using HHI, Hamburg Le Havre range shows a modest concentration tendency while on the same time, and for the same years the Gini coefficient indicates a rather a stable evolution. Except for that, his results for European ports during this period were also diversified. In this research, Gini coefficient is going to be used in the same way as Kuby and Reid (1992) and also Notteboom(1997,2006,2010) used it: an index suitable for describing the concentration or deconcentration levels and also tendency towards concentration during a particular period. Consequently, in the upcoming analysis, the two indicators are going to be used to indicate:

- The fluctuations of concentration tendency for every range during the years of study
- Gini coefficient is also going to be used for the comparison between the ranges.

4.3 Construction of the database

The indicators that are going to be used will depict the concentration/deconcentration tendency in European container ports .According to the literature review, the accuracy of the results are affected greatly from the number of ports that are going to be used and also from the accuracy of the data (more ports and more accurate are the data, the more accurate will be the result.). Accordingly, Eurostat was chosen to be the database that was going to serve the purpose of this research.

Eurostat

The initial database included 244 ports, and the TEU volumes of the container ports per Quarter of the Year. Due to lack of data in some ports, there had to be a distinction between the ports that included valid data for the whole period of interest (2007-2012). This is the reason why the sample was reduced in 158 ports (see Appendix ***Table 1*** and ***Table 2***).

However, during the formation of the data it was discovered that there were some inefficiencies referring to the data.

To be more specific, there was a lack for information, from the moment that the database did not include Le Havre port, and also the port of Marsaxlokk appeared to have a really small amount of TEUs across the years of interest, and on the same time it was mentioned in the literature as on of the most important transshipment ports in the East Mediterranean.

Ports	sum2007	sum2008	sum2009	sum2010	sum2011	Sum2012
Marsaxlokk	45171	53013	87127	94564	97777	92615

In order to overcome this drawback and have the most accurate results as possible, the following steps were taken:

In the first place, a research of Espo for the period (2008-2011) was taken in order to be used as a comparative approach with the results given by Eurostat. On the same time, data from International containerization Yearbook were used 2010-2011-2012, the Scandinavian port Association, the Spanish port association, the Swedish port association, Finish port association along with dataset provided in the article of Musso(2013). Additionally, the dataset was also checked by data obtained by the author from the websites of the respective port authorities. The databases mentioned along with the websites of the Port authorities, are all mentioned in the references sector.

Next section indicates the steps taken in order to complete the database.

ESPO

The first step was to check the accuracy of the ESPO research. ESPO research was a research about the ports created by professor Notteboom, with a combination of data from Eurostat and the respective port authorities. As found also by the author himself, the dataset in ESPO matched perfectly with the data from the Port Authorities. When the dataset of Eurostat deviated from ESPO's results, the combination of data from ESPO and port authorities covered the gap. 75 ports of the dataset was covered by a combination of ESPO and Eurostat.

Containerization International

The dataset from internationalization yearbook contained data for a limited amount of container ports (the most important ones in volume), so, small amounts of ports were the ones that were able to be double-checked by this method. In this respect, 23 ports were checked through this particular database.

Port associations

Port associations used gave a great amount of information about the ports concerned, however it has to be mentioned that there was almost no deviation between the dataset of Eurostat and the dataset of the port associations referring to the smaller ports. Despite the fact that these associations included even more ports that could make the research models even more accurate, no extra ports from these databases were incorporated, because the attempt was to increase the validation of the results of the current data (Eurostat database) and not to expand them even further. In this respect, 28 ports could be checked by the port associations databases.

Port authorities

Port authorities were the most difficult part referring to the data compilation. Especially in the smaller ports, not only there were cases where the statistics were not described in English, (port of Napoli and some Norwegian ports) but there were also some cases where the ports had results until 2006.Except for that, the English port authorities along with the English port association would not give any information concerning their container traffic but only for someone who is a member. In these terms, 40 of the ports were checked concerning to their results by the respective port authorities.

Musso (2013)

The paper from Musso provided also viable information referring to the Italian ports and more specifically the ports of Napoli, Savona, Trieste and Civitavecchia. Although during the literature review, there were many authors who supplied with data concerning ports of the current dataset, Musso's help was substantial from the moment that the above mentioned ports where the ones that were not able to find valid data either on Eurostat nor ESPO.(especially in case of Trieste and Napoli for the year 2007).

Table 3, indicates the final dataset used in this research. The first column indicates the range that the port belongs to, the second one the port , the next 6 columns the data for the respective years, and the final column presents the databases that were used in order to verify the results. Two values for the year of 2012 that are marked with red color(ports of Bordeaux,Brest,Nantes,Dunkuerque) are ports that there could not be found results for this period, and in these terms, the traffic of the previous year was established(year 2011) in order to be able to have the MINIMUM inaccuracy concerning to the results. This also was the method applied for Guandeloupe port for the lack of data for periods 2008 and 2012.

The next table was constructed by the author and indicates all the ports that are going to be used in the analysis. The map was constructed by the use of Google maps

Table constructed by the Author according to different databases by the use of Google maps

4.4 Construction of the ranges

In order to specify even better the concentration phenomenon, a distinction had to be done concerning the ranges that are going to be studied. In the previous years, various authors distinguished the ranges in different ways depending on the geo-economic phenomenon that they wanted to study. Notteboom (1997) distinguishes and uses the range of Hamburg-Le Havre range, Baltic port range and West Mediterranean range for his study concerning the competition dynamics between the ports. However, he

mentions the existence of the other ranges, (Uk ports, Baltic Sea and East Mediterranean).Ducruet and Lee (2006) trying to identify the connection of concentration to the ports and their proximity to cities, distinguish the ranges in a broader respect (West med and Iberian Peninsula, East Med and Black Sea and North west Europe) They mention that in general every port competes for traffic with almost every other port in Europe in terms of the globalization process. Therefore, the distinction of the ranges is something difficult and depends on the author and the scope of study. Two of the most proper distinctions between the ranges where the ones initiated by Espo (2009) and Notteboom (2006) distinguish ports ranges as Hamburg Le Havre Range, Mediterranean range, UK range, Atlantic range, Baltic Sea, and Black sea. On the other hand, Espo(2009) makes an even detailed separation creating the following ranges: Hamburg Le Havre Range, East Mediterranean range, West Mediterranean range, UK –Irish range, Atlantic range, Scandinavian ports and Baltic Sea, and Black sea.

Acknowledging the above-mentioned distinctions, a new distinction about ports is going to be created, that is going to be the same with the one created by Espo (2007) with some slight diversifications.

Ranges	Number of ports
Scandinavian range	39
Atlantic port range	22
Baltic Sea	13
Black Sea	3
East Med	15
West MEd	29
HamburgLe Havre	15
Uk-Irish	21

Range categorization constructed by Author, based on Espo(2007)

Hamburg Le Havre range: The abovementioned authors recognize the important of this particular range: handling almost half of the container traffic in the whole Europe, is an important range that has to be studied in terms of concentration.

Mediterranean range: Previous literature (Notteboom 2012) has mentioned that during the 90 is the Mediterranean ports have been trying to gain market share from Hamburg Le Havre range, creating fierce competition between the two ranges. However, generalizing Mediterranean as a unique range, would not be the proper thing to do As Rodrigue (2012) mentions that from the moment that East Mediterranean and West Mediterranean have their own hinterlands to serve and on the same time the competition between them is not so fierce as with other ranges, it is wise to separate Mediterranean sea to two different regions and study them separately. It has to be stated that Rodrigue chose to incorporate Black Sea ports in the East Mediterranean something that is not going to be done in this research for two main reasons: First of all Black Sea ports can be characterized as important competitors of East Mediterranean ports and secondly all the previous researchers studied Black sea separately because it

can be considered the epitome of concentration phenomenon, considering the competition from other two ports of the region.

Atlantic port range and Black Sea port range: these two port ranges include ports that both compete with much stronger port ranges for traffic domination. Black sea has to compete the emerging East Mediterranean ports while Atlantic ports face competition from both Hamburg Le Havre and West Med range.

Uk-Irish ports.in his article about Irish ports, Brunt (1999) mentions the fact that Ireland has been always the main trading and economic partner of England. Something that is illustrated also in port relationships where feeder services along Irish and UK ports take place. Accordingly, it is important to study UK and Ireland in a common range of ports.

Scandinavian range. Espo (2007) measured Baltic Sea and Scandinavian range as a common range, possibly due to the feeder services with the Scandinavian Peninsula. However, acknowledging the importance of the Baltic ports, by previous authors, the Baltic Sea is going to be separated in this study by the Scandinavian ports and it is going to be studied separately.

The following table indicates the geographical separation of the ranges that are going to be used in this research:

Map indicating the ranges, constructed by the Author

CHAPTER 5

Empirical analysis and interpretation

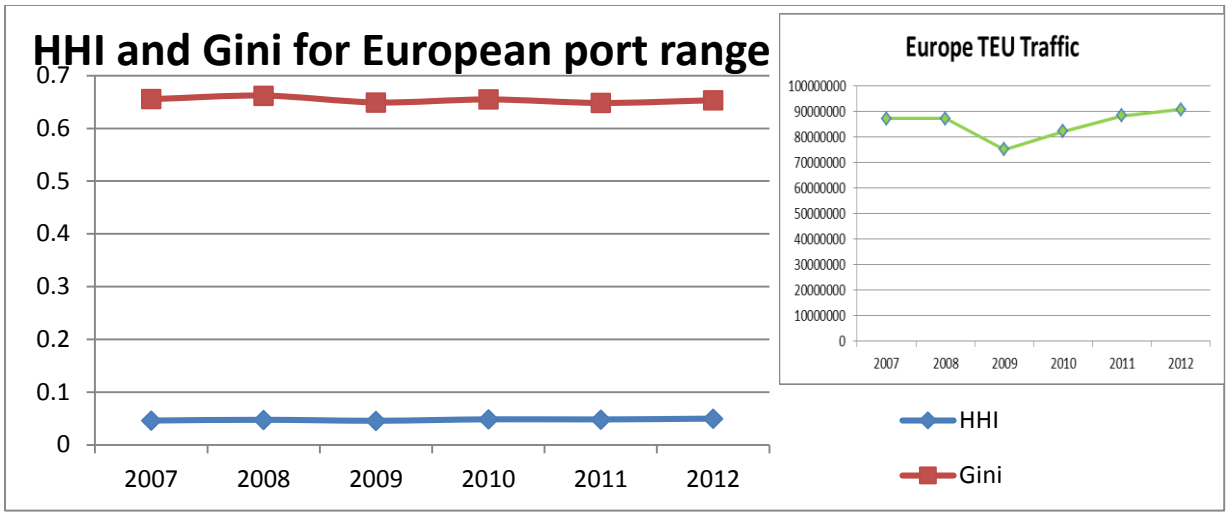
5.1 Introduction

This chapter will find and analyze the concentration tendencies in European container ports by the use of the two methods, Gini and N-HHI. First, a general approach of European port range will be analyzed. Later on, each port range will be analyzed separately.

5.2 Europe as a port range

According to previous authors, the European port range (Notteboom (2010), started experiencing a deconcentration tendency by the end of 2008(when the first signs of the crisis were obvious). This is confirmed also in this study .The next table indicates the results of N-HHI and Gini. Both indexes have a down warding tendency. As the graphs and the table show, the year of 2009 is the one with the lowest concentration levels in whole Europe, probably a result of the economic recession, which according to previous authors started to show up in the late 2008. Gini coefficient shows also a deconcentration tendency during this period. What can also be seen is that both indexes follow the same pattern of results referring to concentration/ deconcentration tendencies. The last year of observation (2012) both indexes show a tendency towards concentration. What can also be seen is that while N-HHI result may interpreted as low concentration, the Gini coefficient gives highly concentrated levels. This diversity of results is also seen by previous authors who used these two indexes. (See Notteboom's research 1997).

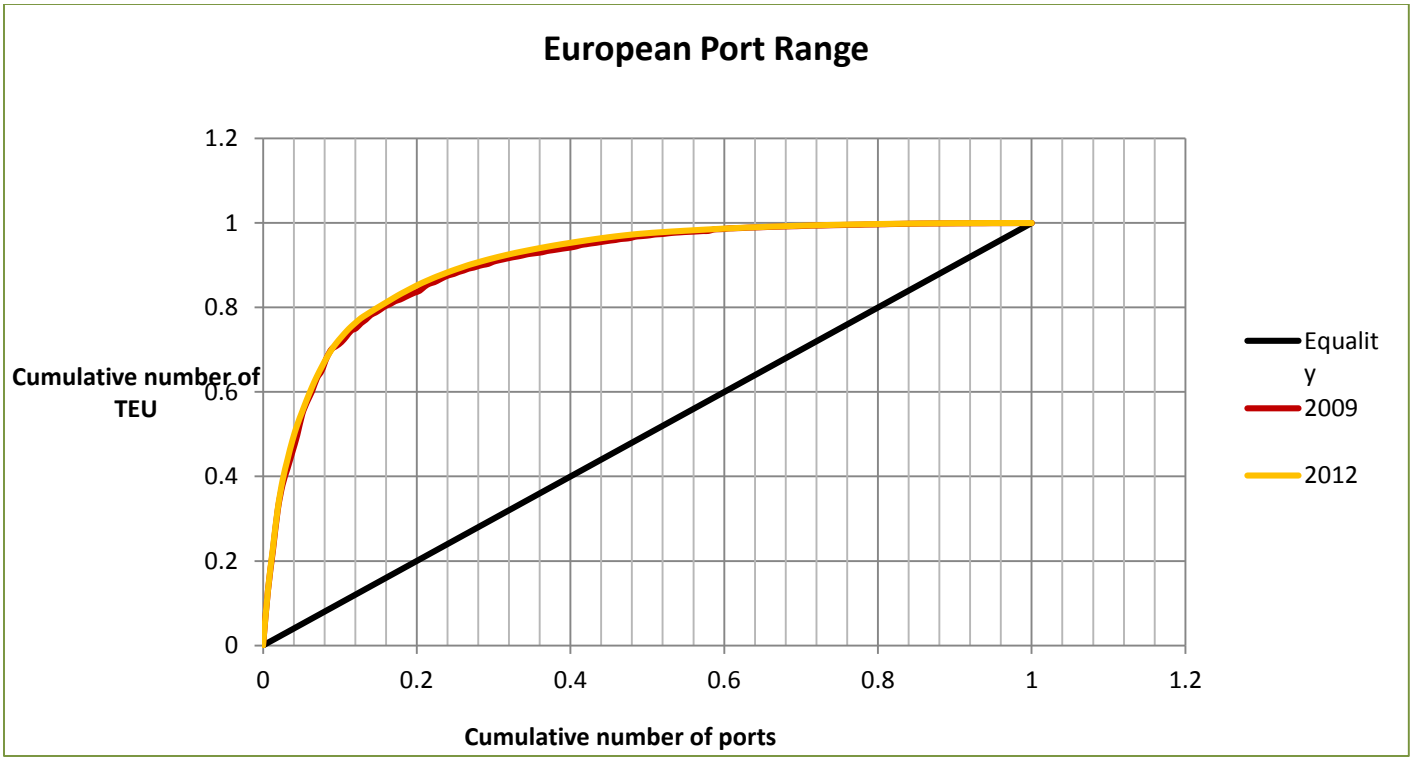
INDEX	2007	2008	2009	2010	2011	2012
HHI	0.045785	0.047255	0.04541	0.048156	0.047906	0.04523
Gini	0.655286	0.661884	0.649189	0.65476	0.648252	0.653245



HHI and Gini results as constructed by Author

However, it is difficult to identify the reasons for the constant fluctuations when studying European port range as a whole. The reason is that European port range consists of ports that belong to different countries with different economic policies and diversified government interference to port is issues. As seen in previous chapters, there is a variety of reasons that can explain concentration or deconcentration tendency during the years and these reasons differ from country to country or from port to port. Accordingly, the only thing that can be steamed out at this point is that during the year of crisis (2008 and 2009) the concentration levels in Europe decreased.

The next graph shows the changes in concentration as it can be seen by the Lorenz curve. According to the graph, the distribution of traffic has become more unequal from 2009 to 2012. This is obvious from the fact that the Lorenz curve in 2012(orange line) deviates from the line of equality more than the Lorenz curve that represents the year 2009(red line). From the moment that the Lorenz curve is the visualization of Gini results, this confirms the findings of Gini coefficient.



Shift in concentration for European port range between 2009 and 2012(Lorenz Curve created by Author)

5.3 Analysis of the ranges

Having seen a general overview of the European port range, it is interesting to see how the different ranges reacted during the years.

The following Table summarizes the N-HHI results for every port range

Range	2007	2008	2009	2010	2011	2012
Baltic Sea	0.071783	0.067073	0.048533	0.052706	0.06	0.06806
H-Le Havre	0.149861	0.146096	0.140955	0.149937	0.153623	0.154078
Black Sea ports	0.766706	0.656627	0.524275	0.490045	0.523585	0.486145
UK-Irish	0.132922	0.121986	0.149604	0.159414	0.149876	0.15876
Atlantic	0.093728	0.09195	0.069439	0.070291	0.063929	0.073499
East Med	0.133439	0.05679	0.066808	0.088837	0.165202	0.28224
Scandinavian	0.125028	0.130244	0.133084	0.127751	0.116013	0.111933
West Med	0.077537	0.080418	0.073633	0.076958	0.076837	0.091362

Normalized HHI for every port range for the period 2007-2012

The above table summarizes the flow of concentration levels for each region for the period studying. As it can be seen, the results fluctuate significantly during the years. Previous researchers see these kind of fluctuations also for other periods. A first look at the results shows that Black Sea is a highly concentrated range exceeding 0.2 units of N-HHI during all the years. The rest of the ranges are characterized as moderate concentrated or deconcentrated. The region with the lowest level of deconcentration is Baltic Sea that never exceeds 0.1 units of N-HHI .The following table gives a graphical perspective of the N-HHI results.

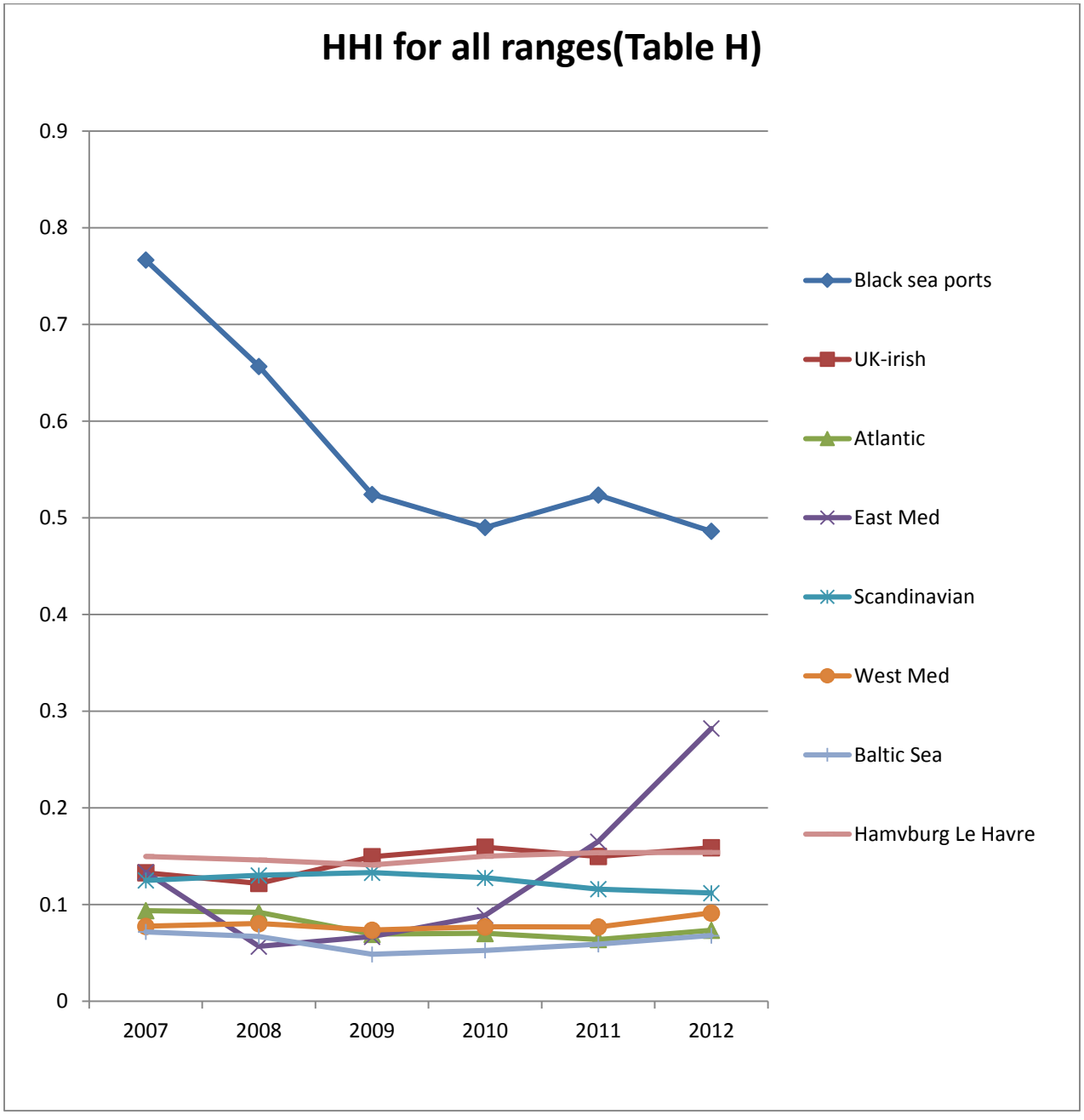


Table with HHI results for all the ranges as constructed by the author.

Gini coefficient and Lorenz Curve for the port ranges

The next table indicates the results of Gini coefficient as generated by the calculations in the Excel Sheet. It is important in this case to be able see and compare the ranges.

ranges	indicator	2007	2008	2009	2010	2011	2012
Atlantic	G	0.503481	0.491781	0.439602	0.447284	0.431662	0.447687
baltic sea	G	0.371499	0.35407	0.316413	0.353261	0.370005	0.378415
Black sea	G	0.583195	0.538762	0.477472	0.477472	0.477711	0.461445
East Med	G	0.461527	0.400053	0.410667	0.443494	0.491005	0.546855
H-La havre	G	0.596736	0.596065	0.582129	0.592118	0.612081	0.61559
Scandinavi	G	0.569835	0.569677	0.563127	0.559426	0.554058	0.541554
UK-irish	G	0.523796	0.528356	0.528983	0.541067	0.529066	0.528139
West Med	G	0.564929	0.595021	0.556934	0.57249	0.563033	0.572255

The results given in the table are seen also in Table G. This table provides a comparative visualization of the results and it is an important tool for the further analysis. A first look shows that Hamburg Le Havre range can be considered the most concentrated tendency of all, while Baltic Sea is the most deconcentrated one.

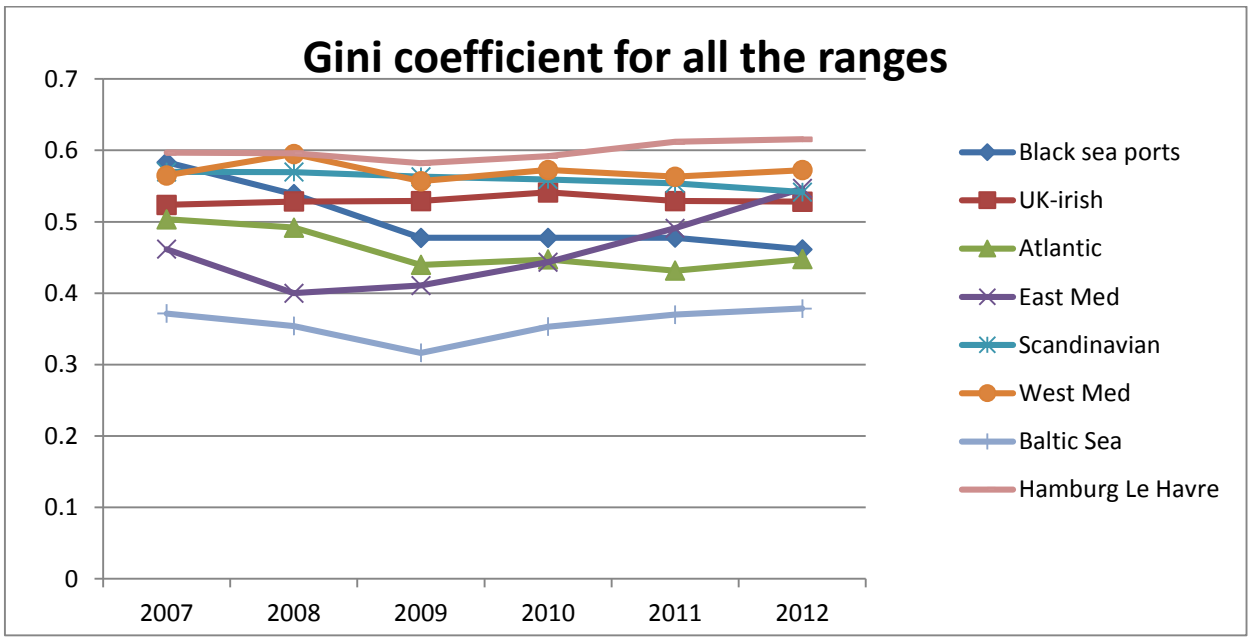


Table with GINI results for all the ranges as constructed by the author.

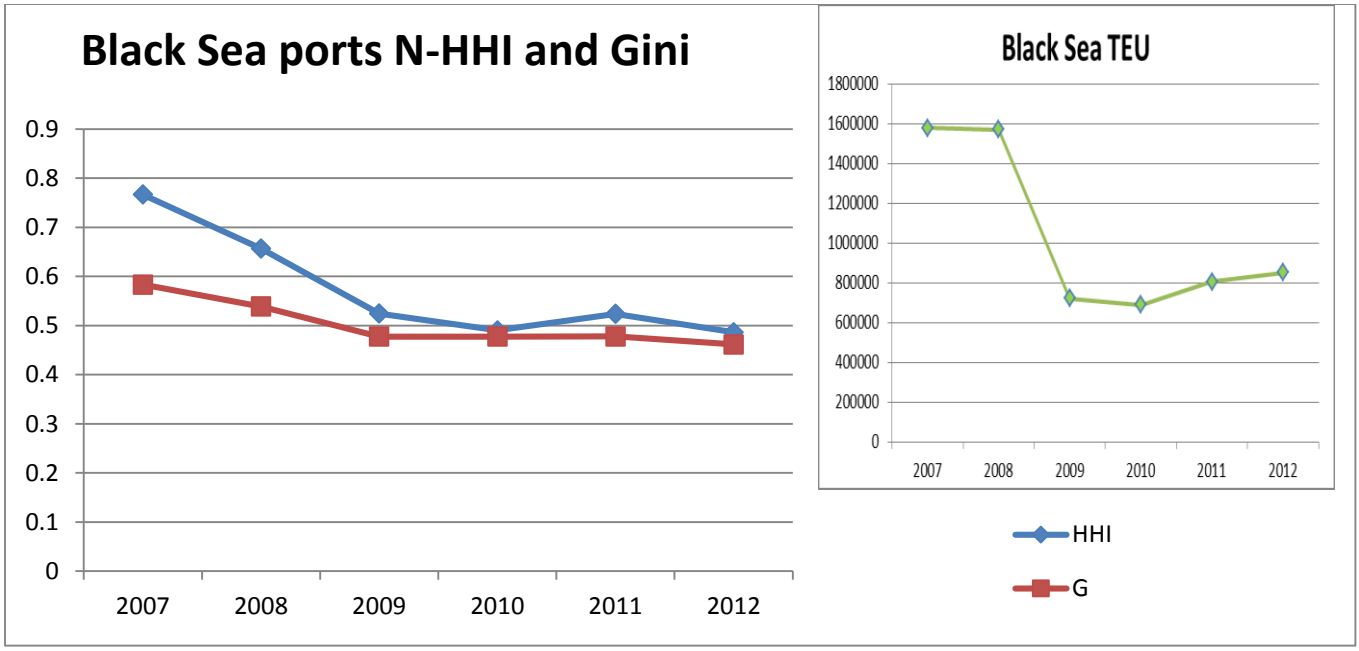
The following pages are going to analyze separately every single range. Each range is going to have a Table that shows the N-HHI results, the Gini results and the TEU traffic for the period of study. Despite the fact that there cannot be done any comparison between the two indicators, (N-HHI relies on the number of

ports while the GINI is calculated on percentages) all the regions are going to be analyzed in this motive because many interesting results may be stemmed out.

5.3.1 Black Sea

In the current analysis, the sample of Black Sea ports (3 ports) is rather small including ports of Varna, Burgas and Costanta. The Black Sea ports are in a strategic geographical point from the moment that they connect East Asia with Europe.

indicator	2007	2008	2009	2010	2011	2012
HHI	0.766706	0.656627	0.524275	0.490045	0.523585	0.486145
G	0.583195	0.538762	0.477472	0.477472	0.477711	0.461445



Results of HHI, GINI, and TEU (Author's calculations according to different databases)

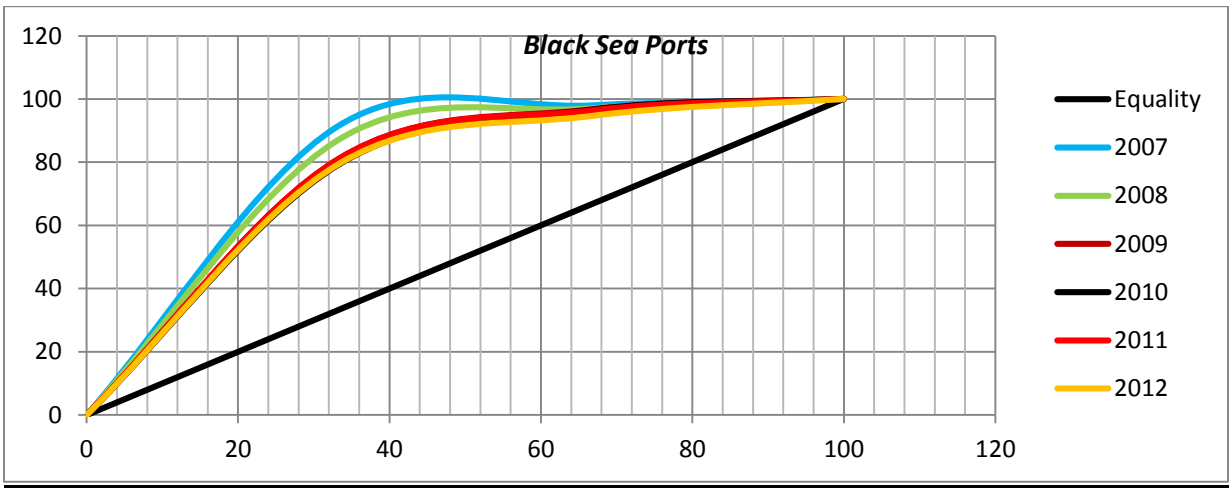
N-HHI: The N-HHI is in extremely high levels in period 2007(0.766706) indicating highly concentrated range. Referring to concentration tendency, there can be seen a deconcentration tendency in all the years until 2009 and later on after 2011.

GINI: Gini coefficient for Black Sea has particular interest in terms of study. First of all, Black sea is the range with the most rapid deconcentration tendency so far, coming at the lower level of Gini index in 2009(0.47742), Seeing Gini coefficient levels , it can be said that it is a moderate concentrated range, while N-HHI shows high level of concentration. However, this particular range, gives the opportunity to the writer to show why the N-HHI is not the proper index for comparing the ranges. In this attempt Black sea (3ports) and Hamburg Le Havre (15 ports) are going to be compared.

N-HHI results show, that Black sea ports are considered (depending on the time period), three to six times more concentrated than Hamburg Le Havre(see table H). On the other hand, GINI results, show that Hamburg Le Havre is the most concentrated region in comparison with Black Sea which is placed somewhere in the middle. So, here comes the question: which of the two indexes is wright? The answer is Gini coefficient. To be more precise, Black Sea is indeed a concentrated region. In the current sample, it has only three ports and Costanta has far higher amount of traffic from the other two (Varna and Burgas). So, in these terms, it is expected the results to show moderate or high concentration levels. By this perspective, HHI has good results. Comparing it though with other ranges, the results are wrong because as Notteboom(1997) and Ieda and Lee(2010) observe, N-HHI is dependent of the number of ports that every port range has, and there cannot be made a comparison with port ranges that have different number of ports.

On the other hand, Gini coefficient takes into account the percentages of TEUs and the percentages of ports, meaning that it can be used in order to compare port ranges with different number of ports. This is the reason why in this case, the wright result is the one Gini that generates. Accordingly seeing Table G, Black Sea is less concentrated than Hamburg Le Havre.

Concerning the concentration tendency during the years, it is obvious by both of the indexes that Black Sea ports follow a deconcentrated route. Lorenz Curve results show the same thing from the moment that the year 2007 is the year with the highest deviation from the Equality line.



Shift in concentration for Black Sea ports during the years 2009 and 2012(Author's calculations)

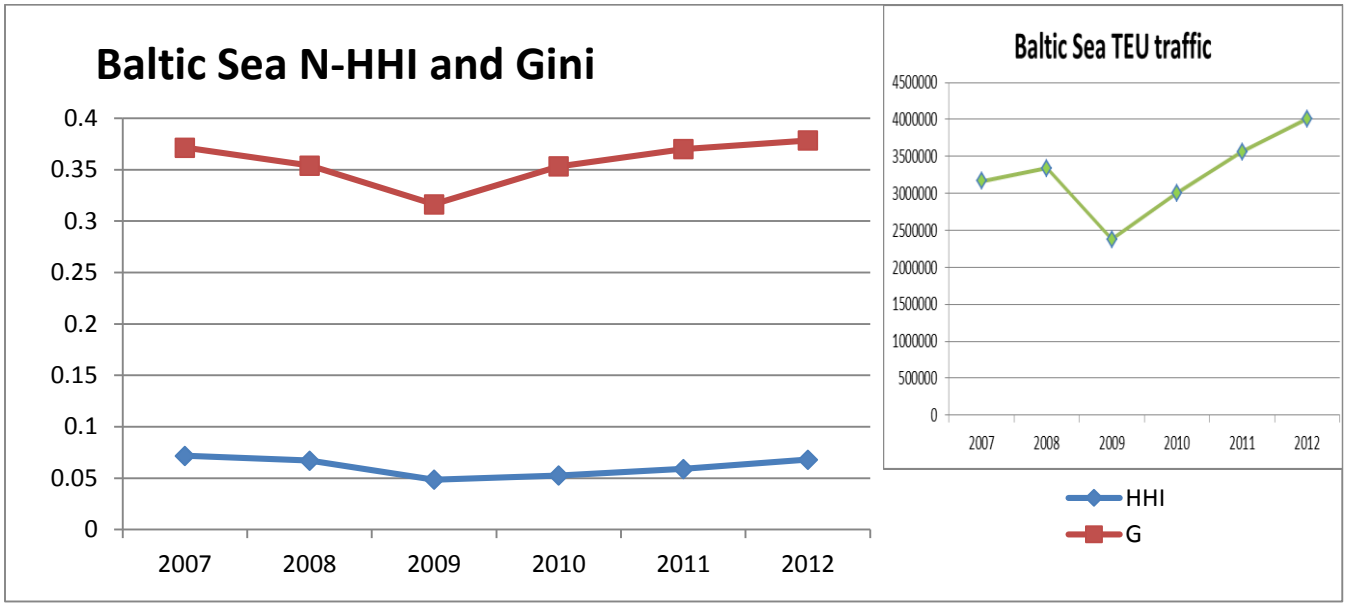
Discussion of the results: The initial boost of traffic especially in port of Constanta was due to the increased investments to the port according to Notteboom (2013). The investors believed that this port could become the main transshipment hub in the Black Sea region. This explains the boost of traffic in 2007 However, according to the author, the crisis along with the increase of traffic of port of Piraeus and the upraise Turkish ports in the region resulted in a decrease of Constanta's container traffic. The

author also mentions that this means that the shipping lines prefer currently the Black Sea ports as ports of feeder services and not ports of call in the region. So, the deconcentrated tendency it is not an outcome of the intra- competition but the inter –competition of Black Sea ports with ports from other ranges.

5.3.2 Baltic Sea

Baltic Sea (13 ports) can be considered a port range with small amount of traffic (reaching 4million TEUs in 2012. The next table and graph indicate the results for N-HHI and GINI coefficient respectively for the years studied.

indicator	2007	2008	2009	2010	2011	2012
HHI	0.071783	0.067073	0.04853256	0.052706117	0.05903925	0.06806011
G	0.371499	0.35407	0.316413	0.35326080	0.3700048	0.37841462

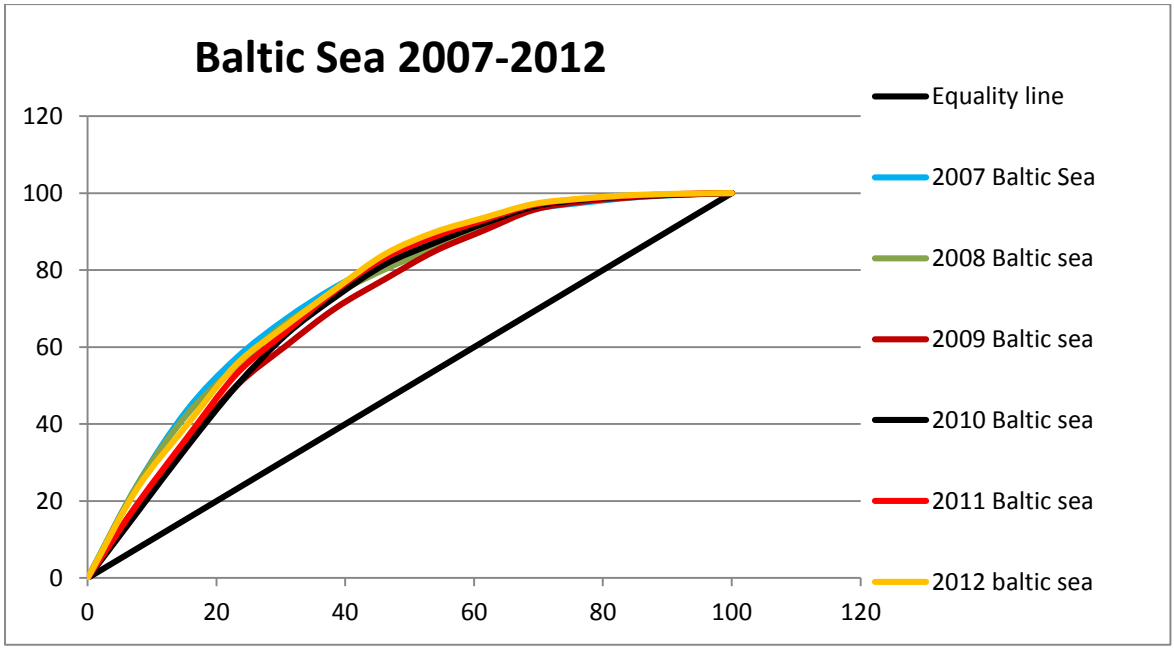


Results of HHI, GINI, and TEU (Author's calculations according to different databases)

HHI index: Baltic Sea appears to be a rather deconcentrated region. As it can be seen in the diagram, during the crisis but also when the economy started to revive, Baltic Sea ports were characterized by low concentration levels. The lowest one was the year of 2009 reaching an amount of 0.048533, starting once again going upwards from 2010 and on.

Gini index: Comparing Baltic range with the rest of the ranges, it can be said that is by far the most deconcentrated region in the European port system. (see Table G). Concerning Baltic Sea itself, Gini coefficient levels are below 0.4 so, Baltic Sea is also confirmed as a deconcentrated region. Moreover, Gini coefficient depicts a diversity of (de)concentration tendency during the years. Even before the crisis,

a deconcentration tendency was obvious, (the phenomenon reached its peak in year 2009). From that period and on, a concentration trend can be seen during the years.



Shift in concentration for Baltic Sea ports during the years 2009 and 2012(Author's calculations)

The Lorenz Curve indicates exactly the same tendencies with the Gini coefficient. A close look shows that the line representing 2009 is closer to the line of equality, meaning that the port traffic is more evenly distributed among the ports. Adittionally, the years 2007 and 2012 can be considered as the ones with the highest degree of dispersion from the line of equality (concentration), indicating a less evenly distributed system. This also goes on with the same way for the period 2007. From the moment that Gini coefficient can be characterized as the quantitative version of Lorenz's results, the same outcomes mean accuracy in the calculations.

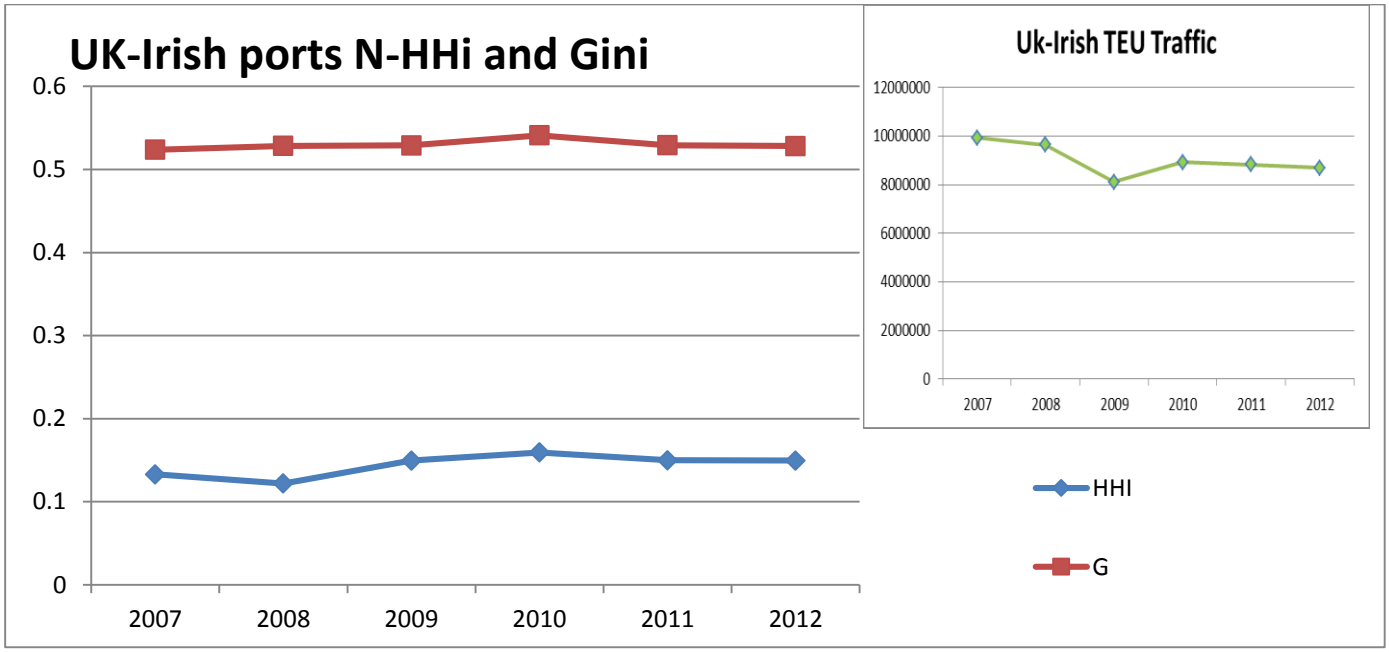
Discussion over the results:

According to the research of ITTMA(2009) ,until 2009 the polish ports of the Baltic region had a steady growth in market share but still not in significant numbers .The reason according to the study is that these ports could not compete the North European ports (mainly Hamburg which was also competing for polish hinterland) .Hamburg's superiority in barge and rail infrastructure was the reason why they had to be based only in feeder services, something that means deconcentration of the port traffic. This is also mentioned by Notteboom (2012) meaning that the feeder service status continued also after the first years of crisis. One of the main reason that Baltic seaports managed to maintain at least a relative growth in their traffic figures the years after the crisis is according to Notteboom(2013)and Shipping and marine magazine (2013) the cooperation agreements(the ports of Hamina and Kotka which created a common port in 2010.) The result was the increase in the volume of port traffic after the downfall of 2008 and 2009(years of crisis).

5.3.3 UK- Irish ports

UK and Irish ports (21 ports) consists of 21 ports with a traffic between 8 and 10 million TEUs during the years of study. As it can be seen from the initial database (see Appendix), the ports of Southampton and Felixstowe are the ones exceeding 1.4 mil TEUs , with the rest of the ports having significantly less traffic. These figures are a first indicator that this region may be concentrated.

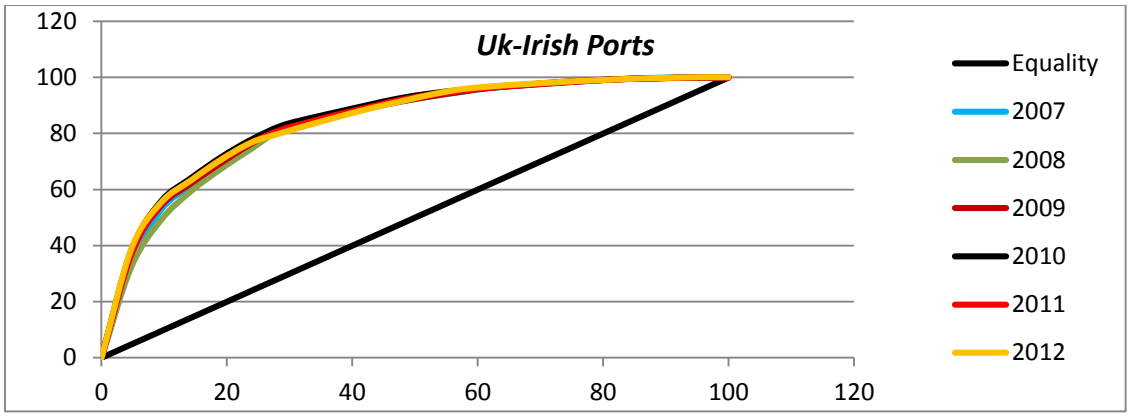
indicator	2007	2008	2009	2010	2011	2012
HHI	0.132922	0.121986	0.149604119	0.159413949	0.149875867	0.149575867
G	0.523796	0.528356	0.528983415	0.541067014	0.529065924	0.528138537



Results of HHI and GINI and TEU(Author's calculations according to different databases)

N-HHI: Indeed the results for Uk- Irish port range indicate moderate concentration levels. The year with the lowest concentration was the year 2008 .Later on, N-HHI levels are steady with a slight reduction of the concentration levels the last two years.

Gini: Comparing it with the rest of the ranges, UK-Irish ports are somewhere in the middle being less concentrated than Hamburg Le Havre, West Med and Scandinavian ports. Speaking for the range itself, Gini coefficient also shows moderate concentration levels (approximately 0.55 units all the years of study.). Gini coefficient depicts a rather steady route in concentration levels until 2009, an increase afterwards, moving to deconcentration tendency the last two years of study.



Shift in concentration for Black Sea ports during the years 2009 and 2012(Author's calculations)

The Lorenz Curve indicates that concentration tendency does not change significantly during the years, as it is seen also in Gini coefficient. The year 2008(green line) is the year with the highest deconcentration tendency, something that agrees with Gini.

Discussion of the results: The deconcentration tendency for both indicators during 2007-2008 can be justified by a variety of reasons. Monios and WILMSMEIER (2012) mention that the long period of deconcentration process (started from 1985) is caused by the phenomenon Notteboom (2010) calls multi-port gateway region. The English ports lost significant amount of traffic by the Hamburg Le Havre ports because that private ports do not have the infrastructure support that can be seen in ports that are in a public-private concession model. Consequently, the big load centers (Felixstowe, Southampton) could not provide to the shipping lines competitive economies of scale driving English ports to a feeder service status. This is the reason why the UK ports indicate a deconcentration tendency (see the Gin coefficient results).

Except for that, hinterland and port Infrastructure investments by the smaller ports (Tees and Hartepool, Clydeport) which applied port- centric logistics according to Monios and WILMSMEIER(2012) is the reason why they gained market share in the United Kingdom and consequently a reason of deconcentration in Uk-Irish region.

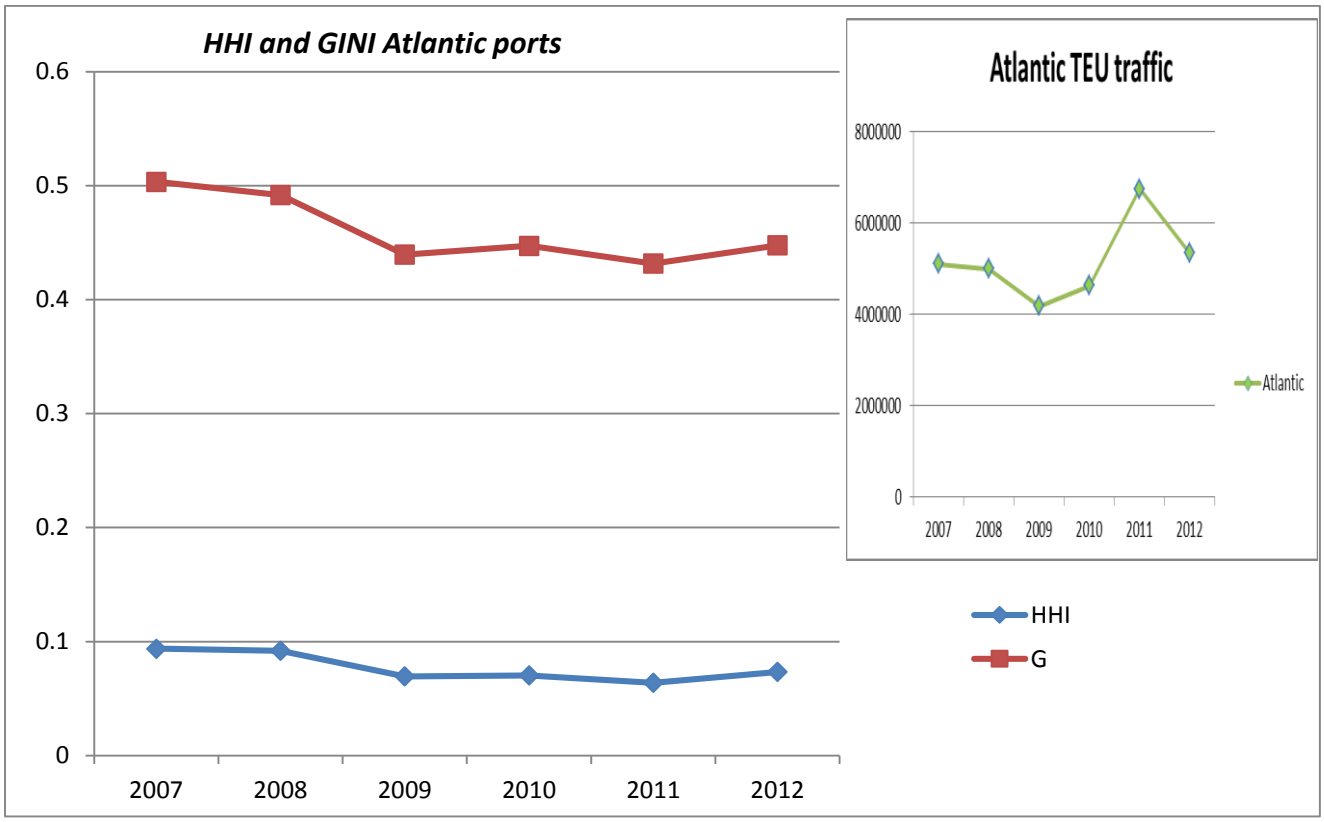
UK ports do not offer economies of scale. On the same time the bigger load centers of the region (Felixstowe, London, Southampton) despite the fact that investments have started in their container terminals (especially London with the London Gateway expansion that DP World tries to establish), they do not offer the economies of scale, something that means that still, they function as ports of feeder services and not as ports of call, something that justifies why English ports cannot succeed in high concentration levels.

5.3.4 Atlantic Ports

Atlantic Ports (22) is a range with a rather low traffic comparing the rest of the ranges.

The biggest port is Las Palmas that exceeds 1 million TEUS followed by the port of Bilbao.

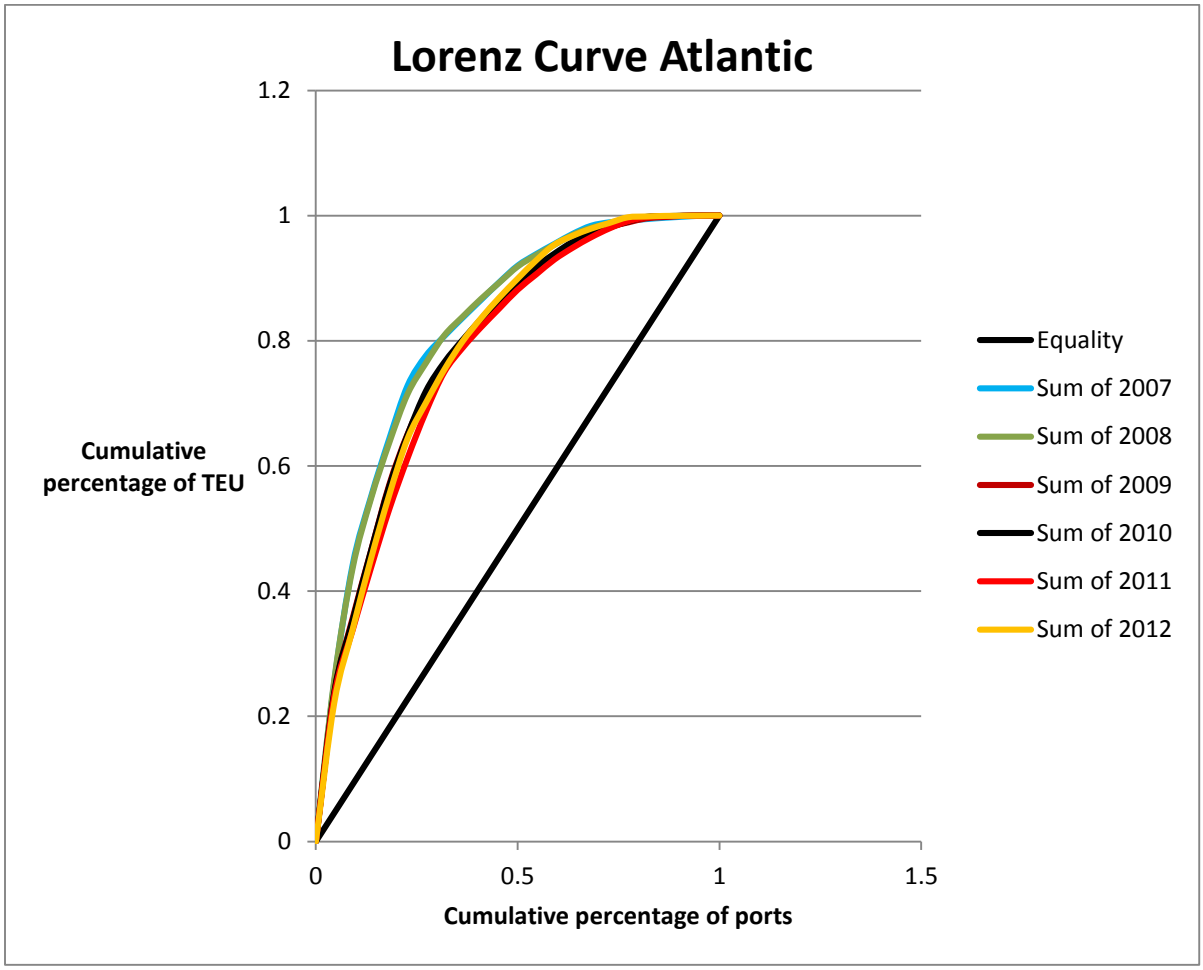
indicator	2007	2008	2009	2010	2011	2012
HHI	0.093728	0.09195	0.069438972	0.070290882	0.06392891	0.073498597
G	0.503481	0.49	0.44	0.45	0.43	0.45



Results of HHI, GINI, and TEU (Author's calculations according to different databases)

HHI: According to N-HHI Atlantic Ports can be considered a deconcentrated range. All the years of study, the N-HHI never passed 0.1. Concerning the trend of N-HHI, it follows almost the same route as the majority of the indicators, a deconcentration trend until 2009 and afterwards increasing HHI results.

Gini coefficient: Comparing it with the rest of the ranges it can be seen that Atlantic range was one of the less concentrated ones, being over passed in terms of deconcentration by Baltic Sea and East Med. However, after 2009, East Med's levels of concentration increased significantly becoming far more concentrated region than Atlantic. Referring to Atlantic range itself, Gini results indicate Atlantic ports as a moderate concentration level range, something that comes in contradiction with N-HHI's results. Referring to concentration tendency, Atlantic ports show a deconcentration tendency among the years of study(the same with N-HHI) , as the rest of the ranges until 2009.Afterwards there is fluctuation in the Gini results ending with a concentration trend the years 2010-2012.



Shift in concentration for Atlantc Sea ports during the years 2009 and 2012(Author's calculations)

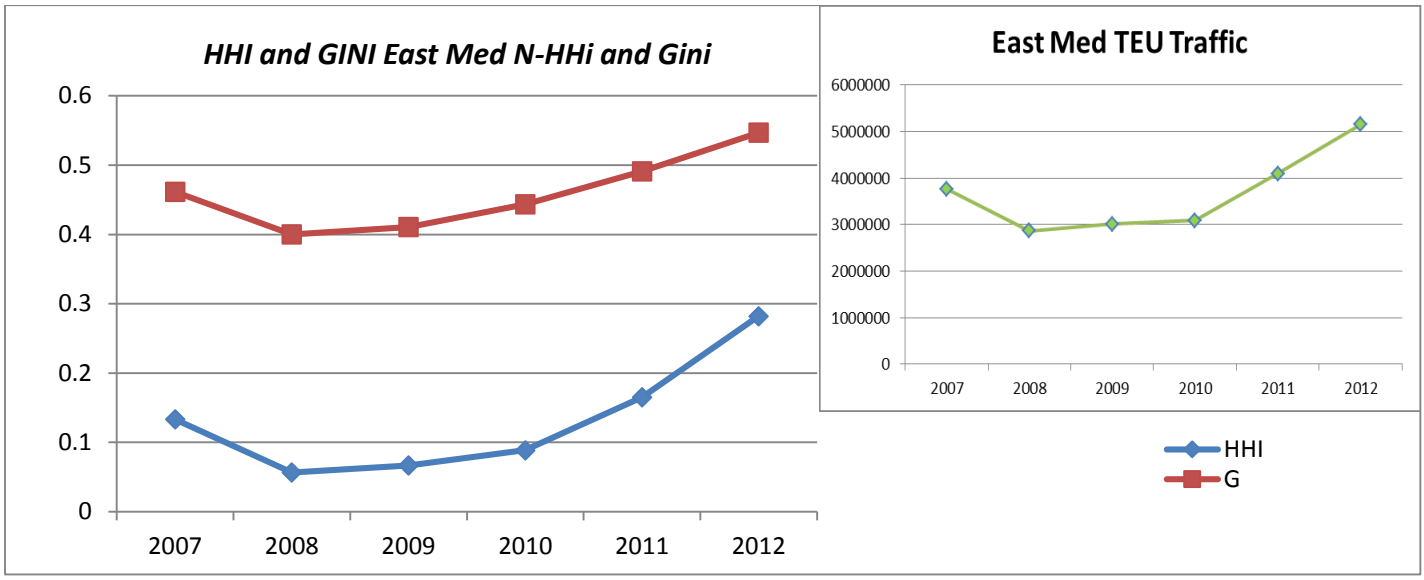
The Lorenz shows again the fluctuations in concentration tendency as depicted in Gini coefficient. The year 2011 has been one of the years with the lowest deconcentration tendency while the year 2007 was the one that Atlantic range had been most concentrated.

Discussion over the results: Atlantic ports**:** According to Notteboom (2012) the ports of Lisbon, Leixoes and Sines tried to win even more market share through transshipment function (MSC is established it's dedicated terminal in port of Sines) .Except for that, infrastructure expansions like the further expansion of XXI terminal container terminal operated by PSA, strengthened the position of the port according to Capitao (2012). This shows that the ports that have the proper infrastructure and support by the shipping lines tend to concentrate the TEU cargo in the expense of the rest of the ports in the region.

5.3.5 East Mediterranean

East Mediterranean (15 ports) is a port range that has only one port Piraeus exceeding 1 million TEUS followed by ports as Taranto and Koper which do not exceed half million TEUS.

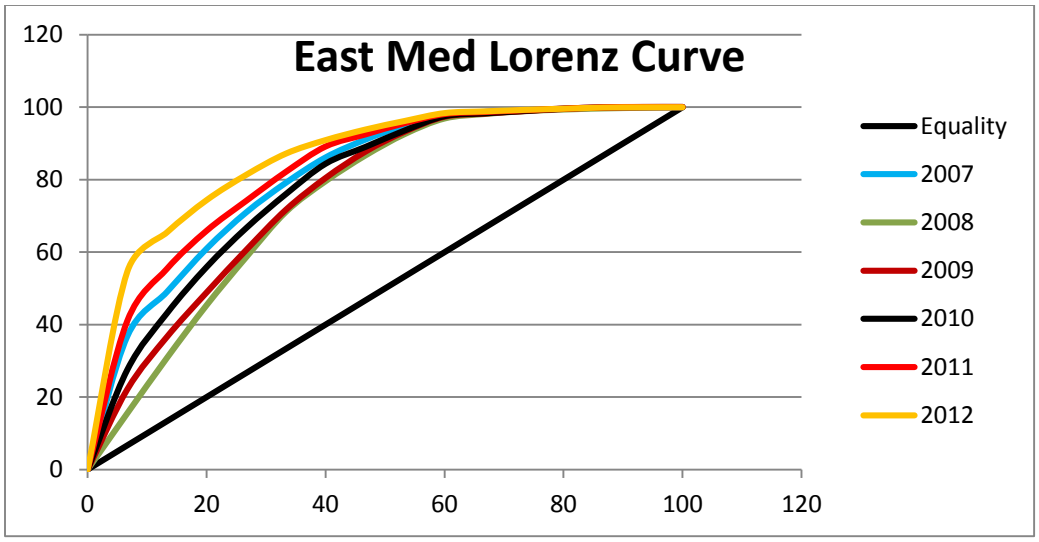
indicator	2007	2008	2009	2010	2011	2012
HHI	0.133439	0.056790122	0.066807839	0.0888368	0.16520248	0.28224002
G	0.461527	0.400052913	0.410666502	0.44349353	0.49100513	0.54685541



Results of HHI, GINI, and TEU (Author's calculations according to different databases)

HHI: East Mediterranean ports show changes in their concentration tendency. From 2007-2008 there has been a deconcentration tendency and from 2008-20112 there has been an increase in concentration levels. In this respect, during the years, it can be characterized as a deconcentrated range (years 2008, 2009, 2010) and moderate concentration levels for years 2011 and 2007). In the final year of study (2012), East Med is experiencing high concentration levels, something that is attributed in Cosco's terminal huge increase of traffic.

Gini: Comparing this region with other regions, it can be stated that it was one of the most deconcentrated regions, something that changed rapidly after 2009(see Table G).The range started to follow a rapid concentration trend. It has already overcome ranges such as, Black Sea and Atlantic in terms of concentration Gini results show East Med as a moderate concentrated range, having a partial agreement with N-HHI's results. Referring to the (de)concentration tendency during the years, both of the indicators show exactly the same pattern. A deconcentration period until 2008, and afterwards a huge increase of concentration levels until 2012.



Shift in concentration for Black Sea ports during the years 2009 and 2012(Author's calculations)

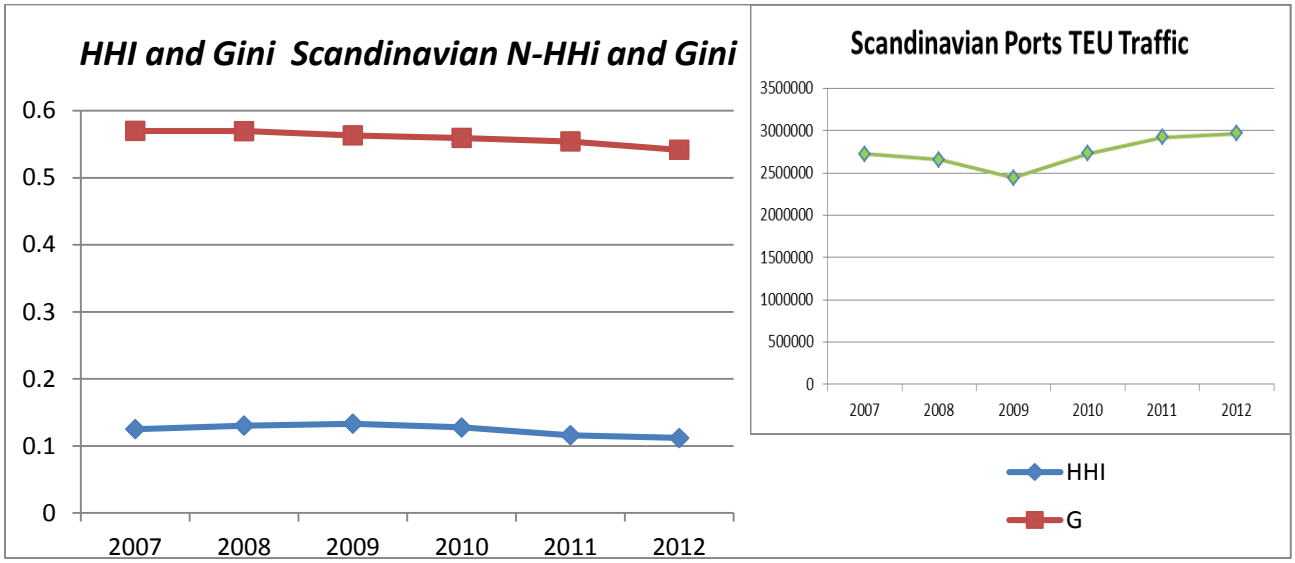
The above-mentioned are also confirmed by the Lorenz Curve .The year that the curve is closer to Equality line, is the year of 2008, coming in line with Gini results. Moreover, the Lorenz curve for the year 2012 deviates by the Equality line meaning high concentration levels.

Discussion: Port of Piraeus as mentioned by Notteboom (2012) was one of the major winners during the crisis. This was the result of the establishment of Cosco pacific as the operator of the port's second terminal (pier 2) in 2009This is the main reason why the port managed to do so well even during the years of the crisis reaching approximately 2.1 million TEUS in 2012. According to Notteboom(2012)The recent NAPA cooperation agreement (ports of Koper, Venice, Trieste, Rijeka and Ravenna) showed the ambition of these ports to become a gateway to central Europe taking advantage the transit times advantage for transporting cargo from Asia route to France and Germany. According to Napa Press Conference (2013), Napa ports (Adriatic ports that signed co-operation agreement) offer a transit time advantage of 5 days in comparison with the Hamburg Le Havre ports for the goods to be transported from Port Said to the central Europe hinterland. However, a variety of reasons are the ones that make these ports incapable to question Piraeus's domination. The infrastructure superiority of the northern ports Notteboom(2012) make them unable to penetrate in the central Europe hinterland .Another reason that Rodrigue(2012) mentioned is that despite the advantage of time that Mediterranean ships offered, they could not compete economies of scale that shipping lines could achieve in the bigger North European ports. He also mentioned that these ports deviated significantly from the main shipping routes, and until recently there were more targeted into feeder services. So, the Napa ports may not be in a mature enough level to compete for port-of call services. Finally, some of these ports did not reduce their charging fees in order to attract the shipping lines. As an example, MSC, through its official website announced in 2011 that the THC costs in port of Koper are going to be increased due to the economic recession and the constantly increasing port fees. The results were a decrease of 30000TEUS for port of Koper between 2011-2012.

5.3.6 Scandinavian ports

Scandinavian ports (39 ports) is one of the ranges with the lowest amount of traffic in the European region (the biggest amount is almost 3 million TEUS in 2012).Ports of Gothenburg and Arhus are the biggest ports in the range but none of them overpasses 1 million TEUs.

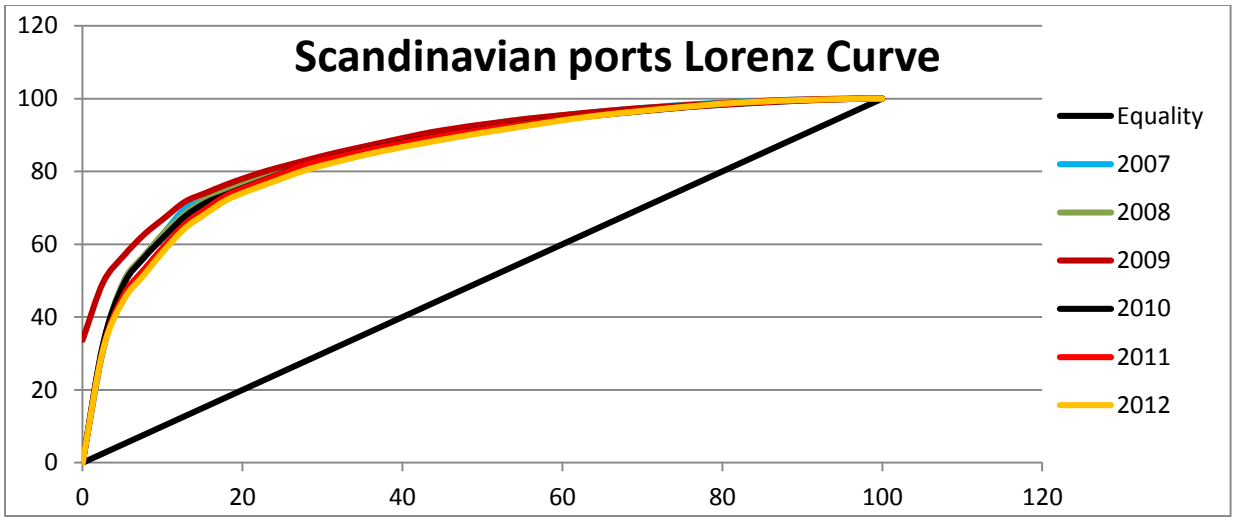
indicator	2007	2008	2009	2010	2011	2012
HHI	0.125028	0.130244	0.133084	0.127751	0.116013	0.111933
G	0.569835	0.569677	0.563127	0.559426	0.554058	0.541554



Results of HHI, GINI, and TEU (Author's calculations according to different databases)

HHI: Scandinavian ports show moderate concentration according to N- HHI .Looking it however during the years; it is obvious that there is a deconcentration tendency.

Gini: Gini coefficient shows also a deconcentrated range (Gini levels between 0.55 and 0.56). Comparing it with other ranges, it can be said that this particular range is one of the most concentrated ones, having higher levels of concentration in every single range except for Hamburg –La Havre and East Med diachronically. Referring to deconcentration tendency, both of the curves (N-HHI and Gini) show a deconcentration tendency as the years go by, with some slight diversifications. This is also obvious in the Lorenz Curve were the year 2009 is the one deviating the most from the line of Equality and the year 2012 is the one that has the most equal distribution.



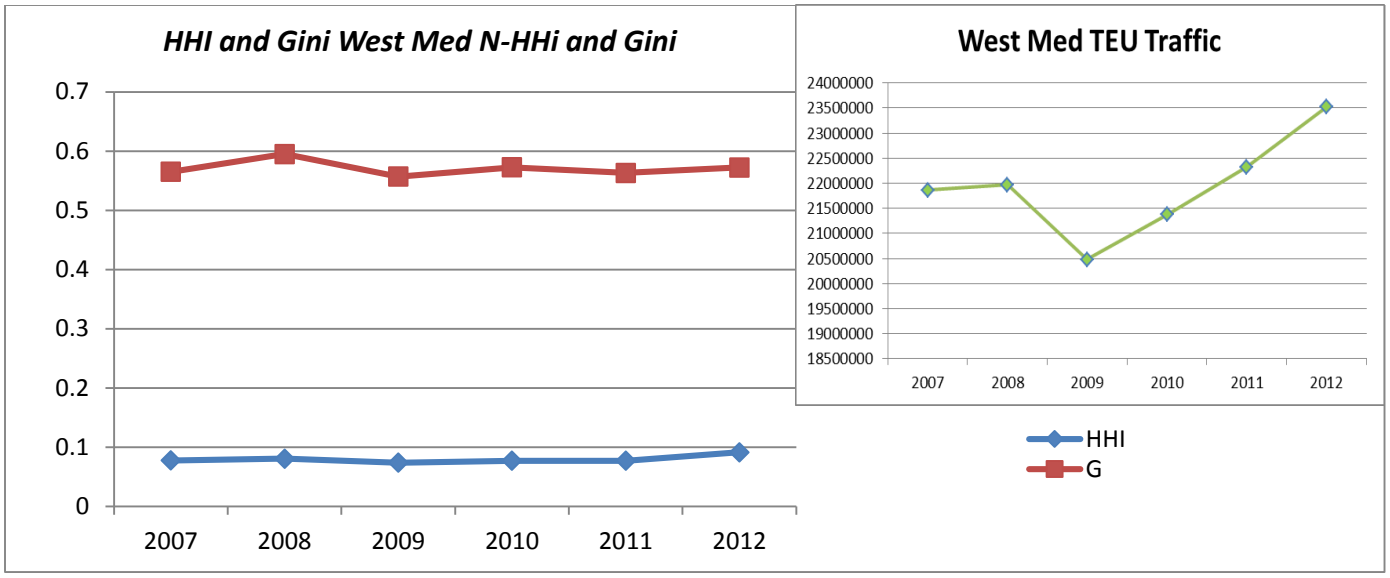
Shift in concentration for Black Sea ports during the years 2009 and 2012(Author's calculations)

Discussion: The Scandinavian range is one of the most concentrated ones. The reason is the fact that this range includes 39 ports and only six of them have a traffic above 140000TEUs during the years of observation with the ports of Goteborg and Aarhus being the only ones that handle more than 400000TEUs. Except for that, the port of Goteborg created intermodal infrastructure (Notteboom (2013)) in the hinterland, creating even higher growth in concentration levels. This unequal distribution is depicted in N-HHI. However, during the years, a deconcentration tendency is shown. This can be justified by the fact that the Scandinavian peninsula is a hinterland that both Baltic Sea ports and Hamburg Le Havre range ports try to capture .Even from 2009 the port of Rotterdam announced an increase in feeder services towards Scandinavia with two more shipping lines Team Lines and Unifeeder starting operations in feeder services. Therefore, these ports face a deconcentration tendency because the bigger ports from other port ranges, try to capture the port of call operations as seen in the Gini coefficient.

5.3.7 West Mediterranean

West Mediterranean ports (29 ports) are the ports that have the highest number of transshipment hubs. Half of the ports in the sample have more than 400000 TEUs with Gioia Tauro and Algeciras being the ones with the highest port traffic.

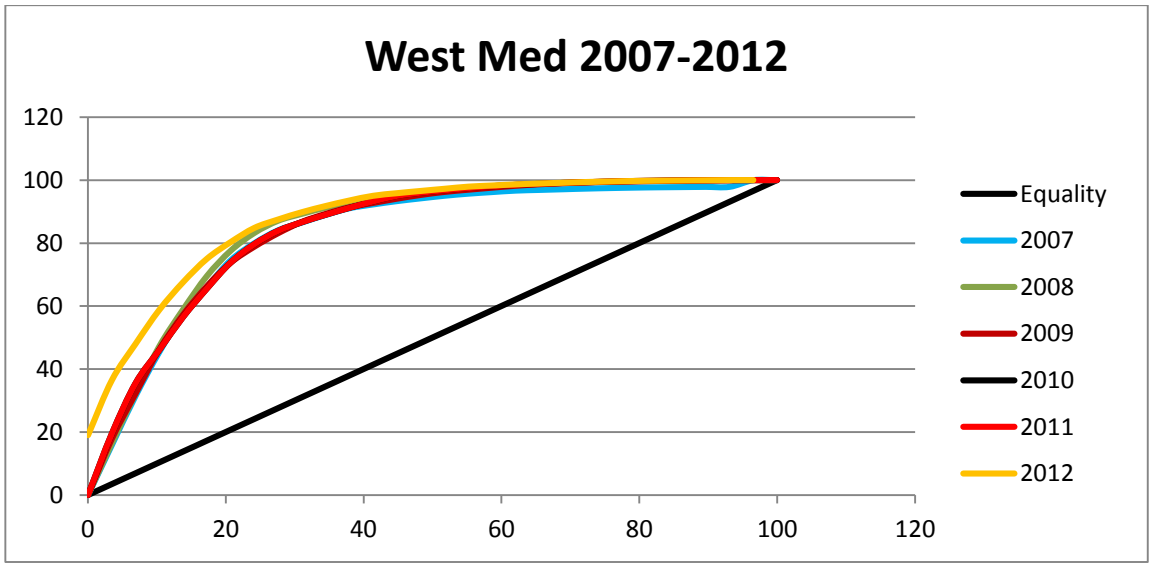
indicator	2007	2008	2009	2010	2011	2012
HHI	0.077537	0.080418	0.073633	0.076958	0.076837	0.091362
G	0.564929	0.595021	0.556934	0.57249	0.563033	0.572255



Results of HHI, GINI, and TEU (Author's calculations according to different databases)

HHI: West Mediterranean can be characterized as a deconcentrated region. None of the levels were above 0.1, reaching the highest level at 2008(0.595021) and the lowest one at 2011(0.563033).

Gini coefficient: On the other hand , Gini coefficient shows a moderate concentrated range. Comparing with the rest of the ranges it can be regarded as one of the regions that were considered as the highest ranges in comparison with the rest, excluding Hamburg Le Havre that is always the most concentrated region. Referring to concentration tendency, both ranges follow the same pattern all the years of study. This range shows a series of fluctuations during the years of study until a concentration tendency in year 2012. This is also depicted in the Lorenz curve.



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Shift in concentration for West Med Sea ports during the years 2009 and 2012(Author's calculations)

Discussion: According to the traffic figures, this range has many transshipment ports that handle great amount of traffic. However, shipping lines prefer hubs that have transshipment function and on the same time a good hinterland connection. Consequently, the West med transshipment ports that are almost 75% pure transshipment function, cannot compete Northern ports like Rotterdam that manages to have both transshipment and gateway function in almost the same levels. This is the reason why during the years of study there can be seen a rather steady route and not an increasing one in both HHI and Gini coefficient in the ranges. Moreover, the Inter-competition from ports outside the EU plays an important role: Algeciras (stronghold of APM Terminals of the AP Moller Group) focuses a lot on east-west and north-south route (Notteboom 2013) for its container traffic operations. However, the latest years the ports have been facing competition from the port of Tanger Med, also port from APM Group, and this is the reason that traffic figures are not increasing in the similar way as the past.

Furthermore, some of the smaller ports gain ground. One of the ports gained ground was the port of Tarragona that despite being a small one, gained volume of traffic because of the operations of ZIM lines in the Contansa terminal (increase its cargo from 47425TEUs in 2008 to 243071TEUs in 2009).

Ligurian ports [Genoa (6th biggest port In the sample), La Spezia (7th biggest port in the sample) and Savona (16th biggest port in the sample)) lost significant amount of cargo because they face strong competition by the north ports that offer better hinterland connection through barges and rail according to Notteboom (2013).from the moment that so big ports lose cargo, it is a natural consequence for the range to have deconcentrated figures.

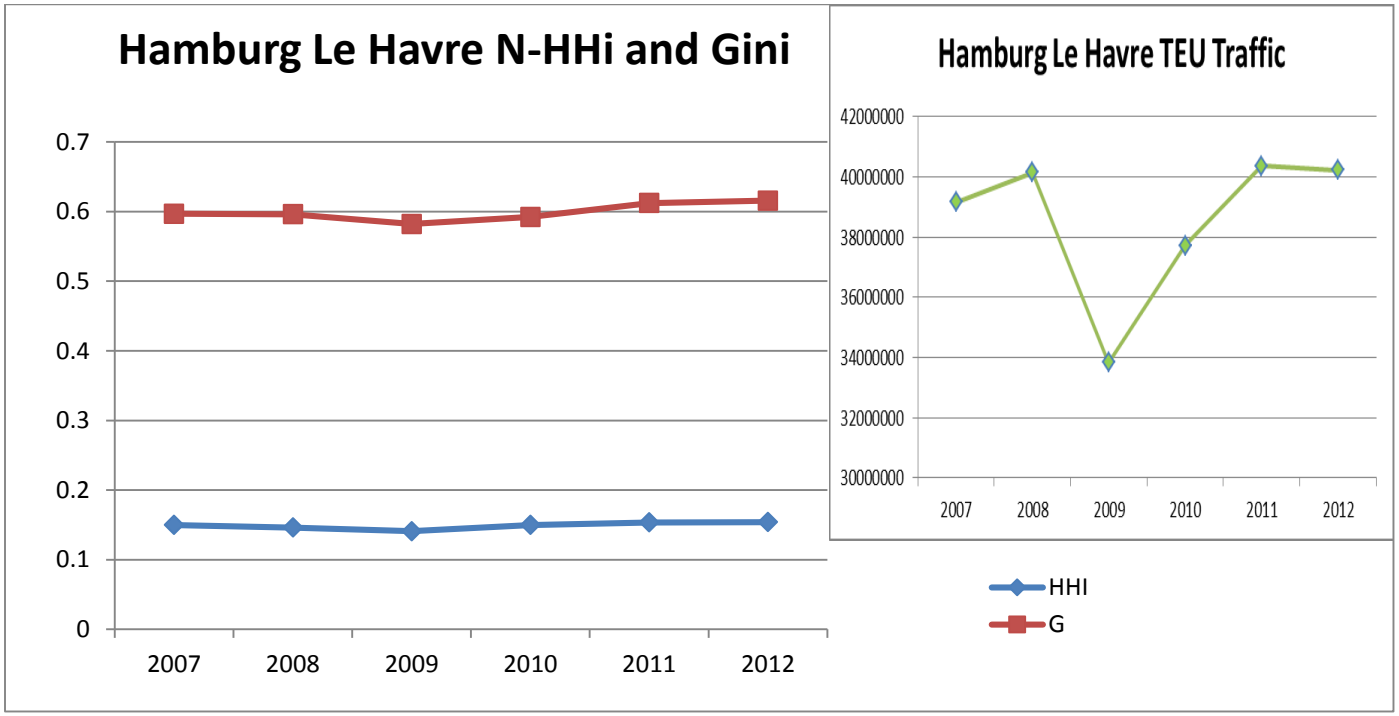
Except for that, the Change of the RTW routes play a significant role for West Med ports. Mediterranean ports were supposed to gain advantage from the Suez Canal that gives them the opportunity to provide a more direct access to the Balkans and consequently to the central Europe. However, during the years of the crisis this is not the case. Notteboom, Rodrigue and Monie (2010) indicate that during the years of the crisis, the shipping lines decided to change the RTW route from Asia to Europe, and instead of using The Suez Canal, following the route from the Cape canal in South Africa. This was because shipping lines wanted to reduce Suez Canal's extraordinary charges and the piracy in Somalia that causes significant amount of problems. The result is that the Mediterranean ports lost significant amount of traffic, absorbed by the Northern ports. This is also one reason why during the period 2008-2009, a deconcentration tendency is observed in the West med ports.

The above-mentioned discussion proves two things: That indeed the range faced severe problems due to the crisis, and these evidence shows that West Med can be regarded a region that is rather deconcentrated and not concentrated one. In this respect, probably the results generated by N-HHI seem to be the wright ones.

5.3.8 Hamburg Le Havre Range

Hamburg Le Havre (15 ports) is the range with the biggest pots in European continent since includes Rotterdam (biggest port in Europe) and ports such as Hamburg, Antwerp and Zeebrugge. It has the biggest cumulative traffic from all the ranges in the sample reaching 42 million TEU in 2011.

indicator	2007	2008	2009	2010	2011	2012
HHI	0.149861	0.146096	0.140955	0.149937	0.153623	0.154078
G	0.596736	0.596065	0.582129	0.592118	0.612081	0.61559



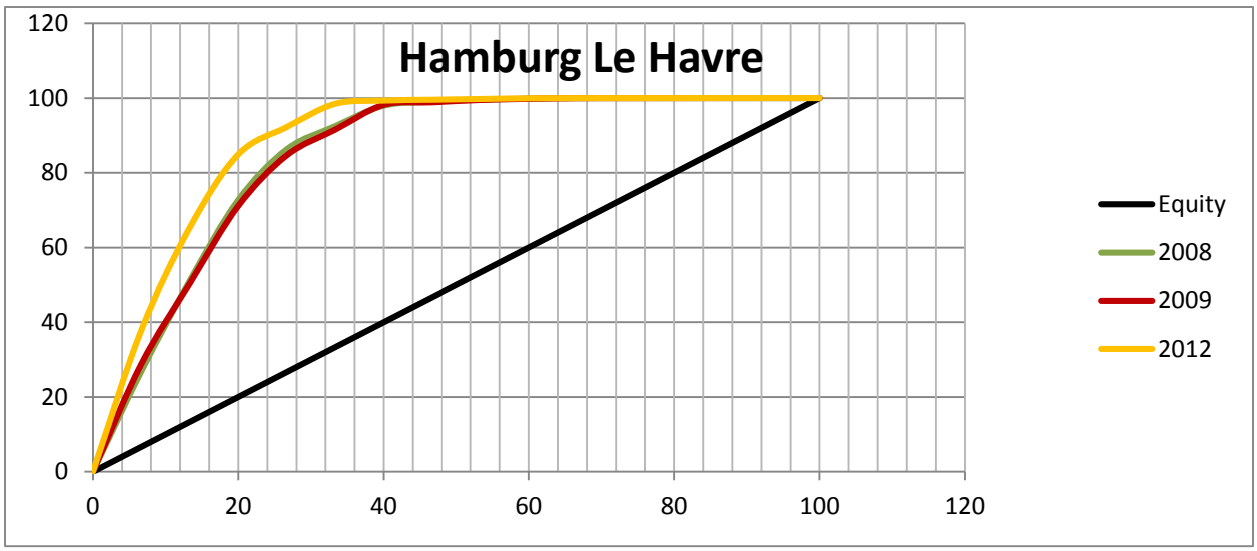
Results of HHI, GINI, and TEU (Author's calculations according to different databases)

HHI: Being the port region with the biggest amount of traffic, according to the database, Hamburg Le Havre range is considered a region with moderate concentration according to HHI results. (It is between 0.1 and 1.8) In year 2007 it was approximately at 0.149861(units measured by N-HHI) coming to the lowest levels the year of 2009 and going in an upcoming route afterwards.

Gini coefficient: Gini coefficient levels show also a range with moderate concentration levels. Comparing the range with other ranges, as it can be seen; it remains the most concentrated region in the European range all the years of the study (see Table G).

Concerning concentration tendency, until 2009 there had been a deconcentration route. Later on, the years of 2010, 2011 and 2012 the range is characterized by a concentration tendency.

Lorenz Curve: The same result is depicted also in Lorenz Curve graph. In order to be more visible for the reader, some of the years were excluded in this graph. As it can be seen, the year 2012 is the year with the highest concentration tendency of all while the year 2009 has been the one with the lowest levels of concentration.



Shift in concentration for West Med Sea ports during the years 2009 and 2012(Author's calculations)

Discussion: As it can be seen by the analysis of the previous ranges, concerning the concentration figures for the range itself, it has to be said that Rotterdam, Hamburg and Antwerp are the ports that create a sort of oligopoly, be the only ports that exceed 8million TEUS. This is the reason why this range has a moderate concentration tendency. The reason that the concentration is not in high levels has to do with the fact that there also ports with a significant amount of container traffic (Zebrugge, Amsterdam and Bremenhaven) that possibly allow the range to have just a moderate concentration. The increase in concentration levels in the period 2011 and 2012 has to do with the fact that the from the year of 2009 and on , a lot of the shipping lines started to concentrate the container traffic in Hamburg and Rotterdam according to Notteboom, Rodrigue and Monie(2009) leaving the rest of the ports out of the equation.

Referring to the comparison of the range with the rest of the ranges, it is obvious that Hamburg Le Havre plays a pivotal role in concentration patterns for the whole Europe. Mediterranean ports started losing cargo traffic that is concentrated in the northern ports from the change of RTW routes. Baltic ports lose ground from Hamburg because it has better hinterland connection. Uk-Irish ports and Scandinavian ports function as feeder services ports for Hamburg Le Havre ports. All these evidence explain the reason why Hamburg Le Havre range have is much more concentrated in comparison with other ranges and on the same time, it has an increasing concentration tendency according to Gini coefficient.

5.4 Factors resulting to (de)concentration patterns

After having analyzed the results and the reasons behind them, this part is going to search reasons of (de)concentration patterns and whether these reasons are the same as the ones mentioned by the authors described in Chapter 3.

Dedicated terminals and the role of global operators

Port of Piraeus is an example in the empirical analysis indicating how a concession of a port terminal may result in the concentration of the cargo. From the moment that Cosco started operating, (late 2009 and mainly 2010) the traffic figures increased dramatically concentrating the cargo to the specific port).

Cancellation of terminal projects.

Hackett (2009) during his analysis on how APM responded the first two years of crisis mentioned that APM's Chief Commercial Officer, Richard Mitchel stated that the main target of the company at least for now (during the crisis) is to generate cash from the current facilities and not generating new Greenfield sites. This means that the construction of new terminal facilities is postponed. Consequently, the deconcentration that is attributed in the creation of Greenfield investments and in the capture of smaller ports by big terminal operators, is something that is not going to confirmed in the period studied. This is one reason that the Gini coefficient and the HHI has an upward scale.

Hinterland connection.

According to various authors (Notteboom (2010), ITMMA (2009), the major concern of a shipping line in order to select a port of call especially in a crisis period is pricing.The ports benefiting are the ports that are able to provide better hinterland transportation in order to reduce the price for the shipper .Port of Goteborg's hinterland connection is one of the main reasons as mentioned before for the increase of concentration level in Scandinavian ports. Moreover, evidence were found, that the port ranges of Baltic and also the Napa ports in East Med were losing significant market share from the North ports of Hamburg Le Havre range, and the main reason has been the advanced hinterland connection of these ports (including barges and railway systems).

Economies of scale

The big ports of Hamburg Le Havre range, were able to offer economies of scale in the shipping lines, and this was one reason that they managed to concentrate cargo in expense of other ports in other regions (Hamburg from polish ports in Baltic Sea and Rotterdam, Antwerp from NAPA ports).

Shipping lines change of policy

Notteboom, Rodrigue and Monie (2009) mention that shipping lines started concentrating the traffic from the Far East - North Europe route when the crisis started to Hamburg and Rotterdam leaving big load centers such as Antwerp out of the equation. This is the reason why the HHI is slightly increases from 2009 to 2011. The fact that either GINI or HHI are not increasing in a higher scale, is because the rest of the ports in this range still handle significant amount of cargo and still are considered big load centers. As an example, Antwerp managed to increase its dominance in routes towards Middle East, Africa and India.

RTW routes

The change of the RTW(Round the world routes) by the shipping lines seems to have affected greatly the ranges of the south, As mentioned before, the costs of Suez Canal along with the piracy in Somalia forced a lot of the shipping lines(Maersk and Grand Alliance)to change route towards the Cape canal. This had as a result the increase of concentration in North ports and the decrease in the West Med ports.

Chartering vessels

Decisions of the shipping lines are a focal point for the concentration of traffic in ports. ITTMA (2009) a common strategy of the shipping lines before the crisis was the chartering of vessels in order to satisfy the increasing demand. ITMMA report (2009) states that most of the shipping lines tried to return the chartered vessels when the crisis broke up in 2008. MSC was the only shipping line that decided to increase the number of chartered vessels, seeing the crisis as an opportunity in the market. This is one of the reasons for the increase in the concentration levels like Algeciras and Sines that are strongholds of MSC.

The crisis itself caused deconcentration

''Shipping lines massively suspended liner services particularly on the Far East-Europe and transpacific trade routes'' Notteboom, Rodrigue and De Monie (2010). The results were a drop of Far East Europe trade by 21% during the years 2008-2009. This phenomenon is also depicted in the current research's results were the traffic for the period 2008-2009 is significantly reduced. This reduction is obviously one of the main reasons for the reduction of the N- HHI index and Gini index levels, something that is going to be analyzed in the next page.

The graph indicates the total TEU traffic for Baltic Sea ports and the two indicators used during the analysis. What can be seen is that both indicators follow a parallel route with the total TEU traffic indicator almost in all years of observation(except from the year 2007-2008 where the traffic was going upwards while the indicators followed the opposite direction).This is normal from the moment that both N-HHI and Gini are calculated by the use of TEU. Therefore, fluctuations in TEU affect also the indexes. This means that the great reduction of TEU due to the crisis in 2008 and 2009 is also obvious in Gini and N-HHI results. Therefore, the conclusion is that the crisis itself caused great deconcentration due to the reduction of the cargo traffic.

Of course, it does not mean that only the fluctuation of traffic affects concentration tendency. In order to strengthen the above mentioned argument, the viewer of this research should see in the next graph how the differences in the results between traffic(TEU) and N-HHI and GINI from year 2007 to 2008 and 2011 to 2012 for the same period in Hamburg Le Havre Range.

As it can be seen, the year 2007-2008 the TEU traffic was increased while Gini and N-HHi decreased. Except for that, the years 2011-2012 the TEU traffic decreases but on the same time the two indicators have an up warding direction. This result indicates that it does not mean that only cargo increase/ decrease itself may cause the concentration/deconcentration tendency but there are also other kind of reasons.

Role of global terminal operators

Furthermore, the examples of Algeciras which is questioned by the port of Tanger (recently started operations by MSC) and the port of Tarragona (stronghold of Zim lines) indicate smaller ports that are able to gain significant ground in the expense of the big load centers. This is another reason why West Med has so low levels of HHI index in comparison with other ranges and maybe this is one indication of the peripheral port challenge explained by Hayuth in 1981.

The competition of ports from other ranges

The analysis has shown many examples where ports from other ranges have an important role in the deconcentration of a port range. As an example, the Baltic ports and the Uk-Irish ports do not have the opportunity to increase significantly their concentration levels because of the competition they face from Hamburg Le Havre range. From the moment that the shipping lines chose ports like Hamburg or Rotterdam as port of call for the RTW services, the bigger ports of UK are settled in a feeder service level. This means that the big ports of UK are not able to reach load center status that could increase also their concentration within their own range.

Cost reduction

An example is the port of Koper, which did not manage to decrease the charging fees for the shipping lines. As a result, MSC increased the THC costs significantly, (official site of MSC) something that affected the traffic figures of the port for the next season. Therefore, it is confirmed that the cost reduction increases the capability to attract more traffic.

Deconcentrated government leads to deconcentration of cargo

According to Notteboom (2012), in 2011, Rotterdam and Antwerp were considering a common shareholding for acquiring a part of Duisburg port. The German government denied the offer and announced it would give its shareholding in the Duisburger Hafen AG .According to Notteboom's research, for the rest part of the port, it is more obvious that shareholders such as city of Duisburg and North Rhine-Westphalia state, will show even more interest in the case that the German Government decides to stop intervening in Duisburg port. The abovementioned indicates a deconcentration governance model

by the government (giving the rights of Germany's largest inland port to the local state. On the other hand, the denial of Rotterdam and Antwerp joined offer indicates that the government tries to avoid a further concentration of traffic figures in the big load centers. This is possibly because the German port of Hamburg may lose ground. No matter the reasoning, this indicates a move towards the slowdown of concentration tendency that the big load centers try to achieve by expanding their hinterland.

Chapter 6

Discussion and conclusions

6.1 Summarizing the findings from the empirical analysis

Looking the results of the empirical analysis, some important outcomes steam out.

- **Europe as a port range showed a rather stable route in concentration.** During the year of crisis, a deconcentration tendency was observed .From 2010 and on, Europe moves towards concentration. However, the fluctuations are not so fierce as the ones that are observed in the different ranges. This has to do also with the fact that when Europe is studied as a range, the amount of ports is extremely big in order to be able to express the fluctuations as they can be observed in smaller ranges.
- **The year of crisis (2009) was indeed the year of the great changes for the ranges studied**. According to the literature (ITMMA 2009), the end of 2008 and mainly 2009 was the year when the results of the crisis became obvious. According to the current results, there the overwhelming majority of the port ranges can be characterized by deconcentration during that particular year, as it can be seen by both the indexes used. The main reason for deconcentration seems to be the reduction of traffic figures. However, as proved in the empirical analysis this was not the only reason for the deconcentration.
- **The next years follow a 'concentrated' approach.** After 2009, most of the ranges depict a significant increase in concentration levels (with the exception of Scandinavia and Black Sea)...After the initial 'shock', shipping lines tried to redirect their policies in order to be able to withstand the harsh economic situation .This is why they try to gather the traffic in the bigger ports in order to create economies of scale. Referring to the ranges with deconcentration tendency, they were forced to be in a feeder service status because of the competition from other ranges. Accordingly, their bigger ports were not able to be the port of call anymore. This affected the ability of ports like Constanta and Felixstowe to attract great amount of cargo not only from the competing ranges but also inside their own range. The conclusion is that after a fierce financial crisis, concentration is the dominant phenomenon because of the need for economies of scale. However the results in UK and Baltic ports clearly show that even concentration tendency can be questioned by the policies and the decision making of the governments and the shipping lines.
- **There is diversity of the results between the ranges**. Gini coefficient indicates differences during the years (some ranges have upward tendency and some others downward) something can be considered as a clue that the ranges are affected by different factors referring to the (de)concentration levels.

- **N- HHI and Gini coefficient should be used together.** The example of Black Sea clearly indicates that HHI is an indicator used in order to have a first opinion about the (de) concentration level and tendency of a particular route, while Gini coefficient is the index that provides safe results concerning the comparison of the ranges.
- **N-HHI and Gini coefficient follow the same tendency patterns in the overwhelming majority of the ranges.** Seeing the (de)concentration patterns diachronically, there can be observed both N-HHI and Gini follow the same (de)concentration route in all the ranges among the years of study. This means that despite the fact that these two indicators explain the distribution of the traffic differently, both agree concerning whether the tendency for a specific route comes towards concentration or deconcentration. However, it has to be mentioned that there were some exceptions like some differences in UK-Irish range.
- **There cannot be made a clear distinction of the factors resulting concentration and deconcentration when the ranges are compared.** As seen in the after-statistics analysis, a reason resulted in concentration for a specific port range is the reason why another port range was deconcentrated. Consequently the factors driving to these phenomena, are greatly affected by the scope and the area studied by the researcher. So, there cannot be stated government intervene or the global operators decisions is strictly a reason for concentration or a reason for deconcentration. Of course, there are some factors such as economies of scale, and advanced technology that are mainly connected with concentration for reasons explained before.
- **Shipping lines and global operators are the ones changing the game.** As shown in the empirical analysis, decisions of shipping lines and global operators are the main reasons that drive the changes in port system especially after 2010.Examples from the analysis of the ranges explain the conclusion. APM decided to postpone any new construction of terminals and this probably resulted in the concentration of cargo in the big ports. Shipping lines decided to move container cargo from Antwerp and Hamburg to Rotterdam port, and these results in a slight increase in concentration of Hamburg Le Havre range. In Black Sea, Notteboom (2013) clearly mentioned that the shipping lines where the ones decided that Black Sea ports should maintain their feeder service level. In East Med, Cosco shipping line obtaining Piraeus as its dedicated terminal changed significantly the concentration patterns skyrocketing Piraeus just after the crisis.

6.2 Comparison with previous authors

The results come in line with the analysis of previous authors:

Notteboom and Ducruet (2012) analyzing data for the ports until 2009, they indicated that the concentration tendency comes in a parallel way with cargo distribution. This is also depicted in the results of the current research. Except for that, they indicated that the next years of the crisis , a concentration tendency would follow, Something that was also mentioned by Notteboom(2013), where he analyzed the European port ranges and how they operated in the years of crisis. Indeed, the HHI and Gini coefficient increase in the majority of the ranges as the years pass.

Notteboom (1997) talking about then N-HHI mentioned that this index is not the proper one for comparison between the ranges. This is also demonstrated in the current research as mentioned before in the case of comparing the Baltic Sea with the Hamburg Le Havre range.

Monios and WILMSMEIER (2012) studying the UK ports with data until 2010 show a deconcentration tendency that is attributed to many reasons explained before. This tendency is also depicted in the current years of study for the UK-Irish range and for the next two years (2011 and 2012).

Ducruet and Notteboom (2012) mentioned that the results of concentration indexes are in a parallel route with the traffic of cargo among the years. The same results come also in the current research as mentioned in previous pages. The results agree with Ducruet's study (2009) that when the range studied is not in a positive economic situation, the phenomenon that dominates is the concentration tendency.

The current study agrees with Wank's argument that every port case is different. Consequently, far from the mainstream arguments that may drive towards concentration (economies of scale) or deconcentration (the economic crisis itself), every port range and even the comparison between the port ranges has to be studied separately.

Taafee's (1963) theory that concentration may lead to the total extinction of some smaller ports, is not confirmed at least with the current database. Even during the period 2011-2012 were concentration tendency is observed, there is no port that had zero traffic. However, it has to be said that in the initial database obtained by Eurostat, there were some ports that had 0-container traffic in some of the years. However, they could not be used because there were also some years that these container ports did not record at all their traffic. So, they were not selected for the research because they were considered as not trustworthy.

6.3 Limitations

- As mentioned in the Database part, the initial part of Eurostat had many inaccuracies and this was the reason why there was a combination of port authorities and other databases in order to be able to find the most accurate result. However, it was impossible to identify every single of the 169 ports by looking to the respective port authorities, due to either unknown language, or the fact that they demanded membership in order to view the data.
- It is known by the literature that transshipment ports results have overestimated data (their traffic figures are counted 3 times) it was impossible to identify the transshipment percentage for every port in the sample.
- There could not be interpreted every single fluctuation of the port ranges. The general tendency is depicted and justified for every port range. However, some fluctuations could not be attributed to a specific reason (eg the upward tendency of Gini coefficient and N-HHI for UK-Irish range for the years 2008-2009) and the same problem for the Scandinavian range.

- The ports of Hamina and Kotka were merged in 2010. However, it was not possible to regard them as separate ports in the empirical analysis for the years before 2010. So, these two ports are considered as one port (Haminakotka) also for the years 2007-2009.
- During the empirical analysis, there were found no evidence for reasons of concentration like port fees for two reasons. First, the majority of the ports required a membership in order to be able to identify such reasons and secondly because it was extremely difficult to make an accurate identification for all the 159 ports studied in this research.
- The ports marked with a red sign (Dunkerque, Nantes Saint-Nazaire, Guadeloupe , Bordeaux, Brest) were the ones that it was not possibly to identify their traffic for a specific number of years. Consequently, the cargo traffic of the previous year was used in order to have the minimum amount of interference in the results.
- The results from the two indexes do not agree in all the ranges. To be more specific, in the ranges of West Mediterranean and Atlantic ports, the N-HHI indicates them as moderate concentrated regions while the N-HHI indicates them as low concentrated ranges. This was something faced also by previous authors in the literature, and most of the time it is faced when the sample contains a large number of evenly matched firms (in that case ports). This goes on with the results of the European port range. Despite the fact that the two indicators agree on concentration tendencies , this is not the same on how N-HHI and Gini characterize a specific region(Highly concentrated or moderate concentrated).However, the characterization of a range was not the main target of this study in the first place so, this does not affect the main target of the research.

6.4 Conclusions

This study tried to identify why and how did the concentration of traffic in European ports changed during the years (2007-2012). It is the first time the phenomenon is studied in such a wide number of ports (the previous bigger research used 75 ports). The main conclusion is the European port ranges faced a deconcentration tendency when the crisis became obvious. Afterwards, the majority of the ranges seem to have a concentrated tendency with an exception of Scandinavian ports and Black Sea.

Especially, port ranges before the crisis show deconcentration tendency according to the results of 2007-2008 and from previous researchers. During the years 2008-2009, the results of the crisis started to be obvious in maritime industry.

The years followed (2010-2012); the majority of the European ranges indicate an increase of concentration tendency even in slight levels. This is mostly attributed to the attempt of the shipping lines to create economies of scale in an environment of recession. This is the reason why they turn to the big load centers, in order to be able to have much bigger volume of cargo and on the same time lower cost for the shipper due to better hinterland connections. Referring to the ranges that show deconcentration tendency during the years of study, (Black sea and Scandinavian ports); this seems to be a result of the competition with the other ranges (Hambug Le Havre and East Med). These ranges have ports that function as ports of call (eg Rotterdam and Piraeus) forcing Scandinavian ports and Baltic Sea ports to be

in a feeder service status. This prevents the ports to be able to create such an environment that can attract higher amount of cargo from other ranges but also within their own range. However, the results indicate many fluctuations in all the ranges from the mainstream described above. Many smaller ports that managed to gain significant amount of cargo during the period of crisis something possibly affected the calculations from showing even higher concentration figures.

This study tried also to identify some of the reasoning behind concentration patterns. The results come in line with the assumption that every port range or even port case is different. There cannot be any strict distinction between the factors that concentrate or disperse the container traffic to specific ports. In every port range, a reason for concentration in a specific port may be the reason for deconcentration for another one.

Moreover, in every port range a combination of government, shipping lines and global operators' roles and costs is the reasoning behind the concentration tendency. However, in every range it is obvious how important is the role of terminal operators and shipping lines in the concentration patterns. In some cases, small ports were made the stronghold of the shipping lines (Sines stronghold of MSC), concentrating cargo. In other cases, shipping lines decided to change RTW route concentrating cargo to the big load centers of Hamburg Le Havre ports.

6.5 Further research

According to the findings, the factors for (de)concentration differ for every port range. It is interesting for further researchers to do a more deep analysis concerning the factors that affect the concentration in each range, studying every single port, something that was not possible in such a big amount of ports. Moreover, a research in a smaller scale (one or two ranges) with the use of GECI concentration index is going to shed lights in some questions remained unanswered, like why UK-Irish ports kept concentrating in the year of the great recession (2008-2009). Finally, an interesting topic will be to identify the reasons why the two indexes (N-HHI and Gini coefficient) happen to have diversified results in some cases and in some they do not.

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Port Authorities statistics facts and figures

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- **Antwerp PA** http://www.portofantwerp.com/en/search/content/Maritime%20cargo%20turnover
- **Finnish port Association**: http://www.finnports.com/eng/statistics/
- **Spanish Port Association**: http://www.puertos.es/en/estadisticas/estadistica_historica/index.html
- **Swedish port association: http://www.transportgruppen.se/In-English/Association-ports-of-Sweden/**

- **Bremerhaven PA** http://www.bremenports.de/index.php?SEARCH_SUBMITTED=1&id=326&languageid=2&sort=&order=&SEARCH_BUTTON=Suche+abschicken&SEARCH_TERM=STATISTICS
- **Bristol PA**: http://www.vlaamsehavencommissie.be/en/vhc/page/maritime-traffic-european-ports-uk-bristol
- **Cagliari PA: http://www.porto.cagliari.it/index.php?option=com_content&view=article&id=80&Itemid=89&lang=en**
- **Costanza PA** http://www.portofconstantza.com/apmc/portal/static.do?package_id=st_dt_gr_marfa&x=load
- **Gdansk PA**: http://www.portgdansk.pl/about-port/dct-gdansk

- **Genova PA: http://www.porto.genova.it/index.php/en/search?searchword=statistics&ordering=newest&searchphrase=all&limit=10&areas[0]=content**
- **Gothenburg PA**:

http://www.portofgothenburg.com/About-the-port/Volumes-and-freight-flow-/

- **Hamburg PA:http://www.hamburg-port-authority.de/de/Seiten/Suche.aspx?k=statistics**
- **Copenhagen PA: http://www.cmport.com/corporate/finance/annual-reports**
- **Koper PA:http://www.luka-kp.si/eng/isci?IDpm=-1&koren=1&find=statistika+2007&x=0&y=0**
- **Le Havre PA:http://www.havre-port.fr/en/press/gb-statistics/gb-statistiques-annuelles**
- **Lingurian ports Pas**: http://www.ligurianports.it/sections/la-spezia-uk
- **LisbonPA:http://www.portodelisboa.pt/portal/page/portal/PORTAL_PORTO_LISBOA_ING/STATISTICS**
- **London PA:http://www.pla.co.uk/Search-Results?x=0&y=0&strSearchTerm=pola+report**
- **Marseile PA:http://www.marseille-port.fr/fr/Rechercher/GPMM**
- **Malta PA:**http://www.maltafreeport.com.mt/content.aspx?id=107940
- **Napoli PA**:http://www.porto.napoli.it/en/statistiche/stat2.php , http://www.porto.napoli.it/en/statistiche/stat2.php
- **Lemessos PA:**http://www.cpa.gov.cy/CPA/page.php?pageID=1&langID=13
- **Rotterdam PA**:http://www.portofrotterdam.com/en/general/pages/search.aspx?k=PORT%20STATISTICS
- **Belfast PA**:https://www.google.gr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CDEQFjAA&url=https%3A%2F%2Fwww.belfast-harbour.co.uk%2Fuploads%2Fpdf%2F1372325686--BHC-Annual-Report-2012-13.pdf&ei=hTm4UsyLCs-c0wWLmYCADw&usg=AFQjCNHNoGZtrRGrBiAOnJfL9JE6pOfxEw&sig2=nsasOuXRjLwED1muGNAFKw
- **Potrsmouth PA**:http://www.portsmouth-port.co.uk/search_results
- **Riga PA**:http://www.rop.lv/en/about-port/statistics.html?view=statistics
- **Setubal PA:**http://www.portodesetubal.pt/setubal_e_sesimbra_estatisticas_portuarias.htm
- **Tallin PA**:http://www.portoftallinn.com/key-figures
- **Tenerife PA**:http://www.puertosdetenerife.org/index.php/en/component/content/article/9-contents/1316-estadisticas-tf-tf?highlight=YToxOntpOjA7czoxMDoic3RhdGlzdGljcyI7fQ==
- **Trieste PA:** http://www.porto.trieste.it/statistiche/index/language:eng
- **Venice PA**:https://www.port.venice.it/en/the-port-in-figures.html
- **Zeebrugge PA**:http://www.portofzeebrugge.be/nl/node/61
- **Rotterdam PA**:http://www.portofrotterdam.com/en/News/pressreleases-news/Pages/20090915_02.aspx
- **NAPA PAs**:http://www.portsofnapa.com/index.php?t=news&id=28

Appendix

Table 1 Initial database from Eurostat

Ports	2007	2008	2009	2010	2011	2012
Rotterdam	10773401	10630961	9579284	11017466	11,339,868	10,938,505
Hamburg	9913531	9767266	7030928	7905518	9,035,091	8,890,713
Antwerp	7878920	8378854	7014340	8144370	8,316,776	8,174,374
Bremerhaven	4883959	5451388	4552027	4858328	5,911,217	6,111,200
Gioia Tauro	3464179	3164793	2724706	3896666	3,307,005	3,725,193
Algeciras	3419850	3297611	2953082	2776841	3,583,452	4,098,683
Felixstowe	3342272	3131426	3020943	3415134	3,248,593	3,367,693
Valencia	3048903	3606341	3654428	4211175	4,338,333	4,470,506
Barcelona	2605593	2564537	1845878	1927901	2,005,826	1,745,445
Southampton	1905186	1616786	1384671	1566550	1,590,520	1,439,482
Constanta	1444655	1369554	584458	546056	653,306	675,403
Piraeus	1383831	437301	667135	850254	1,680,856	2,815,064
Las Palmas de Gran Canaria	1296491	1289802	989487	1101628	1,269,740	1,194,346
Genova	1229586	1461909	1311207	1020049	1,276,926	1,577,567
Zeebrugge	1190971	1400838	1466904	1436758	1,157,415	930,119
La Spezia	1130071	1185922	840367	1180605	1,205,001	1,180,751
Marseille	1058472	901411	943244	1030938	1,095,219	17,830
Bilbao	956112	894149	443463	532000	572,748	609,996
London	857751	983471	646419	732697	736,938	685,682
Goteborg	840868	863881	824217	891497	913,885	921,772
Dublin	744156	676543	548467	553977	523,572	526,739
Liverpool	675678	673896	588850	661973	664,025	632,261
Gdynia	611948	610944	376240	476982	591,063	658,735
HaminaKotka	576469	627149	349169	402420	501,652	531,762
Lisbon	554774	555850	500322	512022	542,576	486,520
Málaga	542405	428623	289877	298401	492,551	352,331
Livorno	528815	216054	425620	369862	452,641	412,419
Medway	514533	767582	422884	439767	402,229	298,101
Aarhus	502011	458461	384705	446329	431,359	404,288
Santa Cruz De Tenerife	475635	390211	338879	322644	345,364	284,716

Cagliari	461834	181585	233702	486616	555,646	580,242
Thessaloniki	459920	242041	264014	289224	327,061	359,260
Taranto	449202	444386	436155	258305	286,122	111,041
Helsinki	434631	423958	366563	400689	334,210	360,977
Leixões	433713	450121	450100	481792	514,158	632,801
Amsterdam	408742	431768	231927	57107	14,537	16,842
Lemesos (Limassol)	376662	416504	353679	332457	338,418	301,601
Klaipeda	321432	373263	247996	295226	382,194	381,371
Koper	306942	356885	334317	480981	586,913	556,392
Hull	303153	262320	181956	202119	219,700	268,231
Belfast	264567	255017	213789	214563	219,203	211,756
Luebeck	262931	256993	171968	167504	153,130	151,492
Venezia	262585	290973	228957	237690	225,087	272,764
Forth	256885	274374	231812	216582	245,045	242,041
Vigo	244069	247892	193586	213006	212,210	198,390
Napoli	225598	191182	127058	224193	271,728	293,565
Riga	206664	212055	179828	254560	303,004	362,283
Cork	196775	186930	148586	147385	156,661	166,010
Oslo	195249	189192	178548	201893	208,799	202,817
Dunkerque	194777	214345	211974	200826	270,981	0
Palma de Mallorca	192283	174675	124604	76180	64,657	56,644
Helsingborg	188828	135935	111980	148851	174,525	177,043
Waterford	186040	173237	119223	71084	63,823	38,898
Ravenna	184195	202655	218222	142337	102,257	191,827
Alicante	179741	151358	132420	147803	154,661	158,954
Tallinn	176912	179608	129409	151969	197,717	227,809
Rauma	174866	171064	143139	160649	189,778	206,315
Kobenhavns Havn	164883	165119	126384	131512	141,052	143,072
Rouen	159015	142434	122237	129944	130,940	245
Tees & Hartlepool	153923	155798	178468	252439	263,559	254,743
Sines	150038	220470	253495	382082	447,497	553,065
Rijeka	148161	170388	123373	121091	128,390	123,549
Salerno	145688	99103	143931	52289	52,299	85,289
Cadiz	145229	128957	106760	109239	132,436	136,978
Nantes Saint-Nazaire	145169	149407	145662	166273	178,661	0
Grimsby & Immingham	144735	160077	133264	109550	125,580	211,171
Sevilla	135012	130452	129736	152614	164,660	156,261

Savona	131578	139785	71236	111101	116,557	148,052
Trieste	121689	147383	156219	261055	409,979	427,139
Caniçal	110807	101181	99774	98234	95,411	85,952
Ancona	110105	122175	167833	141681	135,639	149,017
Castellón	101929	88208	67075	103956	130,963	160,934
Varna	100370	154304	112469	118863	122,881	128,390
Gdansk	94725	183207	232887	509887	684,711	933,426
Port Reunion (ex Pointe-des Galets) (Reunion)	93290	90764	87015	86732	90,926	1,256
Bristol	86767	68104	72547	70761	63,227	64,697
Ponta Delgada (Ilha de S. Miguel, Açores)	83786	80590	97142	96130	103,320	76,998
Guadeloupe (Guadeloupe)	82031	0	136485	149775	163,433	0
Portsmouth	79982	59739	57064	51938	56,477	56,039
Clydeport	75536	59859	71356	82096	94,889	90,058
Gavle	67096	103812	108522	100307	118,836	117,190
Bordeaux	65749	55898	80723	55403	61,305	8
Cuxhaven	63844	63731	57153	65801	73,768	59,210
Aalborg	63780	64556	58315	63725	108,652	110,083
Moss	56586	54597	44242	52423	61,767	61,267
Tyne	54539	60036	37176	57203	72,723	50,296
Larvik	52286	57253	55994	58015	68,819	61,699
Szczecin	50144	61194	51206	54703	54,663	56,541
Cardiff	48297	33547	15479	20160	19,881	17,773
Tarragona	47138	47415	243071	254945	225,747	192,939
Cartagena	47036	46755	58680	64489	72,329	66,588
Marín-Pontevedra	46555	29160	30593	48685	37,669	39,978
Marsaxlokk	45171	53013	87127	94564	97,777	92,615
Moerdijk	44344	94480	102316	117876	74,840	72,148
Malmo	43637	41399	30159	28453	30,298	31,220
Kristiansand	43341	43984	35412	42166	39,700	44,583
Stockholm	42781	37292	27401	26111	28,432	35,834
Aalesund/Langevaag/Spjelkavik	41718	42033	49044	59586	61,220	58,324
Pori	38103	36012	28379	21611	21,197	26,394
Palermo	35991	37239	28658	29775	17,243	14,149
Esbjerg	33957	25379	31523	36367	37,954	34,318
Oulu	33299	31390	30971	32175	23,318	26,994

Borg	32841	37600	37206	35286	38,008	39,880
Bremen	32155	32121	26886	17172	13,322	22,256
Vasteras	31867	25272	21817	21419	24,696	21,705
Burgas	31200	46559	23909	23565	29,325	46,007
Bergen	31057	33270	28357	25772	28,048	29,939
Ploce	30112	35205	25684	20155	22,437	16,851
Malta (Valletta)	30100	40656	14655	12535	11,314	12,737
Brest	28645	33292	33313	42695	7,138	0
Aberdeen	27682	27422	27587	33515	34,968	37,608
Fredericia (Og Shell-Havnen)	25174	32992	36322	56223	63,196	70,775
Varberg	23501	12207	9150	7957	9,075	8,301
Grenland/Skien/Porsgrunn/Bamble	23495	22799	12763	17500	20,879	26,264
Stavanger	22971	26887	21084	19607	13,838	24,423
Melilla	22158	21693	25546	22389	47,654	54,856
Turku	21955	23009	17600	13846	7,490	6,611
Bodo	20944	12508	17211	15155	16,050	17,029
Kiel	20394	16526	14190	24856	31,628	33,108
Volos	17509	21814	20518	23827	20,301	24,152
Tromso	16845	10210	14224	15815	11,926	15,877
Catania	15479	13545	10918	10667	14,402	21,183
Civitavecchia	15070	9900	28730	9291	6,132	36,810
Oxelösund (ports)	14087	11437	7736	11056	18,360	14,163
Ceuta	13963	15468	13476	9568	11,459	16,120
Gijon	13849	26095	27465	35570	35,860	48,607
Trondheim	13695	10745	8699	13992	13,474	14,449
Setúbal	12425	19952	27440	51733	1,366,364	77,577
Kristiansund	12253	13910	12480	14194	13,460	10,581
Kirkwall	12237	11689	13255	12203	13,457	20,616
Halmstad	11935	14989	17507	27354	25,261	28,799
Umea	11914	12370	16566	17563	19,685	18,912
Figueira da Foz	10665	9951	8995	2527	404,681	309,913
Heraklion	10594	8740	17880	19885	18,921	16,687
Karmsund/Haugesund/Karmøy	8717	7293	8249	7295	7,610	7,284
Raahe	8501	9206	3734	4703	4,327	4,903
La Coruña	8476	7918	7778	5623	5,581	4,760
Ferrol	8244	500	401	440	542	915
Floroe	7881	6669	6762	8936	7,091	4,251

Bremanger/Svelgen	6716	3607	2540	4024	4,417	3,594
Maloy	5839	5910	7542	9954	10,113	16,596
Sundsvall	4283	4923	7461	8553	19,232	25,779
Split	3487	5038	2853	3397	3,627	3,642
Eigersund	2879	3830	3743	5498	5,530	3,906
Gent (Ghent)	2570	2390	8542	19697	36,374	60,634
Brake	2334	215	267	179	169	375
Pozzallo	2205	1698	1141	676	457	2,817
Kokkola	2045	2476	6845	12152	18,266	14,602
Drammen	1496	9151	11397	14546	19,854	25,789
Monfalcone	985	4281	479	331	433	683
Molde	916	1393	926	647	79	206
Rostock	759	2586	2245	2207	592	787
Harwich	718	4681	2385	2509	1,393	1,342
Terneuzen	705	2296	4026	5018	298	2,720
Santander	330	435	1888	1520	2,140	1,136
Emden	276	101	519	956	818	710
Almeria	213	203	1425	2767	18,334	20,738

Table 2 Final port map from a combination of different databases

Ports	2007	2008	2009	2010	2011	2012
Rotterdam	10790829	10783825	9743290	11145804	11876921	11865916
Hamburg	9913531	9737110	7007704	7895736	9014165	8863896
Antwerpen	8,176,614	8662891	7309639	8468475	8663947	8635169
Bremerhaven	4892000	5448189	4578642	4888655	5915487	6134000
Gioia Tauro	3464179	3467772	2857000	2851261	2338000	2721104
Algeciras	3419850	3297611	2953082	2776841	3583452	4098683
Felixstowe	3342272	3131426	3020943	3415134	3248593	3367693
Valencia	3048903	3606341	3654428	4211175	4338333	4470506
Barcelona	2605593	2564537	1845878	1927901	2005826	1745445
Southampton	1905186	1616786	1384671	1566550	1590520	1439482
Constanta	1444655	1369554	584458	546056	653306	675403
Piraeus	1383831	437301	667135	850254	1680856	2815064
Las Palmas de Gran Canaria	1296491	1289802	989487	1101628	1269740	1194346
Genova	1855026	1766605	1533627	1758858	1847102	2064806
Zeebrugge	2020723	2209715	2328198	2499756	2206681	1953170
La Spezia	1187000	1246000	1046063	1285155	1307274	1247218

Marseille	901411	851425	876757	953435	944047	1062408
Bilbao	956112	894149	443463	532000	572748	609996
London	857751	983471	646419	732697	736938	685682
Goteborg	840868	863881	824217	891497	913885	921772
Dublin	744156	676543	548467	553977	523572	526739
Liverpool	675678	673896	588850	661973	664025	632261
Gdynia	611948	610944	376240	476982	591063	658735
HaminaKotka	766173	806573	454072	512674	612598	631042
Lisboa	554774	555850	500322	512022	542576	486520
Málaga	542405	428623	289877	298401	492551	352331
Livorno	528815	216054	425620	369862	452641	412419
Medway	514533	767582	422884	439767	402229	298101
Aarhus	502011	458461	384705	446329	431359	404288
Santa Cruz De Tenerife	475635	390211	338879	322644	345364	284716
Cagliari	461834	256564	736984	629340	613933	627,609
Thessaloniki	459920	242041	264014	289224	327061	359260
Taranto	449202	444386	436155	258305	286122	111041
Helsinki	431406	419809	357204	399903	392342	404895
Leixões	433713	450121	450100	481792	514158	632801
Amsterdam	408742	431768	231927	57107	14537	16842
Lemesos (Limassol)	376662	416504	353679	332457	338418	301601
Klaipeda	321432	373263	247996	295226	382194	381371
Koper	306942	356885	334317	480981	586913	556392
Hull	303153	262320	181956	202119	219700	268231
Belfast	264567	255017	213789	214563	219203	211756
Luebeck	262931	256993	171968	167504	153130	151492
Venezia	262585	379,072	369,474	393,913	429,893	458,363
Forth	256885	274374	231812	216582	245045	242041
Vigo	244069	247892	193586	213006	212210	198390
Napoli	460,812	481521	515868	532432	526768	546,818
Riga	206664	212055	179828	254560	303004	362283
Cork	196775	186930	148586	147385	156661	166010
Oslo	195249	189192	178548	201893	208799	202817
Dunkerque	194777	214345	211974	200826	270981	270981
Palma de Mallorca	192283	174675	124604	76180	64657	56644
Helsingborg	188828	135935	111980	148851	174525	177043
Waterford	186040	173237	119223	71084	63823	38898
Ravenna	184195	202655	218222	142337	102257	191827
Alicante	179741	151358	132420	147803	154661	158954
Tallinn	176912	179608	129409	151969	197717	227809
Rauma	174866	171064	143139	160649	189778	206315
Kobenhavns Havn	164883	165119	126384	131512	141052	143072
Rouen	159015	142434	122237	129944	130940	245000
Tees & Hartlepool	153923	155798	178468	252439	263559	254743
Sines	150038	220470	253495	382082	447497	553065
Rijeka	148161	170388	123373	121091	128390	123549
Salerno	145688	99103	143931	52289	52299	85289
Cadiz	145229	128957	106760	109239	132436	136978

Nantes Saint-Nazaire	145169	149407	145662	166273	178661	178661
Grimsby & Immingham	144735	160077	133264	109550	125580	211171
Sevilla	135012	130452	129736	152614	164660	156261
Savona	230000	252837	196317	196434	170427	168000
Trieste	266000	335943	276957	281629	393193	460035.8
Caniçal	110807	101181	99774	98234	95411	85952
Ancona	110105	122175	167833	141681	135639	149017
Castellón	101929	88208	67075	103956	130963	160934
Varna	100370	154304	112469	118863	122881	128390
Gdansk	94725	183207	232887	509887	684711	897000
Port Reunion (ex Pointe-des Galets) (Reunion)	93290	90764	87015	86732	90926	1256
Bristol	86767	68104	72547	70761	63227	64697
Ponta Delgada (Ilha de S. Miguel, Açores)	83786	80590	97142	96130	103320	76998
Guadeloupe (Guadeloupe)	82031	82031	136485	149775	163433	163433
Portsmouth	79982	59739	57064	51938	56477	56039
Clydeport	75536	59859	71356	82096	94889	90058
Gavle	67096	103812	108522	100307	118836	117190
Bordeaux	65749	55898	80723	55403	61305	61305
Cuxhaven	63844	63731	57153	65801	73768	59210
Aalborg	63780	64556	58315	63725	108652	110083
Moss	56586	54597	44242	52423	61767	61267
Tyne	54539	60036	37176	57203	72723	50296
Larvik	52286	57253	55994	58015	68819	61699
Szczecin	50144	61194	51206	54703	54663	56541
Cardiff	48297	33547	15479	20160	19881	17773
Tarragona	47138	47415	243071	254945	225747	192939
Cartagena	47036	46755	58680	64489	72329	66588
Marín-Pontevedra	46555	29160	30593	48685	37669	39978
Marsaxlokk	1900000	2330000	2260000	2370000	2360000	2540000
Moerdijk	44344	94480	102316	117876	74840	72148
Malmo	43637	41399	30159	28453	30298	31220
Kristiansand	43341	43984	35412	42166	39700	44583
Stockholm	42781	37292	27401	26111	28432	35834
Aalesund/Langevaag/Spjelkavik	41718	42033	49044	59586	61220	58324
Pori	39381	37454	29087	22390	21635	27126
Palermo	35991	37239	28658	29775	17243	14149
Esbjerg	33957	25379	31523	36367	37954	34318
Oulu	32154	30921	30224	31054	32617	41742
Borg	32841	37600	37206	35286	38008	39880
Vasteras	31867	25272	21817	21419	24696	21705
Burgas	31200	46559	23909	23565	29325	46007
Bergen	31057	33270	28357	25772	28048	29939
Ploce	30112	35205	25684	20155	22437	16851
Malta (Valletta)	30100	40656	14655	12535	11314	12737
Brest	28645	33292	33313	42695	7138	7138
Aberdeen	27682	27422	27587	33515	34968	37608

Fredericia (Og Shell-Havnen)	25174	32992	36322	56223	63196	70775
Varberg	23501	12207	9150	7957	9075	8301
Grenland/Skien/Porsgrunn/Bamble	23495	22799	12763	17500	20879	26264
Stavanger	22971	26887	21084	19607	13838	24423
Melilla	22158	21693	25546	22389	47654	54856
Turku	21955	23009	17600	13846	7490	6611
Bodo	20944	12508	17211	15155	16050	17029
Kiel	20394	16526	14190	24856	31628	33108
Volos	17509	21814	20518	23827	20301	24152
Tromso	16845	10210	14224	15815	11926	15877
Catania	15479	13545	10918	10667	14402	21183
Civitavecchia	15070	9900	28730	9291	6132	36810
Oxelösund (ports)	14087	11437	7736	11056	18360	14163
Ceuta	13963	15468	13476	9568	11459	16120
Gijon	13849	26095	27465	35570	35860	48607
Trondheim	13695	10745	8699	13992	13474	14449
Setúbal	12425	19952	27440	51733	77577	49350
Kristiansund	12253	13910	12480	14194	13460	10581
Kirkwall	12237	11689	13255	12203	13457	20616
Halmstad	11935	14989	17507	27354	25261	28799
Umea	11914	12370	16566	17563	19685	18912
Figueira da Foz	10665	9951	8995	2527	404681	309913
Heraklion	10594	8740	17880	19885	18921	16687
Karmsund/Haugesund/Karmøy	8717	7293	8249	7295	7610	7284
Raahe	9108	9400	3977	5130	4038	5291
La Coruña	8476	7918	7778	5623	5581	4760
Ferrol	8244	500	401	440	542	915
Floroe	7881	6669	6762	8936	7091	4251
Bremanger/Svelgen	6716	3607	2540	4024	4417	3594
Maloy	5839	5910	7542	9954	10113	16596
Sundsvall	4283	4923	7461	8553	19232	25779
Split	3487	5038	2853	3397	3627	3642
Eigersund	2879	3830	3743	5498	5530	3906
Gent (Ghent)	2570	2390	8542	19697	36374	60634
Brake	2334	215	267	179	169	375
Pozzallo	2205	1698	1141	676	457	2817
Kokkola	2036	2542	7083	12235	18259	14723
Drammen	1496	9151	11397	14546	19854	25789
Monfalcone	985	4281	479	331	433	683
Molde	916	1393	926	647	79	206
Rostock	759	2586	2245	2207	592	787
Harwich	718	4681	2385	2509	1393	1342
Terneuzen	705	2296	4026	5018	298	2720
Santander	330	435	1888	1520	2140	1136
Emden	276	101	519	956	818	710
Almeria	213	203	1425	2767	18334	20738
Le Havre	2656171	2488654	2240714	2358077	2215262	2300000

Table 3 Distinction of port ranges and Databases used

ranges	Ports	database
H-Le Havre	Rotterdam	PA,ESPO,IY
H-Le Havre	Hamburg	PA,ESPO,IY
H-Le Havre	Antwerpen	PA,ESPO,IY
H-Le Havre	Bremerhaven	PA,ESPO,IY
West Med	Gioia Tauro	PA,ESPO,IY
West Med	Algeciras	PA,ESPO,IY
UK-irish	Felixstowe	PA,ESPO,IY
West Med	Valencia	PA,ESPO,IY
West Med	Barcelona	PA,ESPO,IY
UK-irish	Southampton	PA,ESPO,IY
Black sea ports	Constanta	EU,Espo,PA
East Med	Piraeus	PA,ESPO,IY
Atlantic	Las Palmas de Gran Canaria	PA,ESPO,IY,spanish port association
West Med	Genova	PA,ESPO,IY
H-Le Havre	Zeebrugge	PA,ESPO,IY
West Med	La Spezia	PA,ESPO,IY
West Med	Marseille	PA,ESPO,IY
Atlantic	Bilbao	EU,PA
UK-irish	London	EU,Espo,PA
Scandinavian	Goteborg	EU,Espo,Pasweedish port associations
UK-irish	Dublin	Eu
UK-irish	Liverpool	Eu
baltic sea	Gdynia	Eu
baltic sea	HaminaKotka	Eu,Espo, Pa,Finish port association
Atlantic	Lisboa	EU,Espo,PA
West Med	Málaga	Eu,spanish port association
West Med	Livorno	Eu
UK-irish	Medway	Eu
Scandinavian	Aarhus	Eu
Atlantic	Santa Cruz De Tenerife	EU,Espo,PA
West Med	Cagliari	EU,Espo,PA
East Med	Thessaloniki	Eu
East Med	Taranto	Eu
baltic sea	Helsinki	Eu, finish port association
Atlantic	Leixões	Eu
H-Le Havre	Amsterdam	EU,Espo,PA
East Med	Lemesos (Limassol)	Eu
baltic sea	Klaipeda	Eu
East Med	Koper	EU,Espo,PA

UK-irish	Hull	Eu
UK-irish	Belfast	EU,Espo,PA
baltic sea	Luebeck	Eu
East Med	Venezia	Eu
UK-irish	Forth	Eu
Atlantic	Vigo	Eu,spanish port association
West Med	Napoli	EU,Espo,PA,musso 2013
baltic sea	Riga	eu,espo,pa
UK-irish	Cork	Eu
Scandinavian	Oslo	Eu
H-Le Havre	Dunkerque	Eu
West Med	Palma de Mallorca	Eu
Scandinavian	Helsingborg	Eu,Sweedish port association
UK-irish	Waterford	Eu
East Med	Ravenna	Eu
West Med	Alicante	Eu,spanish port association
baltic sea	Tallinn	EU,PA
scandinavian	Rauma	Eu, finish port association
baltic sea	Kobenhavns Havn	EU,Espo,PA
Atlantic	Rouen	EU,PA
UK-irish	Tees & Hartlepool	Eu
Atlantic	Sines	Eu,Espo
East Med	Rijeka	Eu
West Med	Salerno	Eu
Atlantic	Cadiz	EU Espo
Atlantic	Nantes Saint-Nazaire	Eu
UK-irish	Grimsby & Immingham	Eu
Atlantic	Sevilla	Eu,spanish port association
West Med	Savona	EU,Espo,PA,musso 2013
West Med	Trieste	EU,Espo,PA,musso 2013
West Med	Caniçal	Eu
East Med	Ancona	Eu
West Med	Castellón	Eu,spanish port association
Black sea ports	Varna	Eu
baltic sea	Gdansk	EuEspo
Atlantic	Port Reunion (ex Pointe-des Galets) (Reunion)	Eu
UK-irish	Bristol	EU,Espo,PA
Atlantic	Ponta Delgada (Ilha de S. Miguel, Açores)	Eu
Atlantic	Guadeloupe (Guadeloupe)	Eu
UK-irish	Portsmouth	EU,Espo,PA
UK-irish	Clydeport	Eu
Scandinavian	Gavle	Eu,Sweedish port association
Atlantic	Bordeaux	Eu,PA
H-Le Havre	Cuxhaven	Eu
Scandinavian	Aalborg	Eu

Scandinavian	Moss	Eu
UK-irish	Tyne	Eu
Scandinavian	Larvik	Eu
baltic sea	Szczecin	Eu
UK-irish	Cardiff	Eu
West Med	Tarragona	Eu,spanish port association
West Med	Cartagena	Eu,spanish port association
West Med	Marín-Pontevedra	Eu,spanish port association
West Med	Marsaxlokk	PA,ESPO,IY
H-Le Havre	Moerdijk	Eu
Scandinavian	Malmo	Eu, sweedish port association
Scandinavian	Kristiansand	Eu
baltic sea	Stockholm	Eu,Sweedish port association
Scandinavian	Aalesund/Langevaag/Spjelkavik	Eu
scandinavian	Pori	Eu, finish port association
West Med	Palermo	Eu
Scandinavian	Esbjerg	Eu
Scandinavian	Oulu	Eu,finish port association
Scandinavian	Borg	Eu
Scandinavian	Vasteras	Eu
Black sea ports	Burgas	Eu
Scandinavian	Bergen	Eu
East Med	Ploce	Eu
West Med	Malta (Valletta)	Eu
Atlantic	Brest	Eu
UK-irish	Aberdeen	Eu
Scandinavian	Fredericia (Og Shell-Havnen)	Eu
Scandinavian	Varberg	Eu
Scandinavian	Grenland/Skien/Porsgrunn/Bamble	Eu
Scandinavian	Stavanger	Eu
West Med	Melilla	Eu,spanish port association
baltic sea	Turku	Eu,finish port association
Scandinavian	Bodo	Eu
Scandinavian	Kiel	Eu
East Med	Volos	Eu
Scandinavian	Tromso	Eu
East Med	Catania	Eu
West Med	Civitavecchia	EU,Espo,PA,musso 2013
baltic sea	Oxelösund (ports)	Eu,Sweedish port association
West Med	Ceuta	Eu
Atlantic	Gijon	Eu,spanish port association
Scandinavian	Trondheim	Eu
Atlantic	Setúbal	Eu
Scandinavian	Kristiansund	Eu
UK-irish	Kirkwall	Eu

Scandinavian	Halmstad	Eu,Sweedish port association
scandinavian	Umea	Eu
Atlantic	Figueira da Foz	Eu
East Med	Heraklion	Eu
Scandinavian	Karmsund/Haugesund/Karmøy	Eu
scandinavian	Raahe	Eu, finish port association
Atlantic	La Coruña	Eu,spanish port association
Atlantic	Ferrol	Eu
Scandinavian	Floroe	Eu
Scandinavian	Bremanger/Svelgen	Eu
Scandinavian	Maloy	Eu
scandinavian	Sundsvall	Eu
East Med	Split	Eu
Scandinavian	Eigersund	Eu
H-Le Havre	Gent (Ghent)	Eu
H-Le Havre	Brake	Eu
West Med	Pozzallo	Eu
Scandinavian	Kokkola	Eu, finish port association
Scandinavian	Drammen	Eu
East Med	Monfalcone	Eu
Scandinavian	Molde	Eu
H-Le Havre	Rostock	Eu
UK-irish	Harwich	Eu
H-Le Havre	Terneuzen	Eu
Atlantic	Santander	Eu,spanish port association
H-Le Havre	Emden	Eu
West Med	Almeria	Eu
H-Le Havre	Le Havre	PA,ESPO,IY