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**Concentration evolution of the container
throughput in the Mediterranean ports**

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ABSTRACT

This report presents the analysis of the concentration evolution of the container throughput in the Mediterranean ports from 2.000 to 2.015. Nowadays, the Mediterranean region is not only a completely mature market but also one which presents a strong demand which is likely to continue growing during the following years.

In order to examine the level of concentration of the container terminals, different indexes have been used. These are the Concentration Ratios (*CR1*, *CR3* and *CR10*), the Gini coefficients and Lorenz curve, the Herfindahl-Hirschman Index (*HHI*) and the new Geo-Economic Concentration Index (*GECI*).

The main conclusions derived from this report are the following. Firstly, the total container throughput in the Mediterranean area during the last fifteen years has experienced an impressive growth, from 18.398.741 million TEUs in 2.000 to 46.166.931 million TEUs in 2.015. Secondly, the container throughput concentration has experienced a slight decrease during the first decade of the 2.000s (from a *HHI* of 0,069 in 2.000 to 0,054 in 2.015) after what it seems to have stabilised around the same values with minor fluctuations.

Moreover, the gravity centre of the container traffic of the area has shift from the Western Mediterranean to the Central Mediterranean, especially due to the growth in number of total TEUs and market share of the ports of Ambarli (Turkey) and Port Said (Egypt). Finally, the ports which have experienced the most positive evolution (with an increase of their market share) are the hubs, which involve a larger percentage of transshipment activity.

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1. Introduction

In terms of globalization and international competition, the international container maritime shipping is a key factor. The continuous growing progression in the use of containers since its introduction in the 60s as a standardized cargo unit in maritime shipping and its technological revolution has brought in many changes in port competition. As a result of this growth, all the parties involved in the process of containerization have been adopting new strategies in order to survive in a sector which is showing a fierce competition.

Since the beginning, containerization has enabled intermodality, shifting the monopolistic position of ports in his direct influence area, mainly known as hinterland. Moreover, port competition is not about enlarging the influence area anymore but to the function of container transshipment, which means attracting the throughput with origin or destination to another port.

Moreover, when it comes to container traffic growth, the Mediterranean ports have never had it easier than during the last two decades. Compared to the early 1990s, the pace of demand growth in the Southern European container ports is now much stronger accounting for a much larger share of the total region. In fact, two different issues are the main reasons for this advantageous situation. On the one hand, the port modernisation and privatisation that has taken place in the area during the last decade has transformed the efficiency of regional ports to the point where the main global shipping lines are now comfortable with the idea of direct calls to them. On the other hand, container transshipment has completely altered the global market as it has shifted the global movement of containers. However, not only these two facts have provided a much larger share of demand in the area, but also the emergence of centrally located hub ports allows the integration of the local markets with the major global trades, especially those between Asia and Europe.

Thus, the Mediterranean region is now not only a completely mature market but also a market which presents a strong demand which is likely to continue growing during the following years.

2. Objectives

This minor thesis examines the evolution of the container throughput on the Mediterranean ports. The main objectives are to investigate if it has been an increase or decrease of the container traffic in the area as well as if these ports have performed a trend towards port concentration or deconcentration during the last fifteen years, from 2.000 to 2.015. Furthermore, through all the collected data it will be analysed which ports have experienced a more positive growth of their container throughput as well as those which have suffered losses in their market share.

Moreover, this document is organised as follows:

- In chapter 3 is presented the State-of-art. First, a brief resume of the history and evolution of containerization since its introduction in the maritime shipping up to nowadays is presented. The formation and evolution of the global maritime network of container shipping are also exposed in this chapter. Later on, the evolution of containerization in the Mediterranean area as well as worldwide is presented, giving further detail of the main container ports.
- Chapter 4 presents the methodologies which have been used to carry out this minor thesis. The Concentration Ratios, the Lorenz curve and Gini coefficients, the shift and share analysis, the Herfindahl-Hirschman Index and the Geo-Economic Concentration Index are presented.
- Then, chapter 5 presents the results obtained through the application of the previously given methodologies.
- Chapter 6 presents the discussion of the results.
- Finally, chapter 7 gives the conclusions extracted from the analysis of the results and its discussion.

3. State-of-art

3.1. Containerization

Containerization must be seen as one of the main components of globalization as it has suffered a continuous and increased development since its introduction in the global market. Containerization started an acceleration phase of its global diffusion as a key support of the export strategies of the Asian economies (*Bernhofen et al., 2015*).

Furthermore, empty containers flows and the configuration of transhipments hubs, which increased its importance while economies of scales were applied to maritime shipping, did also affect to the increase of containerized flows.

One of the essential factors to the continuous growth of containerization is the increase of the number of ports worldwide, as it grew from 57 in 1970 to 317 in 2010. Moreover, the concentration of container throughput did also suffer some variations through the same period of time. From 1970 to 1990, there was an uninterrupted trend of concentration with the emergence of mega hubs, like Hong Kong, Singapore, Rotterdam and Hamburg. During the following five years the situation changed and a small deconcentration trend took place. Hereinafter, the concentration of the container throughput got stable due to the setting of new transshipment hubs and the ongoing growth of Chinese ports.

Over the time, the continuous development of container terminals towards specific and defined roles has directly influenced competition, selection and concentration in global maritime activities. Furthermore, due to the emergence of new markets and its rapid growth, container terminals have been recognized as the most dynamic and globalized part of maritime operations.

3.1.1. Brief history and evolution

Containerization must be defined as an intermodal system of transport for different types of cargo that makes use of standard containers capable of standardized methods of handling, which make transport and storage rapid and easy while can be interchanged between ship, railway wagon and truck (*Slack and Gouvernal, 2016*).

Nowadays, container traffic can be divided in two main types. The first and most extended one, which englobes the exchange of containers across local and regional markets, is due to term by the widely known as gateway ports or hinterland ports. On the other hand, since the 1990s when the shipping lines began to develop new services to take advantage of the largest vessels, some ports started to be used to tranship containers between these ports. These ports are usually located at strategic position between the main global markets and, in traffic volumes, they are the ones which have experienced the highest growth during the last decades. As a consequence of this, some

gateways ports have extended their activities to transshipment. Now, a brief history of containerization and the different patterns it has presented through years are explained..

Before the arrival of containerization to the global industry, the technology for loading and unloading general cargo from land transport to ship and back again through the process of shipping was completely stuck in the past. By the time, the whole process was slow and hard. Some technological advances were developed, like the use of ropes and pallets for stacking and transporting, but it was still not enough. Following to the introduction of the railways, it became obvious that the main problem in freight transport was between the land and the sea transport modes.

Thus, the container revolution did not start until 1956 when Malcom Mclean, a trucking entrepreneur from North Carolina, redesigned a converted World War II tanker, named the Ideal-X, with a reinforced deck to sustain the load of 58 containers. It was send from Port Newark to Houston, Texas, in the United States. The success of the first container journey was immediate due to the large cost savings derived from the mechanized loading and unloading of containerized cargos. Shortly after this, McLean's company, which was later known as Sea-Land Service, was already taking orders to ship containerized cargo to other destinations. Following to the creation of the container, in 1959 the first purpose-built container crane started to operate and was capable of loading one 40.000 pounds box every three minutes. Investment in larger shipping capacity started to be profitable after this moment since containerization had strongly reduced the ship's average time in ports.

By the early 1960s, containerization was already stablished on many routes between the US mainland and Puerto Rico, Hawaii and Alaska. Some years later, in 1966, container technology was set to go global, as the first container services in a transatlantic trade were handled. By the 1970s, it already had been established regular transatlantic (Northern range of Western Europe and American East Coast) and transpacific (Japan/Australia and American West Coast) services through the first ports in the world to adopt containerization (New York, Yokohama, Oakland and Hamburg), which belonged to the economic triad which leded globalization. During the first years, these pioneer ports meant about an 80% of the global container throughput but nevertheless most of them lost their leadership over the years due to their limited opportunities for port expansion and a shift of trade patterns.

By the mid-1970s, containerization started to expand within these main ports as well as with its regional trade partners. Many of these ports increased their market share to become one of the world's most dominant container ports until the emergence of the Chinese ports in the 2.000s. By the end of the 1970s, it started the diffusion of containerization in many of the adjacent ports to the triad, such as those in the Caribbean, Latin America, the Mediterranean and East Asia (Thailand, Taiwan and Hong Kong). Furthermore, many other intermediary locations in the Middle East and India were also involved in this growth of containerized shipping between Asia and Europe as some big opportunities to add port calls to the existing routes were presented.

During the 1980s, the East and Southeast of Asia, excluding China, were totally involved in global trade relations and the global diffusion of containerization was already a fact, involving every time a larger number of ports and a higher value of total cargo. Due to this increase on the number of ports, the maritime shipping strategy shifted from serving point-to-point to the appearance of hubs-and-spoke services. It was by this time when some of the main transshipment hubs started to emerge along major shipping corridors, like Singapore, Dubai and Algeciras.

From the mid-1990s, the container had already become the main mean for global freight distribution, partly as a result of the massive entry of China in global shipping networks and the appearance of post-panamax ships (from 4.000 TEUs to 5.000TEUs). Some new transshipment hubs, such as Freeport and Gioia Tauro, appeared as a link between regional ports and deep sea services, as well as new gateways emerge due to the increasing growth of emerging economies like Vietnam, Mexica and Brazil. By the early 2.000s, China gateway ports massively increased their export capabilities due to massive manufacturing clusters (Ningbo, Guangzhou).

Finally, by the 2.000s, linked to the peak growth in global container shipping, some new ports emerged to cope with congestion along a range (Yingkou, Taicang) or as new transshipment hubs inserted in collapsed maritime shipping networks (Tanger Med, Prince Rupert). During the first five-year period of the decade, container ports in developing economies were incorporated at full service in the global trade system and a complete shift in the dynamics of container ports took place as the triad showed some signs of maturity. Within Pacific Asia, China rapidly overtook the position of the main container ports in Japan, Korea and Taiwan and the Singapore – Gibraltar corridor

strengthened with the settling of some transshipments hubs. However, in 2008 a financial crisis took place meaning a significant decline of global container throughput, although its effects were not uniform. This crisis broke the uninterrupted growth of the global container transport system since its introduction.

However, during the last two decades, the collapse of the main global financial institutions which was followed by a strong economic and financial crisis, has led to the current slowdown of global container traffic. Up to that moment, containerized traffic had experienced an unprecedented continuous growth. Anyway, the change suffered by the container terminal industry during these years in terms of management structure in ports, through its privatization and liberalization, has strengthened its position towards the world. Container terminals have also been given the opportunity to provide reliable services and hinterland connection that fit into global alliance networks. Furthermore, other key factors in the positive evolution of container terminals in the last two decades have been thanks to the shipping industry itself: the adoption of large container vessels, the appearance of new long-distance trade corridors and the development of a specialized freight industry requiring longer turnaround times.

3.1.2. The waves of containerization

Although containerization was introduced more than seventy years ago, it still continues with its diffusion within global transport systems. However, this diffusion is not uniform in time and space as it depends on the changes experimented by the global economy. Based on these changes, the evolution of containerization might be explained through economic cycles and its waves. For an individual port, a cycle represents the full realization of its hinterlands (gateway) and foreland (hub) potential in light of geographical and site characteristics. For a port range, a cycle relates to the setting and interrelations of its ports to serve its commercial hinterlands, with some gateways dominating. At the global level, a cycle means the complete diffusion of containerization within the port system (*Guerrero and Rodrigue, 2014*).

As *Guerrero and Rodrigue (2014)* did in their own study to better understand the temporal and spatial dynamics of containerization, cycles must be looked over long (decades), medium (years) and short (months) waves.

Long waves are typically used to investigate the main stages involved in an entire cycle in the time lapse of a decade. At the global level, the four long waves which are usually defined in the development of containerization are presented below (Figure 1).

- The adoption wave, which took place in the early 1960s. Containerization was not a well-known technology and there was no big competition, so the services offered were specific. Anyway, it quickly demonstrated its effectiveness in port operations and started to achieve productivity.
- The acceleration wave, during the 1970s. Containerization started to appear as one of the means of transportation of the future. New services as well as new networks were established, what permitted to increase not only productivity and growing volumes but the application of economies of scale.
- The peak growth wave, by the 1990s. It became the leading support of world trade as its diffusion was massive. Network development led to the emergence of hubs enhancing regional and global shipping networks.
- The maturity wave, in the late 1990s. As any other system based on economic cycles, containerization growth started to be closely related to economic changes and not to its own diffusion anymore.

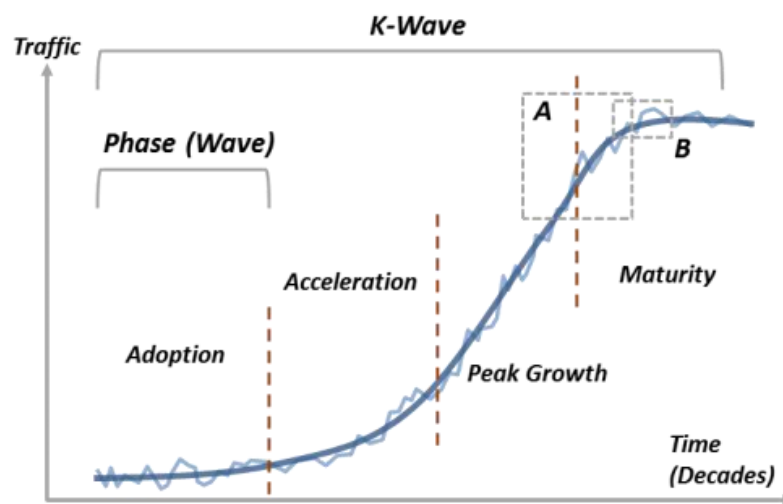


Figure 1 : Long waves of containerization. *The waves of containerization: shifts in global maritime transportation (Guerrero and Rodrigue, 2.014)*

In terms of medium waves, they serve to analyse the changes which take place when a long wave shifts to the next one and are especially useful at identifying the conditions associated to it. It means, a point of inflection affecting a time lapse of a few years.

Finally, short waves consider the fluctuations of monthly port traffic, since while some ports remain stable through all the year, others experience periods of peak and low activity.

3.2. The global maritime network of container shipping

The introduction of containerization in the global trade as well as its adaptation and diffusion worldwide during the last decades has directly led to the formation of a global maritime network of container shipping. Thus, the technological revolution that has taken place during all this process has evolved to the creation of new forms of relationships among countries, regions and ports, affecting mainly to the transport costs and to the shipping companies which have been forced to form new alliances and enquire new strategies.

3.2.1. Formation of maritime networks

During the whole process of creation of a global maritime network of container shipping, route and port choice have become key factors of the overall network cost and its performance as traffic flows are their natural outcome. Meanwhile, all the main players of the transport chain, such as shippers, ocean carriers and forwarders, have tried to gain the greatest possible benefit of the situation.

According to *Notteboom* (2009), all the different factors which are involved in port choice can be grouped in the demand profile of the port, the supply profile of the port and the market profile of the port. Hence, a port choice criterion typically includes the following factors:

- Physical and technical port infrastructure, including nautical accessibility
- Terminal infrastructure and equipment, hinterland accessibility and intermodal offer
- Geographical location versus the main shipping lanes and the hinterland
- Port efficiency expressed as port turnaround time, terminal productivity and cost efficiency
- Interconnectivity of the port (sailing frequency of deep-sea and feeder shipping services)
- Reliability, capacity, frequency and cost of inland transport services

- Quality and cost of auxiliary services such as pilotage, towage and customs
- Efficiency and cost of port management and administration
- Availability, quality and cost of logistic value-added activities and port community systems
- Port security and safety and environmental profile
- Port reputation

Thus, the distribution of cargo flows in port systems is directly derived as a result of port choice and supply chain decisions of all the players involved in the process. Moreover, in literature, port hierarchies have mainly been established considering ports as heads of land-based transport corridors looking to expand their hinterland while others have suggested a trend towards an increasing level of cargo concentration in port systems. (*Taaffe et al*, 1963). Furthermore, although the development of peripheral ports and offshore hubs has a clear maritime purpose for cargo distribution towards secondary ports (*Slack and Wang*, 2.002), their emergence has always been analysed as a port regionalization process leading to the formation of a regional load centre network. In other words, this is the reason why port systems have often been only linked to coastal morphology, geographic proximity and administrative boundaries, rather than being defined from a maritime perspective of inter-port linkages.

When analysing global maritime networks on a local level, large ports face important limitations in terms of lack and cost of available land to go ahead with their expansion. Congestion and bottleneck effects at terminals situated within dense urban environments are also some of their main limitations. Anyway, as *Lee et al.* (2.008) pointed out, port-city separation and the shift of modern terminals to outside urban area may be avoided through efficient planning policies. On a more regional level, the relentless global trade growth has substantially increased the number of intra-regional shipping connections, developing denser and more evenly distributed networks. This can be easily found in emerging economies where maritime transport plays a crucial role. India, Brazil and the Middle East are examples of this.

Furthermore, *Ducruet and Notteboom* (2.012) demonstrated that globalization and technological progress in the maritime industry were responsible for the increased share of the services over 5.000 kilometres of distance, from 7% in 1996 to 10% in 2.006. On the other hand, the increased share of shortest links, from 51% in 1996 to 55% in 2.006,

showed that long-distance links remained inferior to the number and importance of intra-regional linkages, defined as short-sea shipping or hub-and-feeder services with a high sailing frequency. When referring to the geographic coverage of the maritime global network, the top 100 worldwide shipping links represented a 52% of total worldwide vessel traffic in 1996 while it had fallen to about 39% in 2006. These 100 links mainly connect neighbouring ports, prevailing then intraregional unions. Furthermore, there is a noticeable dominance of three main poles: Asia, Europe and North America. In each of these poles, a small number of ports constitute the main market: the East Asian corridor, the North European range and the US east and west coasts. In 1996, only the ports of Buenos Aires (Argentina), Santos (Brazil), Jeddah (Saudi Arabia) and Colombo (USA) could be highlighted as the main ports outside these poles. Besides this, the link between Asia and the two other large poles was the strongest interregional link. The situation had not suffered big changes at 2006 with only highlighting the appearance of Busan (South Korea) as the bridge between East Asia and North America.

During the development of the whole global maritime network, the centrality of the ports has also been a key factor. It can be approached at both local and global levels. On a local level, degree centrality can be measured as it is defined as the number of connections incident upon a port. It must be understood as a measure of connectivity. Moreover, on a global level, it sticks out betweenness centrality, defined as a measure summing for each port the number of its positions on the shortest possible paths within the entire network. Unlike degree centrality, betweenness centrality can be studied as a measure of accessibility. Given this, hub ports will have both high degree and betweenness centrality due to their role as inter-regional pivots in the global network, meaning this that they will redistribute cargoes to other satellite ports.

3.2.2. Liner shipping networks through time

Container shipping must be understood as a complex combination of end-to-end services, line-bundling services and pendulum services, which are all interconnected to form extensive shipping networks. *Notteboom* (2006) also noted that port hierarchy in the container business is intrinsically linked to the shipping lines' design of these liner service networks in terms of variables, such as service frequency, vessel capacity, fleet mix, vessel speed and the number and order of port calls.

With globalization, new maritime shipping patterns emerged leading to the development of new logistical strategies:

- The globalization of maritime services
- The emergence of global strategic alliances among the container shipping lines and the standardisation of routes
- The concentration of container routes with an East-West orientation
- The development of new cargo-handling technologies
- The size increase of ships
- The increase of service frequencies
- The establishment of hub ports and the greater use of feeder services
- The provision of global logistics services

However, after the decade of the 90s, carriers and their strategic alliance were forced to continuously reshape their liner shipping networks in order to introduce new types of liner services on the main east-west trade lanes. The main reason which led to this situation was the increase of cargo availability, since the largest ships operate on multi-port itineraries only calling at a limited number of ports. A good example of this situation is the Europe-Far East trade as mainline operators and alliances running services in this area stick to line bundling services with direct calls in each of the main markets. Approximately, carriers select up to five regional ports of call per loop.

On the other hand, as a result of containerization, the shipping lines started to give attention to the whole transport chain as they considered the oceanic and land links and the nodes (ports) as an integrated system. Some global liner operators like Maersk Line, MSC and CM-CGM developed a strong presence in secondary routes, basing their networks on traffic circulation through some specific hubs. Moreover, they extended the use of larger ships and developed strong cooperation between shipping lines in order to increase their productivity.

However, during the last decade, some hub-feeder container systems and short-sea shipping networks have emerged to deal with the increasing volumes while connecting to other port ranges. Moreover, the economics of transshipment have led to the establishment of intermediate hubs with terminals mostly owned by carriers or port operators. Hence, they became multi-modal operators (*Battistini and Cazzaniga*

Franceschetti, 1996). In most of the cases, these intermediate hubs have been developed within offshore locations on small islands with an implicit local cargo base. Anyway, the development of offshore hubs as not excluded transshipment activities at traditional gateway ports.

3.3. Containerization in the Mediterranean

In particular, when talking about Europe, since the introduction of containers in the 1960s, the ports of Northern Europe have always been way more successful than the Mediterranean ones. In fact, the hinterlands of the ports of Rotterdam, Hamburg and Antwerp extend almost to the Mediterranean itself. The superiority of these ports still predominates nowadays, mainly due to their inland transport links with interior markets.

By the 1980s, the ports of Northern Europe still dominated the European container trade, also including the Asian traffic which went through the Suez Canal. That was both because of their optimal location towards the Atlantic Ocean and their multiple connections with the industrial hinterlands of the continent. However, over the following twenty years until the beginning of the 2.000 decade, the Mediterranean, in terms of maritime shipping, moved from being a regional centre of exchanges to being a link with global networks. Mediterranean ports became important nodes in global trade networks bringing together the old and new markets as new economic forces came into play reshaping global patterns of trade due to the explosion of globalization. The development of East and South Asia led to trade between them and North America across the Pacific Ocean and to Europe via the Indian Ocean and the Mediterranean Sea.

Moreover, transshipment in maritime container traffic started to grow remarkably in a significant number of ports in the Mediterranean during these years, especially due to the expansion of the major international container route ways between Europe and Asia. At the beginning of the 1990s, container traffic in the Mediterranean was about 7 million TEUs, less than a quarter of the European total and a slight 8% of the world container traffic. By the end of the decade, the traffic had reached 16 million TEUs, meaning more than a third of the European total and a 10% of the global traffic. This accelerated growth led to a capacity increase of container ships. Thus, shipping lines started to develop global networks which resulted in the concentration of main-line

services at a small numbers of hubs. Likewise, these hubs provide regional distribution by feeder services.

Therefore, as the container shipping industry was restructuring itself, the Mediterranean became a new focus of activity. Although North American trade was still dominated by the Northern European range, container terminals in the Mediterranean offered opportunities to the emerging economies in East and South Asia and North Africa. Furthermore, in the case of round-the-world services, using a Mediterranean hub and feeding to other parts of Europe, saved between 2500 and 3000 km or up to five days of sailing for the mainline service (*Scorza, 1994*).

Hence, many Mediterranean ports like Marsaxlokk (Malta), Cagliari (Italy) and Limassol (Cyprus) saw in pure logistic transshipments hubs a key to success as they did not possess an adequate hinterland to exploit. Other continental ports like Gioia Tauro (Italy), Algeciras (Spain), Damietta, Alexandria and Port Said (Egypt) assumed the transshipments role due to their favourable locations at the extremity of peninsulas or to trans-Mediterranean routes. Accordingly, Algeciras was at the western gateway to the basin; Marsaxlokk and Gioia Tauro in the centre, and the Egyptian ports were the eastern gateways of the Mediterranean. In addition, Cagliari developed as the heart of the western basin while Limassol assumed the same position in the eastern basin; Taranto (Italy) controlled the access to the Adriatic Sea, and Piraeus (Greece) and Izmir (Turkey) were gateways to the Black Sea.

At this moment, the main shipping companies established their hub locations through the whole Mediterranean Sea: SeaLand-Maersk at Algeciras, Contship at Gioia Tauro, The Grand Alliance (Hapag-Lloyd, NYK Line, Neptune Oriented Line and P&O Containers) at Marsaxlokk, P&O Containers at Cagliari and Genoa and Evergreen at Taranto.

As a result of this increasing emergence of transshipments hubs, feeder ports which supply them experienced a significant growth while the traditional hinterland-oriented ports, like Barcelona (Spain), Marseille (France) or La Spezia (Italy) started to lose some traffic.

Anyway, during this period, Mediterranean ports still could not compete with the Northern European Range as they were not linked yet with the Central European

markets. Rail transport seemed the best opportunity as it allowed to ship large quantities at long distances. However, the rail network was still a weak point of the Mediterranean countries. Both for Spain and Italy, the main problem was congestion through the mountain passes and access points, while for the Balkans the need was to link Greece and Turkey with the rest of the network. Nevertheless, the Mediterranean ports needed to integrate themselves in a multimodal network which allowed them to compete with the northern ports.

However, during the last decade, like many other gateways regions in Europe, the Mediterranean area has witnessed a recent rise of the number of load centres, a situation which is far to be ended. The well known as the chance of the peripheral ports supports this transition of a single gateway situation to a multi-port gateway region and is preceded by three main factors:

- The new requirements related to deep-sea services like good maritime and inland accessibility and availability of terminal.
- The impressive growth in the container market during the last years.
- Potential diseconomies of scale in the existing seaports, noticed especially by lack of space for further expansion.

Anyway, the situation is not that easy for small and medium-sized ports as they sometimes can be overshadowed by the massive expansion of larger seaports. Furthermore, they also have to face major issues such as securing hinterland services. Small-scale container ports usually have difficulties to build up an extensive network of intermodal services, so they tend to shuttle part of their container flows to larger ports in the region in order to be directly linked to a extensive hinterland network. This is commonly known as inter-port traffic.

In order to visually sum up the evolution of the container throughput in the Mediterranean ports during this period of time, the two following images are presented. The first one presents the situation and total container throughput of the 30 main ports of the area in 2.000 while the second one gives the same information but in 2.015.



Figure 2 : Situation and container throughput of the main Mediterranean ports in 2000. *Author's own elaboration.*



Figure 3: Situation and container throughput of the main Mediterranean ports in 2015. *Author's own elaboration.*

3.4. Containerization in the rest of the world

Every day, thousands of containers filled with consumer goods and raw materials are hauled on trucks and trains, stacked onto freighters and ferried on ships from port to port across the globe. All these ports link the six continents through countless shipping routes. However, global trade tends to concentrate in many specific areas with some ports predominating over the others. Hereafter, the world busiest ports are presented classified by continent.

3.4.1. Asia

The emergence of many ports around the Asian continent during the first years of the 2.000s completely changed the situation of global maritime shipping at that moment. Nowadays, it is not wrong to say that not only the Asian continent but specially China dominates the whole container maritime shipping network. In 2.015, from the top 10 of the busiest ports of the world ranked by number of total throughput, nine were Asian ports and, still even more impressive, seven were Chinese ports: Shanghai, Shenzhen, Ningbo-Zhoushan, Honk Kong, Guangzhou, Qingdao and Tianjin. Singapore, Busan (South Korea) and Dubai (United Arabian Emirates) completed the ranking. With the exception of the Port of Guangzhou which is further inland at the confluence of three major rivers, all the main Chinese container port terminals are located over a long section of the country's east coast, stretching from Shenzhen in the South to Dalian in the North. Hereinafter, a brief description of the ports, its evolution during the last years and its current situation will be made. The ports are presented in the same order that they are ranked in the world busiest container ports ranking.

Currently, the Port of Shanghai has managed since 2.010 to retain the crown as the world's busiest container port. In 2.015, its throughput of 36,5 million TEUs also represented a 3,5% increase on the previous year. Although the improved performance was not easy to achieve due to the slow foreign trade development in the country and the hard competition from the neighbouring ports, the port, which is situated at the Yangtze River delta, enjoys the most developed hinterland in the country. It can also extend its reach to the interior provinces via river ports. Furthermore, the Shanghai International Port, the main operator, has invested in eleven feeder ports in the nearer cities, which contributed in 2.015 in more than 2 million TEUs. In addition, the

completion of the fully automated terminal, which is expected by the beginning of 2018, will help to reduce the current port congestion.

Anyway, although the Port of Shanghai still maintains the first position in all the container throughput rankings, its growth is not as positive as it is expected, specially due to the fierce competition of other major Asian ports like Ningbo and Busan. Its close regulatory regime, despite the establishment of the Shanghai Free Trade Zone is another. Furthermore, the lack of railways connections for more cost-effective intermodal transport has led to the loss of interest by many shippers and operators.

For its part, the second place in the container throughput ranking is for the Port of Singapore, which for many years before the emergence of the Port of Shanghai held the first position. It moved 30,9 million TEUs in 2015, although it handled 8,7% less containers in that year than in the previous one. This decrease was directly linked to the drop of the Asia-Europe volumes. It also has to be highlighted the fact that about 85% of the container that arrive to the port are transhipped to another port of call. Currently, the Port of Singapore is developing two more terminals, so by the end of the construction in 2018 it will be able to handle a total of 50 million TEUs annually. The container terminals in the port are operated by the major shipping operators: CMA-CGM, Cosco Pacific and PSA Corp.

The top 3 of the world busiest container ports in 2015 ends up with the Port of Shenzhen, which is currently facing the effects of weakening trade in its main hinterland and the fierce competition among the container ports in the Pearl River region, in the southeast of China. In that year, the port stood at 24,2 million TEU, with a growth rate from the previous year of 3,3%. Anyway, the port still possesses a privileged position in the global trade due to its ability to receive ultra large containerships.

Following with the Chinese top ports, it must be highlighted the Port of Ningbo-Zhoushan which reported a growth of 6,1% in 2015 and its volumes overcame the 20 million TEUs barrier for the first time in its history, becoming the fifth port ever to reach this mark. Furthermore, its development during the last two years is impressive, achieving the biggest growth in percentage terms of any top 10 ranked port for two consecutive years. Anyway, currently the port is also noticing the fact that China's economy is suffering a slowdown.

Probably the situation of the port in the Zhejiang province, which has substantially raised its demand in domestic consumption and a huge development of the manufacturing industry, are keys to becoming China's fastest-growing mega port. Nowadays, Zhejiang is the fourth-largest economy in the country and the fifth-largest export-import hinterland, serving a population of 55 million people. In order to assume this impressive growth, Ningbo's port opened a new container terminal last year, the Meishan Container Terminal, and new projects to construct further berths are already in action.

Additionally, although losing the privilege position it had in the 2.000s, the Port of Hong Kong is still one of the busiest international container ports in the world, as it connects to almost 500 destinations worldwide. Anyway, its obsolete infrastructure as well as land constraints and high labour costs, are leading the port to a disadvantage situation opposite to the impressive growth of other Chinese ports which might be difficult to reverse. The port of Hong Kong, mainly a transshipment harbour for cargoes specially focused on China's exports and imports, is inevitably losing its attraction to mainland companies which are closer to the hinterland and already opening up to foreign trade. The main target to solve this situation is to increase their shipping trade with the Middle East countries, including Iran, whose international sanctions were lifted in 2.015.

Finally, other Chinese ports must receive some attention although its position is not as significant as the already mentioned ones. The port of Guangzhou, situated in the Pearl River Delta, is one of them, as despite the continuous economic slowdown that is affecting to the country, it still managed to achieve a 6% rise in container throughput in 2.015. The plans of development of the port are not only limited to coastal areas but also for the creation of a railway system and inland waterways in order to create an intermodal transportation network.

Furthermore, the Port of Qingdao, probably the most important port in Northern China and a vital part of the Bohai Bay port cluster along with the ports of Tianjin and Dalian (the main gateway port of the region), did also manage to achieve a 5% growth in 2.015. The high port concentration in this area is becoming critical to the import and export of goods from north-eastern China, but it also means that the ports operate in a fiercely competitive environment. Thus, the powerful position of the port of Qingdao in the

region is directly linked to its superior docking capacity, integrated port industry chain and diversified profit model, which has led it to become a strategic trading hub in the continent. In 2015 it became the first port to have combined sea and railway transport integrated with customs clearance in China.

But Asia is not only China and it is in the sixth position when the South Korean Port of Busan makes its appearance. Among the main goals of the port are to become the world's second-busiest transshipment port by 2020 and, more immediately, to break the barrier of 20 million TEUs throughput during this year. The Port of Busan is currently marketing its position to shipping alliances and offering pricing incentive schemes in order to attract new businesses which help him to achieve these objects, although it will probably be the investment in new infrastructure what will determine its success. The port is also strongly interested into overseas investment and expanding its work into new markets.

Moreover, the Port of Laem Chabang, in Thailand, is currently the busiest port of South-East Asia, enduring a 3% increase in container traffic in 2015. The port is already facing the development of a single rail transfer operator to support container transferring by railway from roads and to be able to increase its rail capacity to 2 million TEUs. With this, the proportion of rail transport could be increased from 7% to 15%.

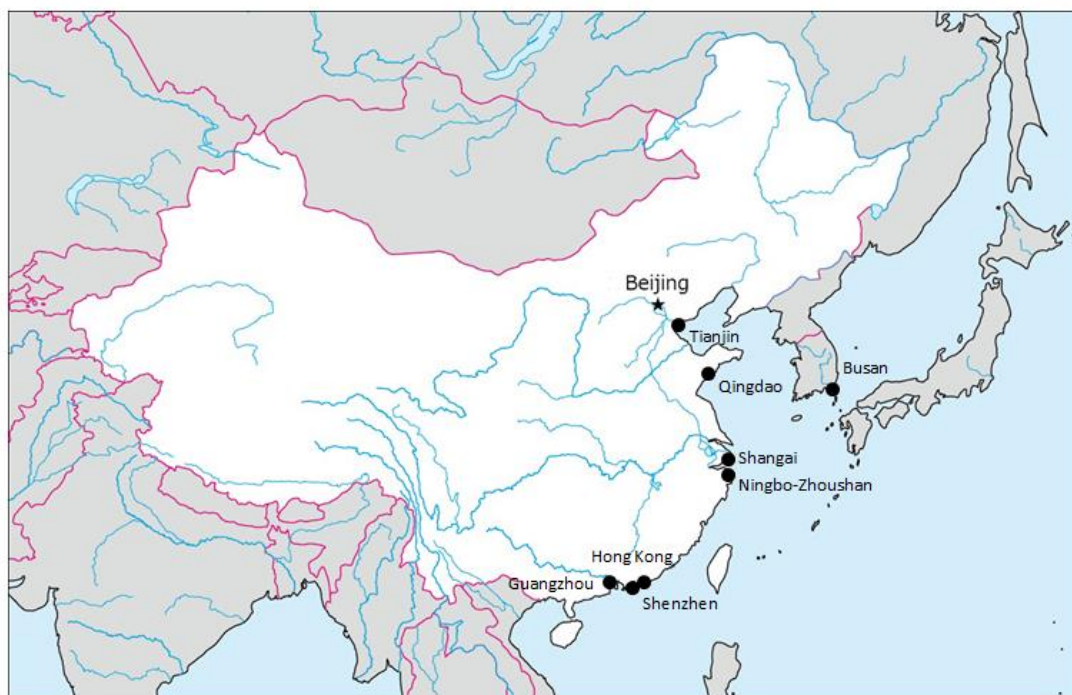


Figure 4: Main container ports in Asia. *Author's own elaboration*

3.4.2. America

Unsurprisingly, the most important container ports in the whole American continent are located in the United States with the Port of Los Angeles at the head. However, during 2015 it suffered a slight drop down in container traffic, especially due to months of congestion because of the long negotiations between employers and labour leaders on a new contract for members of the International Longshore and Warehouse Union. Anyway, volumes remained substantially below the 2014 levels. Anyway, these levels were not only recovered but overcome in 2016. Furthermore, a huge transformation has been due to term in the port especially because of the opening of the TraPac terminal, which has opened the door to port automation in the US.

Following the Port of Los Angeles, its neighbouring Port of Long Beach (USA) is the second-busiest American container port. It has also been the first port in the country to have the biggest global carriers grouped into three huge consortia. Furthermore, the port is not only concerned about ultra large containerships but also understands the importance of meeting the needs of three new container line partnerships. This is the main reason why the Long Beach port is completely readapting and modernising its facilities, including the replacement of the Gerald Desmond Bridge so that whatever size ships can access to its terminals. Anyway, like many other ports along the US west coast, it is still facing the challenge of regaining the confidence of shippers after the chaos suffered during the winter of 2014 and 2015, whose consequences are still enduring.

Moreover, one of the ports with a better perspective in the US nowadays is the port of New York/New Jersey, which had an impressive 10,4% growth during 2015 due to the increase in economic activities associated with port activity throughput in the area. As it was already mentioned, ports in the US west coast suffered of big congestion, what led many shippers and carriers to divert their activities to the east coast. Besides the Port of New York/New Jersey, other ports like Savannah and Charleston, with a growth rated in 11,7% and 10,1% respectively in 2015, also took advantage from this situation. Furthermore, like most of the container ports of the area, these ports are getting ready to receive mega vessels after the opening of the expanded Panama Canal.



Figure 5: Main container ports in North America. *Author's own elaboration.*

In order to mention one non-North American container port, the busiest port is Santos, in Brazil. The Port of Santos, although enduring a continued growth in container throughput, is being strongly affected by the country's political corruption and economic problems. Anyway, despite its plans for investment in new infrastructure to accommodate larger neo-panamax containerships, the port is far from having a strong position in the world ranking of container ports. All the mentioned ports can be seen in the following figure.

3.4.3. Middle East

If there is a container port to talk about in the Middle East, it is without no doubt the Port of Dubai in the United Arab Emirates (UAE). Its current rapid expansion led the port to achieve a 2,2% rise in container throughput in 2.015. Although this number might not be as impressive as the ones presented about the Chinese ports, it must be highlighted that the expansion presented by the Asian ports and the rest of the world can be compared, as the Asian countries have become the absolute kings of container throughput worldwide. Moreover, the Port of Dubai endured a particularly hard year in

2.015 as some unfavourable currency exchanges to lower commodity prices directly affected to trade growth.

Nevertheless, the Port of Dubai, also known as Jebel Ali, is by far the dominant port in the Middle East region, handling over three times the volume of its three closest rivals combined. Furthermore, the port is expected to take huge advantage from the increase in trade due to the lifting of sanctions against neighbouring Gulf State in Iran, as well as the recent acquisition of the Jebel Ali Free Zone, a commercial and logistics park near to the deep-water port. In 2016 the third container terminal of the port was completed, adding a further 2 million TEUs capacity and they are currently working in their fourth terminal, which it is expected to be the most advanced one.

On the other hand, the direct competitor of the Port of Dubai is the Port of Jeddah, in Saudi Arabia. Officially known as the Jeddah Islamic Port, it consists of three terminals, operated by three entities and a nearby port, the King Abdullah Container Port. The port is situated in the newest trade and economic zone as the Saudi government wants to take part into the potential trade through the Red Sea. It is planned to build the largest multimodal terminal of the area as well as connecting it to a new pan-national rail network.

3.4.4. North Europe

When talking about the whole European continent, the Port of Rotterdam in The Netherlands is undoubtedly the one who has held the crown during the last decades. In spite of this, during the last two years the port has suffered a slight drop down in container traffic, as it just experienced a 0,5% growth in 2.015 from the previous year. This is happening especially due to the decrease in Latin American and North American exports. Trade with Russia was also reduced considerably due to ongoing sanctions against the country. Anyway, unlike all the other ports, Rotterdam managed to be the only port in 2.015 which fought against the Chinese economic slowdown and reported a 2% increase in its Asian imports.

However, 2.015 was a particularly important year for the Port of Rotterdam as it opened the world's first fully automated container facility known as Maasvlakte2. Maasvlakte2 contains two terminals, one operated by APM Terminals and the other by DP World on behalf of five liner operators.

Anyway, despite the powerful position of the Port of Rotterdam in the fiercely competitive Northern European region, the Port of Antwerp in Belgium is not making things easy for it. In 2015, the Port of Antwerp was the only European port to achieve a significant volume growth, as they handled a rise of 7,5% from the previous year. Thus, the port handled the become Europe's second-busiest container port and took this position to the port of Hamburg.

Indeed, Antwerp was one of the few European ports to achieve a rise in volume in 2015, as it did not suffer the collapse in Russian trade due to the ongoing sanctions against the country. The port, situated in the River Scheldt, also benefited from the box line alliance reorganization and, specially, from the presence increase of the two largest liner operators, Maersk Line and Mediterranean Shipping Co.

Moreover, the top 3 of the European container ports is closed by the Port of Hamburg, in Germany, which is not going through to his healthful era. Due to the already mentioned sanctions with Russia, the impact of Chinese economy's slowdown and the reduction in volumes traded with Poland, the port suffered a decrease of the 9,3% in container throughput in 2015. Nonetheless, the port managed to highly increase the number of calls from the latest generation of containerships with a capacity between 14.000 and 19.000 TEUs, which grew a 142%. Currently, in order to confront this bad era, investments in the port rail network are being held.

Although out of the top 3, ports like Bremen/Bremerhaven, in Germany, and Felixstowe, in the United Kingdom, must also be mentioned. The first one, holds an important position in the North German area, although it suffered an 8,6% drop in container throughput in 2015, for the third year in a row. This loss is directly related to the slowdown in world trade, particularly in its key markets such as Brazil and Russia. On the other hand, the Port of Felixstowe is the UK's busiest container port and, as most of European ports, also suffered a slight drop in its container throughput.



Figure 6: Main container ports in North Europe. *Author's own elaboration.*

3.5. Description of the main Mediterranean ports

For the analysis of this project, thirty container ports situated in the coastline of the Mediterranean Sea are used, embracing ports from all over Europe, Asia and Africa. Now, the ones with major total cargo throughput and those which have suffered an impressive evolution over the years are presented. In fact, the eight ports presented hereunder match with the top eight ports of the Mediterranean in total throughput in the year 2015. They are presented by alphabetical order.

- **Port of Algeciras Bay (Spain)**

The port of Algeciras Bay comprises the port installations of the municipalities of Algeciras, La Línea de la Concepción and Tarifa, together with the private port terminals of the companies CEPSA, Acerinox, Endesa and Confederación Hidrográfica del Sur, located in the municipalities of Los Barrios and San Roque. The port is strategically placed in the Strait of Gibraltar, point of confluence between the Mediterranean Sea and the Atlantic Ocean and where both Europe and Africa are

closest of each other. Therefore, it is situated in the intersection of the main East-West and North-South axes of global maritime trading routes.

During the 1960s, the main objective of the area was to promote industrial and commercial activity, reason why many companies established their own terminals in the port. This was the case of the metallurgical manufacturing company Acerinox and the petroleum refinery of the CEPSA group. From then on, the port activity of the region changed from passenger and fisheries traffic to the handling of bulk solids and liquids. However, it was not until the settlement of a terminal of the American company Sea-Land in 1975 that container traffic was consolidated. Subsequently, in 1986, the Danish container transport company Maersk established another terminal and invested in the construction of a containers platform known as "Terminal 2.000". In 1999, due to the merger of both companies, the container terminals management became a monopoly. Lately, in 2.003 the TCA (Container Terminal of Algeciras) began its activity.

Finally, nowadays the port counts with two main container terminals. The APM Terminals Algeciras, occupying more than 67 hectares and handling mega-vessels of over 18.000 TEUs and the public Total Terminals International Algeciras, a Korean investment terminal, with over 30 hectares with the newest technology.

The productivity for the Port of Algeciras Bay container terminals is one of the highest both in the Mediterranean area and Europe. As it will be seen in further detail in the discussion part of this minor thesis, the Port of Algeciras has gone from handling a bit more of 500.000 TEUs in 1990 to more than 2.000.000 TEUs in 2.000 and to the current more than 4.500.000 TEUs in 2.015. That means an average annual rate of growth during the last fifteen years of almost a 9%. When referring to the routes served by the carriers of the container terminals, in the Port only 15% of the lines are of medium or short distance, with the sort distance African routes being especially significant; the remaining 85% is mainly distributed among the routes to Central and Southern Africa, America and Asia.

Therefore, the Port of Algeciras is altogether with the Port of Valencia, both in Spain, the most important container ports in the Mediterranean, also heading the top ten in the European total. Since the decade of the 1990s up to the 2.007, the Port of Algeciras was

the top leader of container total throughput in the Mediterranean area, although since then Valencia has taken this position.

- **Port of Ambarli (Turkey)**

The Port of Ambarli is located on the northern shore of the Marmara Sea, heading to the Mediterranean, in Turkey. It is situated at 26 km of the Port of Istanbul, serving the greater Istanbul metropolitan area.

ALTAS Ambarli Port Facilities Trade Company Inc. is its port authority and is responsible for its management, maintaining and improving the infrastructure as well as ensuring the environmental integrity and providing security. ALTAS seeks to assure the continuity of operations of the port's seven terminals and to continuously improve the port to maintain a strong competitive position. Container terminals are not the only ones giving recognition to the port but also its bulk and breakbulk terminals along with the oil and liquid ones.

The Port of Ambarli has three main container terminals: Mardas, Kumport and the main one, Marport. The first one, the Mardas Terminal, launched his operations in 1991 handling steel products and breakbulk cargoes, as it was not until 2002 that it started to handle containers as well. Nowadays it has become one of the major container facilities of the port. The terminal offers 53 hectares of off-dock storage facilities and has annual capacity for 650.000 TEUs.

For its part, the Kumport Terminal, divided in the East and West terminals, started to provide terminal services in the year 1994 with general and bulk cargo in the beginning and in 1996 commenced handling containers. Over the years, Kumport finally got transformed into a container handling terminal. In the year 2011 Kumport was Turkey's third largest terminal and first in import container handling. Since 2002 the rapid increasing trend in turnover was met simultaneously with investment in terminal equipment and technology. In 2007, most of terminal services were acquired by the partnership of Fiba Holding and Turkon, with subsidiaries Kumport Petrol and Kumport Terminal Administration. By 2009, shares held by Turkon were transferred to Fiba Holding, who lately sold its share to SGRF (Oman State Fund) in 2011. In 2015 and as it remains until nowadays, the majority share of the terminal was acquired by the triple consortium formed by Cosco Pacific, China Merchants Group (CMHI) and China

Investment Cooperation (CIC). Kumport has reached during the last year a total annual capacity of 2.100.000 TEUs.

In 1996, the formerly known as the Limar Kumport Terminal become the current Marport East Terminal, which expanded lately with the Marport Main Terminal in 2.001 and the Marport West Terminal in 2.003. The completion of West Terminal's modernization project has increased Marport's annual throughput capacity to 1.900.000 TEUs. The Marport Terminal covers a total area of more than 40 hectares and works with the best technology.

- **Port of Gioia Tauro (Italy)**

The Port of Gioia Tauro is located in Italy, in the heart of the Mediterranean Sea, a meeting point between the East and West shipping routes and the trans-European corridor Helsinki – La Valletta. The port is the largest terminal for transshipment in Italy and one of the most important hubs of the container traffic in the basin of the Mediterranean. The port offers excellent feeder connections to more than 60 ports throughout the entire Mediterranean and Black Sea regions.

The Port Authority of Gioia Tauro was established in 1998. In 2.008, the port expanded its territory covering the Port of Crotona, the town of Corigliano Calabro and the Taureana area of Palmi, creating its own network of harbours.

The port infrastructure allows to accommodate trans-oceanic vessels in transit in the Mediterranean and it is capable of dealing with any commercial category. The port district, which depends upon the municipalities of Gioia Tauro and San Ferdinando, has an area of 440 hectares, excluding water spaces. The main operational area is made up of the Container Terminal in the care of MedCenter Container Terminal S.p.A., which has yards (about 1.600 square meters) along the east side of the channel and receives about 3.400 meters of quays for the storage and handling of containers and the annexed workings. The terminal is equipped with twenty-two quay cranes, three of which are of the type post-panamax and nineteen of the type super post-panamax (nine of these are capable of operating up to twenty-two rows of containers).

Apart from being the main Italian container transshipment hub, the Port of Gioia Tauro is also well-known by the transshipment of automobiles. The car carrier terminal of the port is operated by a joint venture between the German BLG Logistics Group and the

Japanese ICO Shipping Company, handling mainly Asian brands which are moving through Gioia Tauro between Japan, Thailand, Morocco, Algeria, Libya, Turkey and India.

Although the authorities have tried to develop more services in the port, industrial development has been slowing down during the last years.

- **Port of Marsaxlokk (Malta)**

The port of Marsaxlokk, set up in 1988 and located in the small city of the same name in the island of Malta, is one of the main container hubs in the Mediterranean transshipment scenario. Also known as Malta Freeport, the high volume of handled containers is a result of the port's track record and the positive international recognition which the company enjoys with global carriers. The extensive worldwide regular network connections as well as its high performance levels and cost-effectiveness, ease of access to markets with minimal diversion distance and all-year favourable weather conditions have led this port to become one of the Mediterranean leaders in terms of container transshipment.

In 1998, Malta Freeport Terminals undertook a corporate restructuring programme as part of its strategy to consolidate its eminence internationally. The organisational changes, which were fulfilled in 2001, significantly improved the operational efficiency of the port. Since this moment, Malta Freeport Corporation Ltd. now only assumed the role of landlord and authority over the Freeport zone. For its part, Malta Freeport Terminals Ltd. was established in 2001 as the single operating company of the two container terminals and the whole warehousing facilities. This structure was established in order to clearly provide a distinction between the authority and the operator.

Later on, in October 2004, the Government of Malta awarded CMA CGM, the third-largest shipping line in the world, a 30-year concession to operate and develop Malta Freeport Terminals. Since then, the company has been undertaking an ambitious expansion and modernisation programme targeting the Port's infrastructure and equipment. The key objective of these investment programmes is to increase the efficiency of port operations by improving its position to accommodate larger container vessels, increase the capacity for container stacking whilst also attaining faster vessel turnaround times.

In February 2.008, the Government of Malta granted CMA CGM an extension of the concession for Malta Freeport Terminals from 30 years to a total of 65 years. In November 2.011, CMA-CGM transferred half of its shares in Malta Freeport Terminals to the Yildirim Group of Turkey. In June 2.013, CMA CGM sold a 49% interest in port operator Terminal Link to China Merchants Holdings (International) Company Limited.

Nowadays, the Port of Marsaxlokk handles container through two main terminals, easily named Terminal One and Terminal Two. Terminal One has a mainline quay length of 1.000 metres with a water depth of 17 metres, a total area of 539.643 m², 10.499 container ground slots and 653 reefer points. On the other hand, Terminal Two has a total operational quay length for mainline operations of 1.173 metres, 4.791 ground slots, 424 reefer points and a total area of 231.357 m². It is served by eleven super Post Panamax Quayside Cranes.

- **Port of Piraeus (Greece)**

The Port of Piraeus, located in Greece, is the largest Greek seaport and one of the biggest in the Mediterranean Sea. Since the ancient times, it has served as the port of Athens, capital of the country, especially due to the fact that its strategic location makes it an ideal port to be used as a hub for destinations in the Central and Eastern Mediterranean, as well as the Black Sea. It offers a good transshipment location for goods to be destined on this area, as it could save from four to ten days than using alternative ports such as Hamburg, Rotterdam and Antwerp. Nowadays, after some years of decadence due to the big financial crisis that has suffered and it is still suffering Greece, the port is one of the leaders in the Mediterranean in terms of container throughput. Currently, the port is operated by Piraeus Port Authority S.A. (PPA).

In 2.002, the PPA and the Greek government signed a concession agreement, where the Greek government leased the port zone lands, buildings and facilities of Piraeus Port to PPA for 40 years. In 2.008 the duration of the concession agreement was modified from 40 to 50 years. After this modification, the lease should have ended in 2052. Nevertheless, since the Greek government debt crisis started by the end of 2.009, it was planned to privatize several state-owned assets. Hence, in October 2.009, Greece leased half of the container port from PPA to the China Ocean Shipping Company (COSCO) for a 35 years period. Since August 2016, Cosco owns a share of 51% while

the Hellenic Republic Asset Development Fund owns a 23,14%. The remaining 25,86% are owned by other small investors.

Nowadays, the Terminal 1 is operated by PPA S.A. and has a capacity of nearly 1 million TEUs. On the other hand, Terminal 2 has a capacity of almost 3 million TEUs and is run by Piraeus Container Terminal PCT S.A., a subsidiary of COSCO. Furthermore, in 2013 it was finished the construction of Terminal 3 with a capacity of 2.7 million TEU. Thus, the port has a total capacity of approximately 6.7 million TEUs.

- **Port of Port Said (Egypt)**

The port of Port Said is located in the north Egyptian city of the same name. Nowadays, it is the 28th busiest seaport of container transport and the second busiest in the Arab world (only after the port of Salalah in Oman). It also is the busiest container seaport of the country. It is divided into two different ports: Port Said Port and East Port Said Port.

The port is bordered, seaward, by an imaginary line from the western breakwater boundary till the eastern breakwater end. And from the Suez Canal area, it is bordered by an imaginary line extending transversely from the southern bank of the Canal connected to Manzala Lake, and the railways arcade livestock.

The container terminal is located at Port Said Port in the Mediterranean Sea at the northern entrance of the Suez Canal. This privileged location makes deviation angle Zero what according to world studies reduces handling cost by \$2,5 per container and saves from 3 to 24 hour of vessel's waiting duration. Port Said container quay and terminal are located at the extension of Abbas basin south Port-Said port and west canal navigation course.

Regarding to the port history, it was in 1999 when the Egyptian government opened the bidding for a container terminal in the new port at East Port Said. An agreement between the government and Suez Canal Container Terminal (SCCT) was signed in 2004, following which SCCT began a pioneering experiment in the area of East Port Said.

SCCT is an Egyptian joint venture company with domestic and foreign investors. The Dutch company, APM Terminals is the largest stake-holder with 55% of SCCT. It is considered one of the largest companies in the industry worldwide, with more than 63

operations. The company serves 16 maritime lines of the world's top 20 shipping lines. It also accounts for 50% of Egypt's total container industry.

The remains shares in SCCT are distributed as follows: 20% owned by the Chinese Company Cosco, 10,30% by the Suez Canal Authority, 5% are owned by the National Bank of Egypt and the remaining 9,70% are owned by private Egyptian investors.

The current concession agreements are signed in a way that the Government of Egypt is providing all marine infrastructure, the quay walls, the access roads and railways up to the boundary of the terminal and all the public utilities up to the border of the terminal. For his part, the SCCT is responsible of designing and constructing the whole terminal which includes civil works, paving, buildings and utilities construction as well as road and railways within the terminal area. Furthermore, the SCCT has to provide the cranes and all other equipment used in the container terminal as well as employing and training the staff. SCCT will operate the terminal as a multi-user facility for the length of the Concession Period, which is established of 49 years.

▪ **Port of Tanger-Med (Morocco)**

The Port of Tanger-Med is located about 40 km to the east of the city of Tanger (Morocco) and it is expected to be the largest port in Africa as well as one of the main container ports in the Mediterranean area. It went into service in July 2.007, being the newest port of all the ones analysed in this minor thesis. In addition to its role as a strategic platform of container transshipment on Asia-Europe-Africa routes, these container terminals play an essential role in terms of connectivity and development of import-export traffic in Morocco.

The whole port project was implemented, coordinated and managed by the Tanger-Med Port Authority (TMSA), a public limited company whose capital is allocated since 2.008 as follows: 70% for Tanger Mediterranean Special Agency (TMSA) and 30% for FIPAR, the investment company of CDG Group. In 2.008, looking to optimize the operational efficiency of the two core businesses of TMSA, the port and the zones of activities, and to enhance its development capacities, TMSA initiated a process that led to the establishment of a subsidiary dedicated to port activity, the company Tanger Med Port Authority SA (TMPA).

In January 2010, all the public missions and prerogatives related to the management and development of the port complex were transferred from TMSA to Tanger Med Port Authority allowing them to act as a port authority of the port. Since then, the Port of Tanger-Med aims to develop an effective port platform integrated with transshipment activities, import-export and of an added value logistics operations.

The Port of Tanger-Med is formed by the Tanger Med 1, which includes two container terminals as well as railway, hydrocarbons, goods and vehicle ones; the Tanger Med 2, formed by two more container terminals; the Tanger Med Passengers Port, which includes the access zones and border inspections, the 8 berths of boarding passengers and trucks, the regulations zones and the ferry terminal; the Logistics Free Zone MEDHUB, an area of 50 hectares of land surface; and the Tanger Med Port Center (TMPC), formed by 30.000 m² of offices, banks, food court and multi-service spaces, all connected to the train, bus and maritime station.

On the one hand, the Tanger Med 1 contains two container terminals with a total rated capacity of 3 million TEUs, both with a 1.600 meters quay, a stocking capacity of 80 hectares and a depth of 18 meters. The first container terminal (TC1) started its operations in 2007 while the second containers terminal (TC2) started to run one year later, allowed the port to become one of the main container transshipment hubs in the West-Mediterranean area.

The TC1 is operated through a 30 years concession contract granted in 2005 to APM Terminals Tanger, a subsidiary of APM Terminals Group and AKWA Group, the Moroccan leader in the distribution of fuels, gases and fluids. Meanwhile, the TC2 is operated likewise through a 30 years concession contract granted in 2006 to EUROGATE TANGER, ContshipItalia, MSC and CMA-CGM.

On the other hand, the Tanger Med 2 construction began in May 2010 and, with a total nominal capacity of about 6 million TEUs, will bring to the Port of Tanger-Med a total capacity of the container terminals of 9 million TEUs, making of Tanger Med one of the most important transshipment hubs in the Atlantic and Mediterranean. It is expected to start its operations in 2019. The Tanger Med 2 will contain two container terminals. The first container terminal (TC3) will have a nominal capacity of 1.3 million TEUs and

Marsa Morocco will be its concessionaire. The second terminal (TC4) has been meanwhile conceded to APM Terminals.

- **Port of Valencia (Spain)**

The Port of Valencia, also known as Valenciaport, is located in the heart of the Valencia Region and counts with a privileged geostrategic position on the Iberian Peninsula. Formed by three state-owned ports (Valencia, Sagunto and Gandía) along an 80 km stretch of the Mediterranean coast, it is the one and only port of call for regular shipping lines operating in the Western Mediterranean as well as the closest commercial port to the Suez-Gibraltar axis, the main route for interoceanic shipping lines.

Furthermore, it also offers a powerful area of direct influence with a radius of 350 km, an area that generates 51% of Spain's GDP and includes half of Spain's entire working population, and an optimal location close to southern European and to the North African countries (Morocco, Algeria, Tunisia and Libya). Considered a hub for the entire Western Mediterranean, Valenciaport distributes goods over a radius of 2.000 km.

The Noatum Container Terminal Valencia is the main gateway for the Iberian Peninsula and the natural port of Madrid. The main global container shipping lines call at this terminal and its services are complemented by feeder connections to other Regions. Noatum, by far the leading ports and transportation operator in Spain, is owned by institutional investors, the majority of which are pension funds, advised by J.P. Morgan Asset Management Infrastructure Investment Group, and the Dutch Pension Fund Stichting Pensioenfond ABP.

Although the port of Valencia suffered a troubled period when it was caught up in lawsuits and arbitration, it managed to overcome the situation and give a strong performance during 2015, especially compared with its direct rivals. The high local Spanish traffic, the fact that Valencia is less reliant on transshipment cargo and its position as the main port for Madrid-bound cargo, gives to the port a significant confident situation among other ports.

3.6. Main port operators

Now, the main port operators of all the studied ports are reflected on the following tables. On the first one, all the ports are presented by their continent, excluding all the

Mediterranean ports. They are ordered following the world ranking in million TEUs of container throughput.

As it can be seen, in the Asian continent there is not a concrete operator which highlights among the others. In fact, most of the container terminals have their own operator. The PSA International and the Hutchison International are the most important worldwide companies that operate in the continent.

Following to the Middle East, it is quite obvious how DP World dominates the region. When referring to America and Europe, like in Asia, there is no specific companies which dominate the territory. APM Terminals and DP World can be the ones to highlight.

Port	Country	Main shipping operators
Asia		
Shanghai	China	Shanghai International Port Group
Singapore	Singapore	PSA International
Shenzhen	China	China Merchants Holdings International Modern Terminals
Ningo-Zhoushan	China	Ningbo Port Group Hutchison Port Holdings
Hong Kong	China	Modern Terminals
Busan	South Korea	Hutchison Container Terminals
Guangzhou	China	Guangzhou Port Group
Qingdao	China	Qingdao Port International
Laem Chabang	Thailand	LCMT Company
Middle East		
Dubai	United Arab Emirates	DP World
Jeddah	Saudi Arabia	RSGT DP World
America		
Los Angeles	USA	West Basin Container Terminal
Long Beach	USA	Total Terminals International
New York/New Jersey	USA	APM Terminals
Santos	Brazil	Santos Brasil
Europe		
Rotterdam	The Netherlands	APM Terminals DP World
Antwerp	Belgium	PSA International
Hamburg	Germany	HHLA
Bremen/Bremenhaven	Germany	Eurogate

Felixstowe	United Kingdom	Hutchison Ports UK
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Table 1: Main shipping operators worldwide by port. Author's own elaboration.

When referring to the ports located in the Mediterranean area, it has only been considered the ports exceeding a container throughput of 1 million TEUs in 2015. As it can be seen, the APM Terminals dominate the area as they operate in the two main ports in Spain, which also are the two main ports of the Mediterranean. Furthermore, they also operate in Egypt, dominating the throughput through the Suez Canal, and in Morocco, dominating the throughput to the Atlantic Ocean through the Gibraltar Strait.

Port	Country	Main shipping operators
The Mediterranean		
Valencia	Spain	Noatum APM Terminals
Algeciras	Spain	APM Terminals
Port Said	Egypt	Port Said Container & Cargo Handling APM Terminals
Piraeus	Greece	Cosco
Ambarli	Turkey	Marport Terminals Cosco Pacific
Marsaxlokk	Malta	Malta Freeport Terminals
Tanger-Med	Morocco	APM Terminals Eurogate
Gioia Tauro	Italy	Contship Italia
Genoa	Italy	PSA International
Barcelona	Spain	Hutchison Port Holdings TCB Barcelona
Alexandria-El Dekheila	Egypt	Alexandria International Container Terminals
Mersin	Turkey	PSA International
Ashdod	Israel	Israel Port Authority
Beirut	Lebanon	GEPB
Haifa	Israel	Israel Port Authority
La Spezia	Italy	Evergreen Marine Corp
Marseille	France	Intrammar

Table 2: Main shipping operators in the Mediterranean by port. Author's own elaboration.

4. Methodology

Since port system development started to be a matter of research, many studies have been performed. According to *Ducruet et al.* (2009), a minimum of 34 studies based on the evolution of port concentration tendency were conducted from 1963 to 2008. Most of them agreed the main factors of port development are the size of the hinterland, the

strategic location of the ports, regional integration and port competition. However, many authors as *Wang* (1998) argued that it was unfeasible to establish a common model for the development of a container terminal system as the whole process would vary depending on the economic situation of the region. *Wilmsmeier and Monios* (2013) also added the involvement of transport companies, port authorities, government and political factors, regional variations and the specificity of commodity chains as contributing factors to the success of the development of a port system.

Over the years, many empirical studies and research methodologies have been performed in order to categorize the development of the port system. *Hayuth* (1988) applied the Lorenz curve and the Gini coefficient to analyse the concentration of the US port system; *Notteboom* (1997, 2001) studied the development of the European container port system through the Herfindahl-Hirschman Index (HHI), the Gini coefficient and the shift-share analysis. These same methodologies were applied by *Lee et al.* (2014) to investigate the Concentration Ratios of bulk ports in the Korean West Coast as well as by *Wang and Ducruet* (2012) to provide a further understanding of the impact of the new port of Yangshan on the Yangtze River Delta in terms of location. *Pan et al.* (2014) and *Li et al.* (2012) also introduced the HHI to examine the Chinese container port system between 1998 and 2010 and to compare the evolution of container port systems in China and the United States.

Now, the main methodologies used in the literature to analyse the concentration or deconcentration of a container terminal system are presented. They are the Concentration Ratios (CR), the Herfindahl-Hirschman Index (HHI), the Gini coefficient and the Lorenz curves, and the Geo-Economic Concentration Index (GECI). These methodologies have been used to identify the level of concentration or deconcentration of the container terminal system in the Mediterranean. In order to achieve some conclusions about the tendency of a system over a period of time, examining the growth among terminals is essential. All these methodologies are widely used in the current literature to appraise the concentration index of a region.

4.1. Concentration Ratio

The Concentration Ratio is the most basic method to calculate the concentration level by measuring the accumulative percentage of market share of the k largest companies in

a system. The higher the main companies combined concentration ratio, the greater its market power. The formula to determine the concentration ratio is showed in Equation (1):

$$CR (k) = \sum_{i=1}^k S_i \quad (1)$$

In which,

S_i : is the percentage throughput market share of the i th largest container terminal ($i=1, 2... k$).

In this study, it has been applied the one-, three- and ten-terminals Concentration Ratios, known as $CR1$, $CR3$ and $CR10$, to determine the degree of concentration of the top largest container terminals in the system. The concentration ratio ranges from 0 to 100% and indicates the degree of competition in the port system. A concentration ratio that ranges from 0 to 50% may indicate that the system is perfectly competitive and is considered low concentration. Medium and high concentration occurs when the ratio ranges from 50% to 100%, indicating the system is an oligopoly (Sys, 2.009).

4.2. Lorenz curve and Gini coefficients

The Gini coefficients are widely deployed to estimate the income distribution and are visualized by the Lorenz curve. These indicators are pretty useful in assessing the concentration of a system (Sys, 2.009) and furthermore, the Gini coefficients compare equally concentrated levels for ranges with different numbers of terminals (Notteboom, 1997). The Lorenz curve presents the variation in the cumulative throughput of all container terminals while the Gini coefficients are calculated by the ratio of the area between the Lorenz curve and a diagonal line of equal distribution. Its use is prevalent in port studies even though it does not reveal the processes behind the changes in the level of concentration. The Gini coefficient is calculated with the following formula:

$$G = \frac{n+1}{n} - \frac{2 \sum_1^n (n+1-i)x_i}{n \sum_1^n x_i} \quad (2)$$

In which,

n : is the number of container terminals or ports

x_i : is the cumulative market share regarding the throughput of container terminals from the lowest to the highest.

Its value varies from 0 (perfect equality) to 1 (perfect inequality), reaching one when the market is dominated by only one terminal and is fully concentrated and ranging to zero when there is no concentration, matching up the Lorenz curve with the diagonal (*Lipczynski et al.*, 2.005).

4.3. Shift-share analysis (SSA)

The shift-share analysis had been used over the years only in terms of regional economic growth but *Lombaerde and Verbeke* (1989) applied it for the first time to the development of port systems in order to evaluate changes in the respective weight of ports along maritime ranges. This method divides the volume change of a specific port into two elements: the share effect and the shift effect. The share effect shows the throughput growth of a container port if it maintains its market share in the system. Meanwhile, the SHIFT effect, which must be understood as the difference between the actual growth of a specific port and its SHARE effect, reflects the actual share won or lost from rivals by eliminating the growth of the whole system. *Notteboom* (1997) defined the shift-share analysis with the following formulation:

$$SHARE_i = \left(\frac{\sum_{i=1}^n TEU_{it_1}}{\sum_{i=1}^n TEU_{it_0}} - 1 \right) \cdot TEU_{it_0} \quad (3)$$

$$SHIFT_i = TEU_{it_1} - \frac{\sum_{i=1}^n TEU_{it_1}}{\sum_{i=1}^n TEU_{it_0}} \cdot TEU_{it_0} \quad (4)$$

$$ABSGR_i = TEU_{it_1} - TEU_{it_0} = SHARE_i + SHIFT_i \quad (5)$$

In which,

$SHARE_i$: is the share effect in TEUs of terminal i for the period t1-t0

$SHIFT_i$: is the shift effect in TEUs of the terminal I for the period t1-t0

$ABSGR_i$: is the absolute growth in TEUs of terminal I for the period t1-t0

n : is the number of container terminals or ports

$t0$: first year of the time period analysed

$t1$: last year of the time period analysed

4.4. Herfindahl-Hirschman Index (HHI)

As already stated before, concentration in container port systems is widely discussed and it has not been set yet a specific methodology to adequately analyse its evolution over the years. However, a commonly accepted tool to assess concentration is the Herfindahl-Hirschman Index (HHI), which allows to qualitatively analyse the asymmetry of market shares (*Calkins*, 1903).

The HHI takes into account both the number of container terminals and their market shares, in contrast to the methods shown above, and is based on a strict assumption that all firms are engaged in the full competition in the same market (*Lijesen*, 2004). The HHI is defined as the sum of the squared market share of firms in a market expressed as follows:

$$H = \frac{\sum_{i=1}^n TEU_i^2}{(\sum_{i=1}^n TEU_i)^2} \text{ and } \frac{1}{n} < H < 1 \quad (6)$$

For a port system with n number of ports, its value varies from $\frac{1}{n}$ to 1 and it increases as the shares of firms in the market become more unequal, reflecting the differences in market share of the different competitors. Therefore, the HHI reaches a maximum value of 1 when the port system is fully concentrated and dominated by one specific container terminal and, conversely, if the container traffic in the system is equally divided among all the competitors, the HHI reaches its minimum value of $\frac{1}{n}$, which must be interpreted as the lowest concentration.

Anyway, many authors are currently discussing the effectiveness of the HHI methodology as most port systems are shown to be at low level. This situation is due to the fact that each port has a relatively small market share as all ports are considered in the same market, which consequently results in a smaller value of the HHI. Particularly, the large countries, such as the United States and China, as well as the countries with long coastlines, like the United Kingdom and Japan, are in a even lower level of concentration. On the contrary, small countries like South Korea are showing higher

levels of concentration. Thus, the HHI is directly affected by the geographic characteristics of the country. Besides this fact, the countries with a huge international trade volume also present a low concentration level due to the large number of ports required by the transport demand.

4.5. Geo-economic concentration index (GECI)

During the last decade, many authors have stated that most of the existing studies were not accurate enough as the conventional concentration methodologies. For instance, *Le and Ieda (2.010)* suggested that the Lorenz curve and the HHI did not take into account the geographical and economics scale of each country in the study, ignoring the differences between them. For that reason, they introduced a new concentration index named Geo-Economic Concentration Index (GECI). This new GECI is used to examine the concentration dynamics in a port system and, in order to compare the degree of concentration of container terminals in different countries, their geographic and economic differences are eliminated to compare them in the same standard.

Therefore, the main concept of the GECI is to introduce a weigh factor expressed by the distance between two ports to indicate the level of competition between them, interpreted as the degree of the overlapping hinterland of the two ports. Once normalized the distance between the ports through the individual characteristics of each country, such as geography and economic scales, the index can be standardized. Thus, the GECI assumes that each port forms a local market consisted of its own market and the overlapped market with all the other ports, which behave in full competition. The GECI is defined as follows:

$$GECI = \sum \frac{s_i^2}{\sum w_{ij} s_j} \quad (7)$$

In which,

S_i : is the market share of the i th port

S_j : is the market share of the j th port

w_{ij} : is the weight of port j for port i and is defined as,

$$w_{ij} = \exp\left(-k \cdot \frac{r_{ij}}{D_{\text{norm}}}\right) = \exp(-k' \cdot r_{ij}) \quad (8)$$

In which,

k' : is expressed as $k' = k/D_{\text{norm}}$, where k is a constant and D_{norm} is a distance normalization factor that is defined as the economically reasonable interval of ports in each country

r_{ij} : is the distance between port i and port j

On the contrary than the HHI, the GECI currently allows to present higher concentration levels in almost all the countries, particularly in those with a high transport demand. The introduction of the weight factor, the length of the coastline and the international trade volume helps to reduce the influence of such big differences and makes the concentration level comparable between different countries.

5. Results

In this chapter all the numerical and graphical results of the analysis which has been held for this minor thesis are presented. On the first part, all the collected data of the container total throughput will be shown. Afterwards, the graphical results of the application of each of the methodologies described in the previous chapter to the collected data will be exposed. In Chapter 5 the discussion of the obtained results will be performed,

5.1. The data

Table 3 shows the data used for assessing the degree of concentration in the Mediterranean covers the total throughput of the thirty main container ports of the area over a time period of fifteen years, from 2.000 to 2.015. This includes the entire container throughput both for import-export and transshipment traffic. The thirty ports, ordered alphabetically, are all located in the Mediterranean coastline of African, Middle East and European countries. All the data is presented in million TEUs. It has all been taken from the official web pages of the ports as well as from the documents of the annual publication of the International Containerisation.

In *Table 3* it is presented the total container throughput (import + export + transshipment) of the thirty ports selected to carry out this analysis. As it can be seen, the total throughput experiences an impressive growth in the whole area, going from 18.397.741 million TEUs in 2.000 to 46.166.931 TEUs in 2.015. During this fifteen years' time period it performs a continuous positive tendency, with the exception of the

years 2.009 and 2.011. In that years, the total throughput diminished a 3,16% and a 0,09%, respectively.

Afterwards, in *Figure 8* it is presented the temporal evolution of the container throughput of the top 8 ports of the Mediterranean region: Algeciras, Ambarli, Barcelona, Tanger-Med, Valencia, Marsaxlokk, Piraeus, Port Said, Genoa and Gioia Tauro. These ports have been selected as they are the ones with a higher value of total throughput and the ones which have experienced larger changes through time.

As it can be seen, all of them have experienced a positive growth from 2.000 to 2.015, although all of them have suffered throughput losses in some of the years. In 2.000, the ports of Gioia Tauro and Algeciras occupied the top positions far from their next competitors. Fifteen years later, in 2.015, the same situation happened although the port of Gioia Tauro was shifted to the port of Valencia. Thus, the two main ports in total container throughput in 2.015 were from the Spanish Med.

Although the continuous tendency that experience all the ports, it must be highlighted the performance of the ports of Piraeus and Tanger-Med. The first one suffered an impressive throughput loss during the years 2.006 to 2.008. After then, it started to recover and gain market share again. On the other hand, the port of Tanger-Med emerged in 2.006 and managed to reach the top position of the ranking in such a short time period.

Port	Country	TOTAL CONTAINER THROUGHPUT															
		2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009	2.010	2.011	2.012	2.013	2.014	2.015
Alexandria-El Dekheila	EGYPT	505.040	500.000	511.000	495.000	631.000	733.883	762.017	977.011	1.264.455	1.277.433	1.354.813	854.000	1.135.438	1.519.193	1.677.986	1.661.917
Algeciras	SPAIN	2.009.122	2.151.770	2.234.248	2.517.318	2.937.381	3.179.300	3.256.776	3.420.533	3.327.616	3.042.782	2.806.884	3.602.631	4.111.840	4.337.816	4.556.492	4.511.322
Alicante	SPAIN	113.110	133.413	135.526	146.477	153.830	159.237	172.729	179.259	150.827	132.059	147.308	154.185	158.274	148.135	139.273	128.719
Ambarli	TURKEY	280.000	340.000	572.000	773.000	1.078.000	1.185.768	1.446.269	1.940.000	2.262.000	1.836.030	2.540.353	2.121.549	2.439.781	3.318.235	3.445.000	3.062.000
Ashdod	ISRAEL	480.000	511.000	535.000	514.000	545000	586.000	693.000	808.700	827.900	893.000	1.018.000	1.160.000	1.170.000	1.182.000	1.250.000	1.308.000
Barcelona	SPAIN	1.387.570	1.411.054	1.461.232	1.652.366	1.916.493	2.071.481	2.318.239	2.610.100	2.569.549	1.800.213	1.931.033	2.013.967	1.749.974	1.718.779	1.893.300	1.953.282
Beirut	LEBANON	206.946	212.874	224.204	228.231	274.805	282.624	339.174	948.000	945.100	994.601	949.155	1.034.249	1.041.756	1.117.334	1.210.413	1.130.284
Cagliari-Sarroch	ITALY	21.631	25.908	73.657	313.938	501.194	639.049	687.657	547.336	307.527	736.984	629.340	603.236	627.609	702.143	717.016	747.693
Castellon	SPAIN	19.783	24.606	29.446	33.103	35.041	43.773	71.660	101.929	88.208	67.075	103.956	130.963	160.934	193.969	206.551	214.663
Damietta	EGYPT	583.200	639.000	748.000	955.000	1.150.000	1.129.595	830.050	894.185	1.124.969	1.162.301	1.096.052	852.102	755.651	688.070	707.377	719.547
Genoa	ITALY	1.500.632	1.526.526	1.531.254	1.605.946	1.628.594	1.624.964	1.657.113	1.855.026	1.766.605	1.533.627	1.758.858	1.847.102	2.064.806	1.988.013	2.172.944	2.242.902
Gioia Tauro	ITALY	2.652.701	2.488.332	3.008.698	3.148.662	3.261.034	3.208.859	2.938.176	3.445.337	3.467.824	2.857.440	2.852.264	2.304.987	2.721.108	3.094.254	2.959.802	2.546.805
Haifa	ISRAEL	871.000	840.000	906.000	1.014.000	1.031.000	1.107.000	1.053.000	1.149.000	1.251.000	1.134.000	1.266.000	1.236.000	1.371.000	1.357.000	1.196.000	1.215.000
Haydarpasa	TURKEY	290.000	242.000	243.000	244.467	316.982	340.629	400.067	396.637	360.000	187.365	176.468	206.000	368.025	368.000	368.000	122.000
Izmir	TURKEY	470.000	484.000	573.000	700.795	804.563	784.377	847.926	892.217	936.024	821.591	725.675	672.000	867.957	810.000	856.511	656.000
Koper	SLOVENIA	87.000	93.000	115.000	126.000	153.347	179.745	218.970	305.648	353.880	343.165	476.731	589.314	570.744	600.441	674.033	790.736
La Spezia	ITALY	909.962	974.646	975.005	1.006.641	1.040.438	1.028.455	1.136.664	1.187.040	1.246.139	1.046.063	1.285.155	1.307.274	1.247.218	1.300.432	1303017	1.300.442
Limasol	CYPRUS	203.752	257.000	269.000	281.000	297.000	320.130	360.805	377.037	416.970	353.914	348.358	345.740	307.396	277.215	307.660	317.170
Livorno	ITALY	501.339	501.912	519.751	540.642	638.586	658.506	657.592	745.557	778.864	592.050	628.489	637.798	549.047	559.180	577.471	780.874
Malaga	SPAIN	4.062	3.408	2.764	1.650	91.686	247.548	464.838	542.405	428.623	289.871	298.401	476.997	336.265	296.350	87.989	43.281
Marsaxlokk	MALTA	1.033.000	1.165.000	1.244.000	1.305.000	1.461.174	1.321.000	1.485.000	1.901.180	2.334.182	2.261.034	2.370.729	2.360.489	2.540.000	2.750.000	2.900.000	3.075.000
Marseille	FRANCE	722.000	742.000	809.000	833.000	916.277	905.687	946.445	1.002.879	851.425	876.757	953.435	944.047	1.061.193	1.099.271	1.179.918	1.223.173
Mersin	TURKEY	295.000	290.000	390.000	467.111	532.999	596.289	643.749	782.028	887.918	843.917	1.024.171	1.126.866	1.204.820	1.366.498	1.484.000	1.428.000
Piraeus	GREECE	1.161.000	1.166.000	1.404.939	1.605.135	1.541.563	1.394.512	1.403.408	1.373.138	433.582	664.895	850.000	1.681.000	2.734.004	3.199.000	3.493.000	3.360.000
Port Said	EGYPT	503.790	569.000	563.000	659.000	869.000	1.521.855	2.660.449	2.755.805	2.331.962	3.300.951	3.474.792	2.617.043	2.710.723	2.946.560	3.036.000	3.600.000
Taranto	ITALY	3.400	197.755	471.570	658.426	763.318	716.856	892.303	755.934	786.655	741.429	581.936	604.404	263.461	197.317	148.519	0

Thessaloniki	GREECE	229.745	233.904	240.439	269.552	336.096	365.925	343.727	447.211	238.940	270.181	273.282	295.870	317.900	322.310	349.990	351.741
Tangier-Med	MOROCCO	0	0	0	0	0	0	0	600.000	920.708	1.222.000	2.058.423	2.072.948	1.826.313	2.558.426	3.077.764	2.971.336
Tarragona	SPAIN	44.855	39.064	53.121	57.019	17.214	8.980	12.203	47.136	45.903	221.203	255.407	225.747	188.851	147.554	148.636	89.848
Valencia	SPAIN	1.308.101	1.506.805	1821005	1.992.903	2.145.236	2.409.821	2.612.049	3.042.665	3.602.112	3.653.890	4.206.937	4.327.371	4.469.874	4.327.838	4.441.949	4.615.196
	TOTAL	18.397.741	19.269.977	21.664.859	24.145.382	27.068.851	28.751.848	31.312.055	36.030.933	36.307.467	35.157.821	38.442.405	38.405.879	41.071.962	44.491.333	46.566.611	46.166.931

Table 3: Container throughput of the 30 main container ports in the Mediterranean from 2.000 to 2.015. Author's own elaboration

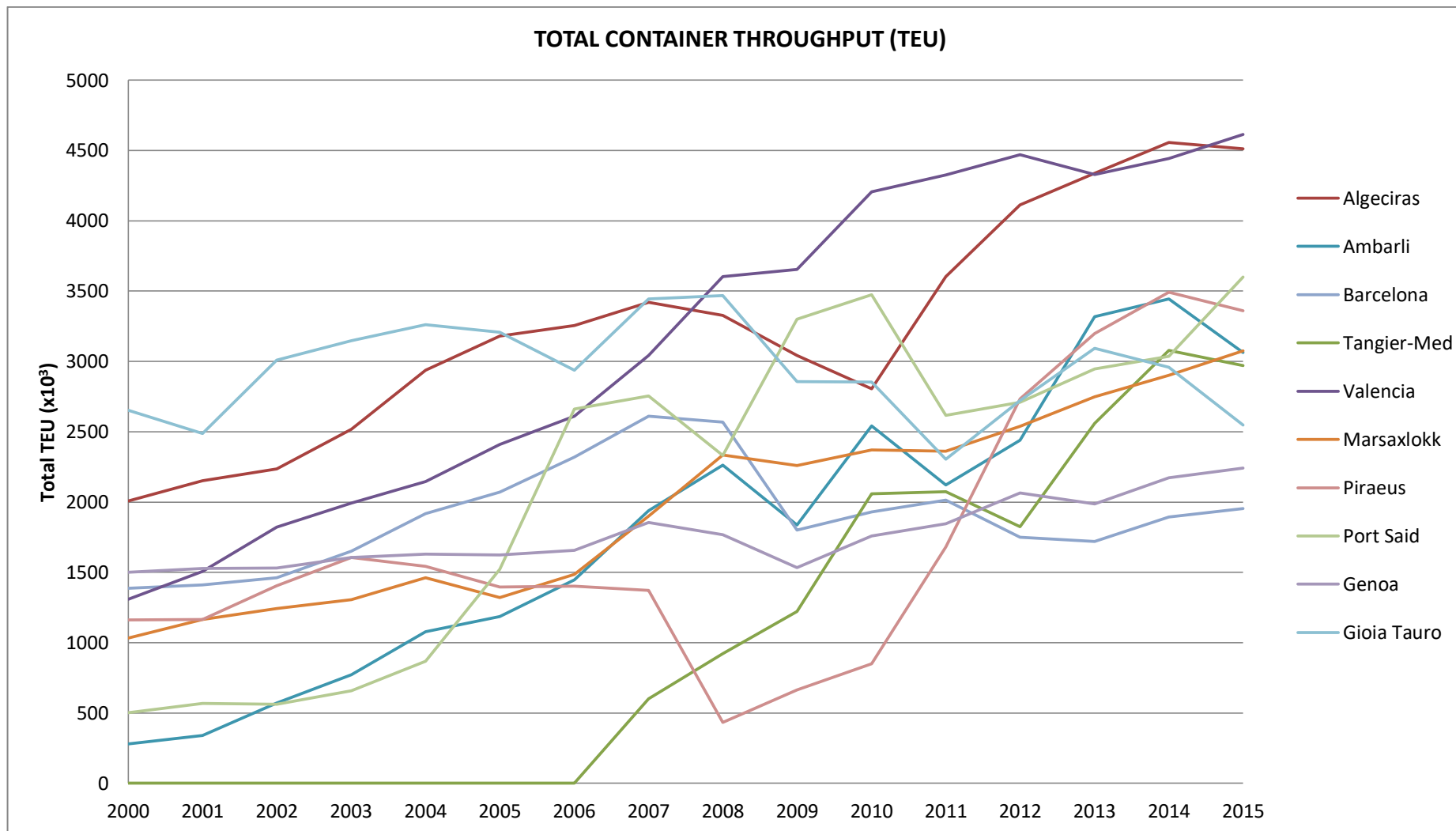


Figure 8: Container throughput evolution of the 10 main container ports in the Mediterranean. *Author's own elaboration*

5.2. Share evolution of the ports

First, as it can be seen in *Figure 9*, an analysis of the share evolution of the container throughput since the year 2.000 up to the 2.015 of the thirty ports which take part in this minor thesis is carried out. In the first year of the analysed time period (year 2.000), seven ports held by themselves a share of the 60% of the total container throughput. These ports were from the biggest share to the lowest: Gioia Tauro (Italy) – 14,42%, Algeciras (Spain) – 10,92%, Genoa (Italy) – 8,16%, Barcelona (Spain) – 7,54%, Valencia (Spain) – 7,11%, Piraeus (Greece) – 6,31%, Marsaxlokk (Malta) – 5,61% and La Spezia (Italy) – 4,95%. Therefore, by the 2.000, the most part of the container throughput of the Mediterranean container port system was concentrated around these seven ports, leaving the remaining 40% divided among a total of twenty-three ports. As it can be observed, these seven ports were strategically situated all over the Mediterranean, covering all the territory from the East to the West. Furthermore, it is necessary to highlight both the ports of Spain and Italy, as they assume more than a 50% of the total container throughput handled on the whole year. This might be explained as by that moment Spain and Italy were the most economically stable and developed countries of the area.

Eight years later, in 2.008, just in the middle of the analysed time lapse in this minor thesis, they were eight the ports which held the same previous 60% of the total container throughput. From the biggest share to the lowest, the ports were Valencia (Spain) – 9,92%, Gioia Tauro (Italy) – 9,55%, Algeciras (Spain) – 9,17%, Barcelona (Spain) – 7,08%, Marsaxlokk (Malta) – 6,43%, Port Said (Egypt) – 6,42%, Ambarli (Turkey) – 6,23% and Genoa (Italy) – 4,87%. Hence, the port of Valencia had reached the first position (although during the previous two years the port of Algeciras occupied this position), leaving the port of Gioia Tauro as the second main container port of the Mediterranean by that moment. Furthermore, it can be seen that two ports of the West Mediterranean (the ports of Ambarli and Port Said) evolved during these years until reaching the first positions and the port of Piraeus suffered a huge decline due to the difficult political and economic situation that Greece had endured during the decade. On the other hand, the position of control which held the ports of Spain and Italy started to be reduced, as by that time they were only handling a 40% of the total container throughput, in front of the previous 50% they were handling in the 2.000.

Finally, to end up with this first global analysis, by the year 2015 they were still eight ports the ones which handled the 60% of the total container throughput, although the situation was quite different. As it can be seen, from the biggest to the lowest share, the ports were Valencia (Spain) – 10%, Algeciras (Spain) – 9,77%, Port Said (Egypt) – 7,80%, Piraeus (Greece) – 7,28%, Marsaxlokk (Malta) – 6,66%, Ambarli (Turkey) – 6,63%, Tanger-Med (Morocco) – 6,44% and Gioia Tauro (Italy) – 5,52%. Thus, the port of Valencia was still the main container terminal of the Mediterranean, although it shifted this position with the Port of Algeciras during all these years. Moreover, must be highlighted the appearance of a new port which had been gaining importance through the years, as it is the port of Tanger-Med, and the comeback of the port of Piraeus after years of decadence.

Thus, from the year 2000 to the 2015, the ports of Genoa, Barcelona and La Spezia went out from the top eight ranking and, consequently, the ports of Port Said, Ambarli and Tanger-Med entered. Moreover, on the one hand, Gioia Tauro lost an 8,9% of market share and Algeciras a 1,15% while, on the other hand, Valencia and Piraeus gained a 2,89% and 0,97% of market share, respectively.

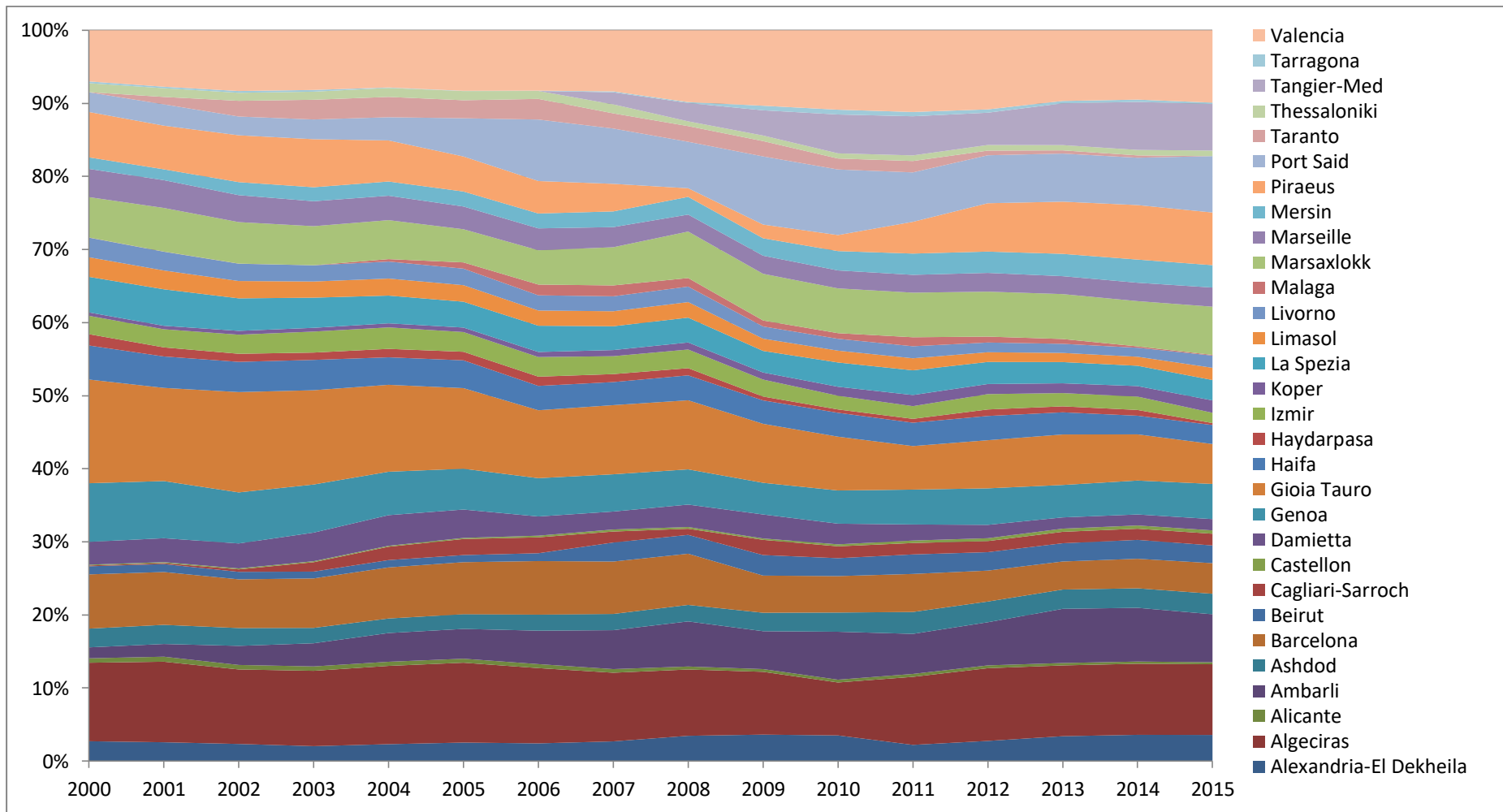


Figure 9: Evolution share of the 30 main container ports in the Mediterranean. *Author's own elaboration.*

5.3. Concentration dynamics measured by the main concentration indicators

5.3.1. Concentration Ratios

Firstly, regarding to the Concentration Ratios, in *Table 4* it has been analysed the largest throughput container terminal in the Mediterranean from 2.000 to 2.015, as well as the three and the ten largest ones. The results of all the *CR1*, *CR3* and *CR10* demonstrate that the concentration of the largest terminals' market share in the whole system is slightly dropping through the years, indicating a lesser extent of concentration or oligopoly in the market.

When looking at the results obtained from the *CR1*, it can be observed this deconcentration trend, dropping from a 0,14 in 2.000 to a 0,10 in 2.015. Anyway, it must be noticed that during fifteen years only three ports (Gioia Tauro, in Italy, and Algeciras and Valencia, in Spain) managed to reach the position of the main container port of the Mediterranean.

Moreover, when referring to *CR3*, it slightly dropped from 0,33 in 2.000 to 0,10 in 2.015. Thus, the same conclusions can be drawn: a slight deconcentration trend during the first five years and the subsequent stabilisation of the market around the same values. Finally, the *CR10*, which dropped from 0,74 in 2.000 to 0,69 in 2.015, confirms this same tendency.

	2.000	2.001	2.002	2.003	2.004	2.005	2.006	2.007	2.008	2.009	2.010	2.011	2.012	2.013	2.014	2.015
Terminal 1	Gioia Tauro	Gioia Tauro	Gioia Tauro	Gioia Tauro	Gioia Tauro	Gioia Tauro	Algeciras	Gioia Tauro	Valencia	Valencia	Valencia	Valencia	Valencia	Algeciras	Algeciras	Valencia
Terminal 2	Algeciras	Algeciras	Algeciras	Algeciras	Algeciras	Algeciras	Gioia Tauro	Algeciras	Gioia Tauro	Port Said	Port Said	Algeciras	Algeciras	Valencia	Valencia	Algeciras
Terminal 3	Genoa	Genoa	Valencia	Valencia	Valencia	Valencia	Alexandria	Valencia	Algeciras	Algeciras	Gioia Tauro	Port Said	Piraeus	Ambarli	Piraeus	Port Said
Terminal 4	Barcelona	Valencia	Genoa	Barcelona	Barcelona	Barcelona	Valencia	Port Said	Barcelona	Gioia Tauro	Algeciras	Marsaxlokk	Gioia Tauro	Piraeus	Ambarli	Piraeus
Terminal 5	Valencia	Barcelona	Barcelona	Genoa	Genoa	Genoa	Barcelona	Barcelona	Marsaxlokk	Marsaxlokk	Ambarli	Gioia Tauro	Port Said	Gioia Tauro	Tanger Med	Marsaxlokk
Terminal 6	Piraeus	Piraeus	Piraeus	Piraeus	Piraeus	Alexandria	Genoa	Ambarli	Port Said	Ambarli	Marsaxlokk	Ambarli	Marsaxlokk	Port Said	Port Said	Ambarli
Terminal 7	Marsaxlokk	Marsaxlokk	Marsaxlokk	Marsaxlokk	Marsaxlokk	Piraeus	Marsaxlokk	Marsaxlokk	Ambarli	Barcelona	Tanger Med	Tanger Med	Ambarli	Marsaxlokk	Gioia Tauro	Tanger Med
Terminal 8	La Spezia	La Spezia	La Spezia	Haifa	Damietta	Marsaxlokk	Ambarli	Genoa	Genoa	Genoa	Barcelona	Barcelona	Genoa	Tanger Med	Marsaxlokk	Gioia Tauro
Terminal 9	Haifa	Haifa	Haifa	La Spezia	Ambarli	Ambarli	Piraeus	Piraeus	Alexandria	Alexandria	Genoa	Genoa	Tanger Med	Genoa	Genoa	Genoa
Terminal 10	Marseille	Marseille	Marseille	Damietta	La Spezia	Damietta	La Spezia	La Spezia	Haifa	Tanger Med	Alexandria	Piraeus	Barcelona	Barcelona	Barcelona	Barcelona
CR1	0,14	0,13	0,14	0,13	0,12	0,11	0,10	0,10	0,10	0,10	0,11	0,11	0,11	0,10	0,10	0,10
CR3	0,33	0,32	0,33	0,32	0,31	0,31	0,22	0,28	0,29	0,28	0,27	0,27	0,28	0,27	0,27	0,28
CR10	0,74	0,73	0,71	0,70	0,67	0,66	0,67	0,65	0,67	0,65	0,66	0,65	0,67	0,68	0,69	0,69

Table 4: CR1, CR3 and CR10 from 2.000 to 2.015. Author's own elaboration

5.3.2. Lorenz curve and Gini coefficients

When talking about the Lorenz curve, in *Figure 10* can be seen that the curves start to coincide more when approaching the year 2.015. The latter part of the Lorenz curves shows that a small 30% of the market share remains with approximately the 10% of the total number of ports, both in 2.000 and 2.015.

Moreover, when taking a look to the Gini coefficients, presented in *Table 5*, it can be seen that it slightly dropped from a 0.594 value in 2.000 to a 0,499 in 2.004. After then, the Gini coefficient seem to stabilize around the same values, with only minor fluctuations.

Years	Gini coefficients
2.000	0,594
2.002	0,571
2.004	0,499
2.006	0,533
2.008	0,525
2.010	0,521
2.012	0,525
2.014	0,551

Table 5: Gini coefficients from 2.000 to 2.015. Author's own elaboration

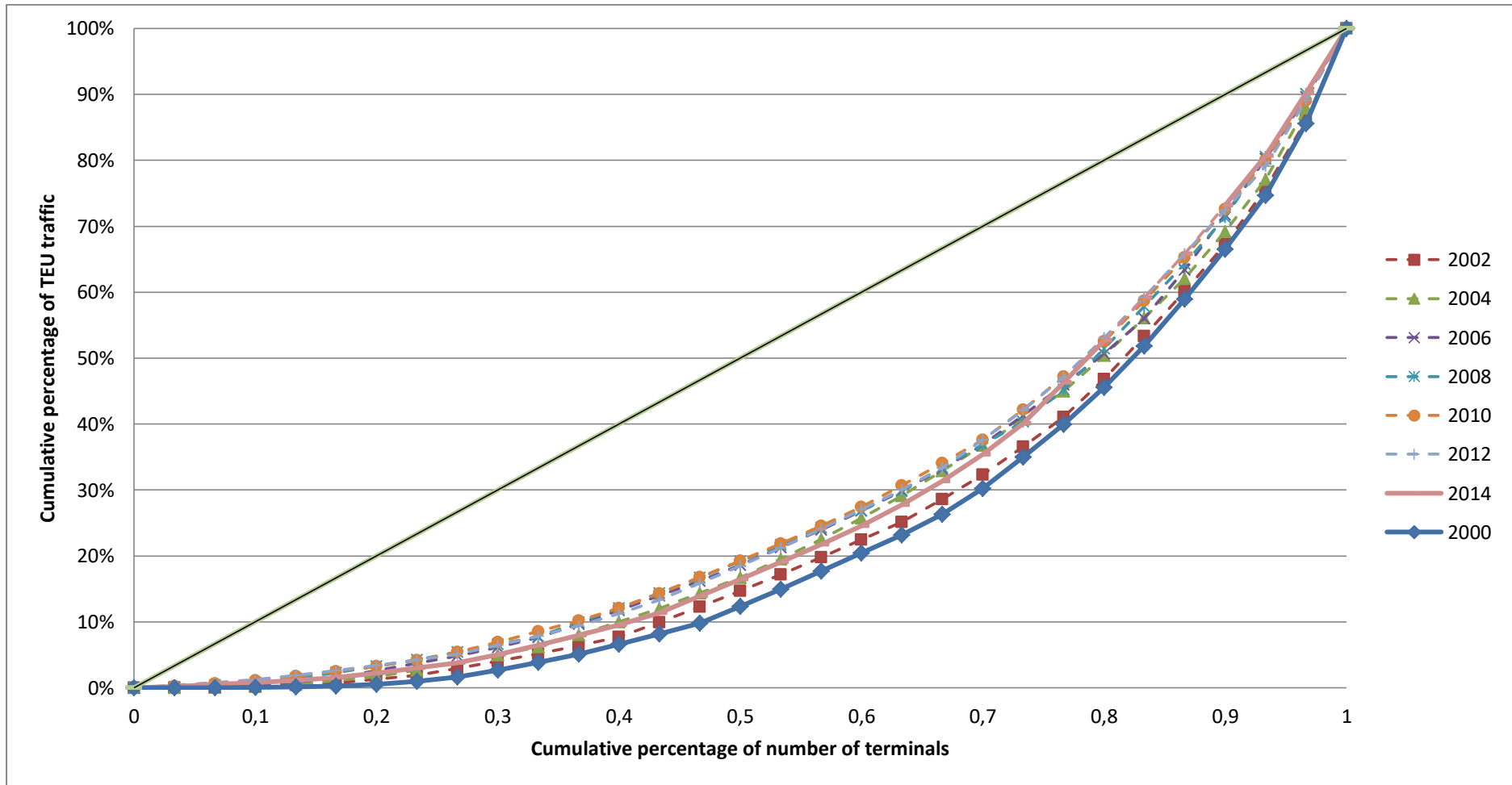


Figure 10: Lorenz curves from 2.000 to 2.015. Author's own elaboration

5.3.3. Shift-share analysis (SSA)

Now, the analysis of the results of the shift-share methodology is presented. The analysis has been presented dividing the whole time period in sections of three years. An analysis of the total time period is also carried out.

As it can be seen in *Table 6* only eight ports showed an impressive positive growth during these years. Clearly, the ports of Ambarli, Port Said and Tanger-Med were the ones who have benefited the most, increasing consistently their volumes by 2.782,20 TEU, 3.096,21 TEU and 2.971,34 TEU, respectively. Furthermore, they reached a higher competition position with their huge gains of 2.359,37 TEU shifts, 2.335,80 TEU shifts and 2.971,34 TEU shifts, respectively, during the total time lapse analysed. It must be highlighted that, in the case of the port of Tanger-Med, it did not even have a container terminal until 2.007. Likewise, the ports of Algeciras, Marsaxlokk, Piraeus and Valencia showed a positive growth, although they lost potential container traffic to the others during some of the time periods. It must also be highlighted the positive growth achieved by the ports of Alexandria-El Dekheila and Mersin, which accumulated a positive volume of 1.156,88 TEU and 1.133 TEU, respectively.

On the other hand, the port of Gioia Tauro had the worst performance in the whole system with continuous negative shift effects and growth, progressively losing share in the Mediterranean area, going from the first position in 2.000 to the seventh in 2.015, with a total loss of 105,9 million TEUs. Altogether with it, the ports of Genoa and Barcelona also lost significant potential traffic during all the periods, although they achieved a positive total growth of 742,27 million TEUs and 565,71 million TEUs, respectively. Anyway, they lost their favourable competition position in favour of some of the south-Mediterranean ports. Hence, these three ports can be considered the biggest sufferers of the appearance and growth of the container traffic in the ports of Ambarli, Port Said and Tanger-Med.

The rest of the ports analysed, as it can be observed, did not suffered big changes nor positive nor negative, remaining as medium or small-sized ports and becoming to a large extent feeders of the main ones.

Port	Share effects					Shift effects					Net growth
	00-03	04-07	08-11	12-15	00-15	00-03	04-07	08-11	12-15	00-15	00-15
Alexandria-El Dekheila	157,78	208,91	73,08	140,85	762,30	- 167,82	137,10	- 483,53	385,63	394,58	1.156,88
Algeciras	627,67	972,52	192,32	510,07	3.032,53	- 119,47	- 489,37	82,69	- 110,59	- 530,33	2.502,20
Alicante	35,34	50,93	8,72	19,63	170,73	- 1,97	- 25,50	- 5,36	- 49,19	- 155,12	15,61
Ambarli	87,47	356,91	130,73	302,65	422,63	405,53	505,09	- 271,18	319,56	2.359,37	2.782,00
Ashdod	149,96	180,44	47,85	145,14	724,50	- 115,96	83,26	284,25	- 7,14	103,50	828,00
Barcelona	433,49	634,52	148,51	217,08	2.094,37	- 168,69	59,09	- 704,09	- 13,78	- 1.528,66	565,71
Beirut	64,65	90,98	54,62	129,23	312,36	- 43,37	582,21	34,53	- 40,70	610,98	923,34
Cagliari-Sarroch	6,76	165,94	17,77	77,85	32,65	285,55	- 119,80	277,94	42,23	693,41	726,06
Castellon	6,18	11,60	5,10	19,96	29,86	7,14	55,29	37,66	33,77	165,02	194,88
Damietta	182,20	380,75	65,02	93,74	880,27	189,60	- 636,56	- 337,89	- 129,84	- 743,92	136,35
Genoa	468,81	539,20	102,10	256,14	2.265,02	- 363,50	- 312,77	- 21,61	- 78,04	- 1.522,75	742,27
Gioia Tauro	828,73	1.079,68	200,42	337,55	4.003,93	- 332,77	- 895,38	- 1.363,26	- 511,86	- 4.109,83	- 105,90
Haifa	272,11	341,35	72,30	170,07	1.314,67	- 129,11	- 223,35	- 87,30	- 326,07	- 970,67	344,00
Haydarpasa	90,60	104,95	20,81	45,65	437,72	- 136,13	- 25,29	- 174,81	- 291,68	- 605,72	- 168,00
Izmir	146,83	266,38	54,10	107,67	709,41	83,96	- 178,72	- 318,12	- 319,63	- 523,41	186,00
Koper	27,18	50,77	20,45	70,80	131,32	11,82	101,53	214,98	149,19	572,42	703,74
La Spezia	284,28	344,47	72,02	154,72	1.373,48	- 187,60	- 197,87	- 10,89	- 101,49	- 983,00	390,48
Limasol	63,65	98,33	24,10	38,13	307,54	13,59	- 18,30	- 95,33	- 28,36	- 194,12	113,42
Livorno	156,62	211,43	45,01	68,11	756,71	- 117,32	- 104,46	- 186,08	163,72	- 477,18	279,54
Malaga	1,27	30,36	24,77	41,71	6,13	- 3,68	420,36	23,60	- 334,70	33,09	39,22
Marsaxlokk	322,72	483,77	134,91	315,09	1.559,19	- 50,72	- 43,77	- 108,60	219,91	482,81	2.042,00
Marseille	225,56	303,37	49,21	131,64	1.089,77	- 114,56	- 216,76	43,41	30,34	- 588,60	501,17
Mersin	92,16	176,47	51,32	149,46	445,27	79,95	72,56	187,63	73,72	687,73	1.133,00
Piraeus	362,71	510,39	25,06	339,15	1.752,39	81,43	- 678,81	1.222,36	286,84	446,61	2.199,00
Port Said	157,39	287,71	134,78	336,26	760,41	- 2,18	1.599,09	150,30	553,01	2.335,80	3.096,21
Taranto	1,06	252,72	45,47	32,68	5,13	653,96	- 260,11	- 227,72	- 296,14	- 8,53	- 3,40
Thessaloniki	71,77	111,28	13,81	39,44	346,77	- 31,97	- 0,16	43,12	- 5,59	- 224,78	122,00
Tangier-Med	-	-	53,21	226,55	-	-	600,00	1.099,03	918,47	2.971,34	2.971,34
Tarragona	14,01	5,70	2,65	23,43	67,70	- 1,85	24,22	177,19	- 122,43	- 22,71	44,99
Valencia	408,66	710,25	208,19	554,49	1.974,42	276,14	187,17	517,07	- 409,17	1.332,67	3.307,10

Table 6: Shift and share analysis from 2.000 to 2.015. Author's own elaboration

5.3.4. Herfindahl-Hirschman Index (HHI)

When taking a look to the Herfindahl-Hirschman curve of the Mediterranean area showed in *Figure 11*, it can be seen that a slight drop is presented from the year 2.000 to 2.007, from a value of 0,0693 to a 0,0548 (*Table 7*). That means a decrease of the 20% in the *HHI* value. The peak value was reached in the first year analysed (2.000) with a value of 0,0693.

However, after the 2.007, the curve seems to stabilize as it only presents minor fluctuations around the same values. Furthermore, it seems to be increasing since 2.011, when it presented a value 0,0544, although it is still too early to make some affirmations.

Year	HHI
2000	0,0693
2001	0,0661
2002	0,0656
2003	0,0632
2004	0,0604
2005	0,0589
2006	0,0574
2007	0,0548
2008	0,0567
2009	0,0558
2010	0,0556
2011	0,0544
2012	0,0562
2013	0,0568
2014	0,0573
2015	0,0584

Table 7: HHI values from 2.000 to 2.015 in the Mediterranean. Author's own elaboration

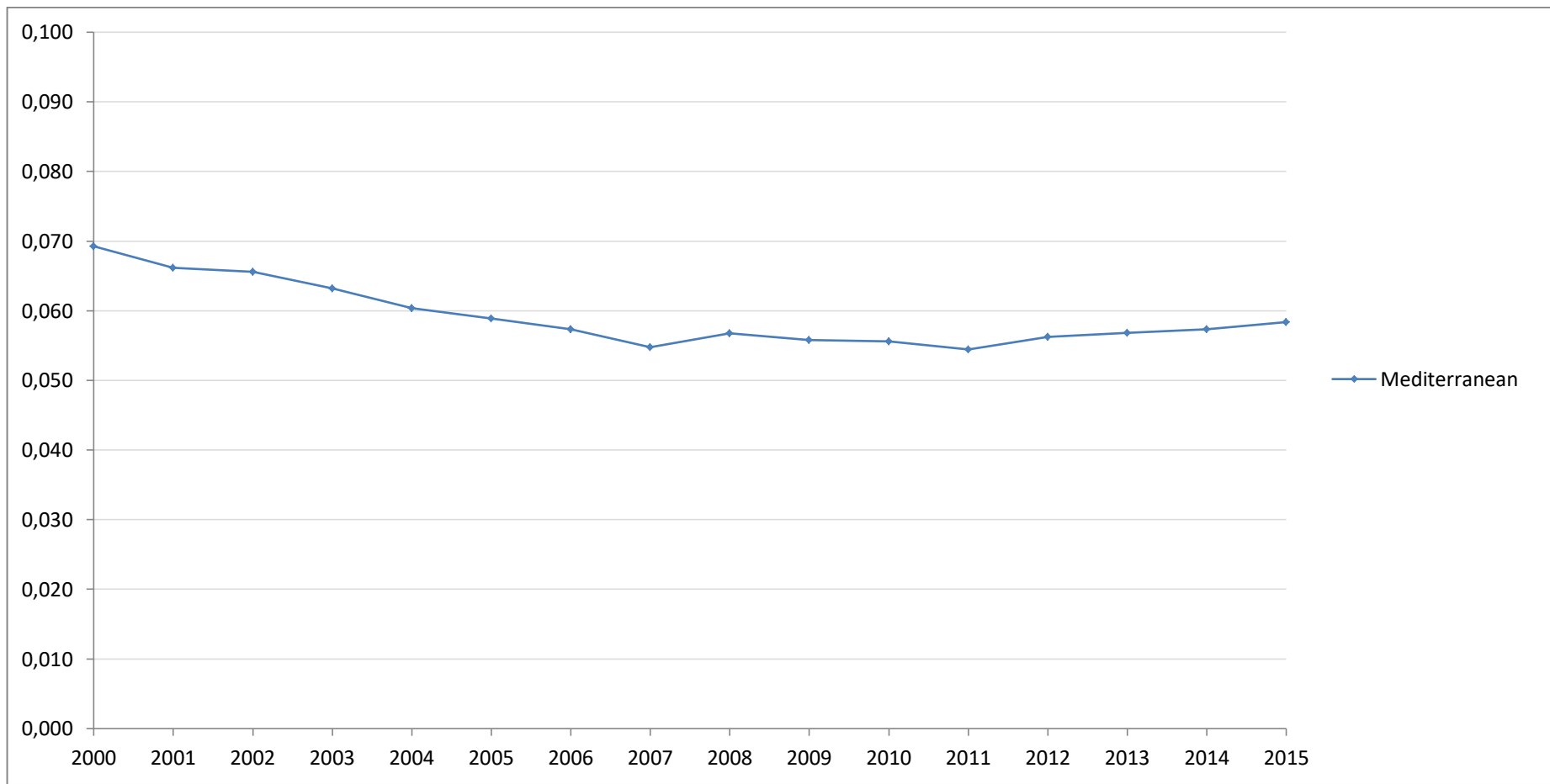


Figure 11: HHI curve from 2.000 to 2.015 in the Mediterranean. Author's own elaboration

3.1.1. Geo-economic concentration index (GECI)

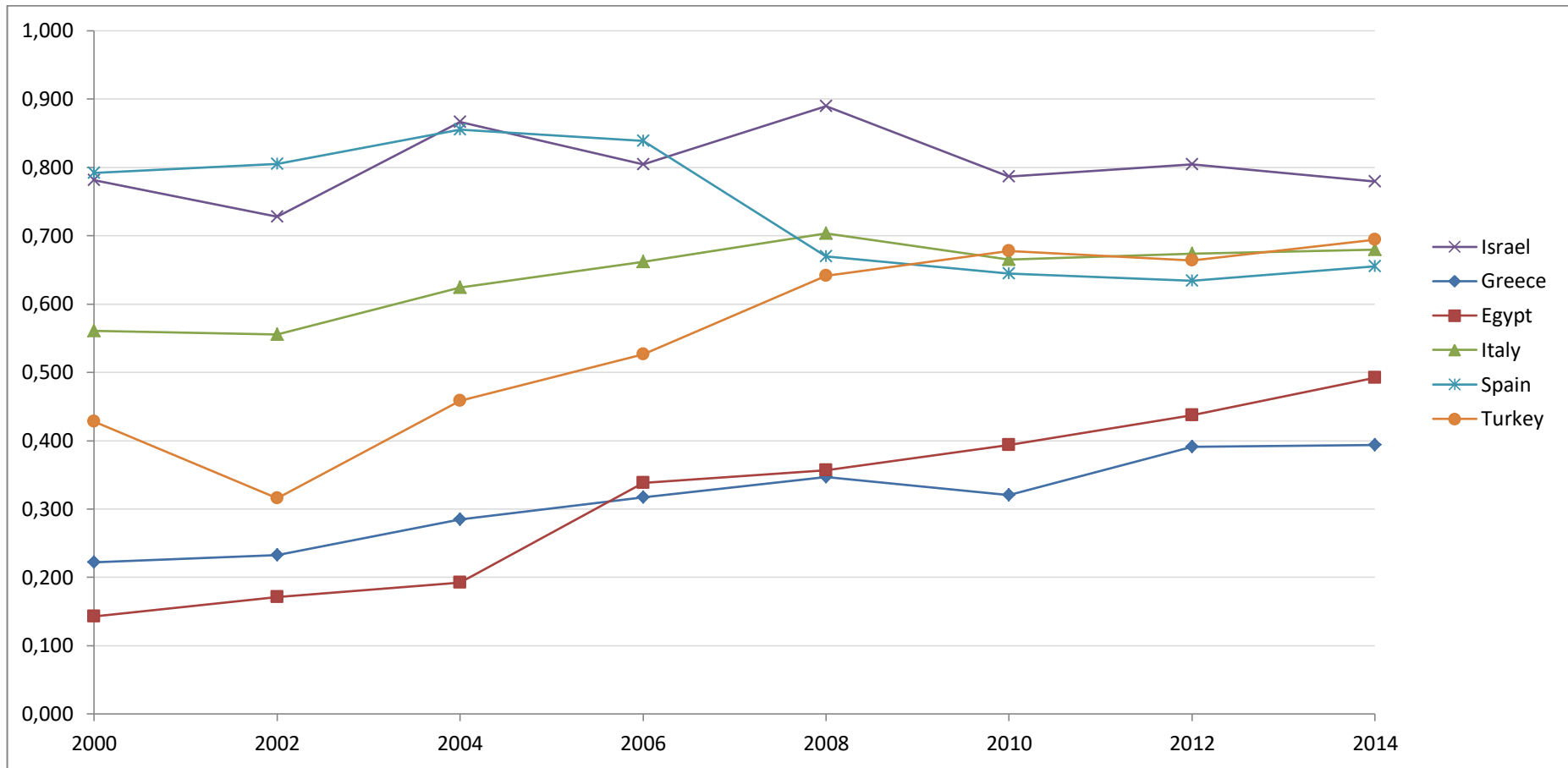


Figure 12: GECI curves from 2.000 to 2.015 in the countries with more than one port considered. Author's own elaboration

For the analysis of the Geo-Economic Concentration Index, only those countries which have more than one ports selected to carry out the analysis of this minor thesis can be studied, as the number of ports is a fundamental element of the formula. This countries are Israel (2 ports), Egypt (3 ports), Spain (7 ports), Turkey (4 ports), Italy (6 ports) and Greece (2 ports).

As it was explained in *Chapter 4*, in order to calculate the *GECI* a parameter k' is needed, which incorporates the country's characteristics into the index. By using the origin-destination data from the *International Container Cargo Flow Survey 2003* in Japan, the value of the parameter k' can be calculated as 0.0044 km^{-1} and it will be used as the reference value for this report.

Now, when referring to the *GECI* curves presented in *Figure 12*, Israel shows an irregular tendency as its *GECI* continuously increases and decreases during the fifteen analysed years. In 2.000 it had a value of 0,781 and in 2.014 it was of 0,779. A peak value of 0,866 was reached in 2.008.

Furthermore, Egypt and Turkey present the most positive evolution of the *GECI* in the whole Mediterranean area, with a continuous positive growth from 2.000 to 2.014. On the one hand, Egypt went from a 0,143 *GECI* value to 0,492 in 2.014, and Turkey from 0,428 to 0,694 in the same time period. Moreover, Greece also presented a positive evolution of its *GECI*, although it showed a slight decrease between 2.008 and 2.010. Anyway, it presents a positive evolution during the whole time period, reaching 0,394 in 2.015 from 0,222 in 2.000.

Italy also performed a positive evolution, from a 0,561 value in 2.000 to 0,680 in 2.015, although it is not as impressive as the ones previously mentioned. Moreover, the worst evolution of the *GECI* was for Spain as it has been continuously dropping from a 0,792 value in 2.000 to a 0,655 in 2.014.

4. Discussion of the results

Now, in this chapter a discussion will be performed, not only trying to identify all the different stages which are provided by the models but also the main reasons that have lead the ports to their current situation.

Firstly, when taking a look to *Table 4*, the results of the Concentration Ratios show that during the first five years of the analysed time lapse there was a slight deconcentration trend, although it seems that since this moment the market has been stabilised, only suffering small variations of between 1 and 2% from one year to the following one. This stabilisation must be understood as the reach of a maturity phase in the waves of containerization in the Mediterranean.

Furthermore, in terms of the Gini coefficient and the Lorenz curves, which can be seen in *Figure 10* and *Table 5*, they clarify the level of concentration without depending on the number of ports. Nevertheless, the results of this methodology allows us to conclude that the coincidence of the latter part of the Lorenz curves during the last years emphasizes a stable market of the larger-sized container ports, with a small 30% of the market share remaining with approximately 10% of the total number of terminals. On the contrary, there is a considerable fluctuation in the market share of the remainder container ports. The traffic volume of the medium and small-sized ports experienced a reduction close to the half of its total throughput over the 15 years. Hence, this might explain the deconcentration trend and subsequent stabilisation of the market experienced between 2.000 and 2.015, which it mainly is the growth of the larger-sized ports.

After the analysis of these methods, it is the time for the most accepted worldwide concentration indicator, the Herfindahl-Hirschman Index. As it can be observed in *Figure 11*, the concentration in the Mediterranean ports has experienced a slight decrease during the last fifteen years. Anyway, as it has already been said, containerization is nowadays in its maturity phase, so not big changes are taking place around it. The peak of the value of the *HHI* for all the terminals in the area was 0,069 in 2.000, the first year of the range analysed, and suffered a continuous decrease until 2.007, when it had a value of 0,055. However, since that moment, the concentration level of container terminals in the Mediterranean has remained around that value with

only a minor fluctuation. This minor fluctuation is particularly due to the already commented maturity phase achieved by containerization and, furthermore, to the consolidation of the Asian container ports in the global trade, which has also led to this situation.

The deconcentration experienced by the ports of the Mediterranean area is way lesser than the one experienced in other areas around the world. For example, as *Pham et al.* showed in their report *A longitudinal analysis of concentration development for Container Terminals in Northern Vietnam (2016)*, the Northern Vietnam area experienced a significant decrease in his *HHI* from 2.005 to 2.014, which went from a value of 0,391 to 0,152.

Moreover, taking a deep look to the *HHI*, the concentration level has been found for the different regions of the Mediterranean area in order to extract some new conclusions that can help to understand the current situation. As it can be seen, only the Spanish ports and those ports located in the Balkans area have experienced an evolution towards port concentration.

In Spain, the importance of the Port of Algeciras and the Port of Valencia, not only in the Mediterranean area but also worldwide, has led to the growth of the container throughput in the area, as the closest ports to them are working as feeder ports to them in many cases. On the other hand, the impressive growth of the Ambarli Port as well as the big importance of the Port of Piraeus in the whole area has led to this situation. Anyway, this has not been enough to avoid the deconcentration and the following stagnation of the concentration levels suffered by the ports in the Mediterranean.

When referring to the *GECI*, in the case presented in this minor thesis it is not especially helpful as it needs to consider all the ports in each country. However, in this analysis only the thirty leading container ports in the Mediterranean have been considered, sometimes just selecting only one port of a specific country. Therefore, an analysis of the concentration in the whole Mediterranean area has no sense as not all the ports have been selected.

Anyway, the *GECI* has been applied to those countries with more than one port selected. These countries are Egypt, Greece, Israel, Italy, Spain and Turkey. Now, the arguments expressed above about this concentration indicator can be partly proved.

Hence, with the *GECI* results, a consistent tendency towards concentration or concentration after a temporary deconcentration can be observed, especially on Egypt and Turkey, countries which has experienced an impressive growth in one or more of his ports.

Thus, once all the methods presented on the chapter above have been applied to the collected data and their results have been studied, all of them, excluding the *GECI*, agree that the ports of the Mediterranean have suffered a slight tendency towards deconcentration during the first decade of the XXI century. However, since 2.008 this tendency seems to be stalled with only minor fluctuations. Therefore, it is difficult to forecast which will be the tendency during the following years, although it seems that it is currently going towards concentration.

Now, a global discussion about the evolution of the container ports in the Mediterranean and the reason that has led to that situation as well as brief discussion of the concentration indicators used in this minor thesis are presented.

The evolution of the container throughput in the ports of the Mediterranean during the last fifteen years has been more than positive. Most of the ports have performed a continuous positive growth and many of them have achieved an important position in the world container traffic. Nevertheless, in some regions, the impressive growth of one port has led to the stagnation or decline of some of the neighbouring ports, as all of them have not performed the same evolution.

In 2.005, the only ports exceeding the 1 million TEUs limit were, from the West to the East, the ports of Algeciras, Valencia, Barcelona, Genoa, Marsaxlokk, Gioia Tauro and Piraeus, with most of the other twenty-three ports being incapable to strive against them. Thus, the totality of the ports which dominated the container traffic in the Mediterranean Sea in that year were on the European side and all of them concentrated on the West, with only the Greek Port of Piraeus located in the middle-East area of the region. Hence, it is obvious that the European countries, which were far more developed and held better economic conditions than the African and the Middle East ones, controlled the container traffic in the area by that moment.

Fifteen years later, in 2.015, the situation was not that different, although some changes had taken place. Now, the ports who exceeded the 2,5 million TEUs limit were, once

again from the West to the East, the ports of Tanger-Med, Algeciras, Valencia, Genoa, Marsaxlokk, Gioia Tauro, Piraeus, Ambarli and Port Said. Some other ports, like Barcelona, Alexandria-El Dekheila and Mersin, could still compete against them and had an important annual container throughput while many others had to see how their cargo traffic had been cut to a minimum.

However, as it can be seen in a quick look to a map, in 2015 the main container terminals of the Mediterranean were far more distributed than before, covering now the whole region. Furthermore, all the new ports that emerged to the top positions during these years were all situated in the African and Asian coastlines (Tanger-Med, Ambarli and Port Said), a signal that some of the African and Middle East countries were experiencing important changes in their economic and political situation which allowed them to equally compete with their neighbouring European countries.

Finally, it must be pointed out that the fact that these ports have achieved this important position in the container traffic of the area is not by chance. All of them are located in privileged and strategic locations which makes them perfect to control the traffic of their regions and extend their importance to new areas and markets. On one side, the ports of Valencia, Algeciras and Tanger-Med have a strategic location to control the traffic that goes from the West to the East through the Gibraltar Strait. On the other side, the Port of Genoa allows to connect the traffic that comes to the Mediterranean with Central and North Europe all through its large hinterland. The ports of Gioia Tauro and Marsaxlokk, both of them located in the middle of the Mediterranean Sea, are also doubtless ports of call for the East-West container traffic. Besides them, the port of Piraeus also connects the traffic that goes through the Mediterranean to the Balkans area and Eastern Europe. Finally, the port of Ambarli holds a unique position as a connection point between the Mediterranean Sea and the Black Sea while the port of Port Said connects to the Red Sea through the Suez Canal.

Hereinafter, it is attempted to verify which are the main reasons that have led the top container ports of the Mediterranean to their current situation. Sometimes it will be geopolitical or economic issues while others depend more on business strategies. However, the decline of some of the ports is directly linked to the substantial growth of a neighbouring one. The following analysis is divided in three zones: Western, Central and Eastern Mediterranean.

The Western Mediterranean area

Since 2001, when the Port of Valencia overtook one of its main rivals, the Port of Barcelona, it has kept this position as the Spanish leading import-export gateway. The main reason for this situation can be easily explained with the fact that the city of Valencia is 350 km away from Madrid, the capital, while Barcelona is 621 km. Thus, this fact is seen by terminal managers as a clear disadvantage of the Port of Barcelona. Furthermore, Valencia Port Authority has heavily invested in infrastructure to achieve this impressive traffic growth.

However, it was in 2007, when the shipping line Mediterranean Shipping Company (MSC) opened its own dedicated container terminal next to the terminal operated by Marítima Valenciana, when its growth started to be unstoppable. The main objective of the company was to ensure guaranteed berthing on arrival for its own vessels playing important East-West services. Moreover, until 2008 they outsourced the terminal management to Marítima Valenciana's parent company, Dragados-SPL. After that moment, container on the container terminals started to rotate in and out of the port as despite having his own terminal, MSC also continued to make major use of the Marítima Valenciana terminal. In that year, the shipping line committed 70% of its import-export traffic to the public container terminal along with a 30% of transhipped boxes. The establishment of the Port of Valencia as its own transshipment hub by the company led the port to become the first Mediterranean container port in 2008.

Since then, the main goal of the Port of Valencia was to grow its traffic share flow to Asia, which was dominated by that time by ports in the Northern Europe range. However, in order to move forward this situation, the Port needed to be directly linked by railways to France, in order to cut three to four days off the voyage around Gibraltar and up into Northern Europe for some of the port's shipping lines.

However, difficult times hit the port in 2013. After an average of 6% growth in transshipment traffic in the Mediterranean which doubled that of the rest of the world, the only transshipment hub in the Mediterranean which did not grow was Valencia. It was then when the American investment company, JP Morgan Asset Management, committed 100 million euros to the expansion and development of the Noatum terminal (the before called Marítima Valenciana terminal) facilities. To ensure that the port could

handle the rise in volume and to boost its competitiveness, the expansion included increased quay and yard space and improved intermodal infrastructure. In fact, these investments have helped the port to increase its cargo traffic and achieve a positive evolution during the last two years.

Moreover, since the Port of Tanger-Med began to be built in the early 2.000s on the Moroccan side of the Gibraltar Strait, all eyes were on the Port of Algeciras. Anyway, since the beginning the port was not constituted as a threat to the existing traffic at the Spanish port, as in order to cope with forecast traffic growth in the western Mediterranean, all ports would have to expand its capacity. In fact, the opening of Tanger-Med was sometimes seen as a beneficial effect on the region in terms of logistics provision.

The Tanger-Med Port was set to become an important new strategic port at the entrance to the Mediterranean, as well as the engine of development for the whole of Northern Morocco. APM terminals, one of the main shipping lines, invested 150 million euros before 2.010 in order to provide a terminal which formed part of Maersk's global network. This decision was due to the fact that the company had long used the Port of Algeciras as its major transshipment hub in the Mediterranean, but by that moment the port expansion possibilities were limited. In order to share cargo traffic, the two main ports of the Gibraltar Strait handled to cooperate and establish common harbour and tariff conditions to strengthen the Strait's position as a power centre of global trade.

As it can be rapidly seen in all the data showed above, the emergence of the Tanger-Med Port was absolutely impressive, as it handled to be one of the busiest containers ports in the Mediterranean in the risible time period of three years. In 2.013 the transshipments volumes in the port accounted for up to 95% of annual throughput. Thus, it managed to become one of the main trade areas between Europe and Africa.

The Central Mediterranean area

In the central Mediterranean area, the evolution of the Port of Piraeus in Greece is the most important. As it can be seen in all the data showed in the previous chapters, it has had the most irregular evolution of all the studied ports. While during the first part of the 2.000s decade it achieved a positive growth, from 2.005 to 2.008 it suffered a huge

decline in his total cargo traffic. Since then, the port has experienced an impressive growth up to become the fourth busiest port in the Mediterranean.

This positive evolution during the last 5 years is a clear result of the privatization that has taken place in the port. Since 2002 the Greek State and the Piraeus Port Authority (OLP) entered into a concession agreement whereby the Greek State conceded to OLP the exclusive right to use and develop the grounds, buildings and facilities of the port. The agreed duration was of 50 years and the Greek State had to obligatory possess at least the 51% of the share capital. The agreement also gave OLP the right to concede to third parties the use of parts of the port and to expand existing activities.

It was in 2009 when the OLP entered into an agreement with the Piraeus Container Terminal S.A. (SPC) and its unique shareholder, the company Cosco Pacific Limited. Cosco is a Chinese state-owned company officially located in Hong Kong and the current largest liner carrier in China. Through this agreement it was conceded to the SPC the use of the port installations of the Piers II and III and the surrounding area of the Container Terminal Facility 4. Furthermore, the SPC was granted with the exclusive right to use and commercially exploit the above land area and the right to use, together with OLP, the adjacent berthing sea area. Moreover, it was agreed the self-financing of the works to upgrade Pier II and III. The duration of the concession agreement is 30 years. Since then, the port considerably improved its capacity and consequently, the container throughput was substantially increased, achieving the top positions of the fastest growing ports in the world between 2011 and 2012.

In 2012 the obligatory possession of the 51% of the OLP share capital by the Greek State was abolished, giving green light for the privatization of OLP. One year later, in September 2013, Cosco and the Greek government agreed that the company would invest an extra 230 million euros to increase the annual capacity of the terminal. Furthermore, the growth may continue as Cosco expanded its investment to increase the annual capacity to 6.2 million TEUs by 2020.

Thus, Chinese investment in the Port of Piraeus has helped to modernize the terminal equipment, bring in businesses from shipping companies which are close partners of Cosco and notably enhance operating efficiency. With this, the port has recovered its strategic position in the container market not only in the area but worldwide.

The Eastern Mediterranean area

While the container traffic moving via the Eastern Mediterranean and through the Black Sea comprised nearly 10 million TEUs in 2003, it managed to increase up to 17 million TEUs in 2015. This positive evolution was especially due to a higher demand dominated by import-export flows into Turkey and transshipment traffic in Egypt. Specifically, the main container ports in Egypt were highly developed to increase the availability of deep water transshipment capacity. Furthermore, the continuous increasing opportunities for expansion in the Black Sea, helped many ports in the area in his potential growth.

On the one hand, Egypt opened in 2004 the Suez Canal Container Terminal (SCCT) in the Port of Port Said, a brand new facility, developed, managed and operated by SCCT, a local Egyptian company whose major shareholder is APM Terminals, which provides new transshipment capacity offered by the private sector.

Clearly, SCCT was by that moment the exception to the rule in Egypt, having a completely privatisation of the sector. However, in 2005 the Egyptian Government let the Hutchison Group enter into agreements with a consortium led by the Alexandria Port Authority for the construction, operation and management of the two terminals of the Ports of Alexandria-El Dekheila. As a part of these agreements, some existing general cargo handling terminals in the two ports were rebuilt into modern container handling facilities.

On the other hand, in 2005 Turkey also started to redirect the whole sector through port privatisation, starting by the container handling operations in the Port of Mersin. Reasonably, as ports in the Eastern Mediterranean started to move towards privatisation, many shipping lines started to show big interest in investing in terminal operations in the area. The motivation of the companies was basically to grow its business by taking its expertise into new markets and provide a neutral container handling platform for use by all shipping lines and cargo exporters and importers. Thus, the establishment of the main shipping lines in the area tended to bring high volumes of cargo traffic.

5. Conclusions

This minor thesis has provided an analysis on the dynamics in the Mediterranean container port system. While container port hierarchy and port competition in the world

has become complex mainly due to structural changes in logistical, economic and institutional settings, the Mediterranean has not lagged far behind. The Mediterranean ports are not working anymore as individual ports that handle ships but within a complete supply chain and network linked to the rest of the world.

The latest changes that took place in the port environment during the first part of the XXI century, made some authors to affirm that the whole European port system would lead to further port concentration. Anyway, this minor thesis has showed that this situation is far to be a true fact at least in the Mediterranean. While the first seven years of the analysed time period showed a slight trend into deconcentration, since 2.007 the situation has stabilized and has suffered minor fluctuations. However, the situation might be swapping since the last years seem to lead to a concentration trend, although it is too early to draw some conclusions about this.

Moreover, the Mediterranean area has seen the increase of the number of competitive ports in the region, what is widely known as the chance of the peripheral ports. Some ports have overcome their lack of capacity or few intermodal system resources and have derived part of their cargo to larger neighbouring seaports and consequently, to an extensive hinterland, a fact that allows them to attract further cargo to their terminals. Thus, it is more than obvious that the success of a port is strongly linked to the ability of the port community to fully exploit synergies with other transport nodes and other players of the logistics networks of which they form part.

Conversely, in terms of the concentration indicators used to perform this analysis, it might be pointed out the fact that all of them show the same tendency in the evolution of the ports, with the exception of the *GECI* which has resulted to be useless in this case. Anyway, the *GECI* opens a really interesting door to further analysis on this same path. Although the entire container ports in the Mediterranean area should be considered, the fact to incorporate the distance between ports and the country international trade raises the analysis to another level.

Finally, when referring to the analysed ports, it would be truly interesting to continue studying their evolution, as their growth is far to be stopped or stabilized. On the one hand, the Spanish Med seems to be further developing and engaging a huge part of the total container throughput of the area, with the ports of Valencia and Algeciras leading

the ranking on the area. In fact, the Port of Valencia has strengthened his situation as one of the main transshipments hubs not only in the Mediterranean but worldwide. Furthermore, a tough competitor in the area has emerged. The Port of Tanger-Med has experienced the fastest growth in the whole area and has become one of the most important container ports in the whole African continent.

Moreover, it has recently been seen the emergence and impressive growth of ports in the Eastern Mediterranean. The regrowth of the Port of Piraeus as well as the emergence of the ports of Ambarli and Port Said among others has opened to the door to further global trade in strategic locations. With the Port of Piraeus connecting to Eastern Europe, the Port of Ambarli to the Black Sea and consequently to Russia and Asia by land, and the Port of East Port Said to Africa and the Middle East to the Suez Canal, nowadays the Mediterranean area is fully connected to the rest of the world in terms of international maritime trade.

Thus, to resume, the main conclusions extracted from this report are the following: the total container throughput in the Mediterranean area during the last fifteen years has experienced an impressive growth, from 18.398.741 million TEUs in 2.000 to 46.166.931 million TEUs in 2.015. Secondly, the container throughput has experienced a slight decrease during the first decade of the 2.000s (from a *HHI* of 0,069 in 2.000 to 0,054 in 2.015) after what it seems to have stabilised around the same values with minor fluctuations.

Moreover, the gravity centre of the container traffic of the area has shift from the Western Mediterranean to the Central Mediterranean, especially due to the growth in number of total TEUs and market share of the ports of Ambarli (Turkey) and Port Said (Egypt). Finally, the ports which have experienced the most positive evolution and have larger increased their market share in the area are the hubs, which involve a higher number of TEUs transhipped from one port to another.

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