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Traffic Evolution and Competition among Italian Containers Terminals

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Abstract

In recent years, the maritime container transport has been subject to several changes. The ultra large and very large carriers involved the need for an evolution of port infrastructures and handling systems for container traffic on a global scale. Moreover, the concentration of ship companies in "Great alliances" constitutes monopolies able to impose infrastructural and management changes to the ports, generating further competitiveness in the system.

The present study investigates the evolution of the Italian port system related to container traffic with the aim to assess the impact of the above phenomena. Starting from a general overview of container movements in the Mediterranean system and in the EU Northern Range, the evolution of the container market in Italian ports has been reconstructed and analyzed also for defining the presence of competition and/or concentration market events.

The existence of a complex and fragmented system has been demonstrated with traffic sprawled in several ports in competition without relevant concentration phenomena. In such a context, the introduction of a national strategy is required to coordinate the ports, realizing cooperative port systems in order to enhance a real maritime development.

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Introduction

In the last years, the maritime container transport has been subject to a deep change due to the choices of several players in the sector. The container freight rate is still affected by the reduction of the world trade after the global financial and economic crisis and an excess in the number of ships has further increased the sector's difficulties (Ha and Seo, 2017). Thus, the shipping companies started to create alliances: the "Great Alliances" (2M: Maersk / MSC, Ocean Alliance, THE Alliance). This horizontal integration of the supply chain allowed the companies involved to cover 81% of the global capacity of the port system and up to 99% of the traffic on the East-West routes (Italian Maritime Economy, 2018), modifying the global shipping market (Ha and Seo, 2017). In the meanwhile, the main shipping companies started also a vertical integration process of the supply chain based on the acquisition of shares of the main terminals in different ports (Ferrari and Merk, 2015). The "Great Alliances", together with the implementation of the vertical integration strategy generated monopolies in the market.

Simultaneously, the phenomenon of large and very-large shipping carriers continues with significant investments in mega-ships to achieve appropriate economies of scale: 118 new mega-ships will be put on the market until 2019 (class 10-23 thousand TEU), of which 47 will be ships of 18-23 thousand TEUs (Italian Maritime Economy, 2018). This has generated unprecedented effects,

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such as the increase of port terminals dedicated to specific navigation lines, with the aim of guaranteeing an easier sea-land transfer of goods (Parola et al., 2016).

Italy is not exempt from these phenomena: the data show that in the Mediterranean, the number of ships exceeding 3K TEUs that transit and touch at least one Italian port has grown by 8% since 2012, while that of ships over 13K TEUs by 56%. Italy, characterized by a high number of ports, could not adequately respond, both from an infrastructural and logistic point of view, to the growing and different needs of shipping companies, as Northern Europe and the nearest Spain. The increase in ships' size and the monopolies of the shipping companies could induce, as also the increase in mega-ships, the choice of a port, imposing on the same port infrastructural and management changes (Musso et al., 2013) and generating further competitiveness within the Italian port system.

Starting from these observations, the present study reconstructs an overview about container traffic in Italian ports. The aim is to investigate the possible factors, relations and phenomena and to evaluate impacts and transformations produced on the container traffic of the Italian ports.

1. Methodology

The analysis carried out in this study follows four different sequential phases using data provided by Assoport in the analysis period (2007-2017).

The first phase deals with the analysis of container ports in the Mediterranean Sea, the Black Sea and Northern Europe, thus comparing countries located near Italy, influenced by same phenomena and similar markets.

The reference context is represented by the Mediterranean system (Mediterranean Sea and Black Sea ports) with 15 countries and 44 ports and the Northern European ports system with 4 countries (Northern France, Belgium, Holland and Germany) and 8 ports.

The second phase focuses on the analysis of container traffic in the Italian maritime system. Quantitative criteria have been set to identify the so-called "minor" ports and the so-called "main" ports on which focusing the subsequent analysis.

In the third phase, the analysis of national container traffic is structured through a breakdown of the ports with respect to the two type of container traffic: 1) transshipment and 2) hinterland traffic. In fact, as in Lupi et al. (2012) the present study defines a classification between the transshipment ports and the hinterland ports. The transshipment ports are identified on the basis of the annual statistics establishing a threshold share of 80% of transshipment traffic on the whole traffic of each port. In respect to the transshipment ports, the overall trend and the specific trend of each port have been assessed. With regard to the hinterland ports, trends and market shares have been defined. In addition, some specific indicators have been used in order to evaluate the concentration, instability and competition between ports on the container traffic market. Indices commonly used to study market concentration are the Herfindahl-Hirschman index (HHI) and the Gini index.

Market share $s_{i,k}$ for port i in time k is defined as the ratio between its actual port traffic $x_{i,k}$ at time k and the total traffic x_k of the ports system at time k . HHI is calculated using the following formulation:

$$H_t \equiv \sum_{i=1}^n s_{i,t}^2 \quad (1)$$

$$\text{with } s_{i,k} \equiv \frac{x_{i,k}}{x_k} \quad (i=1, \dots, n; k=0, 1, 2, \dots)$$

$$\sum_{i=1}^n s_{i,k}$$

Low values of the index indicate a competitive market, where the achievement of zero indicates a condition of perfect competition. Instead, high values of HHI, refer to the possible existence of monopoly conditions on the market.

The Gini index is computed using the following formulation:

$$G_t \equiv \frac{\sum_{i=1}^n \sum_{j=1}^n |s_{i,t} - s_{j,t}|}{2(n-1)} \quad (2)$$

The Gini index assumes values between 0 and 1. When all the ports have the same market share, the index is equal to 0 while, if the traffic is concentrated in a single port, it is equal to 1. Thus, the Gini index can be defined as the relative average market share difference (Santos and Guerrero, 2010).

Finally, a measure of market instability is provided by the instability index (Hymer and Pashigianj, 1962, Mazzucato, 1998), computing as it is shown below:

$$I_t \equiv \frac{1}{2} \sum_{i=1}^n |s_{i,t} - s_{i,t-1}| \quad (3)$$

Finally, in the fourth phase of the study, the dynamics of each hinterland port are analyzed. Two different types of aggregations have been carried out: 1) an aggregation with respect to the containers volumes handling by each port; 2) a spatial aggregation based on port location. Each aggregation of ports has been compared to the national trends in terms of growth rate and market share. Moreover, a Growth-Share Market Matrix (GSM, Twrdy and Batista, 2017) has been used in order both to identify a relation between the characteristics and the market trend of the specific port and to provide clear indications of possible market interferences, competitiveness and potentialities.

2. Results

2.1. Comparison between the Mediterranean system and the Northern Range

The analysis of the Mediterranean system and the Northern Range port system (Figure 1) indicates a similar trend over the years with a contraction of traffic in 2009 and a subsequent recovery since 2011. The Mediterranean system shows higher traffic than the northern European ports, with an increasing trend after 2012. This overtaking is even more significant, including the contribution of the Black Sea with a total movement exceeding 50 Mln of TEUs.

However, container traffic in Northern Europe is very high referring to the number of ports. In fact, the Northern Range is characterized by 8 ports, while the Mediterranean and the Black Sea by 44 ports. This fragmented condition in terms of port supply in the whole Mediterranean system entails a greater attractiveness of the ports of Northern Europe from several European markets (Ferrari and Merk, 2015).

Based on the handled volumes within the Mediterranean system (Figure 2), it is possible to identify three macro groups: a first group consisting of Spain and Italy with values around 10 Mln of TEUs ; a second group consisting of Turkey and Egypt between 3.5 and 4 Mln TEUs; a last group composed of the 11 remaining countries with maximum values between 2 and 4 Mln of TEUs. Greece, given the positive growth trend since 2010, can identify itself as the leader of the third group. Croatia with an average value of movements below 200K TEUs and Cyprus with an average value just over 300K TEUs represent the tail of the last group.

In relation to the two most important countries, after the crisis of 2009, Italian ports recorded a less significant recovery of traffic with respect to the Spanish ports. The growth rate of Spain, in 2011, was 12% with the result that it moves on average more than 1.5 million TEUs compared to Italy.

In Italy 15 Italian ports move an average value of 10 Mln of TEUs whereas the 9 ports of Spain move an average value of 11 Mln TEUs.

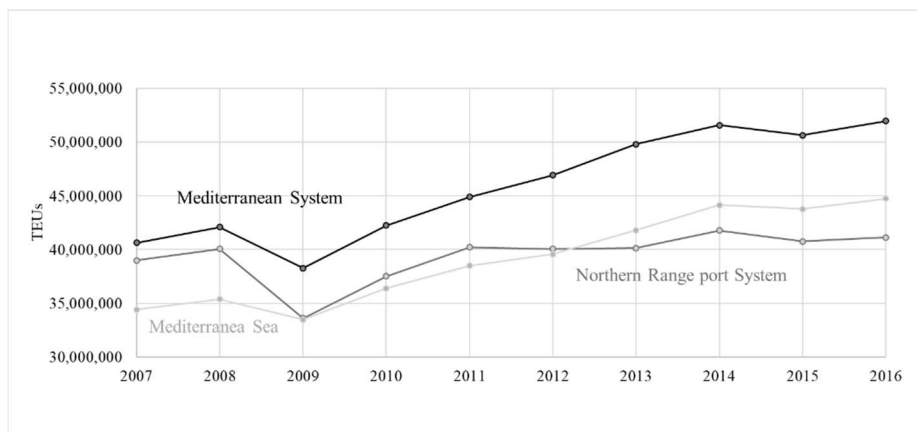


Fig. 1. Trend of annual container traffic in the Mediterranean and Northern Range systems (Assoporti data elaborated by the authors)

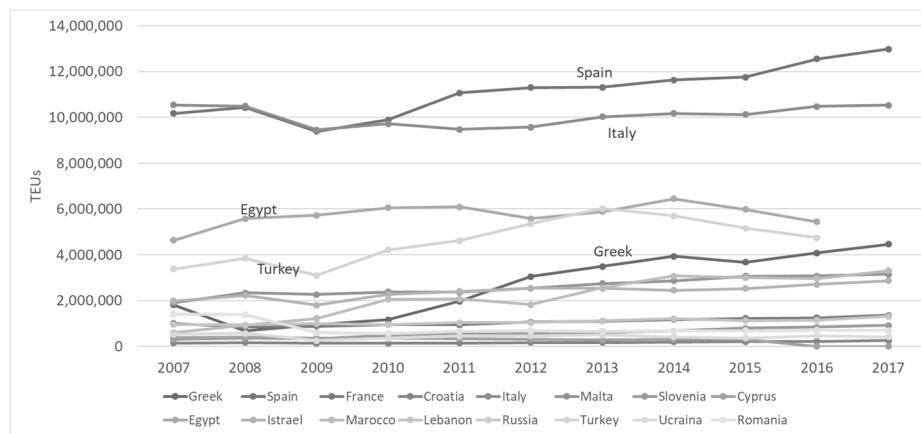


Fig. 2. Trend of annual container traffic in the countries of the Mediterranean system (Assoporti data elaborated by the authors)

The results of the analysis (Table 1) indicate an excessive fragmentation of the demand Italy loses its leading position with an average value of about 700K TEUs per year per port, while Spain (9 ports) has an average traffic of more than 1 Mln of TEUs per year per port.

Tab. 1. Statistics of Assoporti 2016 for container ports in the Mediterranean system

Country	N° ports	TEUs 2016	Average TEUs /port
<i>Greek</i>	2	4,080,921	2,040,461
<i>Spain</i>	9	12,547,016	1,394,113
<i>France</i>	1	1,251,744	1,251,744
<i>Croatia</i>	1	214,348	214,348
<i>Italy</i>	15	10,476,478	698,432
<i>Malta</i>	1	3,080,000	3,080,000
<i>Slovenia</i>	1	844,776	844,776
<i>Egypt</i>	3	5,443,911	1,814,637
<i>Istrael</i>	2	2,708,000	1,354,000
<i>Marocco</i>	1	2,963,654	2,963,654
<i>Lebanon</i>	1	1,147,219	1,147,219
<i>Russia</i>	1	711,339	711,339
<i>Turkey</i>	4	4,739,733	1,184,933
<i>Ucraina</i>	1	464,284	464,284
<i>Romania</i>	1	711,339	711,339

2.1. Container traffic in Italy

Container traffic in Italian ports shows a stability in the long term. the trend of container traffic is still having a greater recovery compared to the value of Italian GDP that is still lower than the value recorded for 2008. In detail, the container traffic market has been visibly affected by the economic crisis with a clear impact on the total handled values. In fact, in 2009 it is possible to note a decrease of about one Mln TEUs from the pre-crisis period. The pre-crisis value, equal to 10.6 Mln of TEUs, has been reached only after 2016.

The growth rate of TEUs handled is characterized by a negative trend up to 2012. A real recovery of the container market in Italy occurs only in 2013 with a growth of 5%. In general, in the following years the growth rate is always lower than 5%.

Tab. 2. Total TEUs moved in Italian ports (2007-2017)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total TEUs Italy	10.609.108	10.549.886	9.514.891	9.777.962	9.526.808	9.618.700	10.082.030	10.221.127	10.190.597	10.573.416	10.651.399
Growth rate		-0,56%	-9,81%	2,76%	-2,57%	0,96%	4,82%	1,38%	-0,30%	3,76%	0,74%

A preliminary spatial analysis of the concentration of container traffic has been done with respect to the Italian geographical configuration distinguishing a North-South grouping and an Adriatic Sea-Tyrrhenian Sea grouping as shown in Figure 3. The first grouping shows that the ports in the Tyrrhenian Sea are those contributing mostly to the traffic container of Italy, while the ports in the Adriatic Sea are less significant with a total traffic of less than 2 Mln of TEUs. The ports of the North part of Italy

show an increasing trend with respect to those of the South. Indeed, in the first years, the ports of the South had a higher traffic, but this situation changed starting from 2010 (Figure 4).

These results highlight the possible influence of the different types of traffic on the distribution between ports. Transshipment traffic is concentrated mainly in the Tyrrhenian Sea entailing the imbalance of flows between the Tyrrhenian coast and the Adriatic coast.

Taking into account the total annual traffic of each port, some of these can be considered "minor" for container traffic and they have been deleted by the following analyses, since they can be considered as a noise for the study of the container market. The selection of the "minor" ports is derived by the following quantitative criteria: those ports that, during the analysis period, move individually less than 1% of the Italian container traffic and overall never exceed 3% of the total movement. It is translated in a threshold value of a handling volume of less than 100K TEUs. Both Ancona for a single year and Savona in the last few years would fall below the threshold value. However, their presence in the statistics for at least 50% of the years of analysis requires their inclusion in the group of the "main" ports.

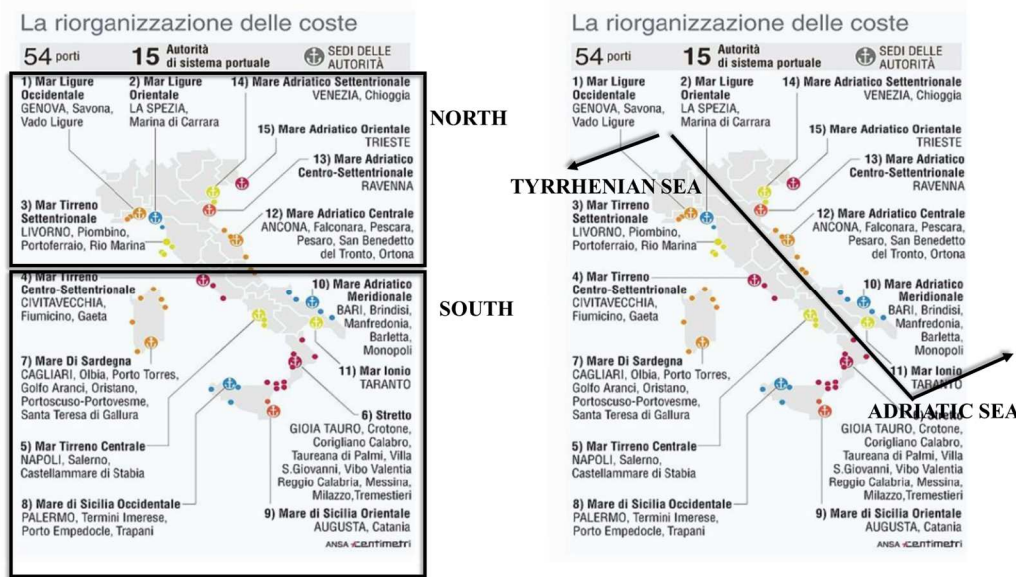


Fig. 3. Spatial grouping (North-South grouping and Mar Tirreno-Mar Adriatico grouping) for container traffic analysis

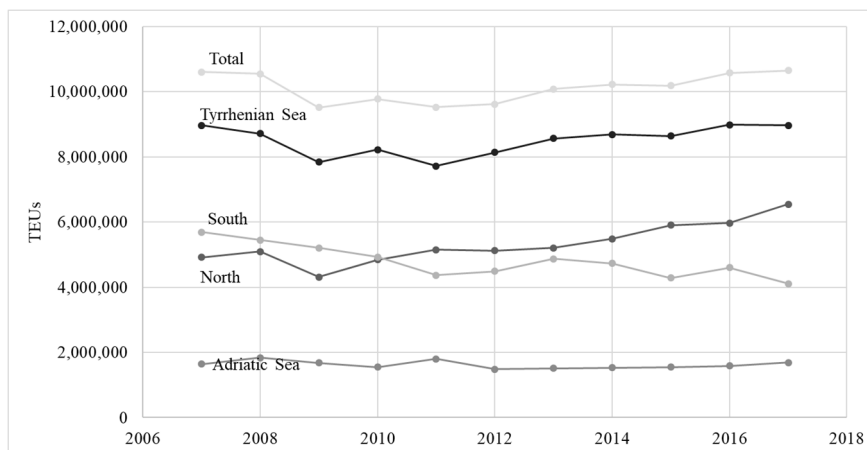


Fig. 4. Annual trend of container traffic in Italy divided by spatial grouping (Elaboration from Assoporti data)

In conclusion, the selection involved the identification of the following 13 ports: Genoa, Savona-Vado, La Spezia, Livorno, Naples, Salerno, Gioia Tauro, Cagliari, Trieste, Venice, Ravenna, Ancona and Taranto.

In 2015 the closure of the container terminal of Taranto has led to the removal of this port from the statistics. The number of ports is high, especially considering the proximity of each port to another. This is a further peculiarity of the Italian port system in addition to the existing fragmentary nature (i.e. high number of ports, grouped in nearby locations).

2.2. Transshipment and hinterland traffic

The division between transshipment and hinterland traffic derives from different quantities of handled TEUs and from

different operations and services. The transshipment ports are Gioia Tauro, Taranto and Cagliari.

The trend of the hinterland container traffic corresponds to the Italian trend (Figure 5) whereas transshipment traffic is characterized by a decreasing trend, especially up to 2011 and in the last 2 years. The overall volume is influenced by the decrease in transshipment traffic due to a contraction (32%) occurring between 2007 and 2017. At the beginning of the analysis period the transshipment ports move more than 40% of the national traffic. This trade has been maintained until 2011. The drop in traffic in recent years confirms what was already highlighted in 2015 by Ferrari and Merk: Italian ports have lost market share due to ports such as Algeciras and Valencia.

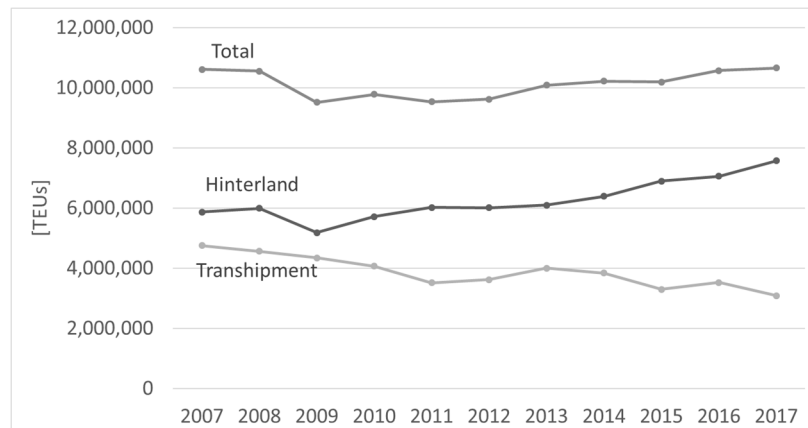


Fig. 5. Annual trend of container traffic in Italy divided by hinterland and transshipment (Elaboration from Assoporti data)

The crisis of transshipment traffic in Italy derives from multiple factors. In 2015, the transfer of the Taiwanese company Evergreen to Piraeus (Greece) entails the closure of the Taranto container terminal. This process starts in 2012 due to the fact that a decrease (67%) in container traffic in Taranto, in comparison to the value of the previous year, corresponds to a relevant increase in traffic in Greece. Moreover, a small quantity of those traffics have been transferred to the port of Bari: in 2015, this port has an increase of almost twice of its movements, absorbing about 30K TEUs of Taranto since the activation of a connection service between the port of Bari and Piraeus.

Tab. 3. TEUs by transshipment's Ports in Italy (2007-2017)

	<i>Transshipment's Ports</i>			<i>Total Transshipment [TEUs]</i>	<i>Total Italy [TEUs]</i>
	<i>Gioia Tauro [TEUs]</i>	<i>Cagliari [TEUs]</i>	<i>Taranto [TEUs]</i>		
2007	3445337	547336	755934	4.748.607	10.609.108
2008	3.467.824	307.527	786.655	4.562.006	10.549.886
2009	2.857.440	736.984	741.428	4.335.852	9.514.891
2010	2.852.264	629.340	581.936	4.063.540	9.777.962
2011	2.304.987	603.236	604.404	3.512.627	9.526.808
2012	2.721.108	627.609	263.461	3.612.178	9.618.700
2013	3.094.254	702.143	197.317	3.993.714	10.082.030
2014	2.969.802	717.016	148.519	3.835.337	10.221.127
2015	2.546.805	748.647	-	3.295.452	10.190.597
2016	2.797.070	723.037	-	3.520.107	10.573.416
2017	2.622.187	463.940	-	3.086.127	10.651.399

The port of Cagliari in 2017 enters into a period of crisis since two phenomena: the acquisition of one of the services managed by Hapag Lloyd from Maersk, which has as its preferred base the port of Tangier (Morocco), generating a further reduction in traffic (36%) in the Sardinian port.; the depth of the seabed, the length of the docks and the very favourable geographical position.

The port of Gioia Tauro with an average traffic of 2.5 Mln of TEUs per year is, in Italy, a leader in the transshipment traffic. However, the port has a progressive decrease in traffic of about 2.6 Mln TEUs in 2017 with regard to the value of 2007 (3.5 Mln of TEUs). Gioia Tauro contributes mostly to the general reduction of transshipment trades. This port suffers from two important phenomena as highlighted by Musso et al. (2013): the progressive growth of competitiveness of other Mediterranean ports such as Tangier, Port Said, Valencia, Algeciras and Marsaxlokk; the transformation of the shipping companies into logistics operators, as in the case of Maersk, strengthening their strategic role in some Mediterranean ports.

The hinterland ports are Genoa, La Spezia, Livorno, Savona-Vado, Naples, Salerno, Ancona, Ravenna, Trieste and Venice. These ports maintain the same ranking over the years in terms of number of TEUs. The ports of Genoa, La Spezia and Livorno preserve, in the last decade, the first three positions and Genoa certainly can be identified as the leader of container traffic due to the increasing trend (over 2 Mln of TEUs from 2012). Naples maintain its fourth position until 2013. Then, it was overpass by the ports of Venice and Trieste.

Finally, it is possible to identify the ports of Salerno, Savona-Vado, Ravenna and Ancona: the port of Salerno has a positive growth trend and the last three ports kept both their position and the number of TEUs.

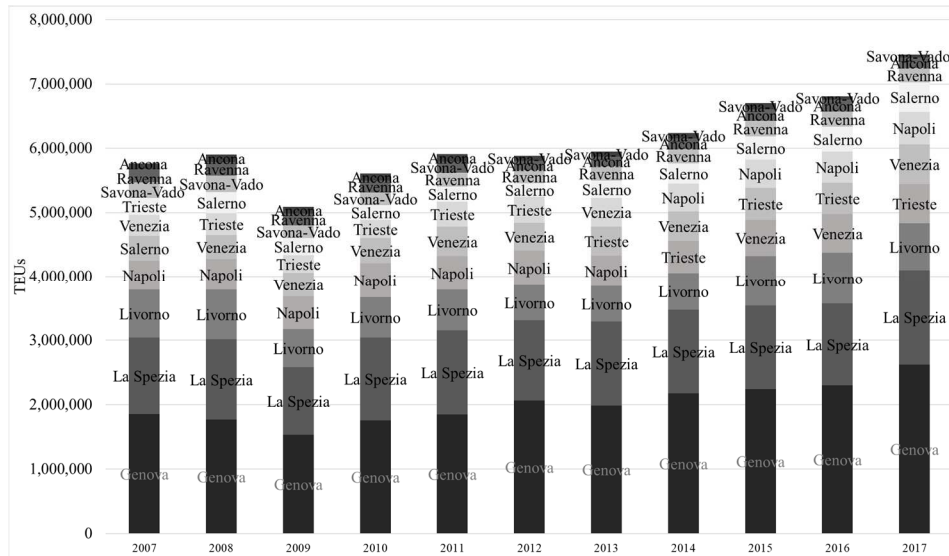


Fig. 6. Position of hinterland ports with respect to annual TEU volumes (Elaboration from Assoporti data)

2.3. Competition and concentration of in Italy ports

Starting from the above data, indicators as HHI and Gini Index have been used to analyze the concentration and instability on the market of container traffic with regard to the hinterland market (Twrdy and Batista, 2017).

From both the adopted indices (Table 4), there is no concentration of the container market both for the distribution of data in the years as well as for the low values assumed by the same statistics.

Tab. 4. Concentration indexes for hinterland container traffic

Concentration Index	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<i>HHI</i>	0,18	0,18	0,17	0,17	0,18	0,18	0,20	0,19	0,19	0,19	0,19	0,20
<i>Gini index</i>	0,04	0,25	0,24	0,24	0,25	0,25	0,27	0,26	0,26	0,25	0,26	0,26

In respect to the indicator commonly used to evaluate the instability of traffic over time (Farris, 2009), the hinterland market for containers in Italy is generally stable (Table 5) as the fluctuations over the years of the index I_t amount to a maximum of 5% and an average of 3.3%. Furthermore, it is necessary to underline how low values of such indicator seem to indicate a fragmentation of the current port supply.

Tab. 5. Market Instability Index for hinterland container traffic

Market Instability	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
I_t	2%	3%	3%	4%	3%	5%	3%	3%	4%	2%	4%

The hinterland ports can be grouped according to their spatial location. It allows the identification of 4 groups: 1) a first group located in the North-West area of Italy, they are Genoa, La Spezia, Savona-Vado and Livorno; 2) a second group in the South-West area including the ports of Salerno and Naples; 3) a third group consisting of the ports of Trieste and Venice in the North-East; 4) a fourth group represented by the ports of Ravenna and Ancona in the eastern part of the country. For each group, an analysis was carried out evaluating both the general trend with respect to the Hinterland volumes and the market share of each port, represented by the Growth-Share Market Matrix (GSM).

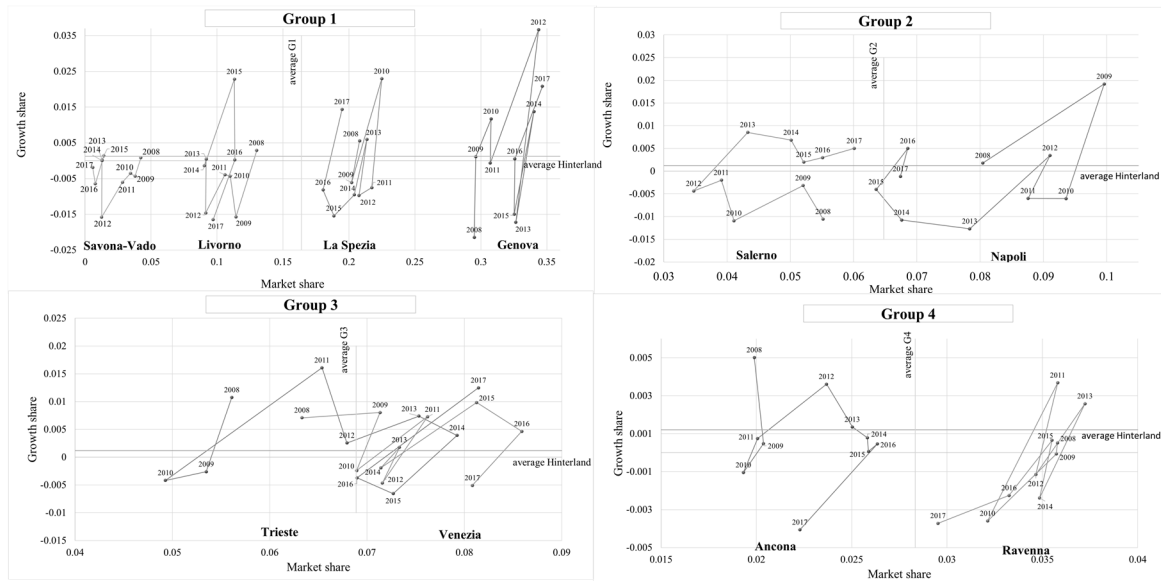


Fig. 6. Growth-Share market Matrix for clustering of hinterland ports

The trend of each group and each port differs significantly from the ideal one, corresponding to the positioning in the upper right quadrant of the X-Y axes of Figure 6. Instead, the trends show variations with respect to the average volume, higher for the ports that have relevant traffic such as Genoa. Moreover, the trends tend to turn on themselves, alternating phases of contraction to others of growth.

In detail, the ports of group 1 (Genoa, La Spezia, Livorno and Savona-Vado) are in a well-defined market segment, in line with their differences in the existing traffic. The ports characterized by a greater market share, have a greater variation in quantities moved between one year to another.

In Genoa, from 2008, there is a constant increase in traffic with a peak in 2012 followed by a contraction in 2013 and 2015. Based on this representation, it can be defined as a growing port, with growth rates often above the average value. La Spezia has undergone a reduction of both parameters since 2010 with a slight recovery from 2016. Even in Livorno there is a steady growth like that of Genoa. Indeed, in 2017 a further contraction is shown compared to the other years. The traffics of the port of Savona-Vado depart from 2008 below the average threshold and continue to contract until 2017.

With regard to Group 2 container traffic in the port of Salerno reduces its market share in the first years of the analysis and there has been an initial recovery since 2012 culminating in 2017 with the achievement of a greater share of traffic compared to 2008. The port of Naples on the other hand shows a decrease in the traffic market share, going from around 10% of the Italian hinterland traffic in 2009 to around 7% in 2017.

The ports of Group 3, Trieste and Venice, move similarly, still often over the national average rate. Starting from different market shares, there is a convergence towards a similar value attested in 2017 of about 8%. Trieste has gradually acquired market share thanks to its draft that allows it to accommodate the largest container ships in the world (Musso et al., 2013).

In 2017 the container traffic in the port of Ancona has a market share lower than in previous years and there is also an annual decrease higher than the values of the previous years of the analysis period. The same negative trend is visible for the port of Ravenna: starting from 2015 a reduction in market share and below-average growth rate.

The results obtained from this analysis are confirmed working for volume levels instead of geographical position. The competitiveness of the specific port in its influence area is evidence of market interference between ports working in the same range of volumes. For example, the 3rd group (Venice and Trieste) consists of ports that both fall into the same level of volumes and these ports embrace the same market area.

3. Conclusions

The study investigates the evolution of the Italian port system related to container traffic, taking into account the phenomena of large shipping carriers and great alliances.

Starting from a general overview of container movements in the Mediterranean system and in the EU Northern Range, the evolution of the container market in Italy has been reconstructed and analyzed.

Italy, placed within the Mediterranean system, assumes a prominent position moving with Spain the largest quantities of containers. However, the comparison with the port supply and the traffics of each country shows for Italy an excessively fragmented reality with an average annual movement by each port lower than countries such as Turkey, Greece, Morocco and Egypt.

In the years of analysis, the limited growth of the container market in Italy is certainly associated with the gradual reduction in transshipment trades. Instead, the analyses conducted on the hinterland traffic show both a low growth share as well as fragmentation of traffic on a large number of ports.

Results of the study clearly underline a need to change the management approach of the Italian port sector development. There is the need to identify strategies at national level for coordinating the evolution of the ports and replacing the competition/interferences with a cooperative approach. This process seems to be absolutely required to better support investments to remain on the market (e.g. to realize infrastructural measures and to increase the sector sustainability). Furthermore, the cooperation between ports should generate a certain resilience to the increasing role of the main shipping companies. Finally, the large and very large shipping carriers (capacity up to 18,000 TEUs) are generating the exit from the market of smaller ships and the increase of the ship average size in the feeder services. In this framework, the cooperation at national level can be the solution given the little opportunity of several ports to accommodate such trends.

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