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Concentration and the formation of multi-port gateway regions in the European container port system: an update

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ABSTRACT

The European container port system features a unique blend of different port types and sizes combined with a vast economic hinterland. This paper provides an update of the detailed container traffic analysis developed by Notteboom (1997) by extending it to the period 1985–2008 and to 78 container ports. The paper also aims at identifying key trends and issues underlying recent developments in the European container port system. These trends include the formation of multi-port gateway regions, changes in the hinterland orientation of ports and port regionalization processes. While the local hinterland remains the backbone of ports' traffic positions, a growing demand for routing flexibility fuels competition for distant hinterlands between multi-port gateway regions. The prevailing assumption that containerisation would lead to further port concentration is not a confirmed fact in Europe: the European port system and most of its multi-port gateway regions witness a gradual cargo deconcentration process. Still, the container handling market remains far more concentrated than other cargo handling segments in the European port system, as there are strong market-related factors supporting a relatively high cargo concentration level in the container sector.

1. Introduction

Europe is advantaged with a long coastline reaching from the Baltic all the way to the Mediterranean Sea and the Black Sea. The European port system cannot be considered as a homogenous set of ports. It features established large ports as well as a whole series of medium-sized to smaller ports each with specific characteristics in terms of hinterland markets served, commodities handled and location qualities. This unique blend of different port types and sizes combined with a vast economic hinterland shapes port hierarchy and competition in the region. A number of port studies have dealt with port competition and development in European regions or in individual European ports. Marcadon (1999), Veldman and Buckmann (2003), Veldman et al. (2005), Notteboom (2007) and Ng (2006) are among the papers discussing container port competition in Northwestern Europe. Brunt (2000) analyzes Ireland's seaport system, while Baird (2002, 2006) analyzes the Northwest European transhipment market in light of the potential establishment of a UK-based transhipment hub. Notteboom (2009) discusses competition and complementarity among container load centres in the Rhine–Scheldt Delta. Mediterranean gateway ports and transhipment hubs also received a lot of attention in recent years (see e.g. Ridolfi (1999), Zohil and Prijon (1999), Goulielmos and Pardali (2002), Gouvernal et al. (2005), Ferrari et al. (2006) and Medda and Carbonaro (2007)). The mentioned port studies provide insight into the competitive dynamics in the respective regions, but lack a European-wide dimension. Instead of analyzing specific port regions or individual ports, Notteboom (1997) described the dynamics in the entire European container port system for the period 1980–1994 and concluded:

> 'the concentration tendency [in the European container port system] will eventually reach a limit or might even develop into deconcentration. [...] The analysis illustrate that the level of port concentration in the European container port system as well as in the individual port ranges stagnated in the nineties. [...] The future development of the European container port system will primarily be influenced by the technological and organizational evolutions in the triptych foreland–port–hinterland and the outcomes of some current (trans)port policy issues.' (Notteboom, 1997, p. 114–115)

The last year of observation in the analysis by Notteboom (1997) was 1994, a year when the European port system started to witness rather significant changes in the economic, logistic and institutional environment. The aim of this paper is twofold. First of all, it provides an update of the detailed container traffic

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analysis developed by Notteboom (1997). While the results in Notteboom (1997) related to the period 1980–1994, this paper extends the observation period to 1985–2008. The number of ports is brought to 78 compared to 36 in the original paper. Secondly, the paper aims at identifying key trends and issues in the recent development of the European container port system and in port hierarchy. These trends include the formation of multi-port gateway regions, port regionalization processes and hinterland dynamics.

The first part of the paper contains a comprehensive discussion on the existing theoretical models on port system development as well as the limitations of these models. The second section identifies recent key changes in the environment in which European ports operate. An extensive port throughput and concentration analysis forms the basis for the third section. In the last part of the paper, we analyze key issues underlying port hierarchy dynamics in Europe.

2. Theoretical notes on port system development

A wide-ranging and longstanding literature in port geography exists on the spatial development of seaport systems in relation to maritime and hinterland networks. Ducruet et al. (2009) identified 34 academic studies on port system concentration published between 1963 and 2008. One of the classic works is Ogundana (1970) on seaport evolution in Nigeria. Another classic is Taaffe et al. (1963) which suggests an increasing level of port concentration as certain hinterland routes develop to a greater extent than others in association with the increased importance of particular urban centres. The geographical system would evolve from an initial pattern of scattered, poorly connected ports along the coastline to a main network consisting of corridors between gateway ports and major hinterland centres. The resulting port concentration can cause degradation of minor ports in the network. The models of Barke (1986) and Hayuth (1981) are quite similar, though they introduced a process of port system deconcentration caused by the growth of former non-hub ports and the emergence of new ports. Deconcentration within a port system, occurs when some of the existing cargo is shifted from large ports to smaller or new ports, or when the large load centres only absorb a small portion of the container growth in the port system. This 'challenge of the periphery' phenomenon has received quite some attention in literature (Hayuth, 1981; Slack and Wang, 2002; Notteboom, 2005; Frémont and Soppé, 2007).

Notteboom and Rodrigue (2005) added a sixth phase in which port regionalization takes place. This phase incorporates inland freight distribution centres and terminals as active nodes in shaping load centre development. The port regionalization phase is characterized by strong functional interdependency and even joint development of a specific load centre and (selected) multimodal logistics platforms in its hinterland, ultimately leading to the formation of a 'regional load centre network'. Although Rimmer and Comtois (2009) argue that the port regionalization phase is nothing more than decentralization, we argue that the regionalization phase is more than just simple decentralization since it involves the expansion of the hinterland reach through a number of strategies linking the port more closely to inland freight distribution centres in a functional way. The port regionalization model has been applied to concrete cases: see for instance Notteboom (2006) for an application to the port of Antwerp.

The models on port system development only capture part of the complexity underlying port system dynamics. First of all, the models on port development portray a high degree of path dependency in the development of ports at a regional scale. Path dependency implies that port systems would follow a similar evolutionary development path. Notteboom (2009b) argued that port development processes show certain degrees of contingency, where strategies and actions of market players and other stakeholders might deviate from existing development paths. Through horizontal and vertical integration strategies, shipping lines, forwarders and intermodal operators have a growing decisional power on supply chain spatial design. Both path dependency and contingency explain why port systems around the world do not develop along similar lines or follow the same sequence of stages as suggested in the models on port system development. The result is some level of disparity among concentration patterns in port systems around the world as illustrated by the Gini decomposition analysis provided in Notteboom (2006b).

Secondly, as pointed out by Rimmer and Comtois (2009), there is a danger of becoming too pre-occupied with the land-based network, without incorporating the realities in the maritime space. Earlier models on port system development typically focus on the size of the hinterland and the role of ports as natural gateways forming the main factors explaining traffic volumes. Today, regional integration and port competition give more importance to nautical accessibility and technological performance within the port. The configuration of liner service networks (e.g. scale increases in vessel size and a limitation of the number of port calls per loop) has a large influence on port hierarchy and the routing of cargo flows through port systems.

Third, the theoretical models focus on cargo concentration at the level of a container port system. This is clearly something else than concentration of cargo at the level of the liner networks of individual carriers (Cullinane and Khanna, 1999) or global terminal operators. From a shipping line's perspective, the economies of scale in all parts of the port triptych (shipping, port and inland operations) would favor a very limited number of load centres in a region. The advantages of concentrating cargo in only one or a few ports of call would be stronger at the level of a shipping line than at the port level, simply because not all carriers will choose the same load centres in their liner service networks. Along the same lines, Frémont and Soppé (2007) argue that port concentration has taken a new form which is that of shipping line concentration characterized by the setting up of dedicated load centres. While there clearly is room for analyzing ports as groups of terminals with their own individual logics (Slack, 2007; Olivier and Slack, 2006), we argue that the study of port system concentration remains valid because of geographical reasons (i.e. the study of sets of gateways in relation to the foreland and the hinterland) and from the perspective of port authorities who manage entire port areas.

Fourth, existing models on port system development tend to undervalue the role of political and institutional factors. Current port dynamics are very much influenced by governance models, port reform and regulatory frameworks (see e.g. Jacobs (2007), Wang (1998), Airriess (2001), Brooks and Cullinane (2007)).

The above demonstrates that the development of a port system is far more complex than mere cargo concentration patterns as suggested by the earliest models. The next section analyzes the main changes that have taken place in the economic, technological, institutional and regulatory environment faced by European ports.

3. Structural changes in the port environment since 1994

The last year of observation in Notteboom (1997) was 1994, a year when the European port system started to witness a rather significant transition, that accelerated in the late 1990s. European ports got embedded in ever-changing economic and logistics systems and were confronted with changing port governance structures. Hence, the contemporary European ports' environment looks very different when compared to the analysis provided in Notteboom (1997).

First of all, the number of Member States of the European Union increased from 15 in the mid 1990s to 27 at present. Economic centres in East and Central Europe, the Nordic triangle and the Iberian Peninsula have taken up an important position next to the traditional economic heartland of Europe. The increased participation of these regions on the European economic scene opened possibilities for new load centres and inland transport corridors to emerge.

Second, the Europe-Far East trade became the most important international trade route during the second half of the 1990s. The China factor had its full effect on liner shipping and reoriented the focus of many container ports towards the East. This implied a shift from the Atlantic Rim to the Suez route, thereby opening windows of opportunity for the Med to play a more important role in accommodating international trade flows.

Third, the deployment of large post-panamax container vessels only started in 1996 with the introduction of the Regina Maersk (official capacity of 6500 TEU, but estimated at 8000 TEU) and in the meantime emanated to unit capacities of 13,500 TEU and more, mainly deployed on the Europe-Far East route. Such vessel developments have increased pressures on nautical access profiles and port turnaround times and, in theory, should give a competitive edge to coastal deepwater load centres and reduce the number of port calls per liner service.

Fourth, logistics service providers, shipping lines and terminal operators have gone through an unprecedented wave of consolidations. This has led to powerful global terminal networks, carrier groups and third-party logistics service providers (3PL). This process was further enhanced by vertical integration strategies of many market players contributing to the emergence of megacarriers. As a result European seaports increasingly have to deal with large port clients who possess a strong bargaining power vis-à-vis terminal operations and inland transport operations (Notteboom and Winkelmans, 2001a; Olivier and Slack, 2006). The loyalty of a port client cannot be taken for granted. The purchasing power of the large market players, reinforced by strategic alliances between them, is used to play off one port or group of ports against another.

Fifth, the European port system has witnessed an influx of global terminal operators since the mid 1990s. Global companies such as DP World from Dubai, PSA from Singapore, APM Terminals from Denmark (AP Moller group) and Hutchison Port Holdings from Hong Kong have entered the European container handling business. At present, these operators each manage between 5 and 10 container terminals spread out over the main European gateway regions (Notteboom, 2002; Drewry Shipping Consultants, 2007). The European entry of large terminal groups has been supported by lower entry barriers following the use of more open and transparent procedures used by port authorities or government agencies with respect to the awarding of seaport sites to private terminal operators (Pallis et al., 2008). The efficiency and performance of these container terminals has received a lot of attention in recent literature, see e.g. Wang and Cullinane (2006) and Notteboom et al. (2000) on European terminals, Martinez-Budria et al. (1999), Coto-Millan et al. (2000) and Bonilla et al. (2004) on Spanish terminals, Barros and Athanasiou (2004) on Greek and Portuguese ports and Barros (2006) on Italian ports.

Sixth, the European port system has witnessed significant advances in inland transportation. Modal shift and 'co-modality' policies have been implemented by supranational, national and regional governments aimed at stimulating the use of barges, rail and shortsea shipping. Rail transportation has been liberalized in Europe through a series of EU Directives and Regulations following the initial Directive 91/440 of 1991 (Gouvernal and Daydou, 2005). The process has been slow in many countries, but most European countries have seen the entrance of newcomers in the rail industry. The inland barge industry has also seen large scale liberalization in countries like Belgium, France and the Netherlands where bottom tariffs and or cargo sharing arrangements (the so-called 'tour-de-rôle system') were abolished in the late 1990s. The European Commission is also supporting the development of short sea shipping (Strandenes and Marlow, 2000). The EC's shortsea policy is supported by the creation of Motorways of the Sea (MoS) and funding mechanisms like the Marco Polo Program. The EC has set a clear policy objective to remove any remaining administrative and customs obstacles towards the creation of an EU maritime space (European Commission, 2009).

Moreover, major changes have taken place in port governance around Europe. Port authorities around Europe have gained a more autonomous status via commercialization, corporatization and privatization processes (Notteboom and Winkelmans, 2001b). Several case studies can be found in academic literature, e.g. Goss (1998), Baird (2000) and Pettit (2008) on UK port policy and privatization, Goulielmos (1999) on Greek port deregulation, Castillo-Manzano et al. (2008) on port reform in Spain and Misztal and Zurek (1997) on the port reform process in Poland. Drastic port reform schemes in countries such as France, Italy, Spain and many east European countries were considered needed in view of increasing efficiency and competitiveness of the ports concerned. The European Commission has taken steps towards a European port policy (Verhoeven, 2009). While a stronger involvement of Europe in port policy formulation remains controversial (see Pallis (1997), Farrell (2001) and Psaraftis (2005)), the European Commission made two attempts in the early 2000s to come to a Directive on the access to port services. While both attempts failed, it has created a more European perspective on port and transport policy issues in particular in relation to port pricing and financing (e.g. Haralambides et al., 2001; Baird, 2004), market access, environmental regulation and the development of the trans-European transport network (TEN-T).

Finally, ports need to comply with ever higher regulatory and societal requirements in the fields of environmental protection (e.g. the EC's Birds and Habitats Directives and the Water Framework Directive), safety and security (e.g. the ISPS code). Rising environmental and social concerns combined with complex environmental legislation result in time-consuming and complex port planning processes which hampered or delayed the further expansion of some existing load centres. Ports and port companies must demonstrate a high level of environmental performance in order to ensure community support and keep a license to operate. However, a 'green' port management also plays an increasing role in attracting trading partners and potential investors. Seaports with a strong environmental and security record and a high level of community support are likely to be favoured.

The above changes in the port environment have to a greater or lesser extent influenced the competitive outlook for established load centres, but at the same time they have also enabled newcomers to enter the port scene, potentially affecting port hierarchy in Europe. It is therefore interesting and relevant to analyze how the interplay of the above changes in the European port environment has impacted the recent functional and spatial development of the European container port system.

4. Container throughput dynamics in the European port system

4.1. General discussion

With a total maritime container throughput of an estimated 90.7 million TEU in 2008, the European container port system ranks among the busiest container port systems in the world.

Europe counts many ports. For example, there are about 130 seaports handling containers of which around 40 accommodate intercontinental container services. In North America there are about 40 seaports involved in containerization and less than 20 are involved in deepsea container trades. Growth in Europe has been particularly strong in the last few years with an average annual growth rate of 10.5% in the period 2005–2008, compared to 6.8% in the period 1985–1995, 8.9% in 1995–2000 and 7.7% in 2000–2005. The economic crisis which started to have its full effect in late 2008 has brought an end to the steep growth curve. Figures for 2008 based on 78 European container ports show that total container throughput increased from 82.5 million TEU in 2007 to 83.2 million TEU in 2008 or a growth of only 0.8%.

Container ports in the Hamburg–Le Havre range handle about half of the total European container throughput. The market share of the Mediterranean ports grew significantly between the late 1980s and the late 1990s at the expense of the ports in the Hamburg–Le Havre range. The significant improvement of the market share of the Med was mainly the result of the insertion of transhipment hubs in the region since the mid 1990s. In the new millennium, the position of the northern range has gradually improved while Med ports and the UK port system lost market share. The Baltic and the Black Sea have strengthened their traffic position. The growth path in market share of each of the port ranges is depicted in Fig. 1.

It is useful to examine the volume of container shifts among port groups in order to get a more detailed insight in throughput dynamics. The net shift analysis provides a good tool for measuring container shifts. The net shift analysis is a customized form of the shift–share analysis, which was first applied in Notteboom (1997). The Appendix A provides a methodological note on the technique. A net shift of zero would mean that the port or port group would have the same growth rate as the total seaport system. The average annual net shift figures for the port groups indicate a gain (positive sign) or a loss (negative sign) of 'potential' container traffic i.e. compared to the situation under which the considered port group would have grown at the same average growth rate as the total European port system. Fig. 2 presents the results of the net shift analysis applied to the European port system for eight consecutive periods. The results confirm earlier findings: growth in Med ports and UK ports is lagging behind in the last three periods of observation (negative annual net shifts), while the Hamburg–Le Havre range and the Baltic show significant positive net shifts.

Table 1 provides an overview of the 15 largest container load centres in Europe. A number of these ports act as almost pure transhipment hubs with a transhipment incidence of 75% or more (i.e. Gioia Tauro, Marsaxlokk, Algeciras) while other load centres can be considered as almost pure gateways (e.g. Genoa and Marseille to name but a few) or a combination of a dominant gateway function with sea–sea transhipment activities (e.g. Hamburg, Rotterdam, Le Havre, Antwerp, Barcelona and Valencia). About 69% of the total container throughput in the European port system passes through the top 15 load centres, compared to 61% in 1985. One third of all containers is handled by the top three ports, whereas this figure was 29% in 1985. These figures suggest an increasing concentration of cargo in only a dozen large container ports. Worth mentioning is that the dominance of market leader Rotterdam has somewhat weakened.

4.2. The emergence of multi-port gateway regions

Comparisons of container throughput figures are typically based on individual ports. This might be misleading when analyzing the gateway function of specific port regions in Europe. An alternative approach consists of grouping seaports within the same gateway region together to form multi-port gateway regions. The locational relationship to nearby identical traffic hinterlands is one of the criteria that can be used to cluster adjacent seaports. In cases there is no coordination between the ports concerned, the hinterland is highly contestable as several neighboring gateways are vying for the same cargo flows. It is argued that container throughput dynamics in Europe can best be analyzed by using 'multi-port gateway regions' as units of analysis, and not the broader port groupings or port ranges as presented in the previous section. The relevance of using a multi-port gateway level is supported by the calling patterns in the liner service networks of shipping lines and associated complementarity and competitive relationships among the ports concerned and communality in hinterland connectivity issues among ports of the same multi-port gateway region (Notteboom, 2009). Fig. 3 provides an overview of the main multi-port gateway regions in Europe as well as transhipment hubs and stand-alone gateways. Stand-alone gateways are somewhat isolated in the broader port system, as they have less strong functional interactions with adjacent ports than ports of the same multi-port gateway regions. The following conclusions can be drawn on the basis of Tables 2 and 3.

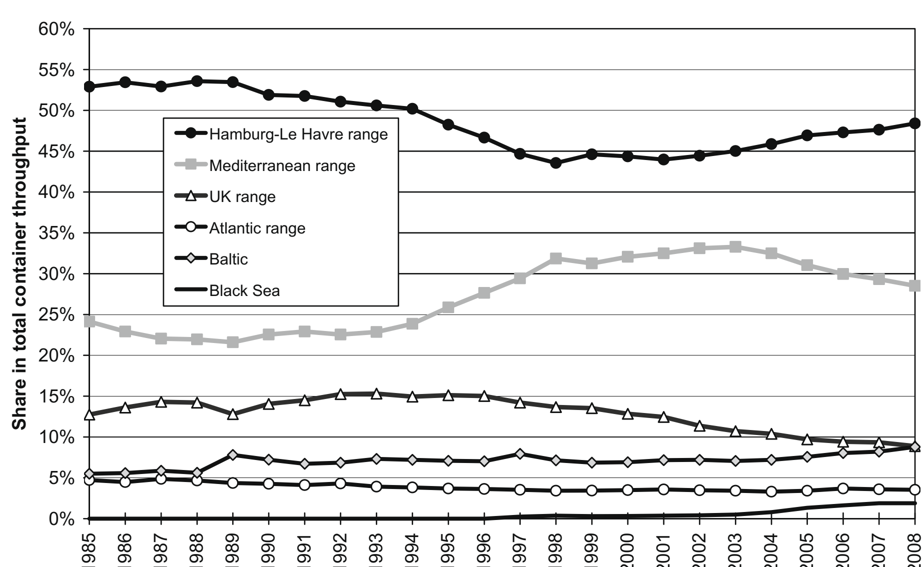

Fig. 1. Market shares of ranges in the European container port system.

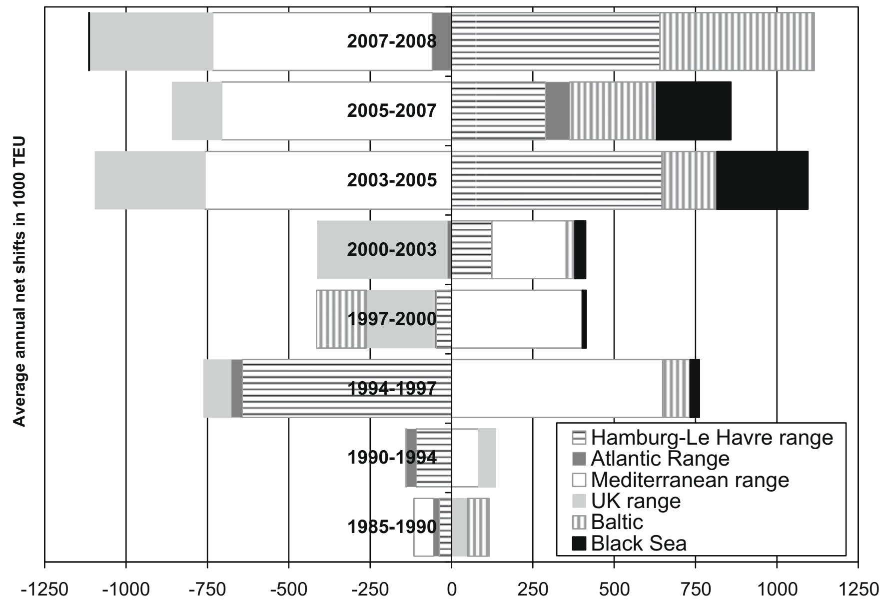

Fig. 2. Average annual net shifts between port ranges in the European port system.

Table 1
Container throughput (in 1000 TEU) of the top 15 container ports in Europe. *Source*: Own compilation based on data respective port authorities.

In 1000 TEU													
R		1985		1995		2000		2005		2007		2008	*R*
1	Rotterdam	2655	Rotterdam	4787	Rotterdam	6275	Rotterdam	9287	Rotterdam	10791	Rotterdam	10784	1
2	Antwerp	1243	Hamburg	2890	Hamburg	4248	Hamburg	8088	Hamburg	9890	Hamburg	9737	2
3	Hamburg	1159	Antwerp	2329	Antwerpen	4082	Antwerpen	6488	Antwerpen	8177	Antwerpen	8664	3
4	Bremen	986	Felixstowe	1924	Felixstowe	2793	Bremen	3736	Bremen	4892	Bremen	5448	4
5	Felixstowe	726	Bremen	1518	Bremen	2752	Gioia Tauro	3161	Gioia Tauro	3445	Valencia	3597	5
6	Le Havre	566	Algeciras	1155	Gioia Tauro	2653	Algeciras	2937	Algeciras	3420	Gioia Tauro	3468	6
7	Marseille	488	Le Havre	970	Algeciras	2009	Felixstowe	2700	Felixstowe	3343	Algeciras	3324	7
8	Leghorn	475	La Spezia	965	Genoa	1501	Le Havre	2287	Valencia	3043	Felixstowe[a]	3200	8
9	Tilbury	387	Barcelona	689	Le Havre	1465	Valencia	2100	Le Havre	2638	Barcelona	2569	9
10	Barcelona	353	Southampton	683	Barcelona	1388	Barcelona	2096	Barcelona	2610	Le Havre	2502	10
11	Algeciras	351	Valencia	672	Valencia	1310	Genoa	1625	Zeebrugge	2021	Marsaxlokk	2337	11
12	Genoa	324	Genoa	615	Piraeus	1161	Piraeus	1450	Marsaxlokk	1900	Zeebrugge	2210	12
13	Valencia	305	Piraeus	600	Southampton	1064	Marsaxlokk	1408	Southampton	1869	Genoa	1767	13
14	Zeebrugge	218	Zeebrugge	528	Marsaxlokk	1033	Southampton	1395	Genoa	1855	Southampton[a]	1710	14
15	Southampton	214	Marsaxlokk	515	Zeebrugge	965	Zeebrugge	1309	Constanza	1411	Constanza	1380	15
	Top 15	10450	Top 15	20841	Top 15	34698	Top 15	50067	Top 15	61305	Top 15	62697	
	Total Europe	17172	Total Europe	33280	Total Europe	51000	Total Europe	73729	Total Europe	89990	Total Europe	90710	
	Share R'dam	15%	Share R'dam	14%	Share R'dam	12%	Share R'dam	13%	Share R'dam	12%	Share R'dam	12%	
	Share top 3	29%	Share top 3	30%	Share top 3	29%	Share top 3	32%	Share top 3	32%	Share top 3	32%	
	Share top 10	53%	Share top 10	54%	Share top 10	57%	Share top 10	58%	Share top 10	58%	Share top 10	59%	
	Share top 15	61%	Share top 15	63%	Share top 15	68%	Share top 15	68%	Share top 15	68%	Share top 15	69%	

[a] Estimate.

The Rhine–Scheldt Delta and the Helgoland Bay ports, both part of the Le Havre–Hamburg range, together represent 44.3% of the total European container throughput in 2008. The market share of the Rhine–Scheldt Delta is quite stable in the last 10 years (about 25–26%) with Rotterdam slightly losing market share in favor of Belgian ports Antwerp and Zeebrugge. The North-German ports have gained market share from 14% in the late 1990s to 18.3% in 2008. Bremerhaven's recent volume surge and Hamburg's pivotal role in feeder flows to the Baltic and land-based flows to the developing economies in East and Central Europe are the main causes. The Seine Estuary, the third region in the Le Havre–Hamburg range, suffers from a gradual decline in its market share from 5.5% in 1989 to 3.2% in 2008. The 'Port 2000' terminals in Le Havre, a new hinterland strategy and the recent port reform process should support a 'renaissance' of Le Havre. Le Havre's strategy goes hand and hand with the ambition of the port to stretch its hinterland reach beyond the Seine basin (its core hinterland) and even across the French border, mainly supported by rail services.

Among the major winners we find the Spanish Med ports (from 4% in 1993 to 7.5% in 2008) and the Black Sea ports (from virtually no traffic to a market share of 1.9% in 2008). These ports have particularly benefited from the extension of the economic hinterland in Europe. In the last couple of years, the ports in the Bay of Gdansk are witnessing a healthy growth and an increasing market share (now 1% compared to 0.5% 5 years ago). The Polish load centres are still bound by their feeder port status, competing with main port Hamburg for the Polish hinterland. The ports at the entrance of the Baltic and the Portuguese port system have a more modest

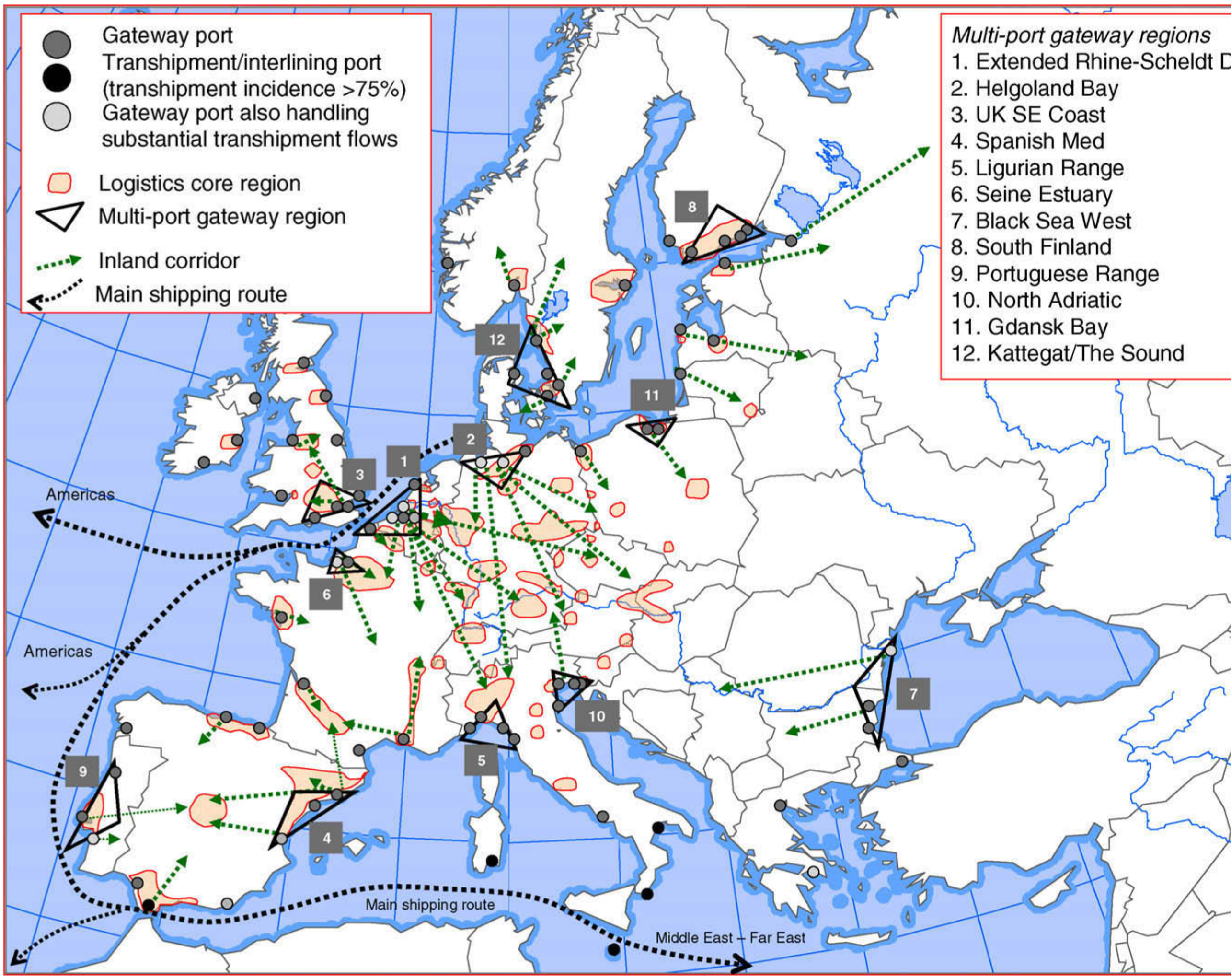

Fig. 3. The European container port system and logistics core regions in the hinterland.

growth path. Portuguese ports Lisbon, Leixoes and Sines are trying very hard to expand business by developing a transhipment role (e.g. shipping line MSC is using Sines) as well as tapping into the Spanish market (particularly the Madrid area) through rail corridor formation and dry port development. After a long period of declining market shares, the Portuguese port system has succeeded in stabilizing its share at around 1.5%. Similarly, the ports alongside the Kattegat and The Sound show a stable market share of 2.2% since 5 years after a period of a declining market share.

The Ligurian ports in Italy have difficulties in keeping up with other regions in Europe. The ports jointly represent some 4.9% of the total European port volume, a decline compared to 6–7% throughout the 1980s and 1990s. The Ligurian ports rely heavily on the economic centres in Northern Italy and also aim at attracting business from the Alpine region, the southeast of France and southern Germany. Just like the Ligurian ports, the North-Adriatic ports have been facing lower than average growth rates. However, in the last couple of years the tide seems to have turned. The recent cooperation agreement among the ports of Koper, Venice, Trieste and Ravenna underlines the ambition of the region to develop a gateway function to Eastern and Central Europe and the Alpine region. The strategy should also enable the region to develop larger scale container operations. With nearly 1.3 million TEU in 2008 the Adriatic ports now handle a fraction of the volumes of the two leading multi-port gateway regions of the Hamburg–Le Havre range.

The UK ports witnessed a rather significant decrease in market share. Many of the load centres along the southeast coast of the United Kingdom faced capacity shortages in recent years. Quite a number of shipping lines opted for the transhipment of UK flows in mainland European ports (mainly Rhine–Scheldt delta and Le Havre) instead of calling at UK ports directly. With the prospect of new capacity getting on stream (e.g. London Gateway, Great Yarmouth and Teesport) there is hope for more direct calls and potentially a (slight) increase in market share. Much will depend on whether the UK and Irish economies regain their strength.

Extensive hub-feeder container systems and shortsea shipping networks emerged in the Mediterranean since the mid 1990s to cope with the increasing volumes and to connect to other European port regions. The transhipment hubs in the Mediterranean have substantially increased their role in the container market. After a steep increase of the market share from 4.9% in 1993 to 14.3% in 2004, the last few years have brought a small decline to 12.2%. This decline came as volume growth in mainland Med ports allowed shipping lines to shift to more direct calls.

4.3. Cargo concentration patterns in the European container port system

At the level of Europe as a whole, Table 1 demonstrated that the top 15 container ports handle about 69% of the total container throughput in the European port system (61% in 1985). These

Table 2
Container throughput figures (1985–2008, in 1000 TEU).

R	1985		1995		2000		2005		2007		2008		R
Main multi-port gateway regions in Europe													
1	Extended RS Delta	4312	Extended RS Delta	7818	Extended RS Delta	11536	Extended RS Delta	17532	Extended RS Delta	21660	Extended RS Delta	22379	1
2	Helgoland Bay	2145	Helgoland Bay	4430	Helgoland Bay	7110	Helgoland Bay	11879	Helgoland Bay	14848	Helgoland Bay	15255	2
3	UK Southeast Coast	1508	UK Southeast Coast	3543	UK Southeast Coast	5080	UK Southeast Coast	5807	UK Southeast Coast	6879	UK Southeast Coast	6568	3
4	Ligurian Range	986	Ligurian Range	2051	Ligurian Range	2949	Spanish Med range	4490	Spanish Med range	5700	Spanish Med range	6214	4
5	Seine Estuary	701	Spanish Med range	1398	Spanish Med range	2742	Ligurian Range	3528	Ligurian Range	4030	Ligurian Range	4045	5
6	Spanish Med range	676	Seine Estuary	1090	Seine Estuary	1610	Seine Estuary	2280	Seine Estuary	2797	Seine Estuary	2642	6
7	Kattegat/The Sound	529	Kattegat/The Sound	986	Kattegat/The Sound	1389	Kattegat/The Sound	1666	Kattegat/The Sound	1969	Kattegat/The Sound	1796	7
8	North Adriatic	376	South Finland	562	South Finland	773	South Finland	1120	Black Sea West	1561	Black Sea West	1573	8
9	Portuguese Range	266	Portuguese Range	470	North Adriatic	692	Portuguese Range	916	South Finland	1395	South Finland	1419	9
10	Gdansk Bay	83	North Adriatic	468	Portuguese Range	670	Black Sea West	902	Portuguese Range	1138	North Adriatic	1273	10
11	Black Sea West	n.a.	Gdansk Bay	142	Gdansk Bay	206	North Adriatic	842	North Adriatic	1095	Portuguese Range	1239	11
12	South Finland	n.a.	Black Sea West	n.a.	Black Sea West	150	Gdansk Bay	470	Gdansk Bay	711	Gdansk Bay	796	12
Transhipment/interlining hubs in West and Central Med													
	Med Hubs	393	Med Hubs	1711	Med Hubs	5732	Med Hubs	9017	Med Hubs	10069	Med Hubs	10172	
Some important stand-alone gateways (ranking based on figures of 2008)													
	Marseille	488	Marseille	498	Marseille	722	Marseille	906	Marseille	1003	Marseille	848	
	Liverpool	133	Liverpool	406	Liverpool	540	Liverpool	612	Liverpool	675	Liverpool	n.a.	
	Bilbao	149	Bilbao	297	Bilbao	434	Bilbao	504	Bilbao	555	Bilbao	557	
	Naples	108	Naples	207	Naples	397	Naples	395	Naples	461	Naples	482	
	Piraeus	197	Piraeus	600	Piraeus	1161	Piraeus	1395	Piraeus	1373	Piraeus	431	
	Malaga	5	Malaga	4	Malaga	4	Malaga	247	Malaga	542	Malaga	429	
	Klaipeda	0	Klaipeda	30	Klaipeda	40	Klaipeda	214	Klaipeda	321	Klaipeda	373	
	Thessaloniki	11	Thessaloniki	211	Thessaloniki	230	Thessaloniki	366	Thessaloniki	447	Thessaloniki	239	

(*) Estimate.
Notes:
Extended Rhine–Scheldt Delta: Rotterdam, Antwerp, Zeebrugge, Amsterdam, Ghent, Zeeland Seaports, Ostend, Dunkirk.
Helgoland Bay: Hamburg, Bremen/Bremerhaven, Cuxhaven, Emden, Wilhelmshaven.
UK South East Coast: Felixstowe, Southampton, Thamesport, Tilbury, Hull.
Spanish Med: Barcelona, Valencia, Tarragona.
Ligurian range: Genoa, Savona, Leghorn, La Spezia.
Seine Estuary: Le Havre, Rouen.
Black Sea West: Constanza, Burgas, Varna.
South Finland: Helsinki, Kotka, Rauma, Hamina, Turku.
Portuguese range: Lisbon, Leixoes, Sines.
North Adriatic: Venice, Trieste, Ravenna, Koper.
Gdansk Bay: Gdynia, Gdansk.
Kattegat/The Sound: Goteborg, Malmo/Copenhagen, Helsingborg, Aarhus.

Table 3
Annual net shifts in 1000 TEU between multi-port gateway regions in Europe.

	Period							
	1985–1990	1990–1994	1994–1997	1997–2000	2000–2003	2003–2005	2005–2007	2007–2008
Extended Rhine–Scheldt Delta	−60	−45	−377	−165	−129	470	118	539
Helgoland Bay	28	7	−239	140	213	300	165	280
Seine Estuary	−6	−71	−28	−22	40	−123	5	−178
Portuguese Range	8	−26	−20	−19	16	−66	9	91
Spanish Med range	−18	−9	95	124	107	25	106	467
Ligurian Range	−34	31	−31	−23	−126	−190	−140	−18
North Adriatic	−27	−21	22	−62	−55	9	33	169
UK Southeast Coast	40	29	−61	−156	−310	−294	−109	−368
Gdansk Bay	0	−9	4	−10	26	37	68	79
West Med hubs	31	119	574	310	288	−247	−475	20
Black Sea West	0	0	29	13	33	280	230	−2
South Finland	58	21	35	73	11	32	13	12
Kattegat/The Sound	4	−10	−102	10	−125	−61	−21	13
Stand-alone gateways	−24	−16	99	−67	10	−107	−4	−1105
$VOLSHIFT_{inter}$	169	207	857	597	745	1120	748	1670

figures suggest an increasing concentration of cargo in only a dozen large container ports. However, this does not imply Europe counts fewer container ports than before. The European port scene is becoming more diverse in terms of the number of ports involved, leading to more routing options to shippers and to a lower concentration index. The normalized Hirschman–Herfindahl index (HH-index) in Fig. 4 confirms this finding. The normalized HH-index is defined as

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

with TEU_i equal to the container throughput in TEU of port i and n the number of ports in the container port system. A higher index means a more concentrated port system. Most multi-port gateway regions show a rather stable evolution in the HH-index or are evolving towards a more evenly distributed system (decreasing normalized HH-index). Only the Black Sea port system (western part) shows an elevated HH-index as a result of the difference in scale and growth path between Constanza and the neighboring Bulgarian container ports. The 'challenge of the periphery' phenomenon underlying the downward pressure on the HH-indices will be discussed later in this paper. The container handling market remains more concentrated than other cargo handling segments in the European port system. Fig. 5 compares five cargo handling segments on the basis of a cumulative market share curve for the 75 largest ports in each of the segments. It can be observed that the concentration is the lowest in the conventional general cargo segment and the highest in the container market. The more elevated concentration level in the European container port system is a classic outcome of lower inland distance friction functions in inland container transport. Other market-related factors behind this observation will be discussed in one of the following sections.

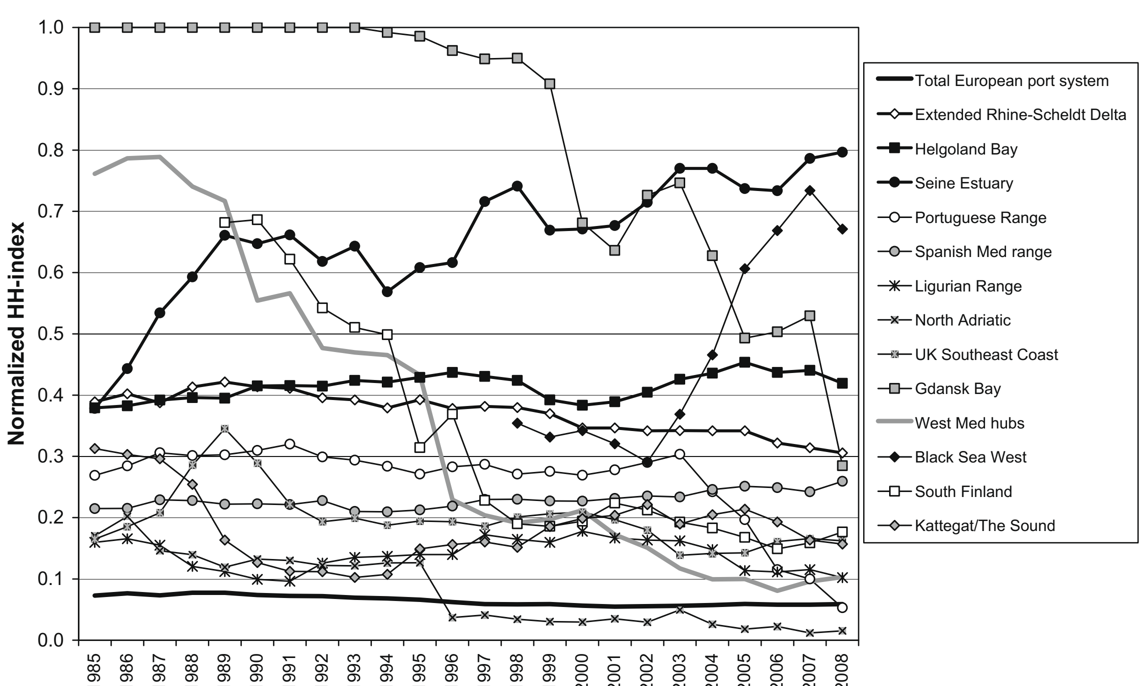

Fig. 4. The evolution of the normalized Hirschman–Herfindahl index for European port regions (1985–2008).

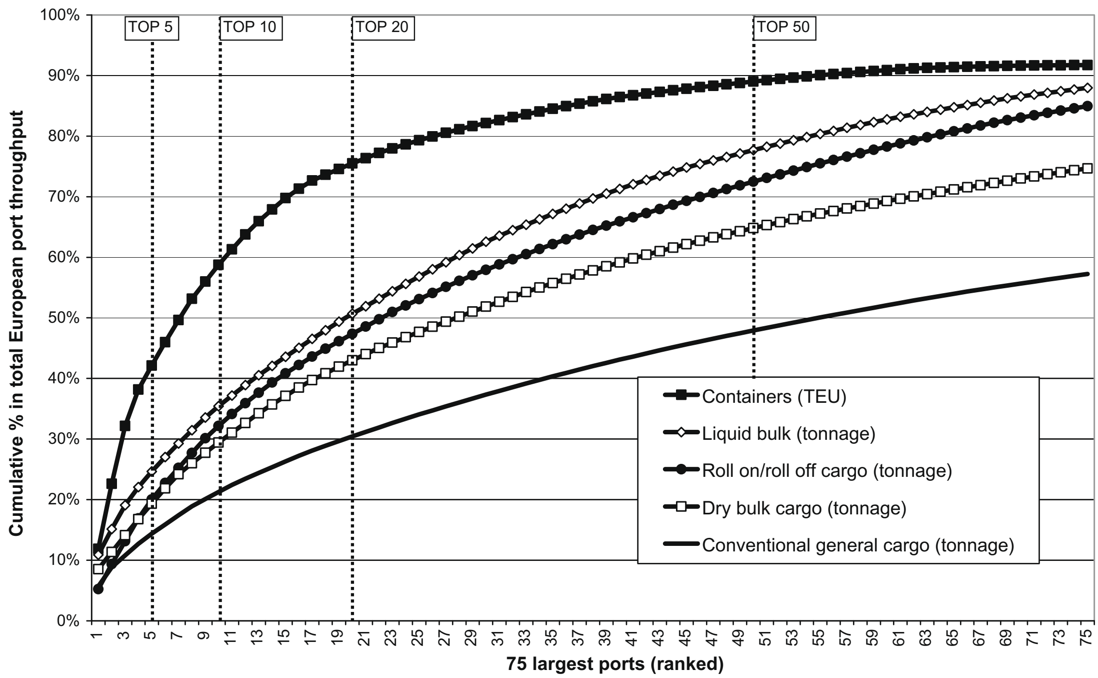

Fig. 5. Cumulative market share of the top 75 ports in each cargo segment (figures for 2008). *Source*: Own elaboration based on base traffic figures from ESPO/ITMMA and respective port authorities.

5. Current issues with respect to competition in and between gateway regions

5.1. The immediate hinterland as the backbone for port rivalry in gateway regions

While corridor development to distant hinterlands attracts more and more attention, local or immediate hinterlands remain the backbone of ports' cargo bases. Even large European gateways such as Rotterdam and Antwerp have a high proportion of container flows that is generated by the port city and its immediate surroundings. Some 40% of containers leaving or arriving in Antwerp by truck are coming from or going to markets within a radius of 50 km of the port. The most significant distance class for Rotterdam is the 150–200 km radius. This is directly related to the port's role as a cargo-generating location linked to the strong manufacturing base of the immediate hinterland (the Netherlands and the Ruhr area in Germany). Catalonia generates significant flows for Barcelona. Port traffic in Ligurian ports to a large extent is dependent on the North-Italian hinterland. Gothenburg has largely based its traffic position on the industrial base in southern Sweden. The importance of the local/national hinterland is further underlined by Fig. 6. About 89% of the land transport flows out of Le Havre are linked to France. About half of the land-based container flows of the Belgian ports of Zeebrugge and Antwerp has an origin or destination in Belgium, while Germany represents more than three quarters of the land-based container volumes of Hamburg (83% in 2004 and 78% in 2007) and Bremerhaven. In 2007, the region Hamburg alone generated 17.8% of the total land-based containerized cargo flows of the port of Hamburg. The Dutch hinterland generates 38% of Rotterdam's total rail/truck/barge flows.

The importance of the local hinterland in ports' cargo bases is the result of the large consumption and production centres (e.g. automotive clusters, petrochemical clusters) surrounding Europe's major ports. It is also a result of emerging logistics poles consisting of a set of gateway ports and logistics zones in the immediate hinterland. The geographical concentration of logistics companies creates synergies and economies of scale, which make the chosen location even more attractive and encourage a concentration of distribution companies in a particular area. Regional trunk lines enhance the location of logistics sites in seaports and inland ports and along the axes between seaports and inland ports. Seaports are the central nodes driving the dynamics in such a large logistics pole. But at the same time seaports rely heavily on inland ports to preserve their attractiveness. The geographical concentration of logistics sites stimulates the development of inland terminals. The corridors towards the inland terminal network can create the necessary margin for further growth of seaborne container traffic in the ports. Inland terminals as such acquire an important satellite function with respect to ports. The rise of inland ports (Roso et al., 2009) and associated logistics corridors enhanced port regionalization processes (Notteboom and Rodrigue, 2005). Market players such as logistics service providers, terminal operators and shipping lines have massively developed inland logistics concepts (see e.g. Rodrigue and Notteboom (2009) on the concepts of 'extended gates' and 'terminal operator haulage'). While most port authorities leave it up to market players to develop inland terminals and to create logistics zones along inland corridors, the attitude of larger load centres seems to be changing. The port authorities of Rotterdam, Barcelona, Le Havre, Marseille, Antwerp and Lisbon all are actively enhancing processes of port regionalization. The increased focus on the hinterland gave impetus to specific coordination mechanisms among stakeholders (van der Horst and de Langen, 2008) and hinterland access regimes (de Langen and Chouly, 2004) in ports around Europe.

A port's geographical distribution of container cargo differs with the transport mode considered. For most ports, inland barge volumes are strongly concentrated on the respective main waterway axes, i.e. 92,000 TEU on the Elbe in relation to Hamburg in 2007, 53,500 TEU on the Weser to/from Bremerhaven, 60,000 TEU on the Rhône to/from Marseille, 159,000 TEU on the Seine to/from Le Havre and about 15,000 TEU on the Danube to/from Constanza. The main European barging ports Rotterdam (2.44 million TEU in

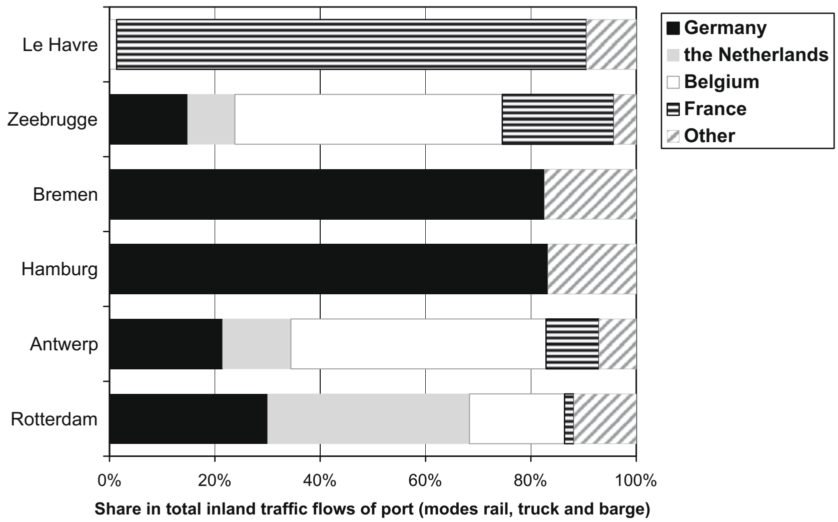

Fig. 6. The hinterland distribution of containerized cargo by road, rail and barge in the main container ports of the Le Havre–Hamburg range – figures for 2004. *Source*: Own elaboration based on data compilation.

2007) and Antwerp (2.2 million TEU in 2007) show a more diverse distribution of containerized flows: the axis Antwerp–Rotterdam, the Rhine Basin, Northern France and the Benelux. The specific cost structure of rail shuttles (i.e. pre- and or end-haul costs by truck and a large share of handling costs in total railing cost) means that rail-based flows tend to penetrate deeper in the hinterland than road-based flows. The leading European rail port Hamburg provides a good example. While Germany generates about 80% of Hamburg's land-based flows, German volumes represent about 60% of Hamburg's total rail volume of 1.89 million TEU in 2007 (figures Hamburg Port Authority). A major concern in many ports is the strong reliance of more local container volumes on trucks. While road haulage has always played a major role in shaping competition among load centres of the same multi-port gateway region for the immediate hinterland, intermodal transport is slowly but surely acquiring a strategic role as well, particularly as a means to create so-called 'cargo islands' in the immediate hinterland of rival ports (see Notteboom and Rodrigue (2005) for a discussion). Logistics sites in the immediate hinterland typically greatly value the flexibility a multi-port gateway region offers in terms of available routing options for import and export cargo. In a logistics world confronted with mounting reliability and capacity issues, routing flexibility is a keystone for the logistics attractiveness of a region. For example, the logistics attractiveness of large parts of Belgium and the Netherlands for the location of European distribution centres (EDCs) is partly due to the existence of and high connectivity in several efficient gateways in the Rhine–Scheldt Delta.

A large portion of the container flows by road are destined for EDCs or other logistics centres in the immediate hinterland of seaports. Containers arriving in these EDCs are typically stripped and after some value adding manipulations the cargo is regrouped to reach the final destinations – even in the more distant hinterland – by truck in a conventional non-containerized form. As such, the penetration level (in terms of distance) of road haulage in the hinterland transport of containerized cargo of the ports tends to be higher than suggested by the traffic volumes in Fig. 6. The dominance of Belgium, the Netherlands and Northern France in accommodating EDCs is one of the reasons why 27% of the total container throughput of the European container port system is routed via the Rhine–Scheldt Delta. Any major changes in the design of distribution networks, e.g. through a move of EDCs to other regions or a network redesign towards a system of Regional Distribution Centres (RDCs) can have an impact on the distribution of container flows among multi-port gateway regions.

5.2. Gateway regions increasingly vie for distant contestable hinterlands

Despite the importance of the local hinterland, port competition in Europe has intensified as inland corridor formation has allowed load centres to access formerly captive hinterlands of other ports. Existing dense networks of direct rail and barge shuttles to nearby destinations are complemented by indirect inland services to more distant destinations built around one or more inland hubs. Extensive cargo concentration on a few trunk lines opens possibilities to economies of scale in inland shuttles (through the deployment of longer trains or larger inland barges) but even more likely to higher frequencies. Containers for the more distant hinterland benefit from a port's strong local cargo base as local containers often provide the critical mass for allowing frequent deepsea liner services.

The rise of economic centres in the Baltic area and the Latin arc (stretching along the coastline from southern Spain to Northern Italy) has created opportunities for several multi-port gateway regions and stand-alone gateways to develop water-based and land-based transport networks to these areas. Up to now, Northern ports, in particular Hamburg, have benefited the most from the latest wave in EU enlargement, whereas new development opportunities might arise for port systems in the Adriatic, the Black Sea (Constanza in particular) and the Baltic Sea. The Czech Republic, Poland, Slovenia and Hungary have strong rail networks while road networks in Eastern Europe are less well developed.

Large contestable hinterlands are increasingly being served not only by the ports of one gateway region, but by several multi-port gateway regions (Table 4). The multiplication of corridors brings about a change in the relationship between gateways and their hinterland. On the one hand, the inland penetration strategy is part of maritime gateways' objective of increasing their cargo base. On the other hand, interior regions are recognizing that it is in their interest to establish efficient links to as many gateways as possible. For example, the Czech Republic is upgrading its trans-European travel corridors intensively (in particular, the corridor four connecting Germany with South-Eastern Europe). This strategy not only prevents these regions from becoming captive to one specific gateway, it also improves the location qualities of these interior economic centres. Hence, the linking up to more gateways implies

Table 4
The position of major multi-port gateway regions vis-à-vis important contestable hinterland areas in Europe.

	Core hinterland regions (estimated share in total land-based container flows between brackets)	Major battle hinterlands					
		West-Germany (∗)	South Germany (Bavaria) Alpine countries	Madrid and surroundings	Southern Poland Czech Republic Hungary	Northern Italy	Southern France
Rhine–Scheldt Delta	Benelux (59%) West-Germany (∗) (23%)	++	++	–	+(Rott.)/°	+(rail)	+(Antw.)/–
Helgoland Bay	North-Germany (∗∗) (47%) West-Germany (∗) (17%) Bavaria (12%)	++	++	–	++	+	–
Spanish Med	Catalonia Madrid and surroundings			++			–/+ (Barc.)
Ligurian Range	Northern Italy		×/°			++	×
Seine Estuary	Northeast France (70%)	°	–				+
Black Sea West	Romania/Bulgaria		°		°/+		
Portuguese Range	Portugal			°			
North Adriatic	Northeast Italy/Croatia		×/°		×/°	++	
Gdansk Bay	Poland				×/°		

++ = Core hinterland region for gateway region, successful intermodal services.
+ = Rather important hinterland region for gateway region, successful intermodal services.
× = Potentially major hinterland region for gateway region, but success limited.
– = Minor hinterland region for gateway region.
° = Potential hinterland region for gateway region, intermodal services planned or started-up recently.
(∗) Includes the states Rheinland-Pfalz, Hessen, Nordrhein-Westfalen, Baden-Wiirttemberg, Saarland.
(∗∗) Inludes Schleswig–Holstein, Hamburg, Bremen, Niedersachsen, Berlin, Mecklenburg–Vorpommern, Brandenburg, Sachsen-Anhalt.

more routing options and flexibility for shippers and logistics service providers who want to set up business in the region.

5.3. The north–south balance in perspective

The dominance of ports in the Le Havre–Hamburg range (particularly the Rhine–Scheldt Delta and the Helgoland Bay ports) in Europe is very apparent when looking at throughput statistics. This observation fuels a decades-old debate on what some observers call the traffic imbalance between north and south. After a period of strong Med growth, the throughput gap between the Le Havre–Hamburg range and the Med ports has been widening over the last 5 years, as demonstrated earlier in this paper. The increasing participation degree of mainland Mediterranean ports in international shipping networks has not resulted in significant traffic shifts from the north to the south. The joint market share of the Le Havre–Hamburg range ports in liner services between the Far East and Europe is estimated at 76%, compared to 24% for West Med ports (Mila, 2008). In the 1980s the Europe–Far East trade was still totally concentrated on Northern range ports. The more local gateway function of mainland Med ports versus a sometimes European wide gateway position (including transhipment flows and land-based intermodal corridors) of ports such as Hamburg, Rotterdam and Antwerp is a major cause for the observed traffic situation.

However, the 'north versus south' discussion does not capture the existing divergence in the development of multi-port gateway regions in both parts of Europe. Hence, not all port regions in the Med are lagging behind the growth path of the Le Havre–Hamburg range (i.e. the Spanish ports are the major winners, while the Ligurian ports and some stand-alone gateways such as Marseille lose market share), and not all port regions in the Le Havre–Hamburg range show a very strong growth path (e.g. the Seine Estuary is losing market share).

In theory, mainland Mediterranean ports offer transit time advantages over the North European ports for accommodating cargo flows between Asia/Middle East and large parts of Southern and Central Europe (time savings for vessels of up to 5 days). In practice, only Spanish Med ports have been successful in large part due to the strong economic growth in Catalonia and Madrid, while Italian and French Med ports lag behind in growth. Italy is somewhat a special case for intra-med trade. While France and Spain are mainly involved in North–South trade, Italy could also represent a gateway for trades with Eastern Europe (Ferrari et al., 2006). However, Cazzaniga and Foschi (2002) demonstrate that North Italian ports collect only a very small portion of the merchandise of the area extending from Bavaria to Hungary. Even worse, significant flows of Italian cargo do not sail from Italian ports but from ports in the Rhine–Scheldt Delta and the Helgoland Bay. There is improvement though. Cazzaniga and Foschi (2002) indicate that North Italian ports increased their market share in total Northern Italian container flows on the Far East trade from 70% in 1995 to 81% in 2001 compared to a reduction of the market share of the Northern ports from 30% to 19% (no recent figures are available). About half of the latter flows (Northern Europe–North Italy) is going by rail (a share that is still increasing) and the remainder by truck. Note that rail has a market share of 25% in Genoa and La Spezia. The percentages of cargo shipped via Northern Europe are thus showing a tendency to decrease, but some observers argue this process is far too slow considering that many shipping lines now have direct mainline vessel calls in the Med.

Gateway ports in the west Med have gained a much better connectivity in the global shipping networks than before, which gives these ports the opportunity to benefit from a higher critical mass and economies linked to larger vessels. But so far, they seem to have difficulties in substantially extending their hinterland reach north through rail services (Gouvernal et al., 2005). While Spanish ports face a major technical problem in setting up rail shuttles to France (i.e. difference in rail gauge), the north–south paradox for North-Italian cargo is mainly linked to a weaker intermodal organizational performance for intra-Italian rail products, and existing (but converging) differences in port efficiency between Northern ports and North Italian ports. Moreover, a smaller critical rail volume means that frequent rail services are hard to maintain and sometimes disappear soon after introduction.

Several initiatives are underway with the objective of improving the position of the Med ports. Next to major terminal expansion plans in ports such as Barcelona, Valencia, Marseille and Genova, West Med ports' investment strategies include a range of logistics platforms both in seaports and in strategic inland locations (e.g. the 'terminal maritima' or tm-concept of the Barcelona port authority), but at the moment these inland operations are mostly modest generating only small volumes. To attract Asian trade distribution to the region, the ports of Barcelona, Marseilles and Genoa have joined their marketing efforts under the umbrella of the association Intermed. The range of actions also includes corridor formation. Next to south–north corridors (mainly rail) included in TEN-T program of the European Commission, the FERRMED association aims at the development of a reticular and polycentric railway axis reaching from the southern part of Spain all the ways to the core economic regions in the Benelux and Germany and further north to Stockholm. The FERRMED axis wants to offer an alternative to the high-volume Rhine–Rhône-Occidental Mediterranean axis.

All these initiatives are taken in a market environment with northern range ports also very active in intensifying their intermodal networks, mainly to inland service areas in France, Germany, the Alpine region and East and Central Europe. The range and diversity of the intermodal service offer of the large load centres in the north is still far bigger and more established than their Mediterranean counterparts. As it is highly unlikely this gap is going to be bridged in the foreseeable future, the traffic position of northern load centres in south European container markets remains a market-driven reality.

To add to the complexity, it is worth mentioning that the competitive position of a port vis-à-vis a specific hinterland region cannot always be narrowed down to cost and quality factors only. Historical (the so-called 'memory' effect), psychological, political and personal factors can result in the routing of flows that diverges from a perfect market-based division. Particularly large established European load centres benefit from decades of preferential attachment processes both at the level of market players, and at the level of political and public support. This mechanism supports a strong belief in their future growth potential and attracts massive investments from public authorities and private port players, even slowing down the tendency towards a peripheral port challenge phase. Incorrect and incomplete market information on the possible alternative routes available to chain managers and shippers results in 'bounded rationality' in the transport chain design, leading to sub-optimal decisions. Shippers sometimes impose bounded rational behavior on freight forwarders and shipping lines, e.g. in case the shipper asks to call at a specific port or to use a specific land transport mode. Opportunistic behavior of economic actors or informal commitments to individuals or companies might lead to non-cost minimizing decisions. Also, some customers might not consider using other ports or other transport modes because they assume that the mental efforts (inertia) and transactions costs linked to transferring activities to other ports or modes do not outweigh the direct and indirect logistics costs connected to the current non-optimal solution.

5.4. Transhipment hubs under scrutiny and its impact on inland freight distribution

Not all ports in Europe are gateways. Marsaxlokk on Malta, Gioia Tauro, Cagliari and Taranto in Italy and Algeciras in Spain act as turntables in a growing sea–sea transhipment business in the region. Terminals at transhipment hubs are typically owned, in whole or in part, by carriers which are efficiently using these facilities. The sites were selected to serve continents, not regions, for transhipping at the crossing points of trade lanes, and for potential productivity and cost control. They are typically located far away from the immediate hinterland that historically guided port selection.

The market share of transhipment hubs in total European container throughput peaked in 2005 (12.2%) but since then started to decline to 11.4% as volume growth in mainland ports allowed shipping lines to shift to direct calls. While some shipping lines still rely on the hub-and-spoke configuration in the Med, others decided to add new line-bundling services calling at mainland ports directly. Maersk Line, MSC and CMA-CGM are modifying their service patterns, giving increasing priority to gateway ports. In reaction, mainly Italian transhipment hubs are reorienting their focus, now serving Central and East Med regions. Algeciras (stronghold of APM Terminals of the AP Moller Group) relies a lot on east–west and north–south interlining and is facing competition from newcomer Tanger Med in Morocco where APM Terminals has also set up business recently. The net result of the above developments has been a slight decline in the market share of the West Med hubs

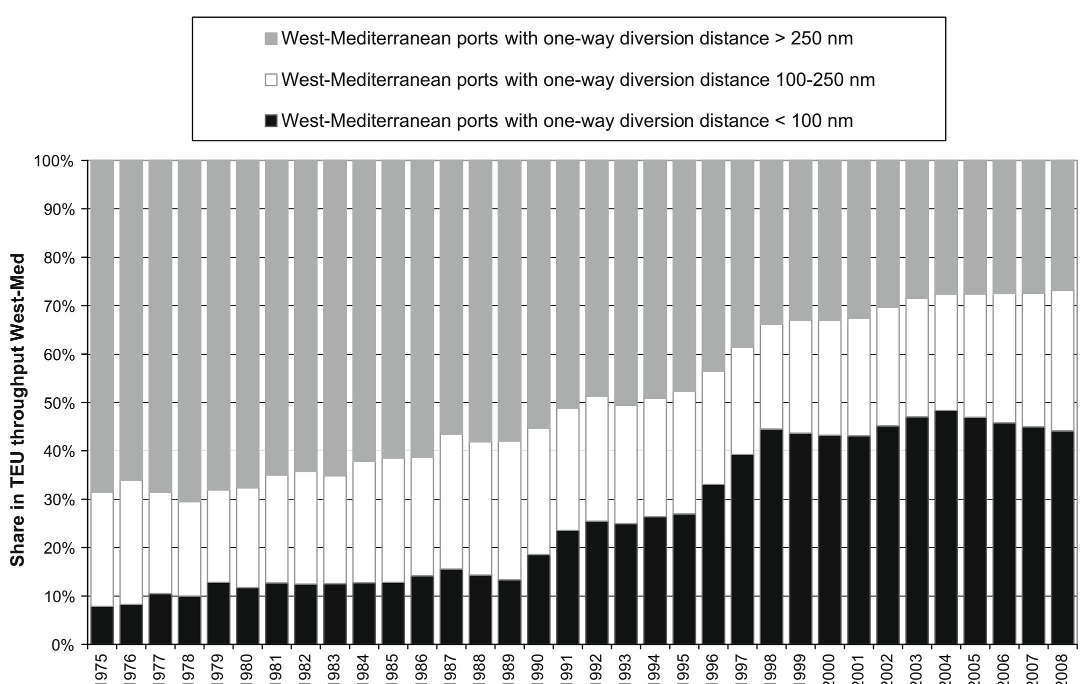

Fig. 7. The market shares of ports in the West Mediterranean. Ports grouped according to the diversion distance from the main shipping route (1975–2008). *Source*: Own elaboration based on data respective port authorities.

in recent years (Fig. 7). The transhipment business remains a highly 'footloose' business. This has led some transhipment hubs such as Gioia Tauro and Algeciras to develop inland rail services to capture and serve the economic centres in the distant hinterlands directly, while at the same time trying to attract logistics sites to the ports.

In Europe, hubs with a transhipment incidence of 85% to 95% can only be found in the Med. Northern Europe does not count any pure transhipment hub. Hamburg, the North-European leader in terms of sea–sea flows, has a transhipment incidence of about 45%, far below the elevated transhipment shares in the main south European transhipment hubs (Fig. 8). Barcelona and Valencia are among the large Med ports combining an important gateway function with significant transhipment flows, i.e. a transhipment incidence of respectively 38.8% and 43.9% in 2008. Sea–sea transhipment in UK ports represented only 7% of total lolo (load on/load off) throughput in 2004.

The connectivity of the Baltic region to overseas trading areas primarily relies on feeder services to hub ports in the Le Havre–Hamburg range. The existing symbiotic relationship between the Baltic port system and the main ports in the Le Havre–Hamburg range (Hamburg and Bremerhaven in particular) is a prime example of how ports in different regions can actively deploy their mutual dependence. In the last couple of years, terminal development in the Baltic Sea is characterized by scale increases in terminal surfaces and equipment. For example, the terminals in Poland are equipped to handle relatively large container vessels, notwithstanding the fact that a very substantial share of the ports' container volumes is feedered from the Le Havre–Hamburg range. Baltic ports are gearing up to welcome more direct calls of mainline vessels. This is particularly felt in the port system at the entrance of the Baltic (Kattegat/The Sound). Ports like Gothenburg and Aarhus are already acting as regular ports of call on quite a few intercontinental liner services. While these ports have a good position to act as turntables for the Baltic on many trade routes, the insertion of these ports as regular ports of call on the Europe–Far East trade remains uncertain. The large vessel sizes deployed on this route, the associated reduction in the number of ports of call and the additional diversion distance make regular direct calls to the multi-port gateway region Kattegat/The Sound less viable compared to other trade routes. A similar type of discussion on the hub-feeder option versus the direct call option applies to other port regions in Europe such as the UK port system and the Adriatic port system.

The dynamics in the transhipment business have implications on freight distribution patterns in Europe. A hub-and-spoke based network means less cargo concentration in mainland destination ports and as such a more dispersed or fragmented inland transport system. Alternatively, traffic growth can lead to an undermining of the position of transhipment hubs in favor of a limited number of large-scale mainland ports, each connected to intermodal corridors.

5.5. The challenge of the periphery

Many gateway regions in Europe have witnessed a recent multiplication of load centres or will witness a multiplication in the future. The 'challenge of the periphery' concept supports this transition of a single gateway situation to a multi-port gateway region. The main challengers in each gateway region are listed in the last column of Table 5.

Forces that support the entry of newcomers include: (a) the new requirements related to deep-sea services (e.g. good maritime and inland accessibility, availability of terminal and back-up land and short vessel turnaround times), (b) the past strong growth in the container market and (c) potential diseconomies of scale in the existing seaports in the form of lack of space for further expansion or congestion. The markets also exert a range of forces favouring a sustained strong position of established large load centres vis-à-vis medium-sized and new terminals. First, the planned additional terminal supply in small and medium-sized ports is typically overshadowed by massive expansion plans in established larger seaports. Second, new entrants in the terminal market often have to overcome major issues such as securing hinterland services and a weaker cargo-generating and cargo-binding potential, typically as a result of a lack of associated forwarders' and agents' networks. New transhipment hubs generally face less of these problems given their remote locations, their weak reliance on

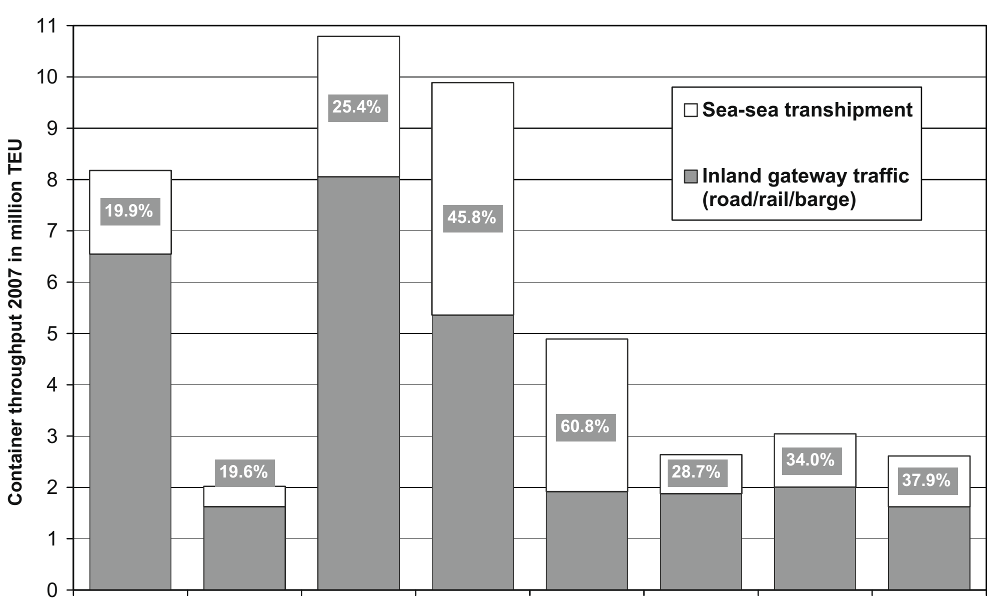

Fig. 8. Inland gateway traffic and sea–sea transhipment in a selection of ports with a significant combined gateway–transhipment function (figures 2007). *Source*: Based on data of respective port authorities.

Table 5
Market share of the leader port in each multi-port gateway region (in %).

	1985	1995	2005	2008	Trend for market share of leader	Main challengers in the periphery
Extended RS Delta	61.6	61.2	53.0	48.2	Decreasing, leader unchanged (Rotterdam)	Zeebrugge (+), Amsterdam (−) Flushing (°/?), Dunkirk (−)
Helgoland Bay	54.0	65.2	68.1	63.8	Fluctuation, leader unchanged (Hamburg)	Wilhelmshaven (°), Cuxhaven (x)
UK SE Coast	48.1	54.3	47.5	48.7	Fluctuation, leader unchanged (Felixstowe)	London Gateway (°), Bathside Bay-Harwich (°) Dibden Bay (X), Teesport (?), Great Yarmouth (°)
Spanish Med	52.2	49.3	53.7	57.9	Recent increase, change in leader (Valencia overtook Barc.)	–
Ligurian Range	48.2	47.1	46.1	43.7	Decreasing, change in leader (Genoa overtook La Spezia)	–
Seine Estuary	80.8	89.0	92.9	94.6	Increasing, leader unchanged (Le Havre)	–
Black Sea West	n.a.	68.6	85.2	87.8	Increasing, leader unchanged (Constanza)	–
Kattegat/The Sound	59.9	46.8	53.2	48.0	Fluctuation, leader unchanged (Gotheborg)	–
South Finland	n.a.	60.3	41.0	44.2	Fluctuation, change in leader (Kotka overtook Helsinki)	Kotka (+)
Portuguese Range	57.9	58.4	56.0	44.9	Recent decrease, leader unchanged (Lisbon)	Sines (+)
North Adriatic	50.5	41.3	34.8	29.8	Decreasing, change in leader (Venice overtook Ravenna)	Trieste (+), Koper (+)
Gdansk Bay	100.0	99.6	85.1	76.7	Decreasing, leader unchanged (Gdynia)	–
Med transhipment hubs	89.3	67.5	35.3	34.1	Decreasing, change in leader (Gioia Tauro overtook Algeciras)	

(+) (Some) terminal(s) already in operation; strong results.
(−) (Some) terminal(s) already in operation; moderate results.
(°) Terminal under construction.
(?) No container terminal yet, planning phase.
(x) Container terminal was planned, but plans abandoned or rejected.

hinterland connectivity and their strong link with one or few shipping line(s) that will use the facilities as turntables in their liner networks (i.e. an operational push instead of market pull).

The hinterland connectivity issue deserves special attention. Large load centres to a greater or lesser extent experience a virtuous cycle. The concentration of large deepsea container volumes in one place makes it easier to build up an extensive network of intermodal services and this in itself attracts even more cargo (partly triggered by economies of scale and density). Small-scale container ports often lack volumes to develop a network of frequent shuttle trains. This in itself can contribute to a perceived lower attractiveness of the port. In view of escaping this imminent vicious cycle, smaller ports tend to shuttle substantial container flows to larger ports in the region (inter-port traffic) in view of linking up to the extensive hinterland network available there. The development of inland hubs in the immediate hinterland opens opportunities for smaller ports to use the extensive hinterland networks even without having to rely on the established load centres directly. The inclusion of such bundling points in the hinterland thus promotes the formation of a multi-port gateway region and increases the complexity and range of possible routing patterns. The minimum cargo volume needed to set up a network of direct shuttles is affected by the level of cargo dispersion in the service area of the port. A port that only serves a dense local economic cluster will obviously face less difficulty in developing a regular inland service than a port handling containers for a large number of final destinations dispersed over a vast hinterland.

5.6. The position of upstream container ports

With a growing demand for a good nautical accessibility and a fast turnaround time for the ever larger container vessels one could assume that the days for upstream ports are counted (Baird, 1996). While in the Med, transhipment hubs with a low diversion distance have succeeded in gaining a position in the market, the North European port system seems to have been going another direction. Large upstream ports, i.e. basically Antwerp and Hamburg, have gradually gained market share at the expense of coastal ports (see Fig. 9). Since 2003, however, the share has stabilized at around 46%, mainly due the rise of Zeebrugge, the recent revival of Le Havre and a regained growth path in Rotterdam after several years of stagnation.

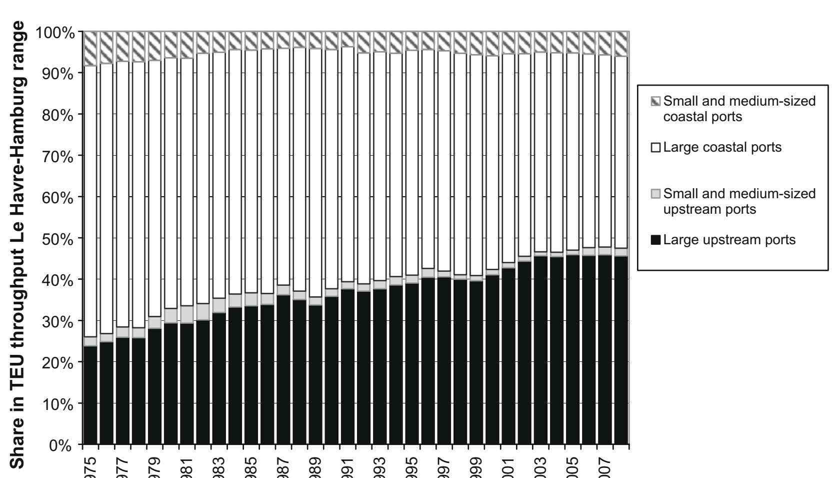

Fig. 9. Evolution of the market shares in the Le Havre–Hamburg range. *Source*: Own elaboration based on data respective port authorities.

Table 6
Port throughput decline in a number of European container ports.

	Volume in 2008 (in 1000 TEU)	Volume changes in 2009 compared to 2008
Rotterdam–Netherlands	10,784	−9.6%
Antwerp–Belgium	8664	−15.6%
Zeebrugge–Belgium	2209	+5.4%
Hamburg–Germany	9742	−28.0%
Bremerhaven–Germany	5448	−16.3%
Le Havre–France	2501	−10.4%
Marseille–France	848	+5.0%
Algeciras–Spain	3324	−8.5%
Barcelona–Spain	2569	−29.9%
Valencia–Spain	3597	+1.6%[a]
St-Petersburg–Russia	1970	−30.0%

[a] Positive growth in Valencia is mainly the result of shipping line MSC which is rapidly developing Valencia into one of their main Med hubs.

Although the discussion on downstream versus upstream load centres cannot be generalized, there still exists a competitive potential for upstream ports in Northern Europe. First of all, there is a growing gap between inland transport costs and maritime freight costs. The price difference per FEU-km (40 foot Equivalent Units) between inland transport and long-haul liner shipping ranges from a factor 5 to a factor 30. Shipping rates typically range between 0.05 and 0.19 euro per FEU-km. The price for inland haulage per truck from North European ports usually ranges from 1.5 to 4 euro per FEU-km depending on distance and weight. By barge the price ranges between 0.5 and 1.5 euro per FEU-km (excluding handling costs and pre- and end-haul by truck). This price gap supports direct calls at an upstream port, certainly in case the port's immediate hinterland has a strong cargo-generating power (as is the case for Antwerp and Hamburg) and in case the upstream port succeeds in outperforming downstream ports in terms of terminal productivity, prices and integrated value-added services, all this in order to compensate for the extra sailing time. Draft limitations remain the worst threat to the position of upstream ports mainly on the Europe-Far East trade. Both Antwerp and Hamburg have responded to the realities in the liner market by engaging in extensive dredging programs to guarantee access for the largest generation of post-panamax vessels.

The future outlook for upstream ports will largely depend on the balance of power between the 'cargo follows ship' principle versus the 'ship follows cargo' principle. Shipping lines are massively prepared to call at upstream ports Antwerp and Hamburg in large part because of their high cargo-generating performance and the savings they can make in onward inland transportation distances. This demonstrates the design of liner services is not only function of carrier-specific operational factors, but also of shippers' needs (for transit time and other service elements) and of shippers' willingness to pay for a better service. However, upstream ports are expected to face increasing competition from coastal ports for accommodating sea–sea transhipment flows, a development reinforced by the 'challenge of the periphery' phase in many multi-port gateway regions.

6. Conclusions

This paper provided an update of an earlier analysis of Notteboom (1997) on the dynamics in the European container port system. Container port hierarchy and competition in Europe has become highly complex and dynamic due to structural changes in logistical, economic, institutional and regulatory settings which were outlined in this paper. European ports are increasingly functioning not as individual places that handle ships but within supply chains and networks. Market players show an increased network orientation and aim to maximize network effects and synergies.

The dramatic changes in ports' environment that have taken place since the analysis of Notteboom (1997) have had an impact on the observed tension between cargo concentration and cargo deconcentration in the European port system. While the load centre concept has merit from the shipping line viewpoint, the prevailing assumption that containerization would lead to further port concentration is not a confirmed fact in Europe. An increasing number of European ports are present on the competitive scene. Moreover, large differences in growth patterns can be observed among multi-port gateway regions. Notwithstanding observed gradual deconcentration processes, the container handling market remains far more concentrated than other cargo handling segments in the European port system, as there are strong market-related incentives for maintaining a relatively high cargo concentration level in the container sector. Out-of-pocket costs alone are not sufficient to understand the current routing of containerized goods in Europe. Comodal bundling effects, connectivity effects and aggregated service quality effects at specific gateway ports mean that a 'natural' gateway for a certain hinterland region is not necessarily the port closest to that hinterland region.

Cargo bundling on trunk lines is shaping the hinterland access of multi-port gateway regions and major stand-alone gateways. A certain level of traffic concentration in a seaport system is required in order to allow a virtuous cycle of modal shifts from road haulage to high-volume transport modes such as rail, barge and shortsea shipping. Europe's long coastline and its specific geographical characteristics are clear invitations to further develop shortsea and feeder networks based on mutual dependence among ports in the same and different regions.

We have demonstrated that local or immediate hinterlands remain the backbone of ports' cargo bases. Functional sets of gateway ports are driving the dynamics in large logistics poles. The creation of these poles poses new challenges in the relations between seaports and inland ports. The challenge remains to increase the share of co-modal solutions and to bundle cargo on short distances. The significant role of local hinterlands to ports' traffic bases and the existing functional interactions between gateway ports and inland centres in regionally-based logistics poles have become important structuring elements in the European transport network.

In a logistics world confronted with mounting reliability and capacity issues, routing flexibility is a keystone for the logistics attractiveness of a region. Interior regions are recognizing that it is in their interest to establish efficient links to more than one gateway or even more than one multi-port gateway region. The linking up to more gateways implies more routing options and flexibility for shippers and logistics service providers who want to set up business in these regions. This process fuels competition for distant hinterlands between multi-port gateway regions. The need for a high level of flexibility is also reflected in the complex networks designed by logistics actors and transport operators.

The success of the port is strongly affected by the ability of the port community to fully exploit synergies with other transport nodes and other players within the logistics networks of which they are part. This observation demands closer coordination with logistics actors outside the port perimeter and a more integrated approach to port infrastructure planning. Individual ports are or should be increasingly benefiting from potential port synergies at the level of multi-port gateway regions. This includes port regionalization processes, coordination actions and the establishment of hinterland access regimes. Port authorities can be catalysts in improving the port-hinterland interface and the structuring of hinterland networks, even though their direct impact on the routing of cargo flows is limited.

The last year of observation in this paper is 2008. In late 2008 a rapidly emerging credit crisis originating in the US caused devastation in the world economy and port systems around the world. Container throughput figures of European container ports in 2009 typically were 10% to 20% lower compared to 2008 (Table 6). At the time of writing this paper, it was still too early to fully assess the structural ramifications of the crisis on port hierarchy and competition in Europe. Reconfigurations in liner service networks already led to traffic changes (mostly negative) for the concerned ports. The resulting cargo consolidation meant that larger ports and their more developed hinterland transport systems seemed to be in a better position than small and medium-sized ports. There are signs that the drop in volumes might also lead to an increased geographical specialization of gateway ports vis-à-vis specific overseas maritime regions. For example, shipping lines have started to consolidate most of their vessel calls on the Far East–North Europe trade in Rotterdam and Hamburg, which historically have a strong orientation on Asian cargo. The crisis has also freed up much needed capacity in ports and in inland corridors, thereby relieving load centres which previously were heavily affected by severe capacity constraints. It is however not entirely clear at this point to what extent a sustained decline in traffic will affect cargo concentration patterns in Europe and might lead to a paradigm shift. This paper provided an analysis of port hierarchy and competition under conditions of high volume growth in the European port system. In a few years time, we will be able to compare the concentration dynamics in a high growth market (till 2008) with port hierarchy dynamics under a scenario of market decline, stagnation or at best modest growth. Such a follow-up study will shed a new and interesting light on how the European container port system behaves under diverging market conditions.

Appendix A

Mathematically the components of the shift–share analysis can be calculated as (Notteboom, 1997):

$$\mathrm{ABSGR}_i = \mathrm{TEU}_{it_1} - \mathrm{TEU}_{it_0} = \mathrm{SHARE}_i + \mathrm{SHFT}_i$$

$$\mathrm{SHARE}_i = \left(\frac{\sum_{i=1}^{n}\mathrm{TEU}_{it_1}}{\sum_{i=1}^{n}\mathrm{TEU}_{it_0}} - 1\right)\cdot \mathrm{TEU}_{it_0}$$

$$\mathrm{SHFT}_i = \mathrm{TEU}_{it_1} - \frac{\sum_{i=1}^{n}\mathrm{TEU}_{it_1}}{\sum_{i=1}^{n}\mathrm{TEU}_{it_0}}\cdot \mathrm{TEU}_{it_0}$$

with ABSGR_i is the absolute growth of container traffic in port i for the period $t_0 - t_1$, expressed in TEU, SHARE_i the share-effect of port i for the period $t_0 - t_1$, expressed in TEU, SHFT_i the total shift of port i for the period $t_0 - t_1$, expressed in TEU, TEU_i the container traffic of port i, expressed in TEU, n is the number of ports in the container port system.

The share-effect reflects the expected growth of container traffic in a seaport as if it would simply maintain its market share and as a consequence would evolve in the same way as the port range as a whole (same growth rate as the range). The net shift reflects the total number of containers (c.q. TEU) a port has actually lost to or won from competing ports in the same range with the expected container traffic (share-effect) as a reference. The sum of the shift-effects of all ports considered equals zero. Periods characterized by high net volume shifts refer to a considerable degree of dynamics and competition within the container port system. The following mathematical expressions were used to calculate the net volume of the shift-effects between (inter) and within (intra) the different port ranges or multi-port gateway regions:

$$\mathrm{VOLSHFT}_{\mathrm{total}} = \frac{\sum_{i=1}^{n}|\mathrm{SHFT}_{ij}|}{2} = \mathrm{VOLSHFT}_{\mathrm{intra}} + \mathrm{VOLSHFT}_{\mathrm{inter}}$$

$$\mathrm{VOLSHFT}_{\mathrm{inter}} = \sum_{j=1}^{m}\left(\frac{|\sum_{i=1}^{r}\mathrm{SHFT}_{ij}|}{2}\right)$$

$$\mathrm{VOLSHFT}_{\mathrm{intra}} = \sum_{j=1}^{m}\mathrm{VOLSHFT}_{\mathrm{intra}_j} \text{ with } \mathrm{VOLSHFT}_{\mathrm{intra}_j} = \frac{\sum_{i=1}^{r}|\mathrm{SHFT}_{ij}| - |\sum_{i=1}^{r}\mathrm{SHFT}_{ij}|}{2}$$

with $\mathrm{VOLSHFT}_{\mathrm{intraj}}$ is the net volume of TEU shifted between ports of group j, $\mathrm{VOLSHFT}_{\mathrm{inter}}$ the net volume of TEU shifted between ports situated in different port groups, $\mathrm{VOLSHFT}_{\mathrm{total}}$ the total net volume of TEU shifted between container ports in the system, r is the number of ports in group j, n = number of ports in the port system, m = number of port groups in the port system.

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