Competitiveness of Port-Cities: The Case of Marseille-Fos - France

Lucie Billaud, Jasper Cooper, Claude Comtois, Suzanne Chatelier, Léonie Claeyman, César Ducruet, Caroline Guillet, Charlotte Lafitte, Jing Li, Walter Manshanden, et al.

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ABSTRACT

This working paper offers an evaluation of the performance of the port of Marseille-Fos, an analysis of the impact of the port on its territory and an assessment of policies and governance in this field. It examines declining port performance over the last decades and identifies the principal factors that have contributed to it. The effect of the ports on economic and environmental questions is studied and quantified where possible. The value added of the port cluster of Marseille-Fos is calculated and its interlinkages with other economic sectors and other regions in France delineated. The paper outlines the impact of the ports' operations, and shows how their activities spill over into other regions than the one in which the port of Marseille-Fos is located. The major policies governing the ports are assessed, along with policies governing transport and economic development, the environment and spatial planning. These include measures instituted by the port authorities, as well as by local, regional and national governments. Governance mechanisms at these different levels are described and analysed. Based on the report's findings, recommendations are proposed with a view to improving port performance and increasing the positive effects of the port of Marseille-Fos on its territory.

JEL classification: R41, R11, R12, R15, L91, D57

Keywords: ports, regional development, regional growth, urban growth, inter-regional trade, transportation, input/output

FOREWORD

This study is the fourth in a series of case studies within the *OECD Port-Cities Programme*, which attempts to identify the impact of ports on their territories and possible policies to increase the positive impacts of ports on their territories. The report has been realized at the request of different actors, including the *Grand Port Maritime de Marseille-Fos* (GPMM), the *Région Provence-Alpes-Côte d'Azur*, the *Département des Bouches du Rhône*, the *syndicat mixte du Schéma de Cohérence Territoriale Ouest Étang de Berre*, the *Communauté d'agglomération Marseille Provence Métropole*, the city of Marseille, the Chamber of Commerce and Industry Marseille Provence, the *Agence d'Urbanisme de Marseille* and the *Union Maritime et Fluviale.*

This working paper is part of a series of *OECD Working Papers on Regional Development* published by the OECD Public Governance and Territorial Development Directorate. It is the first case study of the *OECD Port Cities Programme*. This paper was written by Olaf Merk (OECD) and Claude Comtois (University of Montreal). It was directed by Olaf Merk and it draws on the work of a number of other contributors, in particular César Ducruet (CNRS – Université de Paris I Panthéon-Sorbonne), Walter Manshanden and Evgueny Poliakov (TNO, Netherlands), Nicolas Winicki, Jing Li, Jasper Cooper, Lucie Billaud, Charlotte Lafitte, Caroline Guillet, Léonie Claeyman and Suzanne Chatelier. Within the framework of this study, interviews with a series of actors and stakeholders have been conducted (Annex 1).

The paper can be downloaded on the OECD website: www.oecd.org/regional/portcities

Further enquiries about this work in this area should be addressed to:

Olaf Merk (olaf.merk@oecd.org) of the OECD Public Governance and Territorial Development Directorate.

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EXECUTIVE SUMMARY

Stagnating port volumes in Marseille-Fos have resulted in declining market shares in all cargo categories. Second European port in the 1970s, Marseille-Fos is now fifth largest port. Especially in containers Marseille-Fos has missed many opportunities to grow: neighbouring Western Med-ports that had similar levels container traffic are now two to four times as large as Marseille-Fos in this segment. However, there are some signs or recovery in container traffic since the implementation of the port reform in May 2011.

Determinants of port competitiveness are not always favourable in Marseille-Fos. Its competitors have more deep sea and short sea connections, could in some cases be considered global hubs and are more efficient. Although Marseille-Fos has for a long time been shielded from competition due to its quasi-monopolistic position, it is now subject to fierce competition from Le Havre and Antwerp for what it once considered its natural hinterland.

Port performance has large regional economic consequences, with approximately 40-45,000 port-related jobs and around € 4 billion of economic value added. In the municipality of Fos half of the employment is related to the port; at the same time it also suffers from high levels of port-related air pollution. Although it is a large port, Marseille is not a leading European maritime services centre.

The port of Marseille-Fos is important for the French economy as a whole. It has a multiplier of 2: one euro of new demand within the port cluster leads to one additional euro of supply in France. A third of this effect takes place in Ile-de-France, 10% in Rhône-Alpes, 6% in the PACA region in which the port of Marseille-Fos is located.

The port has formulated an ambitious target of handling 5 million containers (TEU) in 2030; this is five times more than currently the case. In order to reach these ambitions several of the challenges related to hinterland, maritime connections and port efficiency need to be solved. At the same time, environmental impacts need to be mitigated and a more positive image of the port need to be projected in order to get local support for sustained port growth. The maritime heritage of Marseille could be used as an asset to develop into a European maritime services centre, in parallel with the ambitions of the city and urban agglomeration of Marseille.

The relative underperformance of Marseille-Fos could partly be explained by port governance in France. The current debate on a form of metropolitan government for Marseille could be an opportunity to reflect on the regionalisation of port governance.

RECOMMENDATIONS

- Develop a common long term perspective on the West Basin, in close consultation with stakeholders and relevant actors. Part of this perspective could be the transition from a declining petro-chemical and refineries sector towards a green energy cluster. Considerable preparatory work on formulating a vision for the East Basin has already been carried out, but this needs to be implemented.

- Initiate pro-active commercial port policies, e.g. by engaging in acquisitions or partnerships with strategic foreign ports in emerging markets.

- Resolve port hinterland obstacles and open up new hinterlands, such as rail bypass around Lyon, and the canal Saone-Rhine.

- Invest in port external communication and transparent information in order to get more local support for sustained port growth.

- Develop a concrete action plan to attract international maritime services and headquarters to the metropolitan area of Marseille

- Continue “greening” the port of Marseille-Fos, by developing a comprehensive air quality action plan and introducing shore power for ships

- Reflect on a more regionalised port governance model in parallel with the proposed creation of metropolitan government in Marseille.

1. PERFORMANCE

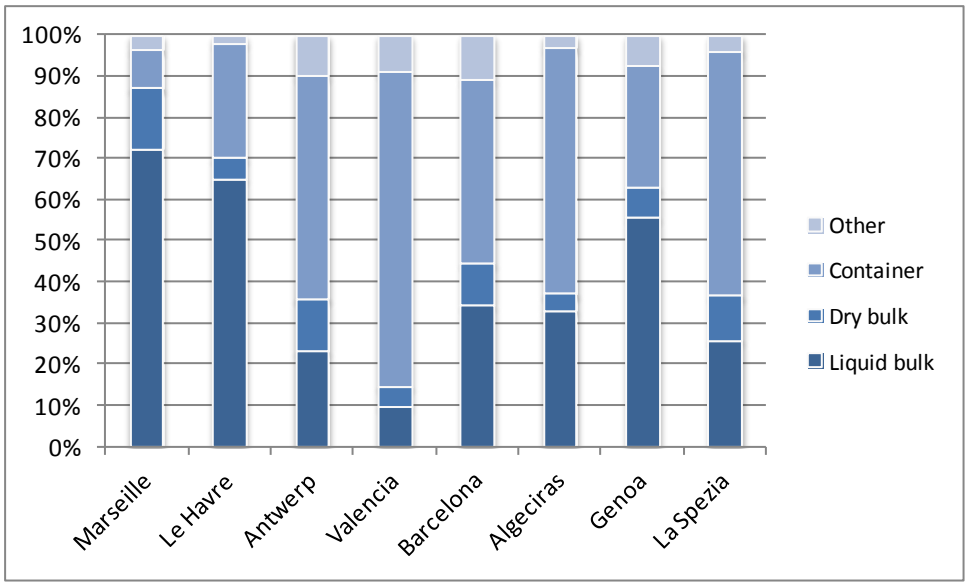
What has been the port performance of the port of Marseille-Fos? That is the central question of this first chapter of the OECD Port-Cities case study of Marseille-Fos. This case study assesses main challenges in port-city development in Marseille-Fos, and provides recommendations to overcome these challenges. In many port-cities world-wide the relation between ports and their cities is a complex and evolving one: ports need less labour but have become more capital and space intensive, which naturally conflicts with space constraints in growing metropolitan regions. Various developments have also strengthened a global-local mismatch connected to ports, with positive spillovers across the metropolitan boundaries, but with negative impacts that are highly localised. This case study assesses this dynamic for Marseille-Fos and suggests ways for improvement. The study has three chapters: on port performance, on port impacts, and on policies and governance. This chapter on port performance gives main characteristics of the port of Marseille-Fos, assesses its performance and then focuses on four determinants of port competitiveness, namely maritime connectivity, port efficiency, hinterland connectivity and competition.

1.1 Port characteristics

The port of Marseille-Fos is a large, multi-site port with multiple challenges. In 2011 it handled 88 million tonnes of cargo, which made Marseille-Fos the largest port in France, the 5th largest in Europe and among the 50 largest in the world. In terms of port surface, the port of Marseille-Fos is a very large port, with more than 10,000 hectares of port area. Its port activities take place on two port sites: a site in the city of Marseille (called East Basins) and a port site situated in the municipalities of Fos, Martigues, Port de Bouc, Port Saint Louis du Rhône (called the West Basins), located at approximately 50 km distance from Marseille. Most of the port activities take place in the West Basins, representing half of the calls, over two thirds of the total cargo volume and 95% of the port surface. The port of Fos forms part of a port-industrial complex that includes refineries, storage and other manufacturing activity. The West Basins has a more urban character, with passenger traffic (ferry and cruise), diverse cargo, and many short range and Mediterranean shipping connections.

Marseille-Fos is highly specialised in liquid bulk goods, in particular crude oil and refined oil. This represents approximately 70% of the total cargo volume. The rest of the ports throughputs are in dry bulk (15%) and containers (10%) and other cargo. This large share of liquid bulk gives Marseille-Fos a rather unique profile. Among the largest European ports, the only port with a similar strong focus on liquid bulk is the other big French port, Le Havre, where liquid bulk represents around 65% of total throughput volume. However, in contrast to Marseille-Fos, Le Havre is much stronger focused in containerised cargo (28% of port volume in 2010). European ports with similar cargo mix profiles as Marseille-Fos are the otherwise much less diversified port of Sines (Portugal); as well as Tees & Hartlepool (United Kingdom) and Tallinn (Estonia), although these two ports have relatively more RoRo- than container-traffic. This large specialisation on liquid bulk distinguishes Marseille-Fos from competitors (Antwerp) and neighbouring ports in Spain and Italy (Figure 1).

Figure 1. Mix of cargo types in Marseille-Fos and other ports

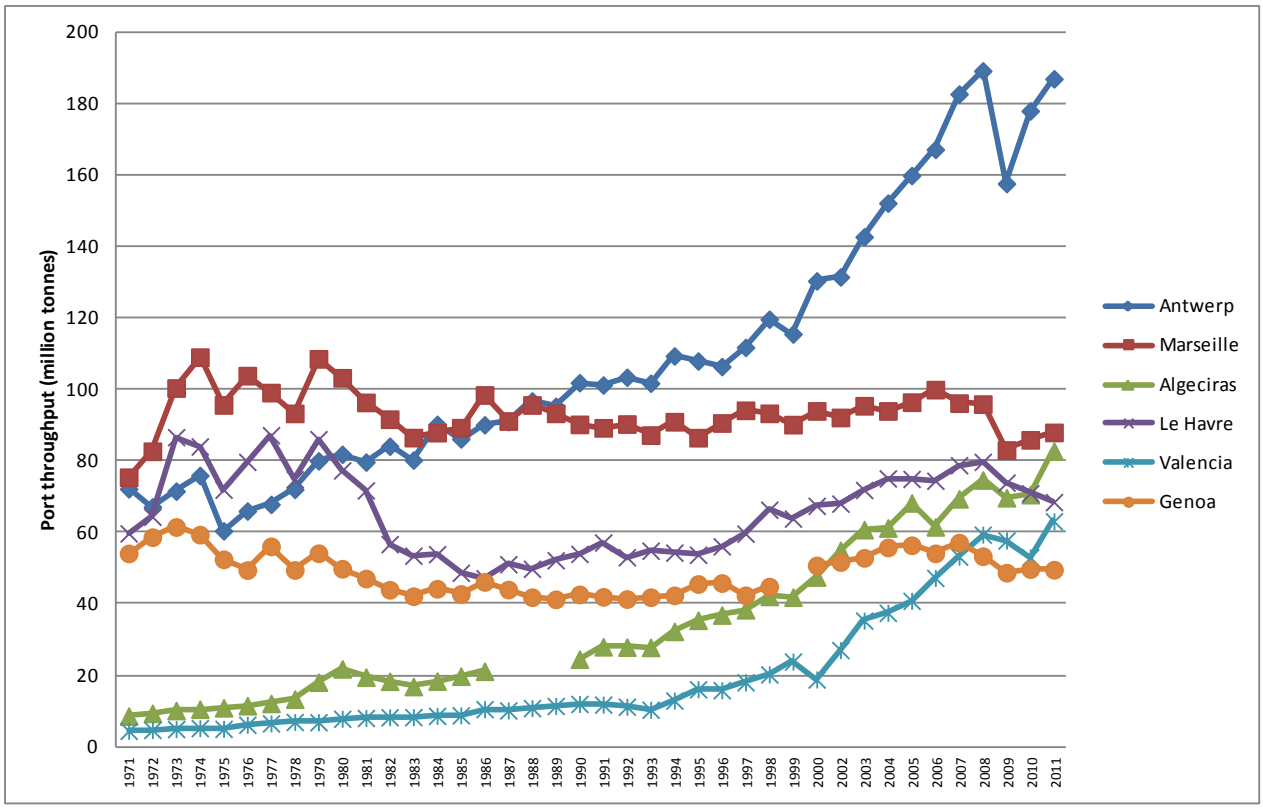


Source: calculations and elaborations of OECD secretariat based on Eurostat data

1.2 Port performance

Port activity in Marseille-Fos has been stagnant over the last decades. The average annual throughput in the 1970s was larger than that in the last decade; the largest throughput, namely 109 million tonnes, was recorded in 1974 and in no other year since then has this record been surpassed. Marseille-Fos' throughput in 2011 was 88 million. This stagnant growth performance (-2% between 1990 and 2011) is in striking contrast with growth rates in Antwerp (83% growth over the same period) and Spanish ports such as Valencia and Algeciras, with even more spectacular rates: 427% and 238% respectively over the same period. The growth rates were more moderate for Le Havre (27%) and Genoa (16%), but still more impressive than the one of Marseille-Fos (Figure 2).

Figure 2. Port throughput development (1971-2011)

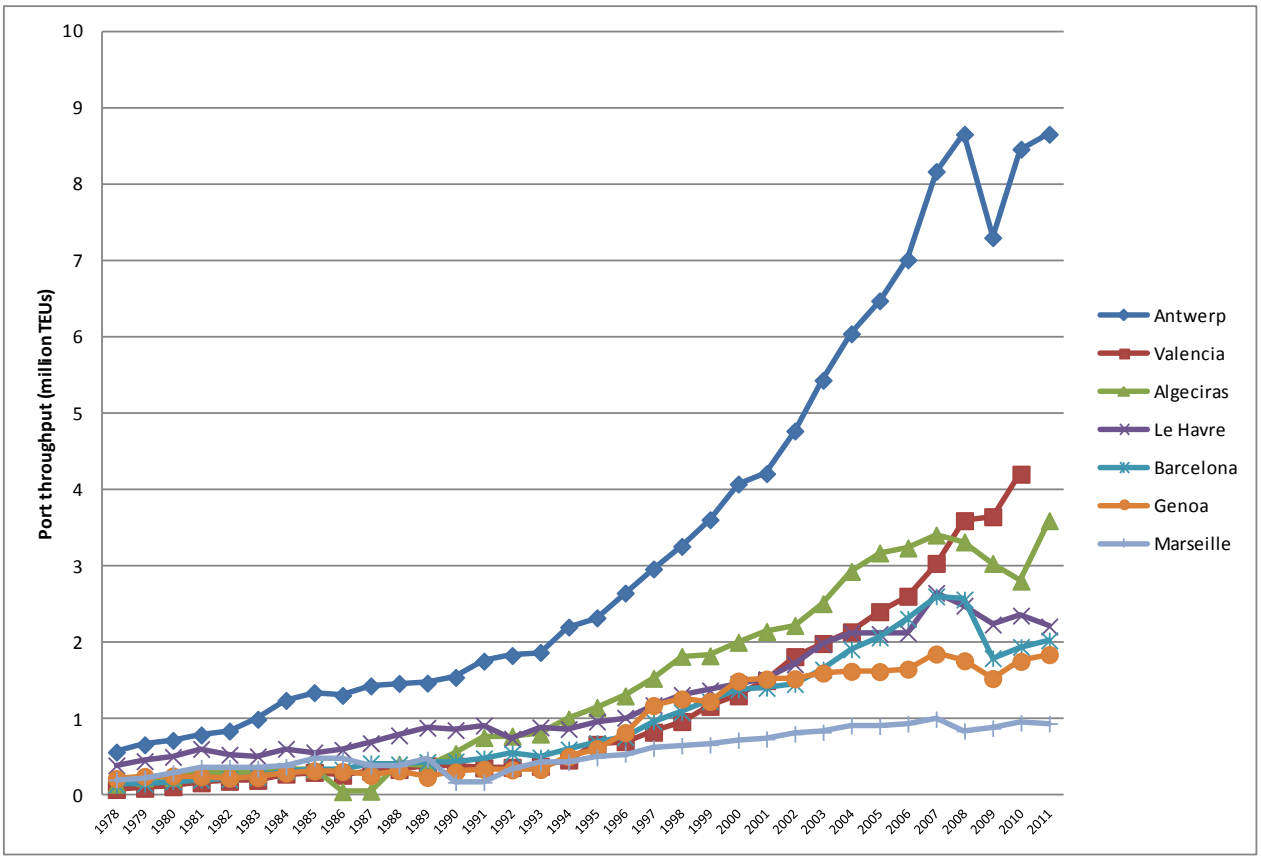


Source: calculations and elaborations of OECD secretariat based on JMM data

These disappointing growth rates have led to declining market shares of Marseille-Fos. The share of Marseille-Fos' total port throughput in European port throughput decreased from 3.1% in 2001 to 2.4% in 2010. Similar decreases are apparent with respect to container volumes (from 1.5% to 1.3%) and also for liquid bulk volumes (from 5.0% to 4.0%).

Missed opportunities can be identified with regards to container traffic. Although Marseille-Fos has seen a certain growth with respect to container volumes handled, they are clearly below those of competitor and neighbouring ports. The port of Antwerp has now nine times more container throughput than Marseille-Fos, as compared to less than 3 times more in 1978. The container volume reached in Marseille-Fos in 2011, 0.94 million, was surpassed in Antwerp in 1983. Other ports in the Western Mediterranean which had more or less similar container traffic in 1978 have now double the volume of Marseille-Fos (in Genoa and Barcelona) up four times Marseille-Fos' traffic volume in Valencia and Algeciras (Figure 3).

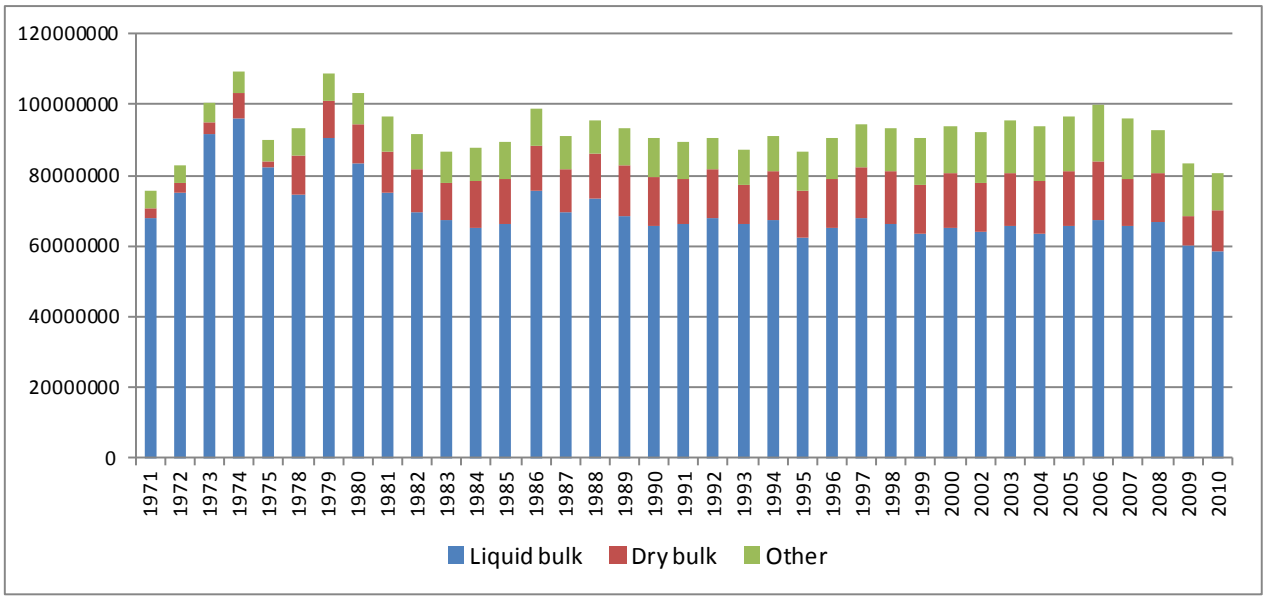
Figure 3. Container traffic in Marseille-Fos and other ports (1978-2011)



Source: calculations and elaborations of OECD secretariat based on JMM data

Growth did not take place either in liquid bulk. Subject to cyclical fluctuations over time, the general trend in liquid bulk cargo in Marseille-Fos is downwards. Current volumes are at its lowest point since 1973, and volumes over the whole of the 2000s do not come near the volumes reached in the 1970s or part of the 1980s (Figure 4). The decline in liquid bulk volumes has resulted in reduced dependence of the port of Marseille-Fos on liquid bulk. If it represented around 90% of total cargo volume in the beginning of the 1970s, it rapidly decreased to 75% in the 1980s and has been below 70% in the 2000s, even though the years after show a sudden increase of the share. In parallel to this long-term decline of the liquid bulk sector, the share of imports and exports in the port has become more balanced: 11% of port volumes in 1971 were exports (the rest was imports); this has developed towards 24% in 2011.

Figure 4. Port growth per cargo type in Marseille-Fos (1973-2010)



Source: calculations and elaborations of OECD secretariat based on JMM data

However, there are some recent signs of recovery in container traffic. The container volumes in Marseille-Fos showed a growth rate of 14.2% between July 2011 and July 2012, whereas competing and neighbouring ports did worse, either showing negative growth rates over that period, such as Antwerp (-0.4%) and Barcelona (-20.7%) or showing lower growth rates, such as in Le Havre (11.1%) and Genoa (13.9%). Although it is of course too early to tell if this signifies the beginning of a more positive growth path, it is interesting to note that both Marseille-Fos and Le Havre showed relatively higher growth container traffic than their competitors, after the long-awaited implementation of the French port reform in May 2011, even though total cargo development for Marseille-Fos was less promising.

1.3 Determinants for port competitiveness

Maritime connectivity

Regional gateway functions

An analysis of these measures shows that Marseille-Fos is a regional gateway but not a global hub. The hub-and gateway-functions of ports can be quantified with three different measures: degree centrality, betweenness centrality and clustering coefficients. These three different port hub measures were calculated for a set of 2177 world ports and their connections in 2011, assessing both absolute values and ranking amongst world ports. Results for main competitor and neighbouring ports of Marseille-Fos are summarized in Table 1. The overall picture that emerges from this assessment is one of great similarity of Marseille-Fos, Barcelona, Valencia and Genoa with regards to port hub functions. Both their absolute and relative values are very close to each other, indicating similar profiles. They are all characterised by high centrality scores, figuring among the top 40 ports with regards to degree centrality (DC) and betweenness centrality (BC).[1] At the same time, their rankings with respect to the clustering coefficient (CC) are more moderate, indicating more limited hub functions. They serve as a regional gateway, but cannot be considered global hubs.

Table 1. Port centrality indexes

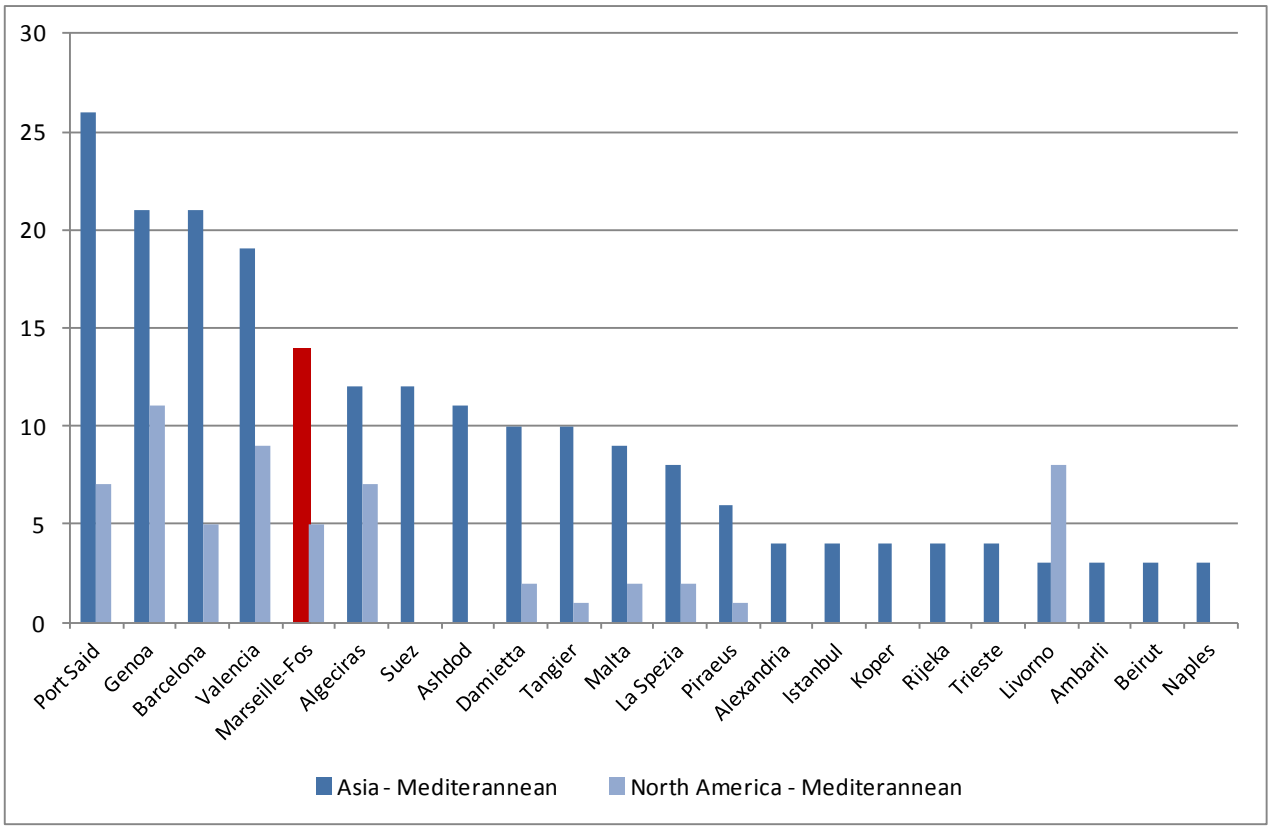
	CC score	CC rang	BC score	BC rang	DC score	DC rang
Antwerp	0.117	6	231455	3	475	3
Le Havre	0.165	18	105358	12	332	8
Algeciras	0.162	16	73992	15	297	15
Barcelona	0.217	49	42777	33	240	22
Valencia	0.223	54	45146	30	237	23
Genoa	0.226	58	36112	39	207	34
Marseille (Fos)	0.220	53	46139	29	204	35

Source: calculations and elaborations of OECD secretariat based on data of Lloyd's Marine Intelligence Unit (LMIU)
Note: CC: cluster coefficient; BC: betweenness centrality; DC: degree centrality

In contrast, Marseille-Fos's competitors in North-West Europe, in particular Antwerp and to a lesser extent Le Havre, do have these hub characteristics. Antwerp is not only the third most central port in the world, but also sixth with respect to the clustering coefficient. Le Havre is ranked 18th in terms of cluster coefficient, which is higher than its position on world port throughput rankings would suggest, although it is lower than its ranking with respect to port centrality. In the Western Mediterranean only the port of Algeciras could be considered to be a real global hub, with high rankings on all three port hub measures. Its competitor Tangier-Med in Morocco has not been able to reach similar levels of centrality or clustering; and scores actually far below Marseille-Fos and other West Med-ports.

Marseille-Fos is fairly well integrated in the intercontinental routes of the largest global container carriers, although less so than other main ports in the Western Med. This can be concluded from analysis of the intercontinental routes of nine of the eleven largest global shipping lines in March 2012 for which these routes are publicly available. In this analysis two types of intercontinental connections were assessed: the Asia-Mediterranean route and the route between North America and the Mediterranean. Marseille-Fos was a port of call in 14 of a total of 60 Asia-Med routes. Port Said was the most important port for this traffic with 26 out of 60, but also West Med-ports were well represented, including Genoa (21 times), Barcelona (21) and Valencia (19), all more frequently called than Marseille-Fos on these routes. Less called ports in the West Med were Algeciras, Tangiers, La Spezia and Livorno. The ranking of Marseille-Fos with respect to integration in North America-Med routes is lower: included in these routes 5 times out of a total of 23 loops, behind six other West Med ports, in particular Genoa (11) and Valencia (9) (Figure 5).

Figure 5. Direct port calls in intercontinental routes of the largest global container carriers (2012)



Source: calculations and elaborations of OECD secretariat based on data from 10 of 11 largest global container carriers

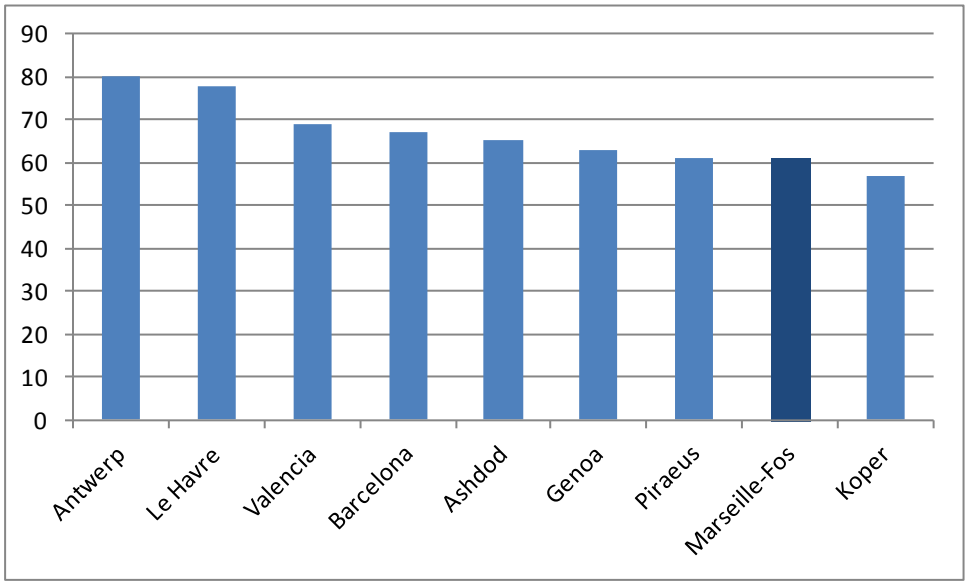
With respect to maritime connectivity, Marseille-Fos cannot be considered to be in competition with other West Med-ports such as Genoa, Valencia or Barcelona. The overlap of Marseille-Fos with these ports in the intercontinental shipping routes is large: they figure to a large extent in the same service loops of global container carriers. E.g. Genoa forms part of all the 14 service loops from Asia to the Mediterranean in which Marseille-Fos is included, Barcelona in 13 out of 14 and Valencia in 11 out of 14. Similar overlaps exist with respect to the North America-Med routes, with complete overlap of Marseille-Fos with Genoa, Livorno and Valencia; and a slightly lesser overlap with Algeciras and Barcelona. These patterns of overlap indicate that Marseille-Fos is not a substitute for these relatively closely located ports, but rather a complement. The competition between these ports for a dominant regional gateway-function is fairly limited. This situation is different from the pattern that can be found in North West Europe. The OECD Port-Cities case study of Hamburg found very limited overlap between intercontinental routes of Hamburg and Bremerhaven, with Hamburg highly included in Asian-European routes and Bremerhaven very present in North America-European route. These ports were almost never paired in the same intercontinental service loop, so acted as almost perfect substitutes (Merk *et al*. 2012)

Relative modest and declining maritime connections

The diversity of Marseille-Fos' maritime connections is relatively limited. The can be concluded from its score on a maritime foreland connectivity index that we constructed for this study, which makes it possible to compare the diversity of maritime of connections of world ports. This index is applied to ports' worldwide traffic distribution at country level, and defined as the inverse of the sum of differences in shares compared with world average, applying a methodology developed in Ducruet et al. (2011). Our

calculations of this index over 2011 show that Singapore has the most diverse set of maritime connections (score 100). The score of Marseille-Fos was 61, with a world ranking of 122nd most diverse port. Scores for competitor and neighbouring ports, such as Barcelona, Valencia, Genoa, Le Havre and Antwerp, were all higher, indicating a wider diversity of maritime connections of these ports (Figure 6). The most important connections of Marseille-Fos are in the Mediterranean, West Africa and North America. Relations with Asia are relatively limited.

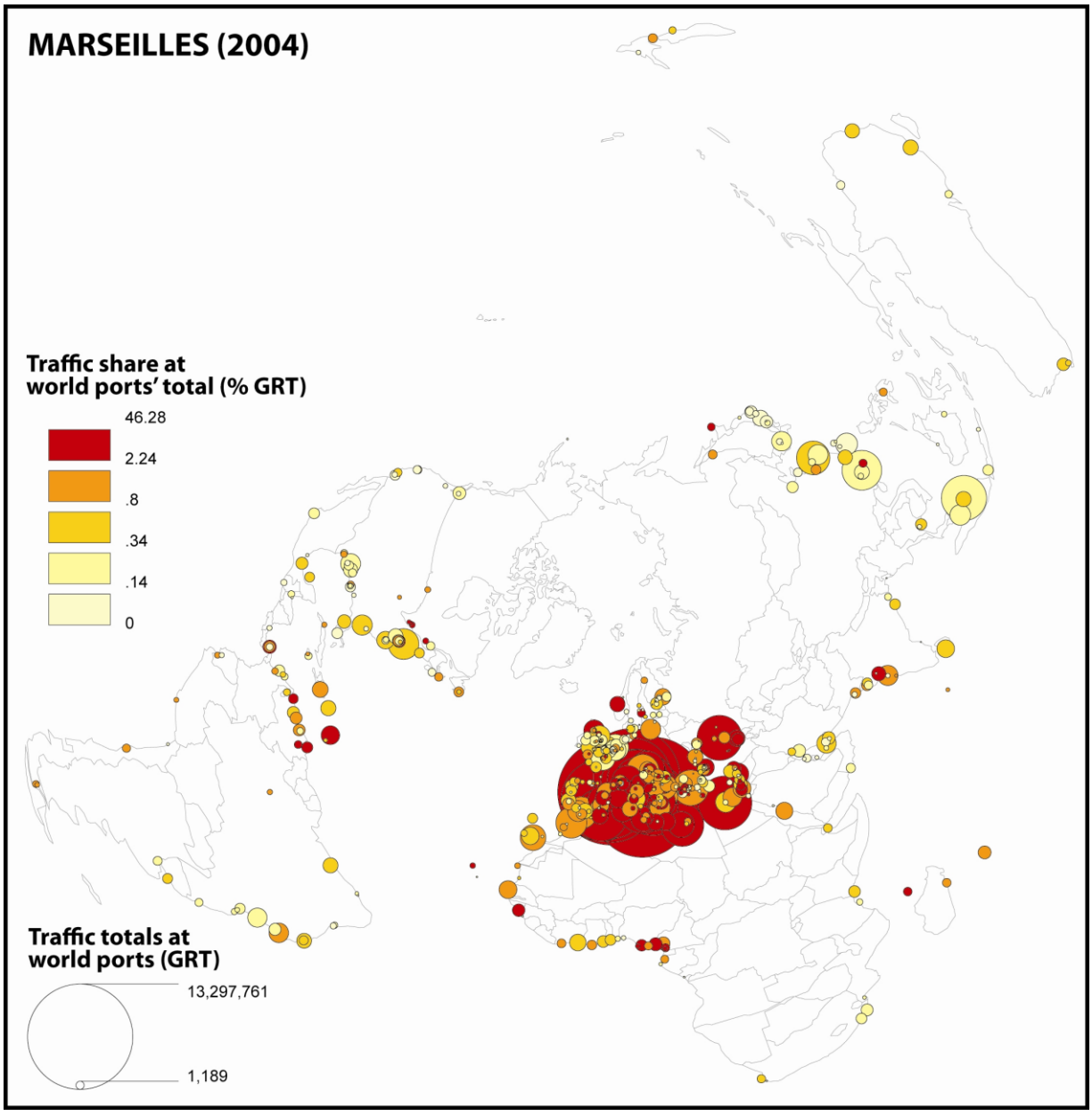
Figure 6. Maritime foreland diversity of Mediterranean and European ports



Source: calculations and elaborations of OECD secretariat based on data of Lloyd's Marine Intelligence Unit (LMIU)

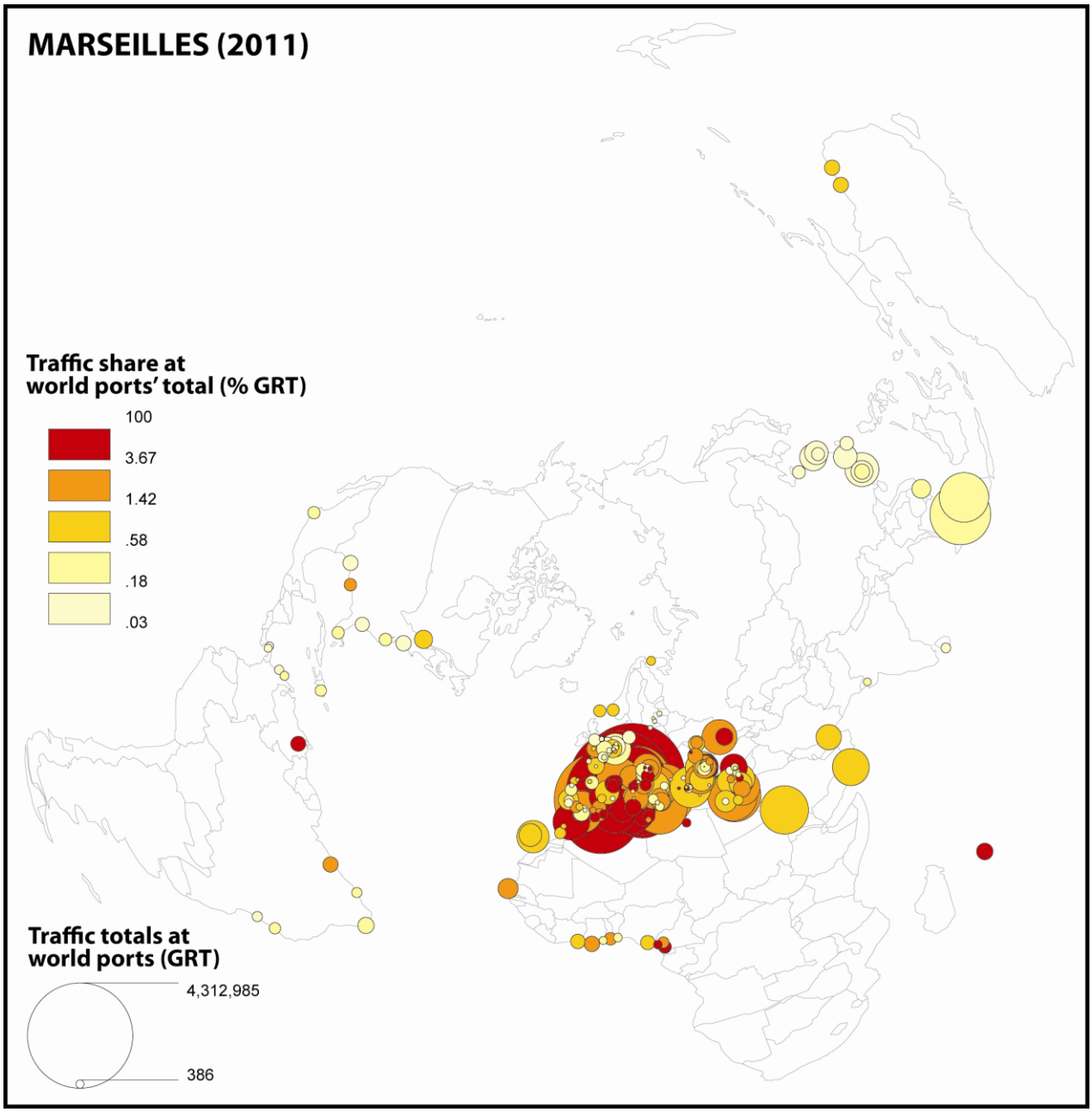
This maritime foreland diversity has declined over the last decade. This can be concluded of the development of the standardised maritime foreland diversity indexes between 2011 and 2004, which declined over his period. Although this is a more or less generic development among European ports, probably indicating shifts in intercontinental trade and port concentration tendencies in emerging markets, the decline for Marseille-Fos is more pronounced than the one for other Western Med ports, including Barcelona, Valencia, Genoa and La Spezia. This decline of maritime connectivity can also be visualised by indicating the ports with which Marseille-Fos is connected via vessel movements. In Figures 7 and 8, all these ports are indicated, with the inclusion of information on the absolute and relative values that this connection represents. The confrontation of the figures for 2004 and 2011 shows that not only the number of connections declined, but also the number of ports for which Marseille-Fos was an important port (as indicated by the red colouring expressing a relatively large share in the total port traffic of that port).

Figure 7. Maritime foreland of Marseille-Fos in 2004



Source: calculations and elaborations of OECD secretariat based on data of Lloyd's Marine Intelligence Unit (LMIU)

Figure 8. Maritime forelands of Marseille-Fos in 2011

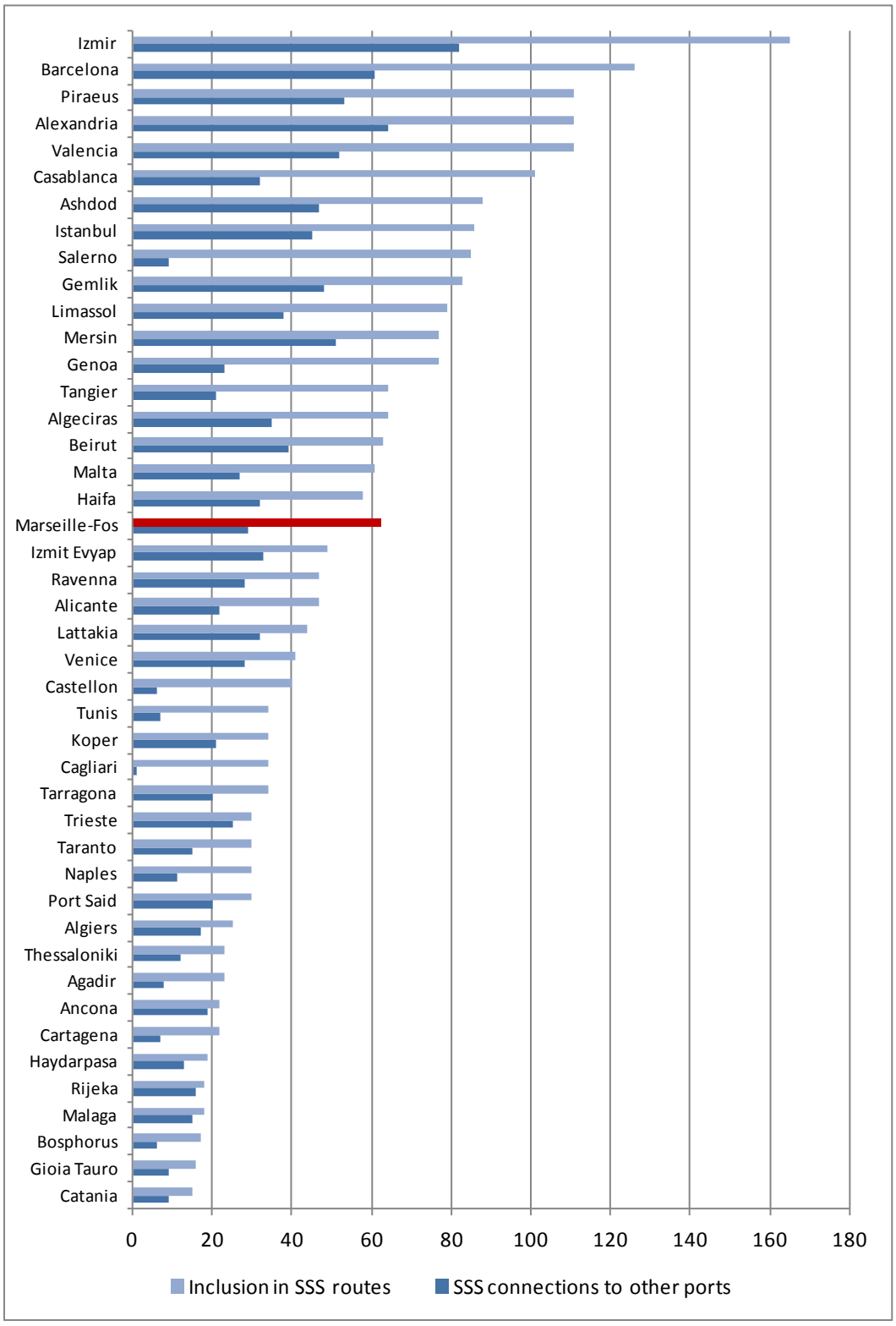


Source: calculations and elaborations of OECD secretariat based on data of Lloyd's Marine Intelligence Unit (LMIU)

Limited short sea connections

The position of Marseille-Fos in short sea shipping is relatively moderate. This can be concluded when analysing a database on short sea shipping constructed for the purpose of this report. This database is based on the different schedules (service loops) in 2011 of main 34 short-sea shipping companies operating in Europe, counting the frequency of 211 European ports in these service loops most frequently mentioned on the website of the European Short Sea network,, as well as the connections between the ports. As such, short sea shipping is here defined as the shipping activities within Europe of companies that define themselves as short sea shipping companies. Only regular liner services in container transport are included in this database which provides a certain bias into our comparison as Marseille (East Basin) counts a lot of short distance RoRo-traffic that is not incorporated in our analysis. From this database it can be concluded that short sea shipping in Marseille-Fos is relatively underdeveloped: it ranks 17th in terms of number of inclusions in SSS-routes and 17th with regards to the number (29) of Med ports to which it is connected via Short Sea Shipping (Figure 9). Barcelona has twice the number of port connections via Short Sea Shipping. Most of the Short Sea Shipping takes place from the East Basin: Marseille is 51 times included, against 11 times for Fos, with the East Basin being connected to 27 other ports against 10 for Fos.[2] The most important SSS-connections of Marseille-Fos are with Barcelona, Valencia, Genoa, Algeciras and Casablanca.

Figure 9. Short Sea Shipping-connections in the Mediterranean (2011)



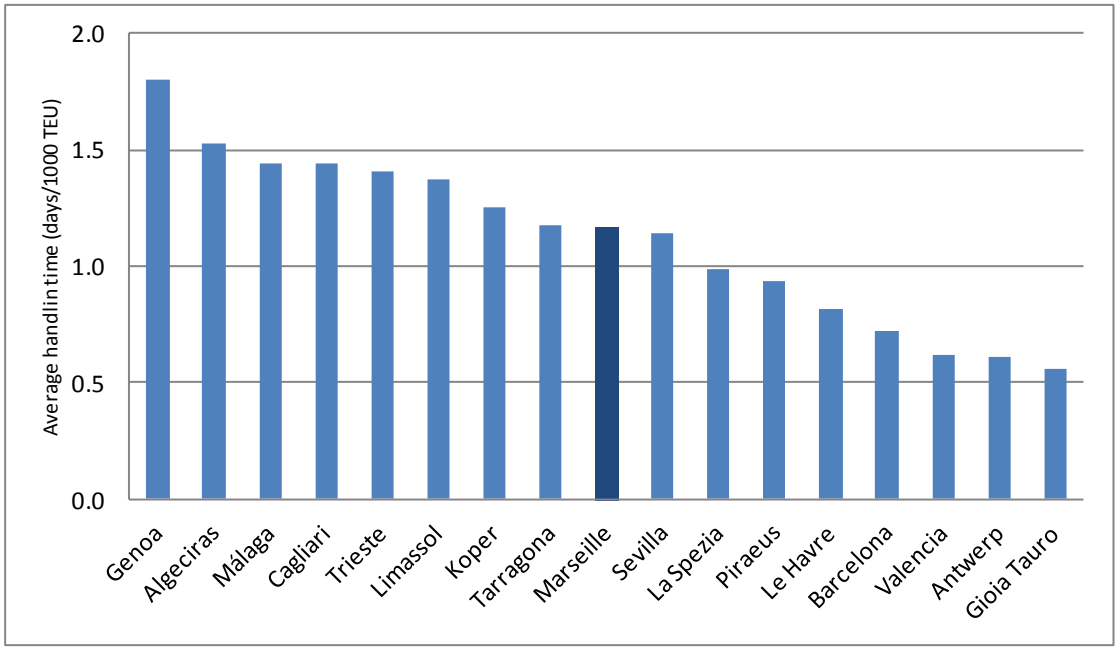
Source: calculations and elaborations of OECD secretariat based on data of 34 main SSS companies in Europe

Port efficiency

Turn-around time of vessels in ports (time efficiency) is one of the determinants of port competitiveness. Time efficiency is here considered to be the average time that a vessel stays in a port before departing to another port, which is known through detailed vessel movement data, as collected by Lloyd's Marine Intelligence Unit (LMIU). This turn-around time is generally considered to be an important determinant of port competitiveness as quick turn-around allows for reduction of port congestion and larger port throughputs. Time efficiency of main European ports was measured using a methodology described in annex 2 and using a LMIU-dataset over May 2011 and container throughput data from Eurostat over the second quarter of 2011. Elaborations and calculations were made to come up with a measurement of average handling time of a port in days per 1000 TEU.

In this respect, Marseille-Fos scores in line with the Mediterranean average, although it is less time efficient than its direct competitors. The average container handling time in the second quarter of 2011 in Marseille-Fos was 1.16 days for 1000 TEUs, almost twice the handling time needed in Valencia and Antwerp. Other Western Med ports, such as Barcelona and La Spezia, and Marseille-Fos' main French competitor, Le Havre, were also more time efficient. Yet, Marseille-Fos turned out to be more efficient than Genoa, Tarragona and other Mediterranean ports (Figure 10). These mixed efficiency scores for Marseille-Fos are in line with findings from a relatively large body of port efficiency studies.

Figure 10. Average container handling time (days/1000 TEU), Q2 2011

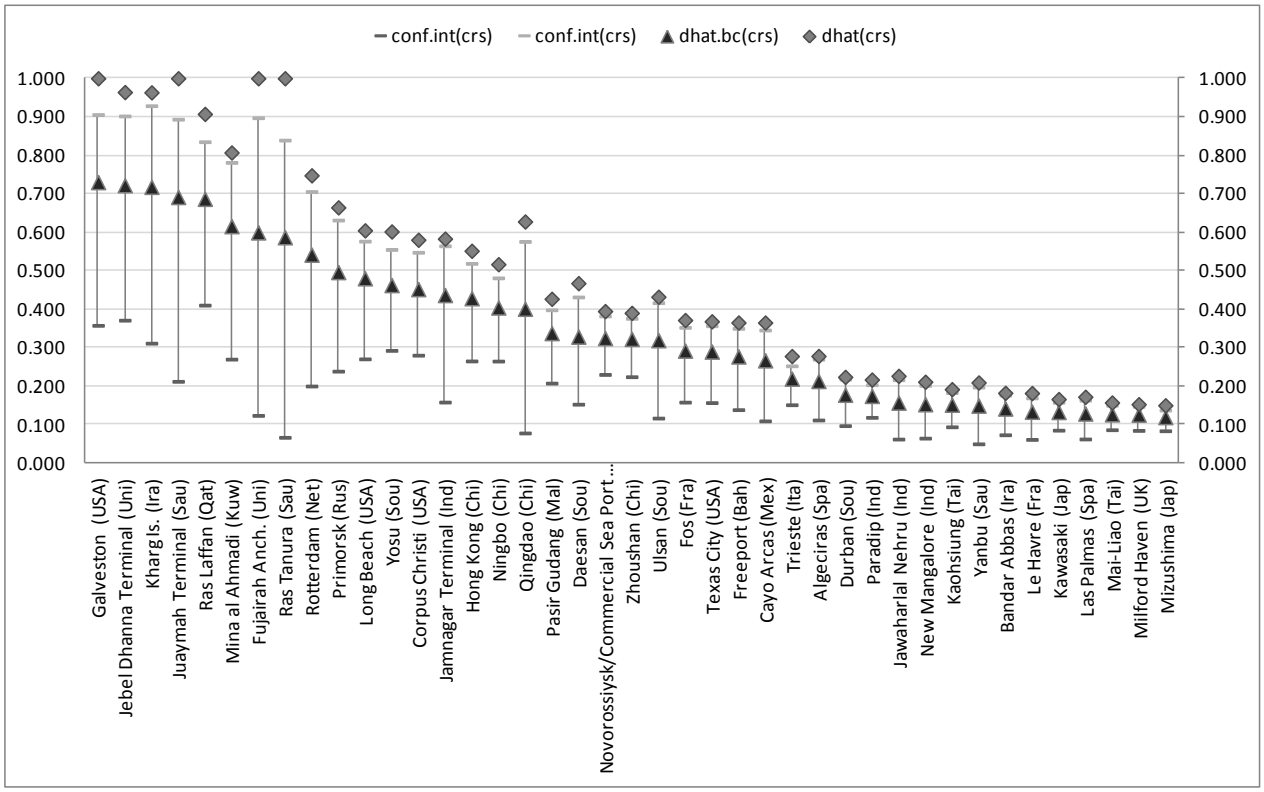


Source: calculations and elaborations of OECD secretariat based on data of Lloyd's Marine Intelligence Unit (LMIU) and Eurostat

With respect to bulk terminals, Marseille-Fos is not among the most efficient world ports, but it performs relatively favourable compared to its competitors. This can be concluded from an analysis that we carried out on port efficiency with regards to bulk goods, using DEA methodology and a unique database set up for this purpose (both dataset and methodology are described in Annex 3). Our findings indicate that the most efficient crude oil ports are very large specialised oil ports in the Middle East, as well as some of the very large ports, including Rotterdam and some of the Chinese ports. Fos did not figure among the most efficient world oil ports, but emerged as the most efficient oil port in the Mediterranean,

being more efficient than Trieste and Algeciras. In addition, it scored higher than its competitors Le Havre and Antwerp (Figure 11). A similar picture can be drawn with respect to port efficiency of Marseille-Fos in the handling of coal and iron ore: not among the world's most efficient, but more efficient than other Med ports, such as Tarragona, Savona, La Spezia, Algeciras and Genoa, as well as its competitors Le Havre and Antwerp (Oliveira and Cariou, 2011).

Figure 11. Efficiency scores for a sub-sample of crude oil ports/terminals

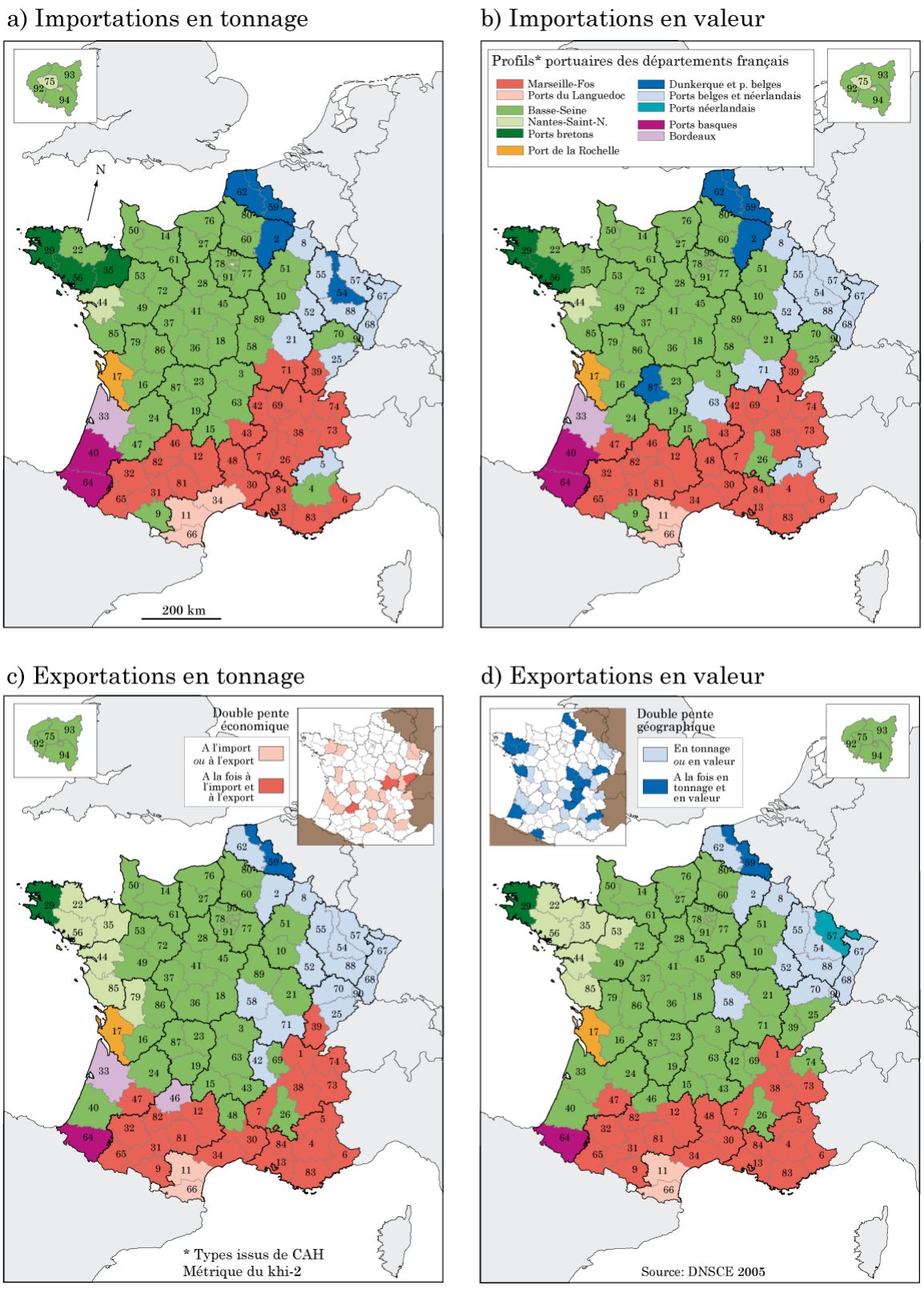


Source: Authors' own calculations.
Note: (dhat) refers to efficiency scores derived using the standard DEA methodology; (dhat.bc) indicates scores derived using the bootstrapping method and (conf.int) indicates the upper/lower bound values of the interval of confidence; (crs) is the abbreviation of constant returns to scale, assumptions used in both methodologies.

Hinterland connectivity

Detailed analysis on port hinterlands in France based on data from 2005 show that Marseille-Fos' main competitors for hinterlands are Le Havre and Antwerp. This analysis is based on data from the French customs on origin and destination of imported and exported goods in France, in volume and value (Guerrero, 2010). The French regions for which the port of Marseille-Fos is the most important port are the PACA region, Midi-Pyrénnées and Rhônes-Alpes, as well as the departments of Lozère and Gard (Languedoc-Roussillon), Haute-Loire (Auvergne), Saône-et-Loire (Bourgogne) and Jura (Franche-Comté). Apart from the local hinterlands surrounding the secondary ports in France, most of the rest of the hinterland in France is dominated by the port of Le Havre. Although the Benelux ports are mostly dominant in the north and east of France, they are actually also over-represented in the department of Hautes-Alpes in the PACA-region, the home basis of the port of Marseille-Fos (Figure 12).

Figure 12. Port hinterlands in France (2005)



Source: Guerrero 2010

More recent data provided by the port authority roughly confirm the dominant hinterlands of Marseille-Fos. Knowledge of the hinterlands of French ports hinterland is limited after the disappearance since 2007 of data from customs declarations which were used to calculate market shares by region. In the absence of other reliable sources today, French ports have punctual knowledge of their hinterland, based on specific studies. Few precise data are available, but in the container segment studies conducted by the French Ministry of Transport provide a more accurate picture of four main hinterland regions of Marseille-Fos: Rhône-Alpes (GPMM market share of 60%), Paris area (3% market share), Burgundy Region (20%) and Midi-Pyrenees (60%).

The hinterland of the port of Marseille-Fos currently does not include nearby foreign countries of regions, such as Switzerland, Germany or Northern Italy. This becomes apparent when analysing the flows of goods by truck, train and inland waterways between the department of Bouches-du-Rhône and regions in North Italy and Switzerland. These flows are limited, in particular in comparison with those coming from Antwerp and South Holland (Rotterdam). Large railway corridors, such as Rotterdam-Genoa and Barcelona-Lyon-Turin-Trieste-Budapest, present a complication for Marseille-Fos to capture these hinterlands.

Inter- and intra-port competition

The port of Marseille-Fos is hardly subject to local inter-port competition, in contrast to Valencia, Barcelona and Genoa. It is by far the most important French Med port, representing around 90% of total French Med port volume and 100% of its container traffic. The other Mediterranean ports in France such as Sète, Toulon, Nice and Port-La-Nouvelle are very small, specialised, without any regional gateway functions. This situation is hugely different for the main Spanish Med ports and the Ligurian ports in Italy. The largest Spanish Med port, Valencia, represents only 20% of the total Spanish Med port volume.[3] It is closely located to two other ports, Barcelona and Tarragona, that have around two thirds of its throughput and that are both, like Valencia, diversified ports with large container volumes. The Ligurian ports in Italy form a constellation of ports, with Genoa being the largest, but with three other ports, namely Livorno, La Spezia and Savona, that together have larger volumes than Genoa (Table 2).

These Spanish and Italian Med ports compete amongst each other for regional gateway functions, whereas Marseille-Fos can take this for granted. This can be illustrated by the intercontinental routes of global container carriers, discussed above. E.g. many of these service loops from Asia or North America include the ports of Genoa, but they also include La Spezia and Livorno. A similar story holds for Valencia, Barcelona and Tarragona, ports that often compete for regional gateway functions. Marseille-Fos is the only French Med port in these loops. A comparison of centrality measures confirms this picture: the secondary ports in these regional port systems are close to the ones of the main ports in Spain and Italy, but not in the French Med (Table 3). This port competition gives incentives to port performance in Italy and Spain, as the effects can be important, as can be illustrated by several examples of shipping companies having shifted their traffic between these ports: ZIM in 2009 from Barcelona to Tarragona, Evergreen in 2009 from Barcelona to Tercat, Maersk in 2009 from Tercat to Barcelona and China Shipping in 2007 from Valencia to Barcelona. Such performance incentives from inter-port competition in the region do not exist for Marseille-Fos. The hinterland of Marseille-Fos has for a long time been a captive hinterland that cannot easily be contested by the Spanish Med-ports or the Ligurian ports; this could also explain why the decline of the port of Marseille-Fos was not more dramatic than it actually was.

Table 2. Volumes of main European West Med ports (2010, 1000 tonnes)

	Total	Container
France		
Marseille-Fos	82,423	7,647
Sète	3,282	52
Port-La-Nouvelle	2,074	0
Toulon	73	0
Spain		
Algeciras	57,286	29,551
Valencia	53,075	40,441
Barcelona	35,322	15,180
Tarragona	32,072	2,336
Cartagena	19,045	612
Castellon De La Plana	12,236	1,151
Italy		
Genoa	41,427	10,746
Livorno	22,662	4,660
La Spezia	16,091	9,573
Savona	12,874	1,442

Source: calculations and elaborations of OECD secretariat based on Eurostat data

Table 3. Centrality indexes of secondary West Med ports (2011)

	CC score	CC rang	BC score	BC rang	DC score	DC rang
Tarragona	0.227	68	23056	75	187	42
Leghorn	0.251	116	21796	78	178	48
La Spezia	0.376	491	9128	193	126	126
Savona	0.338	374	12692	145	94	223
Sète	0.362	444	1762	549	53	491
Port la Nouvelle	0.515	996	335	913	19	1028
Nice	0.429	676	2715	469	8	1470
Toulon	0.679	1405	124	1115	8	1477

Source: calculations and elaborations of OECD secretariat based on data of Lloyd's Marine Intelligence Unit (LMIU)
Note: CC: cluster coefficient; BC: betweenness centrality; DC: degree centrality

Moreover, the relatively limited intra-port competition in Marseille-Fos could not compensate for the lack of inter-port competition. Only with the creation of the Fos 2XL-container terminal in 2010 has some form of intra-port competition been introduced, with one of the terminals operated by CMA-CGM and DP World and the other one by MSC. In practice, however, much of the container traffic remains very dependent on CMA-CGM. The presence of the four large global terminal operators (GTOs) dominating the port terminal market is relatively limited, with only DP World active in Marseille-Fos, but not APMT, HPH and PSA. In many of the largest ports in the world more than one of these GTOs is involved, sometimes all four (Table 4).

Table 4. Presence of four largest global terminal operators in world ports (2012)

Number or large global terminal operators	Port
Two	Antwerp, Sydney, Brisbane, Chennai, Dammam, Guangzhou, Ho Chi Minh City, Le Havre, Qingdao, Shanghai, Xiamen, Zeebrugge
Three	Busan, Hong Kong, Rotterdam, Xingang
Four	Buenos Aires, Laem Chabang

Source: calculations and elaborations of OECD secretariat based on data of global terminal operators

Over the last decade, however, increased inter-port competition has started to emerge from North-West Europe, in particular Le Havre and Antwerp. Both ports operate in the highly competitive Hamburg-Le Havre range, where the main ports compete for large parts of their hinterland. What were once captive hinterlands of Marseille-Fos, such as metropolitan Lyon, have increasingly become contestable hinterlands, with Antwerp, Le Havre and even Rotterdam attempting to grasp market shares. Growth opportunities for Marseille-Fos, such as in eastern France and Switzerland, will have to be grasped in competition with these ports. At the same time, port competition in Spain and the ambition to sustain port growth, has also resulted in hinterland expansion into the south of France, part of the natural hinterland of Marseille-Fos (and Bordeaux). These increased competitive pressures on Marseille-Fos necessitate and important adaptation after decades of relative isolation from competition.

2. PORT IMPACTS

Port performance is a relevant subject in itself, but all the more relevant in relation to its implications: how does port growth translate into growth for a metropolis, does it generate jobs, does it attract firms; and how about negative impacts, such as the environmental effects? These are the questions that will be answered in this chapter, by looking subsequently at port-related employment, value added, indirect economic effects and environmental impacts.

2.1 Port-related employment

Previous studies have indicated that employment related to the port of Marseille-Fos amounts to approximately 40,000 to 45,000 jobs. One study counted port-related 41,300 jobs in 2007 (Entreprises et Territoires, 2009). According to this study more than half of these jobs (22,700) were logistics related, around a third (16,700) related to manufacturing, and approximately 5% (1,900) was service employment mainly based in the city of Marseille. The methodology used for that study was based on a micro-analysis of responses to surveys to firms, indicating a relation with the port or not. This study also gives a detailed overview of which sorts of jobs can be found in which inter-communalities in the Bouches-du-Rhône department. In a comparative study on port-related employment in France by the Port Observatory of the national federation of urban planning organisations (*Federation Nationale des Agences d'Urbanisme*), this same study was used, but an estimated number of 2,500 jobs in yachting was added to this, resulting in 43,800 port-related jobs.

Although these studies certainly have their merits, their methodology is based on a more or less discretionary definition of port-related employment, which makes comparison with other port-cities difficult. In France alone several port-cities use their proper definition of port-related employment, coloured by different local contexts, which means that certain sectors (e.g. in manufacturing) are in some port-cities counted as port-related employment, but not in others. The shortcomings of this are well recognised by the FNAU in its study cited above, in which it proposes a common framework to count port-related employment and the statistical employment codes linked to it (FNAU, 2009). This framework makes it possible to estimate port-related employment in France in a comparative way, which was undertaken for the purpose of this report.

Application of a common definition of port-related employment shows that Marseille-Fos has not only the largest number of port-related jobs, but also has a large diversity of port-related jobs. The total number of port-related jobs found in Marseille-Fos was approximately 32,400 jobs (Table 5). This is almost certainly an underestimation considering that jobs in several sub-sectors could not be included, because it was unknown which parts of these subsectors were actually port-related; these are subsectors like public services related to the port (customs, fire services, rescue workers), restaurants and hotels, public works and port-related services, such as engineering services, technical inspections, insurance, research etc. Port-related employment in Marseille-Fos is twice as large as in the second French port of Le Havre, and three times as large as the third port, Dunkirk. Marseille-Fos has employment in all of the different employment sectors, which indicates a large diversity of port-related jobs. More than half of these are in maritime and land transportation; less than a third of the employment is in port-related manufacturing, such as the petro-chemical industry, metallurgy and the food industry, according to our analysis. This diversity of port-related employment in Marseille-Fos is even more clearly illustrated when a more detailed breakdown of port-related employment is made.

Table 5. Port-related employment in main French port-cities[4]

	Marseille-Fos	Le Havre	Dunkerque	Nantes-St Nazaire	Rouen	Bordeaux	La Rochelle
1. Maritime transport	8533	5267	1193	2030	1106	947	360
2. Land transport	9792	2648	1447	5571	3876	6486	881
3. Logistics and trade	3619	5595	889	1146	2687	1203	131
4. Exploitation of marine resources	97	5	77	25	10	0	97
5. Ship-building and reparation	24	0	0	306	0	0	24
6. Port industries	9632	3230	6853	3054	3894	1604	982
7. Marinas	23	0	4	32	3	358	213
8. Tourism	672	86	28	507	153	274	48
	32392	**16831**	**10491**	**12671**	**11729**	**10872**	**2736**

Source: calculations and elaborations of OECD secretariat based on data of INSEE

Most of these port-related jobs are located in the city of Marseille, but they represent up to half of total employment in some municipalities such as Fos-sur-Mer. Approximately 22,700 port-related jobs are located in the city of Marseille, many of which in maritime and land transportation, logistics and port-related manufacturing. These jobs represent around 7% of the total urban employment. The shares of port-related employment are much higher in the municipalities surrounding the West Basin of the port of Marseille-Fos, ranging from 10% in Martigues to almost 50% in Fos-sur-Mer. The only exception is Marignane, where port-related employment represents only 5% of total local employment. The profile of the port-related employment is markedly different among these small municipalities, with relative specialisations in metallurgy (Fos), petro-chemical industry (Martigues), maritime transport (Port-de-Bouc) and land transportation (Chateauneuf and Port St. Louis du Rhône).

Table 6. Employment related to the port of Marseille-Fos

	Mar-seille	Marig-nane	Mar-tigues	Fos-sur-Mer	Port de Bouc	Château-neuf	Port St Louis	Aix	Berre	Vi-trolle
1. Maritime transport	7578	36	126	314	467	2	10	32	10	0
2. Land transport	7364	135	371	462	196	289	225	681	120	1913
3. Logistics and trade	2574	587	110	465	148	157	98	75	1	504
4. Exploitation of marine resources	38	0	0	0	12	0	0	0	0	43
5. Ship-building and reparation	13	0	7	0	4	0	0	0	0	0
6. Port industries	4501	112	1018	3884	43	58	63	1003	1139	388
7. Marinas	17	0	6	0	0	0	0	0	0	0
8. Tourism	643	8	12	3	1	5	0	307	5	12
Total port-related employment	22728	878	1650	5128	871	511	396	2098	1275	2860
Total employment	321917	18230	17005	10847	4382	4178	1984	88540	4577	25943
Share port employment	**7.1%**	**4.8%**	**9.7%**	**47.3%**	**19.9%**	**12.2%**	**20.0%**	**2.4%**	**27.9%**	**11.0%**

Source: calculations and elaborations of OECD secretariat based on data of INSEE

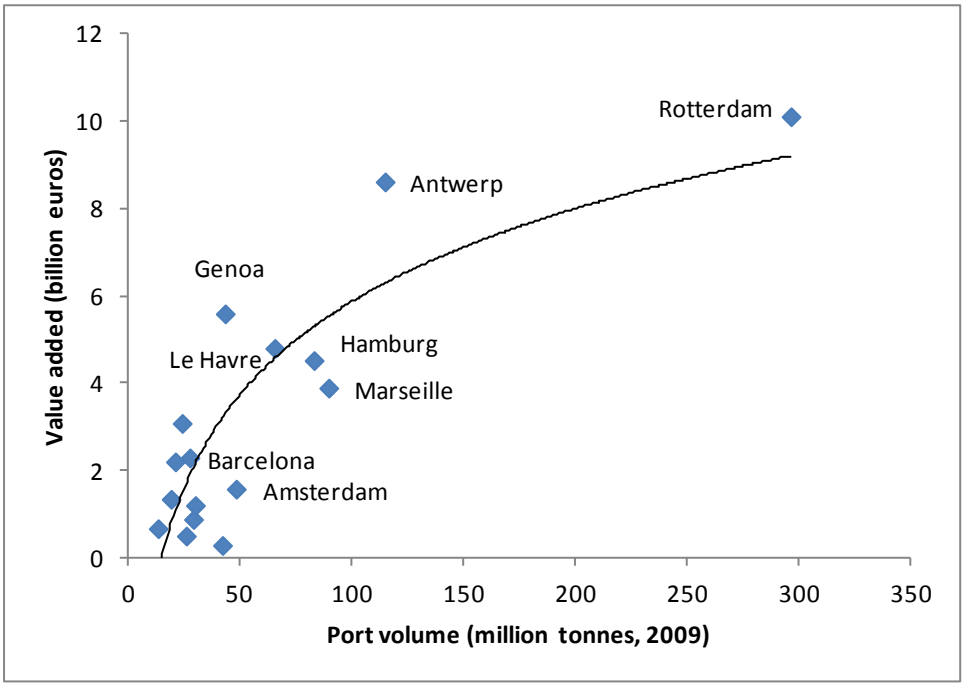
Studies on port-related employment suggest that Marseille-Fos's port specialisation profile could have depressed job creation. Marseille-Fos is a port that is very specialised in liquid bulk, but this cargo category is known for its limited job intensity. This can be concluded from recent research on the relation between port throughput and employment in port regions. Whereas the study found that an increase in one million tonnes of port throughput is associated with an increase in employment in the port region of 600 jobs if liquid bulk is excluded, but only 300 jobs if it is included in the calculations (Ferrari et el. 2012). This is in line with earlier research on the numbers of jobs connected to the different cargo categories in

North-West Europe, which generally concluded that the job ratio related to crude oil and container handling were among the lowest, with general cargo scoring highest (Haezendonck et al. 2000). The overall size of port-related employment in Marseille-Fos is large, but it might have been larger if the port would have had a different specialization.

2.2 Port-related value added

The port-related value added in Marseille-Fos amounts to approximately € 4 billion, representing approximately 3% of the GDP of the PACA region. This calculation is based on an assessment of the port-related employment,[5] discussed in the previous section, and the sectoral labour productivity in France for these different port-related sectors. More than one third of the port-related value added in Marseille-Fos is in the mining, quarrying and energy supply sector (related to the metallurgy sector and petro-chemical sector). More than a fourth of the port-related value added is in transport, storage and communications. Other relatively large sectors are in real estate, renting and business activities, as well as other manufacturing. This value added is slightly smaller than the value added of other ports of similar size. Marseille-Fos' value added, including port-related industries, is almost identical to the one of Hamburg, which has also very similar port throughput volumes[6]. However, value added in both Le Havre and Genoa is higher, whilst their throughput is lower than Marseille-Fos (Figure 12).

Figure 13. Relation between value added and port volume



Source: calculations and elaborations of OECD secretariat based on data of port authorities

2.3 Indirect economic effects

Our study fills the existing information gap on indirect economic effects of the port of Marseille-Fos. Until now, no calculations or estimations of the backward linkages of the port cluster of Marseille-Fos existed. Backward linkages indicate how the port cluster is linked with suppliers of intermediate goods to the port. Such an analysis can reveal the extent and character of the indirect economic links of the port with other economic sectors, based on input/output tables of France. These tables indicate the inputs of each economic sector, such as raw resources or intermediate goods, into all the economic sectors in France. Our estimation of the value added of the port cluster of Marseille-Fos, explained in the previous paragraph, was used to introduce the port cluster of Marseille-Fos as a separate economic entity in these I/O-tables to identify the linkages with economic sectors in France. The extent of the links is expressed in a multiplier score, the character of the links is determined by the sectors with which the port cluster is linked. In addition, for this purpose the national I/O-table was des-aggregated in order to see the indirect economic effect of the port cluster in different regions in France. Regions that were considered to be of interest for this analysis were the region in which the port of Marseille-Fos is located, namely Provence-Alpes-Côte d'Azur (PACA), its neighbouring regions (Rhônes-Alpes, Languedoc-Roussillon, Bourgogne), as well as the dominant metropolitan region in France, Ile-de-France. The results of this analysis are indicated below. As similar analyses were done in previous OECD Port-Cities case studies, these results can be compared with the ones for Marseille-Fos.

The multiplier of the Marseille-Fos port cluster is 2.01; this means that one euro of new demand within the port cluster leads to one additional euro of supply in the French economy. This overall multiplier is the sum of sectoral multipliers weighted by the sectoral shares in the final demand in the port of Marseille-Fos. The multiplier for Marseille-Fos is slightly lower than the overall multiplier found for Le Havre-Rouen (2.47), but slightly higher than the one for Hamburg (1.71) and considerably higher than the multipliers for Rotterdam (1.13) and Antwerp (1.18). These differences can be explained by the country and port size of these respective cases, with the cases of Rotterdam and Antwerp being cases of very large ports in relatively small countries, and Le Havre, Hamburg and Marseille-Fos being smaller ports in much larger countries. The considerable multiplier for the port of Marseille-Fos indicates substantial indirect economic impacts on French economic sectors.

Table 7. Multipliers of the port cluster Marseille-Fos and other European ports

	Multiplier
Marseille-Fos	**2.01**
Le Havre-Rouen	2.47
Hamburg	1.71
Antwerp	1.18
Rotterdam	1.13

Source: calculations and elaborations of OECD secretariat based on data of INSEE and Eurostat

The largest economic links are with transport equipment sector, the food industry as well as the petro-chemical sector. In these sectors the multiplier effect almost reaches three, which means that one euro of new demand within the Marseille-Fos port clusters leads to almost two additional euro of supply in these sectors. Other economic sectors that are relatively strongly linked to the Marseille-Fos port cluster are 'other manufacturing', electrical and optical equipment, as well as mining, quarrying and energy supply. The multiplier effects for traditional port-related sectors, such as transport, storage and communications, as well as wholesale and retail trade, are fairly high, although not among the sectors with the highest

multipliers. Sectors with which the indirect links of the Marseille-Fos port cluster are weakest are non-market services and the real estate sector.

Table 8. Multipliers of Marseille-Fos par sector

	Multiplier
Transport equipment	2.83
Agro-food business	2.69
Coke, refined petroleum nuclear fuels and chemicals	2.67
Other industries	2.57
Electrical and optical equipment	2.51
Mining, extraction et energy supply	2.45
Agriculture	2.27
Hotels et restaurants	2.18
Construction	2.17
Financial intermediation	1.96
Transport, storage and communication	1.92
Wholesale and retail trade	1.90
Real estate, rents and business activities	1.48
Non-market services	1.39
Total multiplier	**2.01**

Source: calculations and elaborations of OECD secretariat based on data of INSEE and Eurostat

Synergy effects within the Marseille-Fos port cluster are very small. Like in Le Havre-Rouen, the backward linkages for firms within the port cluster are very close to zero. This is in striking contrast with the port clusters of Antwerp and Rotterdam. E.g. the overall intra-port multiplier in Antwerp is 1.05, which means that one euro of new demand in the port leads to additional supply in the port of five euro cents. These effects are even higher in the transport, storage and communication sector, as well as the chemical industry, bearing witness to the strong presence of these sectors in the Antwerp port area. A similar distribution of intra-port effects takes place in Rotterdam, even if the extent of this multiplier is smaller. The only sectors for which a significant, albeit small, intra-port multiplier effect (1.01) can be observed in Marseille-Fos are mining, quarrying and energy supply, as well as the petro-chemical industry. The relative lack of intra-port backward linkages in Marseille-Fos could indicate that inter-sectoral links within the port are relatively loose. In contrast with Antwerp and Rotterdam, the spatial clustering of industrial development within the port area has generated only limited synergies.

Table 9. Multiplier effects within the port

	Marseille-Fos	Le Havre	Hamburg	Antwerp	Rotterdam
Coke, refined petroleum nuclear fuels and chemicals	1.01	1.00	1.00	1.05	1.05
Transport equipment	1.00	1.00	1.00	1.05	1.01
Agro-food business	1.00		1.00	1.02	1.04
Transport, storage and communication	1.00	1.00	1.00	1.13	1.07
Wholesale and retail trade	1.00	1.00	1.01	1.03	1.01
Total multiplier	**1.00**	**1.00**	**1.01**	**1.05**	**1.03**

Source: calculations and elaborations of OECD secretariat based on data of INSEE and Eurostat

Despite these limited intra-port synergies, the "embeddedness" of the Marseille-Fos cluster in the PACA region is relatively large. There are indirect economic spillovers from the Marseille-Fos port cluster: new port demand of one euro leads to 6 euro-cents additional supply in the region of Provence-Alpes-Côte d'Azur. Although this effect might seem small, it is in fact large compared to the regional effects of other large ports, in particular Rotterdam and Hamburg. The indirect economic links with the region are particularly large in the petro-chemical sector, food, transport equipment and mining, quarrying and energy supply. The petro-chemical and chemical industry is also in other places (Rotterdam, Antwerp, Le Havre) the industry with relatively close links to the port. The regional transport, storage and communications sector in the PACA-region is less strongly linked with the port than is the case in Rotterdam and Antwerp.

Table 10. Multiplier effects in the port region

	Marseille-Fos	Le Havre	Hamburg	Antwerp	Rotterdam
Coke, refined petroleum nuclear fuels and chemicals	0.11	0.06	0.03	0.05	0.05
Transport equipment	0.09	0.08	0.03	0.05	0.01
Agro-food business	0.10		0.03	0.02	0.04
Transport, storage and communication	0.06	0.03	0.02	0.13	0.07
Wholesale and retail trade	0.06	0.03	0.01	0.03	0.01
Total multiplier	**0.06**	**0.05**	**0.02**	**0.03**	**0.01**

Source: calculations and elaborations of OECD secretariat based on data of INSEE and Eurostat

Table 11. Multipliers of Marseille-Fos per sector and region in France

	Marseille-Fos	PACA	Rhône-Alpes	Île de France	Bourgogne	Languedoc-Roussillon	Rest of France	Total
Transport equipment	1.00	0.09	0.19	0.52	0.04	0.03	0.96	**2.83**
Agro-food business	1.00	0.10	0.15	0.42	0.05	0.05	0.92	**2.69**
Coke, refined petroleum nuclear fuels and chemicals	1.01	0.11	0.18	0.49	0.04	0.04	0.80	**2.67**
Other industries	1.00	0.09	0.17	0.46	0.04	0.04	0.77	**2.57**
Electrical and optical equipment	1.00	0.08	0.18	0.45	0.04	0.03	0.73	**2.51**
Mining, extraction and energy supply	1.01	0.10	0.15	0.42	0.03	0.04	0.70	**2.45**
Agriculture	1.00	0.07	0.12	0.32	0.04	0.04	0.69	**2.27**
Hotels et restaurants	1.00	0.07	0.11	0.34	0.03	0.03	0.60	**2.18**
Construction	1.00	0.07	0.13	0.35	0.03	0.03	0.56	**2.17**
Financial intermediation	1.00	0.06	0.08	0.41	0.02	0.02	0.37	**1.96**
Transport, storage and communication	1.00	0.06	0.09	0.32	0.02	0.02	0.41	**1.92**
Wholesale and retail trade	1.00	0.06	0.09	0.33	0.02	0.02	0.39	**1.90**
Real estate, rents and business activities	1.00	0.03	0.05	0.18	0.01	0.01	0.20	**1.48**
Non-market services	1.00	0.03	0.04	0.13	0.01	0.01	0.18	**1.39**
Total multiplier	**1.00**	**0.06**	**0.10**	**0.32**	**0.02**	**0.02**	**0.48**	**2.01**

Source: calculations and elaborations of OECD secretariat based on data of INSEE and Eurostat

In addition, the Marseille-Fos port cluster has indirect economic links with important neighbouring regions, such as Rhône-Alpes, but the effects on Ile-de-France and the rest of France are more important. The indirect economic linkages of the port of Marseille-Fos with the Rhône-Alpes region are actually larger than those with the PACA region, with a multiplier of 0.10 against 0.06. The largest effect is with

the transport equipment sector (0.19). The Rhône-Alpes-region is home to the second largest metropolitan economy of France, Lyon, neighbouring the PACA-region and also the port of Marseille-Fos' natural hinterland, so the indirect economic linkages are not surprising. What is perhaps more surprising are the large linkages of the port of Marseille-Fos with the metropolitan economy of Île de France, in which Paris is located: almost a third of the additional supply due to new demand in the Marseille-Fos port is taking place there.

High value added maritime services

Major port cities are privileged locations of order centers and convergence of information on monetary transactions, commodity exchanges, the price of chartering vessels and the rules of organization of the maritime industry. Major port-cities differ according to their weight in the provision of maritime services measured by the presence of banking, financial and stock market and the consolidation of insurance companies, the corporate headquarters of carriers and global terminal operators, and the authority to impose standards organizations in the maritime industry, among other sectors.

Existing studies do not consider Marseille to be one of these leading international maritime services centres in Europe. One of the existing studies looks at the leading cities in advanced maritime producer services, defined as multi-office firms for maritime insurance, law and consultancy (Jacobs et al. 2010). In this study Marseille does not figure among the top 20 European cities with the largest number of establishments for Advanced Producer Services (APS). However, Paris does and is ranked 9th with 55 establishments and 6 headquarters. Marseille's competitor Antwerp also has a large maritime APS concentration and is the fifth city in this respect. Mediterranean port-cities in the ranking are Piraeus (2nd), Limassol (7th), Istanbul (10th), Genoa (11th) and Valletta (13th). The Spanish ports of Barcelona and Valencia do not figure in this ranking, which might be explained by the high concentration of maritime APS in Madrid. Another study identifies main cities from which container shipping companies are run, analysing the global office structures of 35 of the largest container shipping companies and global terminal operators (Verhetsel and Sel, 2009). Based on the global connectivity of these cities in terms of multi-office networks, six levels of world maritime cities were identified. Despite the presence of the CMA-CGM headquarters, Marseille scored only 38th out of 50 world maritime cities and was qualified as a level 6 world maritime city, as were Barcelona and Paris. The two first level world maritime cities identified were Hong Kong and Hamburg. Also in this study Antwerp (ranked 11th) and Genoa (14th position) emerged as more important world maritime centres, as did Le Havre (30th rank). A final study on lead maritime cities only looked at 12 cities and did not bother to include Marseille (Menon, 2012).

This perception of Marseille is confirmed by datasets on port-related maritime services collected for this report. From many of these databases, Piraeus emerges as the leading centre in the Mediterranean, as well as several others, but the role of Marseille is limited. Contrary to Antwerp and Genoa, Marseille is not among the largest 30 cities for ship broking, established on the basis of the count of localisation of more than 2,000 ship brokers registered in the World Shipping Register Database. French banks play a relatively important role in ship finance, as measured by shipping portfolio and largest ship finance deal values, but these banks are all headquartered in Paris. Marseille is not a leading location for dredging companies, dominated by Dutch and Belgian companies, but where France is represented by Rouen. Almost all of its shipbuilding activity has disappeared and it is not a main location for international maritime related engineering services, at least not when based on counts in the Lloyd's List Marine Equipment Buyers' Guide 2011. The international role of Marseille is also limited with respect to patent applications in port-related sectors (shipping, petroleum, food etc) based on the OECD Patent Database and with respect to port-related research based on a count of the city affiliations of the authors and co-authors of 576 port-related articles published in leading peer-reviewed academic journals between 1997 and 2011.

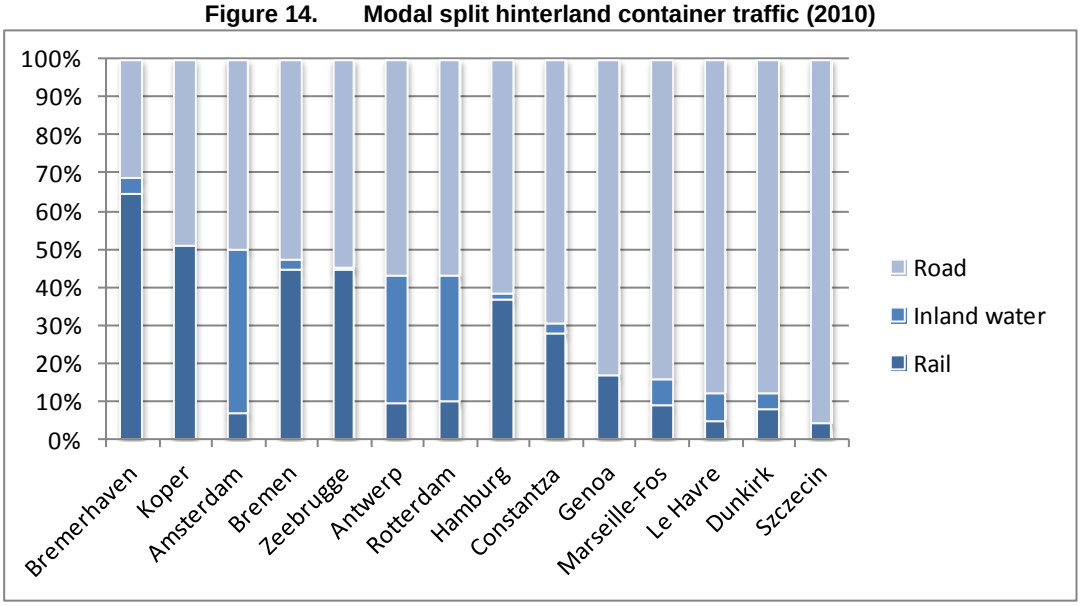
2.4 Environmental impacts

The port of Marseille-Fos has negative impacts on water quality. Environmental damage observed on the eastern sector of GPMM are the consequences of past activities and facilities of the port. The natural environment of the harbor basin is poor, with the former sediment contamination by metallic and organic pollutants. France was condemned by the European Commission for the degradation of ecosystems in this area and the Rhone (INEA 2009). Also on the site of Fos-sur-Mer, environmental impacts due to port infrastructure and port industrial zone located in the town. The positioning of Fos in the 1960s has changed the landscape of the region. Five areas near the site are protected areas, or there are interactions between the port and projects these protected areas. As Marseille, marine sediments have been contaminated. The dredged sediments are now used to backfill the docks or immersed in water, which represents a disturbance to the ecosystem. Water quality in the Gulf of Fos is set in motion by the maritime port, with effluent discharges, and therefore anthropogenic pressure.

The port-related industries in Marseille-Fos have a negative impact on air quality. Quantification of emissions of carbon dioxide (CO2) is 8.2 tCO2e (tonnes of CO2 equivalent) per capita of Marseille Provence Métropole and 109 tCO2e per capita for the sector including industrial port zone of Fos-sur- Wed The average per capita of the Marseille metropolis is comparable to those of cities like Lyon and Lille. But if the emissions of Fos are integrated in these numbers, the average more than doubles (BG Consulting Engineers, 2011). Maritime transport is a source of pollution, with 49% of transportation emissions concentrated services for ships and vessels. Despite its efficiency, maritime ferry and passenger transport emits a large amount of pollutants leading to formation of tropospheric ozone (ozone low altitude), because it uses mostly petroleum products. On million tonnes of CO2 emissions from transport within the SCoT (Territorial Coherence Scheme) West Étang de Berre, 920 000 tonnes are produced by maritime transport (BG Consulting Engineers 2012).

These impacts are partly related to the modal split of hinterland traffic, relatively highly oriented towards truck transportation. Transportation of goods to the port accounts for 11% of CO2 emissions MPM, second only to the emissions from industrial processes in the city (25%). These emissions come mainly from the minimum of 200 trucks that circulate permanently in the city in connection with the port (BG Consulting Engineers 2011). The share of trucks in the modal split of port hinterland traffic is relatively large in Marseille-Fos (85% in 2010); most large ports in Europe have managed to reduce this share either through inland water transport (Rotterdam, Antwerp, Amsterdam), or rail, such as in Hamburg, Bremerhaven, Koper and Zeebrugge (Figure 13).

Figure 14. Modal split hinterland container traffic (2010)



Source : own elaboration on the basis of data from Schiffahrt Hafen Bahn und Technik, Merk and Hesse, 2012; and Beretta et al. 2012

3. PORT-CITY POLICIES AND GOVERNANCE

Previous chapters have focused on challenges related to port performance and port impacts, but what can be done about it, and how? These are the central questions of this chapter on port-city policies and governance. The first part of this chapter will argue how strategic and pro-active port development could improve port performance and thereby increase the impacts of the port. The second part analyses how the port could be an asset for the metropolis of Marseille, so how the positive impacts could be increased; whereas the third part focuses on how the negative impacts could be reduced. The final part delves deeper into how these policies could be implemented, more in particular: what would be needed in terms of governance.

3.1 Strategic and pro-active port development

Long term strategic planning

Several ports are engaged in long term strategic planning. Such long term engagements are expressed in strategic visions that are to a more or lesser extent publicly available. These visions can identify new directions of development, prioritise investments and identify future bottlenecks. If well designed, the strategic planning process can help to engage main stakeholders, strengthen links with clients and create local goodwill. Long term planning is most effective when these long term visions somehow get translated in operational plans, and when these long term visions are regularly updated and revised.

The strategic vision of the port of Marseille-Fos is expressed in its *Projet Stratégique 2009-2013* with an actualisation in 2012. This is a mandatory document required for all GPMs by the State. This document provides a detailed analysis of current challenges of the port, with strategic goals for port development in five different sectors, projections for 2020 (and 2030 in the actualisation in 2012) and the necessary conditions to achieve these goals. The five large sectors (orientations) prioritised in this vision are containers, energy, dry bulk, roll on-roll off (RoRo) and passengers. Targets are announced for the modal split of hinterland traffic, both from Marseille and Fos. In a wider European context, the port considers itself an asset for sustainable development: if more of the French external trade would go through Marseille-Fos instead of Antwerp, the number of trucks on European roads would be significantly reduced according to the document

A key ambitious target in this strategic plan is to handle five times more containers in 2030 as in 2011. This goal of 5 million TEU was in the original plan foreseen for 2020, but pushed towards 2030 in the actualisation of the strategy. The target remains very ambitious, considering that this would require an annual growth rate of 22% in the next 19 years, almost four times the growth rate realised in the container sector in Marseille-Fos over the last 19 years. The plan assumes that global markets will generate an average growth rate of 4 to 5% for European container markets, so the largest part of the growth would have to come from recapturing market shares from competitor ports, most importantly the French market, but penetration in Swiss, German, Italian and Spanish markets is foreseen as well. According to the strategic plan realisation of this target would result in 22,000 additional jobs. The total tonnage projected for 2030 is 156 million tonnes (1.7 times the current volume), which would be realised by doubling RoRo-traffic whilst stabilising and diversifying liquid bulk traffic.

As part of this strategy, the share of sustainable hinterland transport is targeted to go from 15% to 40%. In 2010 85% of the hinterland traffic of containers was done by truck, 8.5% by rail and 6.5 by barge. The strategic plan wants to change this into a 60%/30%/10% distribution in 2030. This would mean that 15 times more containers would have to be transported by rail and 7 times more by barge. Considering the overall container growth targeted, the reduced share of truck traffic would still mean a large increase of the number of trucks, namely a tripling of volumes between 2010 and 2030. Considering that the truck share in Fos (86%) is currently higher than in Marseille (81%), the largest increases would have to be realised in Fos, where currently also the largest traffic growth takes place.

In addition to this strategic plan, a long term vision has recently been developed for the East Basins of the port that needs to be confirmed and implemented. This vision, elaborated by the Cousquer Commission, at the request of the *Conseil de Surveillance* of the Port of Marseille-Fos, proposed to divide the waterfront in three parts: one part, centered around the *Euromediterranée* area for port-city interface development, tertiary sector development and Schengen passengers; a second part devoted to cargo handling, industrial development and logistics; and a third part related to recreation (beaches, nautical center, marine). These strategic orientations have received broad support and will need to be operationalised via the recent City-Port Charter.

A broadly shared perspective on the long term future development of the West Basin would be needed if the ambitions of the *project stratégique* are to be realised. Despite the port strategic plan, there does not appear to be a common vision of the relevant actors. Support for further port development is fragile and the extent and types of future industrial development on the port sites remain largely undefined. Although the *projet stratégique* formulates strategic ambitions and has a relatively long time horizon, it has been able to catalyse a strategic vision for the future shared by the relevant stakeholders for two reasons: it remains preoccupied with the short term and it has not been formulated based on a large consultation of stakeholders. In order to lead such a process, it would b essential to include fact-based assessments, search for common interests and a long time horizon. As such, the ongoing public consultation can be applauded as a basis for further cooperative efforts. This consultation on the port-industrial zone of Fos was launched by the GPMM and piloted by its *Conseil de Développement* in 2011. Its goal is to foster a dialogue between all actors involved in the development of the East Basins. The outcomes of this consultation will be incorporated in the next Strategic Plan of the GPMM (2014-2018).

Wide stakeholder involvement in such a shared vision is essential, along the lines of long term strategic planning in Rotterdam. Port Vision 2030 of the Port of Rotterdam, adopted in 2012, was much less focused on targeting future throughputs, but much more imaginative on how the port of the future could look like based on a comprehensive assessment of a variety of trends that could change the role of ports. With respect to port volumes, it actually described a range of scenarios, emphasizing the flexibility that would be needed to be forward-looking. One of its main observations was the changing European landscape of energy production (rationalisation of refineries) and the ambition to be, in close cooperation with Antwerp, the main petro-chemical and energy hub in Europe. However, the most important accomplishment of the Port Vision 2030 might be the process of stakeholder consultation and engagement used to establish the vision, which not only informed the port authority of challenges perceived by its clients and stakeholders, but that also created a form of buy-in of these stakeholders in the strategic vision of the port.

Connections with forelands

Just like many ports of the world, Marseille Fos was affected by the global economic crisis, which shows that maritime traffic is strongly related to the demand of different sectors of production and distribution. There are the major clients in the global agricultural, industrial, retail or service sector i who decide how and which ports are participating in the process of freight transport. Cargill, Bunge, Louis

Dreyfus Group, the multinational agro-food sector, control the grain trade, traffic volumes and decide on ports of call in networks in America, Europe and China. The adoption of plans to close several European steel industries by Arcelor Mittal profoundly alters the traffic of iron ore both in the Mediterranean and the Rhine area (CCNR, 2006). The global petrochemical industry is also changing. No refineries have been built in the United States and Europe for 30 years. Those that exist are poorly adapted to heavy oils, but some refineries offer more growth potential (Wingert, 2005). The closure of several petrochemical plants in North America and Europe is already foreseen for over 10 years. Strategies induced by global economic processes have unpredictable impacts on port traffic. Freight volumes are more determined than determinants.

The scheme of territorial coherence (SCoT) of Étang de Berre West recognizes the importance of adopting a strategy of diversification of the economic base by hosting companies independent of major clients (CAPM, 2010). GPMM also makes a clear observation of the status of contractors in the field of petrochemical and steel (GPMM, 2009). The massification of flows is the priority for shippers, logistics service providers and end users. Consequently, the development of the Port of Marseille Fos must be associated with an accentuation of economic integration and globalization of markets. This approach is one of the essential conditions for the growth of maritime traffic by improving organizational logics between the actors involved in the transport chain.

The Chamber of Commerce and Industry of Marseille Provence recognizes the geographical eccentricity of Marseille versus Northern Europe (CCIMP, 2009). This perception of the port as "end of the line" must be changed. The conquest of new cargo for the port of Marseille-Fos must be embedded in a new geographical perimeter affirming the role of the port as a maritime interface east-west, north-south and trans-Mediterranean. GPMM (2012), supported by the Council for the Development of Marseille Provence (CDMPM, 2011), stresses the importance of capitalizing on small bulk and intra-Mediterranean short lines. This orientation in the 2009-2013 strategic plan could be based on a twinning program with port cities of Mediterranean Africa and elsewhere.

One way to recapture market in Marseille-Fos could be to be more pro-active in maritime foreland connectivity. Several world ports have developed strategic port acquisitions and relations to attract traffic from emerging markets. One of the largest port terminal operators in the world, PSA, started as the port authority of Singapore. Shanghai and Ningbo Port created a join investment vehicle, the Shanghai Port and Shipping Investment Co, to invest in ports and other activities. Also in Europe, there are several of such examples. The port of Rotterdam has acquired stakes in ports in Oman and Brazil, the port of Antwerp in Indian ports. HHLA, closely related to the port of Hamburg, operates container terminal in Odessa. Most of these ports have divisions that provide port consultancy services to foreign ports. These acquisitions and activities form part of a larger strategy to connect to main ports in emerging markets to create new networks that will facilitate new port traffic. Similar activities take place in some French ports. The port of Rouen has provided technical assistance to ports in Vietnam, Congo, the Central African Republic and Cameroon. The port of Le Havre is strongly linked to the port studies programme of the Normandy Business School (IPER), which provides a large range of executive courses to port administrators from over the world. The activities described here are only to a very limited extent applied by the port of Marseille-Fos. Its ambition to regain market shares and attract traffic to Marseille-Fos could partly be realised by a more pro-active approach towards its maritime foreland.

The containerized trade is dominated by global shippers, carriers and terminal operators (Slack et al, 2002). The presence in Marseille Fos of CMA-CGM, the third largest global container carrier, and Dubai Port World, the third largest global port terminals, can be considered an asset for the port. Clearly, the decision of these companies to use the port of Marseille Fos is motivated by the relative position of this port within their global networks (Alix *et al*, 1999). Business strategies of these corporations exert a significant impact on the volume of containerized flows at the port of Marseille Fos. The presence of these

corporations suggests that the revival of the port of Marseille-Fos requires a sharing of responsibility between soliciting public and private actors, as applied in Hong Kong (Box 1) and Shanghai (Box 2). The aim is firstly to provide a better understanding of the constraints and obligations of stakeholders, as well as the development of concerted action, and secondly, to assess infrastructure needs that will be borne by the public sector, and superstructures funded by the private sector.

Box 1. The expansion of the maritime market shares of Hong Kong

The search for new markets in Hong Kong is affected by the increase in unit labor costs, capital, risk and information. There are also differences between ocean carriers and terminal operators that are capital intensive while managers of land transport networks and shippers are labor intensive. Since 2000, the Port Authority of Hong Kong works in its strategic plans on the management of a single intermodal transportation system that incorporates the activities of ocean carriers, terminal operators, managers of land transport networks and shippers. The search for new cargo is carried out by the extension of spatial margins related to freight distribution centers. Investment strategies of the Port Authority of Hong Kong facilitated the development of an alliance between the conglomerate Hutchison Whampoa, which owns 60% of the terminal Kwai Chung and the Chinese carrier COSCO. This alliance can insert port terminal operations in the same trajectory as that of the Chinese company. This has strengthened the regional organization and created new sites of investment and attractive markets. The private operators of the Kwai Chung terminal encouraged the development of secondary terminals in the Pearl River Delta (Comtois and Rimmer, 1996). In addition, the introduction of electronic data interchange linking the entire supply chain has enabled the establishment of an effective distribution system, based on new corridors of secondary services. While the main roads continue to dominate the transport development, the role of secondary networks is complementary to the main roads. These last are of a multitude of functions: 1) entering new market niches, 2) support the transportation needs of major roads; 3) rebalance regional traffic (Comtois and Slack, 2000).

Box 2. The expansion of the maritime market shares of Shanghai

During the last decade, Shanghai has experienced one of the highest growth rates in container traffic. Shanghai Port is the largest container port in the world with traffic volumes of more than 31 million TEUs in 2011. The importance of Shanghai is partly the result of a redefinition of the functions of production and transport (Comtois and Dong, 2007). The port works in conjunction with the carrier COSCO to facilitate the development of business functions and value added. This approach provides a powerful incentive for the growth of container traffic. This growth must also be interpreted in the context of massive investments in marine equipment along the Yangtze for the loading and unloading of containers, leading to an increase in the volume of containerized cargo between Chongqing and Shanghai. COSCO has reorganized its port through joint ventures with local companies to provide shuttle services for cabotage along the Yangtze. COSCO has established offices, built warehouses, developed cabotage traffic, unified controls in container traffic, strengthened its documentation and forged links between the ports of the Yangtze River and the port of Shanghai.

Connections with hinterland

Governance of port cities is increasingly influenced by the process of developing trade corridors. The goal is to integrate the port system in a multimodal transportation network in order to improve market access, fluidity of trade and the integration in an industrial network. In this context, a port must have interfaces between major oceanic maritime trade and economic activities of ports and inland terminals that provide intermodal structures and connections between the forelands and hinterlands (Klink and Geerke, 1998, Notteboom and Rodrigue, 2005). Obviously, business transactions require an adaptation to hinterland means. Conversely, the amplification capacity of transport modes may allow the expansion of trade. These bonds of mutual causality are now present in the traffic of port cities. The quality and capacity of hinterland modalities, roads and relays are essential to any expansion of trade.

The Rhone-corridor appears as a linear extension of a network of cities ranging from the estuary to the heart of the European continent. Bounded by some of the largest urban concentrations and a network of roads, railways and ports, the system is indeed more characteristics of a corridor, a structure of exchange that occurs along a network linear transportation arteries between a string of cities. A closer examination reveals, however, that the unity of the corridor must be qualified. The urban corridor in the Gulf of Lyon is not really integrated with the cities of northern European ranks. In addition, there are other north-south corridors that compete with the Rhone axis, including the corridor Rotterdam-Genoa and Barcelona-Lyon-axis southern Germany that bypass the port city of Marseille.

Considerable efforts have been made to improve the connection with the hinterland via rail and inland waterways. The ports of Marseille-Fos and Lyon have since 1999 adopted a common strategy to improve connectivity in the form of a multimodal (rail, road and river). In addition to this, they have agreed on a customs agreement to reduce the time of river transport of goods between Marseille-Fos and Lyon to 24 hours and a project to improve the river access for containers. The Port of Lyon hosts and distributes containers transported by rail. Similarly, the port of Fos has organised special treatment for the unloading of barges with grain. An innovative infrastructure facilitates the transferring of grain products directly from the barge to cargo.

With respect to river transport, the port of Marseille Fos took advantage of European strategies. The European Union is engaged in a major effort to promote modes of transport alternative to road transport. The Marco Polo program aims to promote all initiatives in this direction. The first phase of the Marco Polo Programme (2001-2006) has a budget of EUR 75 million. The goal was to reduce traffic congestion in Europe and return to the modal split of 1998 levels. The project involved the diversion of 12 billion tonne-kilometers of road transport to other modes of transport. In the specific area of river transport, the European Transport Ministers adopted in 2001 the Declaration of Rotterdam with a budget of EUR 820 million was also aimed at promoting the sector. The second phase of the Marco Polo Programme (2007-2013) aims to divert 144 billion tonne-kilometers off the road network. During the period 2003-2006, the Marco Polo program has funded 56 projects with 20 included a maritime component (Urli and Guy, 2009). The majority of these projects involved the development of RoRo-services. The European Commission has also launched the Naiads Programme in order to boost river transport. The program acts as a promotional tool for river navigation in public policy.

The project contract state region (CEPR) - Provence Alpes Côte d'Azur for 2007-2013 announces the political will to develop river transport. Several funding arrangements have been made between the State, the *Compagnie Nationale du Rhône* and Regional Councils. GPMM has already stated its intention to develop river transport in the Rhone Plan. Concretely, GPMM took part in the capital of the tri-modal platform Pagny in Burgundy, and recognizes the importance of business partnership proposed by Medlinks Ports which brings together eight platforms of the river Rhône-Saône around the port of Marseille Fos. This vision, shared among stakeholders, would allow for growth of traffic on the Rhône-Saône basin.

Despite these efforts, several challenges related to the hinterland remain unresolved. With respect to railways, the port of Marseille-Fos is owner and manager of railways in the port area, but access to the port railway are penalized by inadequate infrastructure. The Court of Auditors (2011) recognizes that GPMM is not sufficiently integrated with its hinterland. Development Council of Marseille Provence Métropole emphasizes the need to develop a rail link with Italy through the Val de Durance and Montgenèvre. But progress is linked to the reform plan currently underway at the national railway SNCF. Notwithstanding the efforts of the Axis Rhone, Marseille-Fos is far from having completed a system comparable to the dry port of Gothenburg (Box 3), Savannah (Box 4) or Virginia (Box 5). Unlike the majority of hanseatic ports, trucks remain dominant in the modal split of the hinterland, and although inland waterways are increasing the share of rail declined between 2005 and 2011. Major rail corridors, such as those linking Rotterdam-Genoa and Barcelona-Lyon-Turin-Trieste-Budapest complicate attempts of Marseille-Fos to conquer these

new hinterland areas. At the same time, Marseille-Fos managed to get included in the TEN-T corridors 3 and 9.

Box 3. Rail freight transportation in Gothenburg

Gothenburg has developed an extensive system of rail freight: every day, 25 shuttles are used to transport containers in 24 destinations in Sweden and Norway. This system can transport directly containers from ships by rail to distribution centers within a radius of 300 km around the city. The City of Gothenburg has decided to set up this system in 2000 to improve environmental and economic performance of the port. Indeed, the rail freight system, as designed in Gothenburg, facilitates faster transportation of goods to their final destination by limiting emissions of greenhouse gases. In 2002, thanks to the joint financing of the Swedish Ministry of Transport, the Port Authority of Gothenburg and Västra Götaland Region, the city has set up an infrastructure for multimodal transport of goods by rail through the relocation of customs to distribution centers in the hinterland, which limits transhipments. Once arrived at the distribution center, trucks are responsible to transport containers to their final destination. This system is used for the transport of containers of 20 and 40 feet, but in order to have more customers to take advantage of this system, the Port Authority has also implemented innovative container formats, which makes it possible to transport rolls of paper by train.

The rail freight system in Gothenburg is known for its benefits in terms of costs. The speed of container transport has increased as a result of several mechanisms. First, the arrival of the rail freight system has helped to reduce congestion caused by trucks from the port within the confines of the city. This system allows reducing around 360 trucks per day in the city. Secondly, customs decided to operate directly in the hinterland so that goods can be transported more quickly to their final destination. This customs decentralisation also allows more cargo to pass through the Port of Gothenburg which might explain the significant growth in container traffic at the Port from 2001 (which corresponds more or less at the date of implementation of the rail freight system) and 2011: 61.2%.

Each year 200,000 containers are sent to a hinterland of 300km around Gothenburg. This area corresponds roughly to the largest industrial area in Scandinavia, since 70% of Scandinavian industries are within 500km around Gothenburg. Business needs of the region in terms of import and export helps to explain the enthusiasm of policymakers for the rail freight system. In 2011, 887,000 containers passed through the Port of Gothenburg and 374,000 of them were transported to the hinterland by rail freight, which represents approximately 40% of traffic. The objective is to increase the port number of containers transported by rail in 2020 to 50% by increasing the efficiency of the system. To do this, the Port Authority has implemented a participatory assessment of rail freight allowing multiple user categories to highlight areas for improvement. Finally, the efficiency of rail freight from the Port of Gothenburg is enhanced by the ability of the city to integrate it into broader urban development plans, strengthening its coherence.

The success of the rail freight from the port of Gothenburg can be explained by three main factors: a collaborative governance system controlled by an efficient port authority efficient, the importance of public investment and the ability to meet the expectations of users. This system of governance has been made possible by the change of the legal status of the port in 2010, from a municipal service to a public company. Since 2010, the Port Authority is responsible for strategic decisions and cooperates with a large number of players, that is to say, the municipality of Gothenburg, the Ministry of Transportation, the Region Västra Götaland, customs and many operative private actors within the system, for both trains and terminals. The Port Authority is responsible for the coordination of the different actors and has the ability to mediate interests. This allows for better cooperation between actors under the supervision of the Port Authority. Similarly, the number of actors involved in the decision-making process explains the relevance of urban plans associated with the port (such as the proposed Comprehensive Plan and Marieholm 2009). The effectiveness of the implementation of the system also helps explain its success. In fact, the project was approved at city council in 2000. Between 2000 and 2002, 6 rail shuttles were built and 25 of them work in 2011. The rapid development of rail freight has been facilitated by the importance of public investment for infrastructure construction.

Finally, the success of the system can be explained by the ability of public actors to focus their strategy according to the needs of private actors, such as the establishment of specific cargo for transport companies without containers. Meanwhile, the use of rail freight system reduces costs for users: the speed of loading and unloading cargo is reduced, which reduces their parking fees at the dock. Similarly, storage of goods outside the port reduces costs (insofar as the application for the same warehouse is reduced) and finally, the port offers differentiated tariffs for customers choosing to reduce their particulate emissions. The increase in the number of containers transported by rail since the creation of this system, demonstrates its effectiveness and the enthusiasm of users.

Box 4. Savannah Logistics Centre

The Port of Savannah is the main component of the logistics hub of Savannah because of the importance of its market, oriented to transcontinental trade, and the amount of cargo transiting the port. The growth of global business and the amount of incoming and outgoing cargo at the port of Savannah highlighted the need for warehouse and distribution center in the region (Atlanta Business Chronicle, 2009). The logistics center of Savannah is specially developed with the aim to support this request. The Georgia Port Authority owns and operates the Port of Savannah while A & B Properties and Colliers Neely Dales are the main promoters and developers of this logistics pole (A & B Properties, 2009).

The Port of Savannah handled almost 3 million TEUs in 2011 and plans to increase its capacity to 4 million TEUs by 2015. These growth forecasts have led to the construction of warehouses. There is a strong demand for storage of approximately 50,000 m2. The developers plan to increase the operating site by monopolizing land in Jasper County, South Carolina. The acquisition of new land will allow the logistics centre to double the size of its land (Brown, 2009).

The logistics center is part of the Savannah extensive rail network of Northfolk Southern Railway, which offers comparative advantages of transportation. Savannah facilitates the transfer of containers from rail to vessels with a direct connection to the port. The essentially bimodal network can serve the U.S. East Coast, including the ports of New York/New Jersey, Philadelphia and Baltimore (Lower Savannah Council of Governments, 2002). Savannah offers especially services related to storage and distribution in the region (Southeast Real Estate Business, 2006).

Box 5. The dry port of Virginia

The logistics center in Virginia Inland Port facilitates the transfer of containers from truck to rail. The logistics center provides container management for the Port of Virginia and the regional cities. More specifically, containers arriving by truck from the Ohio Valley and Pittsburgh are transferred by rail (Norfolk & Southern Railway) in the Front Royal to the inner harbor (Norfolk Southern Corporation, 2009). The purpose of the Virginia Inland Port is to capture a greater market share in the region of the Ohio Valley (Ohio, Pennsylvania, western Maryland and western Virginia). Before the implementation of the Virginia Inland Port, cargo was transiting through the ports of Baltimore and Philadelphia. To capture the international market and develop the local economy, developers have focused on traffic forecasts in order to attract shippers (Heerwawgen 1996; Online Resource Center, 2009).

Virginia Inland Port is planned in such a way as to establish facilities for containers in a non-congested area where roads and rails which are easily accessible and conflicts related to land use are smaller. The Virginia Inland Port has generated economic benefits because of the rail link between the Virginia Inland Port and Marine Terminal in Hampton Roads, which gives direct access to more than 75 international international shippers (Online Resource Center, 2009). One advantage of Virginia Inland Port is the presence of customs, as the logistics hub is part of the US Custom-Designates Port of Entry.

Active involvement of the national government would be needed to facilitate access to new hinterlands. Progress would need to be made to resolve current bottlenecks, e.g. the rail bypass around Lyon, a large gauge canal connection between the Saône and the Rhine. In addition to these, there are projects where the port itself could find ways to move forward, e.g. a direct canal from the Fos container terminals to the Rhone (Caban Nord).

3.2 The port as metropolitan asset

Structural changes in global logistics suggest a redesign of the interface between the port and the region. Transportation systems are essential to the formation of regional economic spaces. All scenarios of economic development are related to growth in freight traffic, passengers and information. But this growth highlights the connections between infrastructure, industrial production and the built environment. The synergies between all modes of transportation are critical to the success of port cities. The organization of transport systems is more and more based on the quality of logistics services.

Marseille has developed a land use plan that includes a supply of land for the development of a logistics park that meets the needs of the port. A key element of the success of the project is to link the major shipping companies to local freight handlers. Marseille-Fos Port Authority recognizes its multi-functionality, with the participation of five sectors present on the East Basins. Since 2008, the Port Authority has taken steps to allow the reception of larger container ships with deeper draft to Mourepiane. The SCOT for Étang de Berre-West opts for strengthening industrial densification in Fos promoting the transition from a strictly land-oriented approach towards a logic of pools of activities (CAOEB, 2010). These plans can be used for a new direction in the planning of the port, which recognizes the need to introduce innovations in logistics and environmental practices.

The development of logistics activities should foster a culture of entrepreneurship and business based on the knowledge economy. The mass of workers generated by logistics activities requires that they have training in logistics operations. Multi-tasking is frequently required in the industry, with tasks ranging from manual to high technical level. Educational institutions of the Greater Marseille must establish programs and training courses tailored to educate youngsters within the industry, and to provide training for experienced workers who wish to reorient themselves towards logistics activities. The port authority shall keep at the forefront of technology and be on the lookout for new technologies and new equipment. Cooperation must be established with universities and research institutions in Marseille. Exchanges with university research centers become fundamental. The goal is to make the Marseille region a center of excellence in research and training logistics. This reputation can become a powerful promotional tool to attract logistics companies seeking to establish a European platform where there is a reserve of experienced and adequately trained labour.

Attract international maritime services

Strategic documents of the city and agglomeration of Marseille do not only support port development, but also express the ambition to become leading trade and services centre. The economic development strategy 2008-2014 of Marseille Provence Métropole (MPM) considers the port and logistics economy as one of the five economic drivers of the metropolis. Its ambition is expressed in the title of the document: *Métropole euroméditerranéenne des échanges et de la connaissance* (Euro-Mediterranean metropolis of trade and knowledge). Within this ambition, the port and the port-related industries are important constituent elements for becoming the trade metropolis of southern Europe, as well as for the development of the tourism economy. Similar catchwords can be found in the strategic document of the city of Marseille, "Marseille Attractive 2012-2020". The three main axes in this strategy are to become the leading south European trade platform, to be a city of knowledge and creativity and to be "city of destination" (*ville de destination*). Also in this strategy there is a role for the port and its related sectors; firstly to be one of the drivers of the trading ambition and secondly to facilitate the positioning of Marseille as an attractive destination.

These strategic orientations could be used to develop a concrete action plan to attract international maritime services and headquarters. The development strategy of the MPM has the merit of proposing very concrete and measurable actions and several of these actions, e.g. on maritime education, will certainly help to create a more favourable climate to attract international maritime services. However, its focus is not so much on attracting maritime headquarters and services such as maritime consulting, engineering, law and finance, nor are they explicitly targeted by the GPMM or in the Port-City Charter, whereas these would be interesting activities because of their value added, and feasible targets because of the maritime heritage of Marseille and the already existing port and maritime community.

Projecting a positive image

The spatial development of the port of Marseille-Fos is a classical example of the dynamic development of the port-city interface. In seminal article on the relations between ports and their cities, Hoyle introduced the concept of "port-city interface", indicating the spatial relationship between ports and cities (Hoyle, 1989). This interface was a dynamic concept with different phases of port-city development over time, determined by tendencies of population growth, port growth, industrial development, space constraints, leading to port re-location, transformation of former port areas and subsequent disintegration and partial re-integration of port and city functions. In this article, the case of Marseille was used to illustrate the different stages of the port-city interface. These processes have been at work in many large port-cities all over the world, and the changing nature of port-city relations have posed the common challenge on how to sustain support for remaining port functions close to city centres, but also how to maintain links of a local population with port activities that are increasingly located elsewhere, and generally not accessible to the public.

Developments over the last decades have not improved the image of the port of Marseille-Fos. Internationally and nationally, the port was most known for its complicated and conflict-rive social relations, leading to limited reliability and declining port volumes. The interface between the city of Marseille and the East Basins of the port was for many years the source of fierce battles, resulting in a dramatic and impermeable port-city interface, closing off the access and visibility of port functions to the population. The West Basins were far out and invisible to most people from Marseille, but all too visible for the local population subject to severe environmental impacts, but that did not feel empowered to influence decision making on port development. In sum, the port of Marseille provokes local sentiments of mistrust and ignorance at best. The local sentiment of pride in its port, noticeable in the largest European port-cities such as Hamburg, Antwerp and Rotterdam, is strikingly absent in the city-region with the fifth largest European port.

Several world ports are engaged in extensive external communication strategies, in order to sustain local support for port functions. A first and necessary element in these efforts is access and transparency of port information. Many ports provide public annual reports of their activities, including financial reporting, corporate social responsibility, human capital and key public management performance indicators. Several ports also provide information that in most cases most relevant to the population, namely clear and objective information on environmental impacts. E.g. the Port of Los Angeles publishes every year a publicly available Air Quality Inventory Report (Box 6); the port of Antwerp publishes an annual Sustainability Report. In many US ports, meetings of the port commission are accessible to the general public, with agendas and proceedings of the meeting distributed on the port website. New port projects are discussed with the population through information and consultation meetings; and in some cases open to public visits and explained in visitors centres, such as the highly popular visitors centre for the Maasvlakte 2 Port Expansion-project in Rotterdam. Selected European ports, such as Antwerp and Genoa, have port information centres where the general public is instructed about the port and its functions. As part of their external communication strategy, many ports make use of the social media, having large crowds of followers on Facebook and Twitter.

Box 6. Inventory of Air Emissions at the Port of Los Angeles and Long Beach

The Port of Los Angeles and the Port of Long Beach have since 2005 an Air Emissions Inventory in place to measure port-related air pollution and inform the public about this. This inventory is part of the San Pedro Bay Clean Air Action Plan (CAAP) that is designed to reduce air emissions and health risks that are associated with air pollution (see Box x). The 2005 Inventory of Air Emissions serves as the baseline to measure progress on this action plan. The development of the air emissions inventories was coordinated with the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and the South Coast Air Quality Management District (SCAQMD). Port tenants and shipping lines also play an essential role by providing accurate activity and operation information. The activity and operational data collected is then used to estimate emissions for each of the various source categories in a manner consistent with the latest estimating methodologies agreed upon by the Port and participating regulatory agencies. All the detailed annual inventories reports are available to the public on the port websites.

The inventories evaluate emissions from five port-related mobile source categories: Ocean-going vessels (OGVs), Harbor craft, Off-road cargo handling equipment (CHE), Railroad locomotives, On-road heavy-duty vehicles (HDV). For each category, exhaust emission are estimated for the following pollutants: Particulate matter (PM) (10-micron, 2.5-micron), Diesel particulate matter (DPM), Oxides of nitrogen (NO_x), Oxides of sulfur (SO_x), Hydrocarbons (HC) and Carbon monoxide (CO). The ports started to conduct emission estimates of Greenhouse gases (GHG) from port-related operation from the 2006 Inventory, which includes carbon dioxide equivalent (CO_{2e}), carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). By using the 2005 activity levels as the baseline year, the subsequent inventories also provide the comparisons of main air pollutants between the baseline year and the evaluation year. In the latest 2011 report, the Port of Los Angeles reported to see cumulative harmful emissions reduced by 76%, including diesel particulates emissions declined by 71% from 2005, NOx emissions down by 51% and SOx emissions fell by 76%.

Port-related events form part of these external communication strategies. These yearly events range from port anniversaries, world port days, cruise days, etc. The common thread through all these events is public showcasing of the maritime heritage, a variety of ships, opening up of parts of the port and high numbers of visitors. These ports are in some cases also involved in efforts to open up port areas for the general public. E.g. the port of Hamburg has constructed bike paths in the port area and provides booklets with possible bike tours. The Maasvlakte 2 Port Expansion of Rotterdam also foresees a new public beach. In addition, many ports are involved in teaching school children about the port and its functions, port workers in many US ports are involved in volunteer work in local communities to create local goodwill and sponsoring of local community projects.

The port of Marseille-Fos is in comparison modest in its external communication. There are no annual public reports available and a sustainability report only appeared one (in 2008). Although environmental impacts are monitored, they are not published annually or in an accessible and transparent way. Stakeholder consultation seems to take place, but in a relatively limited fashion, with involvement of the general public only when required by law. There are hardly any events of activities aimed at projecting a positive image towards local citizens.

The on-going transformation of the port-city interface, as well Marseille's status as European Cultural Capital in 2013 provide possibilities to increase the positive visibility of the port. As part of the *Euro Méditerranée* urban redevelopment project, the connection of the city of Marseille with the port and the waterfront will be restored, e.g. in the *Terrasses du Port* retail development, with a roof terrace above one of the ferry terminals overlooking the terminals of the East Basin. In addition, former port buildings are transformed for public use, finding new urban uses reconnecting the city with its maritime heritage. The events related to Marseille being the European Cultural Capital in 2013 also provides new possibilities to project an image of the city that is proud of its maritime heritage. These events should be powerful vehicles to catalyse a new expansive external communications strategy of both the port and the city-region of Marseille.

3.3 Reduce negative impacts

Correlations between environmental performance and competitiveness of ports suggest that technological advances can overcome some environmental constraints, while minimizing the negative externalities. On the economic front, improvements in port practices depend on the regional leadership motivated by liberalization in the organization of transport systems. The executives who support the development of the port and sea-river transport often get government support and participation of partners to develop policies and facilitate the development of strategies. In terms of the built environment, the introduction of innovations is associated with the addition of new infrastructure and denser networks to modernize and strengthen the existing port capacity transport business.

GPMM is a recognized leader in environmental management in the region through various strategies of sustainable development on water quality, waste management and treatment of dredged sediments. The initial state of the environment of the western territorial coherence scheme Étang de Berre 2009 and the Annual Report on Sustainable Development 2009 of the GPMM establish rigorous diagnostics and environmental responses to port operations and commercial shipping. The report on methodology, analysis and recommendations for ports (2012) provides an excellent specification for the assessment of environmental performance. The initiative of the Urban Agglomeration of Marseille Provence Métropole, with respect to an analysis of the carbon footprint and the vulnerability of the territory should be welcomed. Despite the complexity of the governance system, it is found that governments have established policies and regulations that improve the environmental health of the Bouches du Rhone.

This legal framework does not allow the Port Authority of Marseille-Fos adequately fulfill its role as a developer of the port area. The region Provence-Alpes-Côte d'Azur is involved in environmental protection and conservation of biodiversity, and the Chamber of Commerce and Industry of Marseille Provence underlined the need to rethink the sanctity of the land. Sustainable policies and practices within the transportation industry seem to indicate the need for flexibility and adaptability of transport systems to the challenges of protecting ecosystems, either through the adoption of technology, products and substances suitable, or genetic engineering (transformation rate of the ecosystem).

Maintaining the balance of ecosystems in ports depends increasingly on compensatory techniques. Some environmental compensation measures can rehabilitate contaminated sites, create new ecosystems and the fight against climate change, in particular targeting the creation of carbon sinks by planting fast-growing trees and the development of peatlands. In the West Basins of the port several of these compensatory measures have been taken in order to show the goodwill of the GPMM in restoring biodiversity. These measures have created a certain spatial lock-in of the port area, as these temporary measures have increasingly been considered as permanent by environmental NGOs, resulting in the paradoxical situation of a port site largely unused for port activities, with fairly limited possibilities of future expansion. Some way out of this situation has to be found, e.g. by permitting environmental compensation outside the port area that could make current nature areas within the port area available for port and industrial use if needed.

However, there is potential to continue the “greening” of the port of Marseille-Fos, in particular by introducing a comprehensive air quality plan. Air pollution is one of the most important negative impacts of large industrial port sites such as Fos, but also for urban ports with a lot of cruise ships, such as Marseille. Some other ports around the world have used several instruments to mitigate these impacts, using incentive schemes, regulation, grants and data. One of the most comprehensive air quality plans for port areas is the Clean Air Action Plan for the San Pedro ports (Box 7). A similar plan could be established for the port of Marseille-Fos. As part of such a comprehensive air quality plan and building on the organisation of the Green Ports Conference in Marseille in 2012, the port could link in to international best practices shared by organisations like EcoPorts and by joining positive incentive schemes such as the

Environmental Ship Index (Box 8). The on-going European rationalisation process of the petro-chemical and refinery industry could be used as an opportunity to start a forward-looking discussion on how existing port infrastructures and sites could be used for a transition into a green industries hub, along the lines of bio mass production or cyclical economies created in Japanese ports such as Kitakyushu.

Box 7. The Clean Air Action Plan for the San Pedro Bay Ports

The San Pedro Bay Ports Clean Air Action Plan (CAAP) is a comprehensive strategy on reducing air pollution emissions from port-related cargo movement. As the largest seaport complex in North America, the two San Pedro Bay ports are also the single largest source of pollution in Southern California, according to the South Coast Air Quality Management District (SCAQMD). In 2005, the twin mega-ports of Los Angeles and Long Beach generated approximately 25 percent of the diesel pollution in the region (O'Brien, 2004). The CAAP is a product in response to address the problem between port's growing operation and its associated increasing environmental impacts on surrounding neighbourhoods in the port city. The CAAP's overall goal was to dramatically reduce emissions and their associated health risks for the Southern California region without hindering the continuous port development. The Plan was first approved in 2006 and updated in 2010 with near-term plans through 2014 and long-term goals, which includes reducing port-related emissions by 59% for NO_x, 93% for SO_x and 77% for DPM by 2023 and standards to lower the residential cancer risk due to diesel particulate pollution in the port region. As part of the Plan, the twin ports have developed Annual Emission Inventories, which are made public, to track the progress in achieving CAAP standards. The CAAP employs a combination of regulations, fees, grants and incentives to the goods movement industry to use cleaner technology and operational systems, such as the Clean Truck Program, the Vessel Speed Reduction Program and the Alternative Maritime Power Program. In support of the development and demonstration of clean-air technology, the two ports have also jointly created a Technology Advancement Program that has provided more than $9 million port- funding to the industry since 2007.

The latest analysis in 2011 indicates that two ports have substantially reduced the key air pollutants from port-related sources since 2005, including a 71 percent and a 75 percent reduction in airborne diesel particulates, respectively. The implementation of several pillar programs has significantly contributed to the achievements at the two Southern Californian ports for reducing air pollution. These programs include the Clean Truck Program (CTP) and the Vessel Speed Reduction Program (VSR). The CTP targets one of the major sources for air pollution at the ports – diesel-powered harbor drayage trucks. It establishes a progressive schedule to ban the old polluting truck from entering port shipping terminals. Since January 1st, 2012, only trucks that meet the 2007 Federal Clean Truck Emission Standard can have access to the terminals. Currently, a fleet of more than 11,000 clean trucks is operating at the ports, including more than 880 natural gas fueled trucks. Two ports together have provided more than $110 million in grant funding to incentivize the replacement of trucks. Coupled with the truck ban and associated fees, the incentives has led to over $1 billion in private investment in upgrading the truck fleet. As a result of the joint effort between the port authorities, terminal operators and the trucking industry, the CTP has so far delivered an estimated 80% and 90% reduction in the rate of truck emission compared to 2007 average air emission data respectively at the Port of Los Angeles and the Port of Long Beach. The goal of the VSR is to reduce NO_x emissions from ocean-going vessel by slowing their speeds as they approach or depart the port, generally at 20 nautical miles (nm) from Point Fermin. The VSR was first adopted in 2001 with voluntarily participation from the shipping liners, after the two ports signed a cooperative Memorandum of Understanding (MOU) with the U.S. EPA, CARB, SCAQMD, Steamship Association of Southern California and Pacific Merchant Shipping Association (PMSA). The Marine Exchange of Southern California provides the vessel speed data for both ports. Since the 2006 CAAP identified the VSR program as one of the main control measures for cutting air pollution, the two ports start offering the incentives of dockage rate deduction to participated vessel operators –15 percent off for compliance at 20 nm, 30 percent off (POLA) and 25 percent off (POLB) at 40 nm. In addition, ocean carriers achieving 90% compliance in a calendar year will receive the incentive for 100 percent of their vessel calls in that year. As of March 2012, POLA compliance is 94 percent at 20 nm and 74 percent at 40 nm, and POLB compliance is 97 percent at 20 nm and 84 percent at 40 nm. In 2007, the two ports estimated that the VSR program has resulted in reducing: 1,345 tons of NO_x, 832 tons of SO_x, 112 tons of PM, and 52,502 tons of CO_2.

The CAAP marks a milestone for the port industry in the process of mitigating environmental impacts that are resulted from maritime operations. The CAAP was a cooperative venture of the two ports that initiated the concept and were the key players among industry stakeholders and agency leaders (Giuliano and Linder, 2011). The key factor to its success is the cooperation from port users, including terminal operators, truckers and shippers, as well as to gain the support from federal, state and local regulatory bodies and nearby communities (Mongelluzzo, 2012). In addition, the ports were under enormous social pressure as the community concerns over health risks that are resulted from port-related diesel emissions had been elevated after a series of air quality studies published on the correlation between cancer and respiratory disease rates and the proximity to the freight-movement corridors. As the cargo

volume rising through the top back in 2004 that called for capacity expansion at two ports, growing public opposition, including a series of lawsuits, has made any expansion plan difficult if not impossible. Moreover, political pressure for legislative efforts for increased regulatory oversight was also one of the driving forces that prompted the ports to respond to public dissatisfaction over air quality, which ultimately led up to the adoption of a comprehensive plan. The CAAP was portrayed as a solution to build credibility of the ports to obtain agreements on future projects as they engaged all the identified key stakeholders. A study considered that "the CAAP was a response to the loss of social legitimacy and to social and regulatory pressures that were restricting the ability of the ports to expand" (Giuliano and Linder, 2011). A final point is that the market power that two ports in Southern California possess also played an important role in their mitigation efforts. The gateway location enables them to have more capacity to impose fees on the industry and hence generate more revenues to implement such environmental policies.

Box 8. Environmental Ship Index

The Environmental Ship Index is an instrument to determine the environmental performance of ships with respect to air pollutants and CO_2. The idea of the index is that ports can reward ships that score high on this environmental ship index, by providing them with lower port dues. The ESI measures a ship's emissions based on the amount of nitrogen oxide (NO_x), sulphur oxide (SO_x), particulate matter (PM) and greenhouse gas it releases. It is a voluntary system, open to shipping companies, ship owners and ports. The ESI uses a formula to provide points to ships according to their environmental performance, considering current international legislation, mainly the International Maritime Organization (IMO). There are currently 1439 ships with a valid ESI score and 18 ports participating, including Rotterdam, Hamburg, Antwerp, Le Havre, Los Angeles and New York/New Jersey. The ESI was developed in the framework of the World Port Climate Initiative (WPCI), committing to reduce the greenhouse gas (GHG) emissions due to port activity. The ESI ship database is filled and administrated by the ESI Bureau of the International Association of Ports and Harbors (IAPH).

As part of this comprehensive air quality plan, introduction of shore power for ships should be considered, building on a current project between GPMM and the shipping company CMN (*Compagnie Méridionale de Navigation*). An increasing number of ports apply shore power to aliment ships that come at their quays. Instead of using their diesel-fuelled auxiliary engines, these ships then use power generated by the local grid, allowing for less local air pollution. Shore power not only requires an on shore power connection, but also ships that are able to connect to this power source. For this reason, shore power is most feasible for and has been pioneered in point-to-point connections, such as ferries and RoRo-ships, such as in Gothenburg, one of the ports to introduce on shore power. Increasingly also other ship types are getting connected to shore power in ports. Main US West Coast ports have introduced shore power for container ships and cruise ships and some ports (Long Beach and Salalah, Oman) have also installed shore power for oil tankers.

Box 9. On-shore power supply in the port of Gothenburg

Since the beginning of the 2000s, the Port of Gothenburg (Sweden) has put in place an innovative policy of using on-shore power supply. Vessels that are at the quay typically use their diesel engines to meet energy needs for certain functions such as lighting, heating and air conditioning. This use of the diesel engine is a source of considerable local air pollution and greenhouse gas emissions. The Port of Gothenburg was the first in the world to propose that vessels be connected to the local energy network, which made it possible for these vessels to shut off their engines during their stay in the port (called "cold ironing").

Since 1989, the Port of Gothenburg has provided electricity to ships calling at the port, but only through several low-voltage cables that did not cover all energy needs. Following the initiative of a large paper manufacturing company, Stora Enso, which sought to improve the carbon footprint of transporting its products, the port began designing a more efficient system in partnership with several navigation companies and Asea Brown Boveri (ABB), a company specializing in electrical products. Operational since 2000, this newer system uses a single high-voltage cable providing 6.6 to 10KW 50Hz, which can power an entire ship from these platforms on the docks. The vessels are

therefore able to stop their engines, resulting in a significant reduction in both noise and carbon emissions. The Port of Gothenburg estimated that a vessel not connected to on-shore power grid emits about 25 tonness of carbon dioxide, 520 kg of nitrogen oxides and 22 kg of particulate matter during its stop. This innovation thus benefits both the environment in terms of climate change, and quality of life and work of the populations on or near the port (residents, dockworkers and ships' crews). To ensure that the electricity supplied to ships is produced with limited air pollution, two wind turbines are used to generate power for ships. Today, one in three ships calling at the Port of Gothenburg uses the connection for shore-side electricity, but this proportion is likely to increase. Roll-on/roll-off ships and ferries are the most frequent users of the new system because the links they provide are back and forth, but all categories of ships may benefit from this new technology. While connecting to the grid requires vessels to invest in technology to use the new system, costs for retrofitting vessels can be offset by the likely savings in fuel.

Through this programme, the Port of Gothenburg has acquired a first-mover technology advantage in connecting the vessels to shore-side electricity. This system is also present in other ports, such as Antwerp, Zeebrugge and Lübeck. However, a significant barrier to technology diffusion is the non-harmonisation of international electricity standards, with some parts of the world using 50 Hz systems and others using 60 Hz systems. This problem hinders retrofitting vessels, although attempts are underway to harmonise. Because of its pioneering role in this technology, the Port of Gothenburg was chosen as the leader of the Working Group on on-shore power supply created by the World Port Climate Initiative.

3.4 Metropolitan port governance

Regionalisation of port governance

France has a tradition of port governance controlled by the central government. This was formalised with the creation of the *Ports Autonomes*, created between 1923 and 1965, in order to reduce the influence of local economic milieu, in particular the chambers of commerce. The strong role of the state continues under the new status of *Grands Ports Maritimes* (GPM), created with the port reform of 2008, implemented in 2011. Also with regards to new port planning, the role of the State is dominant. The decision to build a new port at Fos in the 1960s was developed, planned and run by the State.

Responsibilities for the smaller French ports have been decentralised during 2004-2008, but not the seven large ports, including Marseille-Fos. This port decentralisation delegated the governance of these ports to local governments, as they were not considered to be of national interest. This decentralisation has led to a rich diversity of local port governance models, in which either the *conseil régional* or the *conseil général*, or a mix of these were made responsible for these ports, sometimes complemented by a *communauté d'agglomération* and city (Debrie and Lavaud-Letilleul, 2010). The remaining seven maritime ports were kept under state control, with the logic that these ports were of national interest. Although the ports of Marseille-Fos, Le Havre certainly have roles for the whole of France, this is less the case for the other GPMs, in particular Bordeaux and La Rochelle that seem only of regional importance. In these GPMs the state is the dominant actor, like in the previous *Ports Autonomes*.

Local governments are implicated in some of the institutional bodies of the port of Marseille-Fos, but their influence is fairly limited. They are represented in the *Conseil de Surveillance* and the *Conseil de Développement* of the port. Four out of 17 members in the *Conseil de Surveillance* are representatives of local governments; the other members are representatives of the State, port employees and "qualified persons". Although the State has only 5 representatives among the 17 members, it also nominates the 5 qualified persons. The local government representatives in the *Conseil de Surveillance* are the *Conseil Régional*, *Conseil Général*, *SAN Ouest Provence* and the city of the Marseille. Contrary to the other GPMs, it is not the urban agglomeration of Marseille that is represented in the *Conseil de Surveillance*, but the city of Marseille. Local governments are also represented in the *Conseil de Développement*, but this body has consultative and no decision-making functions, and local government members are also here outweighed by the other members. In addition to the moderate representation of local governments in the port governance bodies, the State is the only shareholder in the GPMM, appoints the directors of the GPMM, has to approve the strategic plan of the port and is an important source of finance for port investments.

The relative underperformance of Marseille-Fos, and other large French ports and port-cities, might be related to the state-led port governance. There are two sides to this question. First, ports that are state-controlled could be less sensitive to local concerns (creating local economic value and jobs, reduction of environmental impacts) than ports owned by city or regional governments. Second, port-cities that are not in charge of their ports could be less inclined to create favourable conditions for sustained port development, such as investments, permissions, planning for logistics areas and creating links to freight transport corridors. This report has observed stagnating port growth, relatively limited local economic value created by the port, large and very localised environmental impacts for which little local support exist, in combination with a conflict-rive port-city interface that is only now starting to synergetic. Although there are several determinants of these outcomes, port governance is without any doubt one of these.

Metropolitan governance in Marseille

Port-city development in Marseille takes place in a context of highly fragmented and polarised metropolitan relations. If France is a country characterised by institutional complexity and fragmentation, this is all the more the case for Marseille. Whereas most cities in France, such as Lille and Lyon, have since 1966 been able to achieve some form of metropolitan coordination thanks to the instrument of *communauté urbaine*, this instruments was only introduced in Marseille in 2001 and has its limits in Marseille, where the *communauté urbaine* of Marseille (Marseille Provence Méditerranée) is only one of the actors in the Marseille metropolitan area. If one would consider the functional metropolitan area, based on measures of economic interlinkages, e.g. indicated by the perimeter of the port of Marseille-Fos, this area would include five additional other inter-communal structures: the *communautés d'agglomeration* of Pays d'Aubagne, Pays d'Aix, Pays de Martigues, Salon-Étang de Berre and SAN Ouest-Provence-Istres. The relations between these inter-communalities and MPM are polarised, fuelled by controversial decisions in the past, e.g. the decision to impose an incinerator to Fos-sur-Mer.

This institutional fragmentation has severe consequences for port-city development. The planning of economic activity is fragmented and generally un-coordinated, as illustrated by the establishment of various *Schémas de Cohérence Territoriales* (SCoTs). These SCoTs gave birth to a list of projects, often compartmentalized, preserving the best interests of 'stakeholders'. Cutting the decision multiple locations, sectors, projects and topics makes it very difficult to draw a line overall policy to increase the capacity to transform the port of Marseille-Fos into a priority transport axes. The Chamber of Commerce and Industry of Marseille Provence stresses the importance of SAN Ouest Provence and the Agglomeration of Martigues to think beyond the perimeter of the SCoT, strengthening dialogue and cooperation with neighboring territories, including Marseille Provence Métropole. It must be recognized that efforts to prepare an inter-SCoT at the metropolitan level in order to increase the competitiveness of the port city at the European level, have had mixed success.This hinders the creation of synergies between economic sectors. In addition, various unresolved metropolitan challenges, including urban transport, housing, unemployment, urban poverty and crime, limit the urban attractiveness needed to attract high value added firms and headquarters in the maritime sector and international trade.

Metropolitan coordination mechanisms based on cooperation can most likely not overcome this fragmentation. The culture of resentment, the limited history of collaboration and the lack of a joint strategic vision make the current government structure a fine vehicle for sustained stagnation. These same mechanisms have worked in a French port-metropolis that is more or less comparable to Marseille, namely Nantes St. Nazaire, but only due to several conditions that all lack in Marseille: a long tradition of cooperation, the same political colour of all relevant actors, joint commitment to the metropolitan idea and a commonly felt need to develop intermodal solutions to withstand the competition of the port of Le Havre (Box 10).

Box 10. Coordination mechanisms between the port of Nantes St. Nazaire and sub-national governments

Nantes Saint-Nazaire has become a Grand Port Maritime since the port reform of 2008. It therefore has the same legal status as that of Marseille-Foss: a public establishment of industrial and commercial character, under the Ministry of Ecology, Sustainable Development and Energy. If the port of Nantes Saint-Nazaire is placed under the authority of the state, its relations with local governments are becoming increasingly interdependent, in particular due to decentralization processes, in which local governments have acquired new responsibilities. However, like Marseille, port facilities extend over several municipalities, with a distance of sixty kilometers between the two facilities most far removed from each other. In fact, the main hub ports are divided between Saint-Nazaire, Montoir-de-Bretagne, Donges and Cordemais, supplemented by smaller terminals, such as the one of Nantes-Cheviré. With 90% of the traffic occurring in the downstream area, especially in energy, which represents 70% of total traffic, mainly treated in Donges, the issue of consultation with local communities arises strongly. So, how to ensure effective coordination and cooperation, considering that the metropolitan area of Nantes Saint-Nazaire has more than 100 municipalities, and is divided between the urban community of Nantes – which became Nantes Métropole in 2004 - and the urban

agglomeration of St Nazaire and its estuary (CARENE), both established in 2001?

Faced with a multiplicity of local interaction levels with the port, various mechanisms to facilitate dialogue with the Port Authority have been put in place. Political cooperation between the various entities began in 1962 with the creation of the "*métropole d'équilibre*" of Nantes Saint-Nazaire by the state. This was reinforced in 1970 by the establishment of the Master Plan of the Metropolitan Area (SDAAM). Until this period, relations between Nantes and Saint-Nazaire were characterized by relative rivalry rather than cooperation, and attempts at reconciliation were the result of the involvement of state rather than of local actors. From 1985, with the creation of the ACEL (Community Association of the Loire Estuary), local governments have benefited from the decentralization process that enhanced their role in the cooperation. The ACEL is a tool for dialogue and debate, which now includes sub-national authorities such as the Region Pays de la Loire, the *département* of Loire-Atlantique, Nantes Métropole, the CARENE and the Chamber of Commerce Nantes and Saint-Nazaire, the port authority and the Nantes maritime association (representing the firms in the port), in order to define common positions on issues of planning.

The creation of the ACEL has helped to highlight common problems; the political will to draw a common vision of the territory is also reflected in the establishment in 2007 of the SCoT (Territorial Coherence Scheme), developed by a joint union composed of 107 elected representatives. This planning document gives general guidelines, which are then applied at the level of inter-municipal structures and in local urban development plans. These two bodies thus show the political willingness for dialogue and territorial coherence, not only within public authorities, but also with other actors.

However, this political dialogue, if it is clearly displayed in the dominant discourse, can be nuanced. The scope of the SCoT is much less extensive than that of the SDAAM, so part of the area South-Loire is not included, reflecting fear of certain local governments vis-à-vis growing cities, as well as political differences. In addition, the political colour of the main local authorities in the region needs to be considered. Since 2004, the *département* of Loire-Atlantique, the Region Pays de Loire, Nantes Métropole and CARENE are all led by the socialist party (PS).

However, unlike Marseille, metropolisation of Nantes Saint-Nazaire remains a political project often expressed and adhered to. If the metropolis of Nantes Saint-Nazaire is not an official reality, elected officials have accepted the creation of a "metropolitan pole". Thus the joint association of SCoT was turned into this metropolitan pole in July 2012. If the metropolitan pole, as a tool for cooperation, is more flexible and has fewer responsibilities than the "metropolis", which is a tool of integration, its creation nevertheless demonstrates a willingness to continue on the path of dialogue in order to offer a coherent political discourse in relation with the port authority.

Local political actors emphasize the importance of a shared vision of the challenges originating from the competition with Le Havre, the connection to the hinterland and the development of inter-modality. To do this, mechanisms exist: first the local authorities, in partnership with the port, in May 2011 became the operator of the rail network, trying to develop a coordinated traffic infrastructure focusing on interregional relations. Thus, they promote a rail link from Lorient to La Rochelle, thereby improving relations between the Port of Nantes Saint-Nazaire and its hinterland and allow the growth of rail freight, which currently only presents 1.5 Mt of traffic volume. The second mechanism of cooperation is centered on inter-modality. Thus, the ACEL has created the Nantes Atlantic Logistics centre, a land area of 120 hectares in the port area at the mouth of the estuary, near Montoir-de-Bretagne. This logistics platform, designated by the port authority as a unique example of intermodality, includes 2LE (Logistics Loire Estuary), which covers maritime (quayside), river (barges to Nantes about 68 km upstream in the estuary), railway, land transport, and airport (with the airport of Gron dedicated to freight).

In order to ameliorate this situation, the State has proposed a form of metropolitan government for Marseille. The exact form remains to be concretised, but the core idea is to create one agglomeration, with various poles so as to respect the diversity and complexity of the territory and local identities. Possible responsibilities identified for such a metropolis are urban transport, environment, economic development, higher education and urban transformation (Premier Ministre, 2012). Elements mentioned for a metropolitan strategy for Marseille included acceleration of the transformation at the port of Marseille-Fos, decongesting urban transport, as well as targets and projects with respect to education, higher education and research, urban transformation and support to firms. The port-related projects that would be supported by the State would be the re-opening of "Forme 10" ship repair yard, the combined transport terminal of Marseille-Mourepiane and the improvement of road hinterland connections of Fos. Strengthening of metropolitan government in Marseille would certainly be to the benefit of port and port-city development,

not only to resolve port-related bottlenecks, but also to improve the articulation of port interest's vis-à-vis local authorities, as can be illustrated by the case of Auckland, New Zealand (Box 11).

Box 11. Metropolitanisation and the re-balancing of multiple port sites: the case of Auckland

Situated on a narrow highly urbanized isthmus, Auckland is a city with multiple port sites. Its many ports form a central pillar of the economy of New Zealand, an island country in the middle of the Pacific Ocean: in 2011, it is estimated that the economic activity generated by the ports of Auckland (import, export and its own activity) accounted for some 21 billion NZ dollars in value, or 16% of GDP (ME 2011). Thus, good coordination of multiple sites is important for the city and for the country. However, current port structure finds its origin in the interwar period, long before the city became a metropolis with a population of 1.3 million inhabitants in 2007, and before the advent of containerization technologies that have completely changed the needs and logistics in the city. During the second half of the 20th century, urban growth (especially residential sprawl), coupled with technological changes in the marine industry have exacerbated the imbalance between the ports of Auckland, less adapted to the context space and modern business. The entanglement of port and urban actors, all competent on a different aspect of ports and acting at various scales, has contributed to a lack of strategic planning and coordination, making the situation even more dysfunctional. However, during the 2000s, following changes in urban governance and port, the city will regain control of the city-port interface, energizing and balancing the activity of its multiple port sites.

During the 1980s, the inadequacy of the port morphology of Auckland is increasingly evident. Divided between a small ferry port linked to downtown center, a commercial port (cargo and container) to the east, and a mixture of activities in petrochemicals, marina, fishing industry, and small cargo operations in an underperforming west port, the city is then faced with an imbalance in the functional port space. This imbalance was characterised by a particularly counterproductive asymmetry between the eastern site, relatively sheltered from the urban growth boundary established by a highway and the possibility of future extensions to the east, and a western port which concentrated on commercial and industrial activities that were cut off from the commercial port in the east, and were in constant conflict with the expansion of the urban fabric. The ferry port, meanwhile, used a simple crossing point for commuters working in the city center, but contributed nothing to the local economy south of the city center (the 'downtown'), a waterfront under -exploited since the relocation of retail to the area north of downtown. Until 1988, the body which governed the ports of the city was the Auckland Harbour Board, consisting of members that were elected for a term of three years. Wanting to boost productivity, the New Zealand Parliament decided in 1988 to corporatise the ports of Auckland, creating the corporation Ports of Auckland Limited (POAL) to purchase land and assets of the Harbour Board. The shares were then placed on the market: the Auckland Regional Council became a holder of 80% of the shares and the Waikato Regional Council of 20%. In 1993 the Waikato Regional Council decided to sell its shares, allowing the Auckland region to redeem them, and, in 2005, to remove it from the Stock Exchange of New Zealand.

This concentration of port governance at the regional level has led to the establishment of the first answers to the east-west asymmetry in the ports of Auckland. During the 1990s, the corporation POAL undertook a process that altered the port morphology in a fundamental way: it gave the Auckland municipalities half of its assets and lands (70ha) in the western port. The strategy of port stakeholders and local governments in Auckland during this period consisted of three elements: 1) the consolidation of cargo in the eastern port, by dredging, land reclamation, and a more intensive use of its commercial docks, 2) the opening of industrial and commercial areas in the western port to urban uses, converting certain areas in public spaces, and by selling other parts to private developers, and 3) the transformation of small central port into a world-class marine terminal, with a cruise port close to a Hilton hotel, in order to directly stimulate the retail sector in the southern district of downtown connected to the port.

Parallel to the regionalization of the port control and implementation of this strategy of rebalancing, Auckland city has progressively consolidated its own structure of metropolitan governance, reinforcing the trend towards better coordination of port sites. Until 2010, the Auckland governance system consisted of a regional council of three provincial councils, four municipal councils and thirty community boards. In terms of urban planning, this institutional complexity resulted in fifteen different provincial and municipal plans, two of which to govern the border area between the port and the city. It was then that the "Auckland Council" was created in 2010. Formed by a merger of the region, provincial councils and municipal councils of Auckland, the new board replaces all the players mentioned above by a single metropolitan actor. It has strong powers of planning, a single masterplan for the city, 100% of the shares of the POAL and a development agency responsible for the conversion of waterfront (port sites to the west and in the center). This new strong metropolitan player with large responsibilities and a clear and integrated vision on the development of Auckland managed to avoid the situation of competition between the different port sites that existed before its creation. Not only has this metropolitanisation countered the trend towards inefficient fragmentation of the port-city space, but it has also made interactions between public authorities and private actors easier, leading towards a more reliable long

term planning.

With respect to the three axes of the strategic rebalancing of the ports of Auckland, the results proved encouraging. Firstly, the commercial port in the east will probably increase its capacity to more than 250% by 2015, and its consolidation strategy of the business is a success. Any future port extension (dredging or reclamation) will be done in the eastern port. The conversion of port sites in the west also seems successful. While retaining its function as marina and fishing port, the western port is now widely open to the public. Public access is now provided with a good mix of public access ways, the maritime heritage has been developed, and residents use these converted spaces to socialize, work and live. Finally, the central port has been integrated into a development project for the "downtown" district, which is experiencing a renewal of its retail and commercial fabric. The main street of the city center was connected to the major axis of the ferry, which is equipped with a new cruise port, contributing significantly to the tourist market in the neighborhood.

Thus, thanks to the synergy between urban planning and the planning of the port sites, urban growth is no longer a factor aggravating the east-west divide in the port area of Auckland. Concentration at the metropolitan level of the competences for planning and development of the city and its ports has prevented fragmentation of ports, induced by governance that was too complex and entangled. By linking the interests of the port to the interests of the city as a metropolis, the governance reforms of the port city of Auckland led to a concentration of commercial operations in the eastern port area, while facilitating a revitalization of the central port area and a conversion of the western port area

A metropolitan government structure would need to go in parallel with a reflection on more decentralised port governance. It is clear that a new metropolitan government body would be a logical candidate to form part of the different port bodies, such as the *Conseil de Surveillance* and the *Conseil de Développement*. But the involvement of metropolitan Marseille could go further. Considering the strategic role that ports like Marseille-Fos play for a national economy, and considering the important role that the French state plays in facilitating or constraining port and hinterland development, it would be difficult to imagine a port governance model without the State. Also in the hanseatic port-cities with a large tradition of city involvement in their ports, national governments play a key role in the development of port-related infrastructure and planning. However, in order to fundamentally resolve some of the challenges of the port metropolis of Marseille with respect to local value added creation and mitigating negative impacts, reflection on a more decentralised port governance model could be considered. This could be a model of joint responsibilities of national and metropolitan government.

ANNEX 1: INTERVIEWED ACTORS

M. ARDITI	Association of forwarders
M. BABRE	Sub-prefect of Istres
M. BALLADUR	President of association of maritime industries (UMF)
Mme BARDIN	Cluster PACA Logistique
M. BEAULIEU	LTM
Mme BENOIST	Cabinet CAPM
M. BERIDOT	Conseil Général 13, head of urban planning
Mme BONNARD	CMA-CGM
M. CAMBESSEDES	First vice-mayor of Martigues
M. CHARRIER	Mayor of Port-Saint-Louis-du-Rhône and conseiller général
M. CHARROUX	President of urban agglomeration of Pays de Martigues
M. CLAUDE	SNCF Freight
M. COUSQUER	Rapporteur on the East Basins for the Supervisory Board of GPMM
Mme DOUADY	City of Marseille, director economic attractiveness
M. FERRARI	SAN, elected counsellor for the economy
Mme FOSSATI	Director of economic development, CAPM
M. FRISON	Association of Industries
M. GARNIER	CMA-CGM
M. GARNIER	Professor in Economics
M. GROLLEAU	Transcargo
M. GROSJEAN	City of Marseille, directory of economic attractiveness
M. HAUTERAT	Carfos
M. HEDELIN	Eurofos

M. HENRY	MedEurope Terminal
M. JALINOT	Director Euroméditerranée
M. LATIL D'ALBERTAS	MPM, Director Economy and territorial attractiveness
M. LIAUTARD	Greenmodal
M. LODOVICCI	Elected counsellor for the urban agglomeration of Pays de Martigues
M. MADELENAT	Wilhelmsen
M. MAHE DES PORTES	President of MGI
M. MALIVERNEY	Logirhône
M. MARCHAND	Marseille Provence Métropole DGA
M. MARCHETTI	Transmavin
M. J. MASSONI	Director of MPCT
M. MAURY	Provence promotion
M. MATAR	TLF Méditerranée
M. MAZZETTI	Forwarders
M. MOIROUX	Town planning agency Marseille (AGAM), research directorate
M. MOREL	Regional counsellor PACA
M. NOYES	Conseil Général 13 conseiller général
M. PAYAN	French association of petro-industries (UFIP)
M. PFISTER	President of the Chamber of Commerce (CCI) Marseille-Provence
M. PONCHON	Port of Arles
M. QUENIAT	Lyon Terminal
M. RAIMONDI	Mayor of Fos
M. REVERCHON	President of Development Council of GPMM
M. RIZOULIERES	Institut d'Études Politiques d'Aix-en-Provence
M. SEMERDJIAN	Provence promotion
M. SPAZZI	Planning director, GPMM

M. TAILLANDIER	DGA CG13
M. TERRIER	President of directory GPMM
M. THOMAS	SAN, director of economic development
M. TOUZE	Marseille Provence Métropole, Economy and territorial attractiveness
M. TRUAU	President of the cruise shipping association (Club de la Croisière)
M. VALETTE	Municipal counsellor for urban planning, and president of AGAM
M. VAN DEN HOOGEN	AACN
M. VIDIL	Marfret

ANNEX 2: TIME EFFICIENCY OF PORTS

Time efficiency of ports is here defined as the average time that a vessel stays in a port before departing to another port. Port time can be known through detailed vessel movement data. Port time can be considered a proxy for time efficiency, as the large majority of port calls will be connected to loading or unloading. Very brief port stays could be connected to re-fuelling, whereas very long port stays could be connected to repairs or other reasons. Both very brief (less than an hour) and very long port stays (more than 10 days) will be excluded in order to increase the probability that the data reflect time efficiency and not something else.

The data used are vessel movements, as collected by Lloyd's Maritime Intelligence Unit (LMIU) for 2011. The data are limited to the month of May; this month is considered to be a representative month by Lloyd's Maritime Intelligence Unit. The dataset contains for most vessels precise arrival and departure times (in hours and minutes). From the port calls of fully cellular container vessels (larger than 100 gt), the observations were excluded where arrival, or departure data, or both were missing, and some observations were excluded because they were considered to be extreme values that would skew the results; these are the vessel calls with a stay in one port of less than one hour or more than 10 days. Canals and strategic passages, as well as "non-port" locations (e.g. countries, straits, continents, seas, etc.) were excluded from the dataset and some paired terminals/ports were aggregated (e.g. Port Botany and Sydney).

In order to derive the total time that vessels stayed in a specific port, some less precise measurements (in days, not in hours and minutes) were incorporated for ports with missing values in the dataset. This is necessary, because for some ports only a very limited set of precise time observations was available, so taking exclusively these and extrapolate these would risk to be inaccurate. For these missing values, it is assumed that the port time for vessels arriving and leaving the same day is 12 hours, leaving the next day is equivalent to 36 hours, with a port stay of 2 days equivalent to 50 hours etc.

The main output indicator that is used is the average difference between "arrival date" and "sailing date" by port and all vessels (in number of days). The average is calculated here by dividing the total time that vessels spent in one port (multiplied by a coefficient of 89/31 in order to estimate the time for the second quarter instead of only the month of May) by the TEU throughput volume in that port in the second quarter of 2011, as reported by Eurostat. The data for the second quarter 2011 were taken in order to align as closely as possible to the May 2011 data from LMIU.

ANNEX 3: EFFICIENCY OF OIL PORTS

In this report the efficiency of oil ports is analysed using the data envelopment analysis (DEA) technique. This empirical methodology derives efficiency scores for each decision-making unit (DMU) involved in a homogeneous production process such as firms or seaports. An efficient port is defined as one maximising output level for the same level of inputs across all observed ports (efficient output-oriented DMU) or minimising quantity of inputs for a given level of output (efficient input-oriented DMU). The efficient production frontier is delineated by a set of efficient DMUs referred to as the benchmark of most performing seaports. The potential gains for less efficient ports (*e.g.* located below the efficient production frontier) are measured by their distance, both from an output- or input-oriented approach, relative to the efficiency frontier. This methodology has been widely used in the most recent mainstream literature[7] [8](Cheon, *et al.*, 2010; Wu and Goh, 2010; Martinez-Budria, *et al.*, 1999; Wang and Cullinane, 2006; Al-Eraqui, *et al.*, 2007; Tongzon, 2001).

The DEA approach has advantages as well as limitations. Among its positive characteristics, DEA does not impose any functional form to the production function or on the shape of returns to scale (*i.e.* non-parametric), such as when adopting a Cobb Douglas production function. For seaports, in particular, it is very difficult to guess or impose whether returns to scale should be increasing or decreasing. Dealing with multiple output processes is another useful property of DEA, especially when addressing port multi-activities and when a certain degree of homogeneity in the production process is observable across ports. DEA also has some negative characteristics, including its deterministic property, which does not allow random noises or measurement errors to be isolated from the measure of pure inefficiency[9]. However, use of the Bonilla (2000) and Barros (2007) bootstrapping[10] technique can help limit this effect.

This sampling technique enables generation of a stochastic distribution and intervals of confidence around the estimators (Simar and Wildon, 2000). The efficiency estimates derived from using this technique are often lower compared to DEA estimates derived from a standard sample. In addition, atypical efficient ports (characterised by low density of observations in the region of the frontier) are characterised by higher degrees of uncertainty. However, because efficiency is a relative measure, depending on observable seaports and inputs considered, any omission may affect the results. A sample excluding potentially efficient seaports or including outliers would respectively shift downward/upward on the efficient production frontier and affect (upward/downward) the relative efficiency scores. To the same extent, omitting input factors or including them with non-documented values (zero or not available [n.a.]) may yield higher efficiency scores for ports that are using high quantities of the omitted input factor or those producing output with "no" input.

There are three different types of efficiency that can be distinguished: *i)* overall efficiency, *ii)* technical efficiency, and *iii)* scale efficiency.

i) **Overall efficiency**. This general indicator, derived from a model assuming constant returns to scale (CRS), provides a measure of overall port efficiency. This DEA-CCR indicator, developed by Charnes, Coopers and Rhodes (1978), assumes that all observed production combinations could be scaled up and down proportionally. Varying production sizes or scales are considered to have no effect on efficiency scoring, which means that small or large ports can equally operate in an efficient way. Efficient ports are both technically and scale efficient. Conversely, inefficiencies (efficiency gap measured in per cent of most efficient port scores) reflect both technical and scale inefficiencies.

***ii)* Technical efficiency.** Pure technical efficiency is estimated by relaxing the constraint on scale efficiency, allowing output to vary unproportionally more or less with a marginal increase in inputs. This DEA-BCC indicator, developed by Banker, Charnes and Cooper (1984), is derived from a model assuming varying returns to scale (VRS), and recognises that smaller ports may face disadvantages caused by production scale effects (Cheon, 2008). By taking into account and neutralising scale inefficiencies, relative gaps in efficiency between ports would thus only reflect differences in operational inefficiency, so-called pure technical inefficiency.

***iii)* Scale inefficiencies.** Scale inefficiencies arise when the scale of production is inappropriate, being above or below optimal levels and generating production wastes. Formally, they are identified when a difference appears between efficiency achieved at technical and overall levels, as measured by the following ratio (Cooper, *et al.*, 2000; see also Fare, *et al.*, 1994).[11]

$$SE=CRS/VRS \text{ and where } SE<1$$

In the equation, CRS and VRS are the efficiency estimates derived from respectively assuming constant and varying returns to scale. When SE<1, ports face scale inefficiency, driving higher overall inefficiency compared to pure technical inefficiency. By contrast, when SE=1, ports are operating at efficient scales, producing at the optimal level for which they were designed. However, the appropriate direction in scale adjustments can be identified only with the nature of returns to scale, that is, increasing (IRS) or decreasing (DRS). For ports operating at IRS (output rises proportionally more than the increase in inputs), production level should be expanded. This is usually the case for ports operating below optimal levels as long as current business traffic, while building up gradually, remains below the optimal capacity of port infrastructure. By contrast, when ports operate at DRS (output rises proportionally less than the increase in inputs) they should scale down their production toward lower optimal levels to limit inefficiencies lead, for example, by bottlenecks. In a long-run perspective, however, the alternative of raising the optimal level of production through investing in higher port infrastructure capacity should also be considered.

Defining and identifying appropriate output and input variables for port production function is crucial. The input/output variables must reflect the main objectives of a port, which in this study is about maximising cargo throughput and productivity while efficiently using infrastructure and equipment. Along the economic theory, output as measured by handling cargo throughput (loaded/unloaded) depends to the same extent on labour and capital inputs. In port literature, labour input is known as the most challenging issue due to lack of data reliability and comparability. One of the main reasons is that port labour organisation is particularly complex, consisting of different types of full- and part-time contracts and contracts partly managed by private, public and port authorities, which make it difficult to collect complete and consistent data. Proxies are often used along the argument that labour is usually closely and negatively correlated to handling equipment: equipment is thus considered to be a proxy for labour. As such, for this study the number of loading/unloading equipment from ship-to-quay and quay-to-shore is collected per port for crude oil terminals. Capital inputs, on the other hand, are more readily available as long as they concern land and infrastructure. Such inputs mainly include terminal surface, quay length or storage capacity.

This study uses a new output dataset, based on a volume output measure: aggregated ship volume in deadweight tonnes (dwt) calling each port. These data can be derived from existing comprehensive databases of vessel movements, which include detailed information on ship types (including volume), as well as arrival and departure times at the different ports. This approach assumes that the volume of a ship calling a port is correlated with the number of metric tonnes loaded or unloaded from that ship. This assumption will hold especially for cargo categories with point-to-point deliveries, such as crude oil. The availability of information on different ship types in the database, including crude oil tankers, makes it

possible to estimate the aggregated ship volume per port for crude oil. While "total dwt calling the port" (output measure) is not perfectly correlated with actual throughput, it is no more imperfect than throughput as reported in metric tonnes.

For the purpose of this study, a database was built to analyse port efficiency across worldwide ports at aggregated and disaggregated activity levels, gathering data for the most recent available year (2011). Most of the input data are drawn from Lloyd's Port of the World 2011 Yearbook, whereas the Lloyd's Marine Intelligence Unit's (for May 2011) comprehensive database of vessel movements was used to derive output data. Given limitations in the data and the DEA methodology, a number of aggregations/approximations were performed in order to ensure estimate reliability.

The sample includes 71 major worldwide ports. The regional pattern reflects a noticeable imbalance in the distribution of terminals across the world. About two-thirds of the sample oil ports are concentrated in Asia (with 34% in the East/Southeast and 24% in the western/southern), while the remaining ports are located in Europe and North America (respectively accounting for 24% and 10% of the total sample). Table x shows the input variables specific to the sample oil ports. Capital inputs are proxied by the capacity of terminal reception of oil tankers, such as quay/jetty lengths, maximum vessel capacity, canal draught/depth and tank storage capacity. Labour input is proxied by the loading capacity of equipment as measured by their discharge rates (tonne/hour) and pipeline/loading arm capacity (diameter in mm).

Table 12. Descriptive statistics of input/output variables of the crude oil port sample

Oil terminal sample	Output May 2011	Quay length	Max vessel capacity (dwt)	Max draught/depth	Tank storage capacity	Discharge rate (t/h)	Pipeline/loading arm capacity
Average	**2,665,512**	**1,833**	**250,346**	**19**	**2,300,030**	**32,016**	**9,623**
Max	33,557,799	16,222	750,000	50	7,092,000	112,000	25,245
Min	2,247	100	2,000	5	123,211	382	2,040
Normalised standard deviation	1.98	1.40	0.66	0.44	1.04	1.13	0.85
N (non missing)	71	52	47	66	9	11	12

Source: OECD database.

ANNEX 4: LIST OF PORT MUNICIPALITIES

33003	AMBARES-ET-LAGRAVE	Bordeaux GPM
33004	AMBES	Bordeaux GPM
33032	BASSENS	Bordeaux GPM
33035	BAYON-SUR-GIRONDE	Bordeaux GPM
33056	BLANQUEFORT	Bordeaux GPM
33058	BLAYE	Bordeaux GPM
33063	BORDEAUX	Bordeaux GPM
33249	LORMONT	Bordeaux GPM
33256	LUDON-MEDOC	Bordeaux GPM
33312	PAREMPUYRE	Bordeaux GPM
33314	PAUILLAC	Bordeaux GPM
33434	SAINT-LOUIS-DE-MONTFERRAND	Bordeaux GPM
33544	VERDON-SUR-MER	Bordeaux GPM
59094	BOURBOURG	Dunkerque GPM
59159	CRAYWICK	Dunkerque GPM
59183	DUNKERQUE	Dunkerque GPM
59248	FORT-MARDYCK	Dunkerque GPM
59271	GRANDE-SYNTHE	Dunkerque GPM
59273	GRAVELINES	Dunkerque GPM
59359	LOON-PLAGE	Dunkerque GPM
59532	SAINT-GEORGES-SUR-L'AA	Dunkerque GPM
59540	SAINT-POL-SUR-MER	Dunkerque GPM
17300	ROCHELLE	La Rochelle
76169	CERLANGUE	Le Havre GPM
76305	GONFREVILLE-L'ORCHER	Le Havre GPM
76351	HAVRE	Le Havre GPM

76489	OUDALLE	Le Havre GPM
76533	ROGERVILLE	Le Havre GPM
76595	SAINT-JOUIN-BRUNEVAL	Le Havre GPM
76657	SAINT-VIGOR-D'YMONVILLE	Le Havre GPM
76660	SANDOUVILLE	Le Havre GPM
13026	CHATEAUNEUF-LES-MARTIGUES	Marseille-Fos GPM
13039	FOS-SUR-MER	Marseille-Fos GPM
13054	MARIGNANE	Marseille-Fos GPM
13055	MARSEILLE	Marseille-Fos GPM
13056	MARTIGUES	Marseille-Fos GPM
13077	PORT-DE-BOUC	Marseille-Fos GPM
13078	PORT-SAINT-LOUIS-DU-RHONE	Marseille-Fos GPM
44020	BOUGUENAIS	Nantes-St-Nazaire GPM
44045	CORDEMAIS	Nantes-St-Nazaire GPM
44052	DONGES	Nantes-St-Nazaire GPM
44074	INDRE	Nantes-St-Nazaire GPM
44103	MONTOIR-DE-BRETAGNE	Nantes-St-Nazaire GPM
44109	NANTES	Nantes-St-Nazaire GPM
44162	SAINT-HERBLAIN	Nantes-St-Nazaire GPM
44184	SAINT-NAZAIRE	Nantes-St-Nazaire GPM
14001	ABLON	Rouen
76157	CANTELEU	Rouen
76164	CAUDEBEC-EN-CAUX	Rouen
76319	GRAND-COURONNE	Rouen
76322	GRAND-QUEVILLY	Rouen
14333	HONFLEUR	Rouen
76384	LILLEBONNE	Rouen
76457	MOULINEAUX	Rouen
76476	NOTRE-DAME-DE-GRAVENCHON	Rouen
76497	PETIT-COURONNE	Rouen
76498	PETIT-QUEVILLY	Rouen
76499	PETIVILLE	Rouen
14536	RIVIERE-SAINT-SAUVEUR	Rouen
76540	ROUEN	Rouen
76592	SAINT-JEAN-DE-FOLLEVILLE	Rouen
76659	SAINT-WANDRILLE-RANCON	Rouen
76684	TANCARVILLE	Rouen
76709	TRAIT	Rouen

76717	VAL-DE-LA-HAYE	Rouen
76727	VATTEVILLE-LA-RUE	Rouen
76750	YAINVILLE	Rouen

ANNEX 5: METHODOLOGY FOR MULTI-REGIONAL INPUT-OUTPUT ANALYSIS

Input-output analysis is a quantitative technique, originally developed by Leontieff, used to describe, analyse and explain economic structures, dependencies and changes. An input-output table describes deliveries from one industrial sector to another, to consumers, government and abroad (export). The corollary concept is that if one industry develops rapidly, the industries that deliver to that growing industry will experience more demand and will also grow. The resulting impact can be expressed by a multiplier. For the purpose of this case study on Marseille-Fos, a multiregional input-output table was constructed.

The basis of the multiregional input-output (IO) table for Marseille-Fos is formed by a 15-sector national IO-table for France from 2005, available on the INSEE web site. Regional and sectoral NUTS 2 (Nomenclature of Territorial Units for Statistics) data with regard to employment (production), value added, wages and population, available in OECD databases, were used to redistribute the IO-table for France to a multiregional IO, in which the inputs and outputs of the regions of PACA, Rhône-Alpes, Bourgogne, Languedoc-Roussillon, Ile de France and the rest of France were distinguished. Highly localised data on employment per activity (related to the port of Marseille-Fos, as well as port-related employment) were used to split PACA into the port cluster of Marseille-Fos and the rest of PACA. The result was an IO-table with seven different regions: the port cluster of Marseille-Fos and the regions of PACA, Rhône-Alpes, Bourgogne, Languedoc-Roussillon, Ile de France and the rest of France.

REFERENCES

BG Ingénieurs Conseils (2011), Profil climat de Marseille Provence Métropole: Bilan carbone et vulnérabilité du territoire, Plan Climat Marseille Provence Métropole.

BG Ingénieurs Conseils (2012), Réalisation du profil climat sur le territoire du SCoT Ouest étang de Berre.

Blum, R., (2010), *La Desserte ferroviaire et fluviale des grands ports maritimes*, Rapport parlementaire

Cheon, S., (2008), Productive Efficiency of World Container Ports ; a global perspective, *Transportation Research Record*, pp. 10-18

Cheon, S., (2009a), Impact of global terminal operators on port efficiency : a tiered data envelopment analysis approach, *International Journal of Logistics Research and Applications*, Vol. 12, pp. 85-101

Cheon, S., (2009b), Evaluating impacts of institutional reforms on port efficiency changes: Ownership, corporate structure, and total factor productivity changes of world container ports, *Transportation Research Part E*, Vol. 46, No4, pp.546-561

Cheon, S., Dowall, D., Song, D., (2009), Typology of Long-Term Port Efficiency Improvement Paths: Malquist Total Factor Productivity for World Container Ports, *Journal of Infrastructure Systems*, pp. 340-350

Coppens, F., (2007), Economic impact of port activity: a disaggregate analysis; the case of Antwerp, Working paper document no. 110, National Bank of Belgium

Cour des Comptes, (2006), *Les ports français face aux mutations du transport maritime: l'urgence de l'action*, Paris

Cour des Comptes (2011), *Le Grand port maritime de Marseille : blocage social et déclin*, Paris

Crozet, Y., (2010), *La contribution du fret ferroviaire à la mobilité des marchandises en France et en Europe*, Club parlementaire HERMES Mobilité et Transport durables, février 2010

Cullinane, K., Song, D., (2006), Estimating the relative efficiency of European container ports: a stochastic frontier analysis, *Research in Transport Economics*, Vol. 16, pp. 85-115

Cullinane, K.P.B., Wang, T.F., (2006), The efficiency of European container ports: A cross-sectional data envelopment analysis, *International Journal of Logistics Research and Applications* 9(1), pp. 19-31, http://pdfserve.informaworld.com/126484__743777491.pdf

Debrie, J., Lavaud-Letilleul, V., (2010), *La Décentralisation portuaire : réformes, acteurs, territoires*, L'Harmattan, Paris

Ducruet, C., Lee, S., Song, J. (2011), "Network Position and Throughput Performance of Seaports", in : Notteboom (ed) : *Current Issues in Shipping, Ports and Logistics*, Brussels

Egis Eau (2012), Etude de l'impact énergétique et des émissions des ports et aéroports de la région Provence-Alpes-Côte d'Azur, Rapport Méthodologique, d'analyses et de recommandations pour les ports.

Ferrari, C., Parola, Gattorna, E. (2011), Measuring the quality of port hinterland accessibility: The Ligurian case, *Transport Policy*, Vol. 18, pp. 382-391

Ferrari, C., Merk. O., Bottaso, A., Tei, A. (2012), *Ports and Regional Development: A European Perspective*, OECD Regional Development Working Paper, Paris

Frémont, A., Franc, P., Slack, B., (2009), Inland barge services and container transport: the case of the ports of Le Havre and Marseille in the European context, *Cybergeo: European Journal of Geography;* www.cybergeo.eu/index21743.html

Giuliano, G. and A. Linder, July 2011. "Motivations for voluntary regulation: The Clean Air Action Plan," submitted for presentation at the 2012 TRB Annual Meeting. Available at http://docs.trb.org/prp/12-2628.pdf

Gouvernal, E., Slack, B., Franc, P., (2010), Short sea and deep sea shipping markets in France, *Journal of Transport Geography*, Vol. 18, pp. 97-103

GPMM (2009a), Projet Strategique 2009-2013

GPMM (2009b), Rapport Annuel de développement durable 2009.

GPMM (2011), L'Évolution des Bassins Est du Grand Port Maritime de Marseille à l'horizon 2025 : un projet ville-port, Commission spécialisée Évolution des Bassins Est, présidée par Yves Cousquer, Conseil de Surveillance, GPMM

GPMM (2012), Actualisation janvier 2012 Projet Strategique 2009-2013

Guerrero, D. (2010), « Les aires d'influence des ports de la France : entre réseau et gravitation, doctoral thesis », Université Paris Diderot – Paris 7

Haezendonck, E., (2001), *Essays on strategy analysis for seaports*, Garant: Leuven

Herrera, S., Pang, G., (2008), Efficiency of infrastructure: the case of container ports, *Revista Economia* 9(1), pp. 165-194, http://www.anpec.org.br/revista/vol9/vol9n1p165_194.pdf

INEA (Ingénieurs-Conseil, Nature Environnement Aménagements) (2009), SCoT Ouest Etang de Berre, Etat Initial de l'Environnement

Jacobs, W., Ducruet, C., De Langen, P.W., (2010), Integrating world cities into production networks: the case of port cities, *Global Networks* 10 (1), pp. 92-113

Market Economics (2011) 'Economic Role of the Ports of Auckland Limited 2010, 2021 and 2031'. Report prepared for Ports of Auckland Ltd. October 2011. Accessed on 27/10/2012. URL: http://www.poal.co.nz/news_media/publications/POAL_economic_role_2011.pdf

Marseille Provence Métropole (2007), Métropole euroméditerranéenne des échanges et de la connaissance ; une stratégie de développement pour 2008-2014

Merk, O, Hesse, M. (2012), The Competitiveness of Global Port-Cities: The case of Hamburg, OECD Regional Development Working Paper, Paris

Mongelluzzo, B., 2012. "How California's Ports Cleared the Air", The Journal of Commerce, January 23, 2012. Accessed on Oct 1st, 2012 at http://www.joc.com/portsterminals/how-californias-ports-cleared-air?page=2

O'Brien, T., 2004. "Quality of Life and Port Operations: Challenges, Successes and the Future", White Paper prepared for the sixth Annual CITT State of the Trade and Transportation Industry Town Hall Meeting. CITT: Long Beach.

Premier Ministre (2012), Réunion de ministres sur l'agglomération marseillaise ; Relevé de conclusions, Hotel de Matignon, 6 septembre 2012

Rodrigue, J. *et al.*, (2010), Functions and actors of inland ports: European and North American dynamics, *Journal of Transport Geography*, Vol. 18, pp. 519-529

Verhetsel, A. and Sel, S. (2009) "World Maritime Cities: from Which Cities Do Container Shipping Companies Make Decisions", *Transport Policy*, Vol. 16, No 5, pp. 240-250.

Ville de Marseille (2012), Marseille Attractive; un projet pour une strategie partenariale, 2012-2020, Marseille

Wu, Y.C.J., Goh, M., (2010) Container port efficiency in emerging and more advanced markets, Transportation Research Part E, 46, pp. 1030-1042.

NOTES

[1] *Degree centrality* expresses the number of adjacent neighbours of a node; it is the simplest and most commonly accepted measure of centrality. It often correlates with total traffic (more connections imply more traffic). *Betweenness centrality* expresses the number of shortest paths going through each node. The *clustering coefficient* estimates whether the adjacent neighbors of a node are connected to each other (i.e. "my friends are also friends"), thus forming triangles (triplets); the coefficient is the ratio between the number of observed triplets and the maximum possible number of triplets connecting a given node. The ratio goes from 0 (no triplets observed) to 1 (all neighbors connected). When it comes to hub-functions in a transport system, in theory the "pure hub" will have a clustering coefficient near zero because it serves as a pivotal platform redistributing flows to/from satellite platforms (spokes) which are only connected to the hub (star-shaped network). Conversely, values close to 1 depict a denser pattern with more many transversal (and thus less hierarchical) links. In a maritime network, transshipment hubs should have low clustering coefficients as opposed to other configurations where links are more evenly distributed among ports (e.g. absence of hubs such as in the Baltic Sea or in the USA). The different port hub-measures are related, but also complementary to each other. Very central nodes (high betweenness centrality) often act as hubs (low clustering coefficient) and it is common to observe a high correlation between degree centrality and betweenness centrality due to the physical constraint of coastlines for circulation. In some cases such as relay and remote hubs, some nodes can have higher betweenness centrality than degree centrality, i.e. they are very central globally but have only a few links locally. This is because they act as "bridge" between sub-components of the network, such as Anchorage in the global network of air freight being a bridge between Asia and North America.

[2] Marseille and Fos have 8 port connections in common, therefore added up they have 29 port connections.

[3] Ports at the Spanish South Atlantic coasts are also included in this figure.

[4] Maritime transport is considered as: auxiliary services for water transport (NAF 2008 Code: 5222Z), Maritime and coastal transport of passengers (5010Z), Maritime and coastal transport of freight (5020Z), Port cargo handling (5224A), Services to ships (9420Z). Land transport is considered as: road transport (4941ABC, 5229A), other land transport (5030Z, 4950 Z, 7712Z). Logistics and trade is considered as: Logistics and trade (5229B), Storage and non-port cargo handling (5224B). Exploitation of marine resources is considered as: Fishing and sea products (0311Z), Fishing industry (1020Z). Ship-building and reparation is considered as: Construction of ships and floating structures (3011Z). Port industries are considered as: Chemicals, petrochemicals and refinery (C20), Metallurgy (C24), Agro-foods (C10). Marinas is considered as: Construction of yachts (3012Z). Tourism is considered as: Tourist buses, travel agencies (7911Z).

[5] This approach builds on a proposal in Musso et al. 2000 to define port-related employment according to the extent to which it is overrepresented in regions with large ports, instead of using own assumptions on which industries are port-related or not. The approach follows different logical steps. As a start, two different groups of regions are defined: port regions and non-port regions; the different industries in which these two groups as a whole are specialised are identified. For the industries in which port regions as a whole are specialised the specialisation index of each individual port region is identified in order to assess how many port regions are specialised in these industries. This information is then compared to a standard probability distribution in order to identify to what extent the employment in these industries can really be attributed to the presence of a port. The more unlikely it would be to find similar specialisations in a random set of regions, the higher is the percentage of the employment in that sector that will be considered "port-related employment". This approach has been followed for France, using a dataset of all municipalities with their employment in 732 sectors in 2011. For this analysis the agglomerations connected to the seven large maritime ports (Grands Ports Maritimes) were considered to be port-cities (see Annex 3 for a list of municipalities included); all the other municipalities were considered to be the non-port localities. Application of this less discretionary methodology confirms that the largest share of port-

related employment in Marseille is in transport and logistics. The estimated total port-related employment is in the same range that was found in earlier studies, between 40,000 and 45,000 jobs.[5] However, findings differ with respect to the distribution of employment over sectors. The largest port-related sector is transport, storage and communication, representing almost 15,000 jobs. However, a large part of the port-related jobs are in non-market services and some major industrial services, including mining quarrying and energy supply; real estate, renting and business activity and other manufacturing. In addition to these sectors, there are port-related jobs in several other industrial and services sectors.

6 Although Hamburg has a large cluster of maritime services, including in ship finance, maritime consulting and engineering, these services have not been taken into account in the definition of port-related industries are these services were not directly linked to the port

7 However, according to the review by Trujillo and Gonzales (2008) there are about an equal number of studies exploring efficiency via estimating a stochastic frontier production with a predefined functional form, suggesting the absence of consensus vis-à-vis the best approach to be used.

8 Cheon, *et al.*, 2010; Wu and Goh, 2010; Martinez-Budria, *et al.*, 2009; Wang and Cullinane, 2006; Al-Eraqui, *et al.*, 2007; Tongzon, 2001

9 This mainly legitimates stochastic frontiers and econometrics approaches though they impose a functional form to the production.

10 Bootstrapping is a re-sampling method consists in constructing a number of resamples of the observed dataset, and of equal size, where each of these is obtained by random sampling with replacement from the original dataset.