Container Ports: An Engine of Growth

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➢   Reflecting the sharp growth in world trade, global container traffic was 7 times higher in 2011 than in 1990 (reaching 600 million TEUs). The surge in container trade is mainly attributed to the increasing penetration of Asian products in developed European and American markets.

➢   Mediterranean ports have improved their relative position, as they continue to handle a steady 9 per cent of world container traffic during the past two decades, at a time when Northern European ports have lost 10 pp of market share.

➢   Three years after the concession agreement with Cosco, Piraeus container terminal is capturing significant market share. Container traffic in Piraeus (which comprises almost 90 per cent of the Greek container market) more than tripled in 2012 compared with 2010 (handling 2.7 million TEUs), while traffic in other Mediterranean ports increased by about 20 per cent during the same period.

➢   Greek ports' potential stems from international transshipment and transit traffic.

✓ Transshipment is the primary driver for Piraeus' impressive dynamics during the past two years, as it accounts for ¾ of the port's container traffic. Looking forward, new investment in infrastructure is expected to increase its capacity by 60 per cent, allowing the transshipment traffic to increase to 2.5 million TEUs by 2015 from 2 million TEUs in 2012 (in line with regional demand) and leave room for transit traffic. As a result, Greek ports appear to be on their way to capturing their fundamental share of the transshipment market (7.6 per cent).

✓ However, Greek ports have significant untapped potential as gateways for transit traffic. As the CEE/Asia container market is expected to reach about 3.3 million TEUs by 2015, transit traffic in Greek ports (mainly Piraeus and Thessaloniki) could reach 1.2 million TEUs in 2015, from only 45,000 TEUs in 2012, if the appropriate investment in land transport is completed (around €3 billion), partly supported by EU structural funds. It should be noted that the transit sector offers far more revenue and value added to the Greek economy than the transshipment sector (about 4.5 times more per TEU), as it also creates the corresponding land freight transport business.

➢   According to our estimates, the value added from the projected increase in container handling in Greek ports (to 4.7 million TEUs in 2015 from 3 million TEUs in 2012) is estimated to rise by around €0.8 billion, or 0.4 per cent of GDP by 2015. Importantly, the long-term benefit could be much larger (€5.1 billion or 2.5 per cent of GDP by 2018), as the multiplier effect from the formation of a cargo-related cluster (mostly from suppliers) is potentially large (multiplier of 1.6 on the value added of the cluster). Indeed, the total employment effect of the increased traffic could reach around 9,000 new jobs by 2015 and more than 125,000 new jobs by 2018.

➢   It is important to note that in order for Greece to reach its potential,

✓ Greek ports need further privatization to facilitate large investments, while

✓ the entire intermodal transport network - ports, road and mainly rail - need a significant infrastructure upgrade (partly through an effective use of EU funds).
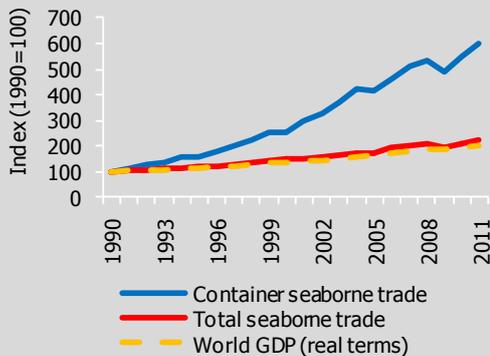
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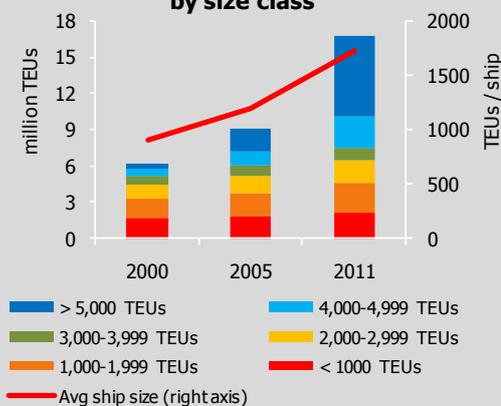e-mail: sava.maria@nbg.gr

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**International seaborne trade
(million tons loaded)**

Source: Review of Maritime Transport 2011, NBG
estimates

**World container fleet capacity
by size class**

Source: Containerization International

Container market: A booming sector globally

The sharp growth in world trade during the past 20 years (6.3 per cent annually) combined with world fleet modernization has led to a substantial expansion in port freight traffic. A crucial development during this period is the increasing degree of containerization (16.5 per cent of total seaborne trade in 2011, compared with 6 per cent in 1990), which makes shipping and handling of cargo far more efficient. In fact, global container traffic was 7 times higher in 2011 than in 1990 and the average containership doubled in size during the same period. As a result, the world port sector has had to undergo an extensive restructuring (privatizations and investment in infrastructure and equipment). For Europe alone, container trade reached 44 million TEUs[1] in 2009 compared with 20 million TEUs in 1996 (33 per cent of world container trade in 2009 from 40 per cent in 1996), with Asian countries accounting for 50 per cent of the flows (compared with 40 per cent in 1996).
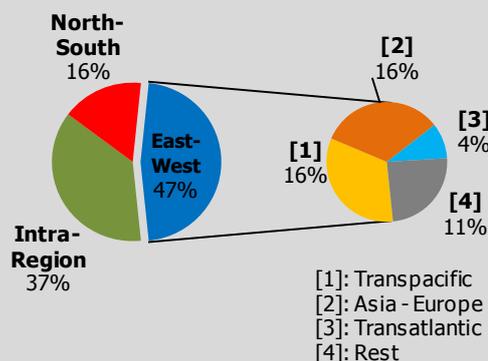
Port operations contribute almost €35 billion in revenue per year to the European economy. In particular, container handling in Europe is estimated to contribute around 1/3 of port revenue from trade activities (even though containers account for just 18 per cent of freight volume). In Greece, container handling covers around 1/5 of port revenue from trade activities (where containers account for 13 per cent of freight volume). The container market in Greece is dominated by two ports, Piraeus and Thessaloniki, which depend mainly on container handling (almost 75 per cent of their merchant port operations).

COSCO in Piraeus: A success story

The market dynamics in Greece have been impressive during the past 2 years, as container traffic in the port of Piraeus (which attracts almost 90 per cent of the Greek container market) has more than tripled in 2012 compared with 2010. This is mainly the result of the concession of pier II of the Piraeus container terminal to China's COSCO Pacific, which had committed to upgrading the port's infrastructure and turning it into a Mediterranean hub. This development drove the Greek market share to about 0.5 per cent of world traffic in 2012 (close to its long-term average) from a low of 0.15 per cent during the period 2008-2010, when operational

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[1] One TEU (Twenty-foot equivalent unit) represents the cargo capacity of a standard intermodal container, 20 feet (6.1m) long and 8 feet (2.44m) wide.

World maritime container trade flows

North-South 16%

East-West 47%

Intra-Region 37%

[2] 16%

[3] 4%

[1] 16%

[4] 11%

[1]: Transpacific
[2]: Asia - Europe
[3]: Transatlantic
[4]: Rest

Source: Review of Maritime Transport 2011, Drewry 2005, NBG estimates

Maritime container trade on East-West routes

million TEUs

— Transatlantic — Transpacific
— Europe-Far East
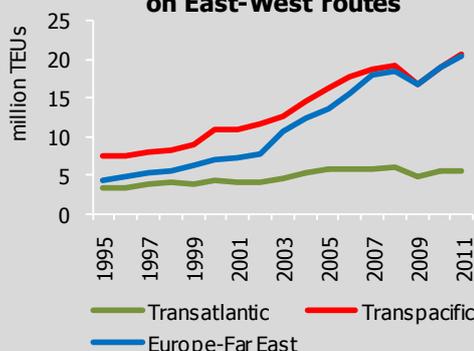
Source: Review of Maritime Transport 2011, HIS Global Insight

World container traffic
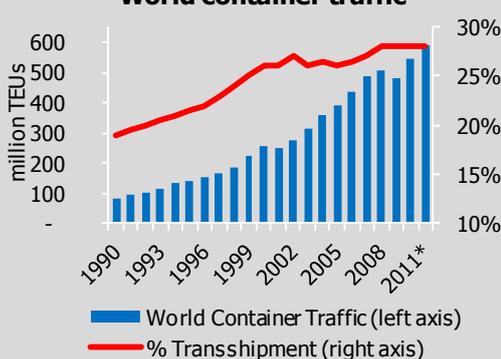
million TEUs

— World Container Traffic (left axis)
— % Transshipment (right axis)

World container traffic for 2011 is based on available data from ports representing 2/3 of world traffic.

Source: Containerization International, Deutsche Bank Research

malfunctions (mainly due to prolonged strikes) affected the port's reliability.

In order to gauge the further potential dynamic of the Greek container terminals, in the following analysis we will focus on: (i) the growth of world container traffic; (ii) the share of Mediterranean ports in the world container market; (iii) a comparison of Greek container terminals with competitive terminals in other Mediterranean ports; and (iv) the actions needed to achieve this potential.

1. WORLD CONTAINER TRADE AND PORT ACTIVITY

Container trade globally grew sharply during the past two decades...

World container trade reached 160 million TEUs (or 1.5 billion tons) in 2011, after posting an annual growth of 9 per cent during the past 20 years (compared with 3.3 per cent for the rest of the seaborne trade during the same period). As a result, container trade accounted for 16.5 per cent of total seaborne trade in 2011, compared with 6 per cent in 1990.

... mainly due to Asia's increasing role

The surge in container trade is mainly attributed to the increasing penetration of Asian products in developed European and American markets. In fact, container trade flows[2] to and from Asia present the highest growth among the three main East-West trade routes[3] (Asia-Europe, Transpacific and Transatlantic). Specifically, during the period 1995-2011, container trade has increased by almost 5 times between Asia and Europe and about 3 times between Asia and North America (transpacific route). On the other hand, container trade flows between Europe and North America (transatlantic route) have increased by just 70 per cent in the same period, remaining below 6 million TEUs in 2011 (compared with about 20 million TEUs for the Asia-Europe and the transpacific lines).

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[2] Regarding container trade origin and destination, geographical areas are defined according to the WORLDNET database and Container Trade Statistics specifications: Europe (Europe, Turkey and other Mediterranean countries) and Asia (Far East, Oceania, Indian Ocean and Middle East).
[3] The three main East-West trade routes account for 75 per cent of total East-West trade flows.

World container traffic (million TEUs)				
	1990	2000	2010	growth '90-'10
Asia	38	145	350	x 9,1
China	6,3	41	147	x 23,2
Rest of Asia	32	104	202	x 6,3
America	21	47	83	x 4
N.Europe	17	33	55	x 3,2
Mediterranean	6,5	23	48	x 7,4
Africa	1,6	6,9	8,9	x 5,5
Total	84	255	545	x 6,4

* Container traffic consists of TEUs originating and destined for ports of a given region, including transshipment and transit cargo.

Source: Containerization International

Average container traffic per port				
	1990	2000	2010	growth '90-'10
Asia	0,35	0,87	2,20	x 6,3
China	0,58	2,16	8,19	x 14,2
Rest of Asia	0,32	0,70	1,43	x 4,5
America	0,21	0,29	0,52	x 2,5
N.Europe	0,22	0,38	0,75	x 3,5
Mediterranean	0,12	0,27	0,50	x 4,2
Africa	0,06	0,17	0,39	x 6,2
Total	0,23	0,47	1,07	x 4,7

* Traffic volumes in million TEUs

Source: Containerization International

World container ports ranking 2011		
#	Port	million TEUs
1	Shanghai, China	31,70
2	Singapore, Singapore	29,94
3	Hong Kong, China	24,38
4	Shenzhen, China	22,57
5	Busan, South Korea	16,18
6	Ningbo-Zhoushan, China	14,69
7	Guangzhou Harbor, China	14,40
8	Qingdao, China	13,02
9	Dubai, Un.Arab Emirates	13,00
10	Rotterdam, Netherlands	11,88
…		
13	Hamburg, Germany	9,02
14	Antwerp, Belgium	8,66
15	Los Angeles, U.S.A	7,94
19	Long Beach, U.S.A.	6,06
26	Valencia, Spain	4,33
27	Port Said, Egypt	4,27
35	Algeciras, Spain	3,60
50	Ambarli, Turkey	2,69
75	Piraeus, Greece	1,68

Source: World Shipping Council, Piraeus Port

## As a result, world port activity increased substantially…

World port activity increases faster than seaborne container trade, as container activity involves loading and unloading operations in several ports along a ship's route, as well as transshipment and empty container handling. In fact, world container trade flows of 160 million TEUs in 2011 created a container traffic of 600 million TEUs in world ports. This figure suggests that each TEU exported was handled by 3.6 ports on average in 2011 (compared with 3 ports in 1990).

… resulting in higher port turnover and capacity…

The sharp growth in container traffic during the past 20 years (to 545 million TEUs in 2010 from 84 million TEUS in 1990) was accompanied by supply additions in the form of: (i) ports which added container handling activities; as well as (ii) increased capacity of existing container ports, which allowed them to benefit from economies of scale. New container ports were developed mainly in America and the Mediterranean (which absorbed half the increase in the respective regions' traffic) and to a lesser degree in Asia (absorbing about 40 per cent of the region's traffic increase). On the other hand, the increased traffic in Northern Europe and Africa was absorbed almost entirely by existing ports which increased their capacity. These developments resulted in an increase in the degree of container traffic concentration. Specifically, the 10 largest ports account for more than 80 per cent of traffic in Africa and Northern Europe, about 55 per cent in Asia and the Mediterranean and 45 per cent in America.

… especially in Asia

The role of Asia has been critical in the development of container traffic. In fact, container traffic in the ports of China (the main Asian market) was 20 times greater in 2010 than in 1990, compared with 5 times greater traffic in the rest of world ports during the same period. As a result, the share of Chinese ports in world container traffic reached 27 per cent in 2010, from 8 per cent in 1990. All Asian ports, taken together, handled 64 per cent of containers in 2010 (up from 46 per cent in 1990), followed by American ports with 15 per cent (down from 25 per cent in 1990) and Northern Europe with 10 per cent (down from 20 per cent in 1990).
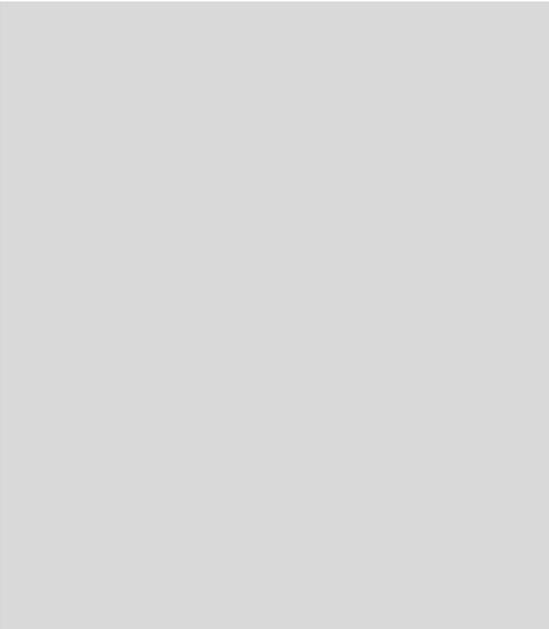
As a result of such high demand, Asian container ports are significantly larger than those of the rest of the world, with the average port handling about 2 million TEUs annually (8 million TEUs for Chinese ports), compared with 0.4-0.8 million TEUs in other regions (see table). Indicative is the fact that of the top 10 world container ports (according to annual container traffic), 9 are located in Asia with the leading ports being Shanghai (China) and Singapore (with each of them handling about 30 million TEUs in 2011). Next in size are North European ports (Rotterdam, Hamburg, Antwerp) with annual traffic of about 10 million TEUs and American ports (Los Angeles, Long Beach) handling about 7 million TEUs each, while the largest Mediterranean ports (Valencia, Port Said, Algeciras) handled less than 5 million TEUs in 2011.

BOX 1: World fleet

The high growth of seaborne container traffic during the past twenty years affected the structure of the world merchant fleet, leading to a substantially higher penetration of container ships in general cargo carriers. Specifically, the available capacity of container ships reached almost 18 million TEUs in 2012, 9 times greater than in 1990. This increase resulted in container ships accounting for 65 per cent of general cargo carriers' capacity (compared with 18 per cent in 1990). As shipping companies pursued economies of scale, most of the new container ships had a capacity of more than 5,000 TEUs (40 per cent of container fleet capacity in 2012, compared with 7 per cent in 2000).

In part, the increased container fleet capacity became necessary due to uneven trade flows between China and the rest of the world. Specifically, China plays a constantly growing role as the origin of container trade flows (i.e. it accounts for 70 per cent of container flows to Europe and America, compared with 50 per cent in 1995), but not as a destination of trade flows. This leads to the transport of an increasing number of empty containers (22 per cent in 2012 from 14 per cent in 1995) and has led to the demand for higher ship capacity to minimize the number of trips.

The larger container fleet, combined with weak demand after 2009, led to overcapacity in the container-shipping sector and to a drop in charter rates (see graph). This market disequilibrium, together with the increase in fuel costs, put pressure on shipping companies' profitability.

Looking forward, there are orders for container ship additions with total capacity of about 3.5 million TEUs to be delivered until 2015-2016 (the orderbook accounts for about 20 per cent of the current container fleet capacity). Against this background, charter rates are expected to remain at relatively low levels in 2013, but subsequently to rise in 2014-2015 (at an average annual rate of 25-30 per cent), as the recovery of demand will more than offset the effect from excess capacity.

World merchant fleet (Dwt)

Source: Unctad

Increasing share of empty containers
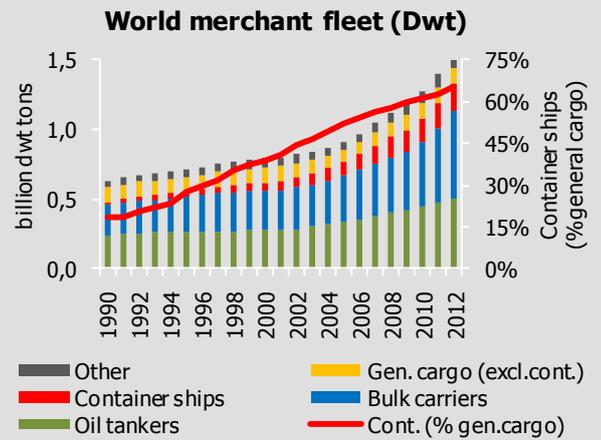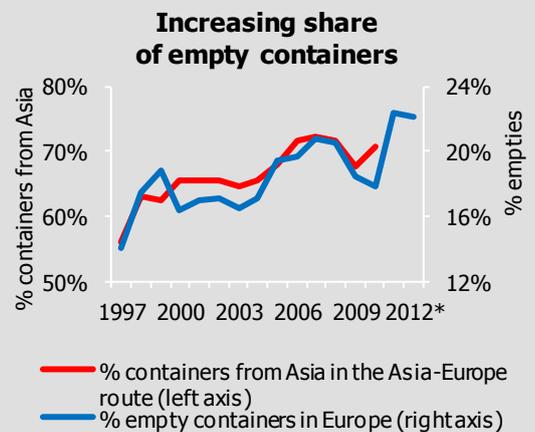
Source: Review of Maritime Transport, Eurostat

Overcapacity and charter rates*
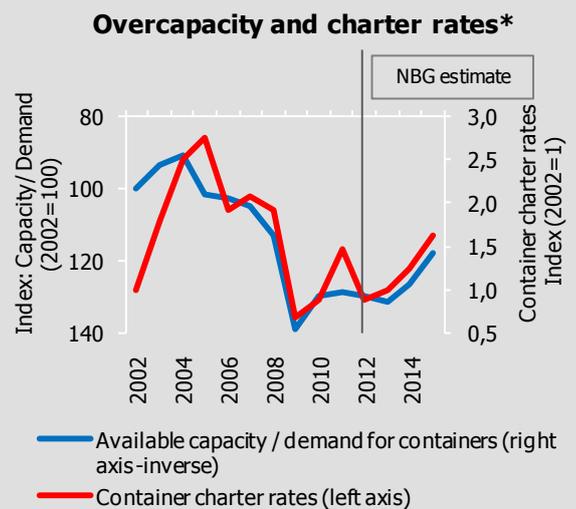
* Time charter rates refer to container ships with a capacity of 2,000-3,400 TEUs.

Source: Review of Maritime Transport 2011, Unctad, NBG estimates

European share of world container traffic

Container traffic for 2011 is based on available data from ports representing 2/3 of world traffic.
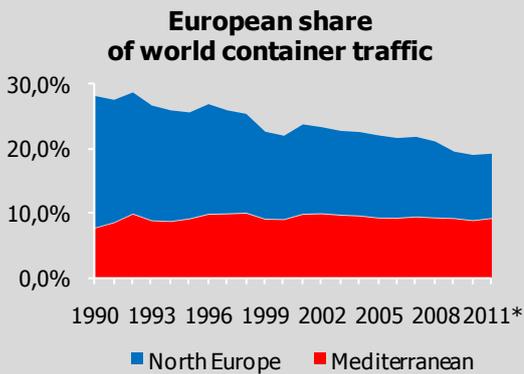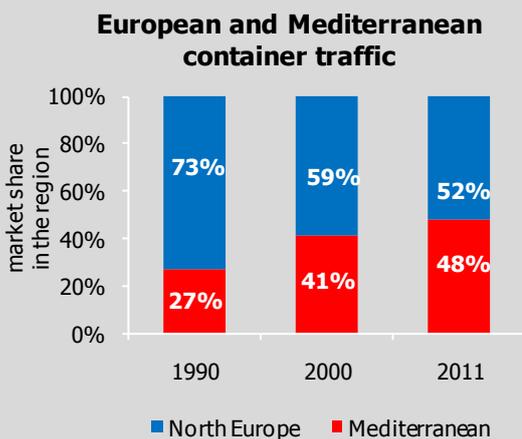
Source: Containerization International, NBG estimates

European and Mediterranean container traffic

Source: Containerization International, NBG estimates

Ownership of World Container Terminals

Source: Drewry (2010) Annual Review of Global Container Terminal Operators.

2. *EUROPEAN AND MEDITERRANEAN MARKET*

The growth in world container trade – mostly the flows between Asia and Europe – led European ports (including those of the Mediterranean) to handle about 114 million TEUs in 2011, from just 23.7 million TEUs in 1990. This increase was smaller than that of Asian container ports, resulting in a drop in Europe's share of world container traffic from 28 per cent in 1990 to 19 per cent in 2011. However, Mediterranean ports continued to handle about 9 per cent of world container traffic during the same period, as they gained market share from ports in Northern Europe (48 per cent of European traffic in 2011, from 27 per cent in 1990). This partly reflects the higher amount of transshipment operations in the Mediterranean (½ of Mediterranean traffic, compared with ¼ of traffic in Northern Europe).
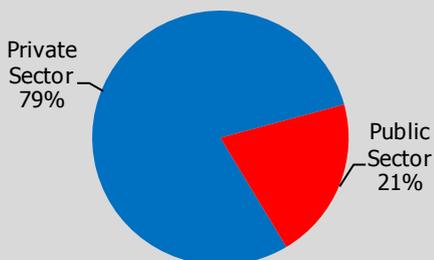
At this stage, it is useful to clarify that there are two types of international traffic handled in main container ports (apart from the local traffic, which consists of trade flows to/from the country where the port is situated):

➢ Transshipment traffic

In this case, the port acts as an intermediate destination, where containers are reloaded to other, usually smaller, ships (feeder ships) and then shipped to their final destination. Transshipment operations are efficient when final destination ports: (i) lack the necessary container handling capacity to serve large container ships; or (ii) require a significant divergence from the ship's main course, to the point that would make the transport cost inefficient for the shipping company.

➢ Transit traffic

In this case, the port is used as a gateway for cargo to reach its final destination using the country's land transport network.

Transshipment and transit traffic results in competition between container ports, on the basis of infrastructure, equipment, cost and quality of service.

Global Terminal Operators' concentration*
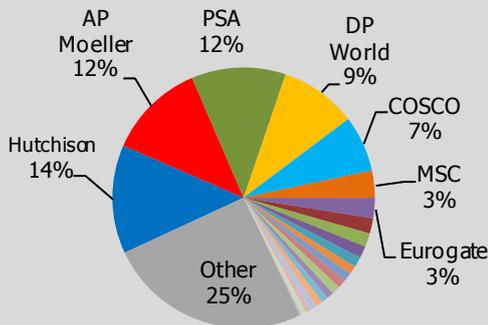
*based on container handling volume

Source: Hawkpoint/ Containerization International Yearbook 2010, Drewry.

Container shipping companies' concentration*

*based on container ship capacity

Source: Containerization International (09/2012)

Mediterranean container traffic

*Container traffic for 2011 is based on available data from ports representing 35 % of Mediterranean traffic.

- East Med. (left axis)
- West Med. (left axis)
- Greek share in Mediterranean traffic (right axis)

Source: Containerization International

a. The Mediterranean market for transshipment container flows

Transshipment is a key factor behind the sector's growth

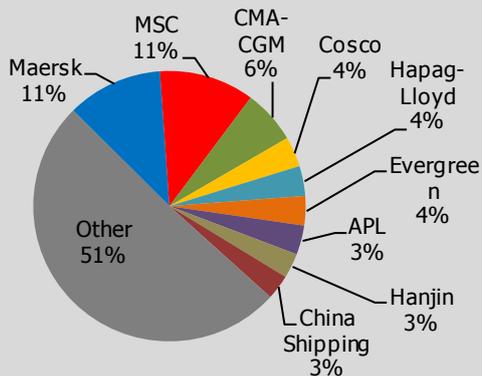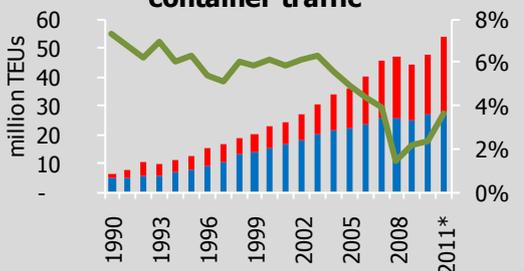Transshipment operations, which account for almost 1/3 of world container traffic, do not depend on the trade profile of the country in which the transshipment port is located. The port choice depends mostly on geographic location and a satisfactory combination of cost and quality of service.

As a result, intense competition occurs between container ports (including a great need for infrastructure investments so that they can attract large container ships), which has led to the privatization of most container terminals (80 per cent of world container terminals). There are 5 major players that dominate the specific sector (Hutchison, AP Moeller, PSA, DP World, COSCO), handling more than half the world container volume. It should be noted that in order to secure a minimum level of profitability, container terminal operators sign contracts with shipping companies which guarantee a specific level of annual container traffic (mainly transshipment traffic). Such agreements are critical, in view of the fact that the container shipping sector is highly concentrated (more than 25 per cent of container traffic volume is transported by four dominant shipping companies) and shipping companies can easily shift transshipment operations to neighboring ports.

An econometric model for the Mediterranean container market

The Mediterranean container market is estimated to amount to around 54 million TEUs in 2011, with almost half of that concerning transshipment traffic. Based on data for the past 30 years, we have constructed a model (see BOX 4) that quantifies the two most important determinants of Mediterranean traffic: (i) growth in world trade (explaining 90 per cent of the growth in Mediterranean traffic); and (ii) increase in containerization (contributing the residual 10 per cent of Mediterranean traffic growth). The large increase of traffic sourced from Asia appears to dominate any regional growth differences between countries in Europe.

East Mediterranean ports gain market share...

During the recent years, a restructuring has occurred within the

Mediterranean container traffic by country (2011)

- Turkey 12%
- Malta 6%
- Israel 5%
- Morocco 4%
- Greece 4%
- Portugal 2%
- France 2%
- Lebanon 2%
- Other 9%
- Spain 20%
- Italy 18%
- Egypt 16%
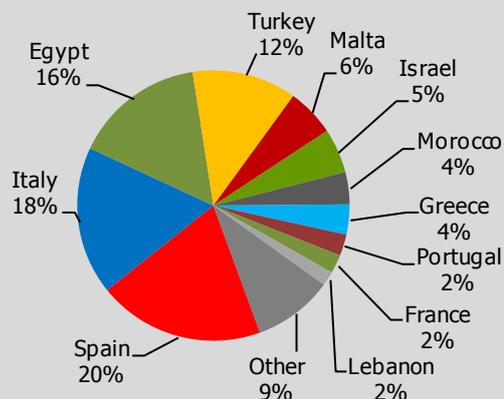
Source: Containerization International, NBG estimates

Container traffic in Greek ports

million TEUs

Piraeus ■ Thessaloniki ■ Other

Source: Eurostat, Containerization International

Container traffic in Mediterranean ports (2011)

- Valencia (Spain)
- Port Said (Egypt)
- Algeciras (Spain)
- Ambarli (Turkey)
- Marsaxlokk (Malta)
- Gioia Tauro (Italy)
- Tangier (Morocco)
- Barcelona (Spain)
- Genova (Italy)
- Piraeus (Gr)
- La Spezia (Italy)
- Haifa (Israel)
- Damietta (Egypt)
- Marseilles (France)
- Alexandria (Egypt)
- Izmir (Turkey)
- Livorno (Italy)
- Taranto (Italy)
- Cagliari (Italy)
- Malaga (Spain)
- Thessaloniki (Gr)

■ Transhipment
■ Non-transhipment

million TEUs

Source: Containerization International, NBG estimates

Mediterranean market. The ports of the East Mediterranean gained market share from those of the West Mediterranean, and accounted for almost 50 per cent of Mediterranean traffic in 2011, up from 28 per cent in 1990. The ports that benefited the most were mainly those of Turkey and Egypt, while those that lost the most market share were 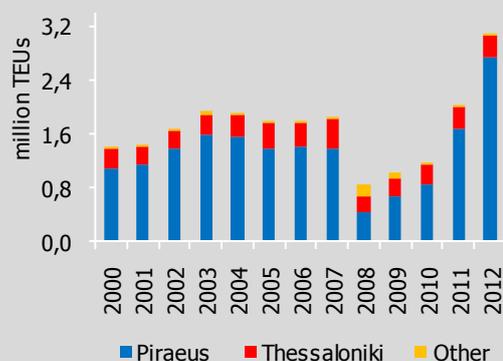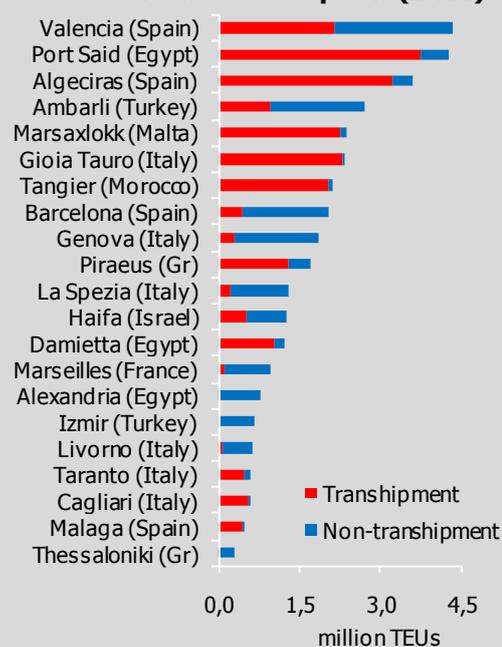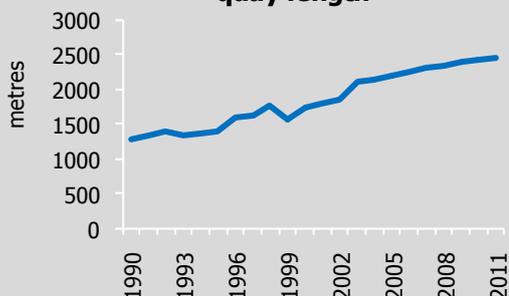those of Italy and France. To a large extent, the shifts in port market shares are attributed to the development of transshipment hubs in the ports of the East Mediterranean (e.g. Port Said and Ambarli), as they improved their infrastructure and attracted large volumes of container cargo.

… with Greek ports only recently taking advantage of this shift

Greek ports attracted about 4 per cent of Mediterranean container traffic in 2011, a share which is on the rise from the 1.5-2 per cent recorded during the period 2008-2010, and this share is estimated to have risen further in 2012, reaching its long-term average of 6 per cent. This is mainly the result of the concession agreement for the operation of pier II of the Piraeus container terminal with private operator COSCO Pacific, which plans to turn Piraeus into a leading Mediterranean transshipment hub and a gateway for Chinese exports to Europe. This agreement revived a port that had lost almost half its traffic during 2008-2010 due to a poor operating environment that forced many shipping companies (like MSC) to shift their cargo to more competitive Mediterranean ports. Specifically, Piraeus handled 1.7 million TEUs in 2011, accounting for about 4 per cent of Mediterranean traffic, of which 76 per cent consisted of transshipment traffic. In contrast, Thessaloniki (the second largest Greek port) is the smallest port in our sample, handling only 300.000 TEUs in 2011, which is less than 0.7 per cent of Mediterranean traffic of which a negligible share is transshipped.

When comparing Greek ports with the traditionally most competitive Mediterranean container ports, the importance of geography for transshipment becomes evident. Besides Valencia (Spain) and Ambarli (Turkey) – whose volume is focused on trade to the domestic market – the ports with the highest volume of container traffic in 2011 are those focusing on transshipment operations. Specifically, almost 70 per cent of Mediterranean traffic is handled in ports serving as pure transshipment hubs like Port Said (Egypt), Algeciras (Spain), Marsaxlokk (Malta), Tangier

Average Mediterranean port: quay length

Source: Mixalopoulos (2004), Container port authorities, NBG estimates

Technical Characteristics of Mediterranean container ports			Mediterranean average*	
	Piraeus	Thessal.	Large	Medium
Container terminal size 2012				
Traffic (mil. TEUs)	2,73	0,32	2,17	0,56
Capacity** (mil. TEUs)	3,60	0,41	3,21	1,24
Container terminal infrastructure				
Maximum Depth (m)	18	12	16	15
Quay length (m)	3,1	0,6	2,9	1,4
Berths	11	3	8	6
Quay area (,000 m2)	837	250	737	519
Container terminal equipment				
Quay cranes	26	4	16	6
Quay cranes per km of quay	8	7	6	5

*Ports are considered **Large** for container traffic over 750,000 TEUs in 2011 and **Medium-sized** for annual container traffic between 250,000 and 750,000 TEUs.

** Based on latest available data (January 2013)

Source: Containerization International, Port authorities, NBG estimates

(Morocco), and Gioia Tauro (Italy). These ports are favored by their geographic location, as they require a very small route deviation from ships traveling through the route connecting Asia with Europe (i.e. the Suez-Gibraltar shipping route).

Reflecting on the growth potential of the sector, Mediterranean ports try to improve their competitive position

The strong dynamics of the port industry during the past 20 years are evident in the Mediterranean market. Specifically, the average size of the Mediterranean container terminals (as measured by the quay length) reached 2.4 km in 2011, from 1.3 km in 1990. Additionally, there was an increase in the annual productivity of container terminal infrastructure (340,000 TEUs were handled per available berth, from 80,000 TEUs in 1990) and equipment (each crane handled 150,000 TEUs in 2011, from 53,000 TEUs in 1990).

However, despite this trend, there are significant differences between the ports. With a view to evaluating the competitive position of the main Greek ports, the following characteristics are considered:

✓ Maximum port depth, determining the port's ability to attract large container ships
✓ Quay length
✓ Terminal area available for container handling and storage
✓ Number of quay cranes (for ship to shore movements)
✓ Number of berths

Provided that the size of a port affects the level of available infrastructure as well as its productivity, for the purpose of the following analysis there is a distinction between: (i) large ports with annual container traffic over 750,000 TEUs (most of the ports in our sample, including Piraeus); and (ii) medium-sized ports with annual container traffic between 250,000 and 750,000 TEUs (among which is the port of Thessaloniki).

Unlike Thessaloniki, Piraeus has strong comparative advantages

Comparing Greek ports with the Mediterranean average, we note that the level of available capacity, infrastructure and equipment in the port of Piraeus is higher than the average port of equivalent size, while the port of Thessaloniki has significant potential for future development, considering that the size of its infrastructure is almost half that of an average medium-sized Mediterranean port

Container terminal productivity 2012				
	Piraeus	**Thessal.**	**Mediterranean average***	
			Large	**Medium**
TEUs per metre of quay	882	527	877	486
TEUs per m2 of area	3,3	1,3	3,4	1,2
TEUs per berth (,000)	248	105	397	117
TEUs per crane (,000)	105	79	131	112

** Ports are considered **Large** for container traffic over 750,000 TEUs in 2011 and **Medium-sized** for annual container traffic between 250,000 and 750,000 TEUs.*

Source: Containerization International, Port authorities, NBG estimates

Container port capacity utilization

Region	
South Asia	76%
Middle East	76%
South East Asia	72%
Africa	70%
Far East	69%
Central America	67%
Mediterranean*	67%
World	67%
South America	66%
North Europe	60%
North America	54%

0% 20% 40% 60% 80%
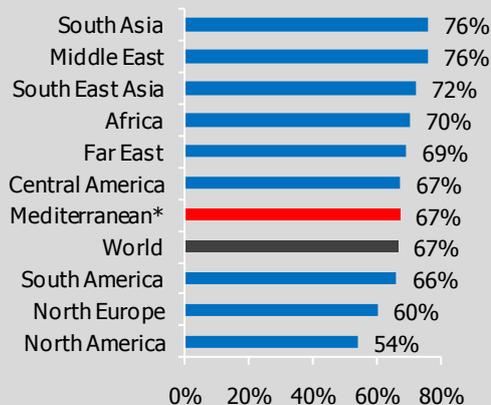
* Mediterranean region data based on our sample

Source: Port Technology International / Drewry 2008, NBG estimates

(see table).

Apart from the level of available infrastructure, it is essential that ports achieve adequate productivity and provide a reliable service of high speed and quality in order to attract shipping companies as customers. Combining the level of infrastructure and equipment with the actual TEUs handled in each port, we find that the available infrastructure (mainly quay length and container handling area) in both Piraeus and Thessaloniki container ports is close to that of the average Mediterranean port of the equivalent size (see Box 2 for a more detailed analysis of Piraeus container terminals). On the other hand, both ports could improve their crane productivity (see table).

An econometric model for Piraeus transshipment potential

In order to evaluate the fundamentally competitive position of the Greek ports, we have constructed a cross-sectional model (see BOX 4) of the container transshipment traffic in the main Mediterranean ports based on two explanatory variables:

➢ the port's distance from the Suez-Gibraltar shipping route

➢ a synthetic infrastructure competitiveness index, based on

  ✓ the main technical characteristics of the ports (depth, quay length, terminal area, number of cranes), and

  ✓ the relative size of the terminals in order to control for economies-of-scale effects.

Based on our estimates, Piraeus – with its current infrastructure (i.e. excluding future investment) - should absorb 6.8 per cent of total Mediterranean transshipment traffic, which is not far from its realized transshipment traffic share in 2012. Including the planned capacity increase in Pier II and the construction of Pier III, based on our estimate of demand growth, Piraeus should handle 7.6 per cent of the total Mediterranean transshipment market by 2015. On the other hand, Thessaloniki does not have significant potential regarding the transshipment segment, as it is relatively far from the Suez-Gibraltar shipping route.

Box 2: Piraeus container terminals

In October 2009 Cosco Pacific, through its subsidiary company Piraeus Container Terminal (PCT), was granted operating rights for 35 years of the largest part of the container terminal in Piraeus (existing Pier II and to-be-built Pier III). Two basic reasons for the necessity of the concession were underlined by the Greek authorities: (i) the substantial investment needs in infrastructure in order to match the new type of demand (mainly larger ships); and (ii) the extra costs of the operational inefficiencies in OLP (that were estimated at around 40 per cent over the standard costs of competitive ports).

As the total fee for the period of concession of 35 years, Cosco offered €4.3 billion in current prices (representing a NPV of around €830 million at a 9 per cent discount rate). Note that the revenue from the concession agreement covered almost 30 per cent of OLP's total turnover during 2011-2012. Moreover, Cosco agreed to make investments of €620 million. In particular, the main terms of the concession agreement were:

➤ to improve the capacity (from 1.6 million TEUs to 2.6 million TEUs annually) and the equipment of the existing Pier II; and

➤ to construct Pier III (with an annual capacity of 1.1 million TEUs) and provide the corresponding equipment,

so as to guarantee an annual capacity of 3.7 million TEUs by 2015.

Concurrently, it was decided that the concession would coincide with the construction of Pier I (with an annual capacity of 1 million TEUs), which would be operated solely by OLP. OLP developed Pier I with investments of €160 million (partly financed through the EIB).

Three years after the concession agreement, Piraeus container terminals are already a success story. Specifically, Pier II almost doubled its traffic in 2012 (to 2.1 million TEUs from 1.2 million TEUs in 2011), reaching a capacity utilization of over 80 per cent (versus a world average of 67 per cent), while Pier I increased its traffic by 27.5 per cent (to 0.63 million TEUs from 0.49 million TEUs in 2011), reaching a capacity utilization of almost 65 per cent. It should be noted that Cosco recently ordered 12 ERTG cranes (above its contractual obligations), allowing for an additional increase of 1.1 million TEUs in the capacity of piers II and III (4.7 million TEUs in 2015 instead of the 3.7 million TEUs originally planned).

Although Pier I still has lower productivity (as measured by handled TEUs per crane) by around 50 per cent compared with Pier II, there are significant signs of improved operations (such as the containment of personnel costs).

Piraeus port container operations

Pier	I	II	III
Operator	OLP	PCT*	PCT*
Traffic 2012 (million TEUs)	0,6	2,1	-
Capacity 2012 (million TEUs)	1,0	2,6	-
Capacity 2015 (million TEUs)	1,0	3,2	1,5
Length (m)	840	1.487	600
Area (,000 sq.m)	268	614	153
Quay cranes	8	18	7
Dockers' team (members)	6	4	4

* Piraeus Container Terminal SA (COSCO)

Source: Port authorities

Employment Cost

	employment cost (% of total cost)
- OLP container terminal	
2009	69%
2010	65%
2011	60%
2012	56%
- Cosco *	40%
- South EU container ports average	39%

* Payroll expenses comprise 17% of total expenses and the other 23% concerns third party fees, as PCT operates mainly through subcontracting

Source: Port authorities

	North Europe	West Mediter.	Adriatic
Distance (,000 km)	43	36	33
Port calls on Asia-Europe route	16	23	16
Duration of transport (round trip days)	70	77	63
Ship capacity (,000 TEUs)	11,4	8,4	6,6
Transport cost (€/TEU)	810	860	920

* Data based on shipping schedule and cost of shipping company CMA-CGM (the only available source with connections to all the above destinations).

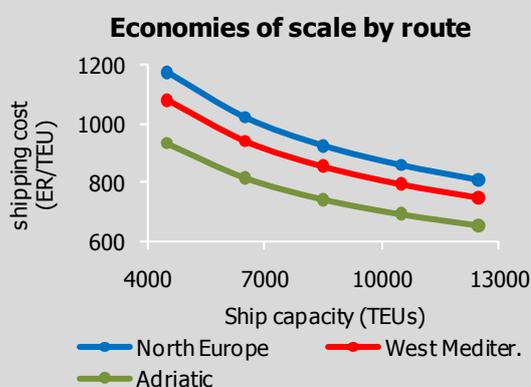Source: NEA Report, "The balance of container traffic amongst European ports", 10/2011

Economies of scale by route

* Estimates assume capacity utilisation of 75% for all ship sizes

Source: NEA Report, "The balance of container traffic amongst European ports", 10/2011

b. The European market for transit container flows

Southern ports can increase significantly their share in the transit market

Container trade flows directed to the European mainland are handled in ports of either Northern or Southern Europe, which have developed into hubs for intermodal transport (from ships to road or rail networks). The most dynamic segment of that traffic (container trade flows between Asia and Europe) is mainly handled in Northern ports (around 70 per cent), despite the fact that they require longer distances to be covered from the Suez-Gibraltar shipping route compared with Southern ports. This is attributed to the greater handling capacity and efficiency of Northern ports, and just as importantly to the better quality of the relevant countries' road and rail transport networks. These characteristics allow shipping companies to benefit from economies of scale, by employing larger container ships and to decrease the total time and cost of transport (see table). In conclusion, improving port infrastructure as well as upgrading the road and rail network in South Europe, is essential in order to redirect part of container traffic from Northern to Southern ports. To that end, European transport policy promotes intermodal transport and funds investments to improve connectivity of member states to the wider European transport network (see Box 3).

Inadequate rail network prevents Piraeus and Thessaloniki from becoming gateways to the CEE

The location of Greek ports of Thessaloniki and Piraeus offers them the potential to become among the most strategic shipping gateways to South East (SE) and Central Europe. Focusing on maritime container trade between Europe and Asia (i.e. east of the Suez), where Greek ports have a geographical competitive advantage, the containerized market[4] of SE Europe[5] amounts to about 0.9 million TEUs, while the relevant market in the rest of the Central and Eastern Europe (CEE)[6] region can reach about 1.6 million TEUs. Of this market (2.5 million TEUs), just 45,000 TEUs

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[4] The market refers to the amount of containerized trade (estimated loaded TEUs originating and destined for a given country) that is passing through global container ports. Empty containers are not included.
[5] Bulgaria, F.Y.R.O.M., Turkey (European), Albania, Bosnia and Herzegovina, Croatia, Romania, Serbia and Montenegro and Slovenia
[6] SE Europe (as described in the previous footnote), Austria, Czech Republic, Hungary, Slovakia and Moldavia

Quality of transport infrastructure

Global competitiveness index

15
12
9
6
3
0

France Spain Slovenia Turkey Italy Morocco Israel Greece Egypt Average

6,5   8,5

■ Rail network   ■ Road network
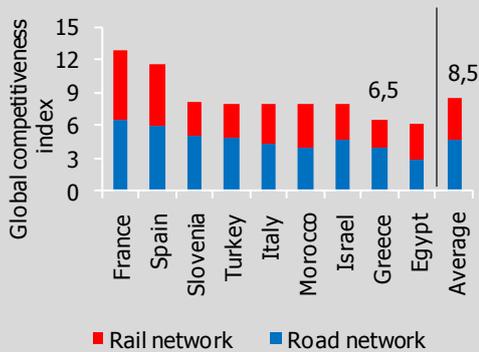
Source: Global Competitiveness Report 2012-13

is transit traffic from Greek ports (mainly through the port of Thessaloniki) – a level which corresponds to just 1.5 per cent of the wider region of CEE.

The main reason for the limited use of Greek ports as gateways for transit container traffic is the low competitiveness of the Greek and neighboring countries' transport network (road/rail). According to the Global Competitiveness index (World Economic Forum), road/rail infrastructure in Greece ranks lower in terms of quality, not only compared with countries of Northern Europe but also compared with most of the Mediterranean competitors. Specifically, Greek infrastructure quality is considered lower than the Mediterranean competitors' average by 15 per cent for the road network and 35 per cent for the rail network (mainly due to inefficient infrastructure and operation).

European Transport Policy

One of the main targets of the European transport policy is to achieve territorial cohesion between member states by developing a safe and efficient transport network. Efforts are concentrated in establishing a single, multimodal network that integrates land, sea and air transport networks throughout the Union, emphasizing rail and sea transport, in order to minimize negative effects on the environment. The funds allocated to the European transport sector during 2007-2013 were about €90.5 billion (accounting for 9.5 per cent of the European budget), higher than those of the previous program 2000-2006 (7.5 per cent of the European budget). Specifically, structural funds related to transport for 2007-2013 consist of:

  i) €82 billion provided by the **Cohesion Policy**, including the Cohesion Fund (CF) and the European Regional Development Fund (ERDF), to be distributed to member states through their national operational and regional programs for the purpose of establishing or developing infrastructure for all modes of transport (including urban), as well as promoting intelligent transport systems, safety and state aid rules. About ½ of the cohesion policy budget is allocated to TEN-T related projects (see below). The European co-financing contribution to the funded projects ranges between 50 and 85 per cent of costs, depending on the type of investment.

  ii) €8 billion provided by the **trans-European transport network budget (TEN-T)**, for investments in infrastructure and equipment and the relevant preparatory studies. Projects included in the TEN-T are those that play an important role in upgrading national intermodal transport networks and mainly in strengthening cross-border connections in order to increase territorial integration between Central Europe and neighboring regions. Fund allocation is not equal among member states, but favors those countries that do not have access to other structural funds. The limit of European co-financing for TEN-T projects is 20 per cent of costs for national network investments, 30 per cent for cross-border connections and 50 per cent for preparatory studies.

  iii) €450 million provided by the **Marco Polo II** program, which focuses on transport services and is used in combination with the TEN-T policy, which focuses on infrastructure and equipment upgrades. Companies eligible for funding are those aiming to shift cargo from road to other more environmentally-friendly networks (rail, sea, inland waterways) along cross-border routes. The level of funds is determined by the amount of modal-shift, providing €2 per 500 ton-km shifted (but not higher than 35 per cent of the cost).

Besides European funds, it is estimated that the completion of transport projects will require **additional funding** of about €60 billion in form of loans and guarantees from the European Investment Bank (EIB), as well as about €275 billion of national funds from the member states. All the above lead to a total budget of €425 billion for investments in the European transport sector.

For the following **programming period 2014-2020,** the funds for projects in the trans-European transport network would be €31.7 billion (€21.7 billion from the Connecting Europe Facility, which will replace the TEN-T budget, and another €10 billion from the Cohesion Policy funds). The rest of the Cohesion Policy's contribution has not yet been decided, as national programs (operational and regional) have not been finalized by member states. However, in the event the transport sector continues to absorb 23.7 per cent of the Cohesion Policy (as it did

during the 2007-2013 programming period), the relevant funds would be about €80 billion, leading to a total funding of €100 billion for the transport sector (in 2011 prices).
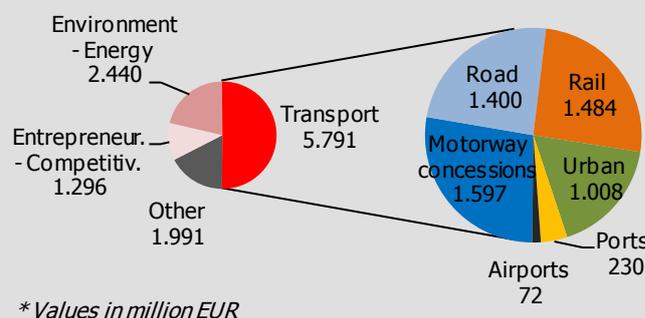
European Ports Infrastructure Policy

Investment in port infrastructure is supported by the European budget, which provides €5 billion for the programming period 2007-2013 (about 6 per cent of the budget for European transport sector). At this point, it is important to note that, apart from direct funding, European ports benefit indirectly from the improvement of the wider transport network infrastructure (road, rail, inland waterways).

The significance of water transport for the European transport policy is proven by the creation of Motorways of the Sea as a priority project within the TEN-T policy, providing €310 million during the programming period 2007-2013 (for actions with a total budget of about €2 billion). This initiative aims at shifting freight transport from road to sea, by promoting investments along specific designated shipping corridors which are: Baltic Sea, Sea of western Europe (from Atlantic Arc to North Sea), Sea of south-east Europe and Sea of south-west Europe). Greek ports are included in the sea corridor of south-east Europe, which also comprises ports of Italy, Cyprus, Slovenia and Malta. This initiative is funded by a combination of sources (CF, ERDF, TEN-T, Marco Polo II, EIB loans and guarantees), which sometimes complicates the organization and completion of the projects.

Support for Greek Transport

During the 2007-2013 programming period, Greece received about €6 billion for transport projects (30% of the Cohesion Policy funds for Greece and 7% of the European funds for transport projects). We note that most of these funds (€5.8 billion) were allocated to 72 priority projects in the transport sector (from a total budget of €11.5 billion for 181 priority projects which absorb 56 per cent of the EU budget for Greece and -- besides transport -- they concern projects targeting the environment, energy, entrepreneurship, competitiveness, etc). The port sector absorbs about 4 per cent of the transport budget for priority projects (€230 million), while most of the funds are allocated to road and rail projects.

European funding 2007-2013 for Greek priority projects

Environment - Energy 2.440
Entrepreneur. - Competitiv. 1.296
Other 1.991
Transport 5.791

Road 1.400
Rail 1.484
Motorway concessions 1.597
Urban 1.008
Airports 72
Ports 230

*Values in million EUR

Source: Greek Ministry for Development, Competitiveness, Infrastructure, Transport and Networks / NSRF Department

Road and Rail network infrastructure			
	Greece	S.Europe*	N.Europe
Rail network			
Competitiveness index (WEF)**	2,5	4,7	5,4
Network coverage (km rail per 100 sq.km of land area)	2,2	5,1	9,1
Single lines	80%	59%	44%
Electrified lines	10%	57%	58%
Share in land freight transport	2,2%	7,1%	14,3%
Road network			
Competitiveness index (WEF)**	4,0	5,4	5,8
Network coverage (km road per 100 sq.km of land area)	89	165	296
Transit freight traffic	0,6%	8,5%	13,3%

excluding Greece

** The index is constructed from an executive opinion survey by the World Economic Forum, requesting an assesment of each country's quality of infrastructure, on a scale from 1 (extremely underdeveloped) to 7 (extensive and efficient by international standards).

Source: Eurostat (2009-2010 data), WEF/ Global Competitiveness Index 2012-13

3. GREEK CONTAINER TERMINALS: LOOKING FORWARD

Effective use of the available EU funds as well as further privatizations in the Greek transport sector are needed for the sector's potential to be realized

Greek ports need further privatization and infrastructure upgrade in order to gain the market share that corresponds to their geographical comparative advantages. Besides EU financial support, private funds need to be mobilized mainly through concession agreements, following the successful example of the Piraeus container terminal. Through such agreements, private terminal operators (which in many cases are also shipping companies) not only provide the necessary funding for infrastructure investments, but also provide their experience and know-how regarding efficient port organization and operations.

Moreover, it should be noted that terminal capacity and infrastructure upgrades are necessary but not sufficient conditions for a significant increase in container traffic. Considering the increased port competition for container transshipment operations as well as the high concentration in the container shipping sector, it is important that container ports are reliable in providing high quality services (i.e. speed, including no disruptions to port operations). As far as smaller ports are concerned, increased size could help attract investors or at least facilitate the search for funding. Indicatively, a proposal under consideration is to bundle smaller ports regionally under holding companies that will offer further freight management concessions (e.g. Piraeus/ Lavrio/ Rafina/ Elefsina, and Thessaloniki/ Kavala/ Alexandroupoli).

In order for Greek ports to become transportation hubs, reforms are also needed in other sectors of the economy. In particular, the Greek economy can benefit from the European transport policy (see Box 3), undertaking investments throughout the intermodal transport chain (ports, road and mainly rail). It is important to note that in order for Greece to be an efficient hub, both its rail as well as its road infrastructure needs to be upgraded, as the preferred inland modal choice depends mainly on the destination's distance. In particular, as rail transport has high fixed costs while road transport has high variable costs, the cost per TEU is lower for road transport over short distances and for rail transport over

Road priority projects	
Area or Line	European and national funding (million euro)
Athens-Thessaloniki motorway (PATHE)*	605
Olympia motorway*	511
Egnatia motorway (branches)	459
Moreas motorway*	297
Aktio	213
Ionian motorway*	184
Patra	86
Igoumenitsa-Preveza	45
Rest of mainland	377
Islands	201
Total	**2.776**

*Concessions

Source: Greek Ministry for Development, Competitiveness, Infrastructure, Transport and Networks / NSRF Department

Railway priority projects	
Area or Line	European and national funding (million euro)
Peloponnese	615
Athens-Thessaloniki	565
Thessaloniki- Greek borders	145
Thriasio	78
Suburban Line	82
Total	**1.485**

Source: Greek Ministry for Development, Competitiveness, Infrastructure, Transport and Networks / NSRF Department

longer distances. According to studies for the European region[7], the break-even point is estimated around 1,100-1,200 km. These results are consistent with actual developments in Central and Eastern Europe, where rail is not a significant competitor to road at distances less than 1,000 km.

Some of the projects already being pursued to upgrade infrastructure are:

(i) The upgrade of the road network is primarily targeted to the main motorways (Athens-Thessaloniki motorway, Egnatia, Olympia, etc.), as well as the international connections with F.Y.R.O.M., Bulgaria and Turkey. These projects (see table) are expected to be completed by 2015 and are financed: (i) by European structural funds up to €2.8 billion; while (ii) an additional circa €5 billion of private funds is allocated for the concession of motorways.

(ii) The upgrade of the rail network mainly concerns the expansion of double-track, electrified sections compatible with higher speeds and the adoption of the European traffic management system (ERTMS). Moreover, the construction of an intermodal transshipment hub in Thriasio, which will soon be connected to the rail network, will handle transit container traffic from the port of Piraeus towards the SE Europe and the rest of Europe. These investments in infrastructure could allow better connectivity to the European rail network and increase the share of rail in Greek freight transport (2.2 per cent in 2010 compared with 7 per cent in Southern Europe and 14.3 per cent in Northern Europe). The main priority rail projects receive a total funding of €1.5 billion and are expected to be completed by 2015 (see table).

Focusing on the main network connecting Athens with Thessaloniki and the Greek borders, the infrastructure investments needed for the land transport of containers from Greek ports to CEE region amounts to around €3 billion.

Finally, there is a need for a supporting policy framework which would encourage the development of logistics and transportation clusters in the major Greek ports. These would provide services

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[7] European Commission (2009), "*Statistical coverage and economic analysis of the logistics sector in the EU*", and Institute for Transport Planning and Systems (2006), "*Cost and strategies for intermodal transport between eastern and western Europe*".

such as freight forwarding, third-party logistics, bunkering, etc. Moreover, the Piraeus repair zone needs infrastructure investment and higher competitiveness (concerning price, speed and reliability of service). This segment would develop significantly if Cosco were to expand its concession agreement to include more port operations, and at the same time develop the ship repair zone of Piraeus (which currently consists of small and dispersed companies) and transform it into a proper shipyard (mainly for repair and maintenance operations).

International traffic in Greek ports could increase by 1.7 million TEUs by 2015…

As mentioned before, container trade comprises three types of traffic with different determinants and thus distinct future developments:

➢ Local traffic (i.e. traffic linked to the domestic economy)

Greek ports handled about 1 million TEUs of local traffic in 2012. According to our estimates, Greek trade flows in real terms (exports plus imports) after bottoming out in 2013 will revive in 2015 to a level similar to that of 2012. Therefore, the level of local traffic is expected to be around 1 million TEUs in 2015. Note that the positive effect of increasing containerization of goods globally is expected to be counterbalanced by the change in the mix of the Greek trade flows. Indeed, Greek exports will form a larger share of trade (compared with imports of goods prior to the economic crisis) and Greece's comparative advantage in services and agribusiness do not require high use of transport by container ships.

➢ Transshipment traffic

Based on our model for the Mediterranean market (see p. 7) and assuming that: (i) world trade will grow at an average annual rate of 4.8 per cent (in volume terms) until 2015; and (ii) containerization will reach 19 per cent of the total cargo in 2015 from 17 per cent in 2012, we expect Mediterranean traffic to reach 70 million TEUs in 2015 from 57 million TEUs in 2012. On the supply side, major infrastructure projects are underway in the container terminals of the region. Some ports are expected to more than double their capacity by 2015 (e.g. Tangier, Damietta), though others have almost no investment plans (e.g. Livorno, Malaga). Overall, we expect the total capacity of the region to

Major Mediterranean port expansion plans			
Port	Capacity 2012 (mil.TEUs)	Capacity additions (mil.TEUs)	Year of completion
Tangier	3,0	5,0	2015
Damietta	1,7	4,0	2017
Barcelona	2,9	2,7	2013
Genoa	2,0	2,0	2014
Marseilles	2,5	2,0	2020
Piraeus	3,6	2,1	2015
Thessaloniki	0,4	0,8	2017*

* Capacity additions in the port of Thessaloniki are scheduled for 2015. However, due to delays in the concession agreements, we estimate the date of completion around 2017.

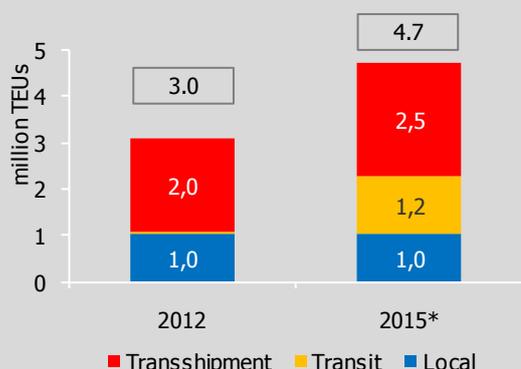Source: Port authorities, NBG estimates

Competing container gateway regions*			
	Aegean Sea	**East Adriatic Sea**	**West Black Sea**
Main ports' capacity 2012 (mil. TEUs)	4,0	1,8	1,7
% region	*53%*	*24%*	*23%*
Main ports' capacity 2015 (mil. TEUs)	6,5	4,1	1,7
% region	*53%*	*33%*	*14%*
Quality of transport infrastructure index	4,5	5,3	3,0

* The main ports contributing to the capacity of each region are: i) Piraeus, Thessaloniki (Aegean Sea), ii) Koper, Rijeka, Trieste (East Adriatic Sea) and iii) Constantza, Vardas (West Black Sea).

Source: WEF/ Global Competitiveness Index 2012-13, Port authorities

Potential container traffic for Greek ports

Source: Port Authorities, NBG estimates

increase by 40 per cent by 2015 – exceeding the projected increase in demand (23 per cent by 2015).

Piraeus is expected to benefit significantly from higher investments. Specifically, new investments will increase its capacity by about 60 per cent by 2015 (from 3.6 million TEUs in 2012 to 5.7 million TEUs in 2015, Cosco and OLP together), improving its competitive position. The fundamental market share of Piraeus is projected to reach 7.6 per cent of the Mediterranean transshipment market (from 6.8 per cent in 2012). In this case, its transshipment traffic will increase to 2.5 million TEUs by 2015 from 2 million TEUs in 2012, with spare capacity to increase transit traffic.

➤ Transit traffic

Based on forecasts for the trade in the Eastern European regions and the dynamics of the containerization rate, the SE Europe/Asia container transit trade market is expected to reach about 1.2 million TEUs in 2015, while the traffic in the rest of the CEE/Asia container transit market should reach about 2.1 million TEUs.

We project that gateway ports in the Aegean, Adriatic and Black Sea should get:

(i) all the container traffic between SE Europe and Asia (as those ports are the geographically natural entry points to South European countries); and

(ii) half the Asian containerized trade with the rest of the CEE region (as central Europe is in the middle of the North-South European axis).

Assuming that the share of Aegean ports should correspond to their relative capacity (see table), Piraeus and Thessaloniki should gain more than ½ of the above-mentioned market (2.3 million TEUs). In that case, Greek transit container traffic would reach about 1.2 million TEUs in 2015, compared with about 45,000 TEUs in 2012.

It should be noted that the container port of Thessaloniki is still in need of significant investments in order to achieve its full potential. To that end, infrastructure investments of about €250 million are required to increase the port's capacity from 0.4 million TEUs to 1.2 million TEUs, and also allow the docking, and high quality servicing more generally, of larger ships. However, these investments, as well as the privatization process, are still in an

Potential Container traffic for Greek ports					
mil. TEUs	Local	Transship-ment	Transit	Total Traffic	Capacity
2012					
Piraeus	0,7	2,0	0,01	2,7	3,6
OLP	*0,2*	*0,4*	*0,00*	*0,6*	*1,0*
COSCO	*0,5*	*1,6*	*0,01*	*2,1*	*2,6*
Thessaloniki	0,3	0,0	0,03	0,3	0,4
Other	0,04	-	-	0,0	0,1
Total	1,0	2,0	0,05	3,0	4,1
2015					
Piraeus	0,7	2,5	0,92	4,1	5,7
OLP	*0,2*	*0,4*	*0,02*	*0,6*	*1,0*
COSCO	*0,5*	*2,1*	*0,90*	*3,5*	*4,7*
Thessaloniki	0,3	0,0	0,31	0,6	0,8
Other	0,04	-	-	0,0	0,1
Total	1,0	2,5	1,2	4,7	6,6

Source: Port authorities, NBG estimates

early stage, and we expect them to be completed no sooner than 2017. Moreover, the land and rail links of the port to the railway network is an important prerequisite for the port to reach its potential.

Therefore, considering the business plans of the two ports, with a capacity utilization of 70-75 per cent in both ports, Piraeus is expected to attract 75 per cent of the Greek transit traffic (0.9 million TEUs) and Thessaloniki the other 25 per cent (0.3 million TEUs).

It is important to note that transit flows (compared with transshipment flows) offer far more revenue and value added to the Greek economy (about 4.5 times more per TEU), as they also create the corresponding land freight transport services (see below).

Combining the three types of container traffic (local, transshipment and transit), Greek ports could attract around 4.7 million TEUs in 2015, up from 3 million TEUs in 2012 (see table). At this point, it is important to note that these projections may underestimate Greek ports' market share, in view of Piraeus port's high quality services and Cosco's vertical integration (i.e. also owning one of the world's largest container shipping companies).

Summing up, the upgrade of Piraeus' container terminal infrastructure (combined with its strategic geographical position and its sizeable local traffic) is attracting significant transshipment traffic. If on-shore transportation links are upgraded, there exists a considerable potential for both Piraeus and Thessaloniki to attract high value-added transit traffic as well. In this context, note the recent agreement between Hewlett-Packard, COSCO and Greek Railways TRAINOSE, which involves the use of Piraeus as a transport hub for all HP products in Central Europe, Eastern Europe, the Middle East, North Africa and the Eastern Mediterranean. Finally, the recovery of domestic trade will also boost port activity.

Short-term increase in value added from the additional traffic could reach €0.8 billion by 2015

Besides the extra direct revenue from the increased container handling in Greek ports, which amounts to about €90 million per

Specifically, there are potential revenue synergies from additional activities, especially in the port of Piraeus, where COSCO's plans are that it will serve as the main hub for container traffic in the East Mediterranean. The main sectors that could benefit from that development are:

✓ Land transport: As mentioned earlier in our analysis, Greek ports could potentially handle about 1.2 million TEUs of transit traffic to/from the CEE region, which would significantly boost revenue for Greek-based land transport operators. Based on current practices concerning the handling of transit flows in Europe, we expect that: (i) the Greek based land transport companies will handle around 60 per cent of the flows; and (ii) the empty containers would be almost ¼ of the total traffic. Against this background and assuming an average distance of around 1,000 km between Thessaloniki and the CEE region, we estimate that the relevant potential benefit for Greece could range between €400-770 million (see table), depending on the mode of transport (road or rail) and the chosen gateway port (Piraeus or Thessaloniki).

In view of our assumptions that:
(i) rail will account for about ⅓ of inland transport (in line with other major hubs, e.g. Hamburg); and
(ii) Thessaloniki port could not attract more than ¼ of transit traffic (as it is far behind Piraeus in terms of privatization process and infrastructure upgrades),
our baseline scenario points to transit revenue of €0.65 billion in 2015.

✓ Bunkering: The current bunkering market in Greece is estimated by market participants at around 3 million mt of fuel, of which about 600,000 mt concern containerships. In view of the fact that bunker fuel prices are around €450 per mt, the revenue resulting from those operations in the port of Piraeus are about €0.3 billion. If the increase in container traffic expected by 2015 leads to an equivalent increase in the demand for bunker fuel supplies, the resulting revenue

Assumptions for potential transit container traffic in 2015

Road Transport

Greek-based hauliers (as % of resident and non-resident hauliers)	60%
Empty containers (% total)	26%
Average transit distance Thessaloniki - CEE (km)	960

Rail Transport*

Empty containers (% total)	26%

* Greek rail transport of containers stops at the Greek borders (Eidomeni-Promaxonas), where the cargo is delivered to foreign rail operators for the remaining distance.

Source: MDS Transmodal Limited (NAPA container market study, Dec 2011), European Commission, NBG estimates

Transit container traffic: Potential revenue in 2015

Revenues in million €	Mode of transport		
	1	2	3
	Road 100%	Road 70% Rail 30%	Rail 100%
Gateway port			
A. Piraeus 100%	767	719	607
B. Piraeus 75% - Thessaloniki 25%	711	647	500
B. Piraeus 50% - Thessaloniki 50%	654	576	392

Source: NBG estimates

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[8] This estimate is based on average revenue of COSCO operations in Piraeus during 2011-2012 (€55/TEU).

Potential container revenue for Greece

Source: Port Authorities, NBG estimates

European ports: Relation between direct value added and port volume
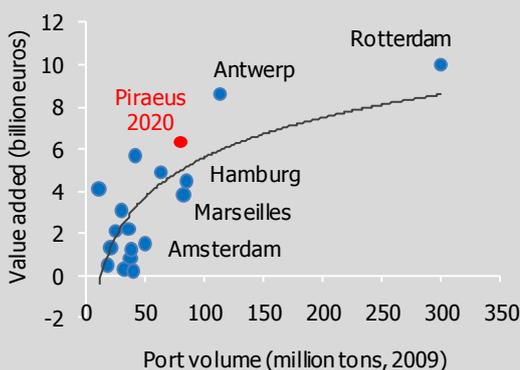
Source: OECD,"Competitiveness of global port cities", 2011

would reach about €0.4 billion annually. To achieve the above-mentioned results, it is necessary to provide a reliable bunkering service at a competitive price. Indicatively, the effect of a single big shipping company shifting its bunkering activity to different ports could exceed 300,000 mt of annual fuel supply (about €140 million in current bunker prices).

Overall, the additional revenue (direct and indirect) from the increase in container traffic could be around €0.9 billion (€1.3 billion in 2015, from €0.4 billion in 2012), if the upgrade of the transport network facilitated transit flows towards the CEE. The bulk of the revenue increase (almost 90 per cent) arises from indirect effects, especially land transport. If we isolate the import component of that revenue (especially in the bunkering sector[9]), the increase on Greek GDP would be around €0.8 billion (€1 billion in 2015, from €0.2 billion in 2012) or 0.4 per cent of GDP. More importantly, the aforementioned increase in revenue would create about 9,000 new jobs (based on each sector's labour productivity).

Long-term increase in value added from the additional traffic could reach €5.8 billion by 2018, through the development of a cargo-related cluster…

Besides the benefits directly linked to the transport and handling of containers in Greek ports, there is also great potential from the creation of a cargo-related cluster around the port of Piraeus, brought about by the increased cargo traffic in the port.

However, the formation of a cluster is a long-term process and its full benefits cannot be expected to be evident before 2018. In particular, taking into account a 3-year lag for the widening of the cluster following the increased traffic, we benchmark the size of the Piraeus cluster in 2012 to the total cargo traffic of 2009 (12 million tons, of which 5 million tons is container traffic or 0.7 million TEUs, with the rest being general cargo). Consecutively, we have used this relationship in order to derive the size of the cluster in 2018 based on the total cargo traffic of 2015 (70 million tons, of which 55 million tons is container traffic or 4 million TEUs). Specifically, we estimate that:

➤ The companies of the maritime cluster of Piraeus (shipping

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[9] We estimate an average gross profit margin of 21% for the oil refining process and another 4% for trade companies (based on the economic performance of Greek companies in 2011).

Cargo-related cluster in Piraeus port Value Added (billion €)		
Activity driver		
	2009	**2015**
Cargo handling (mil. tons)	12	70
of which containers (mil. tons)	*5*	*57*
or mil. TEUs	*0,67*	*4,1*
Impact on Value Added		
	2012	**2018**
Maritime value added	2,2	3,3
Piraeus traffic-related	*(0,2)*	*(1,4)*
Greek fleet-related	*(1,9)*	*(1,9)*
Non-Maritime value added	0,4	2,5
Direct value added from cluster	**2,6**	**5,8**
Multiplier Effect* (x 0.6)	**1,6**	**3,5**
Total value added	**4,2**	**9,3**

* based on a multiplier for major European ports

Source: Policy Research Corporation, OECD, National Bank of Belgium, Eurostat, ICAP, NBG estimates

companies, maritime services, marine equipment, cargo handling, shipbuilding) currently generate value added of about €2.2 billion[10]. Based on the historical evidence from other ports, the value added of Piraeus maritime cluster is extremely high relative to the cargo handled by the port (€180 million of value added per ton of cargo). Using as a benchmark other major European ports (with an average €20 million of value added per ton of cargo)[11], the maritime cluster of Piraeus based on its traffic should be around €0.2 billion. The remaining €2 billion appears to be related to the fact that Greece is a leading power in the shipping sector – controlling about 16 per cent of world tonnage (deadweight), and thus attracts significant maritime operations to Piraeus.

Thus, the projected higher cargo handling (to 70 million tons in 2015 from 12 million tons in 2009) is expected to increase gradually traffic-related value added of the cluster to €1.4 billion in 2018 (from €0.2 billion in 2012). This development will lead to a total value added from the maritime cluster[12] of €3.3 billion in 2018 (from €2.2 billion in 2012), assuming that the €2 billion related to international shipping remains stable.

➤ There is also a network of non-maritime companies (mostly manufacturers and to a smaller degree logistics and other supporting activities), operating in the wider area around a port (Piraeus in our case). In particular, the wider industry and logistics complex of the Thriasio area currently generates value added of about €1.9 billion[13]. As this complex also comprises the Aspropyrgos industrial zone, as well as industries related to the bulk (mainly liquid) ports of Agioi Theodoroi, Elefsina and Megara, only a part of its value added is related to the port of Piraeus. Using as a benchmark other major European ports (with an average

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[10] This estimate is based on data from the study "The Role of Maritime Clusters to Enhance the Strength and Development of European Maritime Sectors", 2009, Policy Research Corporation.

[11] This estimate is based on the studies "The Role of Maritime Clusters to Enhance the Strength and Development of European Maritime Sectors", 2009, Policy Research Corporation, and "Economic Importance of the Belgian Ports", 2012, National Bank of Belgium.

[12] Please note that land transport activities are not considered part of the maritime cluster, as European studies do not include them in their estimates for the value added from maritime clusters.

[13] The value added of the Thriasio area complex is estimated based on the revenue of industries, logistics and land-transport companies in the Thriasio area (Piraeus, Aspropirgos, Elefsina, Magoula, Mandra, Megara), adjusted for the value added component of the corresponding Greek sectors.

Cargo-related cluster in Piraeus port Employment (thousand jobs)		
Activity driver		
	2009	2015
Cargo handling (mil. tons)	12	70
of which containers (mil. tons)	*5*	*57*
or mil. TEUs	*0,67*	*4,1*
Impact on Employment		
	2012	2018
Maritime employment	43	66
Piraeus traffic-related	*(5)*	*(28)*
Greek fleet-related	*(38)*	*(38)*
Non-Maritime employment	11	63
Direct employment from cluster	**54**	**129**
Multiplier Effect* (x 0.6)	**40**	**89**
Total employment	**94**	**219**

* based on the multiplier for major European ports

Source: Policy Research Corporation, OECD, National Bank of Belgium, Eurostat, ICAP, NBG estimates

€35 million of value added per ton of cargo)[14], the non-maritime cluster of Piraeus based on its traffic is currently around €0.4 billion (equivalent to 22 per cent of the value added of the Thriasio complex). Looking forward, the increased container traffic and mainly COSCO's plans for the development of a logistics center in Thriasio, connected to the rail network, could attract a significant number of companies to the area. In particular, based on the projected higher cargo handling, we consecutively estimate the contribution of this non-maritime cluster to reach about €2.5 billion in 2018 from €0.4 billion in 2012 (and thus lead the total value added of the Thriasio industry and logistics complex to about €4 billion in 2018 from €1.9 billion in 2012).

Combining the effects of the maritime and the non-maritime cluster, the direct value added could increase to €5.8 billion in 2018 from €2.6 billion in 2012 (see table on previous page).

Finally, empirical evidence suggests that there is also a significant multiplier effect, over and above the increase in activity from the maritime and non-maritime cluster, related to the suppliers of the cluster. Indeed, this multiplier for major European ports is estimated to be around 1.6[15]. Indeed, the research confirms the fact that port activity supports the economy's growth mainly through the secondary business it creates. Applying this average multiplier leads the total value added from the cargo-related Piraeus activity to increase by €5.1 billion by 2018 (to €9.3 billion in 2018 from €4.2 billion in 2012) or by 2.5 per cent of GDP.

... and about 125,000 new jobs

The above-mentioned activity is expected to increase employment[16] in the port-related clusters to 219,000 by 2018 from 94,000 in 2012, thus creating about 125,000 new jobs (75,000 directly related to the cluster and 50,000 from the multiplier effect).

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[14] This estimate is based on several OECD regional development working papers titled "The Competitiveness of Global Port Cities", 2011-2013.

[15] The multiplier of the maritime cluster is an average from estimated multipliers of major European ports (estimated in the aforementioned two studies).

[16] The employment effects of the maritime cluster are based on the study "The Role of Maritime Clusters to Enhance the Strength and Development of European Maritime Sectors", while the employment effects of the other sectors are estimated based on productivity data from Eurostat.

BOX 4: Econometric models

A. Mediterranean container traffic model

NBG Research estimated a container traffic model in order to assess the medium-term prospects of the ports in the Mediterranean region. Mediterranean traffic is calculated as the number of TEUs handled in ports situated in the regions of: West Mediterranean, East Mediterranean, Iberian Peninsular and North Africa, as they are defined by the Containerization International database.

The model is based on annual data for the period 1980 to 2011. The variables used are the world trade in goods and the containerization rate (the share of containerized cargo to total cargo).

Our estimates suggest that Mediterranean traffic exhibits a low degree of persistence. An increase in traffic by 10 percentage points contributes 2.4 percentage points to next year's traffic increase. An increase in world trade leads to a comparable increase in container traffic in the Mediterranean ports, while an increase in containerization rate by 10 per cent leads to an increase in Mediterranean container traffic by 2.8 per cent.

$$traff_t = 0.24\ traff_{t-1} + 0.97\ tr_t + 0.28\ cont_t\ + 8.02 + 0.98\ ma(10)$$
$$\quad\ (2.69)\qquad (6.39)\quad (2.16)\qquad (6.41)\ (9.53)$$

$$R^2 = 0.98,\ DW = 2.31$$

where:

traff: Mediterranean container traffic in TEUs,

tr: world trade in goods,

cont: containerization rate of world trade,

ma: moving average term.

All variables are transformed in logs.
T-statistics in parentheses below coefficient estimates.

B. Greek ports' transshipment share model

NBG Research estimated a transshipment share model in order to assess the fundamental potential role of Greek container ports in the Mediterranean region. The model is based on cross-section data for the main Mediterranean ports for 2011.

Our sample consists of 21 container ports situated in Greece, Italy, Spain, France, Morocco, Malta, Egypt, Turkey and Israel. It accounts for about 70 per cent of Mediterranean container traffic and comprises most of the Mediterranean ports handling transshipment traffic. The variables used are the

port's distance from the Suez-Gibraltar shipping route and a synthetic infrastructure competitiveness index (based on the main technical characteristics – depth, quay length, terminal area, number of cranes – and the relative size of the terminals).

Our estimates suggest that a larger distance of the port from the Suez-Gibraltar shipping route by 1 nautical mile leads to a lower market share in the Mediterranean transshipment traffic by 0.02 percentage points. A higher infrastructure competitiveness index of the port by 0.1 basis point leads to a higher transshipment market share by 0.26 percentage points.

$$ts_i = -0.02\ dist_i + 2.60\ comp_i + 4.13$$
$$\quad\quad\ (4.07)\quad\quad (3.61)\quad\quad (2.52)$$

$$R^2 = 0.67,\ DW = 2.18$$

where:

ts: share of port i in respect to the total Mediterranean transshipment traffic,

dist: distance between the Suez-Gibraltar shipping route and port i in nautical miles,

comp: infrastructure competitiveness index of the port i

i: Alexandria, Algeciras, Ambarli, Barcelona, Cagliari, Damietta, Genova, Gioia Tauro, Haifa, Izmir, La Spezia, Livorno, Malaga, Marsaxlokk, Marseilles, Piraeus, Port Said, Tangier, Taranto, Thessaloniki, Valencia

T-statistics in parentheses below coefficient estimates.

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