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## Article

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ORIGINAL ARTICLE

Open Access



# The implications of Chinese investments on Mediterranean trade and maritime hubs

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## Abstract

By improving the connectivity between China and Europe, Chinese investments aim to redefine China's position within global transport networks and logistics flows. This article explores the evolution of port activity in the Mediterranean following the implementation of investment strategies through an analysis of container flows and the impact generated by China on the Mediterranean ports. It compares port centrality to assess what influences the Belt and Road Initiative has had on containers flows from its inception until 2019 (pre Covid-19 pandemic). The main results underline that during its inception phase, the BRI had no discernable impacts on port polarization. Further, trade imbalances decreased and even slightly grew in favor of Mediterranean countries. The presence of Chinese investors, COSCO and China Merchants Group, in port operations impacted regional dynamics, mainly in the port of Piraeus in Greece, which became a hub. Connectivity between the main Mediterranean ports and China grew considerably after the BRI, especially with Egypt, Spain, and Morocco, where Chinese port investments have been considerable. The ports receiving the most Chinese investments see the most significant changes in their ranking in the regional port system.

**Keywords:** Port hierarchy and polarization, Chinese investments, Mediterranean

## Introduction

For commercial and strategic reasons, through investment coordination mechanisms such as the Belt and Road Initiative (BRI), China seeks to expand its trade network through the modernization of existing land and maritime transport corridors and through the associated infrastructure investments (Ducruet 2020). These investments are particularly apparent in the terminal operating sector, mainly carried by Hutchison Ports (Hong Kong; privately-owned), China Ocean Shipping Company (COSCO Shipping Ports), and China Merchants (both state-owned). Although the internationalization of Chinese terminal operators started relatively late compared to its European counterparts, it accelerated after 2010 (Wang et al. 2019a, b). China's use of state-owned enterprises, including construction companies, became the primary tool for positioning assets along strategic sea routes (Eran 2016).

Shipping supports more than 90% of China's foreign trade. As Ferrari and Tei (2020) and Chen et al. (2018) underline, analyzing the impacts of investments in container

shipping assets is relevant as containerization is dominant in supporting international trade and represents a strategy for the development of China's economic relations (Merk 2020). From the onset of the Open Door Policy in the 1990s, containerization was the linchpin that allowed China to integrate into international trade and global supply chains, particularly through port infrastructure along its extensive coastline, focusing on its major trade gateways. The internationalization of China's port infrastructure investments, for which it has developed substantial infrastructural and operational capabilities, is expected to shape trade and port development in regions where China is involved. The Mediterranean is such a region.

The geographical relevance of the Mediterranean is undeniable, increasing with the evolution of container shipping, which took place in two phases. The first occurred in the mid-1970s when the first container shipping services in the region began to operate and accounted for its increasing percentage of the world's traffic (Guerrero and Rodrigue 2014). In the second phase that began in the 1980s, the consolidation of container flows in the Mediterranean were influenced by economic expansion, which incited the creation of port infrastructure for container shipping. By the end of the 1990s, after China joined the WTO, its European trade became a significant driving force, which led to a divergence between gateway and hub development. The emergence of transshipment hubs such as Gioia Tauro, Marsalox, and Algeciras is the outcome of a refocusing of the Mediterranean as an obligatory point of transit along Asia-Europe shipping lanes (Matutes and Ye 2010).

China was first granted a concession in the Port of Piraeus in 2009 (Psaraftis and Palis 2012). Then, the acquisition of the Port of Piraeus in 2016 by the Chinese shipping giant COSCO is considered a pivotal event, with an investment of more than 1 billion dollars, becoming a majority shareholder at 66% (Verny et al. 2019). Although mired in geopolitics and some controversy, most European countries welcomed new infrastructure investments inciting existing transport and logistics models to adapt, changing the regional port hierarchy in the Mediterranean.

The nature and impact of Chinese investments have been extensively investigated from the point of view of economic and political strategy. A core element of the strategy, container shipping, has received more limited attention. In a comprehensive literature review, Ferrari and Tei (2020) underlined that between 2016 and 2020, only 14 articles covered container shipping as a central topic in the BRI. Moreover, a particular focus on the Mediterranean in maritime shipping networks concerning the BRI is scarce (Chen et al. 2018) in light of recent developments in the analysis of complex maritime networks (e.g. Ducruet 2020). Accordingly, network elements related to trade flows and port hierarchy can reveal the ongoing effects of Chinese port investments in the Mediterranean.

This article investigates the impacts of Chinese investments on containerization and port polarization in the Mediterranean, by comparing the evolution of port ranking and port connectivity. It considers that port polarization reflects port competitiveness in a network creating hubs that attract more container flows. A temporal analysis of Mediterranean port traffic and Chinese investments between 2000 and 2019 is undertaken. The 2000–2019 period represents the inception of trade relations between China and Europe, most of which transiting through the Mediterranean. The analysis predates the Covid-19 pandemic and the ongoing reassessment of Chinese investments by a number

of recipient countries (e.g., debt crisis in Sri Lanka in 2022). China-Mediterranean trade and COSCO's position as a port user will be analyzed through port concentration trends. It is assumed that the evolution of connectivity between the Mediterranean and China and the evolution of the port hierarchy, may reveal the impacts of Chinese investments in the region.

### Literature review

A core aspect of Chinese investments concerns the development of port infrastructure and supporting shipping and trade networks. Notteboom et al. (2022) underline how ports are organized to meet the needs of the global economy, including regional and local development patterns. Port and shipping network development are thus synchronized with trade developments, but the nature of this synchronism can be challenging to assess. Chinese investments seek to increase trade flows and reaffirm the development of maritime value chains, which was documented by Ferrari and Tei (2020) through the development of a group of specific transport and logistics corridors covering three different continents. Centrality measures provide a comprehensive quantitative benchmark for evaluating strategic port development and competitive positions, including their connectivity (Liu et al. 2022).

The literature about port infrastructure investments focuses on financial issues, sometimes leaving transport characteristics and flows in the background. In this context, Gómez (2021) presented how Chinese investments evolved in the development of port infrastructure, enabling Chinese firms to become major shareholders or operators of terminal facilities. Merk (2020) showed how Chinese investments in European container ports have gone from being practically nonexistent to representing approximately 10% of the total volume in about ten years (2007–2017). According to Cheng and Yiu (2016), the financial strategies promoted by Chinese institutions have several objectives, but the main one is promoting Chinese companies internationally by granting them a competitive advantage through investments in strategic infrastructures.

Wang et al. (2019a, b) underlined that Chinese terminal operators invest in ports located along the “21st Century Maritime Silk Road” (MSR) by selecting strategic hubs. In the Mediterranean, the BRI has become an investment engine, with Huang (2016) claiming that the BRI has the potential to turn underdeveloped regions into a new cluster of economic activity by incorporating successful experiences from emerging market economies. Bagatine (2018), in his analysis of the first five years of the BRI, showed how investments have increasingly focused on non-traditional port hinterlands such as Central Asia.

Finally, the literature shows how China seeks to position itself regionally and globally. Aoyama (2016) mentioned that the BRI is not only a regional policy but a global strategy for China to achieve its ambition to become a leading economy. In the same vein, Amodio (2019) showed the strategic goal to strengthen China's role on a global scale, promoting international investment flows and commercial outlets for national products. The creation of a global investment network of maritime infrastructures is one of the main approaches pursued to increase accessibility and connectivity between Asia to the Mediterranean. Claims about the potential of Chinese investments have systematically been overly positive, which requires a more pragmatic assessment.

While the literature covering Chinese investments focuses on specific transportation projects (e.g., Wang et al. 2019a, b; Eran 2016; Ekman 2018), the contribution of this study is to compare port centrality by demonstrating what impact the BRI has had on containers flows. It underlines the possible effects of port investments on Mediterranean shipping flows, focusing on container transport from 2013 to 2019. To what extent the BRI has changed regional port hierarchy and polarization, as it can be revealed by container throughput and infrastructure investments?

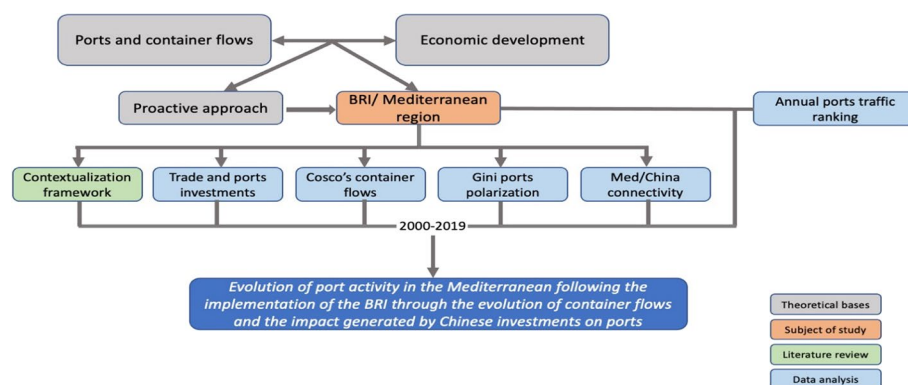
## Methodology

Trade should be considered an indicator of transnational economic integration, but it mostly relies on maritime infrastructures, shaping its development and orientation (Pavlicevic 2017). Through the analysis of Chinese bilateral trade with the Mediterranean as well as the FDI associated with port infrastructures, it is possible to evaluate how much Chinese trade expansion in the Mediterranean has influenced its port activity.

Previous research on the relationships between ports and economic development underlined the reciprocity between infrastructures and regional development (Rietveld 1989; Banister 1995; Notteboom et al. 2022). This approach can be divided into two perspectives. The first proactively considers ports as engines of regional development, while the second, more reactive, considers ports as nodes articulating economic development. The role of ports as factors of regional agglomeration has been underlined in several theoretical and empirical investigations (Konishi 2000; Limao and Venables 2001; Tabushi and Thisse 2002; Ago et al. 2006; Behrens et al. 2006).

The current research will focus on the proactive approach since it matches more closely with the BRI strategy, where trade is expected to follow large transport infrastructure investments (Fig. 1). The assumption is that port cities have a comparative advantage that is mainly derived from their locational advantage, which can be capitalized upon through the accumulation of infrastructures (Haddad et al. 2006).

First, a contextualization of the BRI is presented through a review of the recent literature addressing container trade in the Mediterranean. Then, through a temporal analysis of trade between 1995 and 2019, the evolution of the trade balance between China and the rest of the world will be examined. The time frame relates to events before the Covid-19 pandemic and the related disruptions which are not investigated in this paper.



**Fig. 1** Methodological approach

The trade balance indicator is important for the analysis since it can be calculated at the level of trading partners, regions, and in total terms, as well as by product group, making it possible to determine which products and/or partners have a competitive disadvantage. The goal is to understand the extent to which trade balance variations, if any, can be affected by Chinese investments.

Subsequently, by looking at container traffic accounted by COSCO for each port, it is possible to determine its impact on regional port development. As one of the main state-owned companies that China uses to make investments in Mediterranean ports, it is important to determine its influence on regional container flows. By using data from each port, a geographical variation in the importance of COSCO in container flows will be analyzed.

Also, the Gini index will be used to assess the polarization of the Mediterranean ports that could be attributed to the BRI. The first step was to compile two sets of data into a single database. The AlphaLiner set covers the period from 2000 to 2020 and corresponds to a top 100. The Institute of Shipping Economics and Logistics (I.S.L.) set contains a maximum of 401 usable values. The analysis is based on a dataset of 40 container ports over the 2000–2019 period. Concentration indices are well-known tools aimed at assessing the level of concentration in a market and are considered useful due to their ease of application and simplicity of interpretation. They have been widely used in port systems to assess port competition, estimate temporal variations in concentration, establish port development models, or as general market descriptors. Calculating concentration levels with the Gini coefficient is simple allowing an accurate assessment of port polarization. Grifoll et al. (2018) underlined that the Gini method is a valid tool in the analysis of port concentration.

Then, the share of Chinese investment in Mediterranean ports will be assessed using the Liner Shipping Connectivity Index (LCSI) to compare the country-level connectivity of Mediterranean ports with China for the reference period (2010–2019). This allows a before/after BRI comparison with enough time lag to expect consequences on port volumes and trade flows. Port connectivity between countries is defined as access to frequent and regular transport services in the flow of containers between ports. Therefore, it is a determining variable in the competitiveness of ports as elements of the transport chain.

Last, containerization is the most important and direct factor in assessing the competitive strength of ports. Consequently, a classification of annual port container traffic will be presented. This ranking corresponds to an ordinal statistic performed through a correlation analysis to analyze port hierarchy. The data was collected from the same reference time frame.

## **China-Mediterranean trade and the BRI: empirical evidence using time series data analysis**

### **The context of Chinese investments**

Using TEU movement datasets and port trade flow dynamics, the China-Mediterranean trade can be framed from a maritime infrastructure connectivity perspective. According to the new trade routes and logistic-port structures related to Chinese investments, Mediterranean ports are at the frontline in the trade and investment dynamics (Amodio

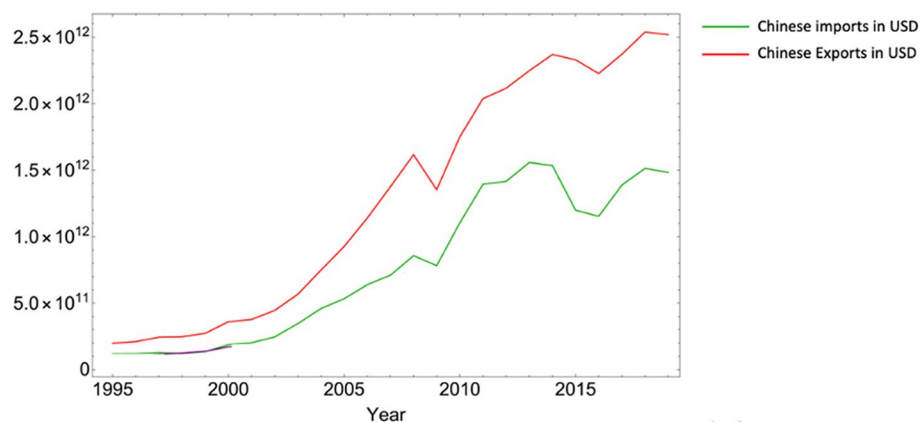
2019). The BRI has regional repercussions on the port system, determining a differentiation characterized by the attraction of economic flows and port development prospects. For instance, in 2017, the Mediterranean area handled 98.9 million TEUs, compared to 83.7 million in 2008, an increase of 18.1%. This growth is not uniform, with differentiated growth rates being observed. For instance, one of the leading port and transshipment hubs, Tanger Med, went from 4% of the total Mediterranean maritime trade in 2008 to 10% in 2017.

Chinese container terminal operators have been expanding internationally by securing concessions. With China's enduring growth as an exporter, the Mediterranean-Asia maritime corridor has seen an intensification of flows (Wang et al. 2020). Chinese corporations are already involved in several investments in transshipment hubs along the main route, such as Colombo in Sri Lanka, gaining a competitive advantage in serving regional local traffic (Ferrari and Tei 2020). These strategies related to the BRI have involved investments in existing ports, improving the connectivity of major shipping routes by deploying additional capacity and services, and developing hinterland connectivity through the setting of transport corridors. Although the BRI is supposed to bring benefits to the regional and global connectivity of the port of Colombo, the failure of the initiative to understand and critically consider the local realities and concerns of Sri Lankans led to serious questions about the true effect of the BRI (Ruwanpura et al. 2020).

### China-Mediterranean trade

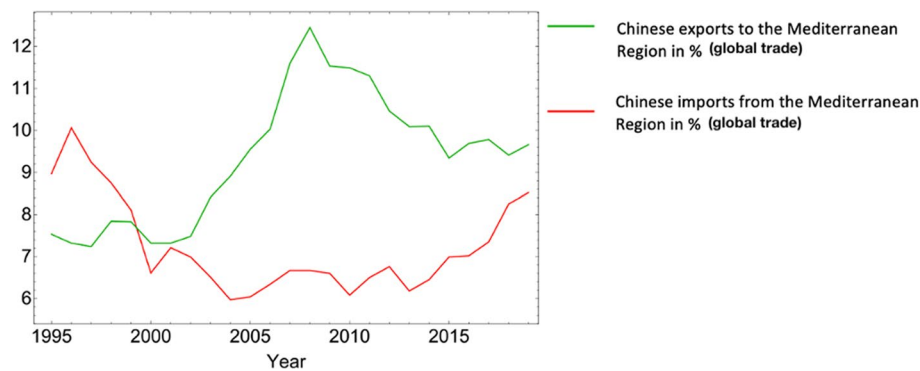
Understanding the impact of China on world trade requires a temporal analysis of trade flows to illustrate key changes in its nature and composition with the trade balance between two different regions an indicator of how trade flows evolved in terms of respective gains. In this case, China is expected to have a positive balance due to the export orientation of its economy and the dependency of European countries on Chinese goods (as is the case for other major markets such as North America).

Figure 2 depicts the evolution of trade between China and the World from 1995 to 2019. Up to 2000, China was maintaining a slightly positive trade balance as it was developing its export capabilities through domestic investments and using foreign direct



**Fig. 2** Evolution of Chinese trade with the World (1995–2017). Source: “The Observatory of Economic Complexity | OEC,” 2021 and diverse data sources (UNCTAD)



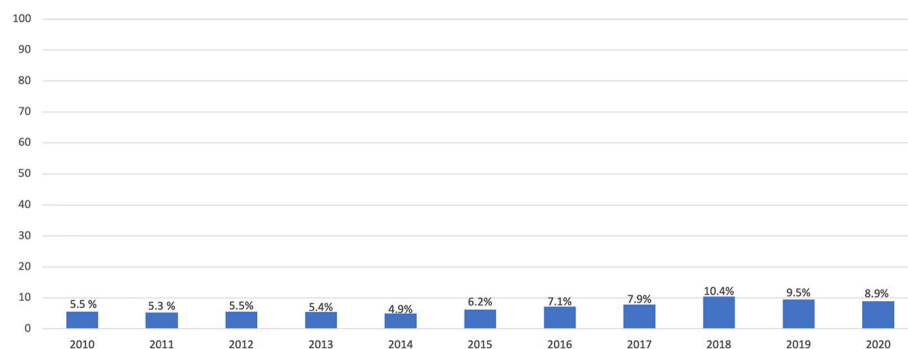


**Fig. 3** Evolution of Mediterranean trade with China (1995–2017). Source: “The Observatory of Economic Complexity | OEC,” 2021 and diverse data sources (UNCTAD)

investments to acquire technical capabilities it lacked (e.g. joint ventures). Since 2000, the growth of both imports and exports has surged as export capabilities became available and as reforms led to the implementation of market principles. Further, the gap between exports and imports expanded during that period, underlining the strengthening of China’s export-oriented role and impacting trade flows.

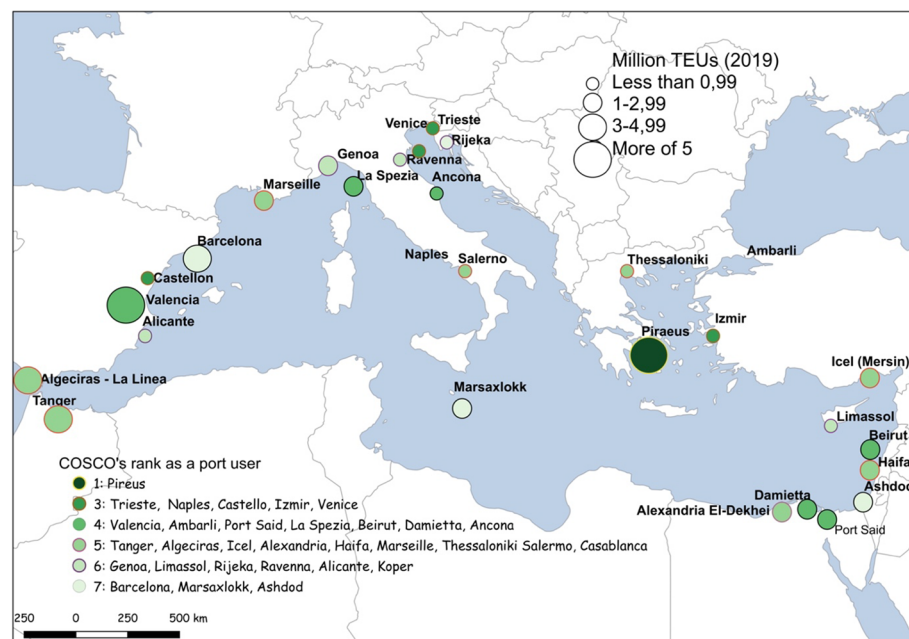
There are, however, notable regional differences, as shown on Fig. 3. Before 2000, the trade balance between the Mediterranean and China favored the former. However, from 2000, the balance shifted, giving a positive predominance to China, exponentially growing until 2008. The trade gap increased, creating an 11% difference in China’s favor, which began to decline in 2010. This gap represented a period following the financial crisis of 2008–09, with a decline in aggregate demand and the reevaluation of the Chinese Yuan, impacting its competitiveness. However, by 2017 there was still a balance in favor of China.

This ongoing change in trade orientation incites China to develop transport infrastructures. It could be argued that the BRI allows for keeping the trade balance in favor of China by supporting the exports of Chinese goods to European markets. However, evidence shows that the BRI does not appear to trigger a change in the trade balance between the two regions, as this trend was already taking place before 2013. Figure 4 shows the share of container traffic in the Mediterranean attributed to Chinese trade.



**Fig. 4** Evolution of the share of container traffic in the Mediterranean attributed to Chinese trade. Source: Mobis-Neoma BS





**Fig. 5** COSCO's customer positioning comparison among major Mediterranean ports in 2019. *Source:* Institute of Shipping Economics and Logistics 2020 and Port Capacity Alliance. Authors' creation

companies, which has been steadily increasing. Since 2013, the year the BRI began to be implemented, this share increased from 4.9 to 10.4% in 2018. It is positively correlated with the share of Chinese imports from the Med. It is negatively correlated with the share of Chinese exports to the Med. between container share changes and changes in the value of trade.

#### COSCO's position as a port user

China's dominance in global trade took off in the 2000s, particularly following its entry into the World Trade Organization. Both the volume and the positive trade balance improved, allowing China to accumulate substantial foreign reserves. Second to the United States, the European Union is one of the largest markets for Chinese goods. Chinese investments in European container ports have grown from virtually being nonexistent in 2010 to approximately 10% of total volumes in 2020 (Merk 2020). With the BRI, these stakes were expected to increase and be associated with additional trade volumes.

Many Mediterranean ports require investment to modernize their infrastructure, add capacity, and connect with their hinterland, a trend that containerization made salient (Fremont 2010). The financial crisis of 2008–09 was a pivotal event as European capital became scarcer, which gave China an opportunity to step in, mainly by taking advantage of the opportunity to position itself economically and geopolitically. However, since BRI-related investments in the Mediterranean are recent, there is a lack of long-term evidence to assess their scale, scope, impacts, and profitability. In addition to benefiting from new port of calls in a rising number of terminals, it is assumed that the creation of logistical networks along the BRI allows for improving the competitiveness of

Chinese goods in a context where the comparative advantages of China in terms of labor are being eroded.

The Port of Piraeus has been a relevant case study since China started to be involved in 2009. Following this investment, Piraeus went from 2% of the Mediterranean container volumes in 2009 to 13% in 2015. COSCO, the main investor, increased port capacity by a factor of 35% by 2020, reaching 7 million TEU. The port has become the most important Mediterranean gateway for Chinese exports (Intesa San Paolo 2016).

In 2016, the Greek Port Planning and Development Committee approved a master investment plan submitted by the Piraeus Porth Authority (PPA) to pave the way for \$670 million in infrastructure improvements. Although the committee did not approve the proposed fourth container terminal, its development remains a possibility if traffic continues to grow. PPA's goal is to raise TEU capacity from 7 million TEUs to 10 million TEUs, making it the largest container port in the Mediterranean (UNCTAD 2019).

Outside Greece, China has been involved in several port investments in the Mediterranean. The most salient include Egypt (Port-Saïd and Alexandria), Israel (ports of Ashdod and Haifa), Turkey (Kumport terminal in Ambarli port, Istanbul), Algeria (Cherchell port), Spain (Noatum Ports), Italy (ports of Savona, Trieste, Genoa, and Naples, although with some delays due to the change of strategies of the Italian government) as well as France (49% stake in Terminal Link, owned by CMA CGM). Egyptian, Israeli, and Algerian ports are seeing the setting of co-located industrial and logistics zones. For Spain, the control of Noatum Ports allows Chinese shipowners to gain a foothold in the ports of Valencia and Bilbao and the inland ports of Madrid and Zaragossa.

Following the expansion of the Suez Canal in 2015, allowing for improved economies of scale in maritime shipping, the larger volumes per port call underlined the need to improve hinterland capacity and connectivity. China articulated investments in rail corridors, allowing to connect Piraeus, Belgrade, and Budapest (where the section from Belgrade to the Hungarian border is currently under construction), an axis that has so far been neglected. Larger ships and more volumes are placing intense pressure on hinterland transportation. The completion and operationalization of this project are expected to increase the hinterland reach of Piraeus within Central and Eastern Europe (IFRI 2018).

A series of trade agreements were signed between China and Italy in 2019, the most significant involving the integration of the ports of Genoa and Trieste into the BRI. Trieste aims to reclaim its gateway function, a role that was eroded in recent years by competition from the port of Koper and even Hamburg. An expansion project is planned for the port to handle post-Panamax ships.

In France, the Grand Port Maritime de Marseille (GPMM) is collaborating with Chinese firms to develop industrial and logistical projects. The development of rail links with Northern Europe is particularly focused on reducing transit time for Asian cargo by about five days. The 2018 agreement with Shanghai International Port Group (a major terminal operator) aims at promoting industrial clusters and circular economy principles related to port activities, addressing environmental issues and the related energy transition, and assessing routing and supply chain strategies that could reduce the carbon footprint of ports and maritime shipping.

Despite increasing investments, COSCO Shipping is not in the first position in any of the regional ports (Fig. 5). Although connectivity between the Mediterranean countries and China has increased, this does not immediately translate into COSCO becoming the primary port user. Within the Mediterranean region, the Chinese company is third overall behind APM-Maersk and MSC, and the latter has an extensive presence in shipping and terminal operations.

The only port where COSCO is the dominant container terminal operator is Piraeus, through its investments in developing and controlling port operations. In addition, by bringing additional container traffic, particularly for transshipment, COSCO transformed Piraeus into the leading Mediterranean port supporting containerized maritime trade with China. COSCO is the third customer using container facilities in three smaller ports: Castellon, Naples, Venice, and Izmir. It is the main shareholder in strategic geographical locations such as Ambarli at the entrance of the Black Sea, Port Said, at the entrance of the Suez Canal, and Valencia. Finally, it can be observed that in the remaining ports, even though some of them are hubs, COSCO is not one of the port's first user. These ports represent marginal positions as COSCO is already present in larger ports granting access to the European market.

## Results

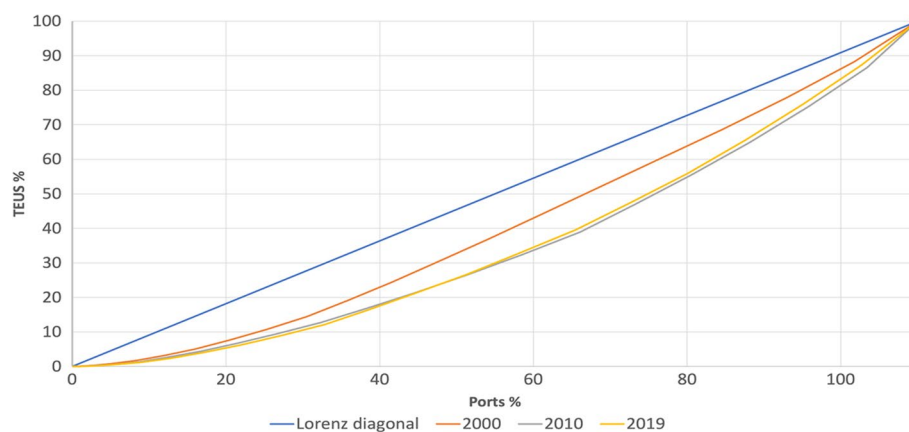
### Concentration trends of ports in the Mediterranean

The Gini coefficient allows correlating the concentration of container port activity before and after the BRI in the Mediterranean, where 0 corresponds to a uniform distribution of container traffic among Mediterranean ports, while values closer to 1, underlining a greater concentration. Based on port container traffic across 40 container ports, a temporal analysis for the Gini index evolution was performed for 2000, 2010, and 2019. These intervals allow for assessing if the Chinese economic insertion in the region has led to a variation in the distribution of container flows and highlight the changes in the comparative advantages within the European port system (Table 1).

The Gini coefficient, after analysis of the databases of ISL and AlphaLiner, reveals that the concentration of the Mediterranean port system has remained similar since 2000, hovering around 0.64. The result obtained shows a stable concentration container traffic, underlining the stability of the transshipment market. However, it does not indicate that Chinese investments have increased polarization. On the contrary, it may give commercial maritime flows to ports that were previously less connected, even if only marginally. In this way, Chinese investments in smaller or less costly ports have led to a very slight change in the distribution of trade flows in the Mediterranean but do not appear to have reduced the ongoing level of concentration.

**Table 1** Gini coefficient of the Mediterranean ports Source ISL and AlphaLiner. Elaboration authors

Year	Gini index
<i>Gini coefficient of the Mediterranean ports</i>	
2000	0.62
2010	0.65
2019	0.64



**Fig. 6** Lorenz Distribution of Container Traffic for Mediterranean Ports, 2000–2019 ISL et AlphaLiner  
Elaboration authors

Percentage-wise, the Lorenz diagonal (Fig. 6), shows an equal distribution in container traffic, with unequal distributions common in most regional container port systems (Rodrigue 2020). For the Mediterranean, the concentration level significantly increased between 2000 and 2010, reflecting the emergence of major transshipment hubs associated with the growth of the Asia-Europe trade. However, between 2010 and 2019, there has been no noticeable change in traffic concentration at the port system level, leading to the assumption that Chinese investments in maritime trade do not represent, at this point, an important factor in the concentration of flows or in reorganizing hubs in the Mediterranean.

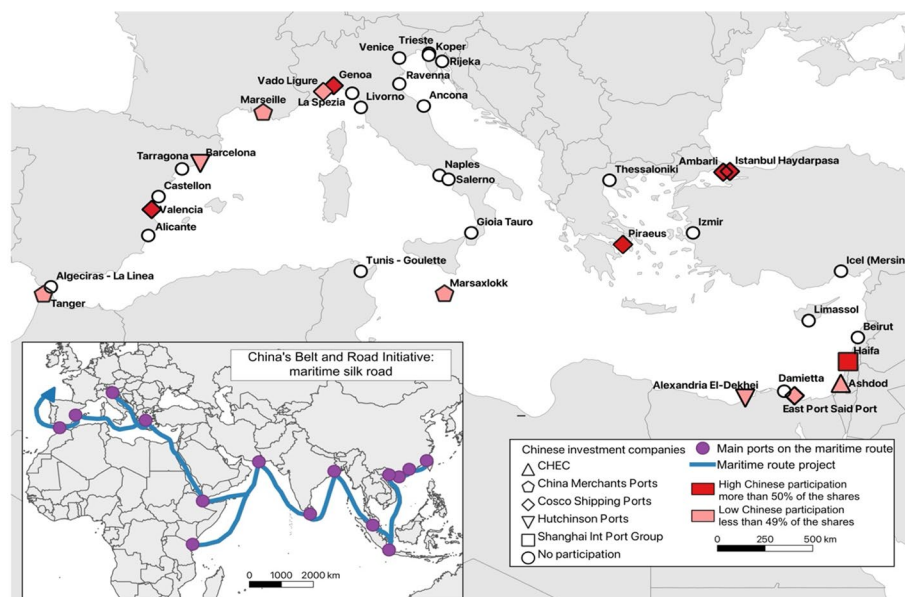
#### China's investments and Mediterranean port infrastructures

Chinese terminal operators are becoming key investment actors in the Mediterranean and at strategic passages such Port Said. The commitment to invest in port infrastructures, or getting involved in terminal operation, is consistently associated with a growth in the regional market share of the concerned ports. Between 2009 and 2017, the share of Piraeus rose from 2 to 12% of the region. These figures were from 4 to 10% for Tanger Med and from 7 to 8% for Genoa (Amodio 2019). China's influence is therefore not limited to trade, but also the development of port infrastructures, further marking its presence as an important strategic decision-making agent. COSCO's investments around the Mediterranean are substantial (Table 2). China has been involved in buying shares (which can give a controlling interest) and investing in a company to expand its operations by purchasing fixed assets. While buying minority shares may not have any impact on a port's overall performance, it provides an opportunity to derive commercial benefits when doing business with strategic partners.

The first case is the acquisition of shares in Piraeus. After the 2016 acquisition, COSCO reshuffled its services, using the Greek port as a hub for vessels passing through the Mediterranean (Ferrari and Tei 2020). After COSCO's strategic decision, the finances of the port authority substantially improved. Profits for the first half of 2019 were up around 20% compared to the same period in 2018. Under the terms of the agreement,

**Table 2** Main Chinese investments or acquisition of a shareholding in Mediterranean ports

Port	Country	Chinese investor	Terms of the transaction
Port said	Egypt	COSCO Shipping Lines (Egypt)	Bought a 20% stake in the Suez Canal Container Terminal (2005)
Port of Haifa	Israel	Shanghai International Port Group Co. Ltd.	25-Year concession signed in 2015, and beginning in 2021
Kumport, Istanbul	Turkey	Joint venture between COSCO Shipping Ports, China Merchants Port Holdings and CIC capital	65% stake acquired in 2015
Vado Ligure	Italy	COSCO Shipping/ China Overseas Ports Holding Company	Acquired in October 2016 a 40% stake in Vado Holding
Port of Piraeus	Greece	China Ocean Shipping Group Company (COSCO)	67% stake acquired in 2016 for 400 million euros
NCTV container terminal in the port of Valencia	Spain	COSCO shipping	Stake of 51% acquired in 2017

**Fig. 7** Presence of Chinese companies and their level of participation in Mediterranean ports Shipping Economics and Logistics database, Assoporti 2018, CMHI, COSCO 2020. Authors creation Sources: Institute of

COSCO is expected to invest at least \$330 million in the port through 2022 (Lauriat 2019) (Fig. 7).

In 2017, COSCO also acquired 51% of Noatum Ports, taking over the terminal in the port of Valencia (Noatum Container Terminal Valencia), the largest container terminal in Spain and one of the three most important container ports in the Mediterranean. In the case of Vado Ligure (Italy), in 2016, APM Terminals transferred 40% of its shares to COSCO. In Turkey, the company invested in the third-largest port, Kumport, near Istanbul, which is considered an important hub between the strategic land belt link and the maritime route. It acts as one of the gateways to the Middle East. The Port of Said, following Chinese investments, has grown its container

handling capacity, making it one of the most important in the region. Finally, in 2004, the Israeli government began privatizing its three commercial ports in Ashdod, Eliat, and Haifa. Shanghai International Port Group (SIPG) won the concession for operating the Haifa port for 25 years (Eran 2016).

In 2020, the deployed rail capacity between China and Europe was estimated to be around 5000 direct trains per year, accommodating around 200,000 TEUs. This is a small share of the estimated 25 million TEUs circulating between Asia and Europe each year (UNCTAD). In the case of the China-France trade, the share of rail is only 1%, but with an annual growth rate of around 10%. The project is also looking for a connection to the German inland port of Duisburg, from where the cargo could continue to the Netherlands, Belgium, UK.

Chinese enterprises have been involved in the construction, operations, and joint ventures of more than 80 port projects worldwide. Figure 7 shows some of the main Mediterranean ports where Chinese enterprises operate. The pattern of Chinese port investments underlines key focus areas, which are likely to precede trade.

Investments have taken place in ports vying to either play the function of a regional hub or a gateway having rail connections to the interior of the European continent. This is apparent in Spain, with a presence in the ports of Barcelona, as well as the majority shareholdings in Valencia. Each port-related investment project is often associated with the construction of industrial parks, logistics clusters, free trade zones, and infrastructures connecting the hinterland (Wang et al. 2019a, b). This strategy is consistent with most port investments and aims to create an infrastructural and commercial ecosystem supporting trade and logistics from which Chinese interests are expected to benefit.

In 2018 COSCO set its sights on the Cantabrian-Mediterranean Corridor, highlighting its presence with its railway terminal in Zaragoza with its willingness to increase terminal capacity to 300,000 TEUs. This will further boost and increase volumes flowing through the Port of Valencia (Gómez 2021). For COSCO, the Zaragoza rail terminal is a strategic infrastructure in Spain. It guarantees the connection with its two maritime terminals, at the ports of Valencia and Bilbao, for which the improvement of the Cantabrian-Mediterranean Corridor and, especially, the Valencia-Zaragoza section is fundamental.

A look at the Mediterranean also underlines a logistics and information technology dimension, with cooperative agreements with logistical operators such as Bollore Logistics and with telecommunication and information technology firms. By collaborating with Chinese firms, these firms are also granted access to the Chinese market (Larcon and Vadcar 2019).

### **Mediterranean ports and global maritime networks**

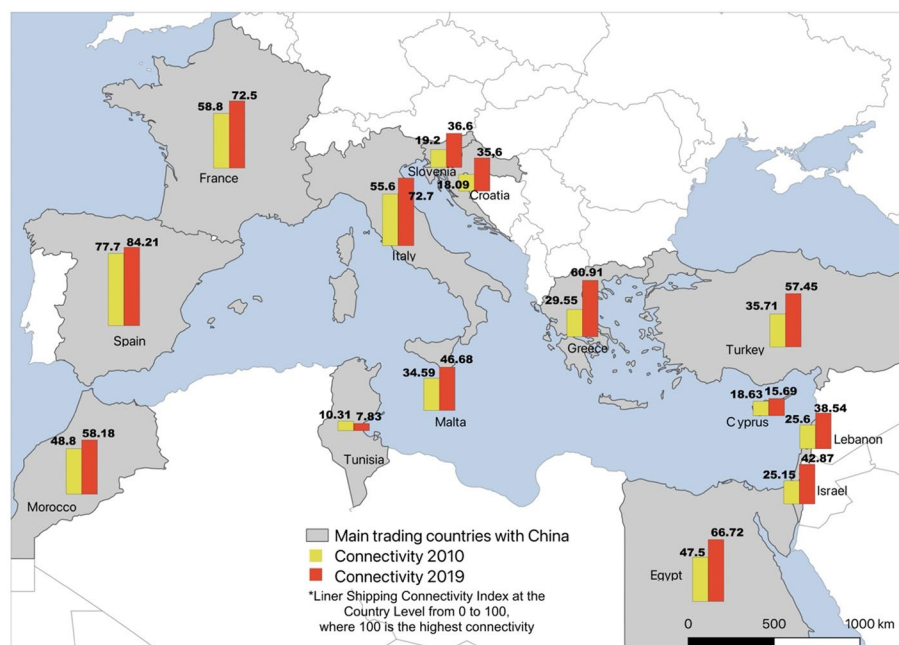
A principal component analysis of the Mediterranean ports underlined that volumes and geographical locations are positively correlated (World Bank, 2018). As expected, the most prominent ports have a low deviation from main maritime routes and exhibit higher logistics performance and transshipment activity than peripheral ports. Two particular categories can be noted:



- Hubs. Algeciras (Spain), Cagliari (Italy), Damietta (Egypt), Marsaxlokk (Malta), and Tanger-Med (Morocco) are important transshipment hubs handling traffic coming from and bound outside the Mediterranean. They have a central location concerning their foreland.
- Gateways. Ambarli (Turkey), Koper (Slovenia), and Trieste (Italy) are more peripheral but account for a large share of traffic bound for their hinterland. However, the share they have in the EU hinterland service remains marginal from these ports, there is low market share of the Hamburg-Le Havre range, in particular Antwerp, Rotterdam and Hamburg. They have a central location in relation to their hinterland.

Using the Liner Shipping Connectivity Index, countries with ports having connections or direct investments with China were retained (UNCTAD 2019). The database periodically collects information on the characteristics of regular services linking Mediterranean ports and ports in China. It includes information on the regular services offered, routes and ports connected, their frequency, type of traffic transported, operators and vessels involved, and their characteristics. The variables are included in the index through an arithmetic average, from which a value of 100 is generated for the port with the highest average index in the first half of 2004.

Figure 8 shows the connectivity of the Mediterranean countries with the ports that trade most with China. To better understand the importance that the BRI has had on maritime relations, a comparison was made between connectivity before its implementation and in 2019. It is worth noting the connectivity of Spanish ports with China was 77.7 before the BRI, the highest in the region. This predominance became even more



**Fig. 8** Comparison of maritime trade connectivity between Mediterranean countries and China before and after the BRI. Source: Data World Bank 2020. Authors creation



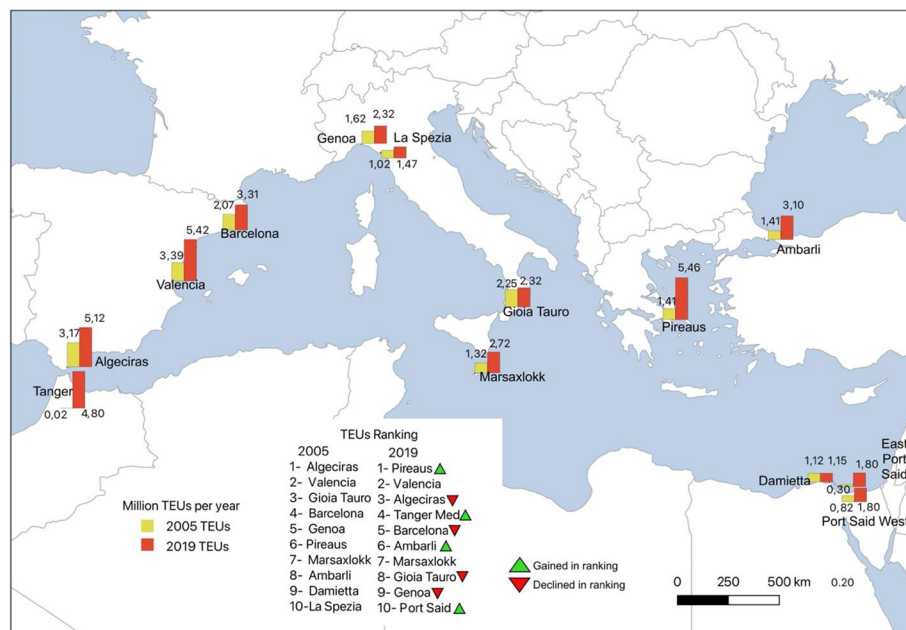
pronounced in 2019, an outcome of the presence of COSCO as a shareholder in the port of Valencia. Connectivity improved to a factor of 84.2, a growth of 8.3%.

Countries that have maintained very low connectivity are Cyprus and Tunisia. Their respective ports have been marginalized due to other ports that are more strategic for China's interests. Their connectivity does not improve over time, remaining at a low level. In contrast, the general rule is a considerable increase in connectivity with China. Comparing connectivity at different moments, there is a 10 to 20 points increase for each country, underlining the probable impact that Chinese investments had on the maritime trade. Finally, the country that has seen the greatest increase in connectivity with China is Greece. The acquisition of control of the port of Piraeus solidified its function as a hub for Chinese maritime flows. The connectivity increase is considerable, from 29.55 to 60.91.

### Annual port rankings between 2005 and 2019

A port hierarchy is developed according to the number of TEUs handled per year. The fluctuation in containers handled does not vary drastically since capacity increases take time and capital investments. Therefore, 2005 was taken as a reference year to show the evolution in the hierarchy of the top ten ports in the Mediterranean (Fig. 9). Two main points can be observed. The first is the variation in the number of TEUs moved per port per year, and the second is the port hierarchy.

First, trade from China has played an important role in the growth of container volumes in the Mediterranean. As can be seen in Fig. 9, the growth of TEUs per year between 2005 and 2019 is substantial in ports where Chinese investments occurred. Ports such as Piraeus in Greece, Valencia in Spain, and Tanger in Morocco, have



**Fig. 9** Mediterranean ports ranking comparison for TEU quantity report before BRI and 2019. Authors creation

increased their container throughput by more than two million TEUs between 2005 and 2019. In addition, Fig. 4 shows the growth of container traffic attributed to COSCO's influence, where the Chinese company is one of the main customers are the ones that have increased their container traffic the most by 2019: Tangier, Algeciras, Piraeus, and Port Said.

Second, the ports that benefited the most were those in the lower national income group. The port of Piraeus improved its position after the Greek financial crisis of 2009. Italy is the country that dropped the most in the ranking, with Gioia Tauro being the third before the BRI and dropping to 8th place for 2019 and La Spezia dropping out of the top 10. Even though it is a regional transshipment hub, it does not have strong connectivity with China, the result of liner capacity deployment. The same is observed with the port of Marsaxlokk in Malta, which ranked 7th before the BRI and dropped out of the top 10 for 2019. Ports dropped from the top positions not because they are less important for regional container shipping, but because they are less used by Chinese carriers. Since 2015, when China acquired a 20% share, Tanger Med and Port Said ranked 4 and 10. Valencia and Piraeus, where COSCO has stakes, moved to the first and second rank, respectively. Evolutions in port positioning can be mainly attributed to China's investment strategies in infrastructure and logistics operations, making them more efficient, but more importantly, to the capacity of Chinese carriers and terminal operators to bring cargo.

## Conclusions

The paper contextualized the implications of Chinese investments in the Mediterranean trade and maritime corridors by combining the temporal evolution of Chinese trade flows, port hierarchy, and port investments. It focused on what can be called the inception phase of the BRI within a port system, where investments are made according to a strategy, but also short-term opportunities. The 2000–2019 period underlines six major issues.

First, understanding the impact of China on world trade as a temporal analysis of trade flows showed an export-oriented strategy leading to a favorable trade balance, both globally and in the Mediterranean region. While China maintained a positive trade balance, it could be expected to gain a significant trade advantage after implementing the BRI. Such an outcome was not observed for the region, meaning that Chinese investments do not appear to have a substantial impact on the balance of trade flows.

Second, the connectivity between the Mediterranean countries and China has increased significantly, but not uniformly. Changes appear in part driven by COSCO taking a stake in terminal operation or becoming an important port user. This underlines the rather unique capabilities of Chinese carriers to deploy their assets to follow China's strategic orientation, and this at the port level. COSCO has been one of the main parties in China's strategic plan, making it the third-largest container terminal operator in the region.

Third, as exemplified by the Gini index, there is no noticeable increase in port concentration. The coefficient revealed that the concentration of the Mediterranean port system has remained relatively stable since 2000. There are no indications that the commercial

strategy in Chinese investments has increased polarization, and it simply changed the dominant gateways and hubs.

Also, by securing the port of Piraeus, COSCO was able to establish a regional hub where it carries out its main operations. In addition, its use of ports with lower container handling capacity has boosted trade flows in the region, and by avoiding the main hubs, it can reduce operating costs. However, the level of inequality remained, with Chinese port investments minimally impacting hub attraction. This is due to the development and use of small and medium-sized ports by Chinese carriers, leading to a substantial increase in container traffic outside the traditional Mediterranean hubs, with large hubs such as Gioia Tauro losing prominence. Diseconomies of scale derived from port congestion and new opportunities in dynamic economies appear to be the key drivers. Therefore, what was presented by Huang (2016), which underlines the potential of the BRI to turn underdeveloped regions into new clusters of economic activity, is supported.

Fourth, Chinese Mediterranean trade and its infrastructure have strengthened Chinese exports by enabling new corridors and infrastructure to support long-distance mainland and maritime trade. Comparing the results obtained with what was seen in the literature review, the research supports what was studied by Cheng and Yiu (2016) and Gómez (2021), stating how China has focused on positioning itself as a port infrastructure developer. The presence of Chinese investors, such as COSCO and China Merchants Group (CMG), in port operations, impacted regional dynamics. Investments have taken place in ports with strategic locations, particularly at both entrances to the Mediterranean (Suez and Gibraltar) and gateway ports having rail connections to the interior of the continent.

Fifth, the Liner Shipping Connectivity Index demonstrated that connectivity grew considerably after the BRI, with Greece benefiting the most, particularly for the port of Piraeus in Greece, which has become a hub for Chinese trade flows in the region. The connectivity of Spanish ports with China was also noticeably improved. China has invested in locations such as Kumburgaz in Istanbul, Port Said, and Valencia, where it is the main shareholder. These locations have a clear strategic value in accessing regional markets around the Mediterranean.

Finally, Chinese investments in infrastructure have been strategic, providing trade flows in geographic areas that give access to important hinterlands. This is reflected in the evolution of the port ranking, where the ports that received the most Chinese investments became better positioned.

Still, the impacts of Chinese investments in the Mediterranean are ambiguous, more focused on the structure of trade flows than its volume at the aggregate level. From this perspective, investments by Chinese State Enterprises are necessary, but not particularly relevant to port competitiveness or benefits to regional economies. In other words, volume growth is shown not to be relevant to regional hinterlands, but only to Chinese interests, leaving aside regional growth in port areas. This underlines a closer look at development in port zones and areas where China has not invested.

For the Mediterranean, the BRI was a driver in restructuring the port system, with some hubs rising in the hierarchy, while others declined. Further research should investigate factors such as merchandise type and their port destinations, as well as secondary

container flows (feeder services) between the ports of the Mediterranean region. Thus, the impacts of the BRI on short-sea shipping within the Mediterranean remains unclear.

The Chinese strategy related to the port hinterland and multimodality is another theme remaining to be investigated. Although some studies have been carried out (Ferrari and Tei 2020), there is still no analysis of the complex relationships between the main ports used by Chinese investors and those used by Chinese shipping companies. Further, it is important to analyze the ongoing developments of Chinese investments in a post-Covid 19 setting, particularly where expectations have not been met and where local stakeholders may find themselves with significant infrastructure-derived debt. Unequal opportunities lead to unequal returns, for which Mediterranean ports are likely to become salient examples.

#### Abbreviations

BRI	Belt and Road Initiative
COSCO	China Ocean Shipping Company
Covid-19	Coronavirus disease
GPMM	Grand Port Maritime de Marseille
LCSI	Liner Shipping Connectivity Index
ISL	The Institute of Shipping Economics and Logistics
MSC	Mediterranean Shipping Company
PPA	Piraeus Porth Authority
TEU	The twenty-foot equivalent unit

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#### Author contributions

OO: Corresponding author, co-responsible for the creation and planning of the work, as well as the assembly of the study methodologies. JPR: Assembly and correction of the work plan and methodology. Analysis of the quality of the work both in the redaction, correction of the language and the fidelity of the data and results. AHM: Writing of different sections of the study, creation of the results of the methodologies used and author of the cartography of the work. JV: Responsible for the provision of data used in this study.

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#### Availability of data and materials

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#### Declarations

##### Competing interest

The authors declare that they have no competing interests.

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