# SHORT-TERM EFFECTS AND LONGER-TERM IMPACTS OF THE COVID-19 PANDEMIC ON THE INTERNATIONAL SHIPPING AND PORT INDUSTRIES

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***Abstract*** *The COVID-19 pandemic had a significant impact on global trade with an initial contraction followed by an inflationary peak in demand. For more than two years, ports and shipping were centre stage in an unfolding global supply chain crisis. This paper identifies the effects and implications of a major disruptor (such as the COVID-19 pandemic) on the activities, operations, management structure and performance of the international shipping and ports industries, with a specific focus on container shipping and ports. Both the short-term impact of the COVID-19 pandemic and the longer-term responses of container shipping and ports are examined, including also the longer-term implications for port governance. The flow of the narrative has also allowed us a digression on the fundaments of shipping and port economics (particularly of the latter), offering readers new insights never addressed before. Lessons learned from our analysis could be useful in addressing other disruptors or uncertainties in and around ports and the global maritime landscape by and large.*

## 1. INTRODUCTION

The year 2020 will go down in history as the year of COVID-19. With the World Health Organization's declaration of an *International Pandemic* on 11th March 2020, its social and economic consequences have spread globally as quickly as the virus itself and, in no small measure, the decease has ushered in a *new normal* which has yet to be fathomed. Concepts such as *teleworking* for business and the *e-campus* for education, particularly in the way these are facilitated by the simplicity of platforms such as Zoom, Teams, etc., are probably here to stay – at least to some extent and in some form. The effects of this on business travel, education and e-commerce are likely to be profound (Suau-Sanchez et al., 2020: Conway et al., 2020; Pokhrel & Chhetri, 2021; Mohdhar & Shaalan, 2021).

Of course, with the outbreak of the pandemic, both global production and international trade initially declined. Naturally, this had to do with the lockdowns in China and the closure of many of its production facilities in January 2020. The situation in China initiated a supply shock in Europe, North America and other parts of the world. Container shipping lines resorted to *blank sailings* on the trade routes with China, while companies tried frantically to reassess their supply chain exposure to that country. The Chinese lockdown led to serious disruptions in global supply chains, demonstrating, if more lessons were needed, the pivotal role of China as the locomotive of global industrial production.

The initial supply shock was followed by a demand shock, i.e., the lockdowns in Europe and North America that followed in March 2020, substantially reduced the demand for Chinese imports. The short-term economic effects of COVID-19 have been most immediately and acutely felt in the contraction of global demand, mainly for merchandize goods, and the curtailing of passenger travel, holidays, and entertainment. It should be noted, however, that the contraction in overall demand experienced over the course of the whole of 2020 has not been as dramatic as many analysts had predicted and, to the benefit of the shipping industry, the same was also true for international trade. The reason was because the contraction of demand experienced in some sectors was compensated for by an increase in demand for others, such as electronic equipment (e.g., computers and peripherals, video game consoles etc.); mobile phones; exercise equipment; home-improvement and gardening materials and last but by no means least, medical equipment, such as surgical masks, gowns and disinfectants, most of which were manufactured in China.

In addition, it should not be forgotten that during the various lockdowns of the first half of the year (H1 2020), inventories were run down, as evidenced by the substantial restocking that took place in the second half of 2020 (H2 2020). This restocking wave, combined with an increased demand for consumer products, initiated a global supply chain crisis which lasted throughout 2021 and the first half of 2022. The peak in demand was partly fed by extensive COVID-related financial support packages implemented by governments in North America and Europe, and the further easing of monetary policies. The resulting excess demand pushed the global logistics system to its limits and became one of the root causes of high inflation (BIS, 2022).

The primary objective of this paper is to identify the effects and implications of a major disruptor (such as the COVID-19 pandemic) on the activities, operations, management structure and performance of the international shipping and ports industries. Hopefully, lessons learned from our analysis could be useful in addressing other disruptors or uncertainties in and around ports and the global maritime landscape by and large. These emerge constantly, both in numbers and severity, due to intensified competition and the need for 'lean and mean' operations for firm survival. Examples of such disruptions range from the effects of wind on high-stacked containers in the yard, to labour strikes or the loss of hundreds of millions of euros because of a successful ransomware cyberattack. Our analysis is undertaken by positioning the immediate impact and potential longer-term implications of this significant disruptor (COVID-19) within the wider context of contemporary research in the area of maritime economics. What follows, therefore, is a critical assessment of some of the key issues and themes in maritime economics research, attempting at the same time to propose new avenues of thought for further port research in a post COVID-19 era. We summarize the main developments by identifying trends and exploring research challenges, gaps and points of (re)orientation. Instead of providing answers, therefore, we provide inputs to ongoing discussions by sketching emerging and eminent issues in the hope that this will provide some guidance for further maritime studies in the field.

With this in mind, the rest of this work is organised as follows: In section 2, the short-term impact of the COVID-19 pandemic on the shipping industry is summarised, with a specific focus on liner (container) shipping. This provides the short-term demand-side context for the immediate and potentially longer-term response of the (container) ports sector, as the supplier of cargohandling services to the shipping industry. Section 3 outlines the confounding effects associated with the more stringent environmental regulations that have been imposed on the shipping industry immediately prior to, and following, the peak of the COVID-19 pandemic. The immediate short-term effect of the pandemic on (container) ports and the shipping industry's response to it are outlined in section 4. The focus of the work is to be found in section 5, where the longer-term implications for the governance of ports is discussed, in relation to the industry's geopolitical and commercial context, potential business models, the standard port governance typologies, the potential emergence of new approaches to port governance and the role played by the various 'models' and measures of port performance. Conclusions are drawn in section 6.

## 2. THE SHORT-TERM IMPACT OF COVID-19 ON SHIPPING

*2.1. Short-term impacts on non-containerized shipping markets*

The COVID-19 crisis has exerted a profound impact on the shipping industry. The two shipping sectors hit the hardest were those most directly concerned with personal mobility and cross-border movements – i.e., ferry services and the cruise industry (Jenelius & Cebecauer, 2020; Urbanyi-Popiolek, 2020; Renaud, 2020). Ferry services and short-sea-shipping (SSS) are of great importance in two respects: a) they provide connectivity to remote territories (e.g., small, inhabited islands) – in other words, they entail *public service obligations* (PSO) and are, therefore, frequently subsidized by the State concerned; and b) they take pressure off congested road transport systems, thus reducing negative environmental externalities (see Raza et al., 2020 for a literature review of this issue). Within the EU more specifically, SSS serves one of the Union's top policy priorities; the *Motorways of the Sea* and their role not only in diverting both passenger and freight traffic from road transport, but also in connecting the transport system of the EU (Trans-European Transport Networks – TEN-T) to that of third countries, notably in Northern Africa and the Middle East (Morales-Fusco et al., 2012; Aperte & Baird, 2013; López-Navarro, 2020).

It thus becomes obvious that the effects of COVID-19 on these two sectors (ferries and SSS) were far-reaching and to an extent they are probably irreversible, in view of the high transaction costs associated with modal shift decisions in the case of SSS, and the EU's limited success in relieving the pressure on its road network (Sambracos & Maniati, 2020). Dry bulk and tanker shipping have also faced reduced demand and consequent hardship during the pandemic. However, given China's significant demand for commodities (e.g., iron ore and coal), dry bulk shipping was expected to do quite well in 2021 and into the immediate future (Danish Ship Finance, 2021), at least until alternative *e*-fuels, such as green hydrogen, ammonia and methanol, create 'different' types of demand both for shipping and port infrastructure (Notteboom and Haralambides, 2023). In 2020 and 2021, tanker shipping was plagued by chronic overcapacity in an era of disinterest in fossil fuels (SSY, 2021; BRS, 2021). Following two slow years of COVID-19, Russia's invasion of Ukraine, and the market upheaval that has followed, there have been steep increases in freight rates and an increase in average tonne-miles in the first half of 2022.

*2.2. Short-term impacts on container shipping: from blank sailings to a global supply chain crisis*

Liner shipping was quick to adjust supply to demand in H2 2020. This was achieved with the 'withdrawal' of shipping capacity (20-30%) from the main trade lanes, something that has come to be known as *blank sailings*. By October 2020, blank sailings overall during the year had reached the impressive number of 515. Port calls were thus cancelled; frequency, connectivity, and quality of service declined; call sizes increased; and the volume of laid-up tonnage rose as well, reaching record levels in H1 2020: by May 2020, laid-up tonnage amounted to 11.6% of the deployed cellular container fleet. To further reduce supply, additional measures were adopted by carriers, such as lower speeds and longer routes, e.g., around the Cape of Good Hope rather than via the Suez Canal. In May 2020, containership transits of the Suez Canal had fallen by 32% year-on-year, to settle at an all-time low of 330 passages (BIMCO, 2020).

These actions, particularly blank sailings, allowed carriers to sustain freight rates during the first half of 2020, even when demand was down. Starting in the late Summer of 2020, the surge in demand quickly reduced idle capacity to only 2% of the global container fleet tonnage. However, the market re-entry of laid-up tonnage did not prevent a rapid rise in freight rates, and an emerging global supply chain crisis.

Thus, burgeoning demand for liner shipping services soon translated into surging freight rates and carrier profits which continued to rise at a rapid pace, hitting record levels, as reflected in movements in the value of the Drewry Composite World Container Index (WCI). In the second week of December 2020, for example, a weekly change in the WCI of 23% ($793) was registered, equivalent to $4,244 for a 40ft container. This was 166,6% higher than that of the same period in 2019. On December 31, the WCI reached $4,359, escalating to $5,221 in the first week of 2021 (an increase of 185% year-on-year). In the same week, the annual changes

in the individual freight rates used to calculate the composite WCI for 40ft containers rose by 212% on Shanghai-Genoa ($8,380); 282% on Shanghai-Rotterdam ($8,882); 148% on Shanghai-New York ($6,385); and 134% on Shanghai-Los Angeles ($4,194). Meanwhile, the transatlantic route New York-Rotterdam saw a rate increase of 31% ($690), while Rotterdam-New York decreased by 14% ($2,185). Price inflation continued apace in 2021, with the WCI reaching a peak of $10,377 per FEU in September. The WCI has been declining continuously since that peak, and a year later, in September 2022, it was around half of the peak value at $ 5,379 (Drewry, 2022).

*2.3. Short-term impacts on container shipping: record profitability and growing discontent*

Realizing handsome profits overall, the one sector which did unexpectedly well in 2020 was liner (container) shipping. The market leader, Maersk Line, reported record profits for Q3 of 2020 and again in Q4. The company reported another record pre-tax profit for Q1 of 2021 that was only just below the amount achieved for the whole of 2020 (Baker, 2021). The average operating margin in container shipping in general increased from 2.6% in Q1 2022 to 55.6% in Q3 2021 and remained at this high level throughout 2022 (Alphaliner, 2022). Anecdotal evidence suggests that, at the peak of the cycle, North American and European shippers may have been paying rates five to ten times higher than what they would normally pay, and many of them may have had to wait for weeks, if not months, to secure a slot on a ship, or find a container to bring their orders from Asia (Attinasi et al., 2021).

The high profitability in container shipping accelerated vertical integration among certain major container carriers. Maersk Line, CMA CGM and MSC embarked on a take-over spree in the air freight business, e-commerce and last-mile logistics, digital platforms and forwarding activities (Paridaens and Notteboom, 2022). Examples include the take-over by Maersk of Senator International (air freight forwarding) and e-commerce firms HUUB (fashion industry), B2C Europe Holding, Visible SCM (US) and Pilot Freight Services; or the take-over by CMA-CGM of Ingram Micro's Commerce & Lifecycle Services (CLS) and the Colis Privé Group in late 2021 to boost its e-commerce expertise. However, not all carriers are walking the path of logistics integration. The high level of liner shipping profitability, combined with emerging vertical integration strategies, can also be considered as some of the underlying drivers for the January 2023 announcement of Maersk and MSC decision to discontinue the 2M alliance: an operational agreement signed in 2015 dealing with joint capacity management on the main east-west trade routes.

In view of all the above, shippers and international transport associations started to publicly express their discontent over carrier behaviour during the COVID-19 crisis. Complaints were naturally lodged to the competition authorities responsible for the regulation of international shipping in the world's largest trade lanes, i.e., in the EU, USA (FMC), China, and Australia. Complaints concerned capacity management strategies; reduced levels of service; capacity withdrawals (blank sailings), lower schedule reliability; rolled containers; additional surcharges; equipment shortages, etc.

In the United States, the record-high freight rates; the unavailability of empty containers to US exporters; and supply chain unreliability in general, led shippers to complain strongly about carrier behaviour. President Biden seconded their voice, stating that "…*nine major shipping companies consolidated into three alliances control the vast majority of ocean shipping in the world and each of these nine are foreign-owned. During the pandemic, these carriers increased their prices by as much as 1000% while families and businesses struggled around the world. These carriers made 190 billion dollars in profit in 2021, 7 times higher than the year before and they raked in the profits, and the costs got passed on as you might guess, directly to the consumers sticking it to American families and businesses. These foreign-owned carriers have also been refusing to carry American-made products back to Asia*…".

On the 16th of June 2022, President Biden signed S. 3580, the "Ocean Shipping Reform Act of 2022," into Law, tasking the Federal Maritime Commission (FMC) to exercise greater diligence in their control of 'undesirable business behaviour' by carriers. President Biden's angry response followed the years-long, albeit lukewarm, assessments of FMC and the Department of Justice (DoJ), according to which "there was nothing 'sinister' in the behaviour of carriers which was only due to market forces and to the excess of demand over supply". The President would have scored much higher, however, had he reminded carriers and regulators that, in 2009, at the heart of the global financial meltdown, when nearly all carriers were on the brink of bankruptcy, governments, one after the other, rushed to pour taxpayer money into them, to salvage them,

because they were 'too big to fail'. One would have thought however that, then too, it was a matter of demand and supply and that it is always tricky to 'have your cake and eat it as well'.

At the time of writing (February 2023), the WCI has tumbled by 80% year-on-year, down to $2000 (Figure 1). Moreover, by looking at the industry's unprecedented orderbook (see next section), rates will most likely fall even further or stabilize at most. After all, shipping alliances have not been very successful in managing capacity[1] and regulators may be proven right in considering the whole thing (i.e., rate hikes during the COVID-19 years) a "matter of demand and supply".

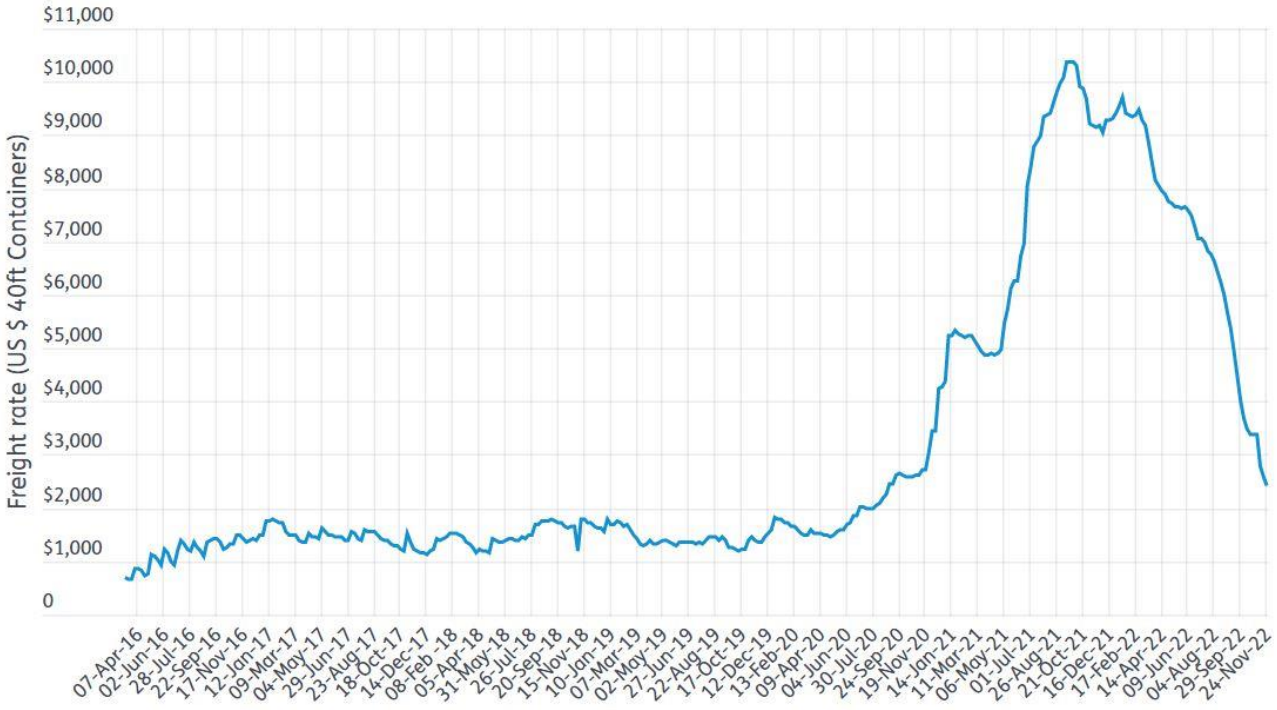


**Figure 1:** Drewry World Container Index (WCI) – April 2016 to December 2022
*Source*: Drewry

*2.4. Short-term impacts on container shipping: dynamics in the vessel orderbook*

Judging from their shipbuilding program, it would appear that the general positive perspective on 2021 and 2022 was a vision shared by container carriers. Compared to just 40 ships ordered in the period January to September 2020 (Chambers, 2021a), as of September 2022, the containership orderbook was approaching 900 vessels, representing 72.5 million dwt or a slot capacity of 7 million TEU (Maritime Executive, 2022). In early 2023, the orderbook for new containerships, most of which planned for delivery between late 2023 and 2027, stood at more than 900 vessels, or more than a quarter of the existing fully-cellular vessel carrying capacity of about 26 million TEU (Drewry and Alphaliner). The orderbook of MSC, the world's largest container shipping line, amounted to more than 1.8 million TEU. This represented a remarkable level of *gross capital formation*, and a *leading indicator*, from an industry which is supposed to be rather good at adjusting its supply to demand[2]. In parallel to this trend, container manufacturers in China were struggling to cope with

[1] See Cariou & Guillotreau (2021) for a detailed game-theoretic analysis of capacity management strategies amongst the members of consortia and global shipping alliances (GSAs) which, to a large extent, are exempted from antitrust regulation (Tang & Sun, 2018).
[2] For research on the formation of carrier expectations and the way carriers adjust their supply of tonnage, see Fusillo and Haralambides (2020).

a very high demand for container manufacturing, due to a notable worldwide shortage in the period mid-2020 to early 2022 which was driving up freight rates and the cost of transport (Youd, 2021).

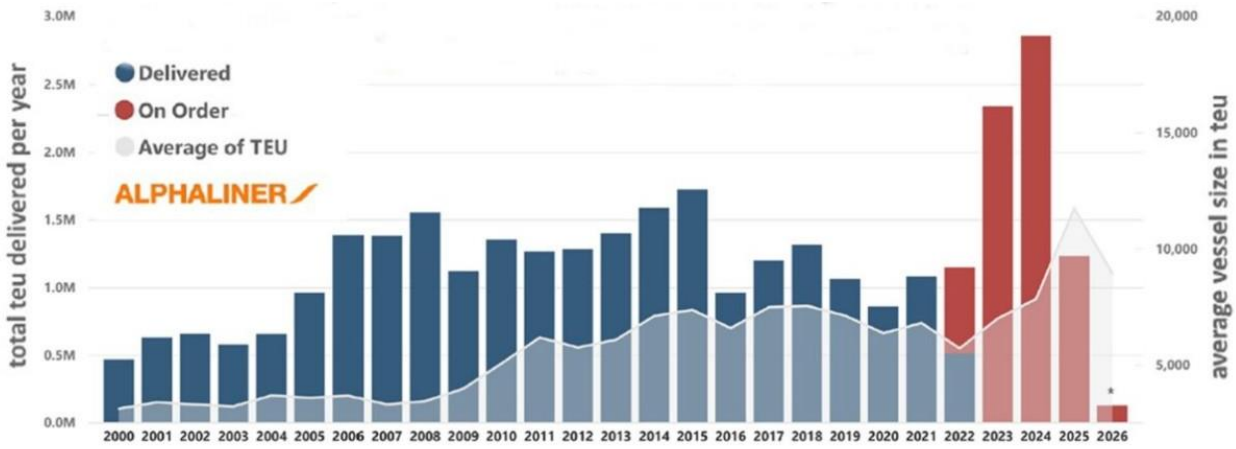


**Figure 2:** Actual and projected containership deliveries from 2000 to 2026
*Source*: Alphaliner

*2.5. Short-term impacts on container shipping: reassessing integration strategies*

Horizontal concentration, as well as *vertical integration* along the supply chain, have been remarkable in liner shipping[3]. In 1998, five alliances and three large independent shipping companies (MSC, CMA-CGM and Evergreen) co-existed. Ten years later, in 2008, the EU repealed Regulation 4056/1986, i.e., the regulation exempting liner conferences from the provisions of competition law, effectively affording them antitrust immunity. As a direct result of this and amidst the negative impacts of the 2009 financial crisis, MSC and CMA-CGM ceased to remain independent, forming a new alliance in 2009. A few years later, in 2015, Maersk and Evergreen joined their respective alliances (2M and Ocean Alliance). In this way, the process of horizontal integration through alliances evolved to a situation whereby the top 10 shipping companies, grouped in 3 alliances, controlled 91.5% of the global container fleet capacity in early 2021. This is a stark contrast to 2009, when the top 10 shipping companies controlled only 70.8% of the total fleet capacity (based on Alphaliner data). Interestingly, at the time of writing, there are no large independent carriers. However, at the same time, Maersk Line and MSC surprised the market, announcing the impending dissolution of their partnership by 2025, and their wish to 'go it alone'. For many (Ju et al, 2023), this move was not totally unexpected. The two companies decided to invest their fathomless profits of the COVID-19 years in what they were best at: door-to-door supply chain integration for Maersk; competitive 'port-to-port *shipping*' for MSC. The two strategies are not compatible, as they lead to two different cost structures: substantial investments in a global network of sales effort around the world, for Maersk, targeting the individual shipper, and ocean transport cost competitiveness for MSC, renowned over the years for its acquisition of new and secondhand tonnage at competitive prices.[4]

The regulatory environment of container shipping might deserve a couple more lines at this juncture. Although regulatory bodies, like the FMC in the U.S., under pressure from shippers, have started to look at

[3] Vertical integration, also known as logistics integration, aims at service differentiation through door-to-door transport and control of the supply chain. For a full coverage of the issue, interested readers can consult Haralambides (2019) and Paridaens and Notteboom (2022).
[4] For an investigation into the forces shaping the evolution of global shipping alliances, see Ju et al (2023).

the causes of liner shipping profitability in the midst of a pandemic, nothing of substance emerged from these inquiries other than a need for closer vigilance. In his 2022 State of the Union address, U.S. President Joe Biden referred to shipping lines as anti-competitive. Still, this political rhetoric was not followed by the Federal Maritime Commission (FMC). The FMC's fact-finding investigation into the effects of COVID-19 on the ocean shipping supply chain (formally known as Fact Finding 29), released in May 2022, found that the high freight rates were not caused by a lack of competition, but were due to a combination of unusually strong demand from U.S. consumers, COVID-19, and congestion in the supply chain (see also above).

There may be some good reasons for the leniency of the regulators, in that shippers' criticisms of global shipping alliances (GSA) have failed to recognize a crucial point which had 'protected' the proliferation of liner shipping *conferences* in the western world for more than 100 years: Unfettered competition in *declining cost industries* (or industries of 'increasing returns to scale') pushes prices down to marginal costs – which are always below average costs – and competition under such circumstances will then become destructive. This is the main motivation behind the (conditional) exemption of GSAs from antitrust laws, and it is exactly the same reasoning that has allowed the continued operation of price-fixing liner conferences in countries where they can still operate legitimately (mainly in Asia). The only difference between the two systems, alliances and conferences, is that the former primarily seek to achieve profitability through cost control, while the latter do so through price-fixing. Finally, although blank sailings have helped carriers sustain rates, these are not without costs, given that laid-up ships (or their beneficial owners) still have to pay the bank, or the K/G investors who have to absorb the losses.

## 3. THE CONFOUNDING EFFECTS OF ENVIRONMENTAL REGULATION

The increasing influence of the environmental agenda on maritime business has already been alluded to above. During the first few weeks of 2020, when COVID-19 had not yet been recognized as the problem it was to become, the focus of interest in the shipping industry was on the potential effect of the IMO 2020 global sulfur cap regulation, particularly with respect to its impact on the operational costs of ships and, thus, on the competitiveness of the shipping industry (Zis and Cullinane, 2020). Considerable uncertainty existed then, and persists still, as to the efficacy of scrubbers (Endres et al., 2018; Comer et al., 2020; Winnes et al., 2020) and the availability of *very low sulfur fuel oil* (VLSFO), the price of which reached a record level of USD 598/MT in January 2020, as market players stockpiled compliant fuel in anticipation of availability issues and even higher prices. In actuality, VLSFO prices slumped throughout 2020 (partially as the result of previous stockpiling) and only began to recover to their previous levels by mid-June 2021. Since then, however, prices have risen to a new high of 1018 USD/MT on June 8, 2022, and have since been in decline to reach about 680 USD/MT by late January 2023 (Ship & Bunker, 2023).

In terms of reducing $CO_2$ and other greenhouse gas (GHG) emissions from shipping, the IMO has been fiercely criticized for a lack of vision and expedient progress (Shi, 2016), particularly in relation to the adoption of market-based measures (Psaraftis et al., 2021). This has prompted the European Commission, within the context of its *Green Deal* strategy, to include shipping in the European Union's Emissions Trading system (EU ETS), irrespective of any future progress made by the IMO. This decision has caused considerable unrest in shipping industry circles, particularly amongst shipowners, and is perceived as a regional measure that undermines the merits of a multilateral approach to regulation, as advanced by the IMO (on the significance of information spillovers between EU carbon emissions trading prices and shipping, see Meng et al., 2023).

With respect to the IMO's *short-term measures* for the abatement of $CO_2$ emissions, at the meeting of its Marine Environment Protection Committee in June 2021 (MEPC 76), the IMO adopted amendments to its MARPOL Annex VI regulations, introducing two new instruments which came into force in January 2023: the Energy Efficiency Design Index for existing ships (EEXI) and the Carbon Intensity Indicator (CII). The latter

effectively measures the energy efficiency of ships in relation to the transport work they undertake in moving freight and/or passengers, and this is then used to operationalize the EEXI, which is a technical instrument, directly comparable to the widely understood workings of the EEDI, but which is more generally applicable to existing ships, rather than just new ones. In the short-term, it now seems that speed reductions might be the only feasible route to compliance with the new measures. Still, these new instruments have not evolved without considerable discussion and controversy, mostly raised by countries exporting perishable or time-sensitive products. The logic of their argument is that longer transit times (due to slow-steaming) would impact negatively on the value of their exports (e.g., fruit or dairy products), and that the deterioration in product quality might in turn lead to modal shifts favouring air transport. However, given the very high speeds of the benchmark year 2008 (24 knots), the speed reductions necessary to achieve the goals of all the short-term measures would be minimal and, as such, unlikely to lead to either product deterioration or modal shifts (Zis & Psaraftis, 2021).

One of the consequences of the coming into force in January 2023 of the new IMO regulations, aiming to reduce maritime carbon emissions and the environmental impact of shipping, is that many container shipping lines have opted for super slow steaming. While this prolongs the transit time on shipping routes, super slow steaming helps to meet carbon emissions targets as well as absorb some of the emerging vessel overcapacity on some of the main trade routes. Furthermore, since the second half of 2022, there is a noticeable increase in vessel orders involving methanol-powered large containerships (placed by Maersk, COSCO and CMA CGM or associated vessel charterers), while also ammonia and some other low carbon fuels are being considered as ship fuels of the future.

## 4. THE SHORT-TERM IMPACT ON PORTS

The combined effects of the COVID-19 pandemic and the concomitant adoption of more stringent environmental regulations saw an immediate, negative, response from the shipping industry. As a consequence, many major ports with a strong gateway function saw their container throughput plunge in H1 2020. Sea-Intelligence (2020) reported that, for some ports, *blank sailings* implied reductions of anything from 20%, up to even 50%: fewer containership calls in the second quarter of 2020 were mainly visible in the main trade routes, e.g., Far East-Europe. Container volumes were also affected, although large differences could be observed among the larger container ports, as illustrated by their year-on-year change in the first half of 2020 (based on TEU): minus 6.8% for Shanghai; -1.1% in Singapore; -17.1% in LA; -6.9% in Long Beach; -7% in Rotterdam; -9.1% in Valencia; -20.5% for Barcelona; and -29% for Le Havre[5]. Only four major ports saw their volumes increase: Gioia Tauro (+52,5%), Tanger Med (+22%), Port Said- SCCT (+23,5%) and Antwerp (+0,4%)[6]. However, the spectacular revival of demand in H2 2020 translated immediately to increased demand for port services, with many ports reporting record throughput volumes in September, October and November 2020. To a certain extent, the rise in demand related to large-scale restocking, taking place first in North America in Q3 2020, and later in Europe in Q4 2020. As an example of this, the port of Los Angeles registered a historic surge in throughput of nearly 50% in H2 2020, and in the week before Christmas the port handled 94% more traffic than in the same week the year before (Port of Los Angeles, 2021); this was followed by another record period in Q1 2021, where throughput was 122% higher than the previous year (Watkins, 2021).

Port and transport networks were caught unprepared for such a fast transition in demand and, as a result, supply chains suffered from shortages in equipment (chassis), truck drivers and dock labour; the latter due to quarantines and constraints on personal mobility due to COVID-19. Congestion and long turnaround times was the result, with the build-up continuing into 2021. Although, at the time of writing, the situation had

[5] Information obtained from the respective port authority websites.

[6] *Source*: Based on data collected by the Port Authority of Valencia.

improved to some extent, as of February 1st 2021 there were a record 40 containerships in anchorage in the San Pedro Bay area awaiting for a berth at the container terminals of Los Angeles and Long Beach (Miller, 2021). Congestion at these two Californian ports had been so severe that, in order to avoid becoming embroiled in it, ships were known to offload, *impromptu*, containers at Oakland, 600 kilometres to the north (Chambers, 2021b). However, as ships are stowed with a certain ship-rotation in mind, such decisions are a stowage planner's worst nightmare, and they tend to worsen the problem rather than solving it (Chou & Fang, 2021). The supply chain crisis made major retailers revise import cargo routings through U.S. ports, as exemplified by Walmart and Nike (see for a full analysis Cariou and Notteboom, 2022).

An important parameter that can partly explain the 'pressure' on the overall system (and the pursuant hike in container freight rates) has been the severe shortage of containers referred to above. Many circumstances can help explain this. First, the decline in international trade took place only in H1 2020, with a precipitous fall of 12% in April-May. This, however, was reversed equally impressively in H2 2020. The system was unable to adjust quickly to the new level of demand, with containers being left – not to say abandoned – in the 'wrong' places, many of them having been used in H1 2020 to carry medical equipment to Africa and Latin America. In parallel with this, given the very high demand for containers in Asia, and the price Asian shippers would pay for them, carriers were returning empties as soon as possible, without offering western exporters the capacity they required (Yang et al., 2021).

An additional pressure on ports has been the increase in average *call sizes*, the intention of which was to partially compensate for blank sailings and lower frequencies. The COVID-19 pandemic brought record call sizes in major ports around the world. For example, Port of Los Angeles broke the all-time record in June 2020 when 34,263 TEU were handled during a single call. The *diseconomies of scale* in container ports that arise from the use of bigger ships (or bigger call sizes) has been widely recognized; for example, see Martin et al. (2015), Haralambides (2017), Haralambides (2019) and Ge et al. (2021). At the risk of over-simplifying, one could say that *the time to handle a container arriving on a large ship is on average longer than that of handling the same container arriving on a smaller ship*. Even in the case of the largest ships, adding extra ship-to-shore cranes beyond, say, five to six, makes little sense both technically and economically. Moreover, in today's container shipping context, and given contemporary containership designs, handling efficiency at berth has less to do with the number of cranes working the ship, and more to do with the availability of cranes that are able to reach row 24 and beyond[7]. Finally, competition with neighbouring ports and the requirements associated with *green port* status further exacerbate a terminal manager's call size headaches. Pressing things to address, jointly most of the time, include (among many others): the minimization of gate congestion; the minimization of dwell times (possibly together with the creation of dry-ports in the hinterland and the modernization of customs services); the minimization of rehandles and container movement equipment, aiming at the same time at the minimization of atmospheric emissions; the synchronization of appointment systems with port equipment availability; the allocation of berths such that equipment movements and emissions are minimized and; incentivizing 'dual-transaction' truck movements inside the terminal (Li et al, 2022).

## 5. LONGER-TERM CONSIDERATIONS FOR THE PORT INDUSTRY

### 5.1 Commercial and geopolitical context

The commercial and geopolitical landscape in which ports operate is changing by leaps and bounds: the seaport of today is increasingly becoming a logistics and industrial node, in the centre of complex, intertwining global supply chains. As such, a functional and spatial clustering of activities takes place in the

[7] For a technical analysis of optimal containership design, see Priftis et al. (2018).

wider domain of a seaport, all aiming, directly or indirectly, at seamless and sustainable transformation and information processes within these global supply chains (Notteboom, 2016).

Although some ports might benefit from shelter policies, designed by regional or national government agencies, seaports generally operate in an efficiency-oriented, competitive and highly dynamic market environment. Neoclassical thinking, founded on the premise that individual welfare is maximized through free markets and trade, dominated much of international economics and trade theory in the post World War II era. Such thinking is increasingly questioned today, and clashes in economic thinking (and economic systems) are surfacing, as exemplified by the tensions between China's 'state capitalism' and the free markets of western economies. Economic shocks, such as the financial-economic crisis of 2008-2009, and the COVID-19 pandemic, combined with rising international trade disputes (e.g., China-US trade relations), and tensions in existing trading blocs (e.g., Brexit in Europe), all add to the observed volatility in international trade and cargo volumes in ports. Despite China's efforts to champion the creation of a *new* global economic order, based on interconnectedness and mutual trust and understanding (Cullinane et al., 2018; Costa *et al.,* 2020; Haralambides and Merk, 2020), the western world came out of the 2008-2009 economic meltdown more wary of the alleged benefits of consumerism, free trade, free movement of persons, and globalization. Since the financial-economic crisis of 2008-2009, the notion of *peak globalization* is gaining ground, as the costs and benefits of globalization begin to diverge according to country, and the international political consensus on the universal economic benefits of globalization is somewhat breaking down (Nussbaum, 2010). Furthermore, the COVID-19 related global supply chain crisis of 2020-2022 and the geopolitical crisis initiated by the war in Ukraine have contributed to political actions and corporate strategies to reduce risks and dependence on certain nations, while embracing notions such as 'trading with friends' and 'friendshoring' (Javorcik et al., 2022).

The impact of such perceptions on international trade have been only too obvious: the GDP Multiplier, a metric often used to link a country's income to its containerized imports, almost halved from 2.2 in the early 2000s to 1.3 today.[8] Often, the theoretical grounds to tendencies such as the above have manifested themselves as introversion, nationalism and populism, at times questioning the ability of western democracies to solve the *new* societal problems just by simple recourse to the well-acclaimed 'rule of law'.

Corporate strategies in shipping and global logistics are also exerting their influence on the port industry. Examples of such developments include consolidation and concentration in container shipping, as well as in terminals and logistics companies, vertical integration along the supply chain and an increasing role of global shipping alliances (horizontal integration; see Figure 3).

[8] Calculations based on figures by IMF and Boston Consulting Group.

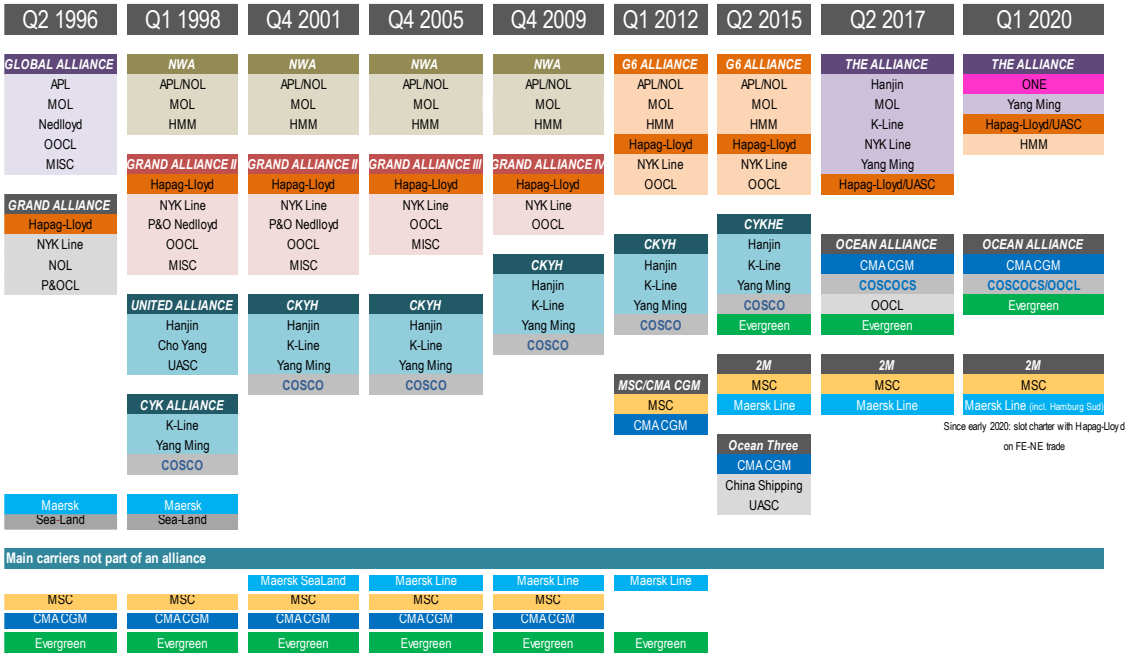


**Figure 3**: The evolution of global alliances in container shipping aimed at joint vessel capacity management
*Source:* adapted from Notteboom et al. (2017)

In other words, to improve their operating margins and offer a better service to their customers, market players in shipping, ports and logistics simultaneously pursue two complementary strategies: cost control through horizontal integration (e.g., shipping alliances, see Figure 3) and service differentiation through vertical integration along the supply chain (Notteboom and Winkelmans, 2001a; Haralambides, 2019; Paridaens and Notteboom, 2022). Ports increasingly compete not as individual entities that handle ships, but as crucial nodes, linking competing global supply chains. The port and route selection criteria of shippers and carriers are thus based on the entire network in which the port is just one node.

The increasing importance of integrating ports and terminals in value-driven supply chains has shifted focus to the importance of horizontal and vertical integration and collaboration among relevant actors, particularly with respect to digital transformation and value capture along the chain. Changes in supply chains are forcing ports and terminals to seek effective integration in such chains when delivering value to shippers and third-party logistics service providers (Robinson, 2002; Mangan et al., 2008). Song and Panayides (2008) provided a conceptual contribution to the measurement and quantification of such integration efforts whose success, however, has also been questioned by Magnan and van der Horst (2020), in the case of certain major European ports.

Thus, modern seaports have evolved from pure cargohandling centres to pivotal entities in a comprehensive and complex mesh of intertwining global supply chains. The competitive battle of ports to accommodate global supply chains – and position themselves within them – has led to functional changes in seaports, as well as in the other nodes of the worldwide transport and logistics network. Nodes increasingly seek co-operation and coordination, for example, by bundling their transport flows to/from the hinterland,[9] or by using available space efficiently, exploiting the complementarity between the supply of possible locations in seaport areas and in dry ports or logistics platforms in the hinterland. Competition between logistics nodes is thus supplemented by functional co-operation between these nodes. An excellent example of nodal 'co-opetition' is the one between the Suez and Panama canals. Years back, the two canal administrations signed an MoU for the exchange of information on best practices. Today, with the clear shift of Asian cargo flows from the US West Coast to Gulf and East Coast ports, the two canals are in direct competition for the *affluent*

[9] e.g., the role of the inland port of Duisburg as a bundling hub connected to Belgian, Dutch and German Gateway ports.

East Coast consumer markets. Based on the type of vertical control of the development process in port-hinterland relations, Wilmsmeier et al. (2011) distinguishes between inside-out development, whereby inland terminals seek greater integration with their seaports (often driven by public sector intervention), and outside-in development whereby inland terminals are used by seaport actors to expand their hinterland. While Witte et al. (2019) rightly observe that most initiatives have followed an outside-in approach, the growing emancipation of inland ports has led to a rise in inside-out developments.

It is not just hard economic factors, however, that guide port development and operations. The growing role of environmental and social considerations also shape the behaviour and strategies of port stakeholders, with a greater role assigned to the setting and achievement of sustainability goals and to rolling out initiatives in the field of Corporate Social Responsibility (CSR), stakeholder relations management, and Green Supply Chain Management. Companies implement such initiatives due to motivational drivers, such as sales to customers and corporate reputation, regulatory pressures, and the growing awareness of individual citizens and stakeholders.

### 5.2 Potential implications for port governance

Port management and the governance of ports are continuously challenged to adapt to a changing port ecosystem. Not surprisingly, a vast amount of literature has focused on port governance reform, port devolution (but also, recently, re-centralization of decision-making powers), port management efficiency, and the effectiveness of port operations.

Both in academic and business circles, various typologies of port governance models have been analysed and adopted. The World Bank's *Port Reform Toolkit* presents an early and commonly used typology, distinguishing between four port administration models, i.e., the private service port, the landlord port, the tool port and the service port.

The landlord model is the most common model of port administration, found in more than 80% of ports around the world. The term 'landlord' derives from the simple fact that the PA, among its many other responsibilities, is the 'curator' and the 'authorized manager' of port land and adjacent aquatic surfaces, to be rented out (leased) for *economic* profit to the private sector. Often, revenues from this activity amount to 50% of total port revenue. As a 'landlord', the PA must optimize the use of its domain[10] by: (1) earmarking port areas for specific uses; (2) awarding concessions and authorizations to a carefully selected 'mix' of companies and; (3) adopting an appropriate pricing system.

Advances in academic research and business practices have revealed the limitations of the port management governance models. Brooks (2004) claims that it is difficult to use the framework of the Port Reform Toolkit or other (such as Baird, 2000) to understand the management of port activities. Furthermore, empirical studies have clearly (and correctly) demonstrated that, notwithstanding the long and interesting academic discourses, in practice there is no such thing as "adoption of a specific governance model". Rather, *port management* is subject to a series of smaller or bigger variations over time. A large body of port economics literature has analysed how the governance model of individual- or groups of (national) ports can dramatically change as a result of far-reaching port reform and devolution programs (see the rich body of case studies in the edited volumes of Cullinane and Brooks, 2006; Brooks et al., 2017, as well as the literature review on *port governance studies* in Pallis et al., 2011 and Zhang et al., 2018), or stakeholder interests (and related lobbying).

The role of the public sector in ports has attracted particular attention. In many parts of the world, a wide range of privatisation, corporatisation and commercialisation schemes (Haralambides, 2017; Notteboom and Winkelmans, 2001b) have resulted in the arrival of global terminal operating and logistics groups, large

[10] Defined here as the total area (land and aquatic) under the statutory responsibility of the port authority.

investment groups and equity fund managers. In a number of cases, this infusion of (private) money has led to greater competition, higher productivity and eventually lower costs which, often, are passed on to importers and exporters, wherever adequate intra- and inter-port competition among stevedores and terminal operators has also been ensured.

In this new environment, the public sector has been forced to reassess its role in the port industry, in some instances generating a discussion on whether public sector port authorities are indeed needed; a discussion often starting from the full privatization examples of the UK, Australia and New Zealand. To our view, this discussion is pointless and dangerously misleading. Irrespective of how infrastructure is financed, developed and managed, the *statutory owner* of port infrastructure, both land and aquatic, is the State. In most cases, the State entrusts (i.e., through port devolution) operational 'ownership' and exploitation rights to a port authority, which can be public or indeed private. Moreover, transferring the regulatory responsibilities of the PA, such as those pertaining to *public service obligations*, or the monitoring and control of nautical-technical services, could never be accepted in many developed and developing countries alike. Thus, despite the greater private sector involvement in the port industry, many port assets or services are not transferred from the public to private sector. Instead, most countries have relied on some form of commercialisation or corporatisation of public port authorities, in order to deflect demands for much greater private sector involvement, and thus safeguard the prerogatives and collective interests of the public.

The privatisation of UK ports in the 1980s is a textbook example of a shockwave port devolution. In many cases, however, the evolutionary trajectory of port governance occurred in different and distinct phases straddling several decades. For example, the decentralisation of port management in China, from the central to the local level, unfolded gradually in three phases between 1979 and 2004, each supported by new regulatory frameworks (Cullinane and Wang, 2006). In recent years, the Chinese port system is undergoing a certain degree of recentralisation, supported by large-scale port co-ordination and integration schemes at provincial level (Notteboom and Yang, 2017; Huo et al., 2018; Ma et al., 2021; Li et al., 2022). The new Chinese orientation on port governance is two-pronged: on the one hand, no efforts are spared in creating national champions (e.g., Shanghai or Shenzhen), able to compete at regional and global level, while on the other hand, greater intra-provincial cooperation and coordination among ports is pursued, to ensure that duplication and resource-wasteful competition are avoided (Wan et al., 2020). Those were also the objectives of the 2016 Italian port reform (Prete and Tei, 2020; Parola et al, 2017), but similar objectives could be found today in most countries including the United States and Japan where, in the case of the latter, port development is centrally included in national development plans. Interestingly, *port devolution* seems to be reversing, with decision-making powers returning to the 'centre'; a trend apparent not solely in ports. It seems to many that concentration and recentralization of all sorts of economic activity might be the answer to the failures of globalization.

Every port is confronted with specific challenges and opportunities in terms of economic and social development priorities, port-city relations, spatial dynamics, environmental pressures, and more. This regional embeddedness implies that ports may go different ways in terms of the tasks, roles and activities they develop and, sometimes, this may require a different management approach. Classifying port management models in neatly labelled packages – assuming one might still have an interest in doing so- is becoming increasingly pointless. Quite a few countries or regions with a strongly centralized port management system have realized that a 'one size fits all' approach to port governance is impracticable as it poses great restrictions in effectively dealing with the regionalism in a seaport system. Ultimately, such rigidity can undermine the necessary dynamism at the local port level.

In actual fact, a large diversity exists even within the same port management governance model. For example, neighbouring ports of a similar scale, applying the same landlord governance model (such as Rotterdam and Antwerp), might in practice show a lot of differences in port management. Such diversity in scale, tasks, organisation and skills can render a port much more attractive to customers vis à vis its competitors. Processes of layering at the regional and local level allow actors to add some regional touches

to port governance practices, without necessarily disconnecting from the national policy, nor breaking out of the existing path. In other words, regional assignment of roles may lead to different management orientations, not necessarily different models.

Ports can learn from specific best practices of other ports, things like formalizing city-port relationships, master-planning, concession agreements or marketing approaches to clients. But the management philosophy of the port, one presumably based on performance and results, should not be much different from that of any other economic activity when it comes to such things as human resources management, informatics, accounting, finance, concession contracts, authorizations, etc. This means that port policy is getting (or should get) more orientated towards the formulation and enforcement of general rules of the (competitive) game, e.g., pricing for cost recovery or harmonization of port statistics, instead of trying to force individual ports into standardized governance models and solutions.

**5.3 A stronger area-specific approach to port governance challenges**

Typologies of port management governance models typically do not go into the specific roles and regulatory and operational functions the port authority adopts, either voluntarily or being obliged to pursue by law. Still, the port economics literature presents us with possible discrete levels of engagement of a port authority (see e.g., the 'passive', 'facilitator' or 'entrepreneur' categorisation in Verhoeven, 2010) and a port's specific roles (e.g., landlord, regulator and operator, see Baird, 1995; Baltazar and Brooks, 2001). As we already hinted above, however, and apart from the very few instances where such categorizations have been used as a roadmap to rationalize financial resources of donor agencies, to be spent among competing ports in the developing world (see for instance World Bank,[11] 2019), hierarchies and typologies such as these today attract rather limited interest, mostly among academics.

In the 2000s, port economists started to argue that the port authority should play a more proactive role in facilitating and coordinating stakeholders in logistics networks, and in developing the necessary competencies to succeed in a highly competitive market (see Notteboom and Winkelmans, 2001a; Comtois and Slack, 2003; Van Der Lugt and De Langen, 2007), perhaps even by adopting a more entrepreneurial role (Verhoeven, 2010). Port authorities have also been encouraged to add a functional role as cluster managers (De Langen, 2004) and community managers (Chlomoudis et al., 2003), to solve collective choice problems in and around the port domain.

In the past two decades, several scholars have offered more insights to the call for a more active facilitator, or even entrepreneurial, role of port authorities. Studies have been carried out to examine the role of port authorities in specific activity areas such as intermodal transport and hinterland development (Notteboom and Winkelmans, 2001a; De Langen and Chouly 2004; Notteboom and Rodrigue, 2005; Van Der Horst and De Langen, 2008; Van den Berg and De Langen, 2011; Magnan and Van Der Horst, 2020; Wan et al., 2020); land management including terminal concessions/leases (Notteboom, 2006; Notteboom et al., 2012; Ferrari et al., 2015); digital transformation as a key enabler of cargo flow facilitation and supply chain coordination; sustainability (Lam and Notteboom, 2014; Acciaro et al., 2014; Ashrafi et al., 2020), green supply chain management in ports (Notteboom et al., 2020); the green port concept (Pavlic et al., 2014); energy efficiency (Iris and Lam, 2019); energy transition (Hentschel et al., 2018; Wang and Notteboom, 2015); the circular economy (De Langen and Sornn-Friese, 2019; Mańkowska, et al., 2020); and port marketing (Parola et al., 2018). In many cases, it is clear that port authorities have moved beyond a purely facilitating role, entering into key investments. This is particularly noticeable in cases where private investors show reluctance to do so, or when there are possibilities to partner with private or public entities. But this has not been always so.

[11] The publication was prepared by Martin Humphreys, Aiga Stokenberga, Matias Herrera Dappe, Atsushi Iimi, and Olivier Hartmann of the World Bank, based on a 2018 World Bank project entitled "Ports Assessment Eastern and Southern Africa", carried out by MTBS (Maritime Transport Business Solutions) under the academic supervision and consistency control of Hercules Haralambides.

Until recently, at least among the ports of the European Union, the development of port infrastructure was not always demand-driven but rather an 'entitlement' of the port, particularly if the port's 'neighbours' were lucky recipients of public funding themselves. Such 'understandings' had created considerable excess capacity which went hand-in-glove with high levels of management inefficiency (Haralambides, 2017).

The empirical findings presented so far suggest that port authorities can follow very different paths in dealing with current issues in various areas of port activity. It has also become evident that tangible achievements and progress made by port authorities in a number of these areas, or action fields, remain somewhat underwhelming. For example, many port authorities are struggling to define their role (or to create one for themselves), to enhance collective actions, and to achieve visible positive results in the field of, say, intermodal hinterland transport (Van Der Horst and De Langen, 2008), including connectivity and the port's relations to inland ports (Magnan and Van der Horst, 2020). Other current challenges include the role of port authorities in the large-scale implementation of cold ironing solutions for deep sea vessels (Arduino et al., 2011; Tseng and Pilcher, 2015; Innes and Monios, 2018; Lorange, 2020) or the largely untapped possibilities for the greening of terminal concession procedures and agreements (Notteboom and Lam, 2018).

As such, a PA-centric approach, advocating an ever-stronger role for port authorities, might not be the right approach. In each 'area of port activity' and for every single initiative ports might be willing to undertake, port authorities and their stakeholders should evaluate whether a) the port authority may have a statutory role to play and b) if so, whether such involvement is likely to lead to a superior outcome, compared to no involvement. In the context of such considerations, the PA needs also to decide whether its involvement should be restricted to its statutory domain, or extend beyond the confines of its legal responsibility; what tools or instruments to use (e.g., regulation, penalty or incentive pricing, knowledge development, data sharing, investments, etc.); whether or how to co-ordinate or form partnerships with other actors; and, finally, whether the PA should act as facilitator or entrepreneur. Thus, the role and function of a port authority needs to be contextual: the PA can be an investor/entrepreneur in one area of activity but remain the usual 'onlooker' in another.

An area-specific approach to port authorities' roles and functions provides a lot of room for further analysis of the strengths and limitations of specific port governance arrangements. The PA's capabilities and regulatory room to manoeuvre and act in one area of activity might be limited. A good example is a PA's inability to make changes to an approved masterplan; changes aiming to adjust the plan to evolving demand scenarios. In other *areas of activity*, e.g., investments in enhancing port security, or in the maintenance of infrastructure with the latest generation of ships in mind, the role and capabilities of the PA might be much more substantial and decisive. In other words, port governance should be tailored as much as possible to the specific needs and ambitions in each activity area. This would naturally render a generalised and static/rigid approach to port governance less relevant. More research is needed to analyse the effectiveness and efficiency of specific port governance arrangements and routines in each activity area.

Finally, a successful port authority – through the lens of efficiency criteria – must adopt a market-oriented management style, based on clear goals, managerial skills and accountability. However, this does not imply that every decision concerning the involvement and actions of the PA in a specific activity area is always taken in the context of a well-prepared long-term strategy or strategic plan. Some actions and initiatives might be the result of *ad hoc* decisions and investments, fuelled by windows of opportunity that arise suddenly at a specific point in time (Jacobs and Notteboom, 2011). An increasingly volatile market environment might imply that the governance structure of PAs will have to be tailored towards more flexible *ad hoc* type of decisions, at least in those business activities that do not entail major regional or national interests. Such an approach has the potential to increase port resilience by continuously adapting the port to opportunities arising from a changing economic geography, economic shocks, sustainability needs or major shifts in the corporate world.

**5.4 From spatial separation in port governance solutions to regional and global entanglement**

Port management models did not 'confront' each other so much in the past, as neighbouring/competing ports typically followed similar port management models and their decisions were fairly, game-theoretically-interdependent. Demand for port services (among competing ports), as an example, has been known to be *kinked* (Haralambides, 2002), i.e., tariffs respond to those of the competitor in two distinct ways: a) they remain unchanged on the way up, but they follow suit on the way down (Figure 4).

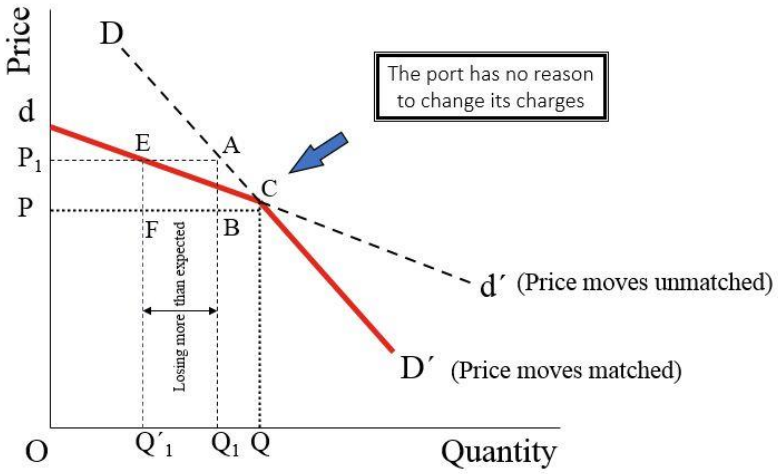


**Figure 4:** The kinked demand for port services
*Source*: Haralambides (2019)

However, this picture is changing. Despite the many calls and efforts for more intra-regional cooperation and coordination among neighbouring ports, especially in areas of activity where public resources might be thoughtlessly and wastefully expended, in other, more business-like areas of activity, such as marketing or pricing, intra-regional competition is intensifying. This brings ports or port groups with different port governance philosophies into head-on competition (e.g., competition between northern and southern European ports).

Moreover, some (mostly public) port groups, in order to anchor firmly their competitive position, are also walking down the path of *internationalisation*. Usually, such policies take the 'innocent' form of an MoU, on things like exchange of best practices or training. Behind them, however, may be hidden more 'sinister' objectives such as tacit collusion, aiming to make the two-port-link the carriers' preferred choice vis à vis competitor ports.[12] This said, PA internationalisation can also be rather modest, combining small, targeted, investments with port management support and advice (see e.g., Dooms et al., 2013 on the internationalisation strategy of the port of Rotterdam). In other cases, PA internationalisation could go hand in hand with a large-scale mobilisation of resources and funds, exemplified by the Chinese port investment spree which in some cases has led to the adoption of new or adapted governance models at the local level.[13]

[12] We are aware of the allegation and of the anecdotal statement. But we are equally aware of the possible legal consequences, were one to be more 'specific' on the objectives of cooperation. The point that is made here however is that regulatory authorities around the world should pay more attention to such 'MoUs', also in their investigations of mergers and acquisitions in shipping.

[13] Compared to other global terminal operators, the international expansion strategy of Chinese public port groups such as Cosco Shipping Ports or the Qingdao Port Group, seems to be strongly embedded in the geoeconomic and geopolitical policies of the Chinese government. As we have said above, the Chinese government is actively supporting the creation of champions able to play a role on the international scene. The role of companies in the Belt and Road Initiative has been made very explicit in the 13th Five-Year Plan: The ambition is to enhance co-operation between China and Belt

The resulting mix of local and imported port governance approaches might lead to clashes in port management styles[14], but it also has the potential to produce efficient, new hybrid or mixed forms of port governance. The above developments give an impetus to the *level playing field* discussion and they could well water down (national) attempts towards the standardisation of port management approaches (see above).

At the same time, many countries around the world are confronted with a shift from the management of individual ports to the management of multi-port regions. Port authorities are thus regionally integrated or even merged. This includes 'bottom-up' integrations such as the cross-border merger of Copenhagen and Malmö ports (De Langen and Nijdam, 2009), the founding of the new *North Sea Port* (Belgium/the Netherlands, Notteboom et al., 2018), or the corridor-based gradual integration process of the ports of Le Havre, Rouen and Paris into Haropa (Deiss, 2012); a development which resulted in the formal merger between the port authorities in June 2021 (Maritime Gateway, 2021). Other port authority integration processes have been more top down, like in the case of the creation of the Italian *port system authorities* (Ferretti et al., 2018) and the integration of Chinese port groups at provincial level (Notteboom and Yang, 2017; Huo et al., 2018).

Irrespective of the drivers behind such integrations, the observed port integration processes in China are resulting in a wider spatial reach of corporatized and commercially driven provincial port groups. As a result, Cosco Shipping Ports, along with the integrated provincial port groups, are investing in foreign ports. In addition to full port authority integration schemes, a range of port alliances and co-ordination initiatives are in evidence too. An example is the *Northwest Seaport Alliance* between Seattle and Tacoma in the US (Knatz, 2017). Less far-reaching and targeted co-operation schemes are widespread and typically involve the creation of *ad hoc* bodies in charge of specific and limited functions, or project-based co-operation initiatives involving a few ports.

### 5.5 Performance measurement and port governance

The performance of ports and port authorities has grown into an important theme in the literature of *maritime economics* (see the content analysis in Pallis et al., 2011 and Woo et al., 2012). Port performance is often approached from a port competitiveness and competition angle, as ports want to position themselves as competitive nodes, with the ability to adapt effectively to intensified port competition around them. Cargo throughput and vessel traffic (i.e., absolute figures, growth, market share) remain important output measures for port competitiveness and, indirectly, so do the effectiveness of existing port governance structures and port reform programs. Despite some concerns on the appropriateness of comparisons across ports, port throughput figures remain a commonly used and simple basis for market share analysis and port rankings. These indicators are increasingly complemented with KPIs in the area of supply chain performance, maritime and inland connectivity, financial performance, customer satisfaction, sustainability, socio-economic significance, port governance, port resilience, etc. (for example, in a European context, cf. the results of the EC FP7 project PORTOPIA). Many of the newer KPIs, however, are still rather experimental, with concerns expressed about their appropriateness, acceptability, and relevance, particularly when one wants to engage in port comparisons . An example of this is the modal split of a port. In most cases, ports in Europe do not report on their hinterland modal split. Even if they do, comparing modal split figures across ports is

and Road countries, with private and corporatized enterprises taking a leading role. Chinese port actors have seized the windows of opportunity created by the BRI to go international (Notteboom and Yang, 2017; Wang et al., 2021).

[14] A notable example was the friction that emerged (and resignations that followed) between the old Greek PA staff and the Chinese management that arrived, as soon as COSCO took over the Port of Piraeus. This said, however, the transfer of ownership and management transformed the port into the number one in the Mediterranean Basin and number 4 in Europe (Pelagidis and Haralambides, 2019).

extremely difficult given differences in applied methodologies and strong variations in the local port context (for example, an industrial port with a lot of internal transport versus a pure transit port).

Port performance studies, in their grand majority, have focused on the performance and efficiency of container terminals, most of them these days being run by private companies. The measurement of the performance of a port authority, however, is by far under-researched. Indeed, it could be rather challenging were one to attempt to measure a PA's efficiency in accounting and finance; concessions and authorizations awarded; engineering designs; planned maintenance work; veterinary, health and security controls, etc. The identification and relevance of governance-related performance indicators for a PA might to some extent be influenced by the PA objectives and the beliefs of PA executives. Empirical research has shown that public port authorities resemble regular for-profit companies, but they also habitually enshrine certain beliefs, such as a perceived 'role' in matters of national security, that set them apart (Van der Lugt et al., 2017).

Moreover, meaningful port performance exercises should explicitly consider the requirements, needs, expectations and perceptions of different stakeholders. Valuable attempts have recently been made in the maritime economics literature to present both qualitative and quantitative approaches to port performance measurement in a multi-stakeholder environment. For example, Ha et al. (2017) modelled the interdependencies among port performance measures, and the combination of weights of interdependent variables. The authors used both qualitative and quantitative evaluations of measures, deriving from multiple stakeholders in their quantitative performance measurements.

The interdependencies (or lack of them) between various port performance measures remain a rather underexplored research area in port studies. For example, the relationships between port throughput and the evolution of the socio-economic indicators of seaports, such as value-added, growth and employment, have not been systematically examined, except for some rather factual exercises (cf., Merk, 2013) or local case studies (a notable exception can be found in Ayesu et al., 2022). The examination of the link between port activity levels, in terms of cargo flows, and land management – e.g., concession awards – is another potentially interesting research theme (e.g., the spatial productivity of port areas and related concession pricing). Many more possible linkages between well-established and more experimental port performance measures can be explored using statistical techniques, decision science, system dynamics modelling or other quantitative and qualitative methods.

Finally, in closing the 'interdependencies' discussion, one should not fail to mention the problem of *multicollinearity* among input variables, such as those used in Data Envelopment Analysis (DEA) and Stochastic Frontier models. In fact, variables like 'number of quay cranes' and 'quay length', or 'terminal surface', are not just collinear but their dependence is almost orthogonal. The problem is usually 'solved' by arbitrarily dropping a collinear variable and, sometimes, the one dropped is the most important; the technical solution prevails over the economic ramifications of a modelling choice and this is a common pitfall in this type of studies (see Psaraftis, 2017).

Port performance is not only about hard economic values; it is also about the cultivation of the soft values of seaports, sometimes necessary to safeguard their 'license to operate' (Van Hooydonck, 2007). Among others, such values include CSR initiatives, reaching out to stakeholders through a well-balanced and effective stakeholder relations management, or achieving broad sustainability goals (see for example the *World Ports Sustainability Program* which explicitly targets the UN Sustainable Development Goals in a port context). As part of the soft values discussion, PAs across the world are attaching greater importance to the role of *transparency and disclosure*, as tools in stakeholder relations management and image building in port management performance (see for instance Notteboom et al., 2015 on disclosure practices of the port of Rotterdam; the extensive analysis on the levels and standards of transparency in the governance of ports by Brooks et al., 2020; or the growth of sustainability reporting by PAs in Geerts and Dooms, 2017).

Despite the renewed academic interest in transparency and disclosure (a most welcome initiative indeed) in daily port practice, the issues may be quite different than the way they are presented in the academic literature. Ports and their decisions, as we have detailed above, are often under the scrutiny and approval of supervisory bodies. The latter usually comprise a representative group of port stakeholders like city, provincial, or regional administrations; labour unions; concessionaires; railways; chambers of commerce and industry; carriers and their agents, etc. These people, in addition to safeguarding and promoting the interests of the port, may have their own personal or corporate 'agendas'. Therefore, indiscriminately disclosing information to stakeholders, particularly on 'sensitive' matters such as cost breakdowns – things that no commercial entity would ever disclose even to its own shareholders – might be counterproductive to the long-term wellbeing of the port. This said, in an increasing number of ports around the world, the greatest part of the documentation produced by the PA is by law uploaded onto the organisation's website. Such documentation among others includes executive decisions, as well as tenders; qualified suppliers; concessions and authorizations; maintenance plans; technical department designs; budgets and much more.

A last point concerning performance measurement relates to the challenge of comparing and benchmarking port and PA performance in a meaningful way. Benchmarking is a continuous process of evaluation of products, services and practices vis à vis those of the strongest competitors, or of the ports recognized as leaders. Such exercises often constitute learning tools for the organisation, with respect to the relative positioning of the port, and for assessing ways to further improve performance. However, key difficulties encountered in earlier research include the identification of a peer group of ports for meaningful and valid comparisons,[15] and the potentially poor comparability of indicator values across ports, given the disparity of methodological variations in data collection and processing. PAs often face a dilemma between the desire to do more international benchmarking (or at least compare to relevant peers), and the desire to focus on highly customised and individualised port performance measures which may not always be amenable to inter-port comparisons.

## 6. CONCLUSIONS

The COVID-19 pandemic has clearly had a significant impact on the level of economic activity of seaports, with many world ports confronted with moderate to strong impacts on cargo volumes and vessel calls, and on the overall activity level in the logistics and industrial clusters in and around them. Economic activity levels in ports are in parallel affected by broader ongoing structural trends in the world economy (e.g., nearshoring and reshoring, dematerialisation of consumption, 3-D printing, energy transition, trade-related frictions), making port actors, planning authorities, and supply chain managers revisit and update their port-related development and investment plans. Furthermore, the COVID-19 crisis, coupled at the same time with China's inroads to port infrastructure investments around the world, through its Belt and Road Initiative (BRI), brings again to the surface discussions on the socio-economic impact and resilience of ports as 'essential facilities' to national and regional interests.

There can be no doubt that the COVID-19 pandemic has revived the importance of risk management and resilience in seaports, characterised by uncertainty and volatility. Port authorities are challenged to further strengthen their organisational resilience, leanness (Marlow and Casaca, 2003) and agility (Paixao and Marlow, 2003). In the post COVID-19 *new normal*, port authorities will be expected to develop capabilities in port resilience planning (Shaw et al., 2017; Vonck and Notteboom, 2016; Verschuur et al., 2020); adaptive port planning (Taneja et al., 2011); and to enhance the adaptive capacity of their ports (Notteboom, 2016), so as to cope with economic shocks and trends, and with the challenges imposed by climate change (Ng et al., 2015). At the same time, port authorities might have a role to play in increasing the overall resilience of

[15] For example, when applying DEA, the 'peers' are those on the frontier. This can lead to a situation where the analyst *de facto* perceives the least bad ports as the best ports. The ambition of a port should not be to become the best performer among its underperforming peers, but to achieve the best performance that it is possible to achieve.

the port ecosystem, and of the individual companies within it, through, for example, financial instruments (e.g., deferring land lease payments), or the deployment of data-driven market analysis tools. While quite a few studies have been published in the past decade on risk management and resilience, there is still plenty of room for the development of novel performance indicators on risk management and resilience in a seaport governance context.

While it is important to acknowledge that many variations and local/regional differences and orientations in port governance systems do exist, they nevertheless persist in presenting and applying discrete port governance typologies (see e.g., Brooks, 2004). We believe that further work and analysis of port management practises, styles and models (sic) call for a more continuous and fluid approach to the subject, whereby even subtle temporal and spatial differences and changes are measured and analysed along a broad spectrum, instead of a set of discrete categories. The growing regional and global entanglement in port governance and management philosophies, orientations and ambitions form a breeding ground for innovative ideas and customized approaches to port governance in an increasingly globalized and connected world. The port research community can contribute to such insights by examining the melting and merging of port governance arrangements, the tensions and opportunities these processes bring, and how internationalising PAs can adapt and embed them in a regional or global theatre.

The role of public entities and of international and domestic corporations in ports, and the desired development path in port governance, are being again revisited. While it is still early days to evaluate whether the current epidemiological crisis and, more importantly, the onslaught of the *new normal*, will create ruptures in port governance trends, it is important to stress that the academia has again a role to play in assisting the business community in continuously assessing trends and challenges, and in identifying gaps and points of (re)orientation. Some of the potential future research areas in port governance will include *inter alia*: (a) exploring new revenue/business models for port authorities (b) the development of continuous and more fluid approaches to port management governance models; (c) a stronger area-specific, targeted approach to individual port governance challenges; (d) research on the conditions and ramifications of an increasing regional and global entanglement of ports and consequent governance solutions; and (e) advancing performance measurement in the field of port governance (Notteboom and Haralambides, 2020).

At the same time, adopting a more macroscopic perspective, it should be stressed that the immediate economic hardships induced by COVID-19 were not systemic (as was the case with the global financial crisis of 2008), but rather the result of an unforeseen external shock. As such, it is to be hoped that the world economy will not only return to pre-COVID-19 levels of activity but will, in all probability, eventually surpass them. Even during the pandemic, economic forecasts were generally positive in this respect, as evidenced by the way China has already started on its route to economic recovery, with a remarkable Q4 2020 growth rate of 6.5%. This brought the country's overall annual growth rate to 2.3%, thus correcting a Q1 2020 contraction of 6.8% (National Bureau of Statistics of China, 2021). However, now that the worst health impacts of the pandemic are, hopefully, behind us, a bleaker economic picture is unfolding, with estimates of China's growth rate for 2022 and 2023 revised downwards to 3.3% and 4.6% respectively (IMF, 2022).

One cause for future (economic) concern is the astronomical amount of money earmarked around the world in the fight against COVID-19, especially for mitigating its effects on employment. Within the EU, the level of spending involved has literally rendered completely meaningless the limits on public spending and budget deficits embodied in the EU's *Stability Pact*. On the positive side, however, the financing of the EU's *Recovery Fund* [what has come to be known as the New Generation EU (NGEU)] through the issuance of mutual debt, and the future payback of this debt through direct taxation, represents the first solid step towards the fiscal integration of the EU that might guarantee its long-term survival (Acharya & Steffen, 2017). The lion's share of the recovery fund will go to Europe's weaker economies (Bulgaria, Romania, Greece, Croatia, etc.), as well as to those hit the hardest by the pandemic (Italy and Spain). On the negative side, it must be said, the Commission's attempts to 'condition' the spending of recovery funding on what it considers to be necessary economic reforms and the 'rule of law' have been rather unsuccessful, with certain member states

questioning the legitimacy of linking 'life and health' issues with conditions and considerations related to economic performance and political governance (Fuest, 2021).

With the 2020 election of Joe Biden as president of the U.S.A., the world was seeking a real commitment to reversing the introversion and isolationism which characterized the Trump administration. Although President Biden is no great proponent of the free trade ethos, in seeking to distance himself from the political and policy idiosyncrasies of his predecessor, he restored better relations with the EU, partly helped by the war in Ukraine and the resulting energy and inflationary crisis. While the relations with China remain tense, the U.S.A. is re-engaging with a multilateralist approach to trade relations and other international issues (Cullinane, 2020). Such a change in approach has been manifest in the representation of the U.S.A. within the IMO where, remarkably, the U.S.A. is now, volte-face, a stalwart of the environmental agenda, in vociferous pursuit of much more stringent measures to secure the best possible environmental performance from the international shipping industry.

Equally, it must be recognized that throughout Europe and the U.S.A., nationalist, protectionist and populist voices and politicians have started to become louder and louder, and concepts such as: localization; near-shoring; friend-shoring; 3-D printing; teleworking and deglobalization in general have been finding fertile ground among the populace. Even under the Biden administration in the U.S.A., for example, there are clear and explicit, yet very ambitious, objectives for the re-shoring of production and associated supply chains, motivated not only by the need (exposed by the COVID-19 pandemic) to reduce the risks associated with supply chain vulnerabilities, but also by the explicit and understandable desire to benefit workers in the U.S.A. If these sensibilities and tendencies are replicated worldwide and if this were to emerge as the *new normal* (i.e., if a reduction in trading distances becomes a possibility), then the negative impacts on the transportation industries, starting from long-distance business-class travel, and progressing then to international shipping, are only too obvious.

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