4

Key performance indicators for ports and the shipping fleet

This chapter provides key performance indicators based on a growing wealth of data derived from satellite tracking of vessels, shipping schedules, and port information platforms. Analysis of these data can help both users and providers of port and shipping services to compare progress and options and improve the efficiency of international maritime transport. The chapter has four sections.

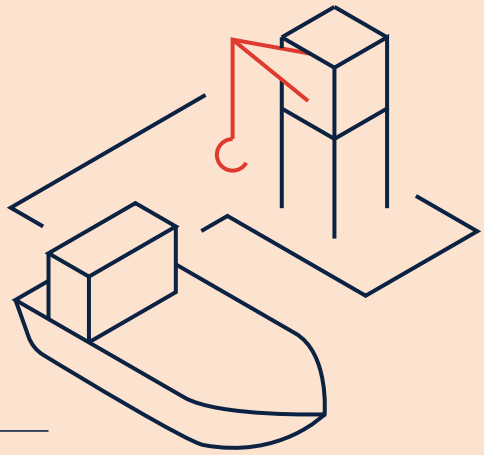
A – Port calls – In early 2020, the pandemic initially resulted in a decline in ship arrivals, but there was a rebound in the second half of 2020 along with an increase in the median time that ships were spending in port. The advanced economies had higher volumes and lower turnaround times compared with smaller and less developed countries which suffered from diseconomies of scale and lower capacities. In Africa, those countries that had most container ship calls – Egypt and Morocco – also received larger vessels and had fast turnarounds.

B – Liner connectivity – There is a growing connectivity divide. Countries with low connectivity cannot generate the volume of trade that would encourage the frequent services they need to better connect to overseas markets. Among the 50 least-connected economies, 37 are small island economies.

C– Port performance – For container, dry-bulk, and tanker-port operations larger call sizes are associated with longer port stays, as it takes more time to load and unload greater volumes of cargo. However, if measured per ton or container of cargo, countries and ports with larger call sizes also record significantly better port performance. For large container ships the fastest average container handling speed is in Malaysia. For loading dry bulk cargo the highest productivity is in Australia, and for loading oil cargo it is in Angola.

D – Greenhouse gas emissions – Over the last decade, the world fleet has become more energy efficient. Nevertheless, there is continued growth in total GHG emissions, of which a high proportion is from container ships, particularly those that are older and less energy efficient. Ambitious measures will be needed to achieve the long-term goal of significantly reducing emissions.

Key performance indicators for ports and the shipping fleet



LINER SHIPPING CONNECTIVITY

The top 5 economies with the highest Liner Shipping Connectivity Index (LSCI) **are in Asia**

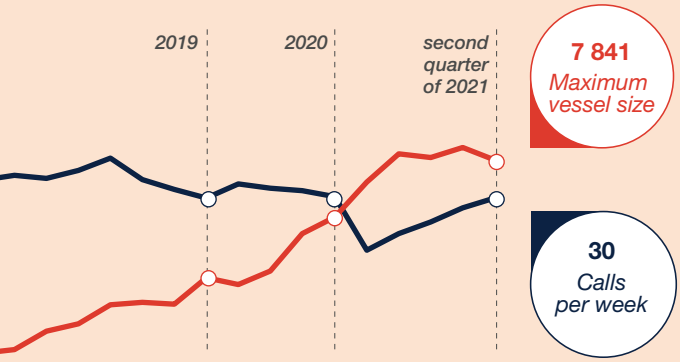
1	China	6	United States
2	Singapore	7	Spain
3	Republic of Korea	8	Netherlands
4	Malaysia	9	United Kingdom
5	Hong Kong, China	10	Belgium

The long-term trend in the distribution of the LSCI shows **a widening gap between the best and least connected countries**

18 of the 25 least connected economies and territories for which an LSCI has been generated **are islands**

PORT OPERATIONS

Larger ships and fewer port calls are two sides of the same coin



Ship sizes have increased faster than trade volumes and total deployed capacity

The fastest loading operation

Dry bulk carriers		Tankers	
Tonnes loaded per minute		*Tonnes loaded per minute*	
48	Australia	113	Angola
28	Colombia	95	Qatar
25	Brazil	90	Kuwait

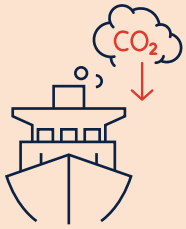
CARBON DIOXIDE EMISSIONS

GHG emissions from shipping must be phased out to avoid the costs of not acting in the face of climate change

Decarbonization measures will have a greater impact on some countries than others, notably on SIDS or LDCs, which may need support to mitigate the increased maritime logistics costs

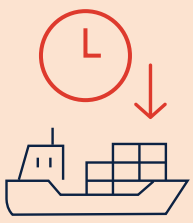
The energy transition in maritime transport implies a major transformation of the industry

In the process of decarbonizing shipping,



maritime transport costs will increase,

and average shipping speeds will decrease

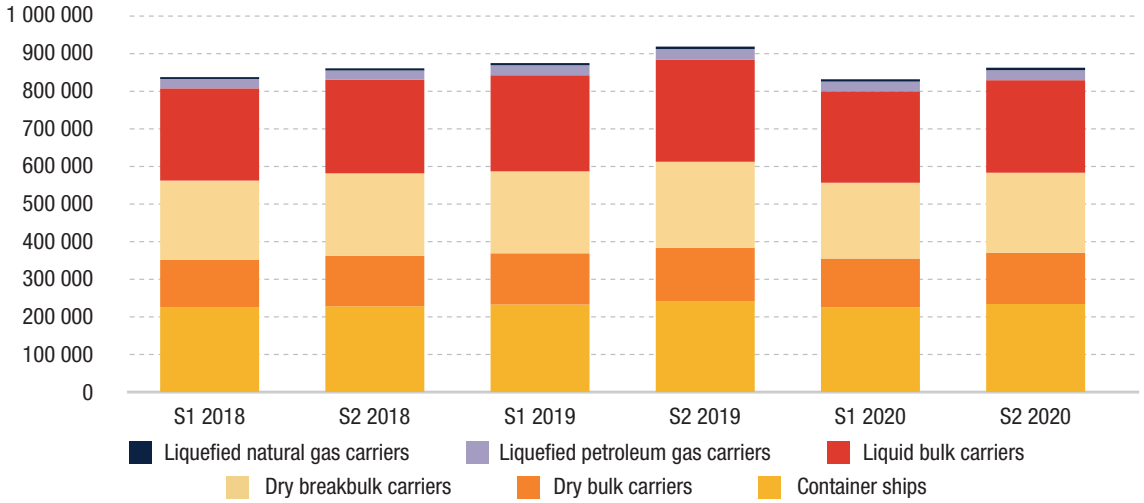


as a result, maritime logistics costs will go up

A. PORT CALLS AND TURNAROUND TIMES

During the first six months of 2020, reflecting the pandemic-induced slump in demand for shipping and port services, the word's cargo-carrying ships as whole made fewer port calls (figure 4.1).[1] The second half of the year saw a rebound across all regions, albeit not to pre-pandemic levels. The highest number of ship arrivals were in Europe, East Asia, and South-East Asia (figure 4.2).

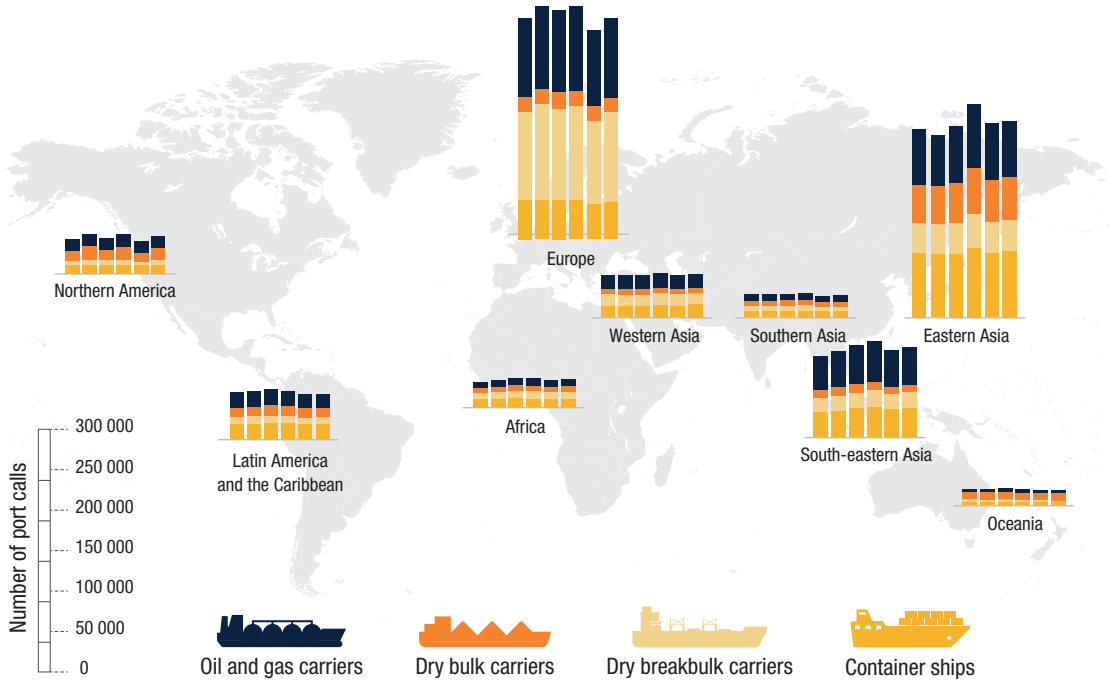
Figure 4.1 Port calls per half year, world total, 2018–2020



Source: UNCTAD, based on data provided by MarineTraffic.

Ships of 1,000 GT and above. Not including passenger and Ro/Ro ships.

Figure 4.2 Port calls per half year, regional totals, 2018–2020



Source: UNCTAD, based on data provided MarineTraffic.

Note: Cargo carrying ships only, not including passenger ships and Ro/Ro vessels.

[1] UNCTAD secretariat calculations, based on data provided by MarineTraffic (www.marinetraffic.com). Aggregated figures are derived from the fusion of AIS information with port mapping intelligence by MarineTraffic, covering ships of 1,000 GT and above. For the computation of the turnaround times, passenger ships and RoRo ships are not included. Only arrivals have been taken into account to measure the number of port calls. Cases with less than ten arrivals or five distinct vessels on a country level per commercial market as segmented, are not included. The data will be updated semi-annually on UNCTAD's maritime statistics portal (http://stats.unctad.org/maritime).

During 2020, to contain the virus, terminal operators, authorities, and intermodal transport providers took steps to reduce social contact. However, this also slowed port operations so that vessels of all types had to spend more time in port (table 4.1). The greatest average increase in lengths of stay was for dry break bulk carriers whose general cargo operations tend to be more labour intensive and less automated. Moreover, when berth space is limited operators may prioritize scheduled container shipping calls or large dry bulk carriers over smaller vessels.

Table 4.1 Time in port, age, and vessel sizes, by vessel type, 2020, world total

Vessel type	Median time in port (days), 2020	Median time in port, % change over 2019	Average size (GT) of vessels	Average age of vessels	Maximum size (GT) of vessels	Average cargo carrying capacity (dwt) per vessel	Maximum cargo carrying capacity (dwt) of vessels	Average container carrying capacity (TEU) per container ship
Container ships	0.71	2.3	38 308	14	237 200			3 543
Dry break bulk carriers	1.15	4.3	5 439	21	91 784	7 405	116 173	
Dry bulk carriers	2.07	2.7	32 146	14	204 014	57 453	404 389	
Liquefied natural gas carriers	1.12	0.8	95 270	12	168 189	74 229	156 000	
Liquefied petroleum gas carriers	1.04	3.0	10 826	15	59 229	12 164	64 220	
Wet bulk carriers	0.97	3.9	15 704	14	234 006	27 242	441 561	
All ships	**1.00**	**2.9**	**14 663**	**18**	**237 200**	**24 956**	**441 561**	**3 543**

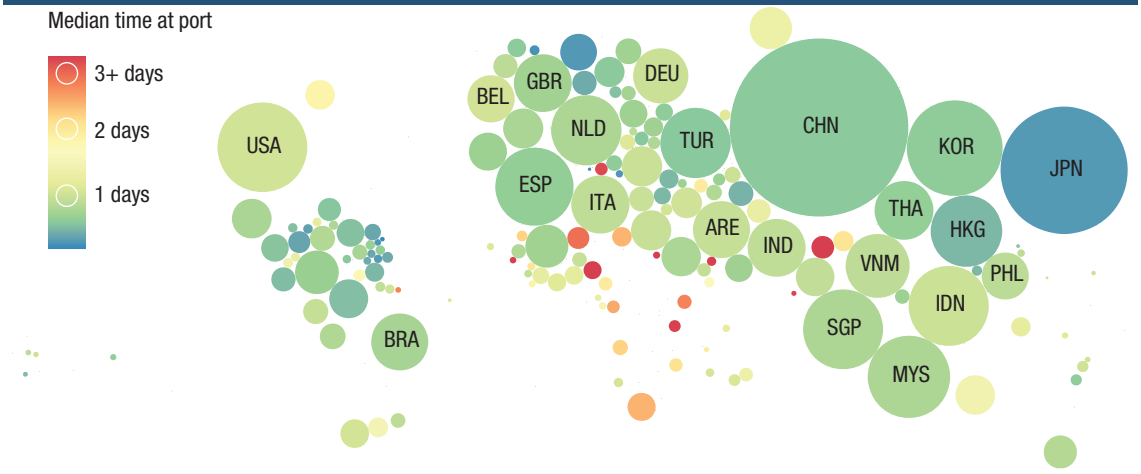
Source: UNCTAD, based on data provided by MarineTraffic (https://www.marinetraffic.com).

Note: Ships of 1,000 GT and above. Not including passenger ships and Ro/Ro vessels.

Among the top 25 countries with the most container ship arrivals, the fastest median turnaround time was in Japan at 0.34 days, followed by Taiwan Province of China at 0.44 days, Hong Kong, China, at 0.52 days and China and Turkey both at 0.62 days (table 4.2). The longest average time in port was in the Russian Federation at 1.31 days, followed by Belgium at 1.04 days, the United States at 1.03 days and Indonesia at 0.99 days. For the container ships calling in its ports, the Russian Federation also recorded the highest average age and the smallest average size.

Figure 4.3 is a stylized map of port calls. It depicts container ship port calls per country, as well as the median time in port. Figure 4.4 does the same for container ship port calls and the maximum size of ship. Figure 4.5 and figure 4.6 zoom in on the same details for African countries. These figurative maps illustrate the importance of Asian economies. They also show that countries with more port calls tend to receive larger ships, while small island states can only accommodate fewer and smaller vessels.

Figure 4.3 Container ship port calls and time in port, 2020



Source: UNCTAD, based on data provided by MarineTraffic.

Note: Ships of 1,000 GT and above. Labelled countries had more than 5,000 container ship port calls in 2020. For the complete table of all countries see http://stats.unctad.org/maritime.

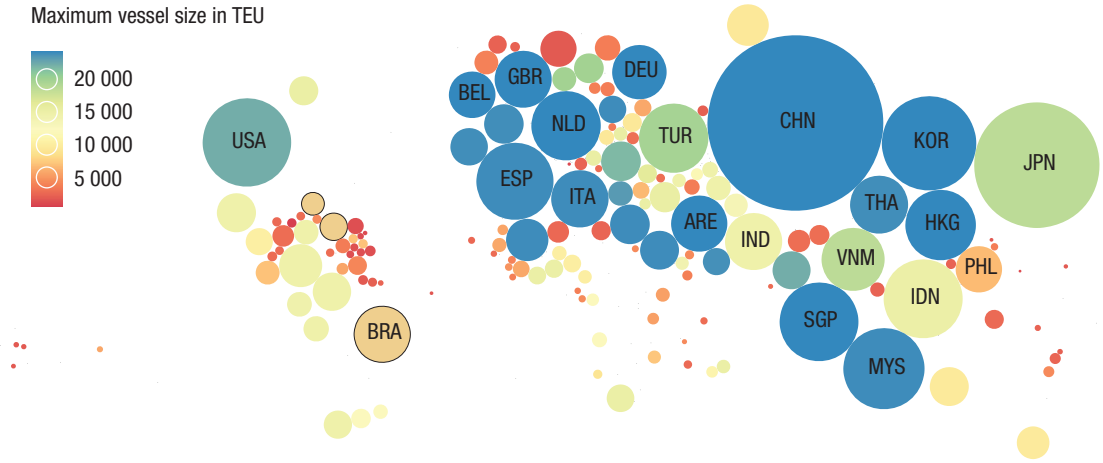
Table 4.2 Port calls and median time spent in port, container ships, 2020, top 25 countries

Country	Number of arrivals	Median time in port (days)	Average age of vessels (years)	Average container carrying capacity (TEU) per vessel	Maximum container carrying capacity (TEU) of vessels
China	74 413	0.62	12	4 637	23 964
Japan	37 959	0.34	13	1 620	18 400
Republic of Korea	21 461	0.64	13	3 056	23 964
United States of America	18 866	1.03	14	5 347	22 000
Taiwan Province of China	16 621	0.44	14	2 665	23 964
Malaysia	15 875	0.80	14	3 706	23 756
Indonesia	15 019	0.99	14	1 509	14 855
Singapore	14 946	0.80	12	5 228	23 964
Spain	14 321	0.66	14	3 258	23 756
Hong Kong, China	11 976	0.52	13	3 637	23 964
Netherlands	11 595	0.80	14	2 942	23 964
Turkey	11 594	0.62	16	3 034	19 462
Viet Nam	9 587	0.90	13	1 966	18 400
Thailand	8 107	0.67	11	2 177	23 656
Italy	7 929	0.92	16	3 886	23 756
India	7 865	0.92	15	4 225	14 500
United Kingdom	7 834	0.73	15	3 465	23 964
United Arab Emirates	7 612	0.95	16	4 232	23 964
Brazil	7 609	0.77	10	5 877	12 200
Germany	7 139	0.98	13	4 442	23 964
Belgium	5 235	1.04	14	4 652	23 964
Philippines	5 181	0.89	15	1 858	6 622
Panama	4 467	0.69	12	4 139	14 414
Morocco	4 317	0.74	14	4 094	23 756
Russian Federation	4 184	1.31	18	1 509	9 400
Subtotal, top 25	**351 712**				
World total	***459 417***	***0.71***	***14***	***3 543***	***23 964***

Source: UNCTAD, based on data provided by MarineTraffic.

Note: Ships of 1000 GT and above. Ranked by number of port calls.
For the complete table of all countries, see http://stats.unctad.org/maritime.

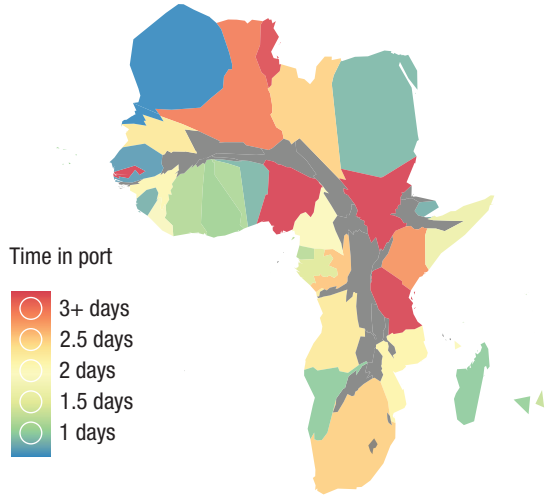
Figure 4.4 Container ship port calls and maximum ship sizes, 2020



Source: UNCTAD, based on data provided by MarineTraffic.

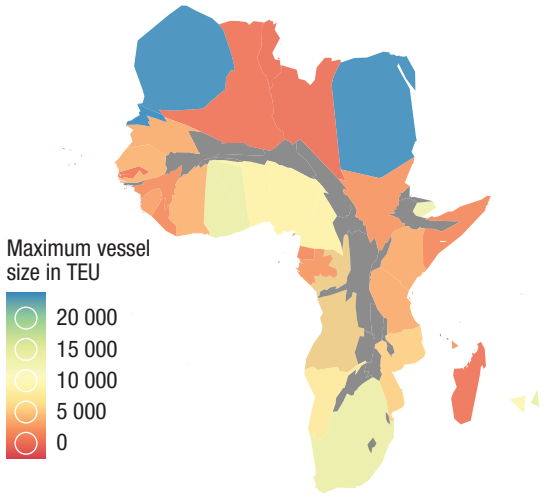
Note: Ships of 1,000 GT and above. Labelled countries had more than 5,000 container ship port calls in 2020. For the complete table of all countries see http://stats.unctad.org/maritime.

Figure 4.5 Container ship port calls in Africa and time in port, 2020



Source: UNCTAD, based on data provided by MarineTraffic.
Note: Ships of 1,000 GT and above.

Figure 4.6 Container ship port calls in Africa and maximum ship sizes, 2020



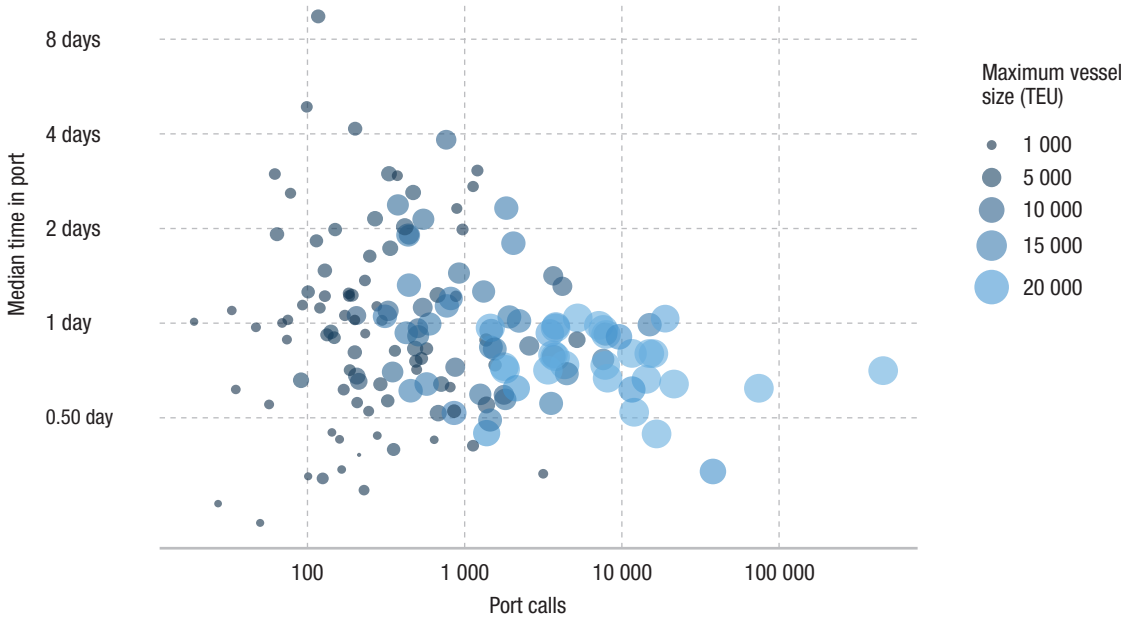
Source: UNCTAD, based on data provided by MarineTraffic.
Note: Ships of 1,000 GT and above.

The longest times in port are generally in Africa – notably in Nigeria, Sudan, and Tanzania – though Morocco is an exception with one of the world's shortest times.

Large ships with more cargo to be loaded or unloaded will normally require longer in port, though ports that can handle larger ships also tend to be more modern and better equipped, so can work more quickly and this is therefore a non-linear relationship (figure 4.7).

Some of the fastest turnarounds are in countries that have very few port calls and only receive ships with a few containers to be loaded and unloaded, so there is little congestion. However, at the other end of the scale, turnarounds are also fast in countries that have many port calls and can accommodate the largest container vessels. These ports benefit from economies of scale and investments in the latest technologies and infrastructure; their efficiency in turn attracts more vessels, further boosting the number of arrivals.

Figure 4.7 Median time in port, number of port calls, and maximum vessel sizes, per country, container ships, 2020



Source: UNCTAD, based on data provided by MarineTraffic. Both axes in logarithmic scale.
Note: Ships of 1,000 GT and above. For the complete table of all countries, see http://stats.unctad.org/maritime.

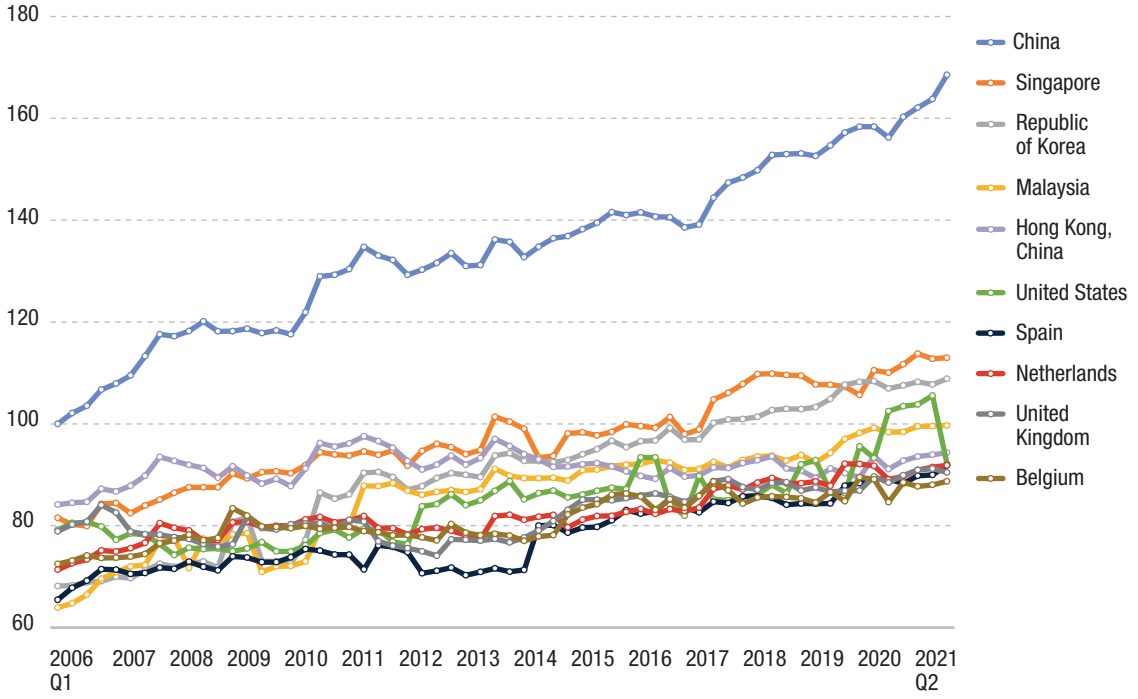
Countries in the middle of the distribution report a wide range of median times, reflecting differences in efficiency and other variables such as vessel age and cargo throughput.

B. LINER SHIPPING CONNECTIVITY

Since 2020, UNCTAD, in collaboration with MDS Transmodal, has reported quarterly values, at both port and country levels, for the Liner Shipping Connectivity Index (LSCI).[2] Countries with better liner shipping connectivity as reflected in the LSCI, generally have better access to overseas markets so can be more competitive (UNCTAD, 2017).

In the second quarter of 2021, the top-five most-connected economies, with the highest LSCIs, were in Asia – China, Singapore, Republic of Korea, Malaysia, and Hong Kong, China. These were followed by the United States and four European countries – Spain, Netherlands, United Kingdom, and Belgium (figure 4.8). In the four succeeding quarters, China widened its lead, while the United States saw a decline

Figure 4.8 Liner shipping connectivity index, top 10 countries, first quarter 2006 to second quarter 2021



Source: UNCTAD, based on data provided by MDS Transmodal. For the complete data set for all countries see http://stats.unctad.org/LSCI.

[2] UNCTAD developed the Liner Shipping Connectivity Index (LSCI) in 2004. The basic concepts and major trends are presented and discussed in detail in (UNCTAD, 2017) and (MDST, 2020).

In 2019, the LSCI, in collaboration with MDS Transmodal (https://www.mdst.co.uk) was updated and improved, comprising additional country coverage including several SIDS, and incorporating one additional component, covering the number of countries that can be reached without the need for transhipment. The remaining five components, notably the number of companies that provide services, the number of services, the number of ships that call per month, the total annualized deployed container carrying capacity, and ship sizes, have remained unchanged. Applying the same methodology as for the country-level LSCI, UNCTAD has generated a new port Liner Shipping Connectivity Index.

Each of the six components of the port LSCI captures a key aspect of a connectivity.

(a) A high number of scheduled ship calls allows for a high service frequency for imports and exports.

(b) A high deployed total capacity allows shippers to trade large volumes of imports and exports.

(c) A high number of regular services from and to the port is associated with shipping options to reach different overseas markets.

(d) A high number of liner shipping companies that provide services is an indicator of the level of competition in the market.

(e) Large ship sizes are associated with economies of scale on the sea-leg and potentially lower transport costs.

(f) A high number of destination ports that can be reached without the need for transhipment is an indicator of fast and reliable direct connections to foreign markets.

Since 2020, the same methodology is applied on the country and the port level on a quarterly basis.

because of the inactivity in the second quarter of a trans-Pacific service of the 2M Alliance which had deployed ultra-large container carriers.

Of the 25 least-connected economies and territories for which an LSCI has been generated, 18 are islands whose LSCI scores have not significantly improved over the last 15 years. These are Anguilla, Antigua and Barbuda, Bermuda, Bonaire, Saint Eustatius and Saba, Cabo Verde, Cayman Islands, Christmas Island, Cook Islands, Micronesia, Montserrat, Niue, Norfolk Island, Palau, São Tomé and Príncipe, Saint Kitts and Nevis, Timor-Leste, Turks and Caicos Islands and Tuvalu. Among the bottom 25, two countries, Moldova and Paraguay, are landlocked so their LSCIs are determined by containerized river transport services. The remaining five economies are Albania, Democratic Republic of Congo, Eritrea, Gibraltar and Guinea-Bissau, whose seaborne trade is often handled by ports in neighbouring countries.

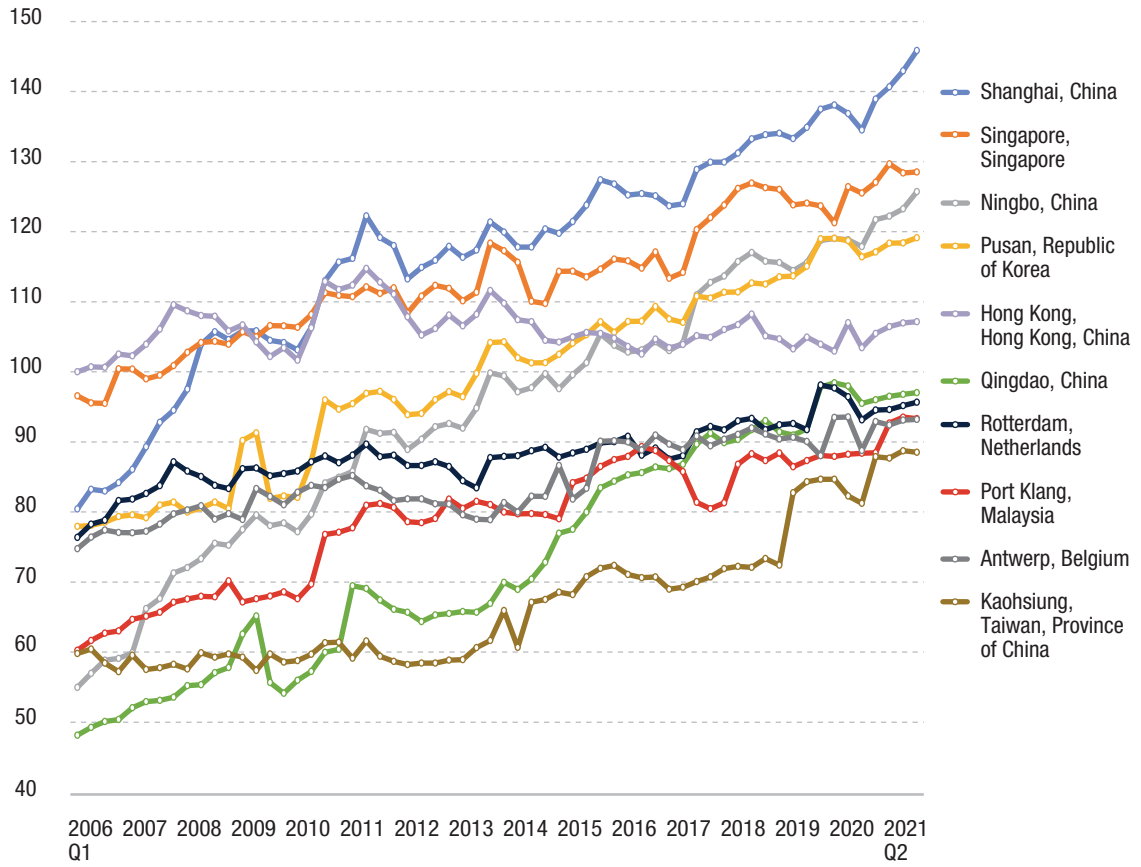
1. A growing connectivity divide

Over the period 2006–2021 the LSCI indicates a widening gap between the best- and least-connected countries, reflected in the dataset as an increase in the standard deviation, from 20 to 28. Over this period, China increased its LSCI by 69 per cent while many SIDS saw their LSCIs stagnate.

Among the 50 least-connected economies, 37 were small island economies. The exceptions were Bahamas, Jamaica and Mauritius which have high and growing LSCIs because they have developed into regional hubs, attracting transhipment of containerized trade for other countries. They can thus also offer their own importers and exporters better access to overseas markets (UNCTAD, 2021b).

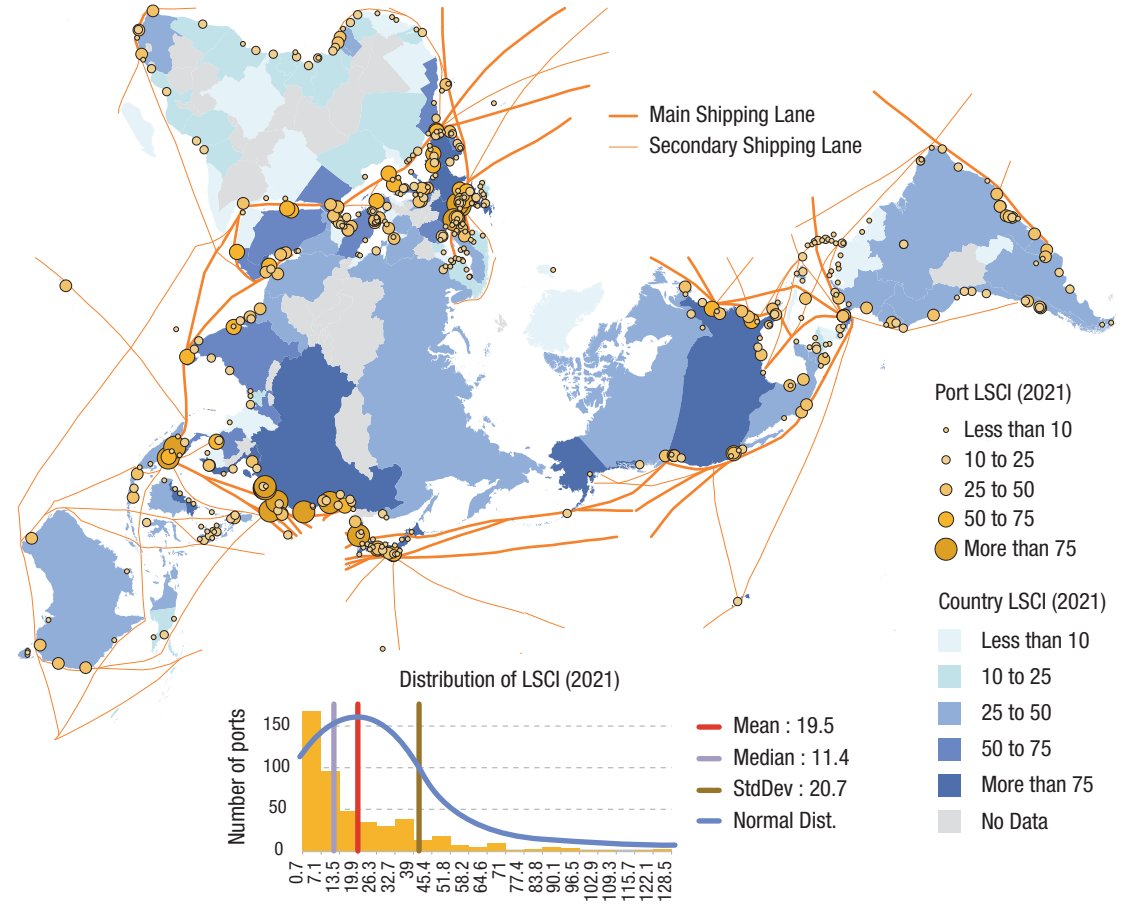
Figure 4.9 depicts the LSCI at port level. Eight of the top ten ports were in Asia, led by Shanghai; the remaining two are in Europe – Rotterdam and Antwerp. The best-connected port in Latin America and the Caribbean was Cartagena, Colombia; in South Asia it was Colombo, Sri Lanka; in North America it was New York/New Jersey, United States; and in Africa it was Tanger Med, Morocco (figure 4.10).

Figure 4.9 Port Liner Shipping Connectivity Index, top 10 ports as of second quarter 2021, first quarter 2006 to second quarter 2021



Source: UNCTAD, based on data provided by MDS Transmodal. For the complete data set for all ports see https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=170026.

Figure 4.10 Liner Shipping Connectivity Index, country and port level, 2020



Source: Jean-Paul Rodrigue, Dept. of Global Studies & Geography, Hofstra University, based on data provided by UNCTAD. LSCI values are average of all 4 quarters of 2020.

2. Larger ships and fewer companies

To cater for growing demand, there are two main options. Carriers can either deploy more ships, and offer more services and direct connections, or they can deploy larger ships, or a combination of the two. In practice, over the last two decades, they have tended to use larger ships (figure 4.11).

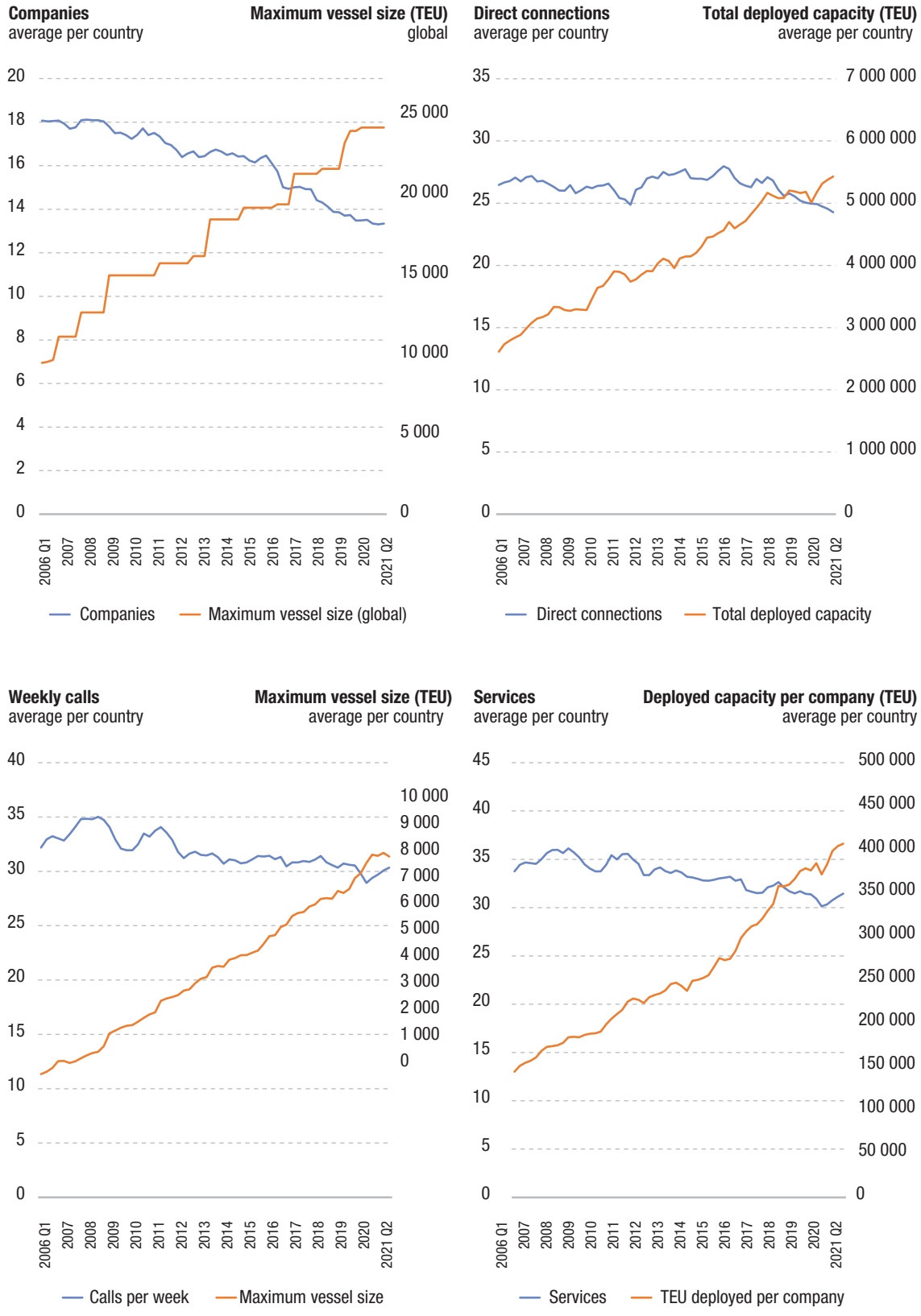
The size of the largest ships has increased significantly, while the average number of companies has decreased. The outcome over this period was a 280 per cent increase in deployed capacity per company per country. Ship sizes have increased faster than trade volumes and total deployed capacity, so if ships are to remain fully loaded they will generally operate on fewer services. Between the first quarter of 2006 and the second quarter of 2021, the average capacity of the largest ship for each country increased by 176 per cent – from 2,836 to 7,841 TEU, while the average number of companies per country fell from 18 to 13.

Between the first quarter of 2006 and the second quarter of 2021 the capacity of the largest ships for each country increased by 155 per cent, to 23,963 TEU. In 2006, four countries had calls from more than 100 companies – Belgium, China, United Kingdom, and the United States. But by the second quarter of 2021, ports in China had services from only 93 companies, followed by Republic of Korea at 63 companies, the United States at 61, and Japan at 60.

Figure 4.12 Illustrates the trends in maximum vessel sizes and number of companies for selected countries from different global regions. Most countries have bigger ships and fewer companies. Among the countries covered in figure 4.12, between 2006 and 2021 the greatest growth in vessel size was in Chile, up by more than 300 per cent, from 3,430 to 14,300 TEU, while the greatest fall in number of companies was in Germany, from 97 to 38.

For the SIDS the situation is different. They generally offer limited and scattered markets so there is little justification for larger ships. The number of companies providing services for most SIDS has remained small, and there is little competition (see Samoa in figure 4.12).

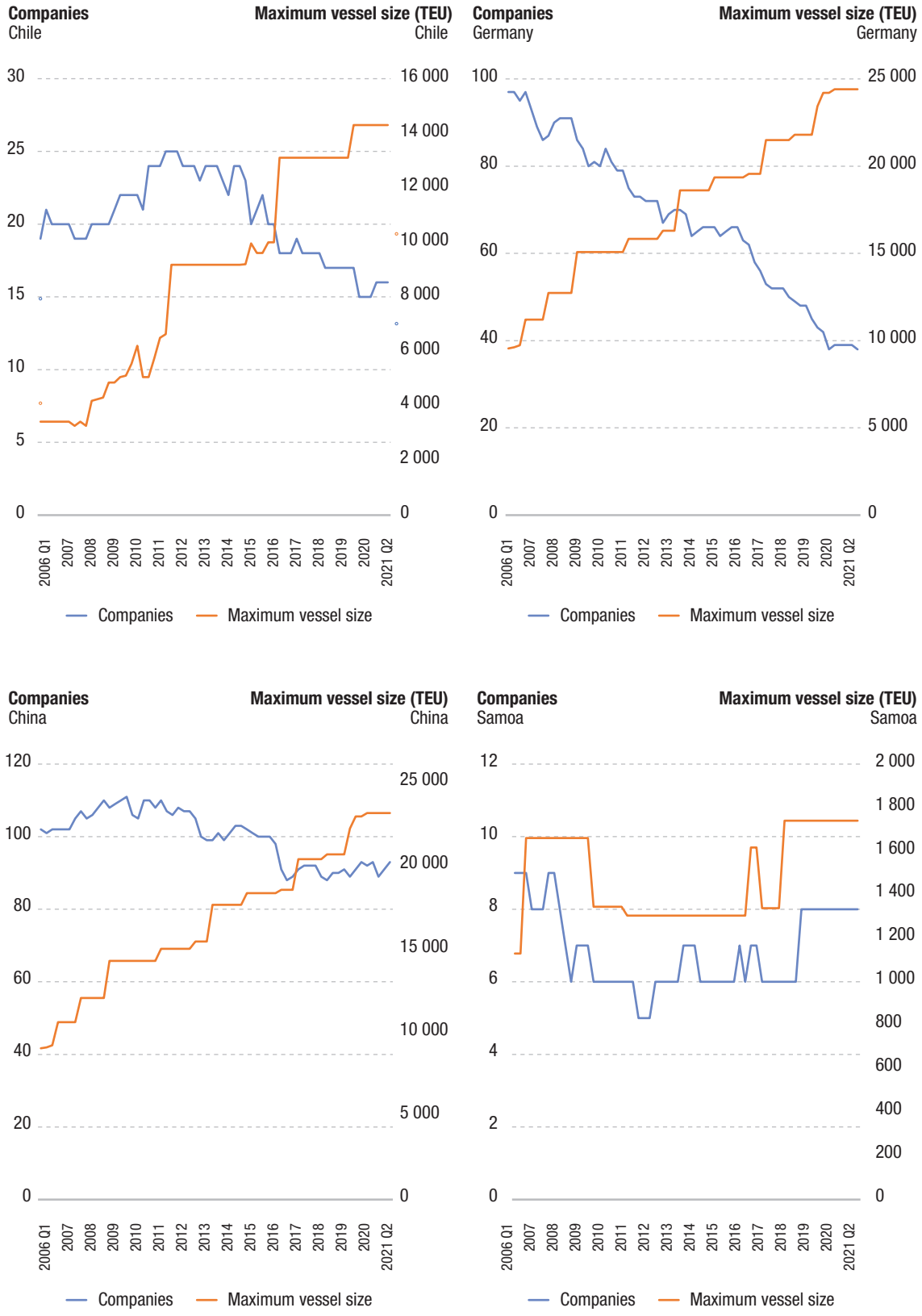
Figure 4.11 Trends in global container ship deployment, first quarter 2006 to second quarter 2021



Source: UNCTAD, based on data provided by MDS Transmodal.

The relationship between total deployed container carrying capacities, ships sizes, and the number of companies in a market is further illustrated in figure 4.13. Moving vertically in the chart, for a given number of companies in a market, the total deployed capacity – how many containers can be carried to or from

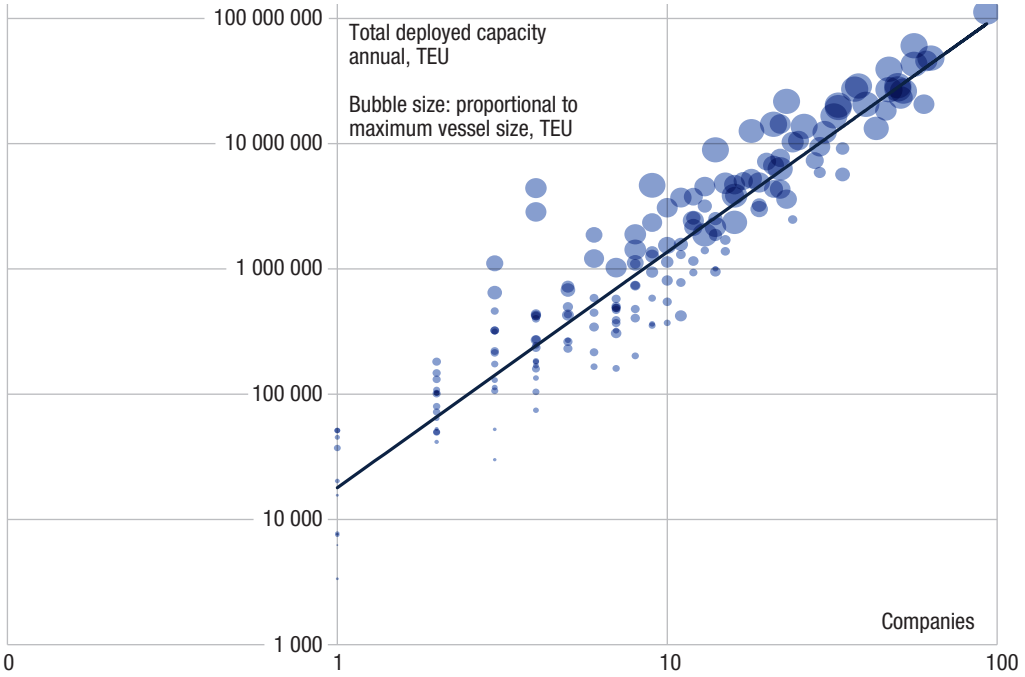
Figure 4.12 Trends in vessel sizes and number of companies providing services, selected countries, first quarter 2006 to second quarter 2021



Source: UNCTAD, based on data provided by MDS Transmodal.

a country – increases with maximum vessel size. For each country, however, there is a trade-off between accommodating more companies or receiving larger ships: moving horizontally in the chart, for a given deployed capacity, the bigger ships are in countries with fewer companies in their markets.

Figure 4.13 Relationship between maximum vessel sizes, deployed capacity, and the number of companies, second quarter 2021



Source: UNCTAD, based on data provided by MDS Transmodal.

3. Bilateral liner shipping connectivity

In addition to the country- and port-level LSCI, UNCTAD also produces a connectivity index for country pairs, the Liner Shipping Bilateral Connectivity Index (LSBCI).[3] Progress in the LSBCI, along with its five component indicators, is illustrated in figure 4.14. Since 2006, on average the LSBCI has increased but there have been a few disruptions – notably the global financial crisis of 2008, and the pandemic from 2020. The financial crisis had an almost immediate impact, but the pandemic impact came in waves – delivering a supply shock that then translated into a demand shock along with differences between countries in the local impact and propagation of the virus.

In addition to these disruptions, since the last quarter of 2018 the LSBCI has shown a downward trend which is more a consequence of ongoing structural transformations. One is the increase in ship size. Between 2006 and 2019 the maximum capacity component of the index more than trebled. Between 2014 and 2019 this was largely offset changes in the other four components, all of which have been declining.

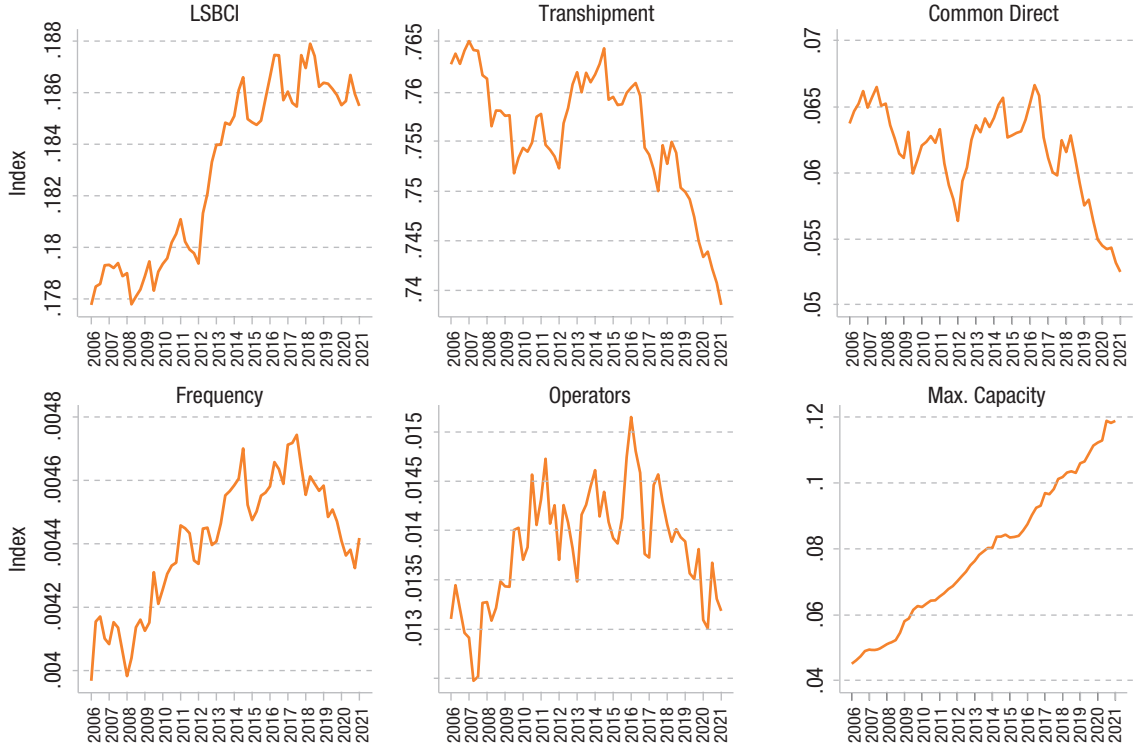
These trends for the component indicators are interlinked. Companies that have invested in larger ships are aiming for economies of scale which should reduce unit costs. Other companies unable to make these investments, and to compete, will either withdraw from unprofitable routes or leave the industry altogether. This reduces the number of operators, which has been happening in all regions – in East Asia for the last seven years, but also in Latin America, and in Sub-Saharan Africa which in addition has fewer operators offering intra-regional connections.

With fewer companies, there are likely to be fewer direct connections. This is confirmed by the evolution of the transhipment component and consequently of the common direct component. Nevertheless, as direct connections are mainly on historical maritime routes the main adjusting variable on those routes is likely to be the number of competing companies.

Increasing ships size also affects the hosting capacity of ports especially those that have improved their infrastructure. This could explain the downward trend since 2017 for the frequency component which reflects the number of port-to-port connections between countries.

[3] The Liner Shipping Bilateral Connectivity Index (LSBCI), which is publicly available in its annual form at http://stats.unctad.org/lsbci, is made of five components: the number of transhipments needed to connect two countries (transhipment variable), the number of common direct connections between two countries (common direct variable), the number of port-to-port connections between two countries (frequency variable), the number of liner shipping companies operating between two countries (operators variable) and, the maximum ship size in TEU deployed between two countries (max. capacity variable). When no direct connection exists between two countries the latter three components correspond to connection (option) with the best (highest) value when taking the lowest connecting segment.

Figure 4.14 Liner Shipping Bilateral Connectivity Index (LSBCI) and its components, first quarter 2006 to second quarter 2021



Source: UNCTAD, based on data provided by MDS Transmodal.

All in all, the LSBCI trend reflects a worsening situation for remote and already poorly connected countries. Added to this is the general increase in freight costs which could have severe consequences for international trade (UNCTAD, 2021a).

C. PORT CARGO HANDLING PERFORMANCE

1. Container port performance

In April 2021, to provide stakeholders with a reference point for maritime trade and transport the World Bank and IHS Markit published a new index, the Container Port Performance Index (CPPI) (World Bank 2021, IHS Markit 2021). This index combines data on vessels, their port calls and the cargos they load and unload, as well as the time they spend in ports.

The first version had data for 2019 and the first half of 2020 (table 4.3), and was dominated by ports in East Asia, led by Yokohama in Japan, which was ahead of King Abdullah Port in Saudi Arabia and Qingdao in China. In Europe, the highest-ranked port was Algeciras in Spain at 10; in South Asia, it was Colombo in Sri Lanka at 17; and in the Americas, Lazaro Cardenas in Mexico at 25.

Table 4.3 Top 25 ports under the World Bank IHS Markit Container Port Performance Index 2020

Port name	Economy	Rank
Yokohama	Japan	1
King Abdullah port	Saudi Arabia	2
Chiwan	China	3
Guangzhou	China	4
Kaohsiung	Taiwan Province of China	5
Salalah	Oman	6
Hong Kong	Hong Kong, China	7
Qingdao	China	8
Shekou	China	9
Algeciras	Spain	10
Beirut	Lebanon	11
Shimizu	China	12
Tanjung Pelepas	Malaysia	13
Port Klang	Malaysia	14
Singapore	Singapore	15
Nagoya	Japan	16
Colombo	Sri Lanka	17
Sines	Portugal	18
Kobe	Japan	19
Zhoushan	China	20
Jubail	Saudi Arabia	21
Yosu	Republic of Korea	22
Fuzhou	China	23
Ningbo	China	24
Lazaro Cardenas	Mexico	25

Source: World Bank and IHS Markit Port Performance Program.

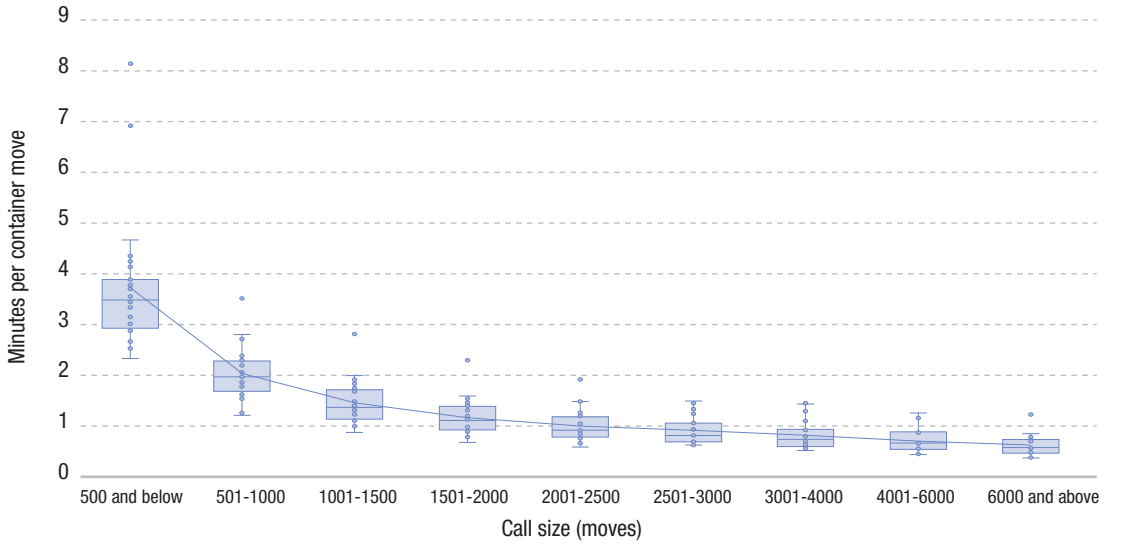
The only other North American port in the top 50 was Halifax in Canada. In Africa, the top-ranked port was Djibouti.

UNCTAD has used the raw data from the CPPI to analyse the relationship between the performance of ports and the time ships spend in them. As indicated in figure 4.15 there are clear economies of scale: the more containers there are to load and unload – a larger 'port call size' – the fewer minutes it takes to load or unload a container. Nevertheless, total time in port increases with call size (figure 4.16), so it is reasonable to compare ports or countries within the same range of call sizes.

Port calls where more containers are loaded or unloaded will need longer to handle them, but also be faster for each individual container move, so the correlation between hours in port and speed of handling a slightly negative (figure 4.17). But limiting the analysis to one port call range confirms the expected high positive correlation between the time it takes to move a container and the time it takes to handle a ship (figure 4.18).

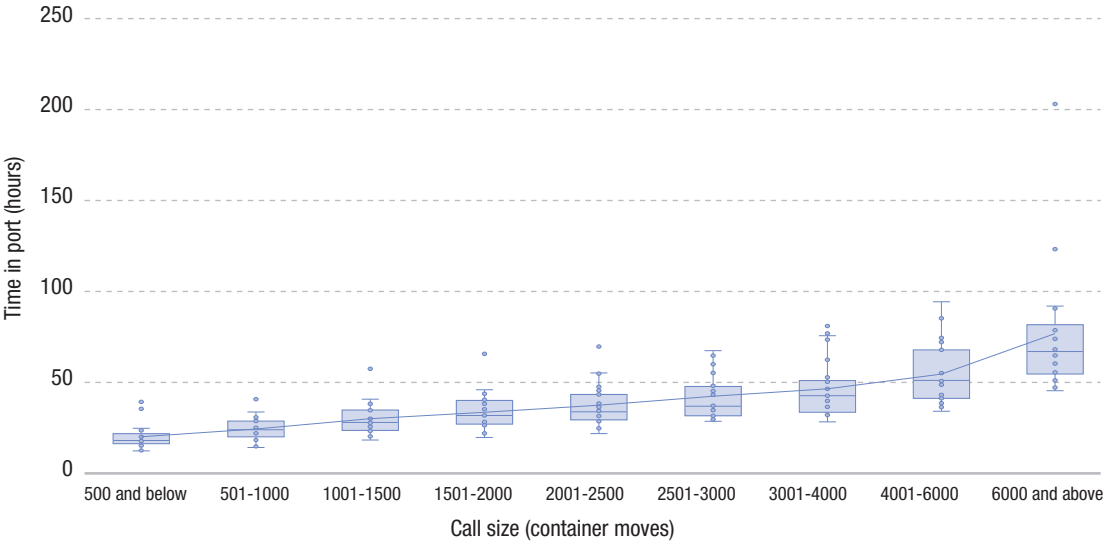
For the top 25 economies, table 4.4 summarizes the speed of container handling. For five of the nine call-size ranges the fastest handling is in Taiwan Province of China, followed by Japan for two ranges, and Malaysia and Hong Kong, China for one range each. The ranking per country roughly follows that of the leading individual ports in table 4.3.

Figure 4.15 Minutes per container move for container ships, by range of port call size



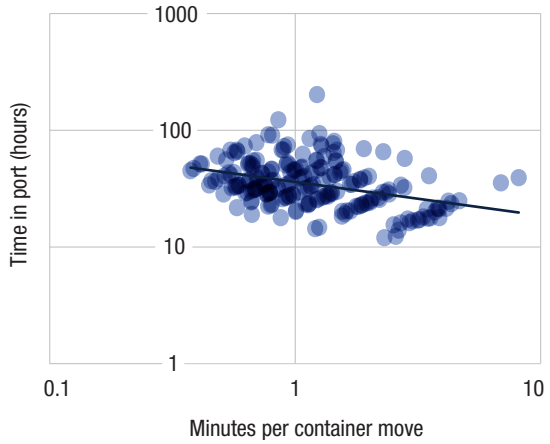
Source: UNCTAD, based on data provided by IHS Markit Port Performance Program.

Figure 4.16 Time in port (hours) for container ships, by range of port call size



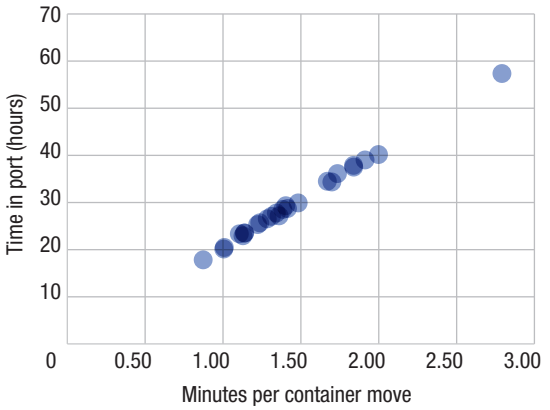
Source: UNCTAD, based on data provided by IHS Markit Port Performance Program.

Figure 4.17 Correlation between time in port (hours) and minutes per container move, all call sizes



Source: UNCTAD, based on data provided by IHS Markit Port Performance Program.

Figure 4.18 Correlation between time in port (hours) and minutes per container move, only calls with 1001 to 1500 containers per call



Source: UNCTAD, based on data provided by IHS Markit Port Performance Program. Coefficient of determination (R2) 0.99.

Table 4.4 Minutes per container move, by range of call size, top 25 countries by port calls

Country\call size	<500	501–1000	1001–1500	1501–2000	2001–2500	2501–3000	3001–4000	4001–6000	>6000
Australia	3.44	2.27	1.84	1.57	1.47	1.31	1.28	1.25	0.81
Belgium	3.71	2.08	1.40	1.10	0.91	0.80	0.73	0.70	0.54
Brazil	3.01	1.96	1.48	1.30	1.16	1.07	0.92		
China	2.92	1.68	1.14	0.92	0.77	0.66	0.57	0.49	0.42
Hong Kong, China	3.21	1.60	1.01	0.79	0.77	0.63	0.58	0.45	
Taiwan Province of China	2.31	1.25	0.87	0.67	0.58	0.69	0.51		
France	3.33	2.21	1.70	1.38	1.27	1.23	1.08	0.89	
Germany	4.13	1.92	1.31	1.13	0.96	0.82	0.73	0.65	0.58
India	2.52	1.55	1.22	0.91	0.79	0.75	0.65	0.55	
Indonesia	4.22	2.35	2.00	1.45	1.04	1.00	0.80	0.67	
Italy	3.55	2.41	1.91	1.54	1.46	1.48	1.44	1.14	
Japan	2.57	1.21	1.01	0.80	0.66	0.75	0.70		
Republic of Korea	2.88	1.63	1.14	0.89	0.78	0.75	0.65	0.56	0.70
Malaysia	3.83	2.03	1.38	0.98	0.79	0.69	0.55	0.46	0.37
Netherlands	8.14	2.70	1.67	1.44	1.23	0.99	0.80	0.67	0.62
Panama	4.33	1.86	1.36	1.04	0.94	0.96	0.78	0.88	1.23
Philippines	4.67	3.51	2.79	2.29	1.91	1.43	1.42		
Singapore	3.87	1.81	1.24	0.95	0.76	0.67	0.59	0.47	0.39
Spain	3.87	1.87	1.29	0.98	0.85	0.72	0.63	0.67	0.48
Thailand	2.69	2.79	1.11	0.94	0.79	0.69	0.70	0.66	0.58
Turkey	3.47	2.03	1.42	1.16	1.09	1.06	0.94	0.64	0.57
United Arab Emirates	6.89	2.41	1.74	1.18	0.85	0.70	0.59	0.52	0.41
United Kingdom	3.79	2.18	1.84	1.53	1.28	1.22	1.27	0.93	0.78
United States	3.16	1.77	1.34	1.16	1.06	1.01	0.93	0.90	0.85
Viet Nam	2.64	1.55	1.13	0.78	0.67	0.64	0.58	0.54	0.52
Average	**3.73**	**2.02**	**1.45**	**1.16**	**0.99**	**0.91**	**0.82**	**0.70**	**0.62**
Median	*3.47*	*1.96*	*1.36*	*1.10*	*0.91*	*0.80*	*0.73*	*0.66*	*0.57*
Minimum	*2.31*	*1.21*	*0.87*	*0.67*	*0.58*	*0.63*	*0.51*	*0.45*	*0.37*
Maximum	*8.14*	*3.51*	*2.79*	*2.29*	*1.91*	*1.48*	*1.44*	*1.25*	*1.23*

Source: UNCTAD, based on data provided by IHS Markit Port Performance Program.

Box 4.1 Port performance in Latin America and the Caribbean – differences between types of terminals

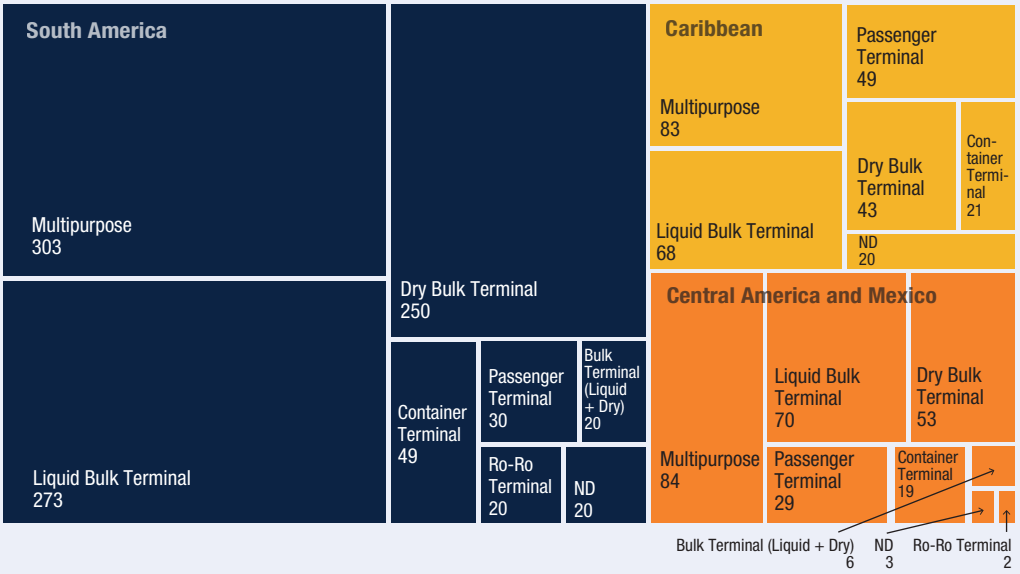
In Latin America and the Caribbean across 50 countries and territories, logistics and port services are provided through 1,967 port facilities. Of these, 1,259 are certified as compliant with the International Ship and Port Facility Security (ISPS) Code, including 982 facilities that handle cargo or passenger transfer services, and 277 that provide other services, such as shipyards, docks, and others.

Nonetheless, according to an intensive survey of port facilities in the entire region carried out by the Economic Commission for Latin America and the Caribbean (ECLAC), there are also another 708, of which 590 are port terminals and 118 are related to other types of service.

Port terminals, including those that are ISPS certified and those that are not, represents a widely diverse geographical distribution. The top ten countries according to the number of port terminals are: Brazil, 306; Mexico, 171; Argentina, 143; Chile and Peru, 97 each; Colombia, 88; Paraguay, 65; Bolivarian Republic of Venezuela, 63; Panama, 48 and Cuba, 45. These 10 countries, out of 50, make up 74 per cent of the region's port facilities.

At the opposite end of the ranking, 15 countries or territories have five or fewer facilities each, and almost all have no more than one terminal by port specialty: Antigua and Barbuda, Bermuda, Belize, Barbados, Turks and Caicos Islands, El Salvador, Aruba, Bonaire, Cayman Islands, Dominica, Anguilla, Montserrat, Sint Eustatius, Saint Barth, and Sint Maarten.

A high proportion of these facilities, 470 in total, are multipurpose terminals. The following chart exhibits the distribution by zones and specialties:



This region is very diverse – in terms of composition, languages, economies, cultural identities, and modes of adaptation to international instruments. The ports systems too differ in terms of maturity and productivity. In the liquid and dry bulk categories, in the most specialized countries, productivity is higher – as in Argentina, Brazil, and Colombia, which move annual volumes close to 600 million mt.

In the last few years region has seen enormous growth in terms of containers, though only four specialized terminals yet have semi-automated processes. Progress in digitalization and paperless transactions has also been slow, and regulatory procedures are not very transparent, making it difficult to promote effective competition. Long-term planning has shown a lack of foresight for ports and connectivity with hinterland infrastructure

Some areas have weakly regulated quasi-monopolistic markets, while others have excessive competition, which may prove harmful. Systems for the design, granting and monitoring of concessions are hampered by institutional weaknesses. These reduce prospects for investment and better multimodal connections and efficient access to markets and ports. The result is often inefficiency and low productivity.

Increasing vertical integration between shipping lines, port terminals and inland logistics heightens the risk of monopoly. In certain areas there are also tensions between management, security, and facilitation. Better security standards would improve development, efficiency, and competitiveness.

Nonetheless, there is some optimism that these problems can be solved – with considerable potential for more containerization and automation of procedures, as well as for improvements in facilitation.

Source: ECLAC, Maritime and Logistics Profile.

2. Dry bulk port performance

VesselsValue[4] has produced a new dataset that combines AIS data on ship movements with data on cargo transfers. This can be used to calculate interesting performance indicators for dry bulk port operations (table 4.5). During the period 2018 to mid-2021, among the top 30 countries in terms of ship arrivals, the average speed of loading ranged from just six ton per minute in Romania and Turkey to 48 ton in Australia.

For dry bulk cargo, unloading tends to be slower than loading, as the operations cannot use the same combination of gravity and conveyer belts. The fastest unloading was in China, at 23 tonnes per minute, and the slowest in Russian Federation, at just 4 tonnes per minute, and in Norway, at just 6 tonnes per minute. These differences partly reflect port performance and economies of scale; Chinese dry bulk terminals are highly mechanized and handle the world's largest iron ore carriers, while Russian Federation and Norway have a long coast with many smaller ports.

Table 4.5 Cargo and vessel handling performance for dry bulk carriers. Top 30 economies by vessel arrivals, average values for 2018 to first half of 2021

	Ton per minute, loading	Ton per minute, discharge	Average waiting to load duration (hours)	Average waiting to discharge duration (hours)
China	19	23	66	56
Australia	48	11	101	50
United States	14	11	101	49
Brazil	25	9	174	131
Russian Federation	12	4	64	71
Canada	17	10	117	70
Argentina	16	7	45	28
South Africa	20	9	83	30
Japan	9	18	43	41
India	14	16	73	63
Ukraine	10	11	55	48
United Arab Emirates	18	10	50	32
Indonesia	10	8	58	54
Republic of Korea	10	16	37	62
New Zealand	10	8	56	26
Chile	11	9	94	94
Turkey	6	9	45	50
Viet Nam	9	11	53	54
Colombia	28	7	39	25
Malaysia	11	13	73	90
Mexico	12	9	68	61
Taiwan Province of China	12	18	34	48
Peru	18	11	82	49
Oman	16	20	80	52
Norway	20	6	84	78
France	10	12	52	55
Saudi Arabia	8	6	49	80
Morocco	8	6	78	127
Romania	6	7	64	29
Mozambique	15	6	94	123

Source: UNCTAD, based on data provided by VesselsValue.

Note: Ranked by number dry bulk carrier arrivals for loading.

[4] Data provided electronically by VesselsValue; https://www.vesselsvalue.com, June 2021.

Ships generally wait longer to load than to unload, though there are significant differences between countries. In Colombia, the average waiting time for unloading is one day while in Brazil it is five and a half days. Brazil also has the highest waiting times for loading – on average more than a week. This is partly a consequence of large vessel sizes and longer distances from the main markets. The shortest waits for loading cargo are in Taiwan Province of China at 34 hours. Some countries encourage owners to arrive early to minimize the risk of missing a scheduled port call.

3. Tanker port performance

For tanker port operations too, loading tends to be faster than unloading or 'discharge'. Among the top 30 countries in terms of tanker arrivals, the fastest loading was by the major oil exporters, reaching up to 113 tons per minute for Angola, followed by 95 in Qatar, 90 in Kuwait, and 86 in Saudi Arabia. For unloading oil, the fastest average speeds were in Japan at 83 tons per minute, followed by Republic of Korea at 67 (table 4.6). As regards waiting times, the lowest average time for loading was in Qatar at 26 hours, and for discharge in Japan at 28 hours.

Table 4.6 Cargo and vessel handling performance for tankers. Top 30 countries by vessel arrivals, average values for 2018 to first half of 2021

	Tons per minute, loading	Tons per minute, discharge	Average waiting to load duration (hours)	Average waiting to discharge duration (hours)
United States	24	33	54	69
Russian Federation	38	27	46	36
China	23	43	45	77
Brazil	46	29	62	66
Saudi Arabia	86	31	37	47
United Arab Emirates	66	25	65	89
Republic of Korea	29	67	50	48
Singapore	26	39	47	43
India	26	50	54	68
Malaysia	28	33	47	65
Netherlands	14	29	59	56
Indonesia	19	20	50	62
Italy	15	32	47	48
Mexico	25	17	77	83
Nigeria	43	9	53	129
Kuwait	90	54	32	37
Iraq	50	8	42	96
Canada	37	39	47	62
Spain	15	27	39	37
Qatar	95	48	26	63
Japan	37	83	35	28
United Kingdom	36	26	53	51
Turkey	54	30	36	37
Norway	63	36	46	72
Angola	113	25	37	84
Belgium	12	16	75	42
Bolivarian Republic of Venezuela	20	13	105	79
Taiwan Province of China	22	48	36	40
Argentina	20	20	39	38
Greece	15	30	55	43

Source: UNCTAD, based on data provided by VesselsValue.

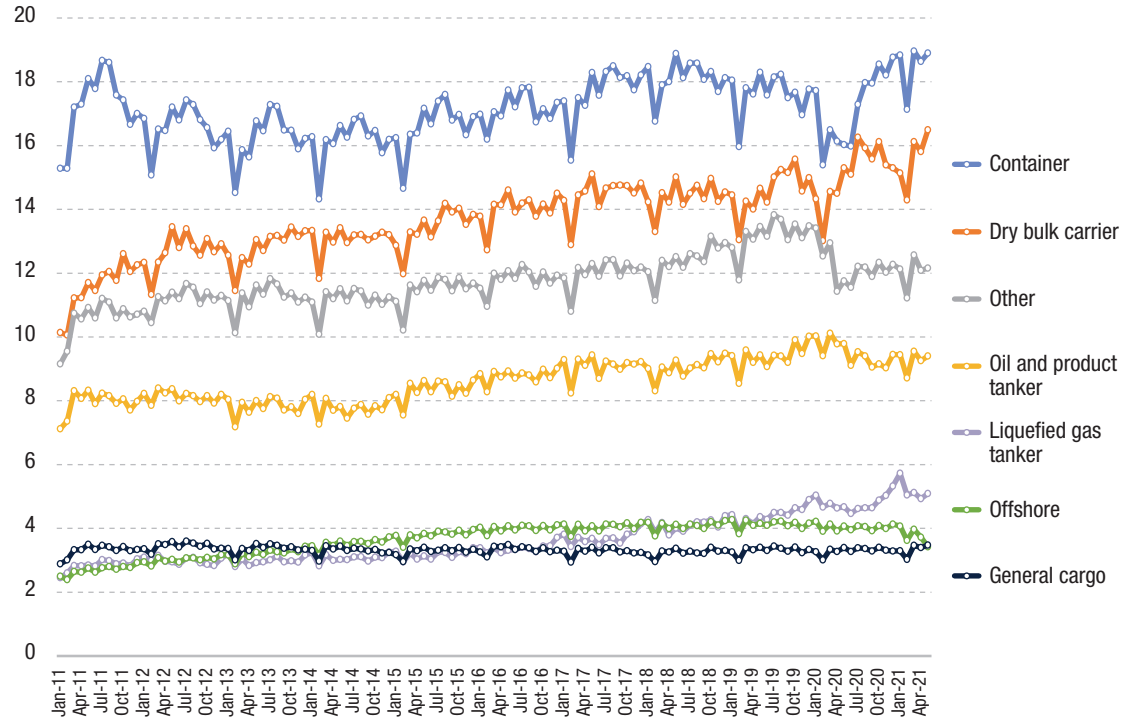
Note: Ranked by number tanker arrivals for loading.

E. GREENHOUSE GAS EMISSIONS BY THE WORLD FLEET

1. Shipping is missing its greenhouse gas emissions targets

Over the last decade shipping has become more energy efficient so total emissions have grown slower than the total number of vessels (figure 4.19). Nevertheless, this improvement will not suffice to meet the emissions targets and the agreed objective of the International Maritime Organization (IMO) "to reduce the total annual greenhouse gas emissions by at least 50 per cent by 2050 compared to 2008" as part of the "Initial IMO Strategy on reduction of greenhouse gas emissions from ships" (IMO, 2018).

Figure 4.19 Carbon dioxide emissions by vessel type, monthly, million tons, 2011–2021



Source: UNCTAD, based on data provided by Marine Benchmark.

The trends for the world's fleet over the last decade reflect its changing composition, with a declining proportion of journeys for general cargo ships and an increasing one for LNG carriers, with correspondingly higher greenhouse gas (GHG) emissions. In figure 4.19 it is also possible to see the annual downturn in traffic around February in line with the Chinese New Year especially in the dry bulk and container sector.

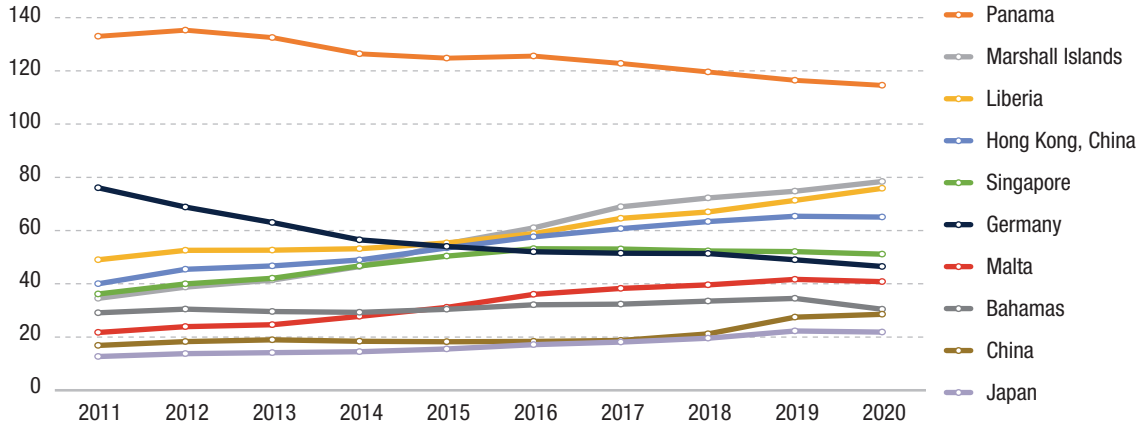
More recently this chart also shows the impact of the pandemic. 'Other' ships include primarily passenger ships, including ferries and cruise ships which were worst affected. Container ships, also saw an initial decline at the outset of the pandemic but subsequently recovered.

2. Assigning emissions to flag states

Emissions by flag state mostly correspond to market shares for tonnage. But because the fleets have different compositions the ranking is not identical. Liberia, for example, has a larger market share than Marshall Islands in terms of total tonnage (table 2.5), but a far smaller share for CO2 emissions because it has a higher proportion of dry bulk carriers, which produce lower emissions per dwt than other ship types. Germany, on the other hand, is ranked only 29 in the world fleet, but 6 in terms of emissions because a high proportion of its fleet is container ships which tend to go faster than other ship types and emit more CO2 per dwt.[5]

[5] Data provided electronically by Marine Benchmark; https://www.marinebenchmark.com, June 2021.

Figure 4.20 Carbon dioxide emissions by flag state, annual, 2011–2020, million tons



Source: UNCTAD, based on data provided by Marine Benchmark.

3. Reducing greenhouse gas emissions may reduce connectivity and increase costs

In June 2021 the IMO's Marine Environment Protection Committee approved a new short-term measure for GHG emissions, with both technical and operational requirements.

Earlier that year, UNCTAD undertook a Comprehensive Impact Assessment of the proposed measure, setting out scenarios for 2030 with or without the measure, across three levels of emission reduction ambition. The aim was to quantify the changes in maritime logistics costs including shipping and time costs. All three indicated an increase in maritime logistics costs.

The IMO subsequently agreed the low scenario, for which the UNCTAD study suggested the following outcomes for 2030:

- A reduction in average speed of 2.8 per cent.
- An increase in average maritime shipping costs by 1.5 per cent.

While significant, these changes are relatively small when compared to typical variations in freight rates. They will also have a very small impact on global GDP and certainly far smaller than the disruption caused by the pandemic or climate change factors, or the costs of not acting in the face of climate change. However the IMO measures will have a greater impact on some countries than others, notably on SIDS or LDCs, which may need support to mitigate the increased costs and alleviate the consequent fallout on their incomes and trade flows (UNCTAD 2021c).

F. SUMMARY AND POLICY CONSIDERATIONS

This chapter has detailed several aspects of port and shipping performance, including fleet deployment and the time ships spend in port, and port performance. It has highlighted persistent differences between ports and countries, and shown how these are shaped by human, institutional, and technological factors.

Developing countries generally perform worse, with higher costs and lower connectivity – a consequence of diseconomies of scale, greater distances from overseas markets, and lower levels of digitalization. These and other countries should be aiming for more competitive commercial environments for port and shipping operations, ensuring that external costs are accounted for.

Costs are likely to increase slightly as a result of measures needed for decarbonization of maritime transport. Smaller and most vulnerable economies may need support to mitigate the increased costs and lower connectivity.

GHG emissions can also be reduced by improving port and shipping performance. If ports can optimize their availability, ships can plan their voyages so as to arrive in port the moment their berth becomes available, thus reducing unnecessary speed and fuel consumption.

Maritime transport will also be transformed by the global energy transition which will increase maritime transport costs and reduce average shipping speeds. Logistics costs increases will be greater for developing than for developed countries.

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