B. CONTAINER SHIPPING: LINER SHIPPING CONNECTIVITY

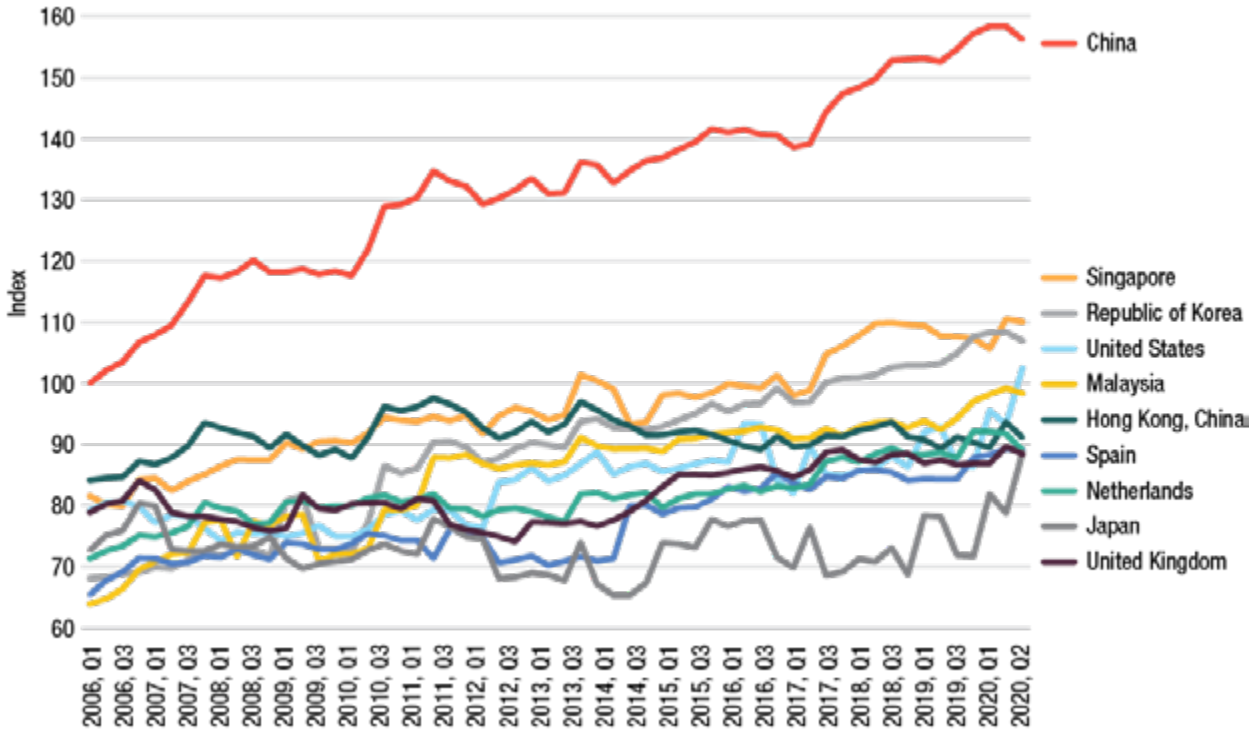
1. Countries' evolving liner shipping connectivity

In 2020, 6 of the 10 most connected economies are in Asia (China; Singapore; the Republic of Korea; Malaysia; Hong Kong, China; and Japan, 3 are in Europe (Spain, the Netherlands, and the United Kingdom), and 1 in North America (the United States) (figure 3.5). The most connected country – China – improved its liner shipping connectivity index by 56 per cent since the baseline year 2006, while the global average liner shipping connectivity index went up by 50 per cent during the same period.

Since 2020, UNCTAD, in collaboration with MDS Transmodal, reports quarterly values for the liner shipping connectivity index, both at the port and country levels.[14] The work is based on empirical

[14] UNCTAD developed the liner shipping connectivity index in 2004. The basic concepts and major trends are presented and discussed in detail in UNCTAD, 2017a and MDS Transmodal, 2020. In collaboration with MDS Transmodal, the liner shipping connectivity index was updated and improved in 2019 to offer additional country coverage, including several small island developing States, and to add a component covering the number of countries that can be reached without the need for trans-shipment. The remaining five components, notably the number of companies that provide services, the number of services, the number of ships that call per month, total annualized deployed container-carrying capacity and ship sizes, have remained unchanged. Applying the same methodology as for the country-level liner shipping

Figure 3.5 Liner shipping connectivity index of top 10 economies, first quarter 2006– second quarter 2020



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

Abbreviation: Q, quarter.

evidence that a country's competitiveness and access to overseas markets benefit from better liner shipping connectivity, which reflects access to the global container shipping network (UNCTAD, 2017a). This section first analyses trends at the country and port levels, and then goes on to discuss developments regarding the different components from which the index is generated.

connectivity index, UNCTAD has generated a new liner shipping connectivity index for ports.

Each of the six components of the port liner shipping connectivity index captures a key aspect of connectivity:

- A large number of scheduled ship calls allows for a high frequency of servicing imports and exports.
- A large deployed capacity allows shippers to trade sizable volumes of imports and exports.
- A large number of regular services to and from a port is associated with shipping options to reach different overseas markets.
- A large number of liner shipping companies that provide services is an indicator of the level of competition in the market.
- Large ship sizes are associated with economies of scale on the sea leg and possibly lower transport costs.
- A large number of destination ports that can be reached without the need for trans-shipment is an indicator of fast, reliable and direct connections to foreign markets.

Since 2020, the same methodology has been applied to country and port levels on a quarterly basis.

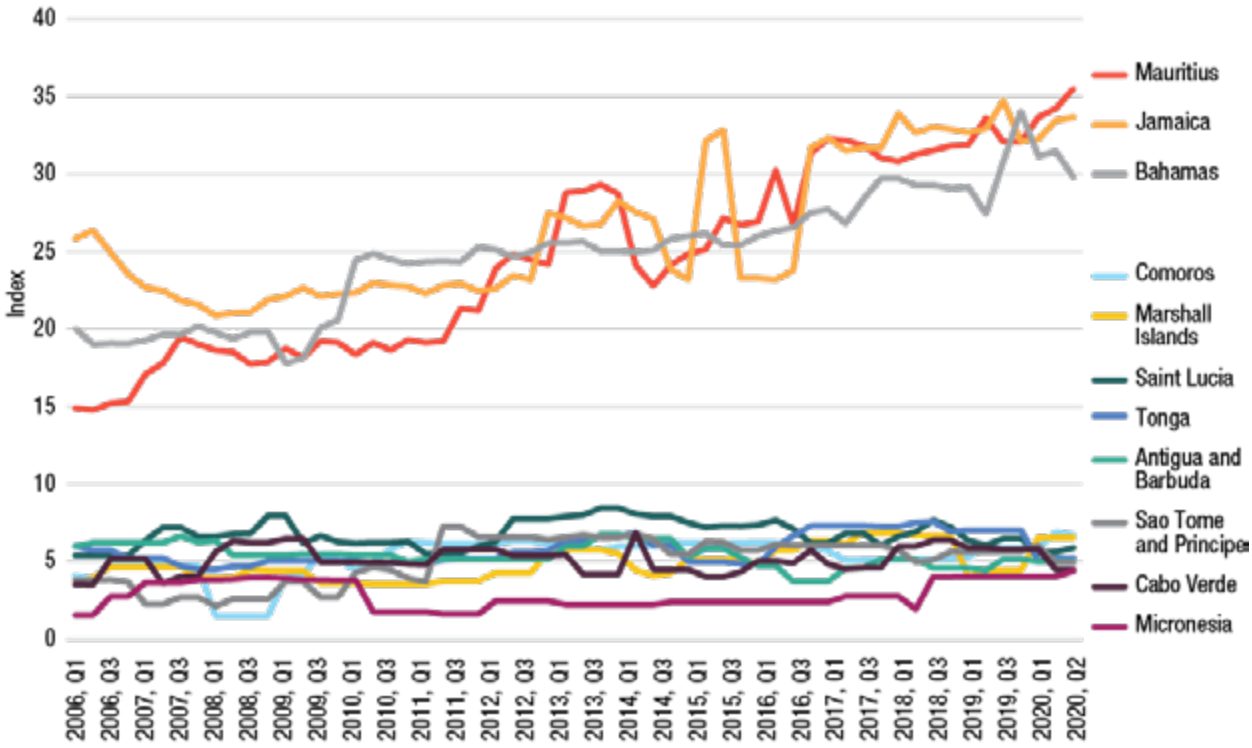
2. Liner shipping connectivity of many small island developing States stagnates

Many small island developing States and other small island economies have poor shipping connectivity. Yet, there is often little they can do to enhance their liner shipping connectivity, which remains limited, given their geographic position, lack of a wider hinterland and low trade volumes. Figure 3.6 depicts the liner shipping connectivity index of selected small island developing States and other small island economies where shipping schedules are reported separately.

A few small island developing States, notably the Bahamas, Jamaica and Mauritius, have been able to position their ports as trans-shipment hubs and increase their attraction as ports of call. Mauritius, for example, has more than doubled its liner shipping connectivity index since 2006. The additional fleet deployment stemming from trans-shipment can also be used for shipments of national importers and exporters. Nonetheless, most small island developing States continue to experience low levels of connectivity, with a lack of improvement over the years.

Among the leading ports in each subregion, Suva, in the Pacific, has the lowest port liner shipping connectivity index (figure 3.8). Among the 50 least connected economies, 37 are small island developing States.

Figure 3.6 Liner shipping connectivity index of selected small island developing States, first quarter 2006–second quarter 2020



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

Abbreviation: Q, quarter.

Among the 20 least connected economies, all except the Democratic People's Republic of Korea, Moldova and Paraguay are small island developing States, and the latter two are landlocked countries, whose low liner shipping connectivity index is generated from containerized river transport services.

Achieving economies of scale, while ensuring some level of competition and choice for their shippers is a difficult conundrum for many small island developing States and other small economies or remote ports. If better port infrastructure, through the use of dredging and specialized port cranes, for example, makes it possible for larger and more efficient ships to call, these same ships will then require fewer port calls to carry the same monthly volume of foreign trade. This may result in even less choice for shippers and a lower frequency of services. Put differently, it may not be possible, especially for small island developing States, to improve on all components of the liner shipping connectivity index, as illustrated in figure 3.9 (see also chapter 4, which discusses the challenge faced by small island developing States in the Pacific).

3. Developments at the port level

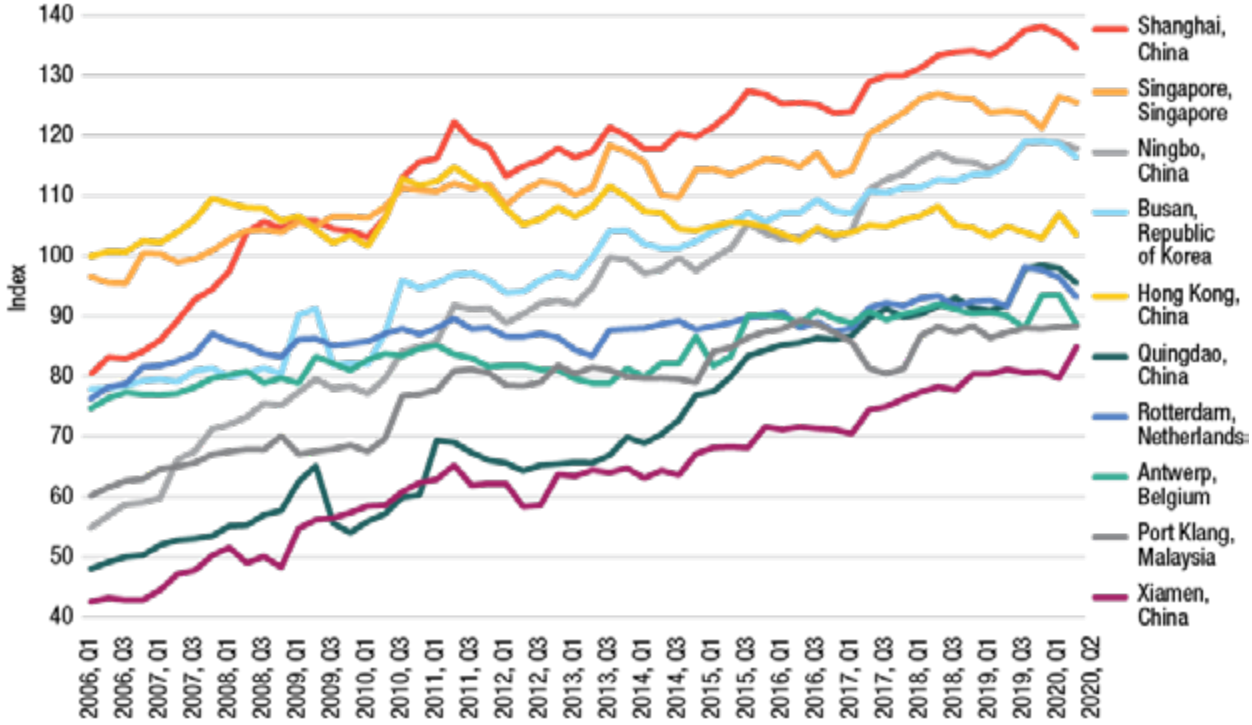
In 2020, five of the top 10 ports are located in China (Shanghai, Ningbo, Hong Kong, Qingdao and Xiamen), three are in other Asian countries (Malaysia, the Republic of Korea and Singapore), and two are in Europe (Belgium and the Netherlands). The liner shipping connectivity index of almost all of the top 10 ports has risen significantly since 2006, except Hong Kong, China, overtaken by four other ports (figure 3.7).

The port-level liner shipping connectivity index is generated for all container ports of the world that receive regular container shipping services.[15] In the second quarter of 2020, the database maintained by MDS Transmodal (www.mdst.co.uk) recorded regular container shipping services in 939 ports worldwide, a 12.6 per cent increase over 2006. This latest port count follows a decline of 3.6 per cent compared with the peak of the first quarter of 2019, when global liner shipping services included 974 ports in their schedules. Most of this recent decline took place during the first two quarters of 2020 and can be largely attributed to capacity management in response to the COVID-19 pandemic.

Figure 3.8 depicts the liner shipping connectivity index of the leading ports in major maritime regions. Several of the regional leaders saw a spike in the index in the second quarter of 2020, as they managed to attract additional services with larger vessels.

[15] For the complete data set providing quarterly values of the liner shipping connectivity index of more than 1,200 ports, from the first quarter of 2006 onwards, see http://stats.unctad.org/maritime.

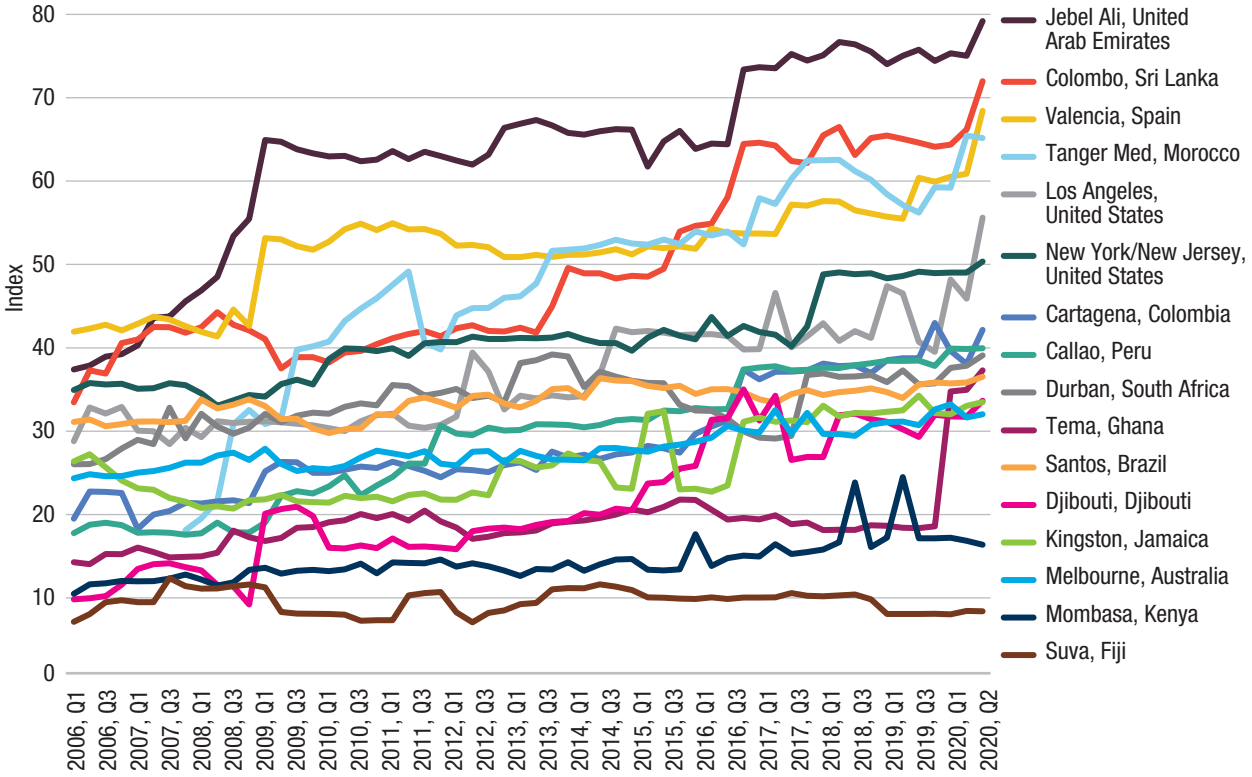
Figure 3.7 Liner shipping connectivity index of top 10 ports, first quarter 2006–second quarter 2020



Source: UNCTAD calculations, based on data provided by MDS Transmodal. For the liner shipping connectivity index of all ports, see http://stats.unctad.org/maritime.

Abbreviation: Q, quarter.

Figure 3.8 Liner shipping connectivity index of leading regional ports, first quarter 2006–second quarter 2020



Source: UNCTAD calculations, based on data provided by MDS Transmodal. For the liner shipping connectivity index of all ports, see http://stats.unctad.org/maritime.

Abbreviation: Q, quarter.

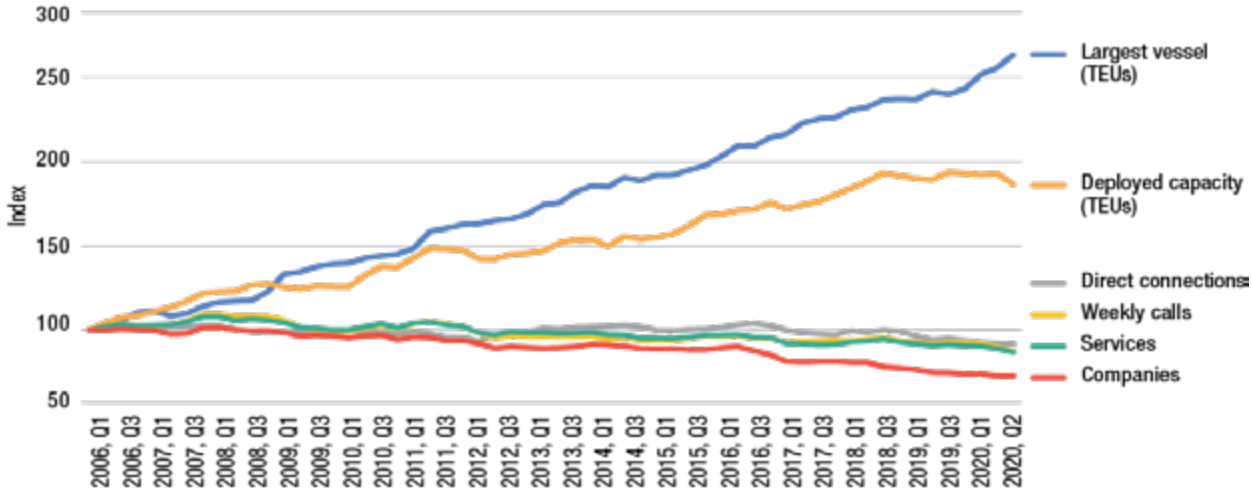
4. Liner shipping connectivity index components: Bigger ships and fewer companies

The liner shipping connectivity index helps to analyse trends among countries and ports. A look at the six components generating the index provides insights into industry developments (figure 3.9). The average fleet deployment per country is a reflection of the long-term trend of consolidation, as vessel sizes and total capacity deployed increase sharply, while the average number of companies that provide services to and from each country continues to decrease. The number of direct connections, number of services and number of weekly calls all follow a similar, slightly downward trend.

5. Fleet deployment during the COVID-19 pandemic

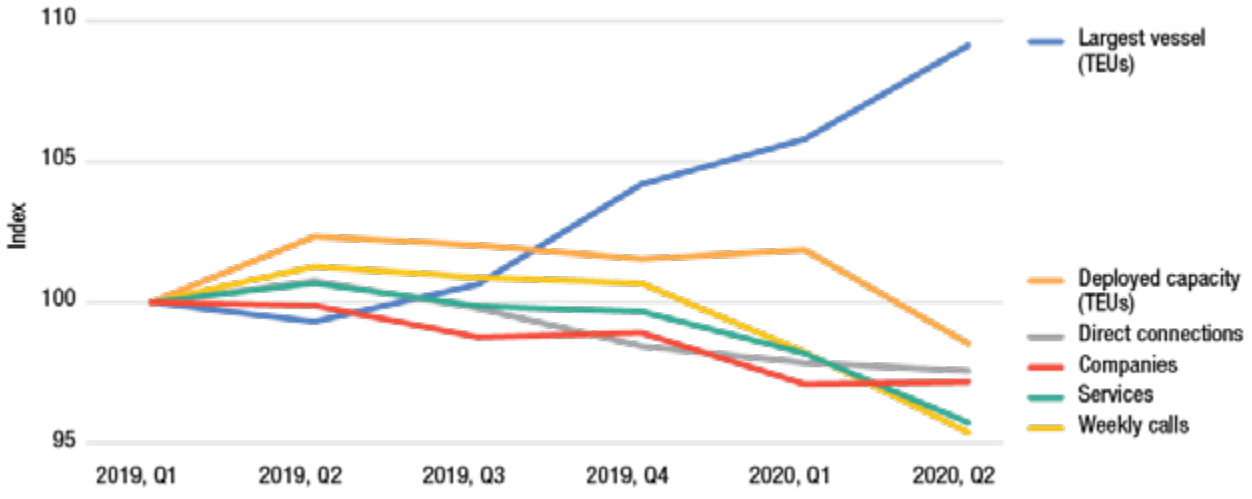
During the first two quarters of 2020, carriers managed their deployed capacity by reducing the frequency of calls and number of services. The average size of the largest container ships deployed continued to grow, in line with the long-term trends analysed in chapter 2. In the first quarter of 2020, scheduled deployed capacity still stood above that of the same quarter of 2019, albeit with a larger number of blank sailings; during the second quarter of 2020, schedules were adjusted further, and total deployed capacity was reduced below 2019 levels (figures 3.9, 3.10 and 3.11).

Figure 3.9 **Liner shipping connectivity index components, first quarter 2006–second quarter 2020, index of averages per country**
(First quarter 2006 = 100)



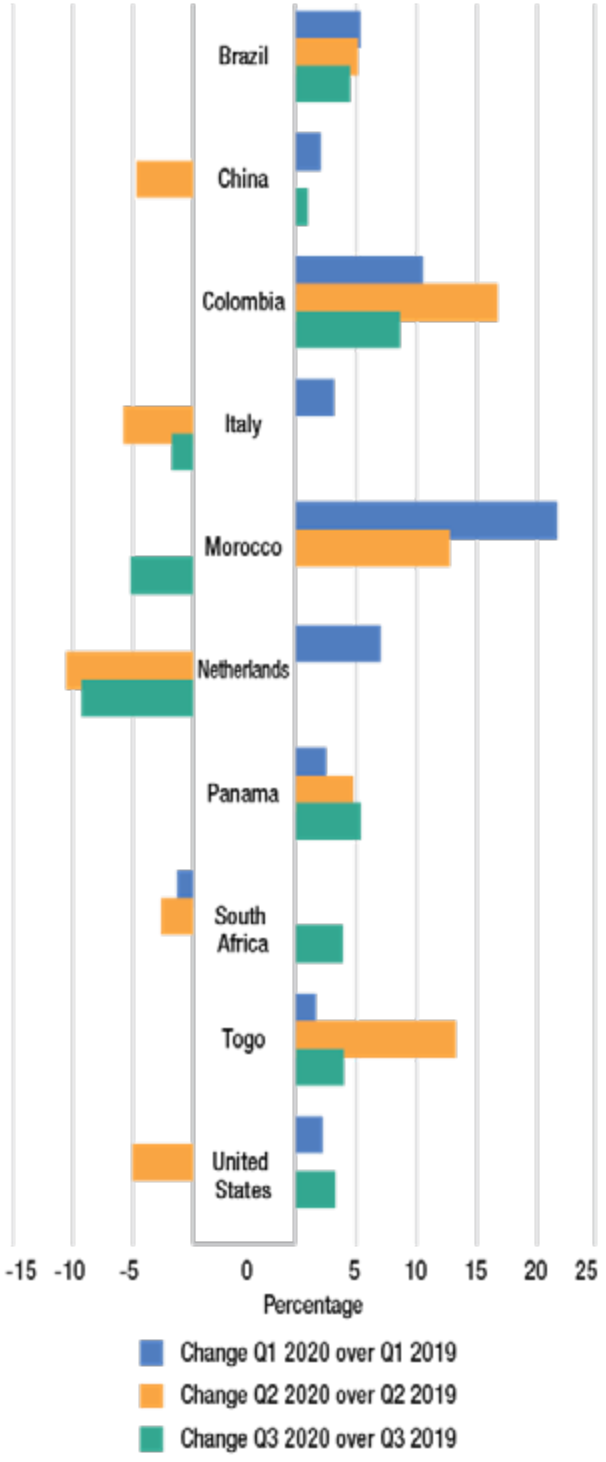
Source: UNCTAD calculations, based on data provided by MDS Transmodal.
Abbreviation: Q, quarter.

Figure 3.10 **Quarterly trends in fleet deployment, first quarter 2019–second quarter 2020**
(First quarter 2019 = 100)



Source: UNCTAD calculations, based on data provided by MDS Transmodal.
Abbreviation: Q, quarter.

Figure 3.11 **Quarterly trends in fleet deployment, selected countries, 2019–2020**
(Percentage change)



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

Note: Timeline: first and second quarters of 2020 compared with first and second quarters of 2019.

Abbreviation: Q, quarter.

Container shipping schedules show that total fleet deployment during the first quarter of 2020 was still above that of the first quarter of 2019 in most economies. During the second quarter, carriers started to reduce capacity considerably. Steps taken by the shipping lines to manage capacity helped them sustain positive earnings during the first semester of 2020, in spite of less traffic (see also chapter 2).

China started 2020 with an increase of 2.1 per cent over the first quarter of 2019, recording a negative year-on-year growth of minus 4.7 in the second quarter. Growth then rebounded to more than 1 per cent in the third quarter. Most European countries underwent a steeper decline. For example, the Netherlands went from plus 7.0 per cent in the first quarter to minus 10.5 per cent in the second quarter and minus 9.3 per cent in the third quarter. Morocco experienced positive growth in in the first two quarters, but lost ground in the third quarter. Togo stands out as gaining deployed capacity, as the port of Lomé is becoming a regional hub for West African trade, especially for Nigeria, where most of the ports are draft restricted.

6. Better connectivity stimulates port traffic

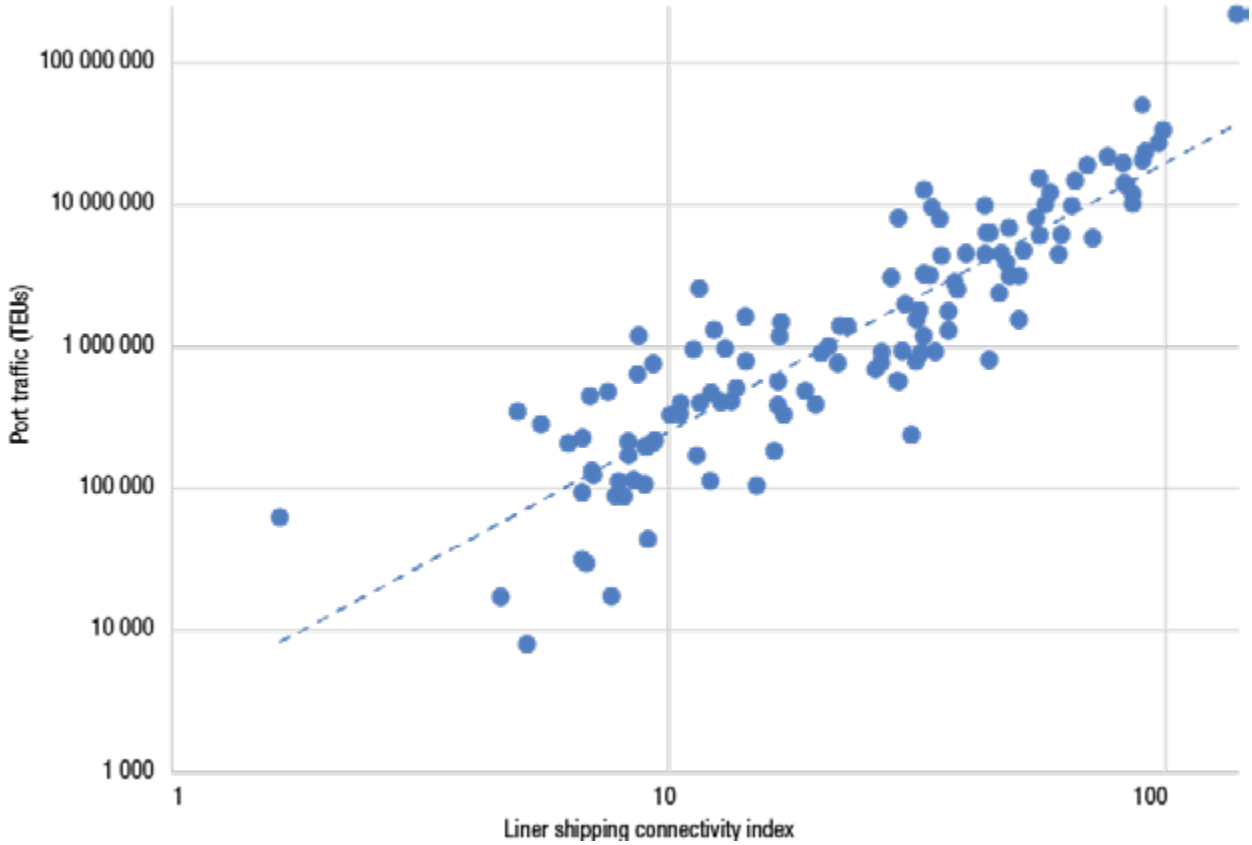
The liner shipping connectivity index is an indicator of the deployment of the world's container ship fleet. It is highly correlated with a country's port traffic. If there is more demand for the shipping of containerized cargo, liner companies will deploy more and larger ships, to achieve a higher level of total fleet deployment. They are also likely to provide more services to better connect the country directly to more countries. As the demand goes up, additional companies will enter this market. These components of fleet deployment are the six components from which the liner shipping connectivity index is generated.

It is interesting to analyse the correlation between these six components, as well as the liner shipping connectivity index, and each country's port container traffic patterns. UNCTAD has been systematically gathering port traffic statistics since 2010 (http://stats.unctad.org/TEU) (see also chapter 1). Figure 3.12 depicts the correlation between the liner shipping connectivity index and the port traffic of countries in 2017, the year for which the most complete statistics are available.

Interestingly, the correlation is not linear. Each additional 1 per cent increase in the liner shipping connectivity index is associated with a 1.896 per cent increase in port traffic. In other words, as more ships and services are provided, port traffic grows exponentially. This statistical finding is in line with the data, port performance and economies of scale recorded by the shipping companies (see section C below).

Similar correlations are observed for the individual components of the index with port traffic (table 3.5). For each component, there is a high and non-linear correlation with a country's port traffic. The highest correlation and the lowest exponential growth are recorded for the total deployed container-carrying

Figure 3.12 Liner shipping connectivity index and port traffic, 2017
(20-foot equivalent units)



Source: UNCTAD calculations, based on UNCTAD port traffic statistics and the liner shipping connectivity index generated with data from MDS Transmodal. Values are given for the first quarter of the 2017 liner shipping connectivity index and 2017 annual port traffic volumes in TEUs.

Note: $R^2 = 0.7851$; $y = 3209.1x^{1.896}$.

Table 3.5 Correlation between components of the liner shipping connectivity index and port traffic

Liner shipping connectivity index component	Coefficient of determination (R^2)	Elasticity
Liner shipping connectivity index	0.79	1.90
Total deployed container-carrying capacity (20-foot equivalent units)	0.90	1.13
Services (number of)	0.87	1.50
Frequency of port calls (number per week)	0.86	1.43
Companies (number of)	0.82	1.90
Size of largest ships (20-foot equivalent units)	0.61	1.53
Direct connections (number of, countries)	0,56	1.96

Source: UNCTAD calculations, based on UNCTAD port traffic statistics and the liner shipping connectivity index generated with data from MDS Transmodal. Correlation and elasticity are based on a power equation (see figure 3.12). Underlying values relate to the first quarter of the 2017 liner shipping connectivity index and 2017 annual port traffic volumes in TEUs.

capacity, as the two variables should largely grow in parallel. As regards additional companies and direct connections to additional markets, exponential growth is much stronger; increasing the number of direct connections by 1 per cent is associated with an increase in the port traffic by almost 2 per cent. In other words, for a port authority that aims to boost its port traffic, it would make good sense to focus especially on attracting additional carriers that provide direct services to a large number of trading partners.

7. Connecting trading partners through the container shipping network

In the second quarter of 2020, there were 939 seaports that were connected to the global liner shipping network through regular container shipping services (figure 3.13). If all ports had direct connections with each other, there would be 440,391 port-to-port liner shipping services. In reality, only 12,748 port pairs had such direct services, that is to say, 2.9 per cent of the theoretical total. For trade between 97.1 per cent of port pairs, containers need to be trans-shipped in one or more other ports. The necessary number of trans-shipments is one or two for most port pairs. The least connected port pairs require up to six trans-shipments. For example, 7 shipping services and 14 port moves would be necessary to export a container from some Pacific island ports to some Atlantic island ports for one trade transaction.

The structure of the liner shipping network is further illustrated in figure 3.14. Through an algorithm, the illustration visualizes ports that are well connected by locating them in close proximity to each other. Ports that have more direct connections in total are represented by larger points. The more distant ports are from each other, the more trans-shipments would be required to transport a container between them. An example of low connectivity depicted in figure 3.14 would be that of connectivity between Coatzacoalcos, Mexico with Basra, Iraq or with Malacca, Malaysia or with Rarotonga, the Cook Islands. Colour schemes reflect the geographical location of the port, and as expected, ports that are geographically closer to each other tend to be better connected with each other through the container shipping network.

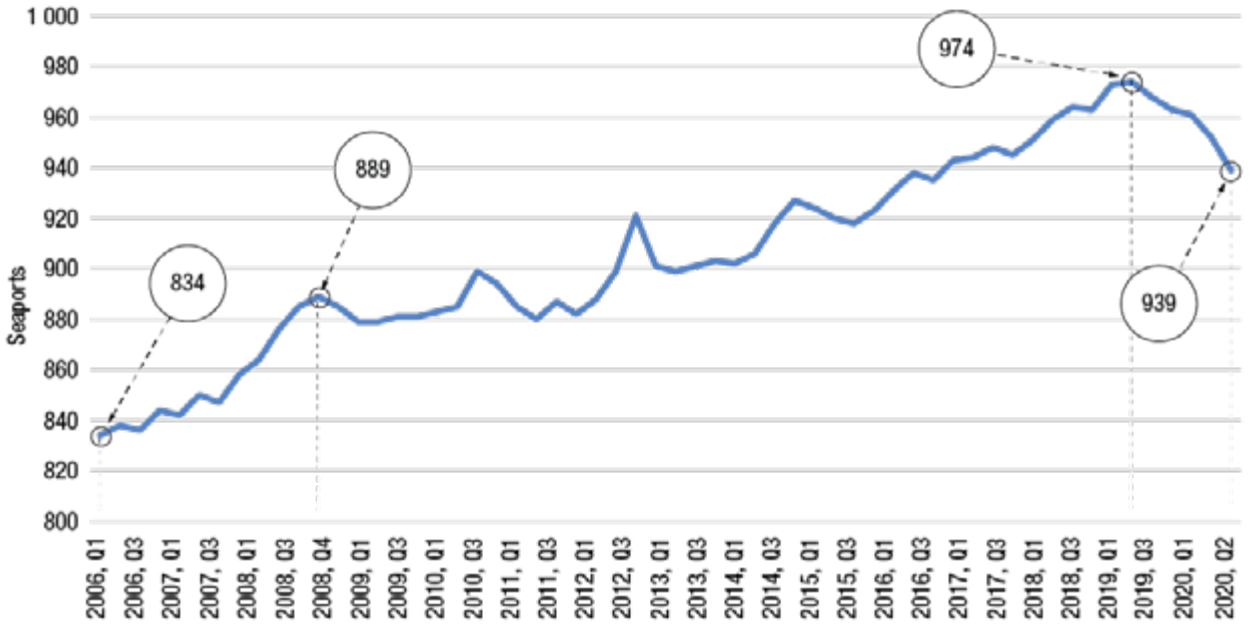
The port pair that is most connected through direct services is Ningbo–Shanghai, China, with 52 liner shipping companies providing 154 direct services and a total deployed annualized capacity of 50.1 million TEUs between the two ports. It is followed by Port Klang, Malaysia–Singapore, with 41 companies; Busan, the Republic of Korea–Shanghai, China, with 38 companies; and Shanghai–Qingdao, China, with 37 companies.

All the top 50 most connected port pairs are on intraregional routes, almost exclusively within Asia, except for two connections within Europe: Antwerp, Belgium-Rotterdam, the Netherlands, with 24 companies and Hamburg, Germany–Rotterdam, the Netherlands, with 23 companies.

In other regions, too, neighbouring ports are generally the most connected with each other. These intraregional connections do not necessarily carry trade between neighbouring ports, but the high connectivity is the result of being connected to the same overseas routes, in combination with feedering and trans-shipment services.

In Africa, for example, Durban and Cape Town, South Africa are connected with each other by services provided by 12 companies. In Angola, Luanda is most connected with Cape Town, South Africa with seven companies, and Mombasa, Kenya is most connected with Dar-es-Salam, the United Republic of Tanzania through direct services by 10 companies. By comparison, there are only six companies that connect Mombasa, Kenya with Ningbo, China. The connectivity

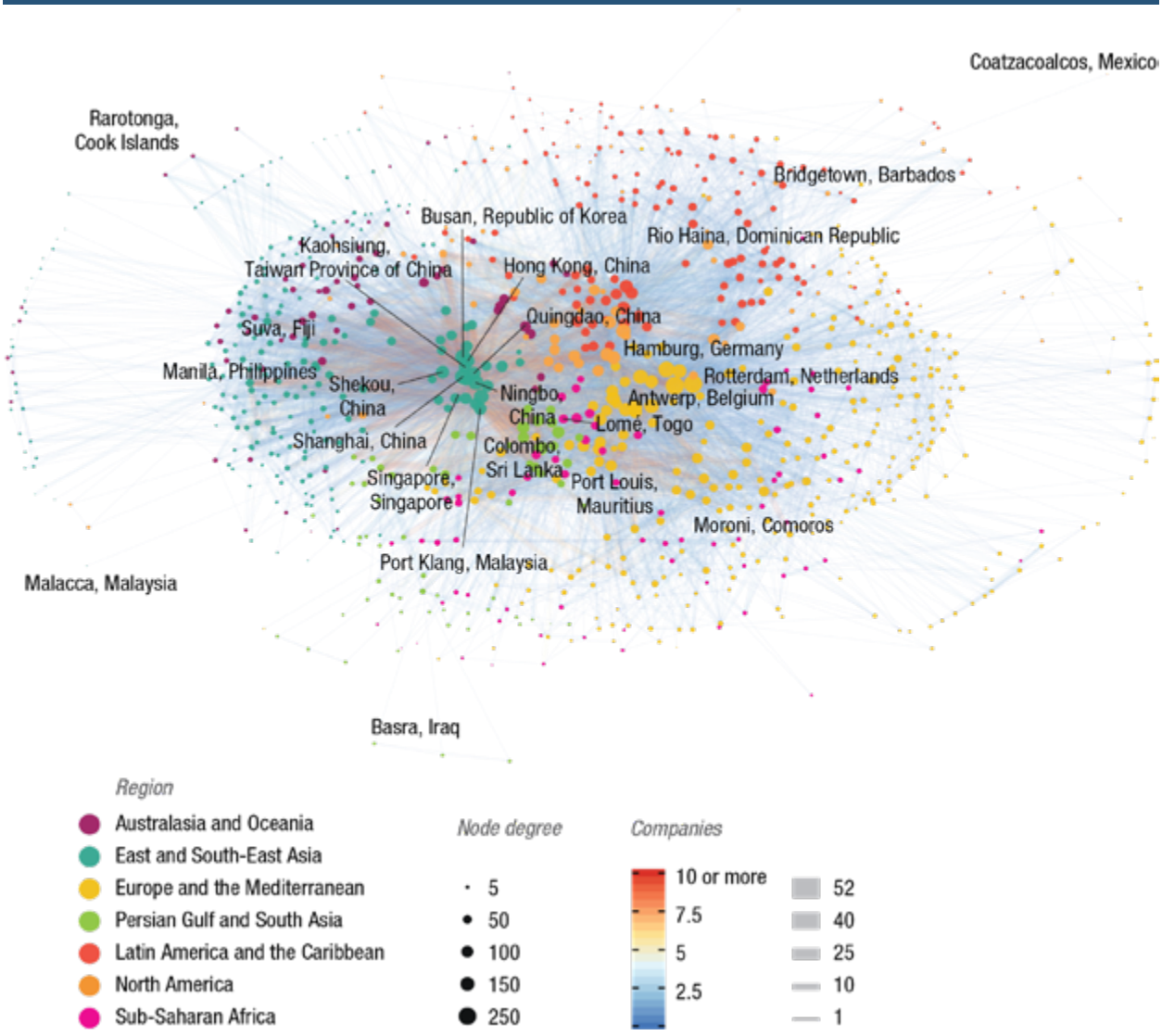
Figure 3.13 Number of seaports with regular container vessel calls, first quarter 2006–second quarter 2020



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

Abbreviation: Q, quarter.

Figure 3.14 Global liner shipping network, second quarter 2020



Source: UNCTAD calculations, based on data provided by MDS Transmodal; visualization by Julian Hoffmann.
Notes: Layout = stress; links = number of companies providing a direction connection.

level of Tanger Med, Morocco is highest with Algeciras and Valencia, Spain, through services provided by nine liner companies.

In South America, Buenos Aires, Argentina is most connected with Montevideo, Uruguay (13 companies) and in Brazil, 14 companies provide direct services between Paranaguá, Rio de Janeiro and Santos. There are 10 companies that connect San Antonio, Chile with Callao, Peru; 15 companies that connect Callao, Peru with Guayaquil, Ecuador and 12 companies that provide direct services between Cartagena, Colombia and Manzanillo, Panama.

In the Pacific, two ports in Fiji (Lautoka and Suva) are connected through services by seven liner companies, while Betio, Kiribati is connected with Lautoka and Suva, Fiji through services by two carriers. Also, Kosrae and Pohnpei, Micronesia have direct services with Majuro, the Marshall Islands that are provided by two companies, while only one company connects these ports with Yokohama, Japan and other ports in Asia. Honiara, Solomon Islands and Port Vila, Vanuatu are most connected with ports in Fiji (four companies) and with Yokohama, Japan and other ports in Asia (3 companies).[16]