

Globalized production, trade, communication and finance depend on connectivity, that is, the possibilities for people, companies and countries to connect with each other. UNCTAD has led the research on shipping connectivity since the first publication of the liner shipping connectivity index in 2004.

More recently, “[c]onnectivity has become a buzz word in development and international economics Viewing economic and social ties as isolated point-to-point interactions is losing ground to more comprehensive approaches, in which ‘networks’ are increasingly becoming the unit of analysis” (World Bank, 2013a). The Group of 20 launched the Global Infrastructure Connectivity Alliance to improve the “linkages of communities, economies and nations through transport, communications, energy and water networks” (Global Infrastructure Connectivity Alliance, 2016). In the same vein, Aid for Trade at a Glance 2017 focuses on promoting trade, inclusiveness and connectivity for sustainable development (World Trade Organization, 2017). In a contribution to the aforementioned report, OECD and UNCTAD (2017) point out that “while digital connectivity can provide new opportunities for developing countries to participate in international trade, traditional trade costs related to physical connectivity can still represent a significant barrier to the physical delivery of goods”. World Bank (2013b) concludes that “[m]aritime transport connectivity and logistics performance are very important determinants of bilateral trade costs: in some specifications, their combined effect is comparable to that of geographical distance”. Improved liner shipping connectivity can help reduce trade costs and has a direct, positive bearing on trade volumes. This is confirmed by numerous studies on trade, seaports and shipping networks (see Wilmsmeier et al., 2006; Sourdin and Pomfret, 2012; Wilmsmeier, 2014; Ducruet, forthcoming; Fugazza and Hoffmann, 2017; Hoffmann et al., 2017; Wilmsmeier et al., 2017; and Geerlings et al., forthcoming, and the extensive literature referred to therein).

Given that maritime shipping continues to be the main mode of transport for most developing countries’ foreign trade, this chapter begins by introducing the concept of maritime transport connectivity at the country level and for bilateral connections (section A). It then discusses in more detail two areas where maritime connectivity could be improved, notably the potential of connecting domestic and international shipping services (section B) and trade and transport facilitation measures that could enhance maritime connectivity (section C). Concluding section D presents policy options and recommendations, building upon the six chapters of the Review.

MARITIME TRANSPORT CONNECTIVITY

MARITIME CONNECTIONS

Country pairs that add a direct route tend to see a reduction in trade costs of 9 percentage points

BEST CONNECTED COUNTRIES PER REGION



Cabotage can enhance operational efficiency along the supply chain, address concerns related to carbon dioxide emissions and energy efficiency and trade prospects through trans-shipment

The potential of cabotage is higher in countries with longer coasts or in countries with islands, where the alternative road transport is costlier or not available

A. CONTAINER SHIP DEPLOYMENT AND LINER SHIPPING CONNECTIVITY

Most manufactured goods are transported by containerized liner shipping services. Container ships have a fixed schedule and call at several ports during a journey. Containers with goods belonging to different shippers are loaded, trans-shipped or unloaded in each port. This type of service is comparable to a city's metro network, where metro stations are connected to one or more lines. Passengers will look at timetables and options to change from one line to another to arrive at a destination. For liner shipping services, the "connectivity" of different countries can be compared by consulting ship schedules and considering options to connect to overseas markets through the liner shipping network.¹

Figure 6.1 depicts the density map of container ships in 2016. The key nodes of the network are Malacca, Panama, the Strait of Gibraltar and Suez, and traffic is denser in general in the northern hemisphere than in the southern hemisphere, with exceptions, for example around Santos (Brazil), South Africa and Mauritius. Some locations are better connected than others, and it is worthwhile to understand the reasons for these differences and options for improvement.

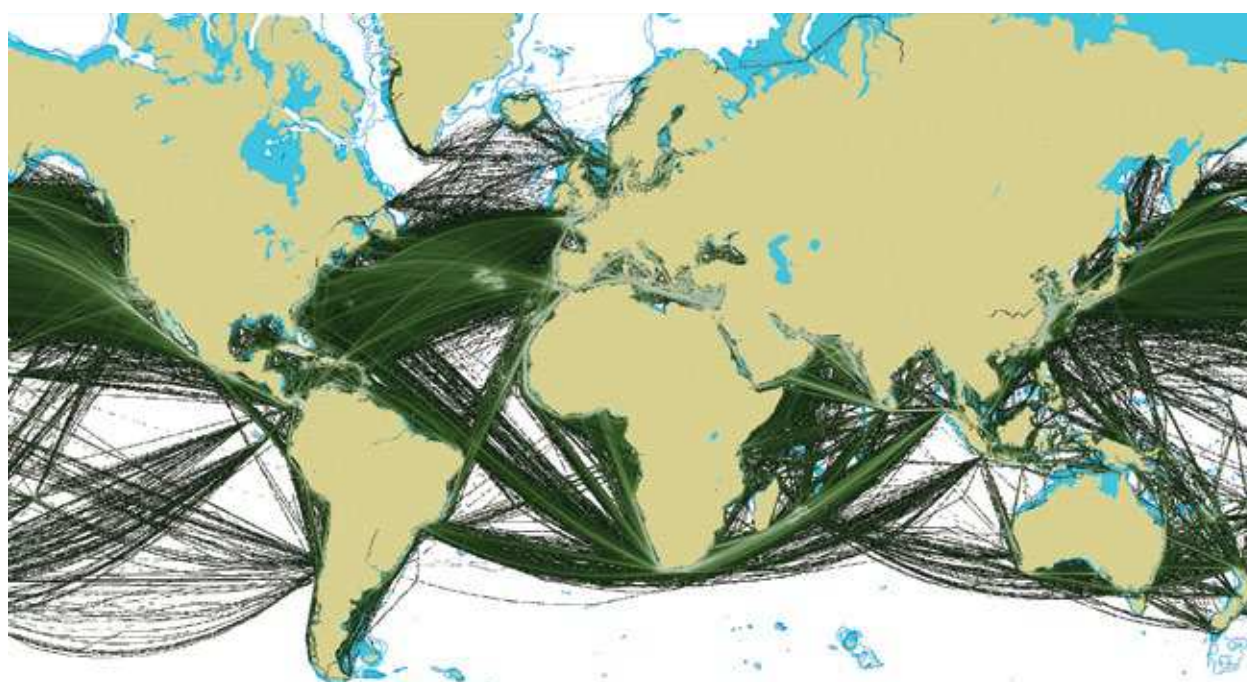
1. Country-level liner shipping connectivity

To compare and analyse countries' positions within the global liner shipping network, UNCTAD in 2004

developed the liner shipping connectivity index. The index, generated from the schedules of the world's container shipping fleet, uses five components: the number of ships deployed to and from each country's seaports, their combined container-carrying capacity, the number of companies that provide regular services, the number of services and the size of the largest ship.² The methodology has remained constant since 2004 and is not dependent on samples, surveys or perceptions. Figure 6.2, panels (a) – (h), illustrates index trends in selected regions.

On the west coast of South America, Panama is the best-connected country of the subregion (figure 6.2(a)). Panama benefits from the Panama Canal, which has encouraged the establishment of trans-shipment ports. Chile and Peru have largely the same level of connectivity, as both countries are served by the same companies and ships. Ecuador is still lagging behind; initially, its main seaport, Guayaquil, was among the last to invest in ship-to-shore container gantry cranes and is hindered by draft restrictions in comparison with the other main ports on the west coast of South America. This example shows that ports along a same route also depend on investments made in other ports served by the same lines. If – for example – only one port invests in container-handling equipment while other ports on the same route do not, ships will need to bring their own gear, and potential savings on the seaside are not achieved. On the west coast of South America, Chile was among the first to invest in ship-to-shore container cranes, and for many years, many ships calling at San Antonio or Valparaiso, Chile continued to sail with

Figure 6.1. Density map of container ship movements



Source: Prepared for UNCTAD by Marine Traffic.

Note: Data depict container ship movements in 2016.

their own cranes, because they needed them in Callao, Peru; Guayaquil, Ecuador or Buenaventura, Colombia. Today, such differences have prompted a trend towards hub-and-spoke networks, and ports like Guayaquil are often served by feeder services with trans-shipment, principally in Panama.

On the east coast of South America (figure 6.2 (b)), Argentina, Brazil and Uruguay are served by the same lines. Although Uruguay is a much smaller economy, it accommodates the same services, not only for its own imports and exports, but also for transit cargo from Paraguay and trans-shipment services into Argentina and Brazil, where cabotage restrictions limit the trans-shipment potential of domestic ports.

In Africa, the best-connected countries are Egypt, Morocco and South Africa (figure 6.2 (c)). Morocco has seen a sharp increase of its liner shipping connectivity index because of the trans-shipment hub Tanger–Mediterranean. In Eastern Africa, Djibouti has significantly improved its connectivity, benefiting from its geographical position and private investments in the trans-shipment hub (figure 6.2 (d)).

On the Arabian Peninsula, the United Arab Emirates, with its hub port in Dubai, has maintained the highest liner shipping connectivity index of the subregion (figure 6.2 (e)). Several countries have benefited from their geographic position, linking East–West services between Europe and Asia to North–South and feeder services that connect their ports to Africa and Southern Asia.

In Southern Asia, Sri Lanka has bypassed its neighbours. Colombo accommodates large container ships that are deployed on services between Asia and Europe, as well as some services to Africa and South America (figure 6.2 (f)). Feeder services from Colombo to ports in India can be done with ships under any flag, as these services are not affected by the Indian cabotage restrictions.

In South-East Asia, Singapore and Malaysia are largely served by the same lines in their Asia–Europe services, and their liner shipping connectivity index moves mostly in parallel (figure 6.2 (g)). In some years, however, the index reflects competition for trans-shipment services. For example, in 2007, Maersk left Singapore for Malaysia for most trans-shipment operations. The other countries in the subregion have not seen improvements in their index, as they continue to connect to overseas markets largely through trans-shipment services via Singapore and Malaysia.

In Eastern Asia, China boasts the highest liner shipping connectivity index, as its ports are the world's major loading locations (figure 6.2 (h)). For many years, Hong Kong (China) and the Republic of Korea benefited from connecting Chinese and

Japanese services to the global liner network through their trans-shipment hubs. With growing trade volumes and revised cabotage regulations for trans-shipment in Shanghai, ships increasingly call directly at ports in China, and the need for trans-shipment in Hong Kong (China) and the Republic of Korea has decreased.

Small island developing States in all regions are characterized by low levels of connectivity. Examples from table 6.1 include Antigua and Barbuda in the Caribbean (four ships on two services), Sao Tome and Principe in the Atlantic (five ships on two services), Maldives in the Indian Ocean (two ships on two services), and Nauru and Tuvalu in the Pacific (one ship on one service). Mauritius, on the other hand, has attracted ships of more than 10,000 TEUs, with 16 ship operators deploying 75 ships on 13 services to and from the island.

The largest container ships of up to 18,506 TEU capacity are deployed on services between Europe and Eastern Asia, calling also at ports in Southern and South-East Asia and in Northern Africa (Morocco). The largest ships deployed on services to North America carry up to 13,950 TEUs.

The liner shipping connectivity index illustrates trends in different countries. For a more detailed analysis, it is also useful to look at the components of the index. Table 6.1 provides data relating to the five components for selected countries (May 2017). Annual deployed container-carrying capacity varies between 6,156 TEUs for Tuvalu and more than 85 million TEUs for China; there were 1,996 container ships scheduled on liner services to and from Chinese ports, compared with just one ship for Tuvalu. Small island developing States in all regions must deal with low levels of connectivity.

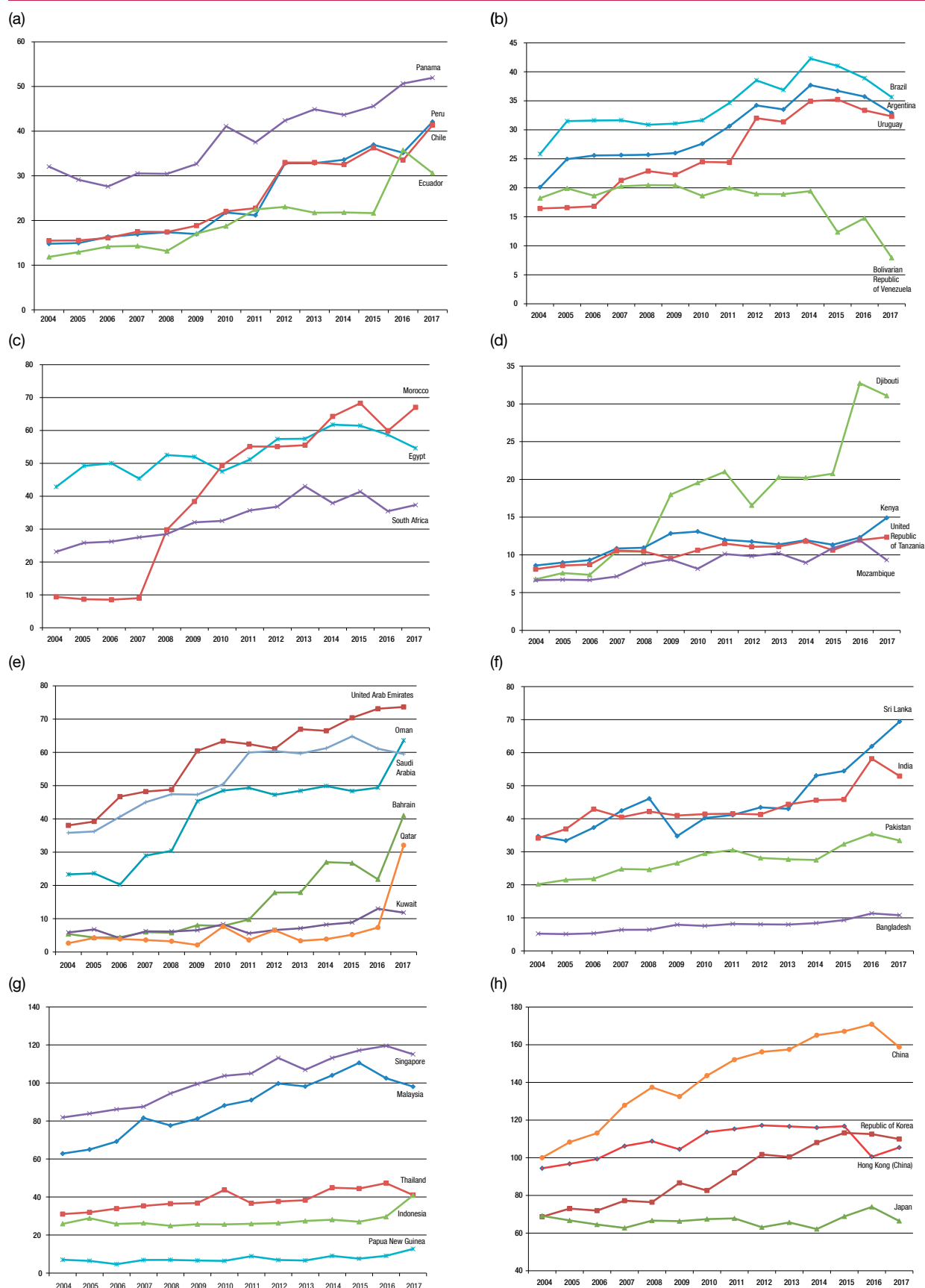
Container ship deployment to seaports in Egypt and Panama is similar overall, even though the maximum ship size that can pass through the Suez Canal is far larger than what is allowed through the Panama Canal, even after the latter's expansion. The larger ships that pass through the Suez Canal do not make use of Egyptian seaports. In Africa, Togo is served by ships of up to 10,309 TEU capacity, connecting Western and Southern Africa (including Mauritius) to Eastern Asia. Ships calling at ports in Ghana, Kenya, or Nigeria have less than half of that capacity. Steps policymakers can take to attract more companies, ships and services are discussed later in this chapter; further details about the structure of the global liner shipping network and country-pair (bilateral) connectivity are provided below.

2. Bilateral liner shipping connectivity

Less than 20 per cent of coastal country pairs have a direct maritime connection between them, meaning that containerized goods can be transported

Figure 6.2. Liner shipping connectivity index, 2004–2017:

(a) West Coast, South America; (b) East Coast, South America; (c) African hubs; (d) Eastern Africa; (e) Western Asia; (f) Southern Asia; (g) South-East Asia; and (h) Eastern Asia



Source: UNCTAD secretariat calculations. For the liner shipping connectivity index of each country, see <http://stats.unctad.org/LSCI>; for the calculation, see endnote 2.

Table 6.1. Country-level container ship deployment, selected countries, May 2017

Country	Deployed annual capacity (TEUs)	Number of ships scheduled on services	Number of services	Maximum ship capacity (TEUs)
Antigua and Barbuda	78 832	4	2	1 116
Chile	4 187 451	129	21	11 629
China	85 347 681	1 996	463	18 506
Democratic Republic of the Congo	173 662	15	7	1 005
Egypt	12 110 793	293	71	14 167
Germany	26 427 472	621	143	18 350
Ghana	1 866 259	111	18	4 596
Kenya	1 815 648	71	17	4 013
Malaysia	36 663 697	906	196	18 506
Maldives	64 256	2	2	1 118
Mauritius	2 339 459	75	13	10 409
Micronesia	9 360	3	1	624
Morocco	12 053 640	312	68	18 350
Myanmar	809 958	43	17	1 468
Nauru	16 276	1	1	626
Nigeria	3 262 826	179	27	4 535
Panama	11 943 496	357	62	12 041
Republic of Korea	40 924 768	1 017	245	18 506
Sao Tome and Principe	41 145	5	2	2 006
Sri Lanka	13 719 661	327	59	18 350
Togo	2 302 871	90	15	10 409
Tuvalu	6 156	1	1	513
United Arab Emirates	20 468 669	393	94	17 387
United States	36 154 504	990	200	13 950
Venezuela (Bolivarian Republic of)	555 826	30	16	2 139

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

Note: The container ship-carrying capacity indicated in this table is not fully comparable to the capacity indicated in chapter 2. For the purposes of chapter 6, only the capacity to transport full containers is considered – reported vessel sizes in TEUs in this table are slightly smaller than those in chapter 2.

between a country of origin and a destination without the need for trans-shipment. The average number of direct maritime connections is half as high in developing countries compared to developed ones.

Table 6.2 provides examples of bilateral fleet deployment to illustrate the different aspects of bilateral connectivity. The highest direct bilateral connectivity is between China and the Republic of Korea. In general, there are high levels of connectivity between neighbouring countries. For instance, ships may call at the ports of two neighbouring countries; some transport bilateral trade between the two countries or call at trans-shipment ports as feeder vessels, and the same ships may transport exports from the two neighbouring countries to third countries.

More than 80 per cent of country pairs do not have a direct connection. This includes large trading nations that lie across the same ocean, for example, Brazil and Nigeria. An interesting question for trade and transport analysts is whether there are no direct connections between the two countries because there is not enough demand, or whether there is not much trade between them because the two trading partners are not well connected. As discussed below, there is evidence for both.

Because of containerization and trans-shipment, any country can effectively trade with another country, even if there is no direct service connecting the two. To capture the level of bilateral connectivity for those cases where there is no direct service, UNCTAD developed the bilateral liner shipping connectivity index (Fugazza and Hoffmann, 2016; Hoffmann et al., 2014). Unlike the country-level index, which provides an index value per country, the bilateral liner shipping connectivity index provides 160 values per country, namely a coastal country's connectivity with other coastal countries.

The bilateral liner shipping connectivity index is generated from five components. For a pair of countries A and B, the index is based on the following factors: the number of trans-shipments required to get from country A to country B, where a lower number leads to a higher index; the number of direct connections common to both countries; the geometric mean of the number of direct connections of countries A and B; the level of competition on services that connect country A to country B; and the size of the largest ships on the weakest route connecting country A to country B.³ The index is symmetrical; in other words, what characterizes liner services from country A to country B also characterizes services from country B to country A.

Table 6.2. Bilateral container ship deployment, selected country pairs, May 2017

Country pairs	Deployed annual capacity (TEUs)	Number of ships scheduled on services	Number of services	Maximum ship capacity (TEUs)
Antigua and Barbuda–Saint Kitts and Nevis	78 832	4	2	1 116
Argentina–Brazil	4 358 270	115	19	9 635
Australia–Singapore	2 650 466	91	17	6 380
Bangladesh–Malaysia	1 612 738	40	16	2 457
Brazil–India	-	-	-	-
Cambodia–Thailand	693 801	34	9	2 181
Cameroon–Gabon	211 154	19	4	3 149
Chile–Peru	3 877 925	119	17	11 629
Chile–Singapore	-	-	-	-
China–Netherlands	11 456 912	156	14	18 506
China–Republic of Korea	38 356 591	911	180	18 506
China–United States	19 331 964	427	57	13 950
Colombia–Panama	6 527 459	203	29	11 629
Djibouti–Saudi Arabia	1 988 139	57	9	8 966
Ecuador–Panama	1 625 393	74	12	9 227
Egypt–Italy	6 090 427	152	30	14 167
Gabon–Namibia	4 260	1	1	710
Germany–Netherlands	19 879 996	409	62	18 350
India–Sri Lanka	6 982 551	150	37	11 569
Kenya–United States	-	-	-	-
Madagascar–France	720	2	1	60
Marshall Islands–Fiji	61 994	7	3	1 617
Mauritius–South Africa	1 451 832	36	4	10 409
Nigeria–Brazil	-	-	-	-
Togo–China	1 201 361	44	4	10 409

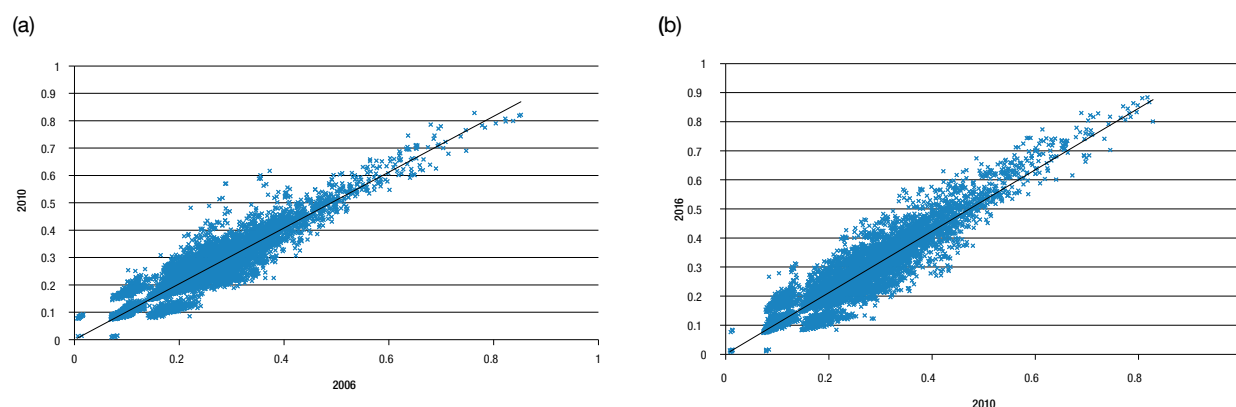
Source: UNCTAD secretariat calculations based on data provided by MDS Transmodal.

Note: Country pairs with no information provided (on this table) do not have a direct liner connection.

Figure 6.3 compares the bilateral liner shipping connectivity index over two periods: panel (a) compares 2010 values with those of 2006, and panel (b) compares 2016 values with those of 2010. Points above (below) the 45-degree line represent country pairs whose index has increased (decreased). Between 2006 and 2010, 61 per cent of country pairs saw an improvement of their index. The figure increases to 68 per cent between 2010 and 2016. The index stagnated for most country pairs in the immediate aftermath of the 2008 economic and financial crisis and began increasing only after 2010.

An analysis of the components of the bilateral liner shipping connectivity index reveals that the average number of trans-shipments required to transport a container from one country to another has grown over the years. This is in line with industry trends. As ships become larger and alliances make more and more use of hub ports from where ships with the most appropriate vessel size for each leg of the total route are assigned, the number of direct services decreases. This reflects the continued need for an optimization of shipping line networks (MDS Transmodal, 2017).

Figure 6.3. Bilateral liner shipping connectivity index trends, (a) 2006–2010 and (b) 2010–2016



Source: UNCTAD secretariat calculations, based on data from the UNCTAD liner shipping connectivity matrix (internal database).

Table 6.3. Top 25 country pairs ranked according to the bilateral liner shipping connectivity index, 2006, 2010 and 2016

Country pairs		Rank in 2006	Rank in 2010	Rank in 2016
Netherlands	United Kingdom	2	2	1
Netherlands	Belgium	5	4	2
United Kingdom	Belgium	1	3	3
Netherlands	Germany	6	7	4
Germany	Belgium	3	6	5
Republic of Korea	China	17	10	6
Singapore	Malaysia	16	5	7
United Kingdom	Germany	4	9	8
United Kingdom	France	8	11	9
France	Spain	10	35	10
United Kingdom	Spain	14	18	11
Netherlands	Spain	19	20	12
Malaysia	China	46	15	13
Spain	Belgium	18	19	14
Singapore	China	23	8	15
Netherlands	France	11	13	16
France	Belgium	7	12	17
Spain	Germany	25	22	18
Hong Kong (China)	China	9	1	19
France	Germany	12	17	20
Singapore	Republic of Korea	55	26	21
Italy	Spain	15	21	22
Malaysia	Republic of Korea	89	71	23
China	Belgium	36	25	24
Spain	China	57	32	25

Source: UNCTAD secretariat calculations, based on data from the UNCTAD liner shipping connectivity matrix (internal database).

In addition to European countries, five Asian countries are found among the top 25 country pairs (table 6.3). Their presence is more marked in 2016 and 2010 than in 2006. A deeper analysis shows that the top 50 bilateral liner shipping connectivity indices are only found on connections between 15 countries and that the top 250 indices are for connections between 40 countries. Bottom country pairs essentially include small and remote islands such as the Cook Islands, Montserrat and Nauru, and the least developed countries.

The definition and construction of the bilateral liner shipping connectivity index, based on hard fleet deployment data, rather than perceptions or surveys, is clearly of empirical interest. The index and its components have a direct bearing on trade costs, and liner shipping connectivity plays a crucial role in determining a country's trade performance. All other factors remaining equal, an

increase by one unit (equivalent to a variation of 0.01) of the index is associated with an increase of the value of exports of containerizable goods by 3 per cent. Lacking a direct maritime connection with a trade partner is associated with lower export values; any additional trans-shipment is associated with a 40 per cent lower bilateral export value. An additional common direct destination is associated with about a 5 per cent higher bilateral export value. An increase by 1,000 TEUs of the largest ship operating on any leg of a maritime route is associated with an increase in bilateral export values of 1 per cent (Fugazza and Hoffmann, 2017; Fugazza, 2015).⁴ Building on data from the UNCTAD liner shipping connectivity matrix, Shepherd (forthcoming) estimates that a reduction in trade costs of 9.09 percentage points can be achieved when country pairs add a direct maritime connection.

The construction and use of the UNCTAD indices on liner shipping connectivity go beyond empirical considerations. The possibility to monitor changes in the indices and their components over time can also help frame practical policy orientations. The data set offers a unique view of the liner shipping network, offering the possibility to understand and take into consideration the position in that network of a specific country or country pair. The indices can therefore be useful monitoring instruments and benchmarks for policymaking.

The next two sections discuss in detail two policy areas where a country's maritime transport connectivity can be improved. Section B looks at maritime cabotage – domestic shipping services – which could be linked to international shipping services, thus potentially improving a country's international connectivity. Second, section C focuses on trade and transport facilitation, through which a country's seaports can be made more attractive to its clients, that is to say, shipping lines and shippers.