

## Liner Shipping Connectivity

An article in a previous issue of the Transport Newsletter (3<sup>rd</sup> Quarter 2004) discussed recent developments regarding a “new geography of trade”. It reviewed recent literature and ongoing research concerning the determinants of trade, i.e. the question of who trades what with whom. Among the relevant aspects that are considered to have an impact on the competitiveness of nations and on the geography of trade are geographical factors such as distance from major markets or being a landlocked country, which are reflected in transport costs. Another important – but often neglected – determinant of competitiveness is transport connectivity, i.e. access to regular and frequent transport services.

Except for bulk commodities, most intercontinental trade is transported by liner shipping services. Access to such services is thus a crucial aspect of competitiveness and hence also of the geography of trade. In this article, we present possible measures that could serve as indicator for available liner shipping services in different countries.

The indicators are generated from data obtained through Containerization International Online ([www.ci-online.co.uk](http://www.ci-online.co.uk); accessed in July 2004). They reflect the services, vessels and their TEU<sup>1</sup> capacity deployed by international liner shipping companies.

### 1) Deployment of container ships

The “fleet deployment” is the number of ships that national and international liner shipping companies deploy on the liner services from and to the country’s ports. A larger number of ships is an indicator that a country’s shippers have more opportunities to load their containerized exports, i.e. that they are better connected to foreign markets.<sup>2</sup>

Table 1 shows the ten economies with the highest number of container ships deployed on liner services from and to their ports.

**Table 1: Fleet assignment (number of ships)**

Rank	Country	Ships
1	China	1 228
2	Hong Kong, China	1 166
3	United States	1 074
4	Singapore	916
5	United Kingdom	861
6	Germany	810
7	Netherlands	785
8	Belgium	774
9	Japan	756
10	Korea, Republic of	734

Source: [www.ci-online.co.uk](http://www.ci-online.co.uk), July 2004.

The country with the largest number of deployed container ships is China (1,228 vessels), followed by Hong Kong (China) (1,166) and the United States (1,074). In Latin America, ports in Panama receive the largest number of ships (243) and in Africa the leading country is Egypt (336). Panama and Egypt both benefit from their geographic position and their canals. The deployment of vessels to Panama, for example, is not a reflection of the volume of Panamanian containerized trade but rather of the leading

<sup>1</sup> TEU stands for a twenty-foot equivalent unit. The number of TEU thus reflects the container carrying capacity of a ship.

<sup>2</sup> Although ships do not arrive empty and not the entire deployed capacity is actually available for a country’s exports, it can be assumed that, on average, the number of deployed capacity is approximately proportional to the actually available capacity.

position of Panamanian ports as transshipment centres at both ends of the canal. It is thanks to these transshipment ports that Panamanian exporters have access to a much larger number of deployed ships than exporters in neighbouring countries Colombia (184 ships) and Costa Rica (87).

The average fleet assignment to Least Developed Countries (LDCs)<sup>3</sup> is only one seventh of the average of Non-LDCs and only 1.9 per cent of that of China.

## 2) Deployment of container carrying capacity (TEU)

A similar picture is obtained if we look at the deployment of container carrying capacity, i.e. considering the number slots for 20 foot equivalent units (TEU). China (3.93 million TEU), Hong Kong (China) (3.75 million) and the United States (2.98 million) are the three countries where the largest fleets are being deployed (Table 2). Egypt (854,203) and Panama (703,432) continue to lead in Africa and Latin America, respectively. In South America, Brazil's ports (464,490) receive most TEU capacity; in Sub-Saharan Africa, the highest TEU capacity is deployed in South African ports (382,351); and in South Asia, ports in Sri Lanka (668,033) receive 56 per cent more TEU slots than India (427,443). Indian containerized trade is often transshipped in Sri Lanka, and the latter's exporters and importers thus benefit from the situation of Colombo as a major transshipment centre.

The Republic of Yemen (129,773), Senegal (95,961) and Benin (92,962) are the three LDCs with the largest fleet deployment in their ports. On average, LDCs receive only 7 per cent of the TEU capacity of Non-LDCs, and only 0.7 per cent of that of China.

**Table 2: Fleet assignment (TEU)**

Rank	Country	TEU
1	China	3 928 913
2	Hong Kong, China	3 749 697
3	United States	2 978 193
4	Singapore	2 471 635
5	Germany	2 249 857
6	United Kingdom	2 169 336
7	Korea, Republic of	2 110 367
8	Netherlands	2 083 832
9	Taiwan Province of China	1 959 434
10	Japan	1 926 790

## 3) Deployment of container ships per capita

In absolute terms, traders in smaller countries will most likely have access to fewer ships calling at national ports than traders in larger countries. Yet, there exist a number of smaller countries that have managed to attract additional liner services by providing transshipment port services. Most containers in Malta, The Bahamas and Singapore are transshipped, i.e. after being discharged, they are re-loaded onto a different containership for further distribution. These additional liner shipping services help to

<sup>3</sup> For a list of LDCs see the United Nations OHRRLLS at <http://www.un.org/special-rep/ohrrlls/ldc/list.htm>.

increase a country's connectivity in spite of perhaps limited national trade. In other words, national exporters and importers benefit from liner services that initially call at its ports to make use of its transshipment facilities, yet at the same time will also offer to transport imports and exports. In order to account for a country's "size", the vessel deployment at a country's ports can be divided by its population, thus generating the vessel deployment per capita (Table 3).

Particularly small island states, which depend on imports for most of their consumer goods, do attract relatively large numbers of container ships. The highest vessel deployment per capita is recorded for those island states that have managed to become transshipment centres, such as Malta (286 ships per million inhabitants), The Bahamas (225), and Singapore (222). St. Kitts and Nevis, Aruba, and Antigua and Barbuda, too, have developed as regional hub ports for neighbouring Caribbean economies, receiving many, albeit relatively small, container carrying ships. Bangladesh (0.27 ships per million inhabitants), India (0.24), Iraq (0.21) and the Democratic Republic of Congo (0.17) are the countries which receive the smallest number of ships per inhabitant.

**Table 3: Fleet assignment (ships) per capita**

Rank	Country	Ships per million capita
1	Malta	286
2	St. Kitts and Nevis	266
3	Bahamas	226
4	Singapore	222
5	American Samoa	214
6	Aruba	178
7	Hong Kong, China	173
8	French Polynesia	143
9	Marshall Islands	133
10	Antigua and Barbuda	131

#### 4) Deployment of container carrying capacity per capita

Malta, Singapore and Hong Kong (China) are the countries in whose ports the largest container carrying capacity per capita of the population is deployed. Most of the top ten countries (Table 3) are islands and most are also host to important hub ports. Hong Kong and Belgium are host to container terminals that serve as hub ports for neighbouring countries; and Panama and the United Arab Emirates are also host to important regional free-zones. The Czech Republic (0.02 TEU per 1000 capita) and Paraguay (0.04) are among the countries that report the lowest TEU assignment per capita; both countries are practically landlocked and only report few river transport liner services on barges that connect their capitals to neighbouring countries' seaports.

**Table 4: Fleet assignment (TEU) per capita**

Rank	Country	TEU per 1000 capita
1	Malta	637
2	Singapore	598
3	Hong Kong, China	558
4	Bahamas	534
5	Panama	243
6	United Arab Emirates	230
7	Aruba	230
8	French Polynesia	229
9	Guam	197
10	Belgium	162

### 5) Number of liner shipping companies

European countries are those that are being served by the highest number of liner shipping companies. Ports in the United Kingdom (133 shipping lines) provide services to intercontinental, regional and also cabotage liner shipping companies. Rotterdam (Netherlands), Antwerp (Belgium), Hamburg and Bremerhaven (Germany), and Le Havre (France) are the main Northern European ports that connect short sea shipping feeder companies services with intercontinental East-West and also North-South shipping lines.

At the other end of the spectrum, Albania, Czech Republic, Greenland, Iraq, Palau, Paraguay, and Sao Tome and Principe are reported with only one shipping line to provide regular maritime transport services to the port(s) of their countries.

**Table 5: Liner companies providing services to the country's ports**

Rank	Country	Lines
1	United Kingdom	133
2	Netherlands	131
3	Belgium	123
4	Germany	114
5	France	105
6	Singapore	98
7	China	96
8	Hong Kong, China	93
9	Spain	91
10	Italy	87

*Note: Not all liner companies provide the service with their own vessels. The figures thus also include companies who charter slots with other companies.*

### 6) Liner services

Usually, shipping lines provide more than just one regular service. On average, the number of liner services provided per country is almost four times the number of liner companies. In the case of China, each liner shipping company provides an average of more than six different liner services. The countries, whose ports are served by the widest range of regular shipping services are China (863 services), Hong Kong (China) (738) and Singapore (669). In Europe, the United Kingdom is connected to overseas markets by the largest number of liner services (538).

**Table 6: Liner services from the country's ports**

Rank	Country	Liner services
1	China	863
2	Hong Kong, China	738
3	Singapore	669
4	United States	623
5	Korea, Republic of	569
6	Japan	539
7	United Kingdom	538
8	Netherlands	506
9	Germany	472
10	France	446

*Note: Includes some double counting if services are being sold under different names.*

In Africa, the first position is held by Egypt (196); and in Latin America, Brazil's ports receive more different liner services (147) than Panama (119). The average number of liner services provided to

LDCs is only one seventh of the average number provided to Non-LDCs; and the largest number provided to an LDC (Senegal) is only one twentieth of that provided to China.

### 7) Average vessel sizes

Ships are a classical example of economies of scale.<sup>4</sup> Companies that operate larger vessels are usually in a position to offer their services at a lower price. Hong Kong (China) (average vessel size of 3,216 TEU), Oman (3,215), and China (3,199) are the three economies whose ports receive the container ships with the largest average container carrying capacity. In western Asia, Omans port Salalah is an important intercontinental transshipment centre that caters mostly for large vessels on the East-West routes. All countries among the top ten (Table 7) are mostly receiving ships on the main East-West trades.

In South America, Argentina receives the largest vessels on average (2,159) and in sub-Saharan Africa the first position is held by Mauritius (1,924), which has become an important subregional transshipment centre in recent years. Switzerland (245), Paraguay (119) and Czech Republic (42) are among the countries with the lowest average vessels sizes, which is explained by their situation of being landlocked countries with river ports that can only receive small container carrying barges.

**Table 7: Average vessel sizes**

Rank	Country	Ship size average
1	Hong Kong, China	3 216
2	Oman	3 215
3	China	3 199
4	Taiwan, Province of China	3 115
5	Canada	3 022
6	Malaysia	2 919
7	Panama	2 895
8	Saudi Arabia	2 882
9	Korea, Republic of	2 875
10	Germany	2 778

### 8) Maximum vessel sizes

The largest ships that call at a country's ports indicate what maximum economies of scale are achievable. Countries that are capable to receive the largest vessels must have deep ports and efficient container handling equipment. Only the countries listed in Table 8 effectively receive vessels of above 8,000 TEU container carrying capacity (data is for July 2004).

In Latin America, Panama (6,555 TEU) receives the largest container ships, and in sub-Saharan Africa, the largest ships call in South Africa (3,501) and Mauritius (3,469).

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<sup>4</sup> "A ship's carrying power varies as the cube of her dimensions, while the resistance offered by the water increases only a little faster than the square of her dimensions; so that a large ship requires less coal in proportion to its tonnage than a small one. It also requires less labour, especially that of navigation; while to passengers it offers greater safety and comfort, more choice of company and better professional attendance. In short, the small ship has no chance of competing with the large ship between ports which large ships can easily enter, and between which the traffic is sufficient to enable them to fill up quickly." From: *Principles of Economics*, by Alfred Marshall (1890), Book Four: The Agents of Production: Land, Labour, and Capital and Organization. Chapter 11, Industrial Organization: Production on a Large Scale.

**Table 8: Maximum vessel sizes**

Rank	Country	Ship size maximu m
1	China	8 238
	Hong Kong, China	8 238
	United States	8 238
4	Belgium	8 076
	Germany	8 076
	Malaysia	8 076
	Netherlands	8 076
	United Kingdom	8 076
9	Singapore	8 063
	Taiwan, Province of China	8063

### 9) Vessels per liner shipping company

Economies of scale also exist as regards the number of operated vessels per liner shipping company. The United States (almost 14 vessels per liner company), Taiwan Province of China (14.4) and China (12.8) are the countries with the largest scale of operation.

The small island states of Bermuda, Cayman Islands, Kiribati, Sao Tome and Principe and Seychelles are the countries where each liner company that is calling at these countries' ports is only operating one single vessel on the route(s) that serve these islands.

**Table 9: Vessels operated per liner shipping company**

Rank	Country	Ships per line
1	United States	14.0
2	Taiwan Province of China	13.4
3	China	12.8
4	Hong Kong, China	12.5
5	Cote d'Ivoire	12.5
6	Oman	10.4
7	Puerto Rico	9.9
8	Singapore	9.4
9	Korea, Republic of	9.2
10	Japan	9.1

*This indicator is derived by combining the data from Tables 1 and 5.*

### A liner shipping connectivity indicator

If we combine the available information about fleet assignment, liner services, and vessel and fleet sizes, it is possible to generate an overall "liner shipping connectivity indicator" (Table 10).<sup>5</sup>

<sup>5</sup> The indicator is calculated as follows: First, each one of the nine individual indicators is standardized so that all nine indicators have the same maximum value of 1.0 and minimum value or 0.0. Second, for each country, the average indicator is calculated. Third, the maximum average is identified (in this case, it is the value for Hong Kong). Fourth, all values are divided by this maximum. Like this, the maximum value of the indicator becomes 1.0.

**Table 10: Liner shipping connectivity indicator**

Rank	Country	Index	Rank	Country	Index	Rank	Country	Index
1	Hong Kong, China	1.000	60	Senegal	0.186	119	Mauritania	0.104
2	Singapore	0.904	61	Ghana	0.185	120	Vanuatu	0.102
3	China	0.847	62	Portugal	0.182	121	Bahrain	0.101
4	United States	0.743	63	Congo, Republic of	0.182	122	Virgin Islands (U.S.)	0.101
5	Netherlands	0.683	64	Gabon	0.181	123	Tonga	0.101
6	United Kingdom	0.665	65	Sweden	0.178	124	Micronesia, Fed. Sts.	0.100
7	Belgium	0.649	66	Nigeria	0.176	125	Papua New Guinea	0.099
8	Germany	0.646	67	Iran, Islamic Republic of	0.175	126	Kuwait	0.099
9	Taiwan Province of China	0.635	68	Guatemala	0.172	127	Gambia	0.099
10	Korea, Republic of	0.627	69	Benin	0.171	128	Mozambique	0.098
11	Japan	0.607	70	Costa Rica	0.171	129	Bangladesh	0.096
12	Malaysia	0.590	71	Philippines	0.169	130	Guyana	0.095
13	France	0.584	72	Romania	0.162	131	Belize	0.093
14	Malta	0.545	73	Finland	0.162	132	Sudan	0.092
15	Italy	0.510	74	Cameroon	0.159	133	Maldives	0.090
16	Spain	0.482	75	Estonia	0.154	134	Kenya	0.090
17	Panama	0.476	76	Jordan	0.152	135	Poland	0.090
18	United Arab Emirates	0.466	77	Dominican Republic	0.151	136	Northern Mariana Islands	0.089
19	Bahamas	0.460	78	Angola	0.149	137	Tunisia	0.088
20	Canada	0.416	79	Barbados	0.148	138	Solomon Islands	0.087
21	Egypt	0.414	80	Djibouti	0.146	139	Palau	0.086
22	Oman	0.409	81	Denmark	0.145	140	Brunei	0.086
23	Saudi Arabia	0.409	82	Norway	0.143	141	Qatar	0.083
24	Sri Lanka	0.374	83	Namibia	0.141	142	Libyan Arab Jamahiriya	0.077
25	Greece	0.321	84	Samoa	0.139	143	Cayman Islands	0.077
26	India	0.310	85	Comoros	0.138	144	Bulgaria	0.074
27	Thailand	0.304	86	Honduras	0.138	145	Kiribati	0.072
28	Jamaica	0.301	87	Croatia	0.137	146	Haiti	0.067
29	Mexico	0.296	88	Marshall Islands	0.137	147	Yugoslavia, Fed. Rep.	0.067
30	Brazil	0.292	89	Viet Nam	0.134	148	Somalia	0.065
31	Australia	0.278	90	Faeroe Islands	0.134	149	Georgia	0.065
32	South Africa	0.266	91	Russian Federation	0.131	150	Cambodia	0.064
33	French Polynesia	0.258	92	Latvia	0.130	151	Switzerland	0.063
34	New Zealand	0.258	93	Ukraine	0.130	152	Myanmar	0.062
35	Israel	0.254	94	Fiji	0.125	153	Eritrea	0.062
36	Yemen, Republic of	0.253	95	Lebanon	0.124	154	Iraq	0.060
37	Argentina	0.252	96	El Salvador	0.124	155	Czech Republic	0.059
38	Trinidad and Tobago	0.252	97	Nicaragua	0.123	156	Bermuda	0.055
39	Guam	0.249	98	Greenland	0.122	157	Congo, Dem. Rep.	0.054
40	Côte d'Ivoire	0.249	99	Syrian Arab Republic	0.122	158	Guinea-Bissau	0.042
41	Indonesia	0.247	100	Equatorial Guinea	0.121	159	Cape Verde	0.040
42	Mauritius	0.246	101	Madagascar	0.118	160	Sao Tome and Principe	0.029
43	Turkey	0.243	102	Antigua and Barbuda	0.118	161	Paraguay	0.026
44	Aruba	0.239	103	Tanzania	0.115	162	Albania	0.014
45	Uruguay	0.239	104	Guinea	0.115			
46	Puerto Rico	0.237	105	Cuba	0.114			
47	Pakistan	0.232	106	Iceland	0.114			
48	Colombia	0.223	107	Ireland	0.113			
49	Slovenia	0.223	108	St. Vincent & the Grenadines	0.112			
50	St. Kitts and Nevis	0.222	109	St. Lucia	0.112			
51	Chile	0.220	110	Algeria	0.111			
52	Ecuador	0.218	111	Lithuania	0.110			
53	New Caledonia	0.214	112	Dominica	0.110			
54	Peru	0.213	113	Seychelles	0.109			
55	Cyprus	0.203	114	Sierra Leone	0.109			
56	Venezuela	0.198	115	Morocco	0.106			
57	American Samoa	0.196	116	Suriname	0.105			
58	Netherlands Antilles	0.189	117	Liberia	0.105			
59	Togo	0.187	118	Grenada	0.105			

The highest indicator is computed for Hong Kong (China), followed by Singapore, China, United States and the Netherlands. Based on this indicator, Panama and the Bahamas are the best connected countries in the Americas, and Egypt and South Africa the best connected countries in Africa.

Countries that are being served by practically the same liner services, such as for example Chile, Ecuador and Peru, also have equivalent liner connectivity indicators.

The average connectivity indicator for LDCs is 45% of that of non-LDCs, and only 11 per cent of that of Hong Kong. The best connected LDC is Republic of Yemen, ranked 36, which owes its relatively favourable position to its location near the main East-West trade route. The best connected African LDCs are Togo and Senegal, ranked 59 and 60 respectively.

Of the fifteen least connected countries, more than half are LDCs (Somalia, Cambodia, Myanmar, Eritrea, Democratic Republic of the Congo, Guinea-Bissau, Cape Verde, Sao Tome and Principe). Albania is mostly being serviced by ports in neighbouring countries, and Bermuda's small volume of trade in goods is moved by air and non-containerized maritime transport. The remaining least-connected countries are either quasi landlocked (Paraguay, Georgia, Switzerland, and Czech Republic) or torn by armed conflict (Iraq, which is partly serviced through ports in Kuwait). The quasi landlocked countries have only limited access to deep sea liner shipping services through river transport or the Black Sea; their situation could be compared to landlocked countries, whose liner shipping connectivity index would by definition be Zero.

#### Causes and impacts

The main "cause" of liner shipping connectivity is each country's own volume of containerized trade, which attracts liner shipping services. It can be said that "supply follows demand". At the same time, however, demand also follows supply. Increased connectivity, together with lower transport costs and trade facilitation, is also an important component of competitiveness and thus helps to explain future trade growth. The challenge for researchers is to identify the mutual causalities between transport costs, transport connectivity, and trade. The challenge for policy makers is to promote better and less costly transport services, which help to promote trade, which will again encourage further improvements in transport services and costs.

Future research could attempt to monitor developments over time, as these also indicate changes in the attractiveness of ports to the shipping lines. Future research could further expand the "connectivity index" to cover inland access to sea ports, including access by landlocked countries. Connectivity through other modes of transport, too, needs to be looked at. Most important for policy makers would be research and policy recommendations regarding possibilities to improve national transport connectivity. Concerning liner shipping, experience suggests that port reform, the introduction of ICTs, and of course infrastructure investment can all help to increase the number and sizes of ships that call at a country's ports and thus contribute to a country's foreign trade competitiveness.

A low "national" connectivity does not necessarily mean that a country's importers and exporters would not have access to ports and liner shipping services. Especially in Europe, the use of neighbouring countries' ports is very common. For many developing countries, however, transit transport still implies high additional costs and delays, and a low connectivity through national ports is a good indicator of the services available to national importers and exporters.

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