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FACILITATION OF TRANSPORT AND TRADE IN LATIN AMERICA AND THE CARIBBEAN

Asset productivity at container terminals in Latin America and the Caribbean: 2005-2013

This issue of the *FAL Bulletin* shows productivity trends at container terminals in Latin America and the Caribbean during the period from 2005 to 2013, comparing them to the trend of earlier years (2000 to 2004). One of the conclusions of the study is that most terminals in the region have improved their quay productivity in recent years, although there are large differences between the three container terminal size categories analysed. However, the author identifies a number of challenges still to be met at the region's ports.

This issue was written by Octavio Doerr of the ECLAC Infrastructure Services Unit.
For more information, please contact Octavio.DOERR@cepal.org.

Background

This issue of the *FAL Bulletin* reports on the evolution of productivity at container terminals in Latin America and the Caribbean in the period from 2005 to 2013, assessing trends in the productivity of assets such as berths, support areas and container cranes in the region's industry over recent years and comparing it with the trend of earlier years (2000 to 2004) in the same industry and with the productivity achieved by terminal operators worldwide. To analyse these trends, both regionally and globally, it uses the port productivity indicators recommended by Doerr and Sánchez (2006). The findings of this study should provide port authorities and operators with an up-to-date picture of productivity at the region's container terminals. The study was carried out by the Natural Resources and Infrastructure Division of the Economic Commission for Latin America and the Caribbean with the collaboration of the 30 terminals surveyed.[1]

I. Productivity measures used at container terminals: berths, terminal areas and cranes

The main physical assets at a container terminal are the berths, storage areas and quayside container cranes used to process ships and handle and store containers. It is a common practice in the industry to measure the productivity of a terminal's assets by the number of containers handled at its berths each year. Thus, the productivity of a container terminal's assets is calculated from the volume of containers moved at its berths, the number of containers moved each year in TEUs and the quantity of assets involved in these operations. In the case of berths, average annual quay productivity is obtained by reckoning the number of containers in TEUs moved per linear metre of quayside available at the terminal per annum. In the case of areas used for storing containers,

[1] Reference is made in this report to the annex, which provides details of the productivity indicator results obtained for each of the terminals in the period studied.

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average productivity is measured by the throughput of containers in TEUs at the terminal each year for each hectare in operational use. In the case of container cranes, average productivity is measured by the number of containers in TEUs moved at the terminal annually by each crane employed for this. Table 1 summarizes the definitions and units of measurement used for these three productivity indicators. See Doerr and Sánchez (2006) for further details on these indicators and others commonly used in the port industry.

Because productivity levels increase with a terminal's size and volume of operations, productivity analyses in the industry classify terminals by their size or level of activity. This study has adopted the classification by annual activity level, taking a large terminal as one handling between 1 million and 3 million TEUs a year, a medium-sized terminal as one handling between 500,000 and 1 million TEUs a year and a small terminal as one handling between 100,000 and 500,000 TEUs a year.

Table 1
PRODUCTIVITY INDICATORS FOR BERTHS, STORAGE AREAS AND CRANES

Asset	Indicator	Formula	Unit of measurement
Container berths	Quay productivity	Number of containers/linear metre of quayside	TEUs/metre
Storage areas	Terminal area productivity	Number of containers/surface area in hectares	TEUs/ha
Quayside cranes	Crane productivity	Number of containers/number of cranes	TEUs/crane

Source: Doerr and Sánchez (2006).

II. Recent activity at container ports in Latin America and the Caribbean

The growth of activity in the region has been driven by a strong and sustained expansion in the market for container transportation, originating in three main factors: (a) a rise in foreign trade, resulting from increased economic activity within and beyond the region, (b) growing supply in the industry, with a steady increase in container logistics services and the development of greater port capacity, and (c) the implementation of a hub and spoke service strategy by shipping lines.[2] This last factor has had a substantial effect on terminals in the Caribbean basin and the ports at either end of the Panama Canal, Colón and Balboa, where activity has increased because of trans-shipment operations and major expansion plans implemented by these terminals.

Container throughput at ports in Latin America and the Caribbean increased by 74% between 2005 and 2013, giving an average annual growth rate of 7%. Different phases in this period need to be singled out, however, because of the effects of the 2009 crisis. From 2005 to 2008, port activity in the region grew by an average of 11% a year. Then, in 2009, there was a sharp drop (-10%) because of the economic crisis, followed by recovery in the three years from 2010 to 2012, with average annual growth of 11%, and finally a sharp slowdown in 2013, when growth was just 1% (see table 2). In this context, the port industry consolidated projects initiated before the period of analysis and also developed a number of projects for new terminals. This exercise examines the evolution of three key productivity indicators for port activity (berths, storage areas and cranes) at a sample of 30 terminals accounting for 53% of all operations of this type in the region. Twenty-four of these terminals were already operating in 2005, two more began operations in 2006, and a new terminal opened in each of 2009, 2010 and 2011.

Table 2
LATIN AMERICA AND THE CARIBBEAN: PORT CONTAINER MOVEMENTS, BY SUBREGION
(Thousands of TEUs)

Subregion	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13	Percentage annual increase
Subregion											
Mexico	2 133	2 677	3 062	3 316	2 884	3 692	4 223	4 878	4 893	129	11
Central America	4 894	5 385	6 763	7 446	6 726	8 449	9 783	10 160	9 970	104	9
The Caribbean	6 392	7 193	7 488	7 650	7 120	7 128	7 506	7 927	7 732	21	2
South America	13 240	15 147	16 839	18 447	16 595	18 819	21 908	22 983	23 702	79	8
Latin America and the Caribbean											
Total	26 659	30 401	34 153	36 860	33 325	38 087	43 420	45 949	46 297	74	7
Percentage annual change		14	12	8	-10	14	14	6	1		
Percentage average annual change in the period			11		-10		11		1		

Source: Prepared by the author on the basis of figures from the port ranking of the ECLAC Maritime and Logistics Profile, <http://www.cepal.org/perfil/default.asp?idioma=IN>.

[2] The hub and spoke system requires trans-shipment of containers at hub ports and has the effect of increasing the number of container handling operations at a region's ports.

III. The evolution of the main container terminal characteristics

A. Data gathering

To conduct this study, it was necessary to obtain information on the evolution of infrastructure and equipment availability and operating data for the berths of each terminal. The first step was to select the terminals that would form the system to be studied, choosing those that were most representative because of their activity level, size, location and degree of development. The information used was obtained directly from the operating companies via personal surveys. This exercise examined the evolution of productivity at 30 terminals, called hereinafter the "terminals", situated in Central America, Mexico, the Caribbean and South America.[3]

B. Infrastructure and equipment at the average terminal

Tables 3 and 4 show the evolution of three key characteristics of the observed average terminal, taking (a) the 30 terminals in the sample (30T) and (b) the 24 original terminals operating in 2005 (24T). Two characteristics concern container operating infrastructure and one the equipment for handling containers at terminal berths. They are the length of the berthing front, the terminal area and the number of quayside cranes. Crane availability is measured by the number of ship-to-shore cranes, the number of mobile harbour cranes, the number of quayside cranes equivalent[4] and the distance between cranes in metres of quayside. The value for the average terminal is obtained by dividing the sum of surface areas, lengths or number of cranes at the terminals by the total number of terminals in operation that year.

Table 3
THREE CHARACTERISTICS OF THE AVERAGE TERMINAL (30T)
QUAY LENGTH, TERMINAL AREA AND NUMBER OF CRANES

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
No. of terminals	24	24	26	26	28	29	30	30	30	-
Terminal dimensions										
Quay length (m)	626	626	642	689	689	722	742	761	762	22
Terminal area (ha)	19.0	19.4	19.4	20.2	20.9	21.5	22.3	23.0	23.8	25
Number of quay cranes										
Ship-to-shore cranes	3.2	3.5	3.7	4.3	4.8	5.0	5.1	5.5	5.7	81
Mobile harbour cranes	1.1	1.0	1.4	1.5	1.6	1.8	1.8	1.7	1.8	60
Quay crane equivalents	3.8	4.2	4.6	5.2	5.7	6.0	6.2	6.6	6.8	77
Distance (m) between cranes	163	150	141	132	120	120	119	116	112	-

Source: Prepared by the author on the basis of surveys and data published by the terminals.

Table 4
THREE CHARACTERISTICS OF THE AVERAGE TERMINAL (24T)
QUAY LENGTH, TERMINAL AREA AND NUMBER OF CRANES AVAILABLE

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
No. of terminals	24	24	24	24	24	24	24	24	24	-
Terminal dimensions										
Quay length (m)	626	626	657	708	732	758	796	792	793	27
Terminal area (ha)	19.0	19.4	20.2	21.1	22.4	22.6	23.8	24.2	24.5	29
Number of quay cranes										
Ship-to-shore cranes	3.2	3.5	3.8	4.3	4.9	5.0	5.3	5.5	5.7	80
Mobile harbour cranes	1.1	1.0	1.5	1.7	1.7	1.9	2.0	2.0	2.0	81
Quay crane equivalents	3.8	4.2	4.7	5.3	5.9	6.1	6.5	6.6	6.9	80
Distance (m) between cranes	163	150	140	135	123	124	123	119	114	

Source: Prepared by the author on the basis of surveys and data published by the terminals.

[3] The terminals are in Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Panama, Peru, Uruguay and countries of Central America and the Caribbean. This report maintains confidentiality as to the terminals surveyed and the information provided by them.

[4] This is calculated by adding the number of ship-to-shore and mobile harbour cranes and multiplying the result by 0.6 for each terminal.

The sample originally included 24 terminals operating in 2005, increasing to 30 by 2013 after six new terminals were brought into service. Table 3 shows an increase in average terminal dimensions (30T), with quay length increasing from 626 m to 762 m and the terminal area from 19 ha to 23.8 ha. However, the greatest increase at the average terminal has been in the availability of quay cranes, with the numbers rising in eight years from 3.2 to 5.7 ship-to-shore gantry cranes and from 1.1 to 1.8 mobile harbour cranes. This indicates that new infrastructure has been created at container terminals and more equipment made available, allowing for greater ship throughput capacity and more intensive ship usage. The increase in equipment availability at the average terminal (77%) has been well in excess of infrastructure growth (22%), indicating that terminals have applied a capacity expansion strategy based mainly on adding equipment and using existing assets intensively rather than adding new assets to the system or extending existing berths. This strategy has its origin in the greater quay productivity demanded by shipping services owing to the increase in the size of their vessels and the consignments handled each time they call in to port, something that is feasible as long as there are spare berths that can take the new equipment and have the characteristics needed to service larger container vessels. Once no more spare infrastructure is available, capacity can only be increased by building new berthing facilities, as has been done at a number of the region's ports. Table 4 shows similar increases in average terminal dimensions for 24T, with quay length increasing from 626 m to 793 m and the terminal area from 19 ha to 24.5 ha. Also, the greatest increase at the average terminal has been in the availability of quay cranes, with the numbers rising in eight years from 3.2 to 5.7 ship-to-shore gantry cranes and from 1.1 to 2.0 mobile harbour cranes, very similar to the increases seen for 30T.

C. Container movements

In the period from 2005 to 2013, the 24 terminals that were there at the start of the period (24T) increased their container movements by an average of 7% a year, with cumulative growth of 75% in annual throughput. Table 5 shows the increase in average productivity at the terminals analysed. For the 30T, the volume moved (TEUs/terminal) increased by 66%, productivity per berth (TEUs/metre of quay) rose by 36%, crane productivity dropped by 7% and area use (TEUs/ha) rose by 32%. For the 24T, the volume moved (TEUs/terminal) increased by 75%, productivity per berth (TEUs/metre of quay) increased by 38%, crane productivity dropped by 3% and terminal area use (TEUs/ha) rose by 35%.

Table 5
CONTAINER MOVEMENTS AT TERMINALS AND PRODUCTIVITY AT THE AVERAGE TERMINAL, PER ANNUM
(Thousands of TEUs)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase per annum	Percentage increase 05/13
30 terminals	11 889	13 119	15 410	17 199	15 998	19 338	22 687	24 563	24 610	-	-
24 terminals	11 889	13 119	14 944	16 625	14 956	17 274	19 386	20 905	20 800	7	75
Latin America and the Caribbean	26 659	30 401	34 153	36 860	33 325	38 087	43 420	45 949	46 297	7	74
30 terminals' share of regional total	42.2%	40.8%	45.2%	46.8%	48.0%	50.8%	52.2%	53.5%	53.2%	-	-
Productivity of the average terminal (30T)											
Terminal (thousands of TEUs)	495.4	546.6	592.7	661.5	571.3	666.8	756.2	818.8	820.3	6.5	66
Berths (TEUs/metre)	792	873	923	959	829	924	1 019	1 075	1 077	3.9	36
Terminal area (thousands of TEUs /ha)	26.1	28.1	30.6	32.7	27.4	31.0	33.9	35.6	34.5	3.6	32
Cranes (thousands of TEUs/crane)	128.9	131.2	129.9	126.5	99.6	110.8	121.3	124.9	120.4	-0.9	-7
Productivity of the average terminal (24T)											
Terminal (thousands of TEUs)	495.4	546.6	622.7	692.7	623.2	719.7	807.8	871.0	866.7	7.2	75
Berths (TEUs/metre)	792	873	948	978	851	949	1 015	1 099	1 093	4.1	38
Terminal area (thousands of TEUs/ha)	26.1	28.1	30.8	32.8	27.8	31.8	34.0	36.0	35.4	3.9	35
Cranes (thousands of TEUs/crane)	128.9	131.2	132.3	132.0	104.9	117.8	125.2	131.3	125.0	-0.4	-3

Source: Prepared by the author on the basis of surveys, data published by the terminals and figures from the port ranking of the ECLAC Maritime and Logistics Profile.

IV. Indicators of productivity at container terminals

A. Terminals in Latin America and the Caribbean: 2000-2004

The evolution of productivity indicators for the container port industry in Latin America and the Caribbean during the period from 2000 to 2004 was examined by ECLAC (2006). This evolution also occurred in a context of strong growth in seaborne trade, privatizations and strong growth in container movements. Container port growth in Latin America and the Caribbean averaged 10% a year during the period. Table 6 presents the increase in the average productivity of terminals by size and of the average terminal for the sample analysed in the period. In the case of the average terminal, productivity per berth was 504 TEUs/metre in 2004, terminal area productivity was 17,244 TEUs/ha and crane productivity was 101,331 TEUs/crane.

Table 6
PRODUCTIVITY AT TERMINALS BY TERMINAL SIZE

Terminal	2000	2001	2002	2003	2004
Large terminal: length 1,200 metres					
Berths (TEUs/metre)	675	645	766	928	1 124
Terminal area (TEUs/ha)	16 896	16 156	19 183	23 230	28 136
Cranes (TEUs/crane)	87 264	83 441	99 075	119 981	145 316
Medium-sized terminal: length 900 metres					
Berths (TEUs/metre)	433	511	569	640	762
Terminal area (TEUs/ha)	11 926	14 090	15 672	17 617	20 984
Cranes (TEUs/crane)	69 413	82 007	91 220	102 538	122 134
Small terminal: length 750 metres					
Berths (TEUs/metre)	193	217	227	270	330
Terminal area (TEUs/ha)	7 639	8 583	8 984	10 691	13 064
Cranes (TEUs/crane)	46 432	52 167	54 609	64 984	79 404
Average terminal: length 800 metres					
Berths (TEUs/metre)	293	326	357	417	504
Terminal area (TEUs/ha)	10 032	11 145	12 214	14 271	17 244
Cranes (TEUs/crane)	58 950	65 490	71 777	83 859	101 331

Source: Prepared by the author on the basis of data from Doerr and Sánchez (2006).

B. Terminals in Latin America and the Caribbean: 2005-2013

1. Quay productivity

Most terminals have been improving their productivity steadily each year.[5] Improvements involving more intensive use of berthing facilities may originate in: (i) increases in ship productivity achieved by adding transfer equipment or improving the productivity of equipment or operating procedures, or (ii) increases in cargo throughput at the terminal, or a combination of these factors. The indicator may decline in value from the previous year when the rate at which new infrastructure is brought into service over the year is greater than the rate of activity growth that year, or simply when activity declines because of a loss of market share or lower overall demand. Figure 1 shows the general trend in the period, with growth in terminal throughput and an increase in quay productivity. In 2005, productivity at T30 terminals ranged from 114 to 1,490 TEUs/metre, while in 2013 it ranged from 274 to 2,074 TEUs/metre. Segmentation by terminal activity level in 2013 shows that larger terminals were more productive throughout the period, with more intensive berth usage, although all of them managed substantial improvements over the eight years. In 2013, large terminals managed 1,441 TEUs/metre, 39% more than in 2005, while medium-sized terminals averaged 877 TEUs/metre, 5% less than in 2005, and small terminals 548 TEUs/metre, 76% more than in 2005. Figure 2 shows the range of quay productivity at each type of terminal in 2013, identifying terminals by size. Table 7 shows the evolution of average productivity at each type of terminal. Figure 3 shows the evolution of average productivity using this approach.

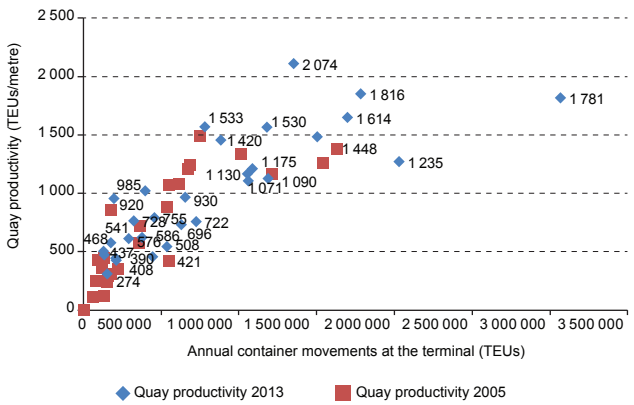
[5] Table A.1 shows the evolution of quay productivity at the terminals in the period from 2005 to 2013.

Table 7
AVERAGE QUAY PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE
(TEUs/metre per annum)

Terminal size	Average quay length (metres)	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
Large	1 100	1 039	1 119	1 145	1 145	1 034	1 125	1 266	1 443	1 441	39
Medium-sized	800	924	1 036	996	1 052	818	1 016	1 066	883	877	-5
Small	500	311	376	492	538	453	469	515	534	548	76

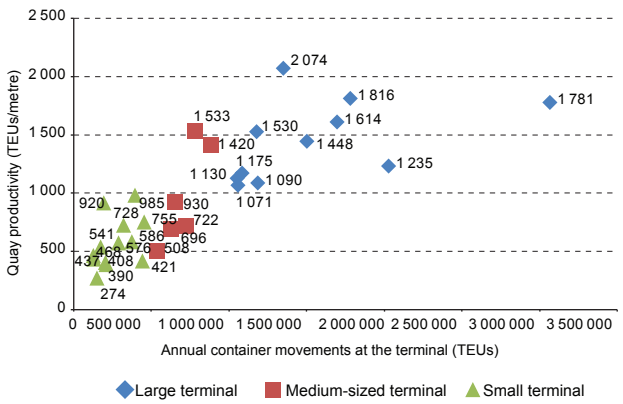
Source: Prepared by the author on the basis of table A.1.

Figure 1
T30 QUAY PRODUCTIVITY, 2005 AND 2013



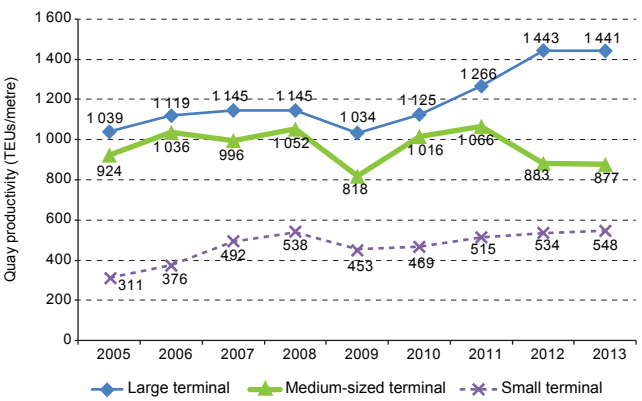
Source: Prepared by the author on the basis of figures from table A.1.

Figure 2
T30 QUAY PRODUCTIVITY, BY TERMINAL SIZE, 2013



Source: Prepared by the author on the basis of figures from table A.1.

Figure 3
AVERAGE QUAY PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE

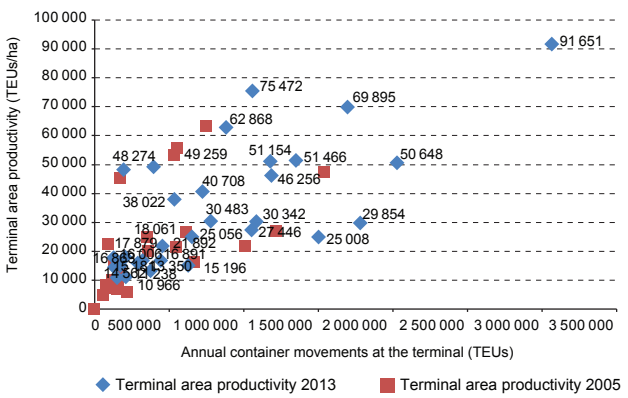


Source: Prepared by the author on the basis of table 7.

2. Terminal area productivity

This indicator also improved steadily each year at most of the terminals.6 In this case, more intensive use of terminal support areas has originated in: (i) extra handling equipment in yards, allowing support areas to be used more intensively, or (ii) increased cargo throughput at the terminal, or a combination of these factors. The indicator may decline in value from the previous year when there is a drop in activity, a loss of market share or lower overall demand. Figure 4 shows the general trend in the period, which was one of rising terminal throughput and increased terminal area productivity. In 2005, the productivity of the terminals in the sample ranged from 3,211 to 63,334 TEUs/ha, while in 2013 the range was from 10,966 to 91,651 TEUs/ha.

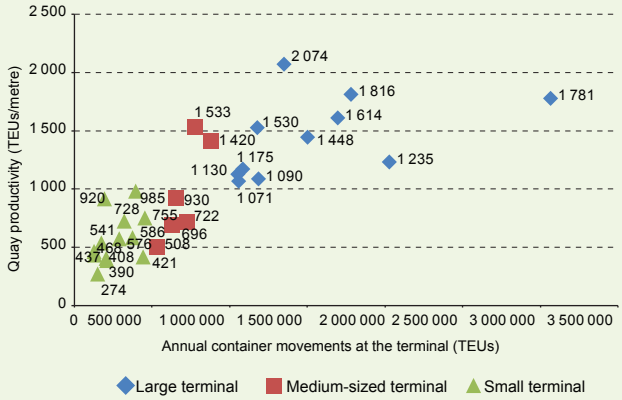
Figure 4
T30 TERMINAL AREA PRODUCTIVITY, 2005 AND 2013



Source: Prepared by the author on the basis of figures from table A.2.

[6] Table A.2 of annex A shows the evolution of terminal area productivity.

Figure 5
T30 TERMINAL AREA PRODUCTIVITY, BY TERMINAL SIZE, 2013



Source: Prepared by the author on the basis of figures from table A.2.

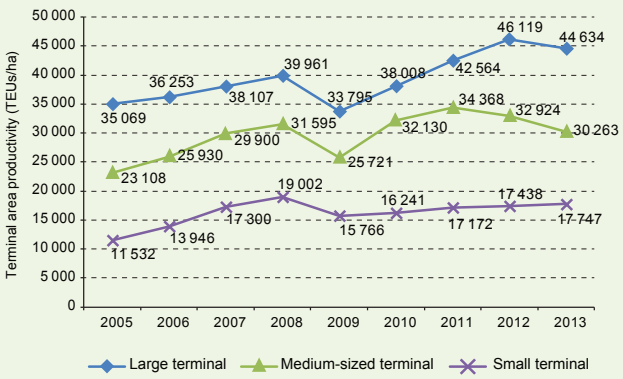
Table 8 shows the evolution of average productivity by terminal type. Large terminals achieved average productivity of 35,069 TEUs/ha in 2005, rising to 44,634 TEUs/ha in 2013, an increase of 27%. Medium-sized terminals achieved average productivity of 23,108 TEUs/ha in 2005, rising to 30,263 TEUs/ha in 2013, an increase of 31%. Small terminals managed average productivity of 11,532 TEUs/ha in 2005, rising to 17,747 TEUs/ha in 2013, a 54% increase. Figure 5 shows productivity ranges for terminal areas at each type of terminal in 2013, identifying the size class. Figure 6 shows the evolution of average productivity by terminal size.

Table 8
AVERAGE AREA PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE
(TEUs/ha)

Terminal size	Quay length (metres)	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
Large	1 100	35 069	36 253	38 107	39 961	33 795	38 008	42 564	46 119	44 634	27
Medium-sized	800	23 108	25 930	29 900	31 595	25 721	32 130	34 368	32 924	30 263	31
Small	500	11 532	13 946	17 300	19 002	15 766	16 241	17 172	17 438	17 747	54

Source: Prepared by the author on the basis of table A.2.

Figure 6
AVERAGE TERMINAL AREA PRODUCTIVITY, BY TERMINAL SIZE

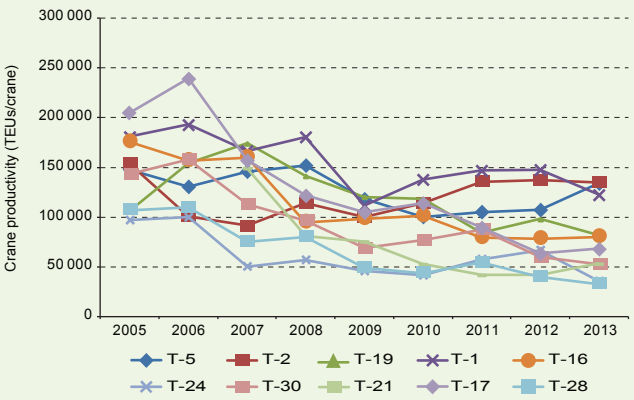


Source: Prepared by the author on the basis of table 8.

3. Quay crane productivity

In this case, there have been two types of developments at the terminals examined. One group of terminals has shown a steady increase in the number of cranes per terminal because of new acquisitions, while a second group has managed sustained annual crane productivity improvements. There may be two main reasons for this.[7] In the first group, the productivity indicator may decline from the previous year when the percentage increase in the number of cranes available outstrips traffic growth in the year or when commercial activity falls because of a drop in market share or lower overall demand (see figure 7). The second group shows sustained productivity improvements, with ever more intensive use of equipment at berthing facilities as a result of rising cargo throughput at the terminal, perhaps supplemented by increases in the hourly productivity of equipment resulting, for example, from improvements in operating procedures (see figure 8).

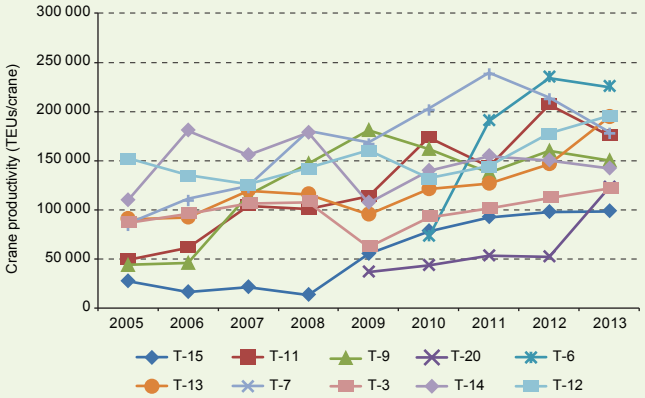
Figure 7
T30 CRANE PRODUCTIVITY (FIRST GROUP)



Source: Prepared by the author on the basis of table A.3.

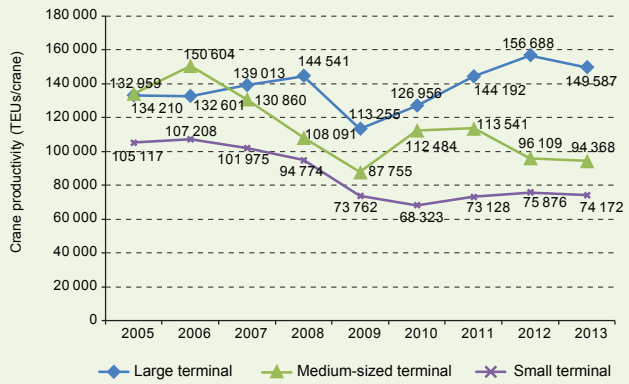
[7] Table A.3 shows the evolution of crane productivity at the terminals. This evolution reveals two phenomena in the industry for this indicator.

Figure 8
T30 CRANE PRODUCTIVITY (SECOND GROUP)



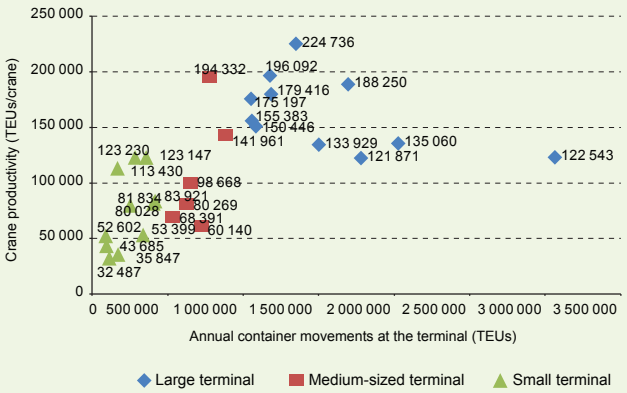
Source: Prepared by the author on the basis of table A.3.

Figure 9
AVERAGE T30 CRANE PRODUCTIVITY, BY TERMINAL SIZE



Source: Prepared by the author on the basis of table 9.

Figure 10
T30 CRANE PRODUCTIVITY, BY TERMINAL SIZE, 2013



Source: Prepared by the author on the basis of table A.3.

Table 9 shows the evolution of average productivity at each terminal type. Large terminals increased productivity throughout the period, with more intensive crane use. These terminals achieved substantial improvements over the eight years (19%). The intensity of crane use at medium-sized and small terminals decreased by 15% and 19%, respectively. Figure 9 shows the evolution of average crane productivity. Large terminals had average productivity of 132,959 TEUs/crane in 2005, rising to 149,587 TEUs/crane in 2013. Medium-sized terminals had average productivity of 134,210 TEUs/crane in 2005, falling to 94,368 TEUs/crane in 2013. Small terminals had average productivity of 105,117 TEUs/crane in 2005, falling to 74,172 TEUs/crane in 2013. Figure 10 shows the spread of crane productivity at each terminal in 2013, identifying the size of terminal.

Table 9
AVERAGE CRANE PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE
(TEUs/crane)

Quay	Percentage