

The preferred scale of container terminals

Vicky Kaselimi, Research Fellow & **Dr. Theo Notteboom**, President, Institute of Transport and Maritime Management Antwerp (ITMMA), University of Antwerp, Antwerp, Belgium

Mind the scale

Both terminal operators and port authorities are interested in knowing the optimal scale for a terminal they are going to operate or lease. Container terminal operators are interested in the terminal scale as it will affect their operational cost structure and will have implications on the commercial strategy needed to attract container volumes. Landlord port authorities, or any other managing body of a port responsible for strategic decisions regarding the provision of a port's infrastructure to terminal operators, are (or should be) implicitly or explicitly interested in the scale of terminals in their ports in the context of the concessioning of port land. When developing a new port area, port authorities might opt to concession one big terminal or, alternatively, to divide the available land into more sections and thus more and smaller terminals.

The purely economic approach: the Minimum Efficient Scale

From a strictly economic point of view, the best possible scale for a terminal is guided by the Minimum Efficient Scale (MES). MES is a central concept in economic literature, with applications to plants and/or firms, mainly in the manufacturing, electric power generation, agriculture, banking and air transport industries. One possible way of defining the MES of a container terminal is by linking this scale to operational efficiency as reflected by the average cost function and therefore to define it as the smallest scale at which output can be produced at minimum average long-run cost.

'Preferred' scale is more than Minimum Efficient Scale

In practice there are more parameters, apart from MES, that define the best possible scale of container terminals. In terminal concessioning procedures, the terminal scale that is 'preferred' in the end is usually different from MES. For example, terminal operators typically want to benefit from economies of scale, while port authorities also have to consider the (internalized) social costs arising from the (imminent) monopoly power of single terminals. The result of this could be that port authorities, when awarding new concessions, encourage container terminal development at less than MES level.

In addition, the geographical segmentation of the container terminal market contributes to the existence of different sizes and cost structures of these markets, which leads to different terminal scales. Also, the development of terminals in different periods of time means that they have access to different technology and thus have different cost curves, leading, in the end, to different terminal scales. In some other cases, the space available for terminal development is so restricted that new terminal capacity development is not possible and expansion can only be achieved through substantial changes to the input mix. Finally, the container terminal scale is also linked to the local shipping patterns and the minimum amount of infrastructure and equipment required for handling the smallest basic unit of shipping using the port as a standard of service acceptable to the ship operator.

From the above, we can conclude that the preferred scale of container terminals is the result of a complex interaction between the MES of the relevant terminal and a number of other

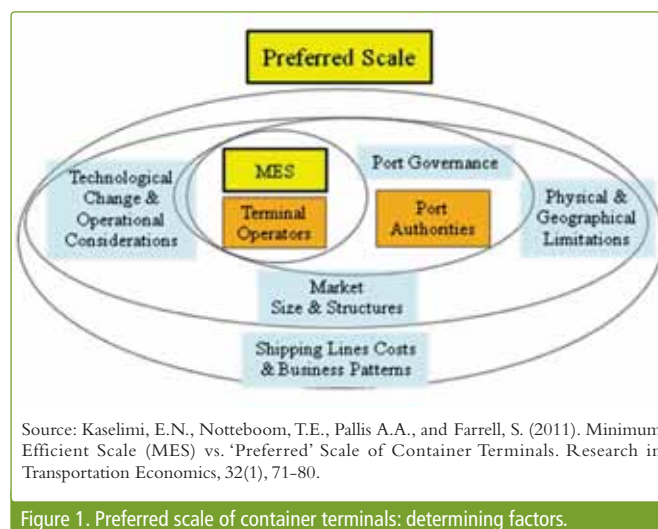


Figure 1. Preferred scale of container terminals: determining factors.

parameters, such as the port governance framework and policy objectives, the market size and structure, technological change and operational considerations, the physical and geographical limitations and shipping lines' costs and business patterns (see Figure 1).

How can we estimate the preferred scale?

When it comes to the estimation of the container terminal scale, the acceptance of the assumption that the preferred scale is not solely based on MES gives us the freedom to choose a method other than the purely economic measurement of the MES. In that framework, the typical statistical cost estimation and engineering approaches that are widely used in economic literature are not so relevant. On the other hand, the proxy methods, that have received a lot of criticism for being unable to give good estimates of MES and efficiency, can be used for the estimation of the preferred scale. Taken into consideration that the actual terminal size is the preferred scale, a revealed preference technique can be used to measure the preferences of terminal operators and port authorities on container terminal scales.

Based on the hypothesis that the observed distribution of terminal sizes will be clustered in some way around the best possible size, we expect that the preferred scale of container terminals can be deduced from the size distribution analysis of terminals. We also argue that the preferred scale is not a single value but instead lies within a range.

Empirical evidence on preferred scale

We performed a size distribution analysis of 333 container terminals worldwide. All terminals operate in ports that handle more than 150,000 TEU and have up to four terminals. Terminal size was measured by focusing on container throughput in TEU at terminal level. The size distribution of container terminals was explored in relation to the following parameters: the continent in which the terminal

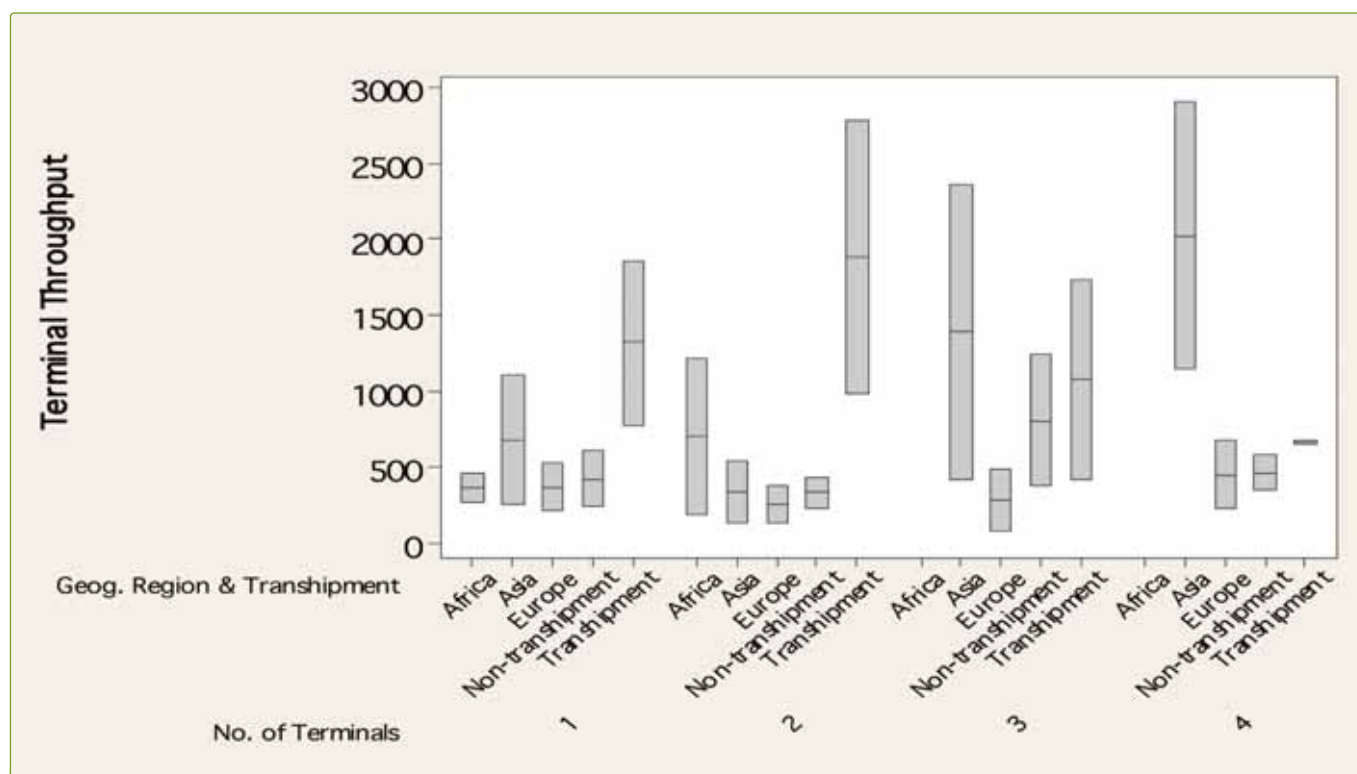


Figure 2. Terminal preferred scale (in 1,000 TEU) by number of terminals in the port.

operates (Africa, Asia or Europe), the number of terminals in the port and the transshipment incidence of the terminal (0–100 percent). Following a differentiated approach, we thus examined three different cases:

- The size distribution of transshipment container terminals with a transshipment incidence of at least 65 percent compared to the size of the remaining non-transshipment container terminals;
- The size distribution of container terminals by continent;
- The size distribution of container terminals by number of terminals per port.

Figure 2 presents the results by number of terminals per port, geographical area and transshipment incidence.

For terminals located in ports with only one terminal, the typical preferred scale ranges from 205,000 TEU to 1 million TEU with the exception of transshipment ports. For two-terminal ports, in Asia, Europe and Africa, the lower bound of the preferred scales start from a throughput of around 130,000–180,000 TEU and goes up to 1.2 million TEU. The exception, once again, is the

transshipment terminals that influence the ranges up to 3.2 million TEU. For terminals in ports with three terminals, the range of the preferred scale shows a wide dispersion. For Europe, the range fluctuates between 80,000 and 500,000 TEU, while in Asia it lies between 400,000 and 2.4 million TEU. For four-terminal ports, there is again a large spread in the range of preferred scales.

The analysis reveals there is not a clear relationship between the scale of container terminals and the number of terminals inside the same port. In Africa, it seems that the scale of terminals increases as the number of terminals in a port increases. In Europe and Asia, the scale ranges are similar but again it seems to be an upward trend in ports with three and four terminals. The scale of transshipment terminals seems to be similar with a slight downward trend especially when it comes to ports with four terminals. Also in non-transshipment terminals, the range in the terminal scale is similar but with an increase when it comes to ports with four terminals. In summary, the scale of the terminals is not decreasing when the number of terminals inside a port increases.

ABOUT THE AUTHORS



Ms. Evangelia (Vicky) Kaselimi is a Research Fellow at University of Antwerp. She is currently conducting Ph.D. research on port and terminal competition. Ms. Kaselimi is also a

Civil Servant at the General Secretariat of Ports and Port Policy, Hellenic Ministry of Maritime Affairs, Islands and Fisheries. Her scientific interests include port economics and policy, port and terminal competition with application of game theory and statistical analysis. Ms. Kaselimi is a member of PortEconomics.eu, a web-based initiative aiming to advance knowledge exchange on port economics, management and policies.



Dr. Theo Notteboom is President of ITMMA (an institute of the University of Antwerp), Professor at the University of Antwerp, a part-time Professor at the Antwerp

Maritime Academy and a visiting Professor at Dalian Maritime University in China and World Maritime University in Sweden. He published widely on port and maritime economics. He is also President of International Association of Maritime Economists (IAME), Chairman of the Board of Directors of Belgian Institute of Transport Organizers (BITO) and co-director of PortEconomics.eu.

ENQUIRIES

Evangelia (Vicky) Kaselimi
Institute of Transport and Maritime Management
Antwerp (ITMMA), University of Antwerp
Kipdorp 59, 2000, Antwerp, Belgium
Tel: +32 (0) 3 265 51 55 Fax: +32 (0) 3 265 51 50
Email: vicky.kaselimi@ua.ac.be

Professor Dr. Theo Notteboom
Institute of Transport and Maritime Management
Antwerp (ITMMA), University of Antwerp
Kipdorp 59, 2000, Antwerp, Belgium
Tel: +32 (0) 3 265 51 52 Fax: +32 (0) 3 265 51 50
Email: theo.notteboom@ua.ac.be
Web: www.itmma.ua.ac.be and
www.porteconomics.eu