Size and specialization as determinant of iberian port performance: new methodology to group different ports

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Size and Specialization as Determinant of Iberian Port Performance: New Methodology to Group Different Ports

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Abstract

The Iberian ports can be characterized in different types regarding the type of specialization, bulk cargo or general cargo, and size as determinants of efficiency. Focus is made on the gaps of literature about port efficiency regarding size and specialization. Data envelopment analysis (DEA) methodology is used. Conclusion about the existence of 5 port groups recurring to size and specialization variables, with significant different characteristics and performance.

1 Introduction

In this paper we show an innovative model to compare Iberian ports that explain some of the complexity of port characteristics and that can be used on future analysis.
Efficiency and competitiveness of ports an important research area for port researchers and users. It is not enough to have the ports in direct competition, it is necessary to understand the reason that explains the performance. It is necessary that managers have an easy, fast and clear methodology for comparing the performance of ports and realize that measures can be taken to improve efficiency and performance. This study can provide this methodology.

2. Literature Review

University studies that analyze the efficiency of the ports are scarce and second Tujillo Gonzalez (2007). The economic study of the port began in the '60s and stood at aspects of the fee structure, capabilities and investments, followed by studies of the impact of ports in economic activity.
The first economics textbooks port appeared in 1971, appearing studies on port productivity and significant factors on investment and planning, trying to determine the optimal size of infrastructure, using the theory of queues and dynamic programming. Other aspects that generated interest were the privatization of ports, the promotion of competitiveness and the criteria for selection of ports. The estimated costs, economies of scale and determinants of costs have also been studied by several authors.
The first studies on port efficiency have emerged in the '90s, modestly. Recently, the efficiency and productivity have been major themes of researchers port, since there have been major changes with the expansion and deepening of ports, with improved

technology, organizational change and privatization and specialization of inputs and terminals, with impacts efficiency and productivity.

According Tujillo and Gonzalez (2007), studies on port efficiency can be classified into three major groups: The first includes studies with one-dimensional or partial indicators of productivity of the port system. The second group of studies includes those who have only one vision of the engineering side, using simulations and the theory of queues. The third group, the most recent estimate covers the technological frontier production using multivariate approaches in the inputs and outputs and is in support of political and economic decision port.

The literature on the topic came in 1982, whereas productivity should be measured only in port, due to the difficulty of comparison, given the differences between ports. Later indicators were used in the comparison of ports and in promoting competitiveness. The measure of productivity was identified as relevant to that port operators and port authorities could locate its port and analyzing the effect of their actions and reforms implemented.

The disadvantage of one-dimensional view ports, as it only compares a variable input, with a variable output, it does not cover the special nature of multidimensional and multivariate ports, which handle various types of cargo such as output and inputs have several related with hand labor, capital and land.

This problem was only resolved through the analysis of TFP (total factor produtivity), which is an index reflecting the overall contribution of all factors relevant input and all outputs. The first application of this methodology has shown the growth of TFP of the port of Ashdod (Israel) due to technological factors and economies of scale.

In 90 years, the application of new methodologies for measuring efficiency were introduced in the ports, but there was a lot of discussion about which method best describes the complex reality of the ports. Studies have focused on the relationship between efficiency and: reforms in the ports, the port ownership, size, transhipment, investment, the hub ports ", time, location and level of service, among other . Moreover, several studies have shown that benchmarking is the best way of regulating port.

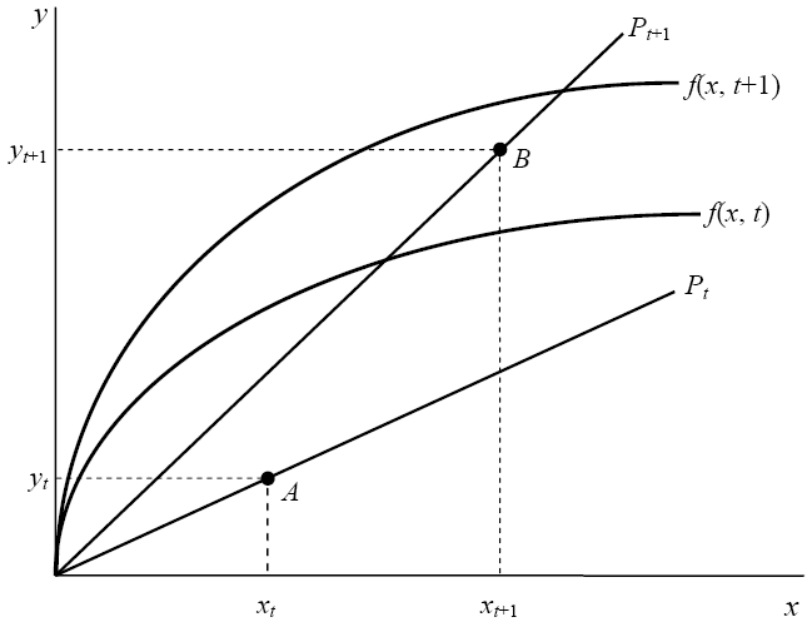
Although it is often confused the concepts of efficiency and productivity, there are analogous notions. Often the changes are due in large measure to changes in the other, which can lead to confuse the two.

Productivity is a simple relationship or ratio between an output and an input (Output / Input). The "Total Factor Produtivity" This will provide the relationship or ratio between the function of output and function of inputs in a multidimensional way. Since the efficiency is related to the comparison between the values of output and input values and the optimum located on the production frontier, which maximizes the ratio output / input ports of a sample. It analyzes what is, but what should be compared to other ports of a sample.

The following graph of Tujillo and Gonzalez (2007), clarifies the difference between Productivity and Efficiency.

- Productivity - Lines Pt 1 and Pt ports together with the same ratio of productivity (outputs: y / inputs: x) at different scales of production y.
- Efficiency - The lines f (x, t 1) f (x, t) is the technology of production and maximum productivity possible with certain technology, certain empirically an enlarged sample ports at different dates. For example, comparing the values of (x y) of port A, the nearest

point on the border line f (x, t) gives an indicator of relative efficiency, compared to best practice sample ports.



2. Metodology

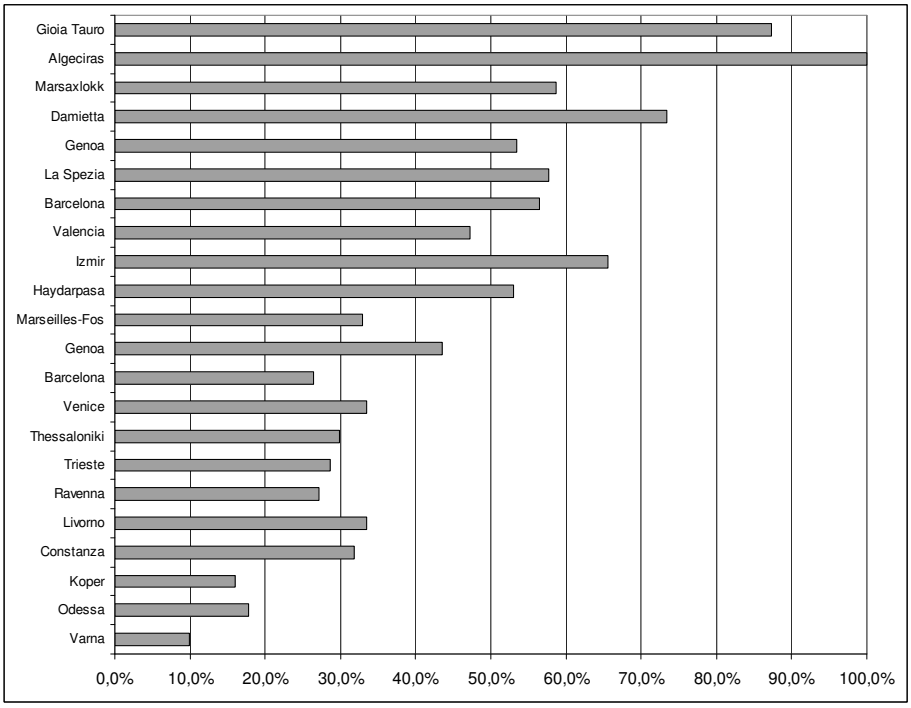
We used efficiency DEA - Data Envelopment Analysis - occasionally called frontier analysis, which was first used in 1978. This is a technique for measuring performance that can easily be used to assess the relative efficiency of DMU - "decision-making units" of organizations such as banks, hospitals and departments. The advantage of DEA is to allow multivariate analysis of inputs and outputs, whether these be translated in monetary form or not.
In this paper we use data from Drewry Shipping Consultants (2000), from the major container terminals located in 22 European ports and from official statistics of Portuguese and Spanish port authorities (2005).

4 Results

4.1 Data Envelopment Analysis of European Port selection

Using the non-linear methodology DEA to assess the relative efficiency of each terminal in the use of its infrastructure facilities and equipment, with input variables of resources: the size of the terminal, quay size and number of cranes, and the variable output annual TEU served, were obtained the following results:

Figure 1 – Efficiency DEA Index for selection of European container terminals (2000)



It is observed that there is a strong correlation between the performance of terminals, measured volume of TEUs, and the heavy commitment of resources for infrastructure and equipment used, including the terminal area, length of the platform and number of quay cranes.

It appears that the major transhipment terminals are the most efficient using resources, what can be explained by the nature of this traffic and by the most efficient combination between mother ships and feeder vessels, without the container leaves the terminal.

Gioia Tauro and Algeciras were ranked first in this sample, showing that the terminals of the other ports have much to do to have a better use of resources available to them.

Furthermore, we observed that there is no correlation between the performance indicator (TEUs) at the terminal size (area of the land / length of quay), or with the average distance between the quay cranes (quay length / number of crains).

The observed values were as follows:

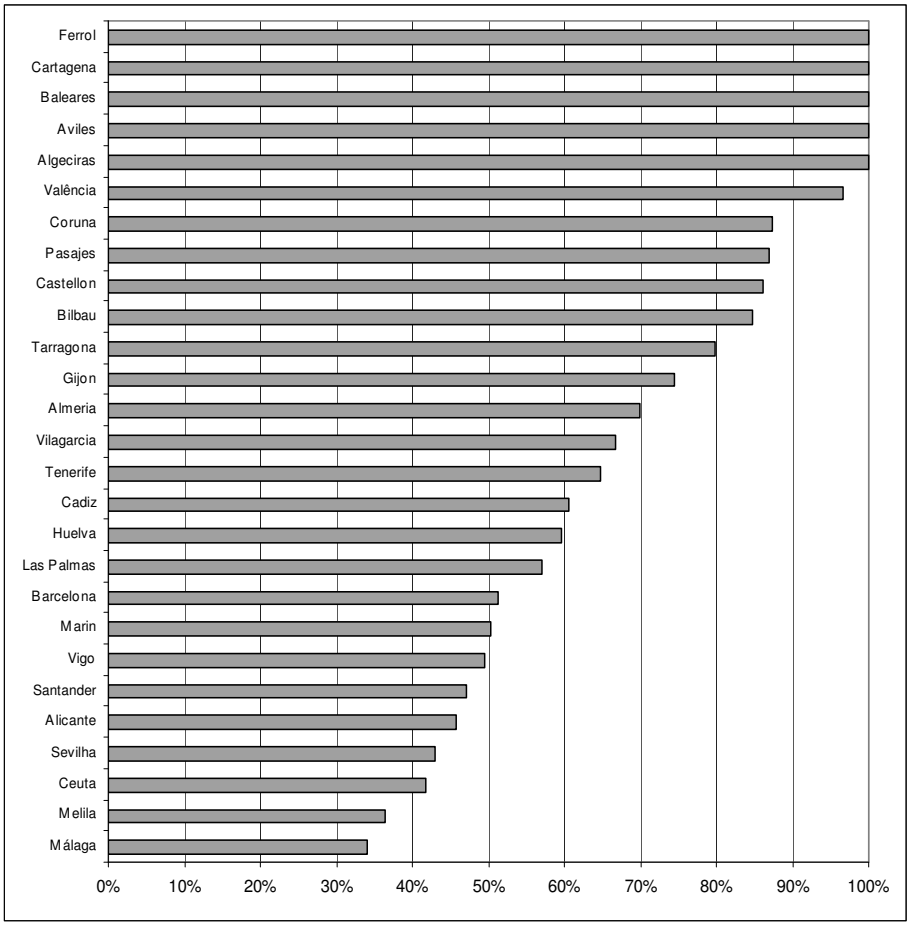
Table 1 – Characteristics of terminals by efficiency level groups

	TEU/sqm of the terminal	TEU/meters of quay	TEU/ number of gantry crains	Distance between gantry cranes (m)	Terminal width (m)
Average	1,3	441	67.000	170	403
More Efficient	3,76	1766	152.000	86	496
Less Efficient	0,10	81	15.000	781	183

4.2 Data Envelopment Analysis of Iberian Port selection

In another analysis of DEA efficiency index, developed for the Spanish ports, was used as a variable input monetary resources expended by the authorities and as output variables the port authority income, throughput of Roro cargo, break bulk, Containerized cargo, solid bulk and liquid bulk.

Figure 2 – Efficiency DEA Index for Spanish Ports, 2005



It is possible to understand that there are port authorities that manage their resources well and can obtain better results for 1 euro spent. This results from a multivariate analysis of the performance component of monetary income and the trade component in the volume of cargo moved by segment.

The Port Authorities of Algeciras, Ferrol, Cartagena, Baleares, Aviles and Valencia are those that maximize results for every euro spent, so are the most efficient. The other must change management practices to improve performance and to be more efficient.

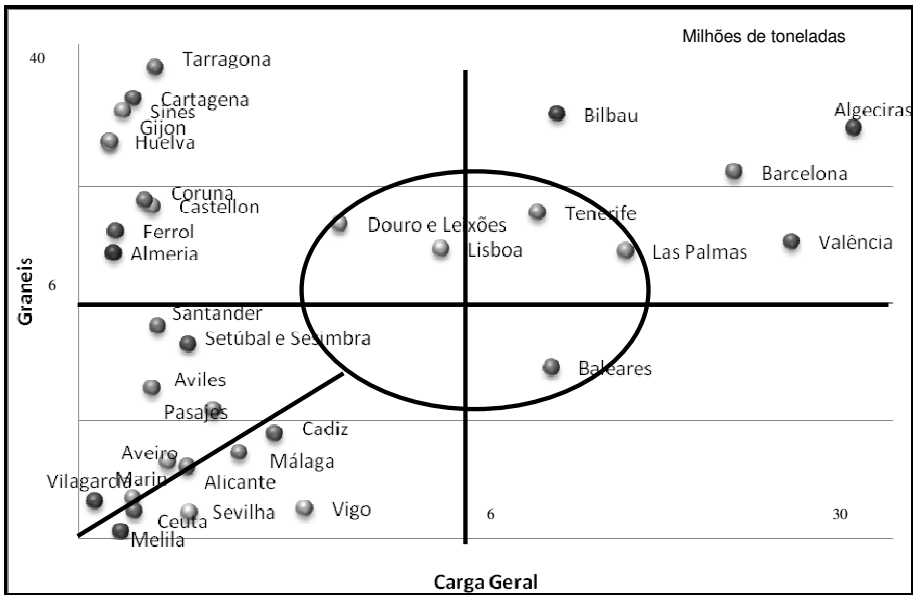
This type of analysis is very important because it compares features and results between different economic units (DMU), allowing decision-makers to realize what they can do to keep up with competitors or to improve the overall efficiency of port.

There is no doubt that it is important to compare the efficiency and performance in a systematic way, either terminal or port, and port authorities, but also all other service providers in ports.
The measure of performance can be further detailed by type of service and segment loading and can be identified several types of indicators that best suit the specific needs of the main types of port users. And this issue is crucial because the comparison is a factor in increasing the competitiveness of ports, with economic benefits to the economy.

5. Discussion

In order to modify and act upon the reality of ports, allowing better reach the objectives of increasing the movement of cargo and vessels, improving performance and quality and enhancement of positive impacts on the economy, using the most effective tools is necessary, first to understand this reality, try to define an explanatory model, classify the different types of ports and identify the characteristics of those who think a reference to a strategy for port development.
From a large number of quantified information of various kinds on the ports of the Iberian Peninsula, in the years 2002 to 2006, and using a statistical factorial analysis, there were the two most important factors that differentiate and classify the ports: the "size of the port on charges of low value" and "size of the port on charges of high value" characteristics of the ports to which almost all the others have high correlation.
Thus, using variables such as bulk cargo and general cargo, is possible to classify the ports and identified the following quadrants:

Figure 3 – Iberian Port specialization and size groups



The analysis of the framework for the empirical data, built the following model to allow the classification of Iberian ports.

Figure 4 – New Methodology for different port group

Bulk Ports / Energy Ports	Global Ports
Local Ports / Niche Ports	Container Ports

In fact, with the use of this model was possible to classify and characterize the following types of ports:

Local Ports or Niche Ports
Most of the Iberian ports have less than 6 million tons of bulk and general cargo, serving limited markets locally, up to 100 km radius, or small niche market very specific, such as the automobile industry, certain clusters of medium and heavy industries and are too close to major ports, which prevents them from developing.

Usually have higher prices per ton for cargos almost captive, because they do not have enough critical mass. Terminals are inefficient and there are small industrial terminals specializations.
This port can be further divided into essentially bulk ports (above the diagonal line), linked to local industries or general cargo ports (below the diagonal line) clusters linked to local production or serving SMEs and secondary cities in hinterlands limited.

Bulk Ports and Energy Ports
They are the biggest Iberian bulk ports, that have more than 6 million tons in bulk, liquid and / or solids, serving areas for heavy industry, electricity production or large refining and fuel tanks, close up to 150 km, and are too close to large multi-regional or regional ports, which prevents them from developing the general cargo.
Prices are usually very low per tonne, for low value cargos, and the port has sufficient critical mass to cover the fixed investments that require terminal, dredging, protection, environment and safety. Terminals are highly specialized, very efficient, and have secondary small activities in support of local populations, as compensation. The land and sea access are usually high level, allowing the entry of larger vessels in the world and are subject to heavy national investment public or private.

Global Ports
They are important ports, multiregional or global multi-faceted, the hinterland and foreland extended beyond its borders, and have over 10/15 million tonnes of bulk and

general cargo, serving multiple activities, large population areas, logistics and industrial activities, beyond 500 km, and are major international gateway or global links. They may be transhipment ports with global significance.
They have usually median price per ton for all cargos, having critical mass to cover the enormous investments that require the development and constant upgrading of the infrastructures and superstructures.
They are constantly expanding and essentially bet on many large and modern specialized container terminal, with large number of gateways, very fast, but also in terminals for agri-food, fuel, highly efficient industrial and leisure related activities, cruises and urban .
The access to the sea and land are usually very deep, allowing the entry of modern and large intercontinental ships.

Regional ports or Islands Ports (in the middle of the 4 main groups)
They are important but are multifaceted regional ports with small and limited geographically or politically hinterland, they have cargo around the 6 million tonnes and in bulk or in general cargo, and they serve important regions with a high activity and diversity of activities, but limited to 200/250 km. Some are located on islands or in regions political / economic isolation, almost as islands.
Practice usually low price per tonne for low and high value cargo for, possessing sufficient critical mass to cover the investment in terminals and dredging. Bet on some small specialized container terminals, agri-food, fuel, inefficient industrial terminals and leisure and cruises. The access routes and land are usually mid-level, allowing the entry of medium-sized vessels.

We did not find any pure container port in Iberian peninsula, so this study must be enlarged.

4 Conclusions

In conclusion, the Iberian ports can be classified and characterized according to the model of five sectors related to its size and specialization, in terms of general cargo and bulk cargo, correlated with many of the differences in performance, cost, infrastructure and services characteristics.

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