PORT EFFICIENCY AND COMPETITIVENESS : THE CASE OF EUROPEAN PORTS

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1. ABSTRACT :

This paper aims to examine the hypothesis that the inter-port competition may lead a port to overinvest and to experience a lower efficiency score.This paper assesses such assumptions, using DEA-window to examine the efficiency of thirty ports in Europe from 2005 to 2014. Then, it includes these scores in a model of competiveness with using the Principal Component Analysis (ACP) and the Analytic Hierarchy Process (AHP). Estimates also show a tendency for ports who invested from 2005 to 2014 to experience a general decrease in efficiency scores, an element which could be explained by the time lag between the investment and the subsequent potential increase in container throughput. In addition, the majority of seaports of the Northern Europe (R3) are competitive but they have lost in terms of efficiency.

Keywords: European seaports, competitiveness, efficiency.

2. INTRODUCTION

Seaports are confronted with global business environment and logistics systems. Around 80 percent of the world'strade volume iscarried by ports. In addition, inter-port competition between ports can lead a port to over-invest and to experience a lower efficiency along the supply-chain (De Oliveira and Cariou ; 2016).

Efficiency has always been recognized as an important port competitiveness factor. In the port economy, competitiveness models included proxies to take account of efficiency in their analyzes. Efficiency was then assessed through indicators of partial productivity, capacity, customer satisfaction (Tongzon and Heng, 2005, Ugboma et al., 2006, etc.). However, no author has included technical efficiency scores in a competitiveness model. We believe that only efficiency scores calculated by conventional methods can representthis one.

To meet these objectives, we follow a two-step methodology. First, we apply Window- based DEA to examine the operational performance of 30 major european container from 2005-2014. Then, we include these scores in a model of competiveness with using the Principal Component Analysis (ACP) and the Analytic Hierarchy Process (AHP).

3. LITTERATURE REVIEW

The DEA window analysis was not employed in seaport context until 2002 and was chosen by Itoh (2002), Cullinane et al. (2004), Cullinane and Wang (2007), Ng and Lee (2007), Al-Eraqi et al. (2008) and Pjevčević et al. (2012).

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The AHP and the ACP has been used to select the competitive port and the important factors in explaining port competitiveness. For example, the works of Slack (1985), Tiwari et al.(2004),Song and Yeo (2004), Lirn et al. (2003), Tongzon (2009), Yuen et al.(2012) and Pires Da Cruz et al. (2013).

4. RESEARCH METHODOLOGY

The DEA window is based on a dynamic perspective, regarding the same DMU in different period of time as entirely different DMUs. The procedureis to consider each port is represented as if it were different port in each period under analysis. Each port efficiency is not only compared against the efficiency of other ports but also again stitsown efficiency at different times.

The Analytic Hierarchy Process (AHP) consists in defining factors and sub-factors that are influencing seaport competitiveness. Relative weights are given for each criterion to finally calculate an overall seaport competitiveness score for each seaport or simply identify the most important determinants of competitiveness.

The Principal Component Analysis (PCA) is used to reduce the available information we have about European seaport systems competitiveness. This technique will also permit us to know the importance of each factor in explaining competitiveness and to calculate a “score” for each port since it is possible.

5. RESULTS AND ANALYSIS

In the first stage, we analysed the efficiency of 30 european ports from 2005 to2013 using the DEAWindow analysis technique.

The available data allow us to focus only on the four main inputs (berth length, number of equipments, number of employees, port size) and one output (the volume of merchandise handled in tons (loading and unloading)).

The estimates show a tendency for ports who invested from 2005 to 2014 to experience a general decrease in efficiency scores, an element which could be explained by the time lag between the investment and the subsequent potential increase in container throughput. In addition, the majority of port of the northern range (R3) were operated inefficient throughout the study period.

At the second stage, we analyze the competitiveness of the ports of our sample. We introduce the average scores (DEA-BCC) obtained with the DEA Window Analysis as an explanatory variable in a model of port competitiveness. Thus, for the same sample of ports, we use other variables that explain competitiveness, in particular : Cost to export/export in US$ per container, number of documents to import/ export, liner shipping connectivity index, the quality of the infrastructure and port logistics performance index.

The next table shows the importance of each of the nine principal components. Only the first three components have Eigenvalues over 1.000, and together they explain over 77.2% of the total variability in the data.

Table 1: Total Variance Explained

component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.246	36.069	36.069	3.246	36.069	36.069	2.485	27.607	27.607
2	2.067	22.966	59.035	2.067	22.966	59.035	2.248	24.973	52.580
3	1.637	18.185	77.220	1.637	18.185	77.220	2.218	24.640	77.220
4	.895	9.944	87.164						
5	.611	6.785	93.949						
6	.401	4.453	98.402						
7	.101	1.125	99.527						
8	.036	.398	99.925						
9	.007	.075	100.000						

To enable the interpretation of our factors, we carry out a factor rotation by Varimax Kaiser Normalization. These three rotated factors are just as good as the initial factors in explaining and reproducing the observed correlation matrix.
Then, we used the the Analytic Hierarchy Process to classify the ports, the results show the ports of the class 3 show an acceptable performance (it has a good maritime connectivity and a high quality of the port infrastructures) handling costs enough low. This class contains the majority of the ports of the the northern range (R3) .
According to the competitiveness scores, Germany, Sweden and the Netherlands have the highest ranks, which confirms that the ports of the northern range (R3) are more developed and competitive than those of the rest of the continent.

6. CONCLUSION

The objective of the paper was to investigate whether inter-port competition has an impact on port efficiency score. Estimates also show a tendency for ports who invested from 2005 to 2014 to experience a general decrease in efficiency scores, an element which could be explained by the time lag between the investment and the subsequent potential increase in container throughput. In addition, the majority of seaports of the northern range (R3) are the most competitive but they have lost in terms of efficiency.

References

Al-Eraqi, A. & Adli, M. & Khader, M. & Barros, C.P. (2008), ''Efficiency of Middle Eastern & East African Seaports: Application of DEA Using Window Analysis''. European journal of scientific research, 23 (4), 597-612.

Cullinane, K. P. B. & Song, D.W. & Ping, J. & Wang, T.F. (2004), ''An Application of DEA Windows Analysis to Container Port Production Efficiency". Review of Network Economics, Vol.3, No.2, pp. 184-206.

Cullinane, K. & Wang, T.-F. (2007) Devolution, Port Governance & Port Performance. Research in Transportation Economics, 17, 517-566.

Figueiredo De Oliveira, G. & Cariou, P. (2014), ''The impact of competition on container port (in)efficiency''. IAME 2014 conference, Norfolk, Virginia, USA.

Itoh, H. (2002), ''Efficiency Changes at Major Container Ports in Japan: A Window Application of Data Envelopment Analysis". Review of Urban & Regional Development Studies, vol. 14, no. 2, 133-152.

Lee, T.W., Yeo, G.T. & Thai, V.V. (2014), "Changing concentration ratios & geographical patterns of bulk ports: the case of the Korean West Coast", *The Asian Journal of Shipping & Logistics*, Vol.30 No. 2, pp. 155-173.

Lirn, T.C. & Thanopoulou, H.A. & Beresford, A.K.C. (2003), ''Transshipment port selection & decision making behavior: analyzing the Taiwanese case'', International Journal of Logistics, 6 (4), 229–44.

Ng, A.S.F. & Lee, C.X. (2007), ''Productivity analysis of container ports in Malaysia: a DEA approach''. Journal of the Eastern Asia Society for Transportation Studies 7, 2940–2952.

Pjevčević. D& Radonji.C & Hrle.Z, & Coli. V (2012), "DEA window ´ analysis for measuring port efficiencies in Serbia," PROMET— Traffic&Transportation, vol. 24, no. 1, pp. 63–72.

Pires da Cruz, M.R. & Ferreira, J.J. & Azevedo, S.G. (2013), ''Key factors of seaport competitiveness based on the stakeholder perspective: An Analytic Hierarchy Process (AHP) model''. Maritime Economics & Logistics (15): 416–43.

Slack, B. (1985), ‘‘Containerization, inter-port competition & port selection’’, Maritime Policy & Management, 12 (4), 293–303.

Song, D. W. & Yeo, K. (2004), ‘‘A competitive analysis of Chinese container ports using the analytic hierarchy process’’, Maritime Economics & Logistics, 6 (1), 34–52.

Sys, C. (2009), ‘’Is the container liner shipping industry an oligopoly?’’,Transport Policy, 16 (5), 259-270.

Tiwari, P. & Itoh, H. & Doi, M. (2004), ‘‘Shippers’ port & carrier selection behaviour in China: a discrete choice analysis’’, Maritime Economics & Logistics, 5, 23–39.

Tongzon, J. L. (2001), ‘’Efficiency Measurement of Selected Australian & Other International Ports Using Data Envelopment Analysis. Transportation Research Part A, 35(2), 107-122.

Tongzon, J. & Heng, W. (2005), ‘’Port privatization, efficiency & competitiveness: Some empirical evidence from container ports (terminals)’’, Transportation Research Part A, 39 (5), 405–424.

Tongzon, J.L. (2009), ‘‘Port choice & freight forwarders’’, Transportation Research Part E, 45 (1), 186–95.

Ugboma, C. & Ugboma, O. & Ogwude, I. (2006), ‘‘An Analytic Hierarchy Process (AHP) approach to port selection decisions–empirical evidence from Nigerian ports’’, Maritime Economics & Logistics, 8 (3), 251–66.

Yuen, C.A. & Zhang, A. & & Cheung, W. (2012), ‘‘Port competitiveness from the users’ perspective: An analysis of major container ports in China & its neighboring countries’’, Research in Transportation Economics, 35(1), 34-40.