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Efficiency of Italian and Norwegian airports: A matter of management or of the level of competition in remote regions?

Rico Merkert [a,*], Luca Mangia [b]

[a] Institute of Transport and Logistics Studies, The University of Sydney, Sydney, NSW 2006, Australia
[b] Go-Mobility srl, 00161 Roma, Italy

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ABSTRACT

Benchmarking has proven to be a useful tool with which to compare and evaluate the performance of airports but sometimes the determinants of performance are not investigated or accurately interpreted. This paper analyses the cost efficiency of 35 Italian and 46 Norwegian airports over time. We apply a two-stage DEA approach, with truncated regression models in the second stage to evaluate the role of competition as a key determinant of the first stage efficiency scores. For that reason we initially use a separate model to measure the level of competition at the relevant airports both from other airports and from surface transport. We show that particularly for regional and small airports, it is the level of competition that impacts on the airport's efficiency. Military use/ownership and size of airports also have a positive impact on efficiency although diseconomies of scale matter when infrastructure is taken into account. Finally, when regressed separately, we find that Italian airports that are managed through a concession have higher efficiency scores than those with partial and temporary partial concessions.

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1. Introduction

Measuring and benchmarking of airports has in the recent past seen an increased interest from practitioners, regulators and academics alike. One reason for this is the constant drive to improve efficiency of airports either to please private investors or public authorities particularly during the period of austerity that many governments around the globe are currently experiencing. As slots become a scarce resource at many airports, efficiency improvements can also be an effective way of increasing capacity. In other words, the airport operators can sweat existing assets rather than building new airport infrastructure (such as runways). Benchmarking is also used by regulators to set efficiency improvement targets as well as caps for airport charges. Finally, the airports themselves can use efficiency analysis and benchmarking to identify best practice cases and to learn from them. In order to do all this effectively, it is paramount to understand the determinants of the measured airports' efficiency.

The most commonly analysed determinants of airport efficiency are the airport's size based on the concept of economies of scale (e.g. Assaf, 2010) and the airports ownership/management structure (e.g. Curi et al., 2010), but there are many other variables that can have an impact on the efficient operation of airports (for a detailed review see Merkert et al., 2012). One

* Corresponding author. Tel.: +61 2 911 41883; fax: +61 2 9114 1899.
E-mail address: rico.merkert@sydney.edu.au (R. Merkert).

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aspect that has not been studied in any depth is the influence of competition on airports' performance. Previous studies have related the poor performance of remote airports particularly to either their remoteness/location compounded by strong seasonal demand swings (Tsekeris, 2011) or to the unfavourable environment around remote airports including, severe weather conditions (e.g. Merkert and Mangia, 2012), when in fact the efficiency determining factor could be simply a lack of competition. This is a substantial gap in the literature as economic theory tells us that market forces usually drive innovation and companies' performance positively. For that reason, this paper aims to investigate the impact of competition and other key determinants on airports efficiency. We apply a two-stage Data Envelopment Analysis in the context of airports from Italy and Norway. As data on the level of competition of our analysed airports was not readily available, we developed our own competition measurement model, whose results were then fed into the second-stage regression models.

The remainder of the paper is structured into three main sections. Section 2 presents a brief introduction to the methodology and data used to estimate the level of competition, the efficiency of the airport and finally the impact of the level of competition and other factors on the estimated airport efficiency scores. The results are presented and discussed in Section 3, whilst Section 4 offers some conclusions.

2. Methodology and data

As the prime interest of this paper is to determine the impact of the level of competition on airports' performance, we estimate in a first step the level of competition faced by the analysed airports and then use the results in DEA second-stage regressions.

2.1. Estimation of level of competition

To estimate the level of competition of individual airports, we developed a model that assumes that each separate transport infrastructure (other airports or surface infrastructure) within a certain distance from the airport (catchment area) is a potential travel/choice alternative for the passenger and therefore a source of competitive market pressure.

For analysing market dynamics in transport various approaches exist with the most commonly applied ones being modal split models based on a logit/probit algorithm and competitive index models. As the former requires a very large amount of data we opted for the latter and developed our own competitive index model based on the work of Firpo and Monti (2011, p. 748). Their model basically indexed the level of competition as a function of the distance between competing airport pairings, as shown in the following equation:

$$Ind_i = \sum_j (r_i + r_j - d_{ij}) \tag{1}$$

where r_i and r_j are the radii of the catchment areas (assuming circular catchment areas) of competing airports i and j, and d_{ij} is the distance between them. As this model does not take into account other modes of transport and also relies on the simplified assumption of circular catchment areas (which can lead to biased results), we developed our own competition index model. Our model accounts for other modes of transport and was inspired by gravitation models (Coulomb's inverse-square law and Newton's law of universal gravitation). The key assumption of our model is that an individual airport faces a derived level of competition C_i which is equal to the sum of n modes of transport within the catchment area multiplied by 1 minus the distance in minutes $t_{i,j}$ over T (catchment area radius kept constant at 120 min) as shown in the following equation:

$$C_i = \sum_{j=1}^{n} \left[w_j \cdot \left(1 - \frac{t_{i,j}}{T} \right) \right] \tag{2}$$

where w_j is a weight for the probability of choosing a mode of transport j and $t_{i,j}$ is a time variable and is measured in minutes from the airport to the other modes of transport terminal/station. The modes of transport considered are: Sea Transport (presence of a port in the catchment area), Air Transport (presence of another airport), Road Transport (presence of a highway junction in the catchment area), Traditional Rail Transport (presence of a station in the catchment area) and High Speed Rail (presence of a dedicated station in the catchment area).

The variable w_j is equal to 1 for each mode of transport if one assumes that passengers and cargo have the same probability of being chosen across the different modes. Alternatively, one can express that variable as $w_j(e_j)$ if it can be assumed that the probability of choosing one mode over another is a function of the price elasticity or other indicators. Another possible option is to use judgment or other statistics to assign a weight w_j to each mode of transport. For the purposes of this paper no weight or function has been considered (after our deliberations we concluded that for linear networks such as railways or motorways, it does not make sense to consider each point of access). What we have done instead is to include, not only the closest airport in the catchment area, but all airports within the catchment area. By doing so we assume that competing with other airports represents a higher level of competition compared to a situation where an airport competes with only other modes of transport. Our final model for estimating the level of competition of an individual airport i is therefore as follows:

$$C_i = \sum_{j=1}^{n} \left(1 - \frac{t_{i,j}}{120} \right) + \sum_{k=1}^{m} \left(1 - \frac{t_{i,k}}{120} \right) \tag{3}$$

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