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Benchmarking airports from a managerial perspective

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ABSTRACT

Benchmarking airports is currently popular both in the academic literature and in practice but has proved rather problematic due to the heterogeneity inherent in any reasonably sized dataset. Most studies either treat the airport production technology as a black box, or separate the terminal and airside activities, assessing them individually. In this article we analyze airports as a single unit due to the direct complementarities, thus avoiding the artificial separation of inputs. Using data envelopment analysis (DEA), we open the black box in which a network describes the production process, thus demonstrating the sequential effects that separate final from intermediate outputs, including those under partial managerial control and those that are known to be non-discretionary. To further improve the benchmarking process, we identify appropriate peers for a case study of 43 European airports over 10 years, through a restricted reference mechanism according to pre-defined characteristics. Compared to basic DEA models, the results of the proposed structure provide more meaningful benchmarks with comparable peer units and target values that are potentially achievable in the medium term. By identifying each unit's individual reference set, unique outliers influence the performance measurement less severely than occurs under basic DEA. In addition, the formulations produce an implementation path that moves the airport towards the Pareto frontier gradually, taking into account the regulatory and business environment in which the unit is located.

1. Introduction

According to the Princeton dictionary, an airport is defined as "*an airfield equipped with control tower and hangars as well as accommodations for passengers and cargo*". Airports can be defined as an important, basic infrastructure to a society in which aviation is one of the drivers of a modern economy. An alternative approach defines an airport as a private production system in which society maximizes social welfare by encouraging airport management to maximize profits, whilst simultaneously considering consumer surplus via some form of airport regulation if deemed necessary. Consequently, it is unclear whether airports should be considered as a not-for-profit, public good, as is the general approach in the United States, or as a private enterprise maximizing shareholder value. Since it would appear to be true that large regions of the world are gradually adopting the privatized form [1] and that independent authorities managing public airports in the United States do not behave differently to their private counterparts with respect to productivity [2], in this research we develop an airport benchmarking methodology from an airport manager's perspective in which we assume that the airport intends to maximize revenues and minimize costs.

Liebert and Niemeier [3] review airport benchmarking studies applied to a diverse range of activities using various methodologies. The methods most frequently applied include price index total factor productivity [4–6], parametric stochastic frontier analysis [7,8] and non-parametric data envelopment analysis (DEA). DEA has been used to compare the performance of airports within national boundaries, including the U.S. [9,10], U.K. [11], Spain [12,13], Australia [14], Taiwan [15,16] and Portugal [17] as well as airports around the world [18,19]. It is rather difficult to draw general inferences since many of these articles arrive at directly opposing conclusions. For example, Murillo-Melchor [13] show that Spanish airports in their dataset suffer from decreasing returns to scale whereas Martín et al. [20] concluded increasing returns to scale for the same set of airports. Abbott and Wu [14] found most Australian airports enjoy increasing returns to scale, Pels et al. [7] argue that European airports operate under constant returns to scale in air traffic movements and increasing returns to scale on the terminal side and Lin and Hong [19] argue that most airports are not operating at an optimal scale. Graham and Holvad [21] and Abbott and Wu [14] argue that Australian airports are more efficient than their European counterparts, Lin and Hong

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[19] argue that the U.S. and European airports are more efficient than their Asian and Australian counterparts and Pels et al. [7] conclude that widespread European airport inefficiency is not specific to a country or region. Consequently, Morrison [22] has called for a balanced approach and a dialog between airport managers and researchers.

The majority of previous studies have treated airport technology as a single production process, avoiding the complexity inherent to airport systems. Gillen and Lall [9] and Pels et al. [7] were the first to argue that the airport could be analyzed as two separate decision-making processes, one serving airside activities and the other serving landside production. Yu [16] is the first to present an operational framework of airport services as a multi-stage process opening the black box via network DEA [23], utilizing a slack-based measure of airport network performance [24]. Yu [16] analyzed airport operational activities decomposed into production, airside and landside services, whilst taking into account environmental factors (population). In the production stage, inputs include labor and quasi-fixed runway, terminal and apron areas. The intermediate products are defined as runway and terminal capacities. The airside outputs include aircraft movements and the landside outputs cover cargo and passenger transportation. We also argue that a single black box approach would be insufficient to capture the rich picture underlying the multi-stage airport technology as demonstrated in Fig. 1. Since the liberalization of the aviation industry in Europe in the late eighties, airports have focused on both aeronautical and commercial landside activities. The network DEA approach recognizes the fact that generalized and fixed costs connected to the two sets of activities can only be split in an artificial manner and that while aeronautical revenues draw from passengers, cargo and air traffic movements, the non-aeronautical revenue is more closely tied to passenger throughput. Although airports may have limited control over traffic volume, non-aeronautical revenues drawn from commercial activities, such as airport cities, are indeed within the purview of airport management. As argued in Oum et al. [25], the omission of outputs such as commercial services is likely to bias efficiency results as it underestimates the productivity of airports whose managers focus on generating additional revenue sources. Many airports attempt to increase revenues from non-aeronautical sources which are not directly related to aviation activities in order to cross-subsidize aviation charges in turn attracting more airlines and passengers to their airport [26]. Revenue source diversification that exploits demand complementarities across aeronautical and non-aeronautical services appears to improve airport productive efficiency [2]. We would argue that it is more reasonable to analyze airports as a single unit because of the direct complementarities, thus avoiding the need to artificially separate inputs between the terminal and airside. Consequently, in this research we develop a DEA modeling approach in order to measure the relative cost or revenue performance of airports with respect to aeronautical and commercial activities, whereby activities are connected via passengers as the common intermediate product.

Another issue that arises in the airport benchmarking literature is the problem of comparability. A base assumption within the DEA context that has been questioned in the literature is the homogeneity of the decision-making unit under analysis and the appropriateness of this assumption with respect to airports [22]. The aim of the formulations presented here are to directly broach the question of airport benchmarking in light of the reasonable level of heterogeneity to be found in any multiple airport study, which is necessary to generate sufficient data points for purposes of analysis. In order to ensure comparability, we apply a restricted reference approach [27] which forms individual reference sets based on similar mixes of inputs or outputs and intermediate products. Certain inputs may be beyond managerial control in the short to medium term yet affect airport performance [18]. In general, capital is frequently treated as a non-discretionary variable over which airport management has little to no control [28]. In this research, capital has been defined in terms of declared runway and terminal capacity which are agreed upon

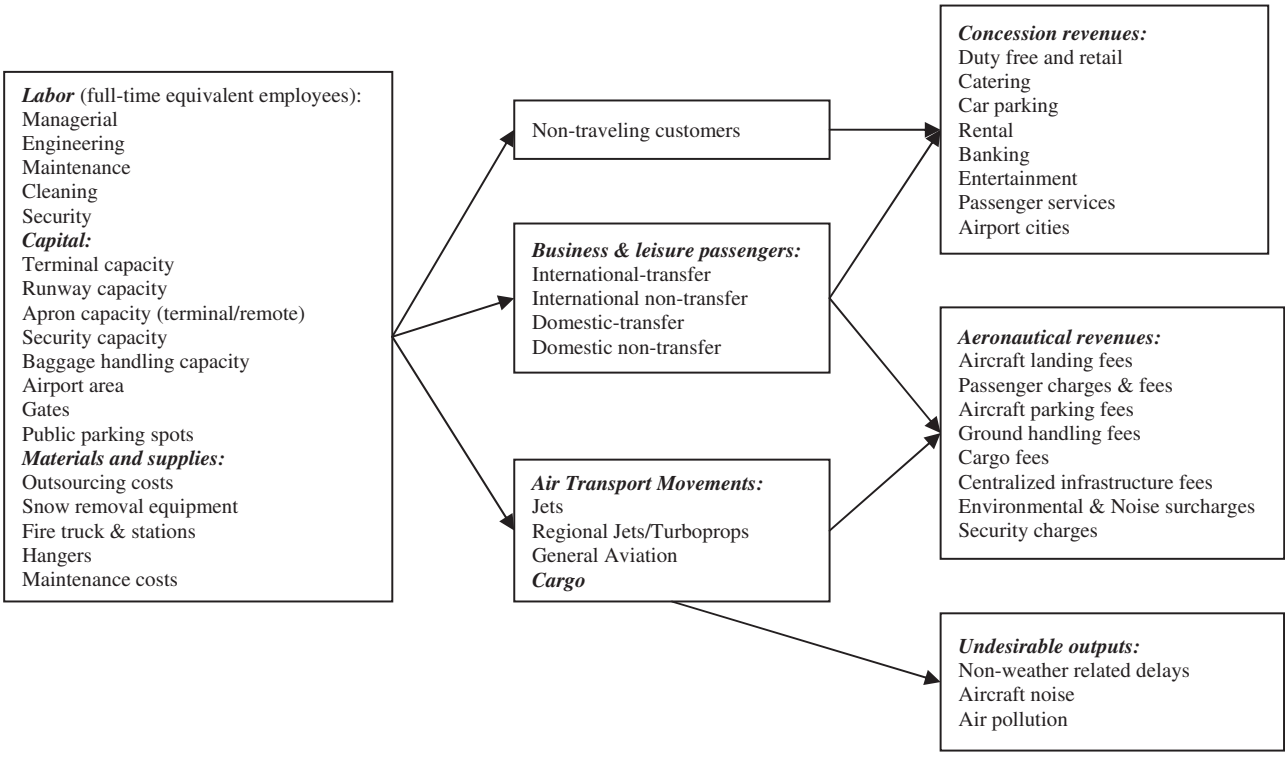

Fig. 1. Airport network technology.