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New evidence on the efficiency of Italian airports: A bootstrapped DEA analysis☆

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ABSTRACT

A bootstrapped DEA procedure is used to estimate technical efficiency of 18 Italian airports during the period 2000–2004. Departing from previous studies, we separate the efficiency related to ability to manage airside activities (operational) from that related to the management of all business activities (financial). In general, Italian airports operate at poor levels of efficiency, with slightly better performance in terms of their financial activities. In the current study, selected intrinsic and environmental characteristics are considered as possible drivers of Italian airport performance. In particular, we found that: (i) the airport dimension does not allows for operational efficiency advantages, (ii) on the other hand, the airport dimension allows for financial efficiency advantages for the case of hubs and disadvantages for the case of the smallest airports (iii) the type(s) of concession agreement(s) might be considered as important source of technical efficiency differentials for those airports running marginal commercial activities; (iv) the introduction of a dual-till price cap regulation might create incentives which lead to the increase of financial efficiency at the detriment of the operational performance. Lastly, the development of a second hub (Milano Malpensa), has negatively affected the performance of the country's national hub (Roma Fiumicino).

1. Introduction

In recent years, airports have been under growing pressure to be more financially self-sufficient and less reliant on government support. Many airports around the world have been commercialized and/or privatized so that airports are operated more like a business [1,2]. Moreover, the increased airline competition brought about by deregulation and liberalization has heightened this recognition and placed airports in a much more competitive environment [3]. To keep pace with such developments, selected recent research efforts have devoted themselves to analyzing the operational performance, in terms of efficiency, of airports, and key issues related to changes in the industry. Despite this interest, the measurement of airport efficiency is not an easy task given the complexity involved at both the firm and industry levels. Indeed, the airport could be considered as a multi-product firm, where disparate elements and activities are brought together to facilitate, for passengers/customers and freight, an interchange between air and surface transport [4]. In addition, government interventions and industry structure could make performance assessment that much more involved. Given these conditions, benchmarking might represent an effective approach for moving airports in the direction of 'best practices' [5].

Various approaches have been used in the literature to deal with benchmarking. One of the most widely known and accepted is Data Envelopment Analysis (DEA) where the frontier, constructed using linear programming (LP), is the benchmark against which the relative performance of the decision making units (DMU) such as airports is measured. Most empirical applications of DEA to airports have investigated their efficiency at the individual country level. For example, beginning with the seminal work of Gillen and Lall [6], recent papers have focused on the U.S. (e.g., [7,8]), Australian (e.g., [9]), Japanese (e.g., [10]), and Brazilian (e.g., [11]) markets.

Within the European context, Parker [12] examined the UK market while Martìn and Romàn [13] considered that of Spain. Importantly, there appear to be relatively few cross-country studies: Adler and Berechman [14], Oum et al. [2,15–17] and Ling and Hong [18] analyzed the performance of airports around the world, while Pels et al. [19,20] focused on Europe.

As far as the Italian case is concerned, a number of DEA-based studies have appeared in recent years, but with mixed or apparently contradictory results. Malighetti et al. [21] investigated the

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efficiency and productivity changes of 34 Italian airports for the period 2005–2006. Low average efficiencies were found with evidence of improved performance among airports larger than 5 millions of passengers. Further, hub premiums and the privatization process were found to be positive drivers of performance, while military activities and seasonality effects appear to operate as obstacles [21]. The authors also investigated scale inefficiency at firm level, finding that Milano Malpensa and Roma Fiumicino work under decreasing returns to scale, while other airports with less than 5 millions of passengers operate with increasing returns to scale [21].

Two papers by Barros and Dieke [3,22] analyzed 31 Italian airports during the period 2001–2003. They introduced the Simar and Wilson methodology [23] shown high values of efficiency,[2] positively affected by drivers such as size, private management, as well as high levels of workload units (WLU). In results different from those of Malighetti et al. [21], Barros and Dieke [3,22] found that most airports in their sample operated under a constant returns to scale. Recent work by Curi et al. [4], extend the findings by Barros and Dieke [3] and found low levels of efficiency amongst Italian airports, in line with results offered by Malighetti et al. [21].

The present work aims to measure the efficiency of Italian airports from two managerial points of view: the first is strictly related to operational activities, while the second considers the ability to generate financial returns from all airport business activities. This breakdown may hopefully provide support for decisions regarding the effective utilization of airport infrastructure, as well as the generation of meaningful financial returns. Results from the two perspectives are then jointly discussed. Moreover, we formally test for global returns to scale, distinguishing technology (namely, the frontier), in the context of a non-parametric model [24]. We then explore recently developed statistical inference tools for DEA [25], which have realized success in earlier studies [26,27]. These tool sets (bias correction, and confidence intervals associated with DEA scores) are particularly useful when the sample size is small, and the number of dimensions used in the production model is high, as is the case of the Italian airport industry.

In what follows, we first describe the Italian airport industry (Section 2), then briefly discuss the methodology adopted (Section 3), as well as the data (Section 4). In Section 5, the study's results and selected comments are presented, with concluding remarks offered in Section 6.

2. The Italian airport industry

2.1. The regulatory reforms

Airport management is witnessing an unprecedented wave of reforms worldwide. These are largely motivated by the growing economic importance of airports, the intensity of competition among airlines, and the budget restrictions imposed by governments on infrastructure investments [14].

The key elements of the current discussion focus on the privatization of management companies, new price regulations, and the increased competition among airports within the same country. As a result, airports are now under pressure to improve their efficiency relative to competitors. De Borger et al. [5] opine that benchmarking analysis is one of the ways to drive airports towards the frontier of best practices. In what follows, we describe the main regulatory reforms that have involved the Italian airport industry.

Currently, the conditions that regulate the access and the management of the airport facilities are defined by four alternative types of concession agreements (see Table 1) granted by the State through Enac[3]: "Total" (T), "Partial" (P), "Precarious Partial" (PP) and "Direct" (D) [28].

Activities covered by the 'T' agreement include: ordinary and extraordinary maintenance of infrastructure (runways, braces, yards, terminals, offices, access roads and connecting thoroughfares), provision of selected services (viz., energy, lighting, water heating, air conditioning, water treatment, waste disposal, cleaning, security, etc.), and location of ancillary structures for passenger convenience (e.g., restaurants, shops, parking). The existing management companies collect all revenues derived from all airport operations and services. The current 'T' concession is a 40 agreement that pays an annual fee to the State.

Under the 'P' agreement, a chosen company is responsible for the landside and relative infrastructures. It perceives both passenger-freight fees and revenues from commercial activities. Enac, on behalf of the State, is responsible for maintaining and developing the airside infrastructures while the airport management company has the duty to maintain landside infrastructures. The PP agreement differs from the others because, in this case, the airport company receives revenues only from commercial activities. Both P and PP allow for a 20-year concession. In the *D* agreement, all activities are directly managed by Enac, with the exception of airlines services, which are generally self-produced.

By the 1990s, several laws and administrative acts were introduced by the Italian government in order to increase national competition and efficiency. In particular, in 1992 and 1993 Laws n. 1498/92 and n. 1537/93 abrogated the duty by the State, or other public authority, to maintain a majority in airport management companies. In 1996, European directives on handling liberalization (EU 96/67) forced, by 2001, airport management companies with passengers in excess of 2 million movements to open the handling market to competitors. The European directive was implemented by Italian Decree 18/99, which introduced the so called "social clause." In this case, new handling companies were obliged to hire employees from the existing pool.

In 2000, the CIPE (Comitato Interministeriale per la Programmazione Economica), with Administrative Act n. 86/2000 (G.U. n. 36 02/13/2001),[4] introduced a dual-till price cap: Tariffs are price capped on the airside, while, on the landside, monopolistic rents are "skimmed" via specific royalties. In 2003, the Ministerial Decree (G.U. n. 169 07/21/2003) entrusted airport management companies to offer luggage and passenger security services. Lastly, the dual-till cap has been modified by Law 248/2005 when the price cap has been based on a "mixed" single-till [29]. For the first time, the cap has been calculated considering both aeronautical margins and a share of non-aeronautical margins greater than 50%. The law assigns the supervision and management of all security services to the airport and airlines companies. However, in order to compensate for the

[2] The number of inputs and outputs used by Barros and Dieke [3,22] may be excessive as discussed by Simar and Wilson [23]. In fact, the convergence rates of DEA estimator become worse as dimensionality (i.e. the number of inputs and outputs) increases, becoming quite slow with 5–10 dimensions. Moreover, an excessive number of inputs and/or outputs, respect to observations, in DEA model causes in a large number of efficient units.

[3] Enac – the Italian Civil Aviation Authority – was established on 25th July 1997 by Legislative Decree no.250/97 as the National Authority committed to oversee technical regulation, surveillance and control of civil aviation. Enac is engaged with the diverse regulatory aspects of the air transport system, and performs monitoring functions related to the enforcement of adopted rules regulating administrative and economic issues.

[4] The Gazzetta Ufficiale (G.U.) promulgates acts of the Italian parliament and decrees of the President of the Republic.