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Are outsourcing and non-aeronautical revenues important drivers in the efficiency of Spanish airports?

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ABSTRACT

This paper evaluates the influence of contracting out, or outsourcing, certain airport services and of commercial diversification strategy. Although most of the effort is being put towards applying non-parametric techniques in airport efficiency studies, we have chosen parametric methodology. We use a distance function, as it has known advantages. The findings show the positive contribution of outsourcing and non-aeronautical revenues on the efficiency of the Spanish airports' network.

1. Introduction

Measurement of an airport's efficiency is important in ensuring its efficiency. Evaluating the efficiency of airports is, however, difficult. Factors such as the ownership structure, political constraints and the economic structure of the region the airport is located in make the evaluation of the efficiency difficult.

Changes in airport ownership patterns have shifted managerial attention towards commercial returns and non-core airport activities. Oum et al. (2006), for example, found evidence that business diversification helps airports achieve higher operating efficiency, because of complementary demands between aeronautical and commercial services. However, they had limited data on outsourcing activities and this may explain why outsourcing had no relationship with efficiency. Low and Tang (2006) found outsourcing to be a substitute for both labour and capital, and could be an alternative to investment.

Spain's airport network was centrally managed until the beginning of the 1990s after which airport authorities were allowed to exploit their facilities on a commercial basis, to improve efficiency. The result was that some core airport activities were outsourced to exploit the complementary demand between aeronautical and commercial services. Here we evaluate the influence of contracting out (outsourcing) and commercial diversification strategy on the technical efficiency of airports.

2. Background

Most of these airport efficiency studies have used non-parametric methods to evaluate their levels of inefficiency. The DEA approach is the most common method used. In Table 1 there are two groups of parametric studies. In the former (Pels et al., 2001, 2003) technical efficiency is obtained through a stochastic production frontier. One main criticisms of this approach is that it ignores the multioutput nature of airport activity. The second group has proposed the endogenous-weight TFP index (EW-TFP) which specifies a flexible functional form for the production transformation function with multiple inputs and outputs; see Yoshida (2004), for details of the methodology.

Oum et al. (2003) considered outsourcing as an explanatory variable for airport efficiency and productivity. They used a soft cost input[1] to characterize outsourcing. However, contrary to common belief, the authors found no relationship between outsourcing and the total factor productivity scores. Despite this, Oum and Yu (2004) affirm that any productivity measure, which does not take into account outsourcing as an input, would produce biased empirical results favouring the airports that contract out most of their services. Moreover, they did not report any results for the influence of outsourcing on the airport variable factor productivity. In summary, it was unclear whether outsourcing influences airport productivity performance. Our paper attempts to close this gap by establishing relevant empirical evidence.

Oum et al. (2003) and Oum and Yu (2004) found that developing the commercial activities of airports could be key to achieving higher total factor productivity levels, because they could take advantage of the complementary demand between traffic volumes and commercial services. Airports with higher cargo handling had higher variable factor productivity, because air cargos require less

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[1] This kind of cost was measured by adding all the indirectly related expenses, which were considered to reflect the extent of an airport's outsourcing activities, to capital and personnel costs.

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Table 1
Studies of airport efficiency.

Year	Authors	Data	Model	Observations
1997	Gillen and Lall (1997)	21 USA airports (1989/1993)	DEA	Explain TE through Tobit
2000	Sarkis (2000)	44 USA airports (1990/1994)	DEA	TE scores are analyzed using Mann–Whitney test
2001	Adler and Berechman (2001)	26 Worldwide airports (1996)	DEA	Use Principle Component Analysis and applied Super efficient DEA model
	Pels et al. (2001)	34 European airports (1995/1997)	SPF	Use a Cobb–Douglas function
2002	Abbott and Wu (2002)	12 Australian airports (1989/90, 1999/2000)	DEA	Malmquist Index (and decompose it), explain TFP's variations through Tobit
2003	Bazargan and Vasigh (2003)	45 USA airports (1996-2000)	DEA	TE scores are analyzed using Kruskal–Wallis and Mann–Whitney tests
	Oum et al. (2003)	50 World airports (1999)	EW-TFP	Further analysing TFP by regression models
	Pels et al. (2003)	34 European airports (1995/1997)	SPF	Use a Translog function and explain inefficiency
2004	Yoshida and Fujimoto (2004)	67 Japanese airports (2000)	DEA	Explain TE through Tobit
			EW-TFP	Explain TE through OLS
	Oum and Yu (2004)	76 Worldwide airports (2000–2001)	EW-VFP	Further analysing VFP by regression models
	Barros and Sampaio (2004)	13 Portuguese airports (1990–2000)	DEA	Explain CE through Tobit
	Pathomsiri and Haghani (2004)	63 Worldwide airports (2000, 2002)	DEA	Use paired-sample *t*-test to test differences in TE scores before/after Sept-11
	Yoshida, 2004	30 Japanese airports (2000)	EW-TFP	Further analysing TFP by regression models
2005	Pathomsiri et al. (2005)	72 Worldwide airports (2000, 2002)	DEA	Parametric and non-parametric test to test TE differences before/after Sept-11
2006	Oum et al. (2006)	116 Worldwide airports (2001–2003)	EW-VFP	Further analysing VFP by regression models
	Pathomsiri et al. (2006)	72 Worldwide airports (2000, 2002)	DEA	Tobit to explain variation in airport productivity
2007	Barros and Dieke (2007)	31 Italian airports (2001–2003)	DEA	TE scores are analyzed using Mann–Whitney Test

Note: TE = Technical Efficiency, DEA = Data Envelopment Analysis; SPF = Stochastic Production Frontier; EW-TFP = Endogenous-weight TFP.
Source: own elaborated from several studies.

input than comparable passenger traffic. We also consider these two aspects in our empirical model, in order to contrast their results.

3. Data and model

We have collected data from 26 airports between 1993 and 1999. The airports covered by the sample were the two hubs, Madrid-Barajas and El Prat-Barcelona. Nine tourist airports in which the percentage of international passengers is above 50%. These were Alicante, Fuerteventura, Gran Canaria, Gerona, Ibiza, Lanzarote, Málaga, Palma de Mallorca and Menorca. Finally, there were the small and medium regional airports, such as Almería, Asturias, Bilbao, Coruña, La Palma, Melilla, Pamplona, Santander, Santiago, Sevilla, San Sebastián, Jerez, Valencia, Vigo and Zaragoza. We have attempted to represent the main types of organizational structures for airport authorities, in terms of their specialization; hub, tourist, regional, etc.

Airport output is easy to identify, but it is not homogenous. Yoshida (2004) points out that the airport industry is the typical example of joint production. While it shares the same set of inputs: capital, labour, land, and other miscellaneous materials, it yields various kinds of outputs, such as passenger loading/unloading, aircraft movements and cargo handling. Therefore, this joint-production characteristic makes it difficult to evaluate the efficiency of airport activities in a unanimous measure.

We use the model proposed by Battese and Coelli (1995) with a slight variation. Instead of using a production function we will use a distance function as it has certain advantages. Distance functions describe a multi-input, multioutput production technology, without making behavioural assumption; such as cost minimization or profit maximization. This is especially suitable for regulated industries. Another important advantage of distance functions is that input and output prices are not needed.

We use an input oriented distance function[2] because with airports, as in most regulated industries, demand is beyond the airports' control and has to be met. Output is exogenous, and hence input orientation is more relevant because input choice is endogenous. The following normalized stochastic translogarithmic input distance function was estimated:

$$\begin{aligned} -\ln(x_{nit}) = {} & \alpha_0 + \sum_i^m \alpha_i \ln y_{it} + \sum_i^{n-1} \beta_i \ln x^*_{it} + \frac{1}{2}\sum_i^m \\ & \times \sum_j^m \psi_{ij} \ln y_{it} \ln y_{jt} + \frac{1}{2}\sum_i^{n-1}\sum_j^{n-1} \gamma_{ij} \ln x^*_{it} \ln x^*_{jt} \\ & + \sum_i^m \sum_j^{n-1} \rho_{ij} \ln y_{it} \ln x^*_{jt} + \theta_1 T + \theta_2 T^2 \\ & + \sum_i^{n-1} \theta_{1i} T \ln x^*_{it} + \sum_i^m \theta_{1i} T \ln y_{it} + v_{it} - u_{it}; \quad \text{with} \\ & x^*_{it} = x_{it}/x_{nit} \end{aligned} \tag{1}$$

where three outputs' measures were considered: aircraft movement (ATM), average size of aircraft (defined as the ratio between passenger volume and ATM), and the share of non-aeronautical revenue in total airport revenue NAR/AR. The latter represents the level of commercial activity developed by the airport. Moreover, we have considered three inputs: the average number airport employees, the surface area occupied by the airport and the number of gates. We have also included a time trend to take into account technical change, i relates to the ith firm, α, β, ψ, γ, ρ, θ are the coefficients to be estimated, v_{it} is a symmetrical error term, i.i.d. has a zero average that represents the random variables that cannot be controlled by the operator, and u_i is a one-sided negative error term that measures the technical inefficiency of each operator and is distributed independently of v_{it}.

The second equation allows us to model the effects of technical inefficiency, as a function of the firm-specific variables that we consider may influence an airport's efficiency; i.e., outsourcing measured as the share of soft cost inputs in total cost defined as all inputs other than labour and capital, non-aeronautical revenue and cargo.

[2] An input distance function characterizes the production technology, by looking at a maximum proportional contraction of the input vector for a given output vector.