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Productivity growth and biased technological change in UK airports

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ABSTRACT

In this paper we estimate the total factor productivity of UK airports using a Malmquist index. Productivity change is factored into an index of efficiency change and an index of technological change. Technological change is further decomposed into indexes that measure the bias in the production of outputs, the bias in the employment of inputs, and the magnitude of the shift in the production frontier. Airports are ranked according to their productivity change for the period 2000–2005. Economic implications are derived.

1. Introduction

While there is an extensive literature on benchmarking applied to a diverse range of economic fields, the scarcity of studies regarding European airports bears testimony to the fact that this is a relatively under-researched topic (Humphreys and Francis, 2002; Humphreys et al., 2002). Research on the technical efficiency and productivity of airports has adopted three alternative methods of measuring efficiency: First, the non-parametric linear programming methods called data envelopment analysis-DEA (Gillen and Lall, 1997, 2001; Murillo-Melchor, 1999; Sarkis, 2000; Adler and Berechman, 2001; Martín and Román, 2001; Pels et al., 2001, 2003; Fernandes and Pacheco, 2002; Sarkis and Talluri, 2004; Yoshida and Fujimoto, 2004; Barros and Sampaio, 2004; Graham, 2005; Barros and Dieke, 2007, 2008; Fung et al., 2008). Second, are methods which use the parametric stochastic frontier model (Pels et al., 2001, 2003; Martín-Cejas, 2002; Barros, 2008a,b). Third, are index numbers approaches, such as the Tornquist total factor productivity index (Coelli et al., 2003, p. 27; Douganis et al., 1995; Hooper and Hensher, 1997) where such indexes are extended and estimated using the endogenous-weight total factor productivity approach (Yoshida, 2004; Oum et al., 2003). We extend the efficiency studies cited above by estimating total factor productivity for UK airports using a Malmquist index, Malmquist (1953). In addition to measuring efficiency change from period to period, our method allows for biased technological change in the production of airport outputs and in the use of airport inputs.

The motivation for the present research is the following: first, in prior research on UK airports' technical efficiency, Barros (2008b) estimated a stochastic frontier model and found that the majority of UK airports were not improving their efficiency after 2000. Barros' results contrast with prior research by Parker (1999) on BAA (British Airports Authority) airports, but these two papers used different data periods and different methods. However, the cause for declining technical efficiency is unclear and therefore an issue justifying more research. Second, recent acquisitions of UK airports by Spanish enterprises have increased competition. In 2004, TBI PLC, the owner of three regional airports in England, Wales, and Northern Ireland

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was acquired by a Spanish enterprise owned by AENA, the company that manages the Spanish airports, and Abertis, a Spanish construction company. In July 2006, BAA was taken over by a consortium led by the Spanish transportation group, Grupo Ferrovial. These acquisitions introduced competition in the field which is reflected in different efficient performance. Finally, while UK airports' technical efficiency has been analyzed using DEA and stochastic frontier models, the productivity growth of those airports has not been analyzed, further justifying the present research. Therefore, the aim of this research is to investigate total factor productivity change of the UK airports using a Malmquist index (Färe and Grosskopf, 1996). The Malmquist index decomposes productivity change into gains or losses due to efficiency change and gains or losses due to technological change. Furthermore, our method relaxes the assumption of Hicks' neutrality in the production of outputs and use of inputs by allowing for biased technological change to occur. Our method identifies the source of the bias in technological change.

The article is structured as follows: Section 2 presents the institutional setting on UK airports. Section 3 presents the productivity models. Section 4 presents the data and the results. Section 5 discusses the results and provides some concluding remarks.

2. Institutional setting

British airports are owned and managed by BAA (British Airports Authority, PLC), Manchester Airports PLC, TBI PLC, and by independent city airports. BAA is the owner and operator of seven British airports and operator of several airports in Italy and the USA, making it one of the world's largest transport-sector companies. The United Kingdom Airports Act of 1986 privatized BAA, although the government maintained a slight ownership share, and concern about monopoly power brought it under price capping regulation. In July 2006, BAA was taken over by a consortium led by the Spanish transportation group, Grupo Ferrovial. As a result, the company was delisted from the London Stock Exchange (where it had previously been part of the FTSE100 index) and the company name was subsequently changed from BAA PLC to BAA Limited.

Manchester airports PLC, formed in 1986, manages several English city airports and is characterized as a PLC (public limited company) owned by local authorities. Following the purchase of a majority shareholding in Humberside airport in 1999 and the acquisition of East Midlands airport and Bournemouth airport in 2001, the company was restructured to create the Manchester Airport Group. Although Manchester Airport Group is registered as a PLC, its shares are not quoted or sold on the London Stock Exchange. Manchester City Council has a majority shareholding (55%) with each of nine other city councils holding 5% each. Therefore, Manchester group is a public limited company.

TBI PLC is the owner of three regional airports in England, Wales and Northern Ireland. In 2004, TBI was acquired by a Spanish enterprise owned by AENA, the Spanish company that manages the Spanish airports, and Abertis, a Spanish construction company. The company has also expanded into international airport management under contract.

In 2008, the International Air Transport Association (IATA) challenged the UK's Civil Aviation Authority's decision to allow costs at London airports to rise by a massive 50% between 2008 and 2013, concluding that the regulators had proved to be impotent in defending the interests of travelers against monopoly practices. However, responding to the Office of Fair Trading's probe into UK airports, the Easy Jet CEO said that consumers need better protection from the airport operators who behave like local monopolists, pushing up prices to hide their own inefficiencies. Although Easy Jet supports the break-up of BAA Company, the BAA argues that consumers will not benefit from having BAA replaced by a series of 'Mini' monopolists. Table 1 presents some ownership characteristics of UK airports.

Of the 27 airports listed in Table 1, 37% are privately owned and 73% are public airports. Only three private airports, all owned by BAA and located in London, are regulated. These airports face RPI-X regulation where the revenue yield per passenger from landing, takeoff, and parking of aircraft is capped by the increase in a retail price index (RPI) minus some predetermined X factor (Hooper and Hensher, 1997). The four airports with the largest number of aircraft movements, including Manchester are subject regulated. The alleged lack of regulation indicates significant competition in this market.

3. Method

We estimate efficiency and total factor productivity change for UK airports using linear programming methods called DEA (data envelopment analysis). The DEA method constructs a best-practice piecewise-linear technology from observed DMUs (decision-making units). An advantage of the DEA method is that it allows one to measure the performance of DMUs which produce multiple outputs using multiple inputs. In addition, the DEA method does not require the researcher to specify an ad hoc functional form, nor does it require one to make unwarranted assumptions regarding the error structure when estimating efficiency using stochastic methods. However, a disadvantage of the DEA method is that all deviation of a DMU's performance from best-practice methods is attributed to inefficiency, even though some of the deviation might be due to random error. Moreover, DEA is an extreme point technique with the efficient frontier formed by the actual performance of best performing airports. Thus, the constructed frontier and the resulting efficiency estimates are dependent on the sample of airports.

The DEA method has been widely used to estimate the reciprocal of the Shephard (1970) input distance function. The reciprocal of this distance function serves as a measure of Farrell (1957) input efficiency and equals the proportional contraction in all inputs that can be feasibly accomplished given output, if the DMU adopts best-practice methods. We link input efficiency indexes across time in order to estimate the Malmquist productivity index. This index estimates the change