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Understanding relative efficiency among airports: A general dynamic model for distinguishing technical and allocative efficiency

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ABSTRACT

The paper introduces a new dynamic frontier model that is used to analyze the impact of both ownership and regulation on airport technical and allocative efficiencies. We differentiate between the short and long-term effects. Based on a large sample of international airports, we find in the short-run the majority of the improvements are from reducing technical inefficiency, which come for the most part from adjusting output, something that can be accomplished in the short-term. There are relatively small changes, in the short run, resulting from improving allocative efficiency. We find that adding economic regulation leads to a decrease in technical efficiency in the short-run. Quite different conclusions hold for the long-term; there are improvements available from reducing allocative inefficiency and comparable benefits are available from cutting technical inefficiency. In the long-run we find that technical and allocative inefficiency decreases by moving away from government owned to fully privatized airports and moving away from rigid regulation.

1. Introduction

Due to heavy competition, airports continue to face increased pressure to be more cost efficient and to serve new airline business models (Assaf and Gillen, 2012). Following airline deregulation, the increased competition among carriers led to reduced fares and market growth of both traffic and routes. The rapid growth in air travel coupled with government's lack of resources meant airports had to acquire capital for expansion by other means. These financial pressures in turn led to a re-evaluation of the exclusive ownership of airports by governments, or the lack of a commercial orientation, if they remained under government ownership. The issue of shifting ownership, in turn, raised the issue of whether economic regulation was desirable or necessary if governance or ownership form changed (Gillen, 2011). Capital markets required that airports improve their cost efficiency and serve a rapidly changing market. The development of the low cost carrier (LCC) business model has been particularly important in bringing pressure to bear in order to improve cost efficiency.

Another factor driving cost efficiency at airports is airport competition. Such competition exists not only in the context of international long haul connecting hubs like Heathrow, Schiphol and Frankfurt, but also for secondary airports that bid for airlines to provide service and to base aircraft at their airport. Istanbul has been growing with double-digit traffic growth but

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their ability to compete with other Middle East hubs will depend on their ability to deliver operational efficiencies. LCCs are footloose and can easily move from one airport to another. Airports compete with each other because the owners, often government, recognize their airports value in promoting economic growth in the region. Such growth depends largely on whether the governments have adopted a form of ownership and price regulation, if imposed, to ensure high performance.

There has been a mix of different types of airport privatizations varying from complete privatization to a mix of public and private ownership. In some jurisdictions airport privatization has been put in place along with some form of price regulation. Some developed economies are reluctant to move away from public ownership or public control; for example, Finland, France, Italy, Spain, Sweden and the United States (U.S.). The choices of ownership type and whether to impose price regulation are important because airports as part of the aviation supply chain will have some impact on the growth and diversity of the economy. Aviation policy will determine the ownership/price regulation combination. The policy will affect the ability of airports to attract needed capital for sustaining investment and to create network connectivity to support growth of trade in goods, services and tourism. The differing types of regulation or ownership combinations will affect these outcomes (Parker, 1999; Oum et al., 2008).

A controversy however does exist with regard to which regulation/ownership combination is superior, where 'superior' is measured in terms of cost efficiency. It may be insufficient to simply measure the impact, or to disentangle the effect of ownership and regulation separately on airport performance. In order to determine which combination of ownership and price regulation affects airport performance the different combinations must be examined (Assaf and Gillen, 2012).

Recent studies have highlighted two important gaps in the current literature regarding airport cost efficiency. Firstly, there have been few studies that analyze the combined impact of ownership and regulation on airport performance; most studies have treated ownership and regulation separately, implicitly assuming impacts are linear additive. Secondly, there has been a lack of the use of more precise econometric methodologies in assessing the joint effect of ownership and regulation on airport performance. Most studies used cost efficiency as the main metric for airport performance without decomposing this metric into technical and allocative efficiency; technical inefficiency arises when, for a given set of inputs, output is less than it could potentially be. Allocative inefficiency occurs when for a given output and set of input prices, the input choices are sub-optimal. The product of these two measures is cost efficiency. Thus cost inefficiency arises potentially from both too little output produced, and producing too little output with an inappropriate mix of inputs given input prices. Therefore, it is potentially possible that airport managers and air policy makers can identify strategies that could improve on either or both inefficiencies and be able to observe the changes in each over time, as different strategies and policies are pursued.

The present study addresses two gaps in the literature offering four important contributions. Firstly, we analyze the combined impact of ownership and regulation on airport performance using an extensive panel data of airports from across the globe. Secondly, instead of focusing on technical efficiency or cost efficiency as the main metrics for airport performance, we decompose the overall cost efficiency into its technical and allocative components using flexible functional forms. Thirdly, and importantly, we introduce a new stochastic frontier model that allows both technical efficiency (TE) and allocative efficiency (AE) to follow a dynamic framework. The notion that efficiency improves in the long-run, in competitive markets, is also quite prevalent. Hence, the use of a dynamic framework is a more realistic assumption. Fourthly, the use of dynamics allows us to analyze the combined impact of ownership and regulation on performance in both the short-run and the long-run (steady state). We are therefore able to identify which of technical or allocative efficiency dominates in the short and long-run. It also allows us to further validate our results and determine whether there are any long-run expected changes due to the effects of the various ownership and regulation forms on airport performance.

The model we propose builds on Kumbhakar and Tsionas (2005) who solved so-called Greene's problem in this context by using a static cost function—share equations framework. Our model relies on the cost function and assume that technical inefficiency and price distortions (that give rise to allocative inefficiency) follow a vector autoregressive scheme which, we believe, is quite flexible. Previous dynamic models of technical inefficiency that do not account of Greene's problem include Tsionas (2005) and Emvalomatis et al. (2011). We develop our model using the Bayesian approach, which recently gained increased popularity in the transportation literature (Farooq et al., 2013; Parry and Hazelton, 2013; Kobayashi et al., 2012; Martin and Voltes-Dorta, 2011; Yan et al., 2009).

The results demonstrate the value of estimating technical and allocative efficiencies separately, and to distinguish the short and long-run differences in possible efficiency gains. In the short-run the majority of any efficiency gains are from reducing technical inefficiency. This will come for the most part from adjusting output, something that can be accomplished in the short-term, recognizing that airports that rely heavily on airside output, rather than on both airside and landside (retail) output, will have fewer degrees of freedom. There are relatively small gains to be had from improving allocative efficiency since the source of the efficiency gains lie in adjusting the input mix or improving productivity, something more difficult to do in the short-term. Quite different conclusions hold for the long-term; there are gains to be had from improving allocative efficiency, and comparable gains are possible from improving technical efficiency for a smaller subset of airports that are either partially, or wholly, owned by government.

The modeling also shows that the gains available in the short-run are from reducing technical inefficiency. This is an output fix and airport managers should focus their efforts and strategies on adjusting output, and place relatively less emphasis on adjusting inputs to improve efficiency. In the long-run, airport managers will have to optimize both input mix and output mix.