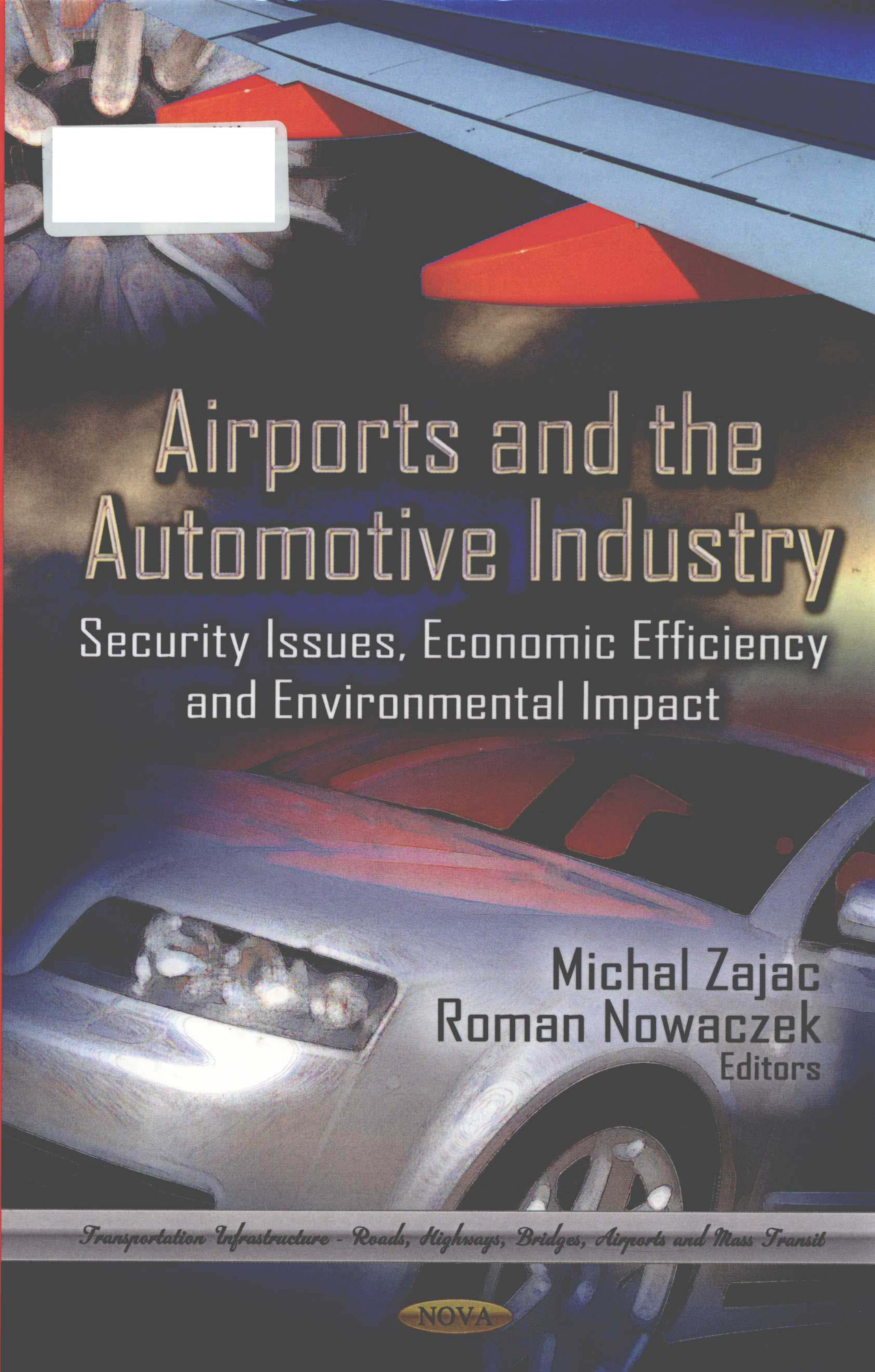
Airports and the Automotive Industry
Security Issues, Economic Efficiency and Environmental Impact
Michal Zajac
Roman Nowaczek
Editors
Transportation Infrastructure - Roads, Highways, Bridges, Airports and Mass Transit
NOVA

TRANSPORTATION INFRASTRUCTURE - ROADS, HIGHWAYS, BRIDGES, AIRPORTS AND MASS TRANSIT

AIRPORTS AND THE AUTOMOTIVE INDUSTRY

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PREFACE

In this book, the authors gather and present current research in the study of the automotive and airport industries. Topics discussed include estimating airport efficiency; intelligent automotive braking technology and performance; shareholder value of European airports; the economic affects of air transportation; fuzzy LARG index model to assess the automotive supply chain; international financial and crisis impacts to the automotive industry; and microbial contamination of aviation fuel as a potential hazard for flight safety.

Chapter 1 – Airport efficiency is important because it has a direct impact on customer safety and satisfaction and therefore the financial performance and sustainability of airports, airlines, and affiliated service providers. This is especially so in a world characterized by an increasing volume of both domestic and international air travel, price and other forms of competition between rival airports, airport hubs and airlines, and rapid and sometimes unexpected changes in airline routes and carriers. It also reflects expansion in the number of airports handling regional, national, and international traffic and the growth of complementary airport facilities including industrial, commercial, and retail premises. This has fostered a steadily increasing volume of research aimed at modeling and providing best-practice measures and estimates of airport efficiency using mathematical and econometric frontiers. The purpose of this chapter is to review these various methods as they apply to airports throughout the world. Apart from discussing the strengths and weaknesses of the different approaches and their key findings, the paper also examines the steps faced by researchers as they move through the modeling process in defining airport inputs and outputs and the purported efficiency drivers. Accordingly, the chapter provides guidance to those conducting empirical research on airport efficiency and serves as an aid for aviation regulators and airport operators among others interpreting airport efficiency research outcomes.

Chapter 2 – Researches indicate that human error is involved in over 90% of accidents. The automotive industry, especially in the area of commercial vehicles, needs new intelligent solutions that contribute to solving the key societal challenges posed by road transport related to the performance, road safety, and cost. “Intelligent” systems can help drivers to avoid accidents. The conventional “add-on” systems, like ABS, ASR, ESC, BAS or EBS support the driver in critical driving/braking situations by influencing the vehicle dynamics in order to avoid accidents or loss in stability or improve its maneuverability. Improvement of the brakes performance through their more precisely controls, under complex variety of operating regimes in dynamic conditions, is imposed as an unavoidable task. According to some initiatives, there is an attempt to move towards a new paradigm, one where vehicles don’t crash anymore. It requires using of contemporary sophisticated methods in the field of artificial intelligence. The control of commercial vehicle braking systems performance and braking performance co-ordination between the tractor axels and its trailer, in the case of vehicle combination, is considered as the most important aspect of active safety of these vehicles. A need to improve commercial vehicles braking performance leads to better control of the most relevant disturbing factors and improving of braking forces management. A solution in the area of new technologies, better performance, and reducing the potential economic cost of the vehicle crashing or loss in stability has been proposed in this chapter by introducing of an intelligent control of commercial vehicle braking system performance. It is done using dynamic neural model of the brake performance. The basic precondition in implementation of intelligent braking was provided by introducing of dynamic modeling, prediction and control of the brakes performance during a braking cycle versus driver and/or road conditions demands (wheels slip). Based on that, the brake actuation pressure was intelligently controlled and adapt to the different driver/road/vehicles demands i.e. intelligent wheels slip has been provided. This allows possibilities for controlling of braking systems performance in a more accurate way then it was the case now a day.

Chapter 3 – The airport business is very capital intensive and substantial investment is needed to accommodate traffic growth. Since there is only very limited research on the resulting dilemma of capital funding requirements and delivering shareholder value, and basically none on the impact of economic regulation on the latter, the aim of this chapter is to explore this issue in depth.

In order to address the question if privatised airports earn their cost of capital, 2003-2009 data is used for a long-term trend analysis, comparing the financial performance of ten publicly quoted European airports.

The majority of sample airports generate a negative economic value added for most of the seven years and correlational research reveals that traffic-induced investment spending is the single most influential factor. Moreover, it indicates a significant relationship between EVA and the respective regulatory regimes of sample airports.

Chapter 4 – The starting point of this chapter is the worldwide trends in the air transportation market since the beginning of liberalization and the main focus is on the aviation activities among the continents. Beside the economic strength of world regions it is important to analyze the changing regulatory framework that actuated fundamental impacts on airline competition and air transportation. The various stages of openness in global aviation markets have implications on special patterns of air industry and market power in several continents. The impacts of liberalization – increased competition which reduces prices and stimulates traffic growth - are not uniform across countries and therefore their effects on the economy differ respectively.

The approach for analyzing the economic impacts of air transportation is to disentangle the value chain of the aviation market into the provision of airport infrastructure and the operation of aviation business. The case of establishing an airport is investigated under the conditions of externalities and monopolistic market structure. The aviation market is explored with respect to the optimization of the network structure of airlines (alliances). The economic advantages of hub-and-spoke networks are determined. In recent years the Low Cost Carrier (LCC) or no-frills point-to-point model is challenging the traditional connecting paths offered by the full service carriers via their hubs. Interdependencies between strategies of airports and airlines are demonstrated in the rising competition between major airports and LCC using secondary airports.

After examining the particular features of the air transportation market that affect the airport infrastructure in various locations the author moves to the public capital hypothesis namely the relationship between productivity and the provision of *public infrastructure*. The economic effects of public investments in transport infrastructure are well assessed in theoretical and empirical terms. Initially huge positive productivity impacts caused by investments in public infrastructure were found. Recent findings indicate that the contribution of public infrastructure to private productivity and output is, at least in the developed countries, modest or even insignificant.

For airports, as a special case of public infrastructure, there exist only a few studies. The analyses focus on the network characteristics, productivity gains and generic effects of regional growth. A further topic relates to the employment effects of airport infrastructure via the catalytic impact on the surrounding economy. More recent studies address the problem of reverse causality between airports and employment growth.

Mostly investigated are the demand driven effects of individual airports. They are subdivided into direct (on airport), indirect and induced effects (intermediate inputs and income effects).The most prominent method to quantify these demand effects is the well known input-output analysis. There is a wide range in the results of the studies concerning the resulting multipliers, which indicate the strong dependence of that method regarding the respective underlying assumptions.

Chapter 5 – Supply chains (SC) in an attempt to become more competitive, are adopting new management paradigms. Among these paradigms the following are considered particularly important to the SC's competitiveness: Lean (L), Agile (A), Resilient (R) and Green (G).

This chapter proposes a fuzzy LARG index model to assess the implementation level of Lean, Agile, Resilient and Green management practices by automotive supply chains (SCs). To attain this objective a numeric-linguistic interface based on fuzzy logic is proposed and an illustrative case methodology followed. Due to the uncertainties surrounding the SC's environment and the qualitative description of the SC's management practices implementation level, fuzzy logic can provide an effective assessment tool able to quickly incorporate changes in the SC's business policy.

Chapter 6 – The international financial and economic crisis effected an immediate recession on the world markets. Sales figures in the automotive industry registered one of the deepest declines among the economic players. Because of the complexity of the industry and the large geographical scope of the production crisis had radical effects. Economic and social consequences are evidence in all parts of the value added chain and all countries involved in the division of labour. The crisis changed the geographic distribution of the production on account of the market and the competitive facts. This chapter is focusing on the impacts of the crisis for the automotive industry, highlighting and embedding the long term trends what is changing the geographical distribution of the production. The financial and economic crisis and the continuing downturn of the economic output made structural changes in this field.

Concerning these changes increasing and decreasing of the production both were used. New emerging countries (China, Central and Eastern Europe) were joining to the value chain, and former rear companies broke to the front position. Considering long term prospect the picture is more complex. Crisis was speed up the former tendencies, where new emerging countries increased their production and number of the automotive players was reduced result of mergers and acquisitions or because of bankruptcy.

Regarding future prospects, the automotive sector is looking forward to a number of challenges that will likely require significant restructuring to realign production capacity with changing patterns of demand. New regulations and new technologies regarding of the powertrain solutions will basically determine the prospects of the industry. Growing share of the urban population will appoint a completely new direction of the developments in the sector not just in the developed economies but increasingly in the emerging and developing world as well.

CONTENTS

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Chapter 1

FRONTIER TECHNIQUES FOR MEASURING AND ESTIMATING AIRPORT EFFICIENCY: AN EMPIRICAL REVIEW WITH PRACTICAL GUIDELINES FOR ANALYSIS AND FUTURE RESEARCH

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ABSTRACT

Airport efficiency is important because it has a direct impact on customer safety and satisfaction and therefore the financial performance and sustainability of airports, airlines, and affiliated service providers. This is especially so in a world characterized by an increasing volume of both domestic and international air travel, price and other forms of competition between rival airports, airport hubs and airlines, and rapid and sometimes unexpected changes in airline routes and carriers. It also reflects expansion in the number of airports handling regional, national, and international traffic and the growth of complementary airport facilities including industrial, commercial, and retail premises. This has fostered a steadily increasing volume of research aimed at modeling and providing best-practice measures and estimates of airport efficiency using mathematical and econometric frontiers. The purpose of this chapter is to review these various methods as they apply to airports throughout the world. Apart from discussing the strengths and weaknesses of the different approaches and their key findings, the paper also examines the steps faced by researchers as they move through the modeling process in defining airport inputs and outputs and the purported efficiency drivers. Accordingly, the chapter provides guidance to those conducting empirical research on airport efficiency and serves as an aid for aviation regulators and airport operators among others interpreting airport efficiency research outcomes.

1. INTRODUCTION

For the past several decades, air travel and correspondingly airport activity have increased dramatically. Even now, in what we could best describe as a time of global uncertainty with economic instability and deteriorating consumer and business confidence, especially in Europe and the US, and political and social unrest, notably the Middle East and North Africa, the world's airports have continued to make possible mindboggling levels of passengers, freight and traffic movements. In evidence, Airports Council International (2012), the peak industry body representing more than 900 airports worldwide, reported that in 2011 its members enplaned/deplaned some 4,931 million passengers (up 4.9 percent from 2010) and approximately 86 million metric tonnes of freight and mail (down 0.1 percent) using 64 million traffic movements (takeoffs and landings) (up 2.0 percent). The picture is just as awe inspiring at the airport level. In evidence, in 2011 each of the world's five busiest airports (Atlanta, Chicago, Dallas/Fort Worth, Denver, and Los Angeles) coordinated in excess of 600 thousand traffic movements. Each of the world's five largest passenger airports also (dis)embarked more than 60 million passengers (Atlanta, Beijing, London, Chicago, and Tokyo), while the five most-important airfreight centers (Hong Kong, Memphis, Shanghai, Anchorage, and Incheon) handled over 2.5 million metric tonnes of freight and mail. Even those airports globally ranked thirtieth in traffic movements (Mexico City), passengers (Istanbul), and freight (Kuala Lumpur) respectively accounted for more than 350 thousand takeoff/landings, 37 million passengers, and 702 thousand metric tonnes of freight (Airports Council International 2012).

Obviously, airports make an important economic and social contribution through facilitating the movement of passengers and freight, regionally, nationally and internationally. As a case, consider the contribution of airports in Australia, the world's thirteenth largest economy with a widely dispersed population of about 22.7 million. In 2011, Australia's 250 or so airports (excluding small airfields and landing strips) generated a total economic contribution of around A$17.3 billion, equivalent to about 1.2 percent of GDP, with employment estimated at approximately 115,200 full-time equivalent employees (Deloitte Access Economics 2012). Of this, the country's 11 largest airports (all capital cities, plus Gold Coast, Cairns and Alice Springs) accounted for nearly 90 percent, with these major airports expected to invest more than A$9 billion over the next decade in infrastructure development. This of course does not include the flow-on benefits of the airport industry to other industries, especially Australia's key tourism and mining industries and the aviation industry more generally, and the central role airports play in logistics networks. Nor does it include the important social role airports play in connecting individuals, families, and communities in Australia with the rest of the country and the world (Deloitte Access Economics 2012). However, it does reflect the increasing diversification of the industry, where only about 20 percent of airport economic activity and less than 6 percent of airport employment now comprises core airport operations with the reminder in non-aviation related commercial and industrial airport precinct activities.

All of this takes place against a backdrop of increasing price and other forms of competition between rival airports and airport hubs, both nationally and internationally, and rapid and sometimes unexpected changes in airline routes and carriers through increasingly fluid aviation alliances and allegiances. It also reflects expansion in the number of airports handling regional, national, and international traffic and the growth of complementary airport facilities including industrial, commercial, and retail premises. The growth of air traffic movements to meet passenger and freight demands has also led to the ever-increasing expansion and modernization of airports to handle more discerning customers and clientele and greater numbers of aircraft of different sizes and capacities, often in response to technological change in the products of the major aircraft manufacturers. At the same time, the airport industry remains highly concentrated and intensively regulated with significant natural and other barriers to entry. Consequently, the many thousands of airports around the world reflect a diverse array of ownership and governance patterns, with privatized and publicly owned often-corporatized airports competing against each other in assorted degrees and differently subject to ongoing reforms and pressures for accountability, competitiveness, profitability, and sustainability. In response to these developments in the industry worldwide, an increasing number of studies have sought to estimate and measure efficiency and productivity in airports.

By assessing the efficiency and productivity of the airport industry—the ability with which they combine various factors in order to produce outputs at a point in time and over time—these studies attempt to highlight current strengths and weaknesses in the management of airports, and recognize and quantify the impacts of the regulatory, institutional and structural factors surrounding them. They also intend to provide due recognition of the barriers to productive and efficient outcomes and make available quantitative information for future reform processes governing airport regulation, including that concerning the pricing of airport services and market entry and competition, and ownership. To address these important aims, airport researchers have employed three main measures of airport efficiency. First, *technical efficiency* refers to the use of productive resources in the most technologically efficient manner. Put differently, technical efficiency implies the maximum (minimum) possible output (input) from (for) a given set of inputs (outputs). For airports, technical efficiency then refers to the physical relationship between the resources used, say, the number of runways, boarding gates and baggage belts, the amount of contracted and in-house labor used and the terminal area, and some desired outcome, including the numbers of aircraft and passengers served and the quantity of freight carried. Second, *allocative efficiency* reflects the ability of an airport to use its inputs in optimal proportions, given their respective prices and the available technology. In other words, allocative efficiency is concerned with choosing between the different technically efficient combinations of inputs used to produce the maximum possible outputs.

Consider, for example, terminal facilities, where check-in kiosks, online/mobile boarding passes and automated baggage drop-off have changed the way that passenger processing is undertaken. These inputs may require fewer labor inputs (for allocating seats, confirming the carrying of dangerous or hazardous goods, and attaching luggage tags) but do require the use of another resource in the form of electronic and mechanical technology. As different combinations of inputs are being used, and notwithstanding differences in the quality of the outputs (such as accuracy or flexibility by passengers in the choice of allocated seating), the choice of passenger processing method is then based on the relative costs of these different inputs. Finally, when taken together allocative efficiency and technical efficiency determine the degree of *productive efficiency* (also known as total economic efficiency). Thus, if an airport uses its resources completely allocatively and technically efficiently, then it can be said to have achieved total economic efficiency. Alternatively, to the extent that either allocative or technical inefficiency is present, then the airport will be operating at less than total economic efficiency. The empirical measurement of economic efficiency then centers on the possible extent of technical and possibly allocative efficiency in a given airport or airport industry. In recent years, economists have been increasingly attracted to frontier techniques to measure the efficiency of airports. These techniques use a production possibility frontier to map a locus of potentially technically efficient output combinations an airport is capable of producing at a point in time. To the extent an airport fails to achieve an output combination on its production possibility frontier, and falls beneath this frontier, it is technically inefficient. Similarly, to the extent to which it uses some combination of inputs to place it on its production frontier, but which do not coincide with the relative prices of these inputs, it is allocatively inefficient. Finally, recognizing expansion of the production frontier over time through infrastructure development, technological improvements, regulatory reform, and improved workplace practices, we can see that total factor productivity (TFP) improvements include technical efficiency improvements for airports 'catching up' to the existing frontier and the future technological gains possible for all (including efficient) airports. Thus, if we can determine production frontiers that represent total economic efficiency using currently best-known practice, we can use this idealized yardstick or benchmark to evaluate the economic performance of real-world airports. This survey concentrates on selected efficiency studies of airports using frontier efficiency measurement techniques published since 2000. We used the *EconLit* and *ProQuest* electronic databases to find refereed journal articles that were representative of the contexts and techniques associated with frontier efficiency measurement in airports. The references in these studies helped identify other articles. We also used Google Scholar to identify other publications not included in the database. Of the 36 studies selected for Table 1, five (14 percent) are of airports in Spain, four (11 percent) in the US, three (8 percent) in the UK, and two (6 percent) each in Australia, China and Portugal. The remaining 49 percent are either represented by single country studies (including Greece, Italy, Mexico, Argentina, Taiwan, Japan, Brazil, Mozambique and Angola) or international regional (Africa, Asia-Pacific, Europe, Latin America and North America) and intra-regional cross-country comparisons. About 30 percent employ cross-sectional observations (where the data is from a single calendar or financial year) with the other 70 percent employing panel (pooled time-series, cross-sectional) data from several years.

Table 1. Selected empirical applications

Author(s)	Method[a]	Location	Airports	Data[b]	Specification[c]	Findings
Sarkis (2000)	DEA	US	44	1991–94	Operating costs, number of full-time equivalent employees, number of boarding gates, number of runways. Number of passengers, amount of aircraft operations, amount of cargo, operating revenues.	Efficiency improving over time because of increasing competitiveness and resource utilization. Whether an airport is a hub for major air carrier and located in a snow belt relates strongly to airport efficiency.
Martín and Román (2001)	DEA	Spain	37	1997	Expenditures on labor, capital, and materials. Air traffic movements, number of passengers and tons of cargo.	Appropriate regulation needs to be in place to be effective in improving airport performance.
Pels, Nijkamp and Rietveld (2001)	DEA	Europe	34	1995–97	Terminal area, number of aircraft parking positions, check-in desks, baggage belts. Air transport movements and number of passengers.	Most airports operating under increasing returns to scale. Large deviations in relative efficiency across airports.
Abbott and Wu (2002)	MI	Australia	12	1989–2000	Number of staff, capital stock, and runway length. Number of passengers and tons of freight cargo	Potential for improvements in efficiency from CPI-X price caps pressure.
Abbott and Wu (2002)	DEA	Australia, New Zealand, UK, Canada and US	25	1998	Number of staff, combined length of runways, land area of airports and number of aircraft standing areas. Number of passengers and tons of freight cargo. Rate of return, capital labor ratio, aircraft standing area, total asset growth rate, state.	Airports reflect only high-income countries thus ignoring quality aspect. Airports in Australia higher ranked in efficiency than international airports.

Author(s)	Method[a]	Location	Airports	Data[b]	Specification[c]	Findings
Martín-Cejas (2002)	DFA	Spain	40	1996–97	Units of traffic labor price and capital price. Total cost (sum of operating, labor, and capital costs).	Need to establish a regulatory system that is flexible to meet changes in costs and future investments through efficient charging methods.
Bazargan and Vasigh (2003)	DEA	US	45	1996–2000	Operating expenses, non-operating expenses, numbers of runways and gates. Number of passengers, air carrier operations, other operations, aeronautical revenue, non-aeronautical revenue, and percentage of on time operations.	Small hubs outperform larger hubs in relative efficiency.
Pacheco and Fernandes (2003)	DEA	Brazil	35	1998	Number of employees, payroll expenses and operating expenditures. Number of passengers, amount of cargo, operating, commercial and other revenues	Managerial efficiency requires actions to improve airport revenues and cost reduction measures. High physical efficiency and low managerial efficiency indicate that the airport concentrates on providing low-value services for its airport revenues. However, revenue generation depends on economic development in region where airport located.
Sarkis and Talluri (2004)	DEA	US	40	1990–94	Operating costs, number of employees, boarding gates and runways. Number of passengers, amount of aircraft operations, amount of cargo, operating revenues.	Managers and policymakers can improve the operational efficiencies of airports through benchmarking.

Table 1. (Continued)

Author(s)	Method[a]	Location	Airports	Data[b]	Specification[c]	Findings
Yoshida and Fujimoto (2004)	DEA	Japan	67	2000	Total runway length, terminal area, access cost, cost of labor. Passenger volume, cargo handling, and aircraft movements.	Efficiency of regional airports lower than others. Newer airports relatively inefficient.
Yu (2004)	DEA	Taiwan	14	1994–2000	Runway, apron and terminal area, and number of air routes connecting with the other domestic airports. Number of aircraft traffic movements (landings and takeoffs) and passengers, and aircraft noise (undesirable output).	Overall mean efficiency of all airports increased over time as a result of increasing competitiveness and improved resource utilization. Offshore airports have prospered due to the rapid development of tourism in their adjacent areas, while the airports located on the main island have been relatively stable.
Lin and Hong (2006)	DEA	Internatio nal	20	2003	Number of employees, runways, parking spaces, aprons, boarding gates and baggage belts, terminal area. Passengers, cargo movements.	Ownership and airport size uncorrelated with operational performance of airports, unlike hub airports, airport location, and national economic growth rate.
Barros and Dieke (2007)	DEA	Italy	31	2001–03	Labor costs, capital invested, and operational costs excluding labor costs Number of planes and passengers, total cargo, aeronautical receipts, handling and commercial receipts.	Application of method to bootstrap DEA scores with a truncated regression offers some improvement in both efficiency of estimation and inference in the second stage and by producing standard errors and confidence intervals for efficiency scores.