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Measuring the technical efficiency of airports in Latin America

Sergio Perelman [a,1], Tomás Serebrisky [b,*]

[a] CREPP, University of Liege, Bd. du Rectorat 7 (B31), 4000 Liège, Belgium
[b] The World Bank, 1818 H Street NW, Washington, DC 20433, USA

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ABSTRACT

Relying on a unique dataset this paper uses Data Envelopment Analysis methods to compute an efficient production frontier for a representative sample of Latin American airports. Latin America has implemented a wide variety of private sector participation schemes in the airport sector since the late 90s. To assess whether privately operated airports had higher rates of total factor productivity growth than public airports we compute Malmquist indexes for the period 2000–2007. Results indicate that privately operated airports enjoyed higher rates of total factor productivity growth.

1. Introduction

During the last two decades there has been a growing interest in measuring the efficiency and performance of airports. On one hand, the process of introducing private participation in the management and operation of airports and the birth of regulatory agencies in charge of setting tariffs for the sector brought along the need to assess the way in which airports are being operated. On the other hand, with the liberalization of competition among airlines, airports started competing with each other for connecting traffic (to become hub airports) which prompted them to increase their efficiency.

This interest has spurred a growing literature aimed at estimating the efficiency of the airport sector. To the best extent of our knowledge, there has not been any study that computes the efficiency and performance of a representative sample of airports in Latin America (LAC). This region has implemented a wide variety of private sector participation schemes including concessions of several groups of airports (Mexico), a single concession of a group of airports with more than 90 percent of the air transport market (Argentina), single airport concessions (Chile), and a combination of single and group airport concessions (Peru). The introduction of private sector brought more than 9 billion dollars of investment to the sector between 1998 and 2008.[2] Several hypotheses can be provided to explain why airport efficiency in Latin America has not been the subject of academic research but the most likely reason is the lack of publicly available data.

The main objective of this paper is to fill this gap in the literature. We are able to do so using data collected from a questionnaire that was sent, as part of a World Bank study on airports, to the major airport operators in LAC (World Bank, 2010).[3] It should be noted that the sample assembled for this study is representative of the air transport sector in the LAC region as it accounts for more than 80% of total passengers and aircraft movements in the region and for 70% of total air cargo. Table 1 lists the airports included in the sample, their type of ownership and passengers in 2008. Latin America and the Caribbean account for a small share of the air transport sector worldwide. Based on 2008 figures (World Bank, 2010) this region only accounted for 7 percent of total passengers, 5 percent of cargo and 8 percent of aircraft movements. Airports are relatively small when ranked on a global scale. LAC has a total of just 4 airports among the top 100 airports worldwide and 14 airports among the top 200. Benito Juárez International Airport in Mexico City, ranked 43rd globally, is the most important airport in the region in terms of passenger traffic, handling a total of about 26.2 million passengers in 2008 (approximately three times less than the

* Corresponding author. Tel.: +1 202 458 2872.
E-mail addresses: sergio.perelman@ulg.ac.be (S. Perelman), tserebrisky@yahoo.com, tserebrisky@worldbank.org (T. Serebrisky).
[1] Tel.: +32 43663098.

[2] Data obtained from the Public Private Infrastructure database, World Bank. Available at http://ppi.worldbank.org/.
[3] The dataset is available upon request from corresponding author.

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Table 1
Airports in Latin American and Caribbean airports included in the sample.

City, Country	Airport name (code)	Type of ownership (2008)	Passengers in 2008
Buenos Aires, Argentina	Aeroparque Jorge Newbery (AEP)	Private	5,687,221
Buenos Aires, Argentina	Aeropuerto Ministro Pistarini (EZE)	Private	8,012,794
El Calafate, Argentina	Aeropuerto El Calafate (FTE)	Private	494,722
São Paulo, Brazil	Aeroporto de São Paulo/ Congonhas (CGH)	Public	13,661,227
São Paulo, Brazil	Aeroporto de Viracopos (VCP)	Public	1,260,112
São Paulo, Brazil	Aeroporto de São Paulo/Guarulhos Governador Andre Franco Montoro (GRU)	Public	20,990,662
Brasilia, Brazil	Aeroporto de Brasilia Presidente Juscelino Kubitschek (BSB)	Public	10,892,330
Manaus, Brazil	Aeroporto Eduardo Gomes (MAO)	Public	1,957,050
Rio de Janeiro, Brazil	Aeroporto de Rio de Janeiro/Galeão Antonio Carlos Jobim (GIG)	Public	10,695,992
Santiago de Chile, Chile	Aeropuerto Comodoro Arturo Merino Benítez (SCL)	Private	9,017,718
Cali, Colombia	Aeropuerto Alfonso Bonilla Aragón (CLO)	Private	2,418,644
Barranquilla, Colombia	Aeropuerto Ernesto Cortissoz (BAQ)	Private	1,207,084
San José, Costa Rica	Aeropuerto Juan Santamaría (SJO)	Private	3,238,602
Guayaquil, Ecuador	Aeropuerto José Joaquín de Olmedo (GYE)	Private	3,236,768
San Salvador, El Salvador	Aeropuerto de El Salvador (SAL)	Public	1,570,012
Guadalajara, Mexico	Aeropuerto de Guadalajara (GDL)	Private	7,393,500
Monterrey, Mexico	Aeropuerto General Mariano Escobedo (MTY)	Private	6,749,240
Mexico City, Mexico	Aeropuerto Benito Juárez (MEX)	Public	26,210,217
Cancun, Mexico	Aeropuerto de Cancún (CUN)	Private	12,786,423
Lima, Peru	Aeropuerto Jorge Chávez (LIM)	Private	8,285,688
Sto. Domingo, Dominican Republic	Aeropuerto de Las Américas (SDQ)	Private	2,719,899

Note: Private ownership in the context of Latin America should be understood as a concession to a private operator. The underlying asset remains under Government ownership. Public ownership: all airports in the sample under operation of a state-owned firm.

number handled by first-ranked Hartsfield-Jackson Airport in Atlanta). As for cargo, the entire LAC region handled a total of 4.6 million metric tons in 2008, only 1 million metric tons more than the amount of cargo traffic handled by the global leader, Hong Kong International Airport (3.6 million metric tons) and three times as much as Miami, North America's cargo hub (1.5 million metric tons).

Table 2 presents descriptive statistics for the average LAC airport in our sample and compares it with the average airport in North America, Europe and Asia. Across size categories, airports in LAC have fewer passengers and aircraft movements. Airports in LAC tend to rely heavily on international passengers relative to airports in North America and Asia-Pacific. The most significant difference in output size between the average airport in LAC and that of the other regions is cargo. In terms of capital inputs, airports in LAC have fewer runways and significantly fewer boarding bridges and tend to be smaller (measured by their terminal size).[4] Labor inputs, measured by employees directly employed by the airport operators, indicate that LAC airports have higher number of employees in smaller and relatively large airports while they have fewer employees in medium airports (5–8 million passengers per year).

[4] To give an idea of the difference in investment in boarding bridges in LAC airports have on average 569,000 passengers per boarding bridge, compared with 359,000, 284,000 and 305,000 in Asia, Europe and North America respectively.

Table 2
Comparison of the airport sector in Latin America with other regions (2006).

Variables	Passengers per year (millions)				All
	<5.0	5.0–8.0	8.0–25.0	>25.0	
Latin American and Caribbean airports (LAC)					
Airports in sample	9	6	6	0	21
Share (%)	42.9	28.6	28.6		100.0
Outputs–inputs					
Passenger (1000)	1804	6257	14,538		6715
Aircraft movements (1000)	39	93	197		100
WLU/aircraft movement	2510	7647	16,228		7898
Employees	277	229	895		440
Runways	1.1	1.5	1.8		1.4
Airport surface (thous. of sq meters)	39.6	57.1	187.3		86.8
Boarding bridges	5.7	9.3	21.2		11.1
Airport characteristics					
Passenger connecting (%)	8.0	3.5	6.2		6.1
Aeronautical revenues (%)	53.8	59.7	56.3		56.3
Europe, North America and Asia-Pacific airports					
Airports in sample	15	11	53	39	118
Share (%)	12.7	9.3	44.9	33.1	100.0
Outputs–inputs					
Passenger (1000)	3245	6309	14,695	40,569	21,009
Aircraft movements (1000)	61	105	204	419	248
WLU/aircraft movement	5132	7434	17,544	49,978	25,744
Employees	260	314	811	2101	1121
Runways	1.7	2.4	2.7	3.5	2.8
Airport surface (thous. of sq meters)	51.0	73.2	132.9	389.8	201.8
Boarding bridges	15.9	27.4	56.7	109.9	66.4
Airport characteristics					
Passenger connecting (%)	12.4	7.8	18.5	33.2	22.3
Aeronautical revenues (%)	54.7	46.3	48.4	49.9	49.5

Source: Data for airports in Europe, North America and Asia-Pacific obtained from Air Transport Research Society Benchmarking Report (2008). Data for airports in Latin America obtained from World Bank questionnaires.

The paper first computes a data envelopment analysis (DEA) activity frontier for commercial airports in the LAC region and identifies the peers of each airport (i.e. comparable airports that operate on the efficiency frontier). We then proceed to measure Total Factor Productivity Changes (TFPC) for LAC airports over the period 2000–2007. The methodology used to perform these estimations consists on the computation of a Malmquist quantity index of TFPC based on the non-parametric DEA approach.

The paper is organized as follows. Section 2 presents a brief review of the existing related literature. In Section 3 we present calculations of a DEA activity frontier for commercial airports in the LAC region and use these results to identify their peers. Section 4 presents Malmquist quantity indexes of TFPC for LAC airports over the period 2000–2007. Section 5 presents some concluding remarks.

2. Literature review

Gillen and Lall (1997) pioneered the use of Data Envelopment Analysis techniques to study efficiency in the airport sector. Their paper uses data from 21 US airports for the period 1989–1993. Using this dataset they define airports as producing two different classes of services – terminal services and movements – and then proceed to compute two different DEA frontiers, one for each of these two services.