A COMPARATIVE AIRPORT PERFORMANCE ANALYSIS AT WORLD LEVEL

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Abstract

Air transportation productivity is a matter of great complexity, and many are the factors that define air transportation performance. A key issue of this sector is the airport. It can be said that there is competition among airports; however, this is limited and depends on factors that are not under the control of the airport administrator. The choice of operating in a specific airport, made by companies that operate in the air sector, depends mainly on factors that are external to the airport organization. Market, company logistics and regulation are among the decision making factors. Thus, the aim here is contributing to knowledge enhancement of the relationship between passenger and cargo traffic with airports revenue by means of Data Envelopment Analysis and statistical inference. This is a comparative multivariate analysis of a sample of airports from many places round the world. Results show that most airports are operating under decreasing returns to scale (DRS). The analysis points out that airport administrators must strive to improve their performance by means of enhancing clients' portfolio in order to find a combination between passengers and cargo that produces an increasing added value with respect to revenues. Additionally, it can be observed that there is a great potential of performance improvement by means of optimizing the inputs in the airports with increasing returns to scale (IRS) profile.

Keywords: Airports, DEA, Efficiency, Performance, Productivity.

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1. INTRODUCTION

It is undisputable that the traditional point of view by which airports were seen only as a public utility subsidized by the government evolved to a commercial point of view (Caves; Gosling, 1999, Doganis; Nuutinen, 1983). Some governments, initially in Europe, noticed the airports commercial potential and decided to create companies that could manage airports in an autonomous way, freeing governments from subsidies. Actually, many airports started to be run as truly commercial independent undertakings and were even privatized. The tendency towards airport privatization, the aim of which was, among others, efficiency improvement, started in the United Kingdom, in 1987 (Humphreys, 1999).

Since the trend towards commercialization has been established, airport management has been strongly based on efficiency evaluation (ATRS, 2007; Park, 2003). For this purpose, many methodologies such as Total Factor Productivity (TFP) and Data Envelopment Analysis (DEA) have been used in the analysis. These tools reveal one airport positioning towards the other ones. Thus, these tools point out at a possible improvement decision to be taken (Fernandes; Pacheco, 2002; Pacheco; Fernandes, 2003). In general terms, although an airport may not be in a direct competition process with another airport, the perception of its positioning is the first indicator of its management quality.

Deeper specific researches for this kind of organization are justified for the fact that the airport is an organization of specific characteristics which comprehends commercial, logistics, safety aspects and also basic infra-structure for regional development.

As many papers already present reviews on this subject, this paper just makes a brief literature review of the airport performance analysis. The discussion of the relationship between the revenue generators and the airport revenue itself at world level is carried out. The analyzed data are based on the ATRS (2007) and INFRAERO airport productivity report for Brazilian airports. It is worth remarking that the ATRS study only refers to airports in Europe, Asia and North America.

2. LITERATURE REVIEW

Many are the articles published about productivity or performance in airports. This topic became well known with the publication of the results of two research institutions: the PCL (Polytechnic of Central London), presently denominated University of Westminster, and ITA (Institut du Transport Aerien), located in Paris.

In 1978, the former PCL published the analysis by Doganis, Pearson and Thompson

entitled *Airport Economics in the Seventies*. In this study, the economic and financial analysis of the main 22 English airports at that time is focused. It may be said that this was the first formal work known in the area of airport productivity.

It was the study "Airport Management", by Doganis and Graham (1987), which originated the first work totally directed to performance indicators at airports, having as a wider target the evaluation of its use as an airport management tool. These indicators are useful to keep up with an airport performance over time, as well as among a group of airports, and help verify their strong and weak points so that the administrators' attention can be oriented. Doganis (1992) dedicated a chapter of his book The Airport Business to airport performance follow-up indicators having as a basis Doganis and Graham's (1987) research. In 1995, Doganis Lobbenberg and Graham elaborated a research about the performance of 25 European airports. After describing the study aims, they define the concepts of performance used in the work, in which techniques of partial and total productivity as well as Data Envelopment Analysis (DEA) technique are mentioned. In spite of mentioning the DEA technique, it is said that it has not been applied to any airport study.

Graham (1995), in an unpublished article, dealt with the mensuration of airport performance, in which she points out the need of researches in the airport performance area to make use of DEA. Fernandes, Pacheco and Ramirez (1997) applied DEA to analyze the performance of a group of Brazilian international airports, focusing on airport costs and operational and non-operational revenues. Gillen and Lall (1997) employed DEA for a series of North-American airports. Actually, they applied it twice – once for terminal services and the second one for the amount of aircraft moves, indicating whether a given airport improved or worsened its relative position in the group. Martín and Román (2001) applied the DEA to evaluate the performance of 37 Spanish airports. They are concerned about knowing the level of performance of these airports before the airport privatization process starts in Spain. They highlight that thinking that the corporatization or privatization will improve the airports performance requires a parallel process of economical regulation in order to be efficient. Pels, Nijkamp and Rietveld (2001), by means of DEA, analyzed the relative efficiency for a group of 34 European airports in the 1995 to 1997 period. They observed that the majority of these airports were operating with an increasing return to

scale profile. Fernandes and Pacheco (2002) examined the efficiency of 35 Brazilian airports concerning the physical capacity of airport components. Yu (2004) expanded this work with the inclusion of variables related to environment and fitting it into the Taiwan domestic airports characteristics.

Oum Yu and Fu (2003) summarized the 2002 report on airports benchmarking, conducted by the *Air Transport Research Society (ATRS)*, in which the productive efficiency of 50 airports located on the Pacific Coast, in Europe and North-America is measured and compared. In this analysis, they approach some factors that are beyond the airport managerial control such as a property structure, that is, if the undertaking is of public, private or mixed nature; the airport size, average aircraft size and airport traffic composition. Pacheco and Fernandes (2003), making use of the DEA analyzed the managerial efficiency of 35 Brazilian airports. Yoshida and Fujimoto (2004) used TFP and DEA methodologies to measure the efficiency of international airports up to small local ones. For doing so, they applied 4 inputs and 3 outputs covering the land and the air sides of the airport. With the different TFP and DEA procedures, they attain the same results - that the local airports in islands are more efficient than the ones in the mainland. Sarkis and Talluri (2004) assessed the operational efficiency of the main 44 North-American airports using DEA and a cluster method. They developed a methodology for performance evaluation and improvement of these airports. Pathomsiri, Haghani and Schonfeld (2005) analyzed the airport efficiency of 71 airports. They took as support the DEA technique in their analysis and approached issues such as the September 11th event impact on airport efficiency.

Martín and Román applied (2006) Surface Measure of Overall Performance (SMOP) and DEA as methods to analyze the performance related to each individual Spanish airport and to make their classification towards efficiency. The majority of the airports have been previously comparing their efficiency according to the results of some partial productivity relations. However, this practice does not supply a good understanding of the total performance of the airport. For this reason, they made use of six different approximations of the classification in order to come to totally different classifications for the Spanish airports. Pacheco, Fernandes and Santos (2006), by using DEA in a bi-dimensional analysis, approached the managerial efficiency of 35 Brazilian national airports, as well as their physical efficiency.

This study used DEA techniques to investigate the impacts of the changes in the airports administrative style between 1998 and 2001. Despite the operational performance decline, there was an improvement in the financial performance.

Malighetti et al. (2007) studied the Italian airports efficiency and used the DEA method for this purpose in 34 airports. The results were that large airports are more efficient than domestic and regional ones. Tobit's regression in stochastic DEA shows that the efficiency is positively related to privatization.

Barros (2008) used the Stochastic Frontier Model to study the technical efficiency of British airports. They are classified according to their productivity for the 2000-2005 period and to homogeneous and heterogeneous variables related to costs. Graham (2008) suggests that the more appropriate technical tools to analyze airport efficiency are TDF and DEA. Martín and Román (2008) made use of four different DEA approaches in order to study the performance related to individual Spanish airports and to classify each airport according to its efficiency. Each method is used to measure and compare efficiency, and potential differences for large, medium and small airports. The study is based on financial and operational data. Oum, Yan and Yu (2008) studied the effects of property on airports economical efficiency by applying the analysis of stochastic frontier with the data of the world main airports.

In the bibliographical review, it can be observed that airports researches are still restricted to regions, which reveals the opportunity for a study to be made on international comparison patterns.

3. METHODOLOGY

Although this research uses statistical inference as regression and graphical analysis tools, the conceptual basis that leads the analysis is the efficiency frontier by means of DEA.

The search of excellence necessarily permeates organizational performance evaluation. The DEA methodology, initially proposed by Charnes, Cooper and Rhodes (1978, 1979), allows a multicriteria approach suitable to performance evaluation, in which many inputs and outputs can be considered. The DEA approach allows the definition of objectives directed to the minimization of inputs, obtaining a specific result, or the maximization of outputs, by the use of a determined level of resources. Figure 1 shows an example considering two outputs and one input, which can be generalized by an n-dimensional approach. In this case, considering a specific resource level, a frontier of the best relations of results is

traced. Observations A, D and E are determinants of the efficiency frontier. Point B is constituted of an inefficient observation that has D and E as references to seek efficiency in the use of its resources, which has a better option at point C. The same analysis can be made for two inputs and one output, being the efficiency frontier the limit closer to the axes.

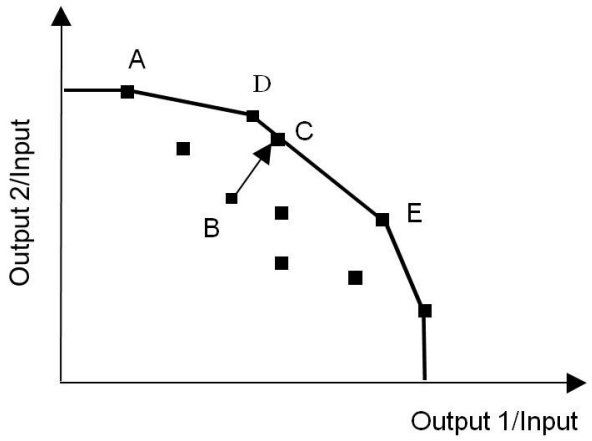


Figure 1 – Efficiency of Results

Banker et al. (1989) and Charnes et al. (1994) present the various formulations developed for the concept of efficiency frontier presented in Figure 1. In the research conducted for this article, the main point is related to the optimization of the ratio inputs/outputs, taking both orientations into consideration. Hence, the approaches directed to the input and output in the VRS – Variable Returns to Scale – model will be analyzed once they refer to organizations with different sizes. The proposed models, known as BCC-I and BCC-O (Banker; Charnes; Cooper, 1984) involve the following linear programming problem:

Input-Oriented BCC Primal

(BCC_p-I)

$$\min_{\theta,\lambda,s^+,s^-} \quad z_0 = \theta - \varepsilon.\vec{1}s^+ - \varepsilon.\vec{1}s^-$$

s.t.

$$Y\lambda - s^+ = Y_0$$
$$\theta X_0 - X\lambda - s^- = 0$$
$$\vec{1}\lambda = 1$$
$$\lambda,\ s^+,\ s^- \geq 0$$

Output-Oriented BCC Primal

(BCC_p-O)

$$\max_{\phi,\lambda,s^+,s^-} \quad z_0 = \phi + \varepsilon.\vec{1}s^+ + \varepsilon.\vec{1}s^-$$

s.t.

$$\phi Y_0 - Y\lambda + s^+ = 0$$
$$X\lambda + s^- = X_0$$
$$\vec{1}\lambda \geq 1$$
$$\lambda,\ s^+,\ s^- \geq 0$$

where X is the vector of the inputs used by the airports; Y is the vector of the quantities produced by the airports; ε is the infinitesimal non-Archimedean constant, which ensures that no input or output is allocated zero weight; s+ and s- are the slack vectors of the outputs and inputs, respectively; θ is the scalar variable that represents the possible radial reduction to be applied to all inputs so as to obtain the projected input values; $\vec{1}$ is a unit vector; λ is the vector the optimal values of which form a combination of units that

make out the performance of the airport under analysis, and establish a direction in which to identify the sources of inefficiency in this airport.

4. CASE STUDY

The case study presented covers 138 airports from several parts of the world: 63 from North-America, 34 in Europe; 23 from Asia and 18 from Brazil. Except from Brazil, the airports are part of the ATRS (2007) airport productivity study. The selection was made considering the study data availability and a limit of boarded plus landed passengers of over one million. The data were obtained from studies carried out by ATRS and statistics from INFRAERO (Brazilian Airport Infrastructure Enterprise) for Brazilian airports. For Oum, Yan and Yu (2008), the Purchase Parity Power (PPP) tries to eliminate the difference among price levels in different countries, converting currencies based on the amounts that are demanded in each country to buy a given basket of products and services. Being so, the monetary data from Brazilian airports were transformed into US$ dollars based on World Bank studies (2007) on PPP.

The Brazilian airports are identified by ICAO code (four-letter) and the remaining ones by IATA code (three-letter). The selected year for the study is 2005. Airports total revenue ranges from three million to two billion American dollars. Concerning passengers, there are airports with more than a million to the ones with almost eighty six million passengers. Most airports have international as well as domestic traffic of passengers. However, there are cases with only one kind of traffic (three airports only with international traffic and nine only with domestic one). Even though a study about the profitability of airports is not an issue to be covered in the present study, it is interesting to observe that there is high correlation between total revenue (TR) and operational cost (OC), as seen in Figure 2. As revenues increase, a greater dispersion can be observed, which can be derived from management strategy or local conditions or both. FRA (Frankfurt) and CDG (Charles de Gaulle) have a cost ratio higher than that of LHR (Heathrow) and NRT (Narita), which may suggest that the first two should seek better operational management. A more interesting trend would be the one that showed decreasing marginal costs with increasing revenue, which can not be observed.

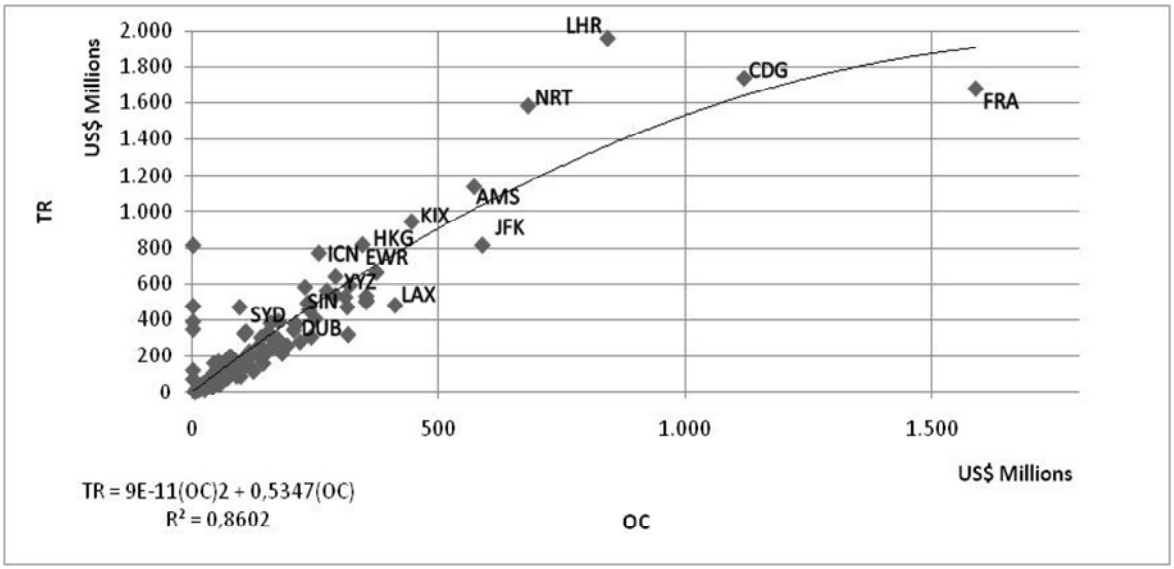


Figure 2 – Airports operational cost (OC) and total revenue (TR) - 2005

Figure 2 shows that some airports stand out from the others in terms of revenue (CDG – Charles de Gaulle; FRA- Frankfurt; LHR – Heathrow; NRT – Narita). A comparison of total passengers and total revenue (Figure 3) reveals that these airports define a detached efficiency frontier in relation to the others. KIX (Kansai) and PEN (Pinang) with the ones cited above delineate an efficiency frontier taking into consideration passengers and revenue. However, just below this frontier, the formation of a frontier can be observed, formed by AMS (Amsterdam), CGN (Cologne), DUS (Dusseldorf), ICN (Icheon), MUC (Munich), VIE (Vienna) and ZHR (Zurich). In these more detached positions, neither the North-American nor the Brazilian airports can be found. Brazilian main airports SBGL (Galeão) and SBGR (Guarulhos) are found just beneath the second frontier described. SBSP (Congonhas) is found in the lowest zone of the relation between passengers/revenue, as well as most American airports. Although the ratio revenue/passengers is not an absolute indicator of efficient management of airports, it indicates some airports that stand out and which can become a reference to the others.

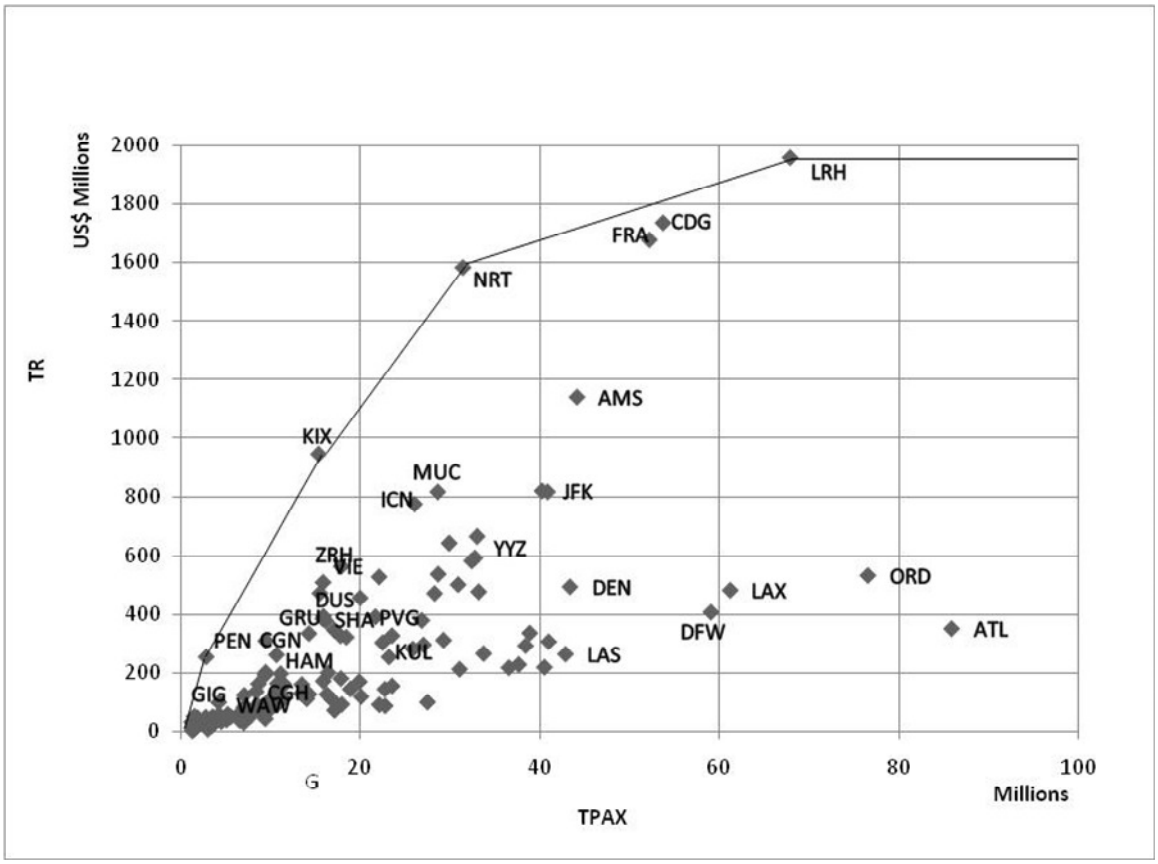


Figure 3 – Airports total revenue (TR) and total passengers (TPAX) - 2005

Many are the revenue sources of airports; a traditional division is the one that splits it into aeronautical and non-aeronautical revenues. According to Doganis (1992), the aeronautical revenue or traffic revenue comes from the tariffs paid by the passengers, airline companies and cargo transporters that are related to the main activities of the airport. And the non-aeronautical revenue comes from trading activities that are not associated with the airports' main business. Among the main sources generating this kind of income, the following are detached: parking services, shops, and concessions, among others. Figure 4 shows the relation between aeronautical revenues (AR) and the non-aeronautical ones (NAR). A diagonal line marks the limit where these two revenues become equal. In Figure 4, it can be observed that from four airports of the sample with higher revenue, FRA is where NAR is detached and, as a contrast, NRT is where AR is detached. CDG and LHR airports are balanced concerning these revenues. Although the literature has been pointing out the importance of the fact that airport management should observe the non-aeronautical revenue, it is necessary to take the airports local conditions into consideration along with their role in the air traffic network. A preliminary approach can suggest three

ways: prioritizing investments to obtain non-aeronautical revenues (FRA style); balancing, dividing the investments efforts into the two kinds of revenue (as CDG and LHR), and the third option would be to focus on investments so as to obtain aeronautical revenues (as the NRT model).

Outputs: AR – aeronautical revenue, in US$ millions;

NAR – non-aeronautical revenue, in US$ millions

Inputs: PAXD – boarded plus landed domestic passengers;

PAXI – boarded plus landed international passengers;

CART – boarded plus landed cargo in tons.

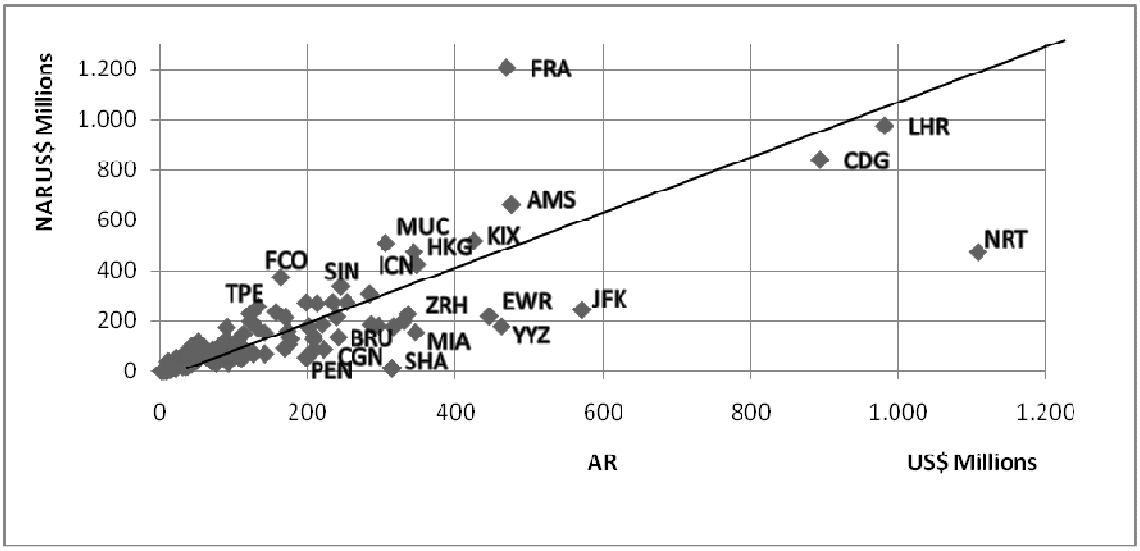


Figure 4 – Airports aeronautical revenue (AR) and non-aeronautical revenue (NAR) - 2005

5. RESULTS

The results of DEA models are presented in Tables 1 to 3. Forty-five airports in input orientation efficiency frontier were found, being 29 of them airports that present constant returns to scale (CRS) (Table 1) as well as the output (Table 2), 2 airports present IRS and 4 DRS. Of the 4 large airports (NRT, FRA, CDG and LHR) which stand out in the description of this case study, only NRT presents CRS, revealing a global efficiency tendency. The others are in the DRS area (Table 3 – annex). As Figure 4 shows, NRT has a heavy emphasis on aeronautical revenue. Either in the input-oriented model, or in the output-oriented one, the majority of airports project themselves from the DRS area. Table 2 shows that the projection in the DRS frontier comprises more airports in the output-oriented model (90 airports, 14 efficient ones and, 76 inefficient ones). Only two airports are in the IRS area and these are

SBGO (Brazil) and TLL (Estonia). These two airports had around 1.5 million passengers in 2005. The difference between the inefficient airports numbers related to IRS and a DRS indicates that many airports very clearly stand out in terms of input and output orientation.

Table 1 – Airports position towards returns to scale for input-oriented DEA variable return to scale model

RS BCC-I	Efficient	Inefficient	Total
IRS	2	28	30
CRS	29	3	32
DRS	14	62	76
Total	45	93	138

Abbreviations: RTS BCC-I – Returns to scale in DEA variable scale model; IRS – increasing returns to scale ; CRS – constant returns to scale; DRS – decreasing returns to scale.

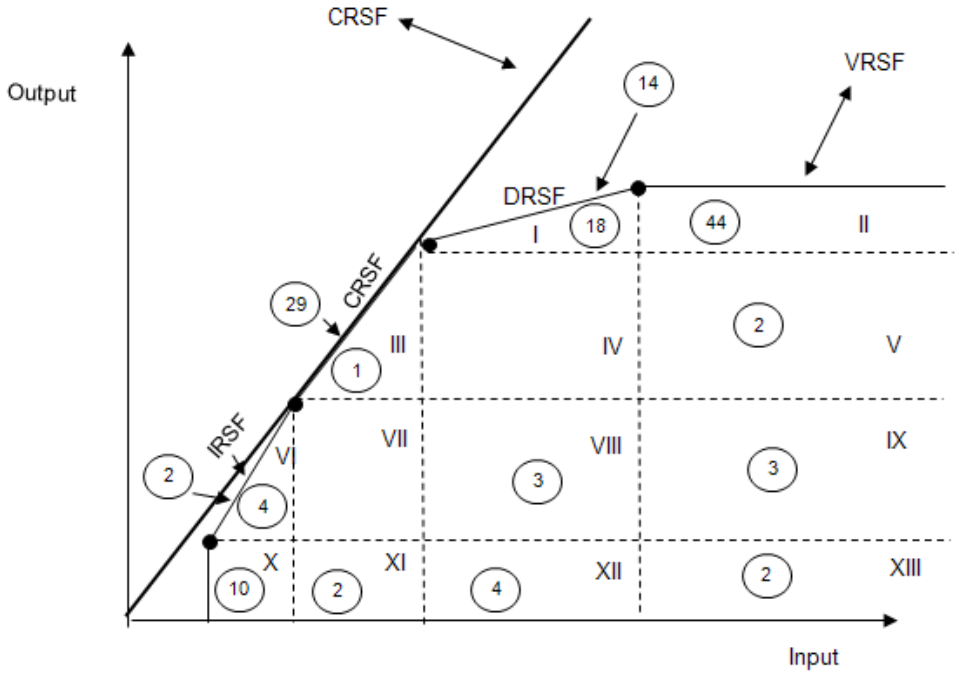
Table 2 – Airports position towards returns to scale for output-oriented DEA variable return to scale model

RS BCC-O	Efficient	Inefficient	Total
IRS	2	14	16
CRS	29	3	32
DRS	14	76	90
Total	45	93	138

Abbreviations: RS BCC-O – Returns to scale in output-oriented DEA variable scale model; CRS – constant returns to scale; DRS – decreasing returns to scale; IRS – increasing returns to scale.

Figure 5 schematically shows the behavior of airports towards efficiency frontier. The figure was divided into quadrants. Quadrants I, III, IV, VI, VII and VIII represent the areas called DEA Pareto-Efficient. This occurs because the airports in these inefficient areas have an augmented number of references for the input-oriented model as well as the output ones equal the number of model variables - in our case, 5 variables. In the present case study, there are 26 airports (18+1+4+3) in the Pareto-Efficient area for input orientation as well as for output. 18 airports are in the Pareto-Inefficient area for input orientation (X, XI, XII e XII) and 51 airports are in the Pareto-Inefficient area for output orientation (II, V, IX, XIII). It can be observed that quadrant XIII is a Pareto-Inefficient area for input as well as for output and it includes two airports. Most airports in the sample are in the DRS quadrants (I and II) for input orientation as well as for output (62 airports out of 93 in the inefficient area). Three of the highest revenue airports of the study sample are references in this part of efficiency frontier (CDG, FRA and LHR), no airport in Asia was placed in this part of the frontier and only one Brazilian airport was placed in this area of the frontier (SBSP - Congonhas). 3 airports are the inefficient airports projected in the DRS: SBBR (Brasília), SBGL and SBGR, the last one is in quadrant I and the others in quadrants II. Four Brazilian airports are in the CRS for input/output-oriented: SBBH (Pampulha), SBEG (Manaus), SBRJ (Santos Dumont) and SBVT (Vitória). The other

Brazilian airports are in the IRS area (Quadrants VI and X).



Abbreviations - CRSF – constant return to scale frontier; DRSF – decreasing return to scale frontier; IRSF – increasing return to scale frontier; CRSF – constant return to scale frontier; VRSF– variable return to scale frontier.

Figure 5 – Airports position scheme towards efficiency frontier

6. DISCUSSION

Data Envelopment Analysis reveals that from the airports that are in the CRS area, most are in the efficiency frontier (29 in the frontier and 3 out of the frontier – quadrants III and V in Figure 5). 10 Brazilian airports are in the IRS area, being 1 efficient and 9 inefficient. These should use the output orientation to increase their revenues more proportionally to inputs. 4 Brazilian airports are in the CRS area and should seek a stable input-output increase. 4 Brazilian airports are in the DRS area, 1 in the frontier and 3 are in the inefficiency area. These airports should seek high added value inputs.

It can be observed that airports can increase their revenue both through non-aeronautical and aeronautical activities. However, it can not be said, at first, that non-aeronautical activities should be prioritized. The airports of NRT in Japan and PEN in Malaysia have shown to be stereotypes of revenue producers through aeronautical activities while the airports of FRA in Germany and KIX in Japan are stereotypes of revenue obtained through non-aeronautical activities.

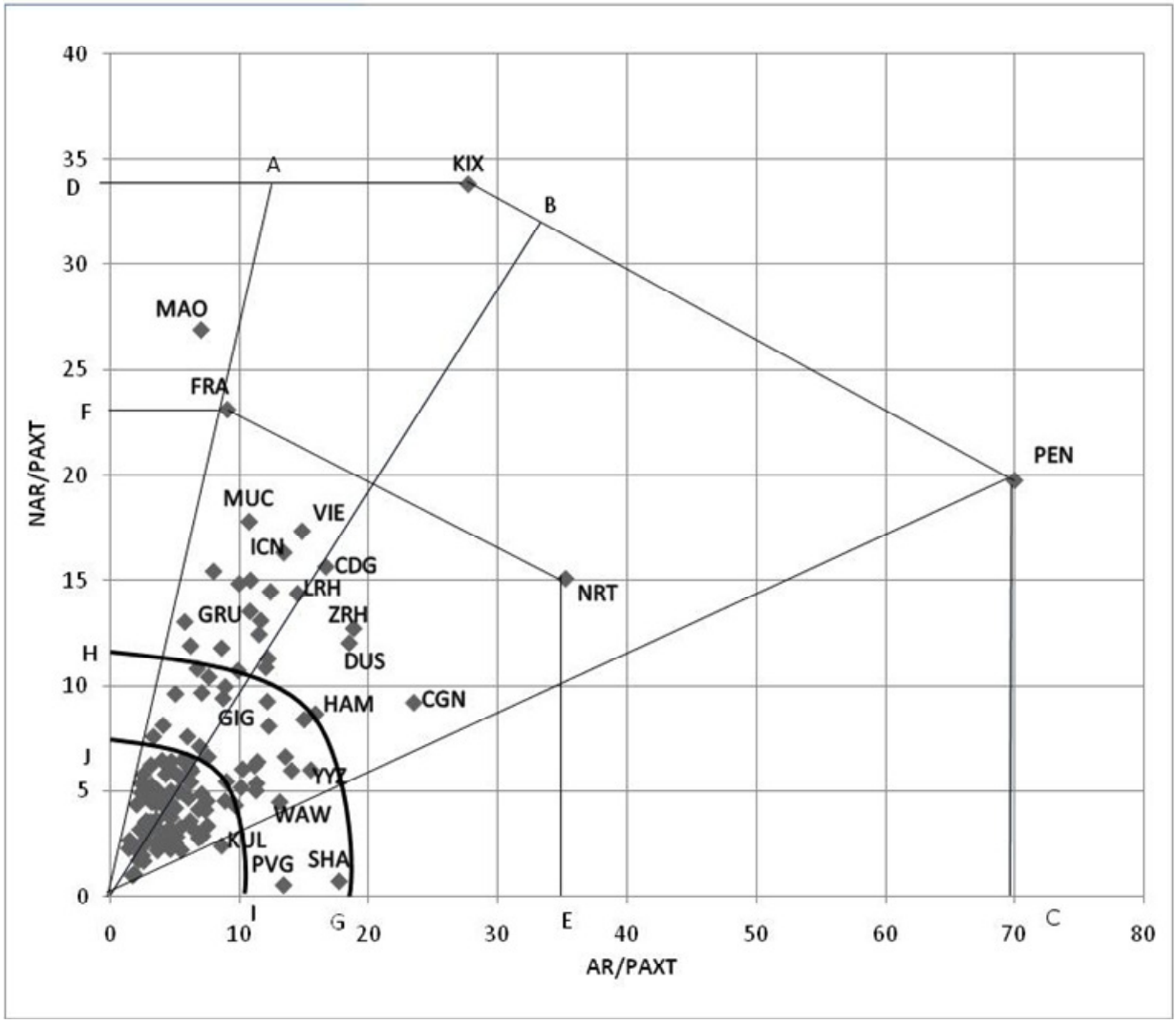


Figure 6 – Efficiency frontier of the relationship aeronautical revenue (AR) and non-aeronautical revenue (NAR) with total passengers (PAXT) (2005)

The graphic analysis of DEA shown in Figure 6 aids the visualization of the airport management orientation. SBEG, PVG and SHA are examples of situations in which the external environment dominates the orientation of revenue. SBEG airport is located in the city of Manaus, in the heart of the Amazon region, and has an Industrial Free Trade Zone with tax incentives with high cargo traffic. The airports of PVG and SHA are in Shanghai, mainland China, which is entering into the trade mechanism of the global economy. The straight line segment from origin B defines the limit where NAR / PAX is equal to AR / PAX. The straight line segments that pass the origin and meet the efficiency frontier region show the possible routes and references to the airports. For

example, airports SBGL and SBGR may improve toward the pattern of KIX (Japan) airport, having ICN (Korea) as an intermediary reference.

It is of foremost importance for performance analysis to observe the various aspects of the variables being analyzed. Thus, the multivariate analysis of the DEA linear programming, statistical analysis and graphical analysis help decision makers to see the consistency of ratings since an airport can go to the efficiency frontier region for a particular characteristic that is not relevant to other airports. Development of airports is heavily driven by the external environment, regulation, local conditions, the role of the airport in the network, etc. However, given these conditions, the managers have a great opportunity for the development of aeronautical and non aeronautical activities. The choice of benchmarks is very important for those airports that are out of the efficiency frontier because they substantially influence investment choices. Obviously, new paradigms can be established; however, the search for a completely new way is a high risk choice.

7. CONCLUSIONS

This article discusses the performance of airports at world level, including in the analysis a number of Brazilian airports. The analysis shows ways of development-oriented to non-aeronautical revenues, aeronautical revenues and for both of them. The international performance benchmarks were identified in a sample of 138 airports with passenger traffic of over 1 million in 2005. In the analysis presented, the main European airports are located in the efficiency area. Most U.S. airports are considered inefficient, among them Atlanta and Chicago that have a large number of passengers and aircraft traffic, and Los Angeles that carries a large amount of cargo. Most airports are in the DRS area, so they need to carefully choose their strategies so as to achieve relevant results. The good performance of Asian airports indicates the emergence of new paradigms in the management of airports. Emerging countries such as Brazil, which have their main airports with efficiency standards below the efficiency frontier, need to improve their excellence process. Being an effective follower may be a good strategy when there are not enough resources to finance innovation.

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ANNEX

Table 3 - DEA Results

code	Airport	BCC-I	RS BCC-I	BCC-O	RS BCC-O
ZRH	Zurich	100%	Decreasing	100%	Decreasing
ABQ	Albuquerque	100%	Constant	100%	Constant
YYZ	Toronto	100%	Decreasing	100%	Decreasing
VIE	Vienna	100%	Constant	100%	Constant
AMS	Amsterdam	100%	Constant	100%	Constant
TPA	Tampa	100%	Decreasing	100%	Decreasing
TLL	Tallinn	100%	Increasing	100%	Increasing
SOF	Sofia	100%	Constant	100%	Constant
SNA	John Wayne	100%	Constant	100%	Constant
BHX	Birmingham	100%	Constant	100%	Constant
SMF	Sacramento	100%	Decreasing	100%	Decreasing
SIN	Singapore Changi	100%	Constant	100%	Constant
SHA	Shanghai Hongqiao	100%	Constant	100%	Constant
SDF	Louisville	100%	Constant	100%	Constant
BRU	Brussels	100%	Constant	100%	Constant
SBVT	**Vitória**	**100%**	**Constant**	**100%**	**Constant**
SBSP	**Congonhas**	**100%**	**Decreasing**	**100%**	**Decreasing**
CDG	Charles de Gaulles	100%	Decreasing	100%	Decreasing
SBRJ	**Santos-Dumont**	**100%**	**Constant**	**100%**	**Constant**
SBGO	**Goiânia**	**100%**	**Increasing**	**100%**	**Increasing**
CIA	Rome Ciampino	100%	Constant	100%	Constant
SBEG	**Manaus**	**100%**	**Constant**	**100%**	**Constant**
SBBH	**Pampulha**	**100%**	**Constant**	**100%**	**Constant**
RIC	Richmond	100%	Constant	100%	Constant
PRG	Prague	100%	Constant	100%	Constant
CVG	Cincinnati	100%	Decreasing	100%	Decreasing
DCA	Washington	100%	Constant	100%	Constant
DEN	Denver	100%	Decreasing	100%	Decreasing
PEN	Penang	100%	Constant	100%	Constant
OSL	Oslo	100%	Decreasing	100%	Decreasing
NRT	Tokyo Narita	100%	Constant	100%	Constant
DUS	Dusseldorf	100%	Constant	100%	Constant
MUC	Munich	100%	Constant	100%	Constant
MLA	Malta	100%	Constant	100%	Constant
FCO	Rome /Fiumicino	100%	Decreasing	100%	Decreasing
MFM	Macau	100%	Constant	100%	Constant
FRA	Frankfurt Main	100%	Decreasing	100%	Decreasing
LJU	Ljubljana	100%	Constant	100%	Constant
HAK	Hamburg	100%	Constant	100%	Constant
LHR	London Heathrow	100%	Decreasing	100%	Decreasing
LGA	LaGuardia	100%	Decreasing	100%	Decreasing
LAS	Las Vegas	100%	Decreasing	100%	Decreasing
HKG	Hong Kong	100%	Constant	100%	Constant
KIX	Kansai	100%	Constant	100%	Constant
JAX	Jacksonville	100%	Constant	100%	Constant
MCO	Orlando	98%	Decreasing	99%	Decreasing
DUB	Dublin	97%	Constant	98%	Constant
HDY	Hat Yai	95%	Increasing	13%	Increasing
SBNT	**Natal**	**94%**	**Increasing**	**49%**	**Increasing**
ALB	Albany	94%	Decreasing	94%	Decreasing
SBCT	**Curitiba**	**91%**	**Increasing**	**90%**	**Increasing**
GVA	Geneva Cointrin	88%	Decreasing	89%	Decreasing
MAN	Manchester	88%	Constant	92%	Decreasing
IND	Indianapolis	87%	Decreasing	94%	Decreasing
PIT	Pittsburgh	86%	Decreasing	89%	Decreasing
EDI	Edinburgh	85%	Decreasing	85%	Decreasing
WAW	Warsaw	84%	Increasing	83%	Increasing
SBBE	**Belém**	**82%**	**Increasing**	**54%**	**Increasing**
PDX	Portland	82%	Decreasing	88%	Decreasing
SBGL	**Galeão**	**81%**	**Decreasing**	**82%**	**Decreasing**
TXL	Berlin Tegel	80%	Increasing	80%	Constant
SBFL	**Florianópolis**	**80%**	**Increasing**	**39%**	**Increasing**
LGW	London Gatwick	79%	Decreasing	89%	Decreasing
PBI	Palm Beach	78%	Increasing	77%	Decreasing
RNO	Reno/Tahoe	77%	Increasing	78%	Constant
ATH	Athens	77%	Decreasing	77%	Decreasing
EWR	Newark Liberty	75%	Decreasing	83%	Decreasing
SBCF	**Confins**	**74%**	**Increasing**	**69%**	**Increasing**
OAK	Oakland	73%	Decreasing	82%	Decreasing
SBPA	**Porto Alegre**	**72%**	**Increasing**	**71%**	**Increasing**
AUS	Austin Bergstrom	71%	Decreasing	74%	Decreasing
ICN	Incheon	69%	Decreasing	71%	Decreasing
HAM	Meilan	68%	Constant	41%	Decreasing
BOS	Bostam Logan	67%	Decreasing	73%	Decreasing
RDU	Raleigh-Durham	67%	Decreasing	81%	Decreasing
SEA	Seattle-Tacoma	67%	Decreasing	72%	Decreasing
BNA	Nashville	66%	Increasing	72%	Decreasing
SJC	San José	66%	Decreasing	80%	Decreasing
CLE	Cleveland-Hopkins	65%	Decreasing	69%	Decreasing
BNE	Brisbane	64%	Decreasing	66%	Decreasing

code	Airport	BCC-I	RS BCC-I	BCC-O	RS BCC-O
CPH	Copenhagen	63%	Decreasing	71%	Decreasing
PHX	Phoenix	61%	Decreasing	74%	Decreasing
ARN	Stockholm Arlanda	61%	Decreasing	65%	Decreasing
SYD	Sydney	60%	Decreasing	67%	Decreasing
JFK	New York	60%	Decreasing	69%	Decreasing
SBGR	**Guarulhos**	**59%**	**Decreasing**	**59%**	**Decreasing**
STL	St. Louis-Lambert	59%	Decreasing	64%	Decreasing
MKE	General Mitchell	57%	Increasing	62%	Decreasing
MCI	Kansas City	56%	Decreasing	78%	Decreasing
SAN	San Diego	54%	Decreasing	77%	Decreasing
ONT	Ontario	54%	Decreasing	78%	Decreasing
TPE	Chiang Kai-Shek	54%	Increasing	53%	Increasing
SFO	San Francisco	54%	Decreasing	70%	Decreasing
MSP	Minneapolis/St. Paul	53%	Decreasing	67%	Decreasing
SZX	Shenzhen Baoan	53%	Decreasing	68%	Decreasing
IAD	Washington Dulles	52%	Decreasing	61%	Decreasing
SEL	Seoul	52%	Decreasing	66%	Decreasing
HEL	Helsinki Vantaa	52%	Increasing	52%	Increasing
FLL	Fort Lauderdale	50%	Decreasing	61%	Decreasing
MDW	Chicago Midway	50%	Decreasing	63%	Decreasing
PVG	Shanghai Pudong	50%	Decreasing	68%	Decreasing
ATL	Hartsfield- Atlanta	47%	Decreasing	64%	Decreasing
AKL	Auckland	47%	Decreasing	48%	Decreasing
DTW	Detroit	46%	Decreasing	67%	Decreasing
SBFZ	**Fortaleza**	**45%**	**Increasing**	**36%**	**Increasing**
SBRF	**Recife**	**45%**	**Increasing**	**44%**	**Increasing**
YOW	Ottawa	45%	Decreasing	49%	Decreasing
CGN	Cologne/Bonn	45%	Decreasing	63%	Decreasing
DFW	Dallas/Fort Worth	44%	Decreasing	60%	Decreasing
SBSV	**Salvador**	**44%**	**Increasing**	**43%**	**Increasing**
STN	London Stansted	43%	Increasing	46%	Decreasing
MEM	Memphis	43%	Increasing	60%	Decreasing
CAN	Bai Yun	42%	Decreasing	55%	Decreasing
YHZ	Halifax	41%	Increasing	42%	Decreasing
CNX	Chiang Mai	41%	Increasing	15%	Decreasing
SAT	San Antonio	40%	Increasing	45%	Decreasing
IAH	Houston	39%	Decreasing	57%	Decreasing
CHC	Christchurch	39%	Decreasing	44%	Decreasing
YWG	Winnipeg	39%	Increasing	25%	Decreasing
YVR	Vancouver	39%	Decreasing	40%	Decreasing
SBBR	**Brasília**	**38%**	**Decreasing**	**41%**	**Decreasing**
YUL	Montréal	36%	Decreasing	37%	Decreasing

code	Airport	BCC-I	RS BCC-I	BCC-O	RS BCC-O
HKT	Phuket	36%	Increasing	26%	Decreasing
MIA	Miami	35%	Decreasing	49%	Decreasing
YEG	Edmonton	34%	Decreasing	35%	Decreasing
YYC	Calgary	34%	Decreasing	37%	Decreasing
BWI	Baltimore	33%	Decreasing	49%	Decreasing
HNL	Honolulu	32%	Decreasing	38%	Decreasing
ORD	Chicago O'hare	32%	Decreasing	57%	Decreasing
SLC	Salt Lake City	30%	Decreasing	52%	Decreasing
LAX	Los Angeles	28%	Decreasing	44%	Decreasing
CLT	Charlotte Douglas	28%	Decreasing	41%	Decreasing
KUL	Kuala Lumpur	28%	Decreasing	42%	Decreasing
MSY	New Orleans	28%	Increasing	24%	Increasing
PEK	Beijing	26%	Decreasing	37%	Decreasing
PHL	Philadelphia	25%	Decreasing	37%	Decreasing
XMN	Xiamen Gaoqi	21%	Increasing	21%	Decreasing
BKK	Bangkok	19%	Increasing	28%	Decreasing