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Efficiency evaluation in an airline company

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INTRODUCTION

Over the past two decades airline companies have faced many changes in markets. The context of air transportation has seen a rapid development, determined by the growing of air transport demand, technological progress, strong investments in the field and the aviation deregulation.

This has stimulated the development of reliable performance measures, since airlines operate in a highly competitive market and experience has demonstrated that progressive liberalisation produces substantial benefits for air transport services that are efficient. Recently, considerable attention has been focused on the performance of various airlines in terms of efficiency, and the operational performance of airlines has received significant attention in the literature.

There are many ways in which one may define and measure performance in this industrial context, but there is no definitive study to guide the selection of different techniques. In our opinion, an important factor to be considered is delay, which can depend on weather, congestion, mechanical breakdowns, etcetera. The idea behind this belief is that the passengers' decision to use the same airline or switch depends on whether they have experienced flight delays or not: Suzuki (2000) posits that passengers who experienced flight delays are more likely to switch airlines for the subsequent flights than those passengers who did not experienced delays. Moreover, it has been demonstrated that lost revenue mainly depends on customer switching to other competing companies in case of irregular or delayed services. A good on-time performance may lead, therefore, to greater customer satisfaction.

OBJECTIVE

The main objective of this study is to evaluate the operational performance of an Italian airline - Air One - for the year 2006 by using the non-parametric approach to efficiency measurement, Data Envelopment Analysis. To this purpose, this work analyses the relative efficiency of Air One domestic routes by also including an undesirable factor, the number of delayed flights.

DATA

The sample on which our study is based consists of thirty-four domestic routes: in order to respect homogeneity assumptions upon units under assessment, we have not included international routes, summer routes and any routes which have not been operating the whole year.

Data are obtained from various internal reports and from Annual Report 2006. Specifically, the data consist of two inputs, total variable direct operating costs (DOCs) and total fixed direct operating costs (FOCs), and three outputs, scheduled revenue, number of passengers and block time hours.

With regard to the outputs included in our model, passenger scheduled revenue represents the main output for a typical passenger focused airline; we have not included charter revenue and all output that is not passenger-flight related, such as cargo revenue. Block time hours, instead, is the time for each flight stage or sector, measured from when the aircraft leaves the airport gate to when it arrives at the stand at the destination airport.

On the other hand, direct operating costs reflect the airline operational characteristics and depend upon the efficiency of scheduling and the nature of the route system. DOCs depend upon airline activity level, that is the amount of flying it does (fuel, handling, catering, landing and airport fees, variable flight crew costs, i.e. bonuses, variable maintenance expenses, check costs), whilst FOCs are not avoidable in the short term (rentals for leased aircrafts, insurance, crew costs, i.e. fixed salaries, crew training)

Moreover, the application of DEA to concrete situation has motivated the inclusion of a special kind of output, an undesirable output represented by the number of delayed flights. The Bureau of Transportation Statistics (BTS) defines a flight to be on-time if it arrives no later than fifteen minutes after its scheduled arrival time.

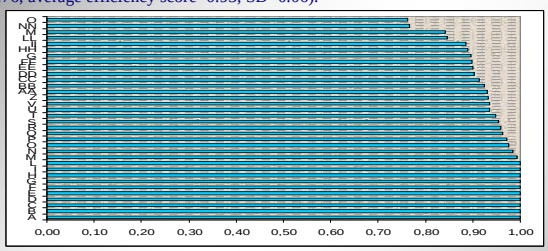
RESULTS

Output from model

For each unit (DMU):
1) Efficiency rating or score (DMUs ranking): first information
2) Identify efficient peers (peer group) and targets for inefficient units

Empirical findings (1)

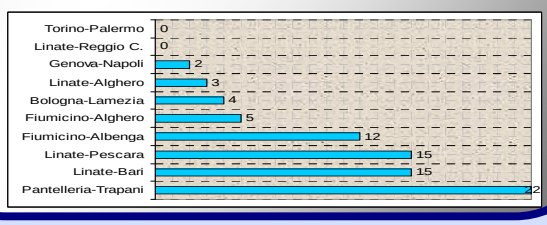
The results consists of a large number of efficient DMUs, nearly one third of the 30 routes. Moreover, the remaining routes are very close to the frontier. Route O is at the bottom of the ranking, having the efficiency rating of 0.7614.
(min=0.76, average efficiency score=0.93, SD=0.06).



Empirical findings (2)

Routes Pantelleria-Trapani, Linate-Bari and Linate-Pescara seem to be the most robustly CCR efficient: they appear very frequently in the peer groups (22, 15 and 15 times, respectively)

DMUs Linate-Alghero (3), Genova-Napoli (3), Torino-Palermo (0) and Linate-Reggio Calabria (0) are not better role models for less inefficient units to emulate

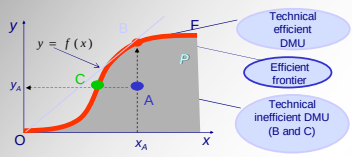


METHODOLOGY

According to Farrell, a technical efficient organisation would be:

✓ one that produces the maximum possible outputs from a given set of inputs (output-orientated measure), or

✓ one that produces a certain level of outputs with the minimum amount of inputs (input-orientated).



We measure efficiency in terms of distance to the best unit on the frontier isoquant (radial efficiency measure). Two classes of methods have been developed for estimating efficiency frontiers, parametric methods and non-parametric methods.

DATA ENVELOPMENT ANALYSIS

➢DEA is a non-parametric method based on linear-programming techniques developed by Charnes, Cooper and Rhodes in 1978.

➢It provides a measure of the relative efficiency of a set of homogeneous organisational units (Decision Making Units, DMUs) in their use of multiple inputs to produce multiple outputs (schools, universities, hospitals, countries, no-profit organisations, banks, firms, shops).

➢Non-parametric approach for estimating efficiency frontiers (it makes few assumptions about the technology structure).

➢Data-based: the best-practice frontier is built empirically from observed inputs and outputs data of each unit, by means of linear-programming.

➢Deterministic: it does not incorporate random noise in the model (outliers and measurement errors may affect DEA efficiency estimates).

➢Extra informations in the form of peer units and targets.

In this work we use a modified input-orientated **CCR model** under CRS (*DEA-Solver-LV software*):

Further constraint for undesirable outputs

$$e_0 = \min\ \theta_0$$

s.t.

$$\theta_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0 \qquad i = 1,\ldots,m$$

$$\theta_0 h_{t0} - \sum_{j=1}^{n} \lambda_j h_{tj} \geq 0 \qquad t = 1,\ldots,z$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{i0} \qquad r = 1,\ldots,s$$

$$\lambda_j \geq 0 \qquad j = 1,\ldots,n$$

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