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The costs of peak-load demand: An application to Gran Canaria airport

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A B S T R A C T

Many airports suffer from peak-load demand problems. To meet unconstrained demand at peak periods, they often invest in extra capacity that may be under used at other times. We use data from the airport in Gran Canaria to illustrate that costs associated with the peak-load problem are not only those related to the new investment. This paper provides a methodology for analyzing the costs arisen due to the peak-load demand, to explore alternative airport policies and to illustrate the problem of congestion at airport terminals. The results suggest that a situation in which airports differentiate charges by peak and off-peak days would be much desirable.

1. Introduction

Many airports suffer from peak-load demand problems. While some of this may worsen terminal capacity problems it largely stems from the perishable nature of the services offered – basically an even spread of landing and take-off slots – and the uneven nature of the demand for their use. With uniform prices over time, the quantity of slots demanded increases and falls periodically. To meet demand at the peak with a single price would require over-invest in capacity that is under-utilized over the remainder of the cycle. Since capacity is costly, there is a motivation to use it optimally and for using peak-load pricing to allocate it efficiently.

Traditionally economists and regulators have link public utility pricing to economic efficiency and the marginal cost as the basis for pricing. Peak-load pricing in transport has been also usually linked to road congestion problems. Congestion at airports, however, occurs when there are "too many" users in the system (e.g. terminals or runways) that consequently assume a higher generalized cost for their trip. If we can identify who causes congestion and when it appears, we will be able to charge them in order to internalize the costs they impose on other users. If the congestion problem only appears in certain periods of time (e.g. hours, days…), the internalization is conducted through peak-load pricing mechanisms. On the contrary, when congestion arises due to a suboptimal effort exerted by airports' managers, airports' agents or even airlines, (e.g. lack of personnel available to handle luggage), other type of congestion pricing mechanism should be applied (Nombela et al., 2004). Thus, peak-load pricing in air transport could be regarded as a particular type of congestion pricing.

Although the work on peak-load pricing is extensive, little has been done on real costs of the peak-load problem. While there is an incentive to spread services throughout the day because it lowers the costs of the land-side workforce and facilities and reduces air-side congestion (Abeyrathne, 2000), most analysis justify peak-load pricing policies in terms of reducing the inefficiency that accompanies over-investment in capacity. There has also been little analysis of the costs in peak periods for specific airlines (Frank et al., 2005; Kemppainen et al., 2007).

Here we use data from the airport in Gran Canaria to estimate the costs associated with the peaks in demand. The airport has significant peaks in arrivals and departures of tourists on particular days of the week, that impose costs, not only on the airport itself, passengers and airport agents, but also on other sectors such as bus service suppliers and hotels. We look at three related objectives: to provide a methodology for analyzing the costs arisen due to the peak-load demand, to explore alternative airport policies schemes in order to induce a more efficient utilization of the airport capacity, and to illustrate the problem of congestion costs at airports terminals whilst the problem of congestion at airports has been usually restricted and modelled in the literature as delay costs.

2. Gran Canaria airport

The Canary Islands has a population of 2 million people and is situated in the Atlantic Ocean, 1000 km to the southwest of Portugal. It is composed of seven islands served by eight airports, five of which offer international services. Gran Canaria, Tenerife South, and Lanzarote are ranked among the ten busiest airports in

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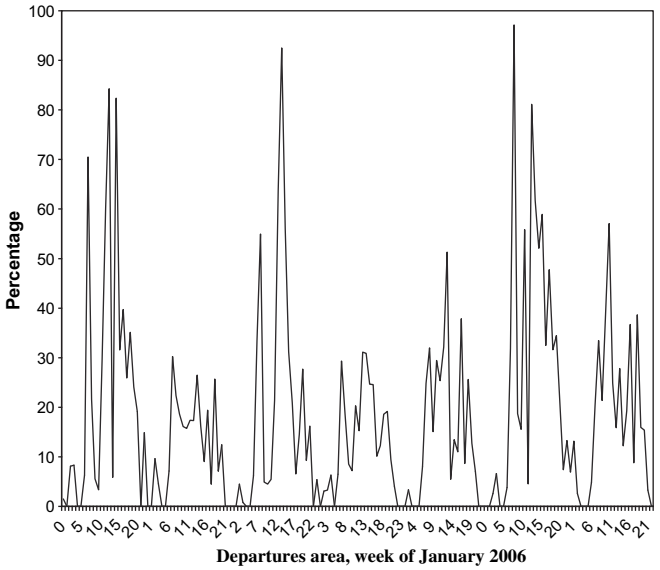

Fig. 1. Percentage of terminal capacity utilization.

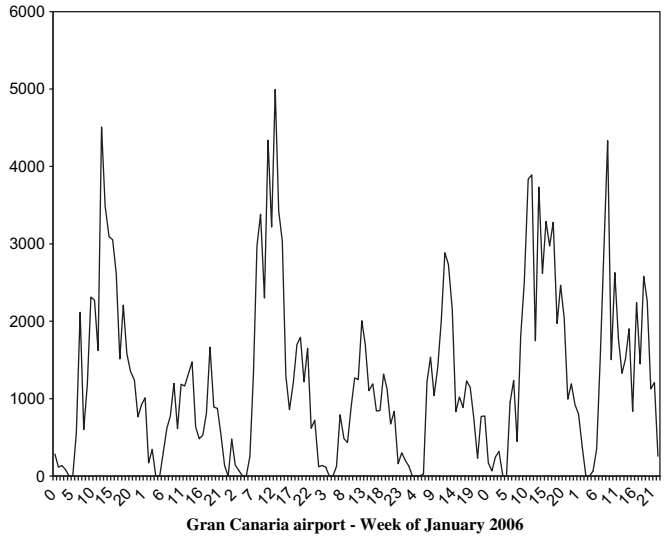

Fig. 2. Distribution of passengers per hour at the terminal: arrivals and departures.

Spain (Aeropuertos Españoles y Navegación Aérea, 2007a) largely because of tourist traffic levels.[1]

Traditionally, most foreign tourists arrive to the islands through a tour-operator, which sells them a holiday package including flight, transport and accommodation. Interestingly, tour-operators conduct their operations by concentrating on a given weekday all flights from the same origin. For instance, most flights from the UK arrive at and leave from Gran Canaria on Mondays and Saturdays, demanding thus a more intensive use of the capacity on those days. A similar pattern can be found at other airports in the Canary Islands, though the selected peak days within the week usually differ across tour-operators and origins. Concentrations of flights allow tour-operators to enjoy costs savings in such things as providing local transport.

Charges at the airport are determined by Aeropuertos Españoles y Navegación Aérea (2007b), the public entity in charge of managing the Spanish airport network. The structure and level of charges tend to be homogenous across airports, and it is mainly differentiated by type of facility and flight; smaller airports, for example, have lower prices. In spite of the clear peak and off-peak in demand, no further differentiation is applied. Such a structure not only affects the behaviour of airlines and ultimately tour-operators but also has implications for other aspects of the local economies.

2.1. The nature of demand at the airport

Gran Canaria airport is the fifth busiest Spanish airport, with almost 10 million passengers per year[2] of which 54% comes from other European countries, mainly Germany, the UK and the Nordic countries, with the rest composed of inter-island and flights from mainland Spain. While both national and inter-islands traffic levels are quite stable, international traffic exhibits peaks during autumn and winter, but falls substantially in spring and summer. For analytical purposes we divide the traffic between the tourist peak season (autumn and winter); daily peaks within a week (e.g. Mondays, Wednesday and Saturdays); and the peaks within a day (e.g. midday or early afternoon hours).

The capacity of an airport is defined in terms of its runways and terminals. In the case of Gran Canaria's terminal, it is useful to distinguish between the arrivals and the departure lounge capacities. There are no major problems in the luggage delivery area, but in the departure area there are constraints imposed by the checking and security controls that restrict handling to a maximum of 3000 passengers per hour. The departures area, therefore, reaches its limits during some days in January (Fig. 1). The capacity of the arrivals area, in contrast can handle close to 6000 passengers, although there are also problems in areas where people wait to meet passengers after they have collected their luggage.

A major challenge at the airport is the daily distribution of passengers and operations as can be seen in Fig. 2 that looks at a week of January 2006; January being a peak month; Mondays, Wednesdays and Saturdays are clearly peak days. In addition, most passengers arrive/leave at midday or early afternoon flights.[3]

Since peaks often evolve over time and can interact between markets, any pricing policy aimed at allowing more efficient use of airport capacity needs to be reactive and, the case of the Canary Islands needs to take into account the whole network of airports involved (Fig. 3). The peaks at the Canary Islands move like a wave from one to the other; e.g. the peak day at Gran Canaria is usually an off-peak day at Tenerife South, while on Thursdays the peak moves to Lanzarote. A similar peak-pattern can be found at Fuerteventura, for which Mondays and Wednesdays are traffic peaks.[4]

Regarding runway capacity (taken as a maximum of 36 movements per hour)[5]; some peaks are already close to the maximum.

[1] In 2007 more than 9.6 million foreign tourists went to the Canary Islands; 2.8 million to Gran Canaria.

[2] Madrid, Barcelona, Palma de Mallorca and Málaga have more traffic.

[3] This is largely because of the convenience of certain flight times. For instance, passengers leaving Manchester UK tend to favour departs at 10 am arriving in Gran Canaria four hours and a half later thus allowing an overall journey to begin around 7 am.

[4] Looking at different tour-operators' packages shows no special preference for travel on a given day either to the Canary Islands or other destinations.

[5] Gran Canaria airport, while having two runways for safety and layout reasons, only uses one at a time.