Managing Airport Congestion – the Effects of Runway Peak Pricing

This article discusses the effects of airport congestion pricing on airlines and passengers. Having researched this for his master thesis, Paul Nibbering compared current pricing systems, like the concept of slot allocation, with weight-based pricing. This article briefly explains the problem of airport congestion, its main causes, and the most-favored solutions against it. A closer look illustrates the methodology of airport congestion pricing and deals with the pros and cons of this method. Since airport congestion pricing is still a relatively underexplored subject in scientific literature, this research should be considered as exploratory. Most European airports still follow a weight-based pricing policy instead of a peak-pricing policy. Results, however, show that airlines can significantly save costs by operating off-peak at peak-load pricing airports. Furthermore, airport congestion pricing appears to be a promising method for reducing airport congestion, but more research is needed to determine the precise effects for all parties that are involved in a possible congestion pricing policy. This study aims to expand the knowledge on airport congestion pricing, and to provide a better insight in the concept of it. As a result, this research is useful to airport operators who are interested in the practice of congestion pricing.

by Paul Nibbering

Research in the field of airport congestion pricing is relatively limited, although the topic has received increasing attention in scientific circles in recent years. According to Pels and Verhoef (2004), congestion pricing in aviation is a relatively underexplored option in the literature. Brueckner (2005) agrees on this point and ascertains that airport congestion pricing has only received periodic treatment in economic literature. Also, Adler et al. (2002) agree with Pels and Verhoef, and they state that only a few papers in the air transport literature have considered airport congestion pricing to replace weight-based airport charges in an attempt to reduce delays. On the other hand, Nombela et al. (2004) argue that the literature dealing with the problem of airport congestion itself is relatively extensive, but that most of these works draw heavily on the analysis of road congestion. Recent works, however, clearly distinguish between road congestion and airport congestion. Based on the obtained information, the following research question has been formulated:

"How can runway peak pricing effectively contribute to the management of airport congestion in such a way that both airlines, airports, as well as passengers, benefit from it?"

Airport congestion cannot be viewed upon as an equivalent of road congestion that evolves on runways instead of roads. Even though early scientific literature often linked airport congestion with road congestion, researchers nowadays are aware of the significant differences between both forms of congestion. The role of atomistic and non-atomistic behavior by road users, in particular, and airlines respectively, emphasizes the difference.
As passenger traffic increases, and considering the limited action that is undertaken to increase airport capacity, it is expected that congestion levels will worsen in the next few decades. For the next 10-15 years, it is expected that passenger traffic will increase by 5 per cent per annum, while only few airports are able to expand their capacity by building new runways and terminals. Kelly (2001) demonstrates that airport and enroute delays cost the airlines in the United States five billion dollars every year. Daniel and Harback (2007) warn that estimates by the aviation industry show that delays will cost 154 billion dollars cumulatively over the next ten years, even with the FAA's current airport improvement plans. These examples clearly demonstrate the worrisome effects that airport congestion has, and possibly, will have on the US and on the global economy. In the next section, the theory concerning weight-based pricing and slot allocation will be presented.

Weight-based Pricing and Slot Allocation

It is relatively common that landing charges are based on aircraft weight, and that these charges are typically calculated per ton of the maximum take-off weight (MTOW). European airports, for example, are commonly following a weight-based pricing policy, except for a few airports that make use of peak-load pricing. Most of the airports only distinguish charges for daytime and nighttime periods in accordance with strict noise abatement policies. This weight-based pricing system is a remnant of the early years of aviation, when the industry relied on cross-subsidization for survival (Daniel, 2001). Originally, airports were privately-owned, and they charged flat fees per landing. However, during the 1930s, most large airports went bankrupt and fell into public ownership. The switch to weight-based landing fees was made between World War II and the 1960s. To promote the development of civil aviation, airports could not solely depend on landing fees as their source of financing. Airport financing primarily came from hangar rentals, parking garages, terminal leases and concessions. Landing fees paid for the costs, remaining after all other revenue sources, were fully exploited (Daniel, 2001).

Photo 1: *zachstern.com*

Slot Allocation

Flow managers in Europe deal with congestion by negotiating increases in capacity with ATC, by allocating slots to aircraft, and by horizontal or vertical re-routing (Leal de Matos and Powell, 2002). Stichting Airport Coordination Netherlands (SACN) gives the following definition of slot allocation:

"Independent slot allocation is an instrument developed to match demand for slots from the air carriers and general aviation to supply of airport capacity. As a result, by avoiding congestion and delays, implementing slot allocation brings economical as well as environmental benefits. In allocating, coordinating and monitoring slots in conformity with the relevant rules, SACN provides services to the aviation industry that contribute to make optimal use of scarce resources."

Slot allocation has its origins in arrangements made by the IATA, originally to facilitate interlining , but were subsequently used for the management of congestion (Bass, 2003).

The economical benefits of slot allocation can, among others, be found in the prevention of unnecessary delays. By preventing delays, valuable passenger time can be saved, and no extra costs for keeping the aircraft and its crew on the ground will be created. SACN claims that it contributes to the optimal use of scarce resources. However, it is doubtful whether the system of slot allocation is as effective and efficient as congestion pricing. The system of slot allocation is based on grandfathering rights, and determining the number of slots is basically a matter of guesswork, whereas congestion pricing generates the exact number of flights that is actually demanded. Therefore, the claim of SACN should be eventually viewed upon within the limits of slot allocation.

Slot allocation can be seen as the equivalent of ground delays. When capacity is limited, arriving aircraft subsequently cause delays (and thus costs) for other arriving aircraft. Therefore, the system of slot coordination was introduced. Flights that head to congested areas are usually issued a departure slot, which is mostly at a later time than initially scheduled. Slots can be found at airports, but also in air traffic control sectors or airspace junction points. The slot allocation is called a regulation. In comparison with the US, European flights often face several regulations. Most of the major European airports make use of slot coordination systems, but there are only a few major American airports that make use of this system as well. At other US airports, there is a so-called 'open entry' system.

Preferences conflicting with Capacity

Abeyratne (2000) argues that the preference for travel is one of the main contributing factors to airport congestion. This is also recognized by Barbot (2005) who states that flights would be more uniformly distributed over the day if passengers had no time preferences. As long as passengers all favor to travel at the same time, peak and off-peak periods will continue to exist. The easiest solution would be spreading flights over the entire day, but this is actually more complicated than it seems. In the current situation, the majority of passengers want to fly during peak hours, although passengers do not share the same value of time. This means that, during peak hours, aircraft are partly filled with passengers that have a low value of time. These passengers therefore indirectly add to congestion, but they are not willing to pay for it. Airline passengers can be roughly divided into three groups: business travelers, leisure travelers, and family/friends visitors. The first group of passengers has a substantially different price elasticity for ticket fares than the other two groups.

Different Business Models, Different Effects

The impact of congestion pricing on hub carriers as well as low-cost carriers seems to be substantial. According to Daniel (2001), hub carriers will have benefits from congestion pricing, but Barbot (2005), on the other hand, lists a number of negative consequences for them. The model of Barbot shows that, when the number of peak-hour flights decreases, congestion costs are lower, and more passengers will fly at off-peak hours. This is obviously a benefit to low-cost carriers, who have no intention

Photo 2: *Spencer Wilmot*

of flying during peak hours in a congestion pricing system, since they try to keep costs as low as possible. In contrary, Oum et al. (2005) indicate that an increase in airport charges is significantly more harmful to LCCs than to incumbent carriers. They argue that congestion pricing leads to higher fares and this hits the heart of the low-cost business. Many passengers that make use of LCCs choose to fly because ticket fares are so low. Once these fares increase substantially, chances are high that they will look for other ways to travel. The client base of incumbent carriers is expected to respond less vigorous on price increases.

The arguments of Oum et al. (2005) are not unfounded. Andy Harrison, CEO of easyJet, claimed that the introduction of an ecotax at Schiphol will seriously harm easyJet's passengers. The ecotax of approximately €25 means an increase of 40 per cent on the average ticket fare of easyJet. As a result, easyJet, the second largest airline at Schiphol, now threatens to move away from Schiphol. In theory, the same effect could also arise from congestion pricing. Corendon Airlines already moved some of its operations from the Netherlands to Germany recently, due to the ecotax.

Internalization

Brueckner (2002) shows that internalization plays an important role within airport congestion pricing. He argues that an airline should only pay for the congestion damage that it imposes on other airlines. This could mean, for example, that a dominant hub carrier only pays a relatively low congestion fee while a small airline would pay a substantially high congestion fee. In addition, Nombela et al. (2004) state that airlines causing delays early in the morning should pay a higher congestion fee than those causing the same amount of congestion during the afternoon or the evening. Zhang and Zhang (2006), on the other hand, claim that the internalization of congestion costs by the airlines would mean the loss of an important income source for the airport for its capacity investment. The airports are left behind with a position of financial deficiency if capacity investment is to be executed at the socially optimal scale. When carriers have market power, the solution will be disadvantageous for a public airport that wants to maximize social welfare anyway.

Who benefits from Congestion Pricing?

Findings of Adler et al. (2002), Brueckner (2002) and Barbot (2005) suggest the value of time will eventually determine the response of the passenger to runway peak pricing. In general, passengers consider peak hour flights as high-quality products and off-peak flights as low-quality products. It was not proven that business travelers will hardly respond to a congestion pricing policy, but it is likely that they will be the group of passengers that will fill up flights during peak hours in a congestion pricing policy.

The findings of this study lead to the conclusion that airport congestion pricing can effectively contribute to the management of airport congestion in that it generates the exact number of flights that is demanded during a day, in contrast to other pricing methods. Daniel (2001) indicated that congestion pricing improves welfare of most major players in civil aviation, so this would mean that airlines, airports and passengers all benefit from congestion pricing. However, it is also stated that airlines would experience negative effects from congestion pricing. Besides that, there seem to be different implications for different types of carriers as well. This makes it relatively hard to define who will eventually benefit the most from congestion pricing.

Results, Implications and Limitations of the Study

This research addressed managing airport congestion and the effects that peak pricing has in reducing airport congestion. With respect to the significance of airport congestion, the results of this research show that airport congestion is increasingly becoming an impediment to airport growth. Several factors play a role

in the evolvement of the congestion problems, e.g. capacity constraints, hub-and-spoke networks, environmental constraints, climate change, and community opposition. Besides this, there is obviously a growing number of people that choose to travel by air as a result of declining air fares. Despite all of this, the research results pointed out that, irrespectively of the imminent congestion problems, the major airports in Europe still do not make use of congestion pricing. Most of the airports only distinguish charges for daytime and nighttime periods in accordance with strict noise abatement policies.

Results show that congestion pricing can redistribute passengers to flights during off-peak hours. Kemppainen et al. (2007) even stimulate mid-size airlines to rearrange their timetables by moving flights from peak to off-peak hours. They state that mid-size airlines can save significant amounts of money by doing so, and that hub airlines will profit as well, because they can operate more efficiently due to the smaller number of flights during peak hours. Adler et al. (2002) think that congestion pricing can also lead to a modal shift, for example, from air to rail, if ticket fares suddenly increase. Passengers with a high price elasticity for airline tickets may be eager to switch to cheaper alternatives. However, modal shift to rail is likely to occur on a small scale only, since rail can only compete with short-haul flights.

The research results also show that airlines can influence airport congestion by means of aircraft size and flight frequency. Next to that, airlines add to congestion by making use of hub-and-spoke systems. Airports primarily influence congestion in the way they are designed. The airport layout plays an important role in the creation of congestion. Furthermore, residential communities in the vicinity of airports can seriously hinder their expansion. Finally, the findings show more constraining factors like environmental constraints and ATC restrictions.

Since there is no airport that makes use of congestion pricing yet, no real-life data could be used to determine its effects on the various parties involved. Hence, many of the assumptions that have been made in this research are based on models of other researchers. Furthermore, only airports in Europe and the United States were studied in the thesis research. Yet, airport congestion is a global problem, and, due to aviation standards and procedures, it is relatively likely that airport congestion will lead to the same results in Asia, for example.

Nonetheless, the above-mentioned limitations, this exploratory research can still be considered as a valuable basis for future research concerning airport congestion pricing. The fact that congestion pricing has not yet been implemented anywhere in the world clearly shows airport operators are suspicious to adopt this policy. Therefore, future research needs to investigate what the exact effects are for all parties involved with the operation of an airport congestion pricing. A distinction needs to be made in the analysis of the effects on several types of airlines. Besides, it is very important to keep an eye on the welfare effects as well. In order to get new insights in the congestion pricing effects, it could be very useful to develop a very large simulation model in which representatives of all parties involved are engaged. Finally, it can be interesting to spend some more energy in the study of alternatives for airport congestion pricing in case that it will not become a success.

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