

SETTING AIRPORT CHARGES AND THE WAY OF IMPLEMENTATION

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Abstract

It is a strong trend in road traffic to implement pricing methods because of heavy congestions. In the same way as in an other transport sector, airport capacity needs to be priced in the congested areas in order to ascertain its efficient use. The aim of this paper is to analyse the possibilities of applying marginal cost pricing models by evaluating the airport charges. I also focus on the possibilities to increase the efficiency of capacity allocation, but it also must be seen in a wider perspective, how to ensure that airport infrastructure capacity is efficiently provided and used.

In the first part I analyse the specific situation of airports, identify the factors, which determine the capacity of an airport. Then the currently used charging system will be presented and analysed. After this a theoretical approach will be presented; how to apply a new charging system based on marginal cost pricing. In the next chapter the purpose is to identify and assess the main barriers to the implementation of the new pricing principles and to recommend strategies to overcome these barriers.

The paper focuses one specific cost aspect, the marginal capacity cost for using existing capacity at major airports. I therefore disregard possible problems with respect to cost recovery of airports that have sufficient capacity during most of the day.

Keywords: air transport, airport, charging, externalities, pricing acceptability.

1. The Situation of Airport Infrastructure

1.1. Specialities of Airport Infrastructure and Costs

Airlines have developed hub-and-spoke networks, up until 1997, based on bilateral agreements between the countries. The European airlines can free develop their most favourable networks since liberalization and the introduction of cabotage rights. Major congestion is generated at hub airports and it is a direct result of demands. Travellers flying through a hub want to minimise layover time. Airlines therefore fly in within an hour or two and then fly out within an hour or two in two or three waves over a 24 hour period. Airport capacity must satisfy this peak demand and slot must be allocated to enable such network patterns. Without the ability to fly in waves, a more fully connected network will grow with inefficiencies and higher prices for passengers. A balance needs to be found, where sufficient infrastructure is available to minimise congestion and delays.

There are several types of difficulties on airports, which can give rise to economic inefficiency. The reasons are the following:

- Because the demand for airport services is in many cases lower than capacity, the airport is a natural monopoly for which the standard efficiency questions arise.
- The demand for airport services is not equal to the demand for transport between only two airports, but among different airports. That is because the size of some markets between airports is so small that the continuity assumption, which is typically employed in economic analysis is not relevant.
- The efficiency problems are increasing, because larger airports are often dominated by one airline.
- Larger airports are often congested, and the natural monopoly problem is also increasing, that makes the appropriate use of existing, and construction of new capacity more and more difficult. The services provided by an airport include four components: the passenger and the freight terminals – often separate buildings – the air traffic control system and the runways.

The infrastructure cost comprises two components, in order to satisfy the users' demand: to construct the necessary facilities and the cost for maintaining them and keeping them available for use by airlines. The average cost is the sum of these (appropriately discounted) components over the lifetime of the facility, which is divided by the total number of users over this period. Opposed to this, the marginal cost takes into account the cost generated by additional take-offs or landings.

Airports in many countries are operated by national or regional agencies or by airlines and prices are designed in order to maximise profits. Airport agencies are not responsible for the allocation of access to runways; this is in many cases the responsibility of the users. Airport congestion is relevant not only for the airport itself and for the efficiency in using its facilities; it is of equal importance for the functioning of the air transport industry at large. A proper way to deal with airport capacity is to improve the functioning of the entire air transport sector.

1.2. Determining Factors of Airport Capacity

The capacity of an airport is defined as the volume of passengers and cargo that can be accommodated within a given time period (e.g. an hour). This capacity is determined by the following components:

- runway capacity: the maximum number of take offs and landings that can be performed,
- terminal capacity: the number of passengers that can move about the terminal at an acceptable pace,
- apron capacity: the maximum number of aircraft per area that can be served,

- air traffic control capacity: the maximum number of aircraft approaching or departing the airport,
- gates: number of gates available.

All components are meant in a time period (hour) and in safe conditions. Increasing capacity mustn't influence safety in a negative way.

If capacity is insufficient to satisfy demand, or there is more demand per time unit than available capacity, then delays will be generated.

To describe the demand for airport capacity, two main types of classifications are needed:

- The traffic pattern at large (the origin-destination demand matrix of passengers), which also reflects the configuration of airline networks (e.g. hub-and-spoke, multi hub, alliances linked networks, linear networks).
- Daily and seasonal, peak and off-peak demand patterns.

2. The Aim and Measurement of Pricing

One of the most important issues regarding airport charges is: spending the revenues collected. Charging will be used to cover total cost, including long-run capital costs. The main question is how to set the charges so as to maximize the social welfare function of all users, including passengers, airlines transporting freight and passengers, airports, their owners and the general public, which means people living in the immediate vicinity of the airports. The objective is constrained by an airport break-even constraint, in which the airport is required to raise sufficient airside funds to cover its variable, fixed and infrastructure costs.

The evaluation of various resources to organise and handle airport activities is the same as the process for the allocation of scarce economic goods. The criteria are that airport capacity is a critical resource in the operation of an airline. The following standards can be used to evaluate the performance of alternative processes for capacity allocation:

- Equity: flight services to small companies are given due consideration by the allocation method.
- (Static) efficiency: the value delivered to the consumers from a resource base. Because the airport slot is a critical point in air service operations, the whole efficiency of the air transportation system depends almost directly on the efficiency of slot allocation.
- Carrier expansion and contraction: carriers with efficient marginal operations (relative to the marginal operations of other carriers) should expand within a given market. Because of critical slots, additional slots can be allocated to those carriers that have relatively high profit opportunities for additional slots. It makes the potential entrant possible since it is similar to an expanding firm. Because of this, the slots for expanding carriers should come from carriers

whose marginal operations are the least efficient, and therefore marginally unprofitable services, and less successful operators should be induced to exit from the business by the selected mechanism.

- **Coordination:** carriers have time limitations to make their operations. This means that benefits can be achieved by better coordination of carrier services. Any system in slot allocation process should promote such coordination of service and capacity use patterns.
- **System-level efficiency:** carrier operations at different airports depend on each other, because any flight must involve (at least) two airports. Systems of slot allocations operating at many different airports must identify themselves with the efficiency gains and reductions in the overall cost. This can result proper coordination among airports.
- **Monopoly and collusion:** slot allocation is one of the main factors in the competition. That is one reason why airlines tend to operate in collusion. In any market, controlling the slots can develop and enforce the non-competitive practices. Therefore, it must be dealt with the slot allocating processes very carefully in order to prevent these possibilities.
- **Long-run industry growth (dynamic efficiency):** the industry is not able to expand without additional capacity. In present, capacity expansion necessarily absorbs important resources. One measure of the need for capacity expansion is the value, which is created by additional slots. If these values, integrated over time, are greater than the cost of expansion, then capacity expansions are in order. The allocation procedure should be supportive to this end. If there are absolute barriers to capacity expansion, it is important to ascertain efficiency in the allocation of the slots.
- **Transaction costs:** the allocation procedure should be cheap to administer, including, that it is necessary to maximise the safety, etc.

3. The Currently Used Pricing System

3.1. *Elements and Aim of Current Pricing*

Direct airport users include airlines, passengers and cargo. The airlines are charged by the airports per landing (according to the maximum take-off weight of the aircraft) and per departing passengers, with a standard two-tariff: transfer and non-transfer charge.

The structure of the tariffs is mainly linked to the technical features of the aircraft such as weight, and the duration of infrastructure use. Landing and take-off charges are determined as follows:

- **Landing charges.** The charge applied to the aircraft is depending on the maximum take-off weight (a price per ton is fixed for the first 25 tons and a higher price for the following tons).

- Parking fees for aircraft on the apron. The charge is depending on the aircrafts' maximum take-off weight and is equal for internal and international flights.

The result is a price structure that does not reflect management and operating costs, and does not differentiate between peak and off peak times. The level of landing charges and parking charges increases for night flights in many cases. This results a further reduction in flying during less congested periods such as night (at those airports where night flying is permitted).

Airport activity related charges nowadays consist mainly of the following two services:

- Airport tariffs. These charges are in accordance with landing and take-off, aircraft parking, passenger boarding, freight loading and unloading, security and control for passengers and freight.
- Handling, which means administrative assistance and supervision, baggage assistance, freight and mail, runway operations assistance, cleaning and ramp services, fuel assistance, aircraft maintenance assistance, air operations and crew assistance, ground transport and catering.

Taking into account the social welfare, this pricing system is inefficient, because it ignores the most important externalities associated with airport use: congestion, environmental pollution and capacity usage. In most countries, airport charges are set by local or national government in order to guarantee sufficient income, which can cover *operational and capital costs*, without taking into account the welfare of airlines, passengers or the public at large.

The landing charges can also include other elements such as a noise and environmental charge (depending on the type of aircraft), a peak time slot (according to the flight take-off time) and apron facility charges. Additional charges per passenger include ground handling facilities and gates.

The airport handling services market is in most cases privatised, and specialized companies handle the baggage and cargo. The tariffs within this market are generally determined through contracts between the handling services operator and the customer, based on a multiplicity of factors: cost, market power and medium and long-term objectives of the operators. The tariffs are therefore unequal, and generally made for the specific customer.

If there exists a tax on aircraft noise emissions, it is normally added on top of the airlines' landing charges, and depends on noise emissions. So the airlines pay, and the airport operators collect these tax, and the latter ones transfer it directly to city, county or federal governments. The revenues have the following objects: to finance the reduction of noise emission from aircrafts, to complete and improve acoustic pollution monitoring systems, to reduce noise pollution and to pay compensation to residents living near the airport area. This charge already exists at many airports. Fees according to NO_x and CO_2 emissions are not yet included in any charges.

Non-aeronautical fees collected from concessions are about 40 and 60% of all airport revenues. The question is where to allocate this additional revenue? Should it be used to expand existing infrastructure or should airside operations alone be covered by it? If the government owns the airport, it is also a question what yield level could be acceptable with respect to airside operations and if airport profitability should include non-aeronautical income. If airport managers received bonuses based on revenue achieved, all aspects of airport revenue would be promoted. However, landside parties depend entirely on derived airside demand in general.

3.2. Impacts of Currently Used Pricing

Any charge for infrastructure use will have influences on total demand for capacity. Although they are only a part of the airlines' total cost, charges for using airport facilities have an impact on ticket prices for travellers and freight senders.

Airport pricing affects following main areas:

- passenger utility,
- airline profitability,
- mode of operation.

3.2.1. Passenger

The passenger pays the price of the ticket and pays directly or indirectly airport tax. Passengers are also influenced by the length of the travel time, which is a function of various airport processing times including air traffic control, runway, apron, security and terminal delays. Passengers cannot be seen as a homogeneous multitude (different income and value of time), that is because these effects may be non-uniform and can result inequalities (from potential, additional welfare and equity point of view).

3.2.2. Airlines

The airport pricing affects airlines' behaviour in many ways. Because of air traffic control and runway congestion, airlines may re-schedule their flights to less congested periods. This can affect the airline competitiveness, because some passengers may travel with other airlines or modes of transport. It also influences revenues due longer layovers and lower productivity. In long-term airlines they may change their networks, which results a different network pattern, and they cannot use various network economies directly resulting from the hub and spoke system.

Prices also have impact on the number of take-offs and landings at each airport, although price elasticity may be low, the higher the charge the lower the demand

is. Standard charges are not at a level that automatically clears the market on the major airports. These typically make clear, which periods of the day have more demand than available capacity. Airlines cannot get as many rights for take off or land – the number of slots – as they demand at existing price levels. The degree of this problem is different in every airport, but some big airports in Europe have more demand during the biggest part of the day than available.

4. Using New Methods for Pricing

4.1. Airport Costs

The airport must decide on the following key issues, according to the nature of the airport authority (privately vs. publicly owned) and to the factors mentioned above:

- the overall objective function,
- charging scheme,
- slot allocation scheme,
- capacity investment decisions.

From a social welfare viewpoint an airport should consider all factors when setting charges on the incoming and outgoing traffic. So the charge scheme should aim at maximizing social welfare, such that costs are covered and externalities internalized. Nowadays, as mentioned above, the charges cover only operational and capital costs, without taking into consideration the social welfare at large.

4.2. New Elements need to be Considered

The price determination mechanism is fundamentally different among the services. It is important to have uniform charging principles on Europe level in the long run, based on the following criteria:

- airport differentiation according to traffic dimension (size of market),
- correlation with the quality and quantity of the supplied services,
- differentiation within airports according to traffic intensity during a day,
- cost recovery considerations, including development and improvement,
- environmental protection goals.

In *Table 1* the main *externalities* are summarised which are caused by air transport and must be included in pricing.

Table 1. Externalities at airports

Externality	Driver
Operational: congestion and delays	Demand profile and volume Airport capacity Technological infrastructure Airport operational characteristics Airframe characteristics and operating conditions (e.g. head up display)
Safety: accidents, congestion, delays	Demand profile and volume Air traffic control behaviour Airport capacity Technological infrastructure Airframe operating conditions
Environmental: noise, air and water pollution	Demand profile and volume Population area and density Aircraft characteristics (e.g. noise) Traffic patterns Airport operational characteristics Technological infrastructure

4.3. Theoretical Background for New Methods

In this part an overview will be given about the economic solutions, which can be used for the new charging scheme. These models include the most important factors mentioned above (peak and off-peak, congestion, externalities and airport economics).

4.3.1. Peak and Off-Peak Time Pricing

First I assume a daily periodicity in demand with peak and off-peak intervals. The question is how should peak and off-peak demand be priced in order to cover the capital costs of an airport. The biggest part of these costs is the investment in capacity, which is primarily depending on peak demand. The solution can be the creation of a social welfare function, which includes five main elements: demand and operating costs in peak and off-peak periods and the cost of capital. Following assumptions are made in solving the problem:

- the objective is to maximize the social welfare function,

- operating costs at each period are equal (we do not have to pay special attention to this),
- the airport has two demand periods: peak and off-peak,
- airport capacity (which has the following important determining factors: runway, terminal, apron and parking) is in this model handled as a single restriction. Usually, the runway capacity is enough limitation and all other constraints are redundant,
- the demand and cost functions are shown in *Fig. 1*.

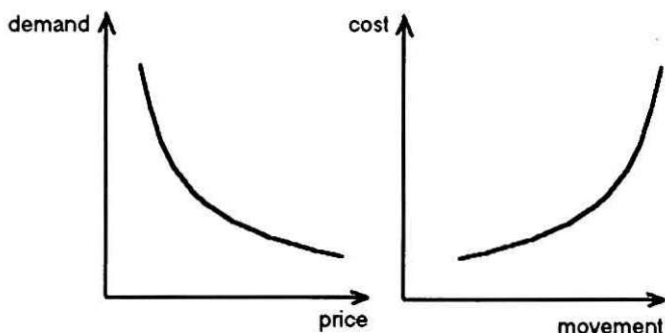


Fig. 1. The demand and the cost functions

The social welfare function, which has to be maximised, includes customer surplus in peak and off-peak time periods and the cost of capital (not so significant), which affects the capacity of the airport. Flights are limited by the capacity of the airport and the total costs must be less than or equal to total revenue. The results of this model suggest that, based on the peak and off-peak demand, it is possible for both periods to share the cost of capital.

4.3.2. Delay (Congestion) Pricing

A critical assumption in the previous model was, that the capacity at an airport is sufficient to satisfy peak period demand. In reality, this is rarely the case, mostly on hub airports, because of the following reasons:

- As many slots are allocated as are equal to capacity. Random disturbances can result delays (or early arrive) of aircrafts; that can also be because of overestimating the capacity. Of course, this can be expressed in delay or disturbance cost.
- The total number of slots is insufficient to satisfy all demand.

The result is traffic delays, which will generate congestion externalities if unpriced.

4.3.3. Externalities

There is a gap between the cost to users (airlines) of utilizing the airport and marginal social costs because of externalities (congestion, environmental), which are a part of the costs imposed on others, e.g. residents near to the airport. Airport charges should also regard these kinds of market failure effects, in a way similar to that of congestion.

4.4. Aim of the New Mechanism

The proposed pricing measures aim to correct inefficiencies including:

- Peak and off-peak charges, needed because of airline network choice. The objective is to ensure efficient use of current capacity.
- Congestion charges, needed because of limited runway capacity: Demand can exceed available capacity, which generates congestion and delay. This delay may not be internalised in its entirety by all airlines. Airlines at hub airports internalise their own congestion costs, which suggests that such charges would be relatively low. However, congestion can be very high at hub airports.
- Noise charges, part of the environmental externalities. If it is not covered, a social cost will result, which exceeds users' cost.

Other externalities (air pollution, accidents, ground traffic congestion) are not considered within this short-term pricing mechanism.

5. Steps of Implementation

One of the important elements concerning to the implementation of the new pricing is: ensure that the schemes are implemented at all airports in Europe. Some airports have already begun to implement peak and night charges, but these additional charges are very low. Meanwhile others are cheaper over night, and the third group is shut down entirely over night. No airport in Europe has any congestion or delay charges implemented yet.

In the short-term, implementation should include peak/off-peak, congestion and noise charges, at all main hub airports. In the medium and long term should be a harmonisation amongst all airports. Small (regional, spoke) airports may not be priced and this could encourage traffic to use secondary airports. Open market mechanisms can encourage higher prices and therefore moving profits from airlines to airports. Meanwhile it is important to ensure for new entrants the availability and use of slots.

The most serious political barriers to implementation are caused by hub based flag carriers and airports, which have monopoly powers. According to the EU

liberalization and 'open sky' policy, airlines and airports should be privatised. This can encourage market mechanisms to solve the pricing problem and can guarantee to prevent monopoly power. Some airports could remain government-owned and regulated, but in this case it is important to regulate airside and landside revenues together. A profit maximizing monopolist, when controlling airside operations and concessions, too, will:

- reduce the price of operations in order to increase travel through the airport,
- increase revenues from concession profits.

6. Barriers of Implementation

The most important barriers of implementation of the new pricing scheme will be discussed in this section. The barriers have three main categories: institutional, acceptability and technological.

6.1. Institutional

The biggest barrier today is the lack of transparency, which is because making suggestions for appropriate tariff setting is very difficult. It is very difficult to find the formula, on which setting airport charges is based. In fact it may be true that no formulas are used to set charges; only simple accounting rules are based on: last year's tariffs, the level of inflation (price increase must be at least equal to this), the competitors' levels (other airports around Europe).

The first institutional and legal requirement in order to begin the policy of new pricing mechanism is to clearly specify the current formulas (which are often set by local or state government). Understanding and publishing these methods will help to:

- reduce lobby power that always prefers the status quo,
- improve acceptability of the entire scheme among politicians and the public.

A second barrier is the lack of harmonization between the countries in the EU. A pricing formula must be developed at EU level, which all countries agree. This formula must ensure minimum differences among airports. The charge level can be different in the countries but the evaluating methods should be similar. It is important, because all externalities must be internalised and not simply passed from one country or region to another. This method must have an appropriate administrative background like EUROCONTROL. This body could ensure that if there is a change in tariffs because of peak demand, the airports are able to respond. Of course e.g. use of newer aircraft with lower noise level should be promoted through appropriate tariffs.

6.2. *Acceptability*

The most airports in Europe are also not yet privatised and hub airports behave like monopolists. If the aim is to maximize social welfare, the results of the methods are different from the current situation. Another issue is the lobby power on the directly interested parties' and the political organizations' side, so it will not be simple to change the pricing mechanisms. Only the implementation in stages can be manageable and several paths are available, as discussed above.

6.2.1. *Airlines*

An important factor is, that airlines push towards monopoly using hub airport market power. The aim of the airline is profitability through aggregation of demand, which causes lower costs. This ensures lower airfares in the long run. Airlines must be allowed to develop hub-spoke networks, therefore it is difficult to achieve a balance through regulations but it must be done. One solution can be to allow lower airport charges for new entrants and limit the maximum airline profits. It must be decided, if international carriers should pay the same price as smaller (regional) airlines. It is not clear, if such different charges break EU and state law.

6.2.2. *Airports*

Another important barrier of introduction marginal cost pricing is generated by the airports. The two main reasons are the following:

- they do not want to annoy and risk of loosing their customers (airlines),
- it is difficult to collect the needed additional data for evaluating tariffs.

Because of this, there is a need to make new local and state governmental legislation in order to implement the new pricing method. Some legislation has already been made, but not in all countries and it does not give an overall solution.

6.2.3. *Passengers*

The last question according to acceptability is: should passengers be charged directly for supplied services? This is already the case in some airports and in some countries taxes are set in addition to the airfare paid. Airlines can also be charged for all relevant costs. Some of these costs will be rolled over to the travelling public, but presumably not the entire sum, because this would be dependent on demand functions.

6.3. Technological

There are already some charges in the air transport industry today; important data are also collected. The delay data is very difficult to analyse and scarcity is not considered at all. Of course research-based improvements in technology can improve the computation of scarcity and delay on an on-line basis. That is because technology cannot be a significant barrier to implementation.

6.4. Summary of Barriers

Expansion of airport infrastructure (e.g. building of additional runways and terminals) generates political, acceptability and legal problems, which need to be overcome. The political problems lie in land use and environmental issues.

The constraints according to the barriers are presented in *Table 2*.

Table 2. The constraints and needed measure according to the barriers of implementation

Measure	Short term	Medium term	Long term
Traffic level (below marginal cost) at small airports	Limited	Smooth limits	No restriction
Change current tariff	Limited	Smooth limits	No restriction
Price discrimination	Allow price discrimination (different tariffs) between international and smaller, regional airlines, if not illegal		
Tariff level	Tariffs equal to or less than marginal cost at large hub airports		
Offer tariff reduction	To airlines, which invest in technology to improve capacity usage		
Tariff structure	Allow two tariffs (peak and off-peak), introduce continually changing charges (based on delay data)		
Slot charges	Research to analyse the market mechanism	Apply to large, hub airports to reflect allocation scarcity	Apply slot charges to all airports
Charge to cover research and IT costs for data collection issues	Add additional charge	Add additional charge	
Limit size of changes	Limitation, until all airports in Europe are using the new pricing principles		
Budget constraint	Airports mustn't be subsidized over a pre-specified level		

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