Price Regulation and the Choice of Price Structures at Busy Airports

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Abstract

The link between regulation and efficient price structures has been recognised in general, though it has been little analysed in the context of busy airports. When demand for an airport's services exceeds its capacity, an allocation problem develops. This may be resolved inefficiently, through congestion, or more efficiently through slot allocation mechanisms or auctions. Slot allocation issues are discussed extensively- while they are very important, the equally important issue of price structures has been relatively ignored. Many countries are privatising their airports, and subjecting them to regulation. However, the issue of how regulation will affect the allocation of capacity is rarely explored. Price regulation constrains the overall levels of prices an airport may charge. Thus, it may not be feasible to rely entirely on prices to ration capacity efficiently. However, the structure of prices will impact on capacity allocation; for example, structures which include higher prices at peaks may perform more efficiently than others. Likewise, when runway capacity is at a premium, uniform prices for all flights at a point of time will be preferable to differential prices for large and small aircraft. The form of the regulation imposed, for example, whether it is cost plus regulation or price-cap regulation, will critically influence the incentives faced by the airport to adopt efficient price structures. Furthermore, the detailed nature of regulation, for example whether a price-cap is expressed in terms of average revenues or a tariff basket, will also affect these incentives. The implications of different regulatory forms will be explored in this paper. Conclusions will be drawn as to which forms of regulation create incentives for airports to implement efficient price structures and which do not. The existing price structures of busy price regulated airports will be discussed in the light of this analysis.

Key Words

Airport slot allocation
Peak pricing
Price cap regulation
Capacity rationing
Allocative efficiency
Average revenue price caps

1. Introduction

These days, traffic at most busy airports outside the US is rationed by slot allocation systems. When demand at airports exceeds capacity, congestion builds up, and this is a very expensive means of rationing capacity. Slot rationing systems have the effect of minimising unnecessary congestion.

The problem with most slot allocation systems is that they are arbitrary, and thus there is no guarantee that the scarce slots will be allocated to those who have the highest willingness to pay for them. As a result of this, there has been a booming literature on slot allocation (see Boyfield, Ed, 2003). In particular the theoretical and practical merits of slot allocations have been given a lot of attention, and the development of secondary markets in slots has also been analysed. While the progress in terms of improving actual slot allocation systems seems to have been slow, at least the issues and options have been canvassed widely.

The working of slot markets constitute an important *half* of the overall slot allocation story. But it is only half of it. The other half of the story, the structure of airport charges, has received very little attention. This half of the story is of potentially equal importance. No matter how efficiently the slot market performs, if the airport price structure is inefficient, the ultimate allocation of the slots will be inefficient. Typically, airport pricing structures at slot constrained airports are inefficient, and encourage the use by flights with relatively low willingness to pay, even when the slot markets are working well.

In this paper, we examine the structure of efficient prices in busy slot constrained airports. Slot mechanisms may perform the primary rationing function of constraining demand to available capacity, but pricing has a critical role in determining who gets the slots. Another important role of pricing can be to allocate between peaks (when demand presses up against capacity) and off peaks (when capacity is adequate) at those airports in which demand is not in excess of capacity all the time.

Thus one central objective of this paper is to outline which price structures will promote efficient allocation of capacity in busy airports. Slot markets are critical, but pricing structures are probably equally so, and in some cases, they are more so. A related objective is to examine how peak and off peak charges can be set optimally.

Many airports these days are either fully or partly privately owned, but subjected to price regulation. The second central objective is to examine what incentives to price efficiently are present when airports are price regulated. It is well understood that some regulatory structures create incentives for efficient pricing, while others do not. The performance of regulatory structures depends on the context. We find that average revenue price caps, which perform poorly in other contexts, can perform tolerably well in the airport situation. However, there is still more work to be done on the design of price caps to promote efficient pricing of airports.

In this paper, we confine ourselves to the short run. The long run issues of optimising investment and price structures over time are complicated, and price regulation opens up a Pandora's box of additional complexities. Solving the short run optimisation problem is a precondition for addressing long run optimisation.

We commence with a brief background to the airport pricing problem. In the next section, we outline the characteristics of efficient price structures in a number of cases, and review the literature on regulation and incentives for efficient pricing. In section 4 we put these elements together, and explore how different forms of regulations perform in terms of encouraging airports to price efficiently. We then discuss these results in the light of actual airport pricing structures, and suggest why these structures remain inappropriate for the capacity allocation task. We also note the limitations of the results so far, and point directions for further work. Some concluding remarks are made in the final section.

2. Background

The problem of excess demand at airports is one which had extensive analysis, at both the theoretical and practical level, over the last three decades. Airports typically have fairly fixed runway capacity, and when the number of movements attempting to use the airport exceed this capacity, congestion in the form of delays mounts up. These delays are a costly form of capacity rationing. One option would be to use the price mechanism, and to raise prices such that they effectively limit demand to capacity. For an airport which experiences excess demand for only part of the day, peak pricing would be a feasible option, and it is unlikely to make a major difference to the charges levied by the airport. For very busy airports, there is a reluctance to rely exclusively on pricing options, possibly because these would result in very high average prices in relation to airport costs.

As a consequence, much of the burden of restraining demand to capacity in actual airport systems falls on slot allocation mechanisms. A capacity limit for the airport is declared, and a slot coordination committee allocates slots to airlines (Bass, 2003). As long as the capacity allocated is efficiently chosen, congestion will be reduced to a minimal level, though it will not be eliminated entirely. The problem then is how these slots should be allocated- typically, this is done by "grandfathering", whereby slots are allocated to airlines in proportion to their use of the airport in previous periods.

This option gives rise to several possible inefficiencies. There is no guarantee that slots will be allocated to those airlines which are willing to pay most for them. Individual airlines which account for a large proportion of demand at a busy airport, such as British Airways at London Heathrow or Lufthansa at Frankfurt, do have an incentive to allocate their own slots efficiently, however. Grandfathering of slots makes it difficult for new airlines to operate from busy airports as there is no established way they can obtain slots (Humphreys, 2003). Thus slot allocation mechanisms may do a good job of lessening congestion, but a poor job of allocating capacity to the users with the highest willingness to pay.

Not surprisingly, much attention has been given to improving slot allocation. One option would be to have a slot auction, whereby airlines which wished to use the airport would have to bid for slots at an auction. While auctions for telecommunications spectra are now commonplace, auctions for airport slots are not. Another option is to form a secondary market for slots- even if the initial allocation of slots were inefficient, trading would ensure that slots went to the airlines which have

the highest willingness to pay for them. Currently, there are difficulties in trading slots, especially in Europe, though slot trades do take place (Starkie, 2003). The slot market may not work perfectly, and there are some concerns that large incumbent airlines may be able to manipulate secondary slot markets to maintain their dominance. Nevertheless, a greater reliance on slot auctions and trading is likely to result in an improved allocation of slots.

This reliance on slots as the main demand rationing mechanism has resulted in less attention being paid to airport pricing structures, since these are not being called upon to serve the primary rationing function. In spite of this, just as slot allocation is an important efficiency issue, so too is the structure of prices, since this will also affect who gets the slots. Busy airports have not been noted for paying much attention to getting their price structures right.

This could well be because they have not had much incentive to do so. Most airports have, until recently, been owned by central or local governments. Publicly owned airports may set various objectives, but efficiency is not often the dominant objective. They may well face an incentive to maximise size, and increase capacity- if so they are not likely to be interested in improving the efficiency of the use of existing capacity, by improving the price structure or facilitating slot trading.

The institutional structure of airports is now changing in many countries. Airports are being either fully or partly privatised- this is likely to give them a stronger interest in profit. To counter act the use of market power, privatised airports are usually subjected to price regulation (Forsyth et al, Eds, 2003). Thus there is the possibility that airports, if efficiently regulated, will have an incentive to price their services efficiently. Much will depend on the form of regulation; for example, it is well recognised that rate of return regulation, to which some airports are subjected, creates the incentive to implement inefficient price structures and to encourage excessive investment in capacity (Sherman,1989). Alternative forms of regulation, such as price caps, have been designed to get around the problems of rate of return regulation, and it has been shown that, under certain circumstances, profit maximising firms will face an incentive to adopt efficient price structures (Armstrong, Cowan and Vickers, 1994). These results are not very general, and much depends on the precise form of the regulation- similar forms can yield quite different results. Furthermore, most or all of the discussion of regulation and incentives for efficient pricing supposes that capacity is unconstrained. Thus we pose the question of whether it is possible to design regulatory rules which induce profit maximising airports with scarce capacity to adopt efficient price structures.

3. Efficient Pricing and Regulation

We proceed by looking firstly at what efficient pricing might consist of in the context of busy airports. We then look at the literature on price regulation and pricing, to distil what results there are on the form of price regulation and choice of price structure. Then thsee two elements are put together, and we ask whether an efficient airport pricing structure can come about for a private regulated airport.

Efficient Pricing of Busy Airports

It will be assumed that an airport faces a fixed runway capacity, limiting the number of movements in total. For simplicity, in much of the discussion, it will be assumed that there is a zero marginal cost of using the runways. There may be a positive marginal cost associated with the handling of passengers, though there will be assumed to be no fixed limit on passenger throughput. Typically there will be large sunk costs associated with the provision of the airport, and large fixed costs of operation. We confine ourselves to the case of no uncertainty or shifting peaks.

Where slots are used, it is assumed that they are traded efficiently. In some actual cases, this assumption may be met approximately. For example, when a large carrier uses a high proportion of the slots at an airport, it has an incentive to at least allocate its own slots amongst its own flights efficiently. Alternatively, it may be that there are several inefficiencies with the slot market as it operates at an airport, but there are not systematic patterns in these inefficiencies. If so, efficient pricing of the airport should lead to an improved, though not perfect, allocation of slots. Where there is a systematic inefficiency in slot allocation (eg small aircraft as systematically preferred) it might be possible to take this into account in the design of the price structure, and implement a second best structure. While this is feasible in principle, it would often be easier to reform the slot allocation rules in the first place.

Airports with adequate capacity

The most efficient pricing for such an airport would involve a zero price for movements, along with a price per passenger set at marginal cost. This first best pricing will not cover costs however, and a cost recovery constraint may be imposed. If so, a Ramsey pricing structure would be called for. The widely implemented system of weight based charges, or charges for movements based on passenger numbers which many airports are adopting, would be a rough approximation to Ramsey pricing (Morrison, 1982).

Airports with modest peaks

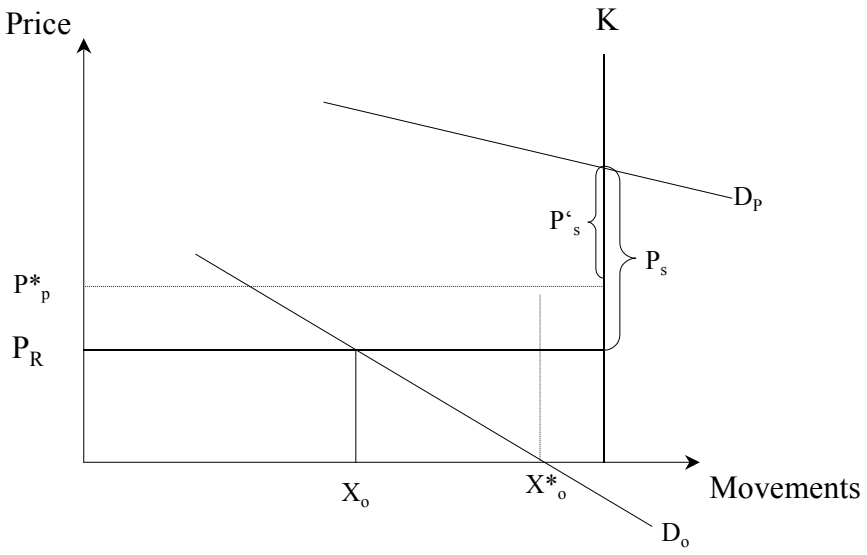
Some airports face excess demand for a small part of the day. If there is no cost recovery problem, and efficient pricing structure would be a uniform price for all movements at the peak which just restricts demand to available capacity, plus a passenger charge which equals marginal cost. Such a price structure may yield revenues to cover cost. If it does not, and cost recovery is a requirement, then an overlay of Ramsey prices will be needed.

Airports with peaks and price regulation

It is possible that peak pricing with even modest levels of excess demand will lead to total revenues being above costs, and the airport may be required by the regulator to keep prices no higher than costs. If so, prices cannot be the sole capacity rationing device. Prices can be combined with a slot allocation system. An efficient constrained price structure would involve a charge at marginal cost for passengers, a zero charge for movements at the off peak, and a uniform charge for all movements at the peak, set at the maximum allowable level. A uniform airport charge would mean that, when

combined with the slot price, all movements with the same passenger numbers would face the same price, and runway capacity would be allocated efficiently.

Fig. 1: Moderately Busy Peak

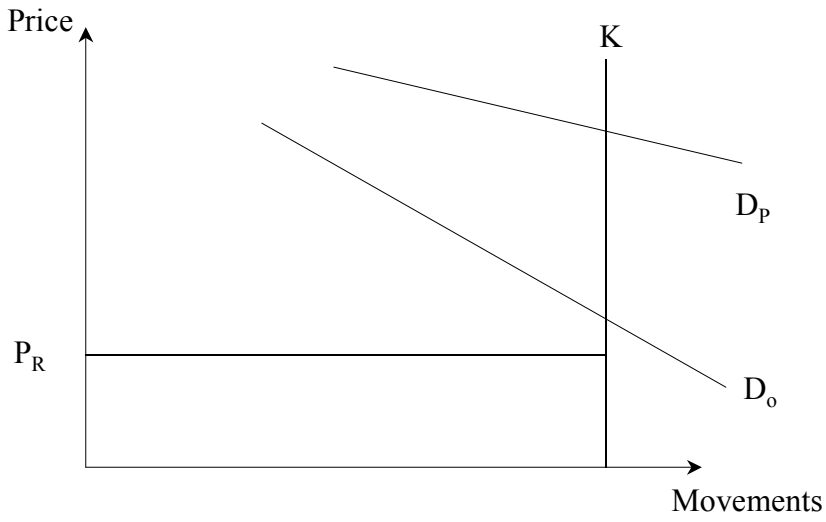


This is shown in Fig 1. The airport operates with fixed capacity of K. The peak demand is shown as D_p and the off peak demand is shown as Do. Capacity in the peak is insufficient to cater for all demand unless the price is very high. If there is a price cap of P_R per movement, prices cannot ration demand at the peak and slot rationing must be used. If there is a uniform peak and off peak price, output at the off peak will be X_o and at the peak will be K. The price of slot will be P_s. However if the off peak price is lowered to zero, and the peak price is raised to P^*_p, the highest consistent with the price cap, output in the peak will be unchanged, though the price of slot will fall to P'_s. The output in the off peak will rise to X^*_o. The airport will gain more revenue and profit. Allocative efficiency will be maximised.

Very busy airports

Some airports face excess demand for all the day, and prices would be insufficient to ration demand if they are regulated. Peak pricing becomes irrelevant, because all of the rationing function is served by the slot allocation system. The airport should impose a passenger charge equal to the marginal cost of handling passengers, and a movement charge which is as high can be within the price constraint. Again, the movement charge should be the same for all movements, or otherwise the slots will be allocated to users with a lower willingness to pay than others.

Fig. 2: Very Busy Airport



This case is illustrated in Fig 2. In this case it is evident that the price cap is set at a level which precludes prices being used to ration demand even at the off peak (though it may be feasible to use prices only to restrict off peak demand to capacity if peak prices are kept very low- though there is no point in doing so). Slots carry all of the allocative burden, and prices are irrelevant. For a busy airport such as London Heathrow, there may be little advantage in differentiating peak and off peak prices, since prices are not needed for the rationing function.

Efficiency issues at constrained airports

There are essentially two efficiency issues that it would be desirable for the price structure to address. These are:

a. The peak/ off peak pricing issue. In the capacity constrained airport with slot allocation, the important aspect is that the off peak price be set at marginal cost (in this case, zero). With slot allocation, peak prices do not have any allocative function. It is desirable that peak prices be set at a level, subject to the regulatory constraint, that enables off peak prices to be set at the efficient level- off peak prices do have an allocative role.

b. The allocation of slots amongst different users. It is desirable that the slots go to those who have the highest willingness to pay. This will only happen if passenger charges are set at marginal cost and there is a uniform movement charge, which when added to the price of a slot, results in a uniform all up cost of using a slot.

Regulation and Pricing

Perhaps the primary objective of the new forms of incentive regulation, such as price caps, was to give the regulated firm an incentive to minimise cost. Older forms of regulation, such as rate of return regulation, performed poorly in this respect because they were essentially cost plus form of regulation- a firm which allowed its costs to rise was permitted to increase its prices. By setting prices in advance, independent of the firm's own costs, the firm was given an incentive to minimise its costs, since any saving would increase its profit.

It was later noted that price caps could also could have desirable property of inducing the firm to adopt an efficient price structure. Certain types of price caps would induce the firm to implement Ramsey prices (Bradley and Price, 1988). Not all forms of price caps have the same effect, however. If the price cap is implemented with a price basket approach, i.e. one on which the firm is constrained to keep an index of its prices, with initially set weights, no higher than the prescribed level, it will move towards Ramsey pricing (Armstrong, Cowan and Vickers, 1994). However, even quite similar price caps need not have the same property. For example, if an average revenue price cap is set, whereby the average revenue (total revenue divided by an indicator of total output) is required to be kept no higher than a pre set level, the resulting price structure will not be a Ramsey one. In certain contexts, suitably designed price caps will induce the firm to implement peak pricing (Brunekreeft, 2000).

With rate of return regulation, the price structure may be specified by the regulator. Even it is not and the firm has the freedom to implement the price structure of its choice, it does not face any incentive to adopt an efficient structure, since all price structures yield it the same profit.

In some countries such as the UK, there is now a moderately long history of price cap regulation in a number of industries including airports, though it must be noted that this regulation is rarely pure price cap regulation (cost considerations affect allowable prices when caps are reset). Guiletti and Waddams Price (2000) have examined how price capped firms have adjusted their price structures, and find some evidence of adjustments, though the evidence is mixed. The regulated airport company, BAA, was one of the firms which adjusted its price structures.

It is important to note that this literature has concentrated on the cases where capacity is adequate, and there is no problem in expanding the output of all of the firm's products. It would be very relevant to the case of an airport which faces no excess demand, and for which the second best, cost recovery price structure is a Ramsey structure. This cause has been considered briefly by the UK Civil Aviation Authority (CAA, 2001). It may not be directly relevant where output is constrained for some or all of the day, as at busy airports. It is also not likely to be directly relevant to the case where prices do not perform the rationing function, at least for part of the day, and an additional mechanism, slot allocation, is used for this purpose.

This poses the central questions of the paper. Is it possible for price regulation to be implemented in a way which gives busy airports an incentive to adopt efficient price

structures? Secondly, if it is, which precise forms of regulation will work best in this regard?

4. Regulation and Incentives for Efficient Pricing

In this section we consider whether price regulation can be designed to give busy airports incentives to implement efficient price structures. The first case considered is that of peak pricing at airports which are busy for part of the day. The second case is where the airport is very busy all of the day. Both these cases involve homogeneous flights. In the next case we consider the situation where flights differ- there are large and small aircraft, and it is possible to price these differently. Finally, the case in which there are positive marginal costs of passenger handling is examined.

Peak Pricing in Moderately Busy Airports with Homogeneous Movements

An efficient price structure in this case is one which sets the price for off peak movements at marginal cost. This will be assumed to be zero, though this assumption can easily be changed. The peak price does not matter for allocative purposes. A higher airport charge for use at the peak will mean that the value of a slot will be lower, however the all up cost of using the airport at the peak will be the same. The price set for the off peak does have an allocative function, since higher prices discourage usage. Thus it is efficient to set this price at marginal cost (assumed to be zero here).

If the airport is subject to an average revenue price cap on movements it will have an incentive to maximise the total number of movements- it can achieve this by setting the off peak price at zero (see Fig 1). Indeed, the airport will have an incentive to set the price at even less than zero, since additional movements encouraged to use the airport will enable it to gain more revenue, which, up to a point, will be above the cost of attracting off peak movements. The regulator may need to specify that the airport is not permitted to charge prices less than zero. Much the same analysis will apply when the price cap is specified in terms of average revenues per passenger- more movements bring additional passengers, and there is an incentive to maximise the total passengers.

When there is a zero marginal cost of passengers, this regulatory rule will work well. However, when there is a positive marginal cost of passengers, the airport will face an incentive to set prices for off peak movements at less than the overall marginal cost, including the marginal cost of the additional passengers the aircraft movements bring. The loss incurred on the off peak movements can be loaded on to the peak movements, within the price cap. There is no incentive to do this at the peak since the number of movements and passengers is fixed.

Regulation with a price cap basket will produce similar results. Here the prices that enter the basket will be those of peak and off peak movements. By lowering the off peak price, additional revenue can be gained, through increasing the total number of movements (or passengers) and thereby increasing the allowable revenue.

Under rate of return regulation, there is no incentive for the airport to implement peak pricing. Given that revenue is fixed in relation to total costs, and costs are fixed, the airport gains nothing through encouraging better utilisation of its facilities through off peak pricing (this also applies in other situations where price structures are an issue, for example with differentiated movements). Where there is a positive marginal cost of passengers, and the airport is allowed to recover the cost of these, it may have a slight incentive to increase movement numbers if the price it is allowed to charge is above the marginal cost of the movement.

Low off peak prices can have a moderately significant allocative effect. If the demand to use the airport is inelastic for all of the day, the allocative effect would not be large. There might be some switching from peak to off peak, but this is stimulated primarily by the non availability of capacity at the peak. Where low off peak pricing might make a difference is where there are some users with elastic demand. These could include regional airlines, and nowadays, low cost airlines. Currently, low cost airlines are moving to secondary airports, which are less convenient, because these are offering them lower prices than the metropolitan airports. If the metropolitan airports were to offer low charges at the off peak, these airlines might be willing to use them.

Overall, price regulation through price caps will give airports an incentive to implement peak pricing, and to ensure that off peak charges are relatively low. The problem which could well emerge is that the average revenue caps form of price caps will give the airport incentives to offer off peak prices which are too low, especially if there is a positive marginal cost associated with movements or the passengers they bring.

Very Busy Airports with Homogeneous Movements

With very busy airports, there may be something of a peak and an off peak, but peak pricing becomes irrelevant. This is because there will be excess demand even at the off peak, and it will be necessary to rely on slot allocation all of the time. There is no point in encouraging off peak use because there is insufficient capacity. The airport has no scope to increase revenue through its pricing. Price regulation will not induce a move to any particular structure of prices.

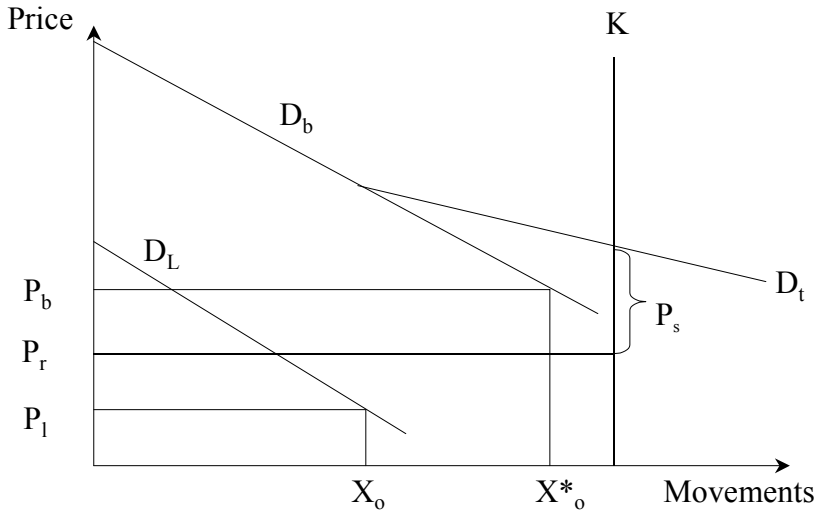
Busy Airports with Differentiated Movements

Most airports face a range of sizes of movements using their facilities. Traditionally, airport charges have been weight based, though many airports are moving towards purely passenger based charging. Both these structures result in smaller aircraft paying less than larger aircraft. When the airport is not busy, and there is a problem of cost recovery, these structures make sense. However, when the airport is facing excess demand, they cease to do so. Airports may face excess demand part of the day, or the whole of the day in the case of very busy airports. The discussion here applies to both types of airport.

The important requirement for efficiency is that the charge for using the airport at a particular period be the same for all users, regardless of size or passenger load. The relevant constraint is that of runway capacity, and this will be allocated most efficiently when all users face the same price. Assuming that slots are

undifferentiated, the price for a slot will be the same for all movements, and to ensure a uniform total price, the airport charge will have to be the same.

Fig. 3: Pricing with Differentiated Users



This is shown in Fig 3. The demand curve of large movements is shown as D_b, and the demand of small movements as D_l. The demand curve for all movements is shown as the lateral summation of these, D_t. If a uniform price for movements, P_R is set, where this level is determined by the regulator's price cap, there will be excess demand to be rationed by slots. Here the slot price will be Ps, and the total price per movement will be given by P_r+P_s. It would be possible, within the price cap, to have differentiated prices. For example, a price P_l could be charged to small movements and a price P_b to large movements (subject to the average of these being no higher than P. There will still be excess demand and the price of a slot may change slightly to P's (not shown). The total price for a small movement to use the airport will now be $P_l+P'_s$, and this will be below the price for a large movement, $P_b+P'_s$. This will be an inefficient outcome, because the willingness to pay to use the airport of a marginal small movement will be below that of a marginal large movement. Efficiency will be maximised when all movements are charged the same price.

Suppose that a busy airport is facing a range of sizes of movement, and that it is subject to price cap regulation. Suppose further that this takes the form of average revenue cap, with the average revenue per flight being specified. Will this regulation give the airport an incentive to charge uniform prices during the excess demand periods?

The answer is no, because the structure of charges cannot alter the revenue received by the airport. This revenue is determined by the total number of movements, and this amount is fixed by capacity. The airport could encourage more large movements at the expense of small movements, but it will gain nothing from this, since its total revenue will be unchanged.

Alternatively, suppose that there is a cap on average revenue per passenger (a structure often adopted, for example at London Heathrow). If this is the regulation it faces, the airport has an incentive to increase passenger throughput where it can, as this will increase total revenue. If it is faced with a choice between charge structures which are weight or passenger based, or a uniform charge structure, then it will opt for the latter. Such a charge discourages smaller aircraft with fewer passengers. In this case, an average revenue based cap has desirable efficiency properties.

It should be noted that the incentive this cap gives is to maximise passenger throughput, not welfare per se. With a restricted choice of pricing instruments, it will opt for a pricing structure will have this effect. If the airport were able to adopt more sophisticated pricing structures, it could move away from efficient uniform pricing. Some small movements may have a high willingness to pay, (perhaps flights on business traveller oriented routes), even though they may not have large passenger loads. Even though it is efficient for them to use the airport, at the expense of a larger movements with a lower willingness to pay (e.g. Charter flights), the airport will prefer to serve the larger than the smaller movement since it can gain higher total revenue from it. An airport will thus have an incentive to develop a charging structure which discriminates against the smaller movement (eg by offering a schedule which gives a rebate according to the number of passengers). This response is feasible, though it is probably not much of a concern.

Regulation with Passenger Costs

It is quite likely that there will be positive marginal costs of serving passengers- indeed it is quite possible that passenger related costs may be of a similar order of magnitude to movement related costs. If this is so, the efficient price structure will be one of a uniform charge per movement plus a uniform charge per passenger. Again, the question arises as to what incentives price regulation will create.

If a price cap on average revenue per passenger is imposed, it is in the interest of the airport to encourage passenger throughput. As long as the average revenue per passenger permitted exceeds the marginal cost of a passenger, the airport gains extra profit from serving additional passengers. This is very likely to be the case since the allowable average revenue would normally be sufficient to enable recovery of all costs, not just passenger related costs.

The problem is that this will give the airport an excessive incentive to increase passengers. It will be in its interest to set a per passenger charge less than the marginal cost of the passenger, and it will recoup the loss of revenue by increasing the per movement charge. It will thus set up incentives which are stronger than optimal to switch to movements with large passenger loads. An airport might, for example, rely solely on per movement charges, even when the marginal cost of passengers is significant. Smaller movements with a high willingness to pay would be discouraged in favour of large movements with a low willingness to pay.

5. Perspectives

Up to now only a minority of busy airports have adopted peak pricing or uniform movement charges (Hague Consulting Group, 2000). This is in striking contrast to other public utility industries such as the energy sector and, in particular, to the airline industry which use sophisticated pricing mechanisms to balance fluctuating demand with supply.

In this paper we focus on the regulatory framework and its incentives for airports to adopt efficient pricing. Our analysis shows

- Cost plus regulated airport have no incentive for peak pricing as charges are cost related and profits cannot be raised by differentiating charges. From the long term perspective, there are substantial incentives to price peaks to low in order to expand capacity and become more capital intensive.
- Price cap regulation can set incentives for peak pricing and uniform charges as revenue and profits can be increased by such pricing regimes.

However, in the real world the expected results might not emerge for various reasons. Further research is needed to analyse why the airport industry is so slow to adopt peak pricing. Some considerations are:

- Incentives and real world regulation. In the paper we assumed ideal forms of cost plus and price cap regulation. However, regulation is not practised in such an ideal way. For instance in the UK price cap regulation is a hybrid form. Every five years the price cap is set with reference to the asset base so that costs and profits play a role in setting the cap. BAA sees themselves as being regulated under a rate of return regime (Toms, 2003) so that it has a reduced incentive to increase the efficiency of their pricing structure. This might explain why the uniform landing charge has less weight than the passenger charges at Heathrow and Gatwick airport. According to Giulietti and Waddams Price ((2000) only two of seven analysed industries adjusted prices under price cap regulation. Giulietti and Waddams Price argue that price capped industries act strategically, being more concerned with long run issues of resetting the cap. They game to raise the level of prices. In addition there are informal contracts with regulator who might influence prise structures. All this suggests that one has to analyse more closely the real performance of regulation and its influence on the airport decision to adopt efficient pricing.

- The form of the price cap. The type of cap might lead to different results (Access Economics, 2001). An average revenue cap tends to encourage peak pricing and uniform charges. Whether a price basket might lead to similar or even better results needs to be proven in theory and practice. Currently only revenue baskets are used in price caps for airports.

- Government ownership of airports. In our discussion we assumed a profit maximising airport. While this might be a useful approximation of a fully privatised airport it might not hold in cases of a partially privatised or public airport. In airports there are obviously a variety of government structures with

different ownership and regulatory models which are worthwhile to study. For example, why is it necessary under price cap regulation for the Irish regulator to set a basic level of movement charges to induce the state owned Irish airport operator, Air Rianta, to increase the effectiveness of its peak pricing schemes? Is the airport not even maximising revenue? Why did the public enterprise BAA introduce peak pricing in the 1970s? Was is the influence of economists trying to improve welfare? If so, how could they succeed then but not succeed after privatisation? How strong is the discipline effect of the capital markets on airport management when the state has a majority stake, as at Frankfurt Airport, or a golden share? If airports are not forced to maximise profits, what do airport managers maximise? Do they minimise conflicts-for instance, with the national carrier to enjoy the "quiet life" (Hicks, 1935, p. 369) of a monopolist? A much richer model of airports is feasible given the principal agent problems of airport management with owners, workers and regulators (Holmstrom and Tirole, 1989), .

- The Strategic behaviour of airports. While peak pricing increases profits and revenue, we cannot rule out that strategic behaviour of airports might lead to a higher pay off. For instance an airport might follow a strategy to charge a high level of undifferentiated charges with a high level of quality and leave the scarcity rent to the main carrier. Both parties might be better off as the airlines is willing to pay the higher prices as this erects an effective barrier to entry for competing services. It might not lobby for a tighter cap in the consultation process enabling the airport to reach a higher level of charges. Such a strategy could be even more effective under a cost plus regulation which sets incentives for gold plating and a high level of undifferentiated charges. This just an ad hoc example of a plausible strategy - there might be other effective strategies which could be analysed.

- The long run. In this paper we have analysed the short run problems of peaks and excess demand ignoring, the long term problems of capacity expansion. Investment decisions are very complex in the airport industry. Airports invest in infrastructure and could face a hold up problem if the regulator gives no credible investment incentives. Furthermore, current prices do not reflect the relative scarcity of infrastructure, so that it is extremely difficult to decide on the appropriate time and dimension of the investment. Politically, expansion must be approved through complex and time consuming planning processes. Very often the investment decision is based on the claimed amounts of direct and induced jobs and not on a benefit cost analysis. All these aspects might play a role in explaining why airports are not so much interested in peak pricing.

- The learning process. Airport managements are undergoing a change from public utility conditions to profit seeking behaviour. Traditionally, charges had only the function to finance airport infrastructure; not to optimise the utilisation of capacity. Thus the adoption of profit increasing price strategies in general such as price discrimination, non-linear pricing, two part pricing and, last but not least, peak pricing might take longer than in other industries. Furthermore, the relevant demand elasticities are not known in detail and the effects of peak pricing on airlines demand for slots have been hardly studied. The positive effects are proven only theoretically, but not empirically, making it difficult for managers to switch to peak pricing. The gains from lowering off peak charges seem to be hard

to forecast, while raising peak charges lead to direct conflicts with the main carrier.

- Legal and political constraints. While the ICAO guidelines (1997) allow for a fixed charge at peak times for congested airports, IATA opposes such systems on the grounds that they "only arbitrarily redistribute costs between different users" (IATA, 2000, p.1). IATA argues that existing peak pricing systems do not influence scheduling and do not improve the IATA slot coordination system. Furthermore the capacity costs should be to be viewed as joint costs to all users so that an average cost pricing system is preferred. While these arguments do not hold up to close examination, they nevertheless show clearly that airports face some political countervailing power from airlines. This at least increases transaction costs for the airport management and might play a role in the slow adoption of peak charges.

6. Conclusions

The discussion of slot allocation will gain a new momentum with the proposed reform of the EU slot directive. In this respect it seems vital to keep in mind that price structures are as important as slot markets. While the determination of efficient price structures have been widely studied and is fairly straightforward the question, how to establish such price structure in an industry which is privatised and regulated remains to be answered. Price regulation implies that at busy airports slots are required to ration capacity. However, prices still serve two important allocative functions namely determining the use of off peak capacity, and who gets the slots.
It is argued that a cost plus regulated airport will have little incentive for efficient pricing as charges are cost related and profits cannot be raised by differentiating charges. Price caps seem to work better as average revenue price caps can set incentives for peak pricing and uniform charges because revenue and profits can be increased by them. In other word price caps work fairly well, though they might create incentives to underprice passengers.

So far airports have shown reluctance to implement efficient pricing for various reasons. Hybrid forms of price caps, wrong designs of price caps, strategic behaviour and learning processes might all contribute to the slow adoption of efficient pricing, though further study is needed.
If we wish to allocate airport capacity efficiently then we need to:

- get slot market working well, and
- get airports to adopt efficient price structures.

While it seems relatively easy to design an efficient slot market, it is difficult to design regulation to induce airports to choose efficient prices. This problem, more so than slot markets, needs more research. A further dimension is the political economy one- how does the interaction of the interests of stakeholders affect policy to implement effective designs for efficient slot markets and price structures at busy airports?

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