Pricing of congested runways: the case of Sydney Airport

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Abstract:

At Sydney Airport, the Federal Airports Corporation has to determine runway prices in the face of significant peak-period congestion (which it hopes to alleviate within a few years by building an extra runway at the present airport).

In the prevailing context of microeconomic reform, the study applies economic efficiency principles to develop a detailed specification for an auction mechanism to allocate peak-period runway capacity. If government wishes to favour intrastate services, a scheme of partial reimbursement might be used, to minimise the loss of economic efficiency arising from favoured access.

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Introduction

In recent years, the world has seen relatively little in the way of construction of new airports - and even relatively little construction of extra runways at established ports. Unlike an earlier era, when the development of the first jet transport aircraft - the B707 - obliged airport authorities to provide longer runways, recent times have seen no technical development compelling the construction of new runways. Also, with most airports being provided by governments or public sector agencies, airport development may have been affected by the prevailing general trend towards reduction in government budget outlays. And increasing hostility to aircraft noise pollution seems to have discouraged airport capacity initiatives.

Thus, with continued growth in the scale of air transport, and with the trend to larger aircraft somewhat abated, congestion is increasing at many ports. While this may lead soon to significant airport investment, there is at many ports an immediate and pressing need to make better use of existing runway capacity.

This study addresses that short-term management issue, and applies the microeconomic reform principles currently proclaimed by many governments, including those in Australia. These principles are taken to include

- a major emphasis on economic efficiency, especially productive efficiency (broadly, the securing of specified output targets at lowest cost)
- the use of carefully designed output prices to secure allocative efficiency (ie to signal to consumers the social costs of their consumption, and to help indicate to producers what consumers want)
- scrutiny of any past practices that have favoured particular groups of users, to see whether such distributive intervention may still be justified
- for the irreducible minimum list of distributive targets, employment of arrangements that secure these objectives while seeking the highest feasible level of economic efficiency.

After considering the development and appplication of these microeconomic reform principles, and after a review of experience in various countries (especially the U.S.), the study looks at the most urgent capacity issues facing the Federal Airports Corporation viz. better use of the runways at Sydney.

The runway as service provider

When a runway is congested, the decision of an individual aircraft operator to execute a landing or take-off results in additional delays to other aircraft. Thus the movement adds to the costs of other users. When deciding whether to execute the movement, the owner of the aircraft compares the financial benefits of the movement with the costs individually experienced. In the absence of any mechanism to sheet home to the individual the costs experienced by others, some of the movements actually

undertaken will be valued at less than the total (social) cost, and in that sense there is excessive use of the runway, with the occurrence of more congestion delay than is in the general interest.

To deal with this problem, some parties advocate reduction in the number of movements by means of administrative regulation. In contrast, the principles of microeconomic reform require an alternative apporach, viz the pursuit of economic efficiency by appropriate use of the price mechanism. Specifically this requires the levying of a movement charge which reflects all social costs, including the cost of delays to others. Because an aircraft movement occupies the runway for much the same amount of time, irrespective of aircraft type, the delay cost is the same for all movements, and hence the efficiency principle requires (as a component of total price) the levying of a *uniform* congestion charge, which does not vary with aircraft type. (Economic efficiency also requires a charge component to match the costs of noise pollution; but that aspect is not considered in this study.) These social costs then provide a floor for the price to be charged If the price were set at that floor, then (in a peak period) the number of movements demanded may exceed the capacity of the runway, in which case price is set sufficiently higher to equate demand with capacity (For an extended discussion of the rationale of peak-period pricing, see Mills, 1989, pp 279-281.)

Whatever mechanism is used to limit access, however, there remains the point that a runway can serve only one user at once, and hence a queue discipline has to be defined. The principal choice is between having some system of prior reservation or simply allowing users to present themselves when ready for service. In the latter case, there is a very obvious need for further rules to determine the order of service - first-come first-served, or priority rules. But even with a reservation scheme, there will need to be rules to determine the order of use on the day, since for both arrivals and departures, the aircraft may not present itself at precisely the pre-arranged time, leading to the occurrence of (a limited amount of) queueing. In all cases, the rules *can* limit the categories of user who will be accepted for service in any particular time-period (or at all).

Unlike most service situations, the runway presents a further complication: its effective capacity varies according to weather conditions. With good weather, movements are made according to visual flight rules (VFR), while limited visibility necessitates the use of instrument flight rules (IFR). Under the latter, the feasible maximum number of movements per hour is significantly reduced, with the extent of the reduction usually depending on the nature of the adverse conditions.

Accordingly, queue disciplines have to be defined for each of the alternative modes of operation. In the case of Sydney airport, the present situation is that at most times prior reservation is not required. However, under certain adverse circumstances (when weather or industrial factors reduce capacity - and sometimes when the demand is particularly high), a movement is not permitted unless the aircraft has a prior reservation, effected through the allocation of a so-called 'slot'.

At busy ports, use of slot-allocation schemes is not uncommon. The prior reservation is valid within a designated time-period, for example 09.00 to 10.00 hours. Opposing factors influence the choice of length of the period: a long span recognises the difficulty an airline faces in operating precisely on schedule, but can lead to uneven rates of attempted movements within the period. Rules are needed to define the treatment of an aircraft which misses the period specified for its slot.

This description of slot-allocation has emphasised the physical characteristics. Nothing in that account pre-judges the question of how to determine the allocation of slots. In particular, although most such schemes rest on administrative allocation, there is no inherent obstacle to relying on market arrangements.

Using prices to allocate scarce runway capacity

The argument so far, then, is that there must be both a set of rules determining the queue discipline, and a mechanism for the allocation of the scarce runway slots. The microeconomic reform context suggests that the price mechanism be used for that allocation, in the hope of getting results that score well in terms of economic efficiency. As with any other allocation mechanism, the pricing details must depend on which queue discipline is selected. Further, the choice of queue discipline may itself be guided by the desire for economic efficiency.

In the absence of prior reservation of runway slots, the price mechanism may be used to 'clear the market' (ie bring the number of aircraft seeking service into line with the capacity of the runway). Given the inherent variability in the system (especially the difficulty in operating airline services exactly to schedule), it is difficult to clear the market so precisely that queueing is completely avoided. For some other contexts, it has been suggested that elimination of queues may be attempted by 'responsive pricing', which requires very prompt and frequent adjustment of prices "so as to clear the market not only on the average with respect to regular predicatable fluctuations in demand and supply but even in response to those fluctuations ... that cannot be fully predicted in advance" (Vickrey, 1971, p.338). However even that author may baulk at having responsive prices announced by the airport control tower, since "[if] a price is to serve a purpose in guiding the decisions of potential users ... the price must be known to the user when he commits himself to the use of the service" (p.338). Thus the price mechanism must take the form of posted prices; these may be held fixed for as much as a year. Higher prices are set for peak periods, to get close to clearing the market then; and at any time when excess demand materialises, aircraft are queued until after the busy period and/or there are priority rules to delay (or even prohibit) aircraft movements in categories considered to be of low value.

As an alternative, prior reservation of slots may be used in conjunction with posted (peak and off-peak) prices. This may help to reduce queueing costs (compared with the use of posted prices only). But the relative inflexibility of slot arrangements - especially the possibility that a slot may not be used - bring its own costs.

With or without slot-reservation, high prices at times of peak demand encourage airlines to use large aircraft, to arrange schedules so as to secure high load factors in peak periods, and to charge higher fares to passengers travelling in the peaks and to charge lower fares off-peak. The last encourages discretionary travel to flourish off-peak, leaving business travellers to pay the higher peak fares (reflecting the high value such travellers usually place on peak-period service). In all these ways, then, do high peak-period runway charges promote economic efficiency. Of course, allocation by willingness-to-pay encourages such airline use of peak capacity as pays the airline well, and this is not quite synonymous with economic efficiency. Further, the discrepancy between profitability and efficiency may be greater when capacity is allocated by a slot system - even a market-oriented one - if the detailed form that is adopted is so inflexible as to result in significant indivisibilities (Borenstein, 1988). Nevertheless the market system may be expected to do better in terms of economic efficiency than the alternative of administrative allocation.

Where slot allocation is to be practised, there are many design parameters to be determined. The main ones are listed in Table 1, which also shows (in the second column) suggested parameter choices for a context requiring economic efficiency. Before considering those choices, however, the next section looks at slot practices in other countries, notably the U.S.

Experience with slot-allocation schemes

In the slot allocations practised in some other countries, the 'owner' of a slot invariably pays the standard movement charge levied in the time-period in question. Usually that charge is so low that the major rationing role is taken by the slot-allocation process.

Administrative allocation of slots

In the U.S., experience with slots goes back to 1968 when the Federal Aviation Administration restricted the numbers of movements at four busy ports. At each of these, the process of initial allocation - and subsequent amendment - was entrusted to a committee comprising representatives of all those carriers licensed to serve the port, under the then comprehensive regulation of the industry by the Civil Aeronautics Board. (For the early history of such slot-allocation, see Appendix II of Koran and Ogur, 1983.)

Table 1 Design parameters for runway slots

Parameter	Suggested parameter choices, if economic efficiency is the principal aim
Allocation mechanism	Prices (perhaps prices bid in a non-discriminative sealed-bid auction)
Permitted time span (within which movement must be made)	15, 30 or 60 minutes, depending on traffic demand pattern
Penalty for missing designated time span?	Yes, cash penalty for persistent failure
Duration of slot access right	Several months
Penalty for non-use?	Yes, cash penalty for persistent non-use
Access right transferable?	Yes, by sales in an aftermarket
Admission of movement without reserved slot?	Yes, whenever such admission not expected to delay movements having reserved slots
Arrangements when runway capacity is reduced (by bad weather etc.)	Allocate by price, perhaps by giving priority to movements for which the bid prices (above) are highest

These scheduling committees were required to reach unanimous agreement, failing which the FAA would intervene to "break any deadlocks by allocating slots on an historic basis (that is, 'grandfather' rights)" (DTC, 1989, p. 74). Observers of this process noted that the unanimity rule seemed to drive the committees to agreements that approximated the allocations that were thought to be the likely consequence of FAA intervention. To explore this issue, Grether, Isaac and Plott (1981) undertook laboratory experiments to simulate the committee procedures, with alternative default allocations of (a) grandfathering, and (b) a uniform lottery. Unsurprisingly, they showed that the experimental results moved close to the respective default allocations. They also noted that while 'trading' within the committees did help to secure some economic gains, generally the allocations did not reflect important economic characteristics such as differences in airline costs.

Although the economic properties may have been poor, the scheduling committees, for a while, did produce workable allocations without FAA intervention. However the demands placed upon the procedure became more exacting in the later 1970s when deregulation resulted in new carriers clamouring for slots. And the difficulties were dramatically compounded in 1981 when the strike by, and resultant shortage of, air traffic controllers reduced the capacity of many airports. At some 22 ports, the FAA then allocated the reduced capacity in proportion to carriers' previous 'normal' schedules. As system capacity recovered, the FAA held periodical lotteries, for the newly-available slots, and sometimes gave priority to new entrant airlines. In late 1982, the FAA substituted, for these individual lotteries "a single one-time lottery ... to determine priority for carriers in all future slot allocation periods. Preference was ... given to a broader class of new entrants" (Koran and Ogur, p.69).

Even though this U.S. experience has demonstrated some inability of airline scheduling committees even to reach unanimity (let alone produce a result giving a reasonable measure of economic efficiency), DTC (1989) pp 79-81 reports some continued use of this procedure in other countries. Also noted there is the continued determination of international carriers, acting through the International Air Transport Association, to attend to their interests at capacity-constrained ports by slot negotiations conducted in behind-closed-doors 'schedule coordination' conferences of carriers (DTC, 1989, Appendix E).

Rules on the timing of movements

The allocation of a slot to an airline confers the right to make one movement each day, within a specified time-period, perhaps of 60 minutes duration. (A landing and subsequent take-off of the same aircraft usually fall in distinct periods, and always require two slots.) In some circumstances, airlines may try to bunch departures on the hour, in which case slots may be allocated to short time-spans (perhaps 10 or 15 minutes), to constrain such bunching.

Also required are rules about making movements outside the specified slot-period, to allow for aircraft delays, for example. The usual approach is to permit off-schedule movements without penalty, save that if the allocated slot-period is missed on a significant proportion of occasions, the airline may be fined, or may even lose the slot.

Duration and transferability of the property right

Once allocated a daily slot, the airline has a right to use the slot for a period of time. Early slot-allocations in the U.S. were to prevail for somewhat indefinite periods, and hence the duration of the property right was uncertain. Later decisions of scheduling

committees could terminate the right, as could and did the FAA, as already noted. Furthermore, slots that were not used (on most days) could be forfeited.

Airlines themselves (and economist critics, too - see "Airline competition and the slot market" (1982)) often wanted to make the slots transferable, an idea initially resisted by the FAA. After earlier rules that permitted trades between airlines (initially on a one-for-one basis), and after a six-week experimental period in 1982, in which the FAA permitted outright sale (Koran and Ogur, 1983, p. 70), buying and selling of slots (at the four ports still capacity constrained) has been legal since April 1986, and there has been a significant amount of dealing.

This U.S. history has provoked considerable criticism on economic grounds. Until 1986, the absence of an aftermarket meant that slots could not be readily transferred from low-value to high-value uses. Later, when a legal market was created, some property rights that were acquired without payment have been sold, sometimes at prices in excess of US$1 million (DTC, 1989, p. 77); this has favoured some airlines at the expense of others.

The existence of such substantial 'permanent' property rights has led to concern that any government-initiated restructuring of the airline industry is made more difficult to implement, and that large incumbent airlines may acquire control of a large share of slots at a single port, thereby becoming able to exercise market power in a manner that is not in the public interest. (For a detailed discussion of this aspect of slot access - and the similar issue regarding terminal gate access - see Levine, 1987, pp. 464-471. Although cautious in crying 'wolf', Levine does see problems at a slot-constrained port for an entrant trying to effect large-scale entry, or to effectively coordinate small-scale entry; these problems arise from network interdependence and from indivisibilities. Broadly similar concerns are expressed in OECD, 1988, p. 164. For an extensive discussion of European difficulties, and a plea for auctioning of slots to help promote airline competition there, see McGowan and Seabright, 1989, pp. 314-320.)

Governments too have recognised the importance of slots in hindering entry. Fox example, in late 1986, in order to secure Department of Transportation approval for its takeover of Eastern Airlines, Texas Air sold to Pan Am some slots at LaGuardia (New York) and at Washington National to allow Pan Am to start a shuttle service between those two cities, in competition with the to-be-merged shuttle of the Texas Air companies, Eastern and New York Air (OECD, 1988, p. 50).

Demand management at Sydney airport

Given the microeconomic reform context, a demand management regime intended to get the best results from the existing Sydney airport runways should have these objectives:

(1) promotion of (static) economic efficiency
(2) flexibility sufficient to allow the regime to cope with reduced runway capacity, due to weather and other adversities
(3) ability to cope with any government policies that are intended to promote distributional objectives (such as concessions for intra-state commuter services - considered later).

This section looks at the recent proposal, in a Department of Transport and Communications discussion paper, suggests some important variations to that scheme, but retains the idea of prior reservation of slots in peak periods. In that context, the key issue is how to allocate the slots.

The Department (DTC, 1989, pp 58-60) envisages a two-step procedure:

- first, available slots are allocated (by administrative means not specified) among the user categories viz. international, domestic interstate, intrastate and general aviation
- second, within each category, slots are assigned by scheduling committee, administrative determination, or auction (with the matter left undecided in the discussion paper)

The unhappy U.S. experience with scheduling committees and administrative determinations in the face of deregulation suggests that this would not be a smooth path. Furthermore, a slot committee at Sydney recently failed to reach a consensus (DTC, 1989, p.36). And there is no reason for supposing that such an approach would score well in terms of economic efficiency.

Thus (with some limited exceptions considered later) the microeconomic reform context points unequivocally to whole-hearted use of the price mechanism, so that slots are allocated on the basis of willingness to pay. Generally, airlines prefer to avoid such schemes; this is illustrated by the IATA mechanism already mentioned, which keeps the horse-trading within the family, and refers to the matter only as 'schedule coordination' (DTC, 1989, Appendix E). Perhaps this can be explained by the dominant position of well-established incumbent airlines in such committees, and the influence of the larger airlines on administrative determinations. It is not merely that such influences may be used to restrict peak-period access by new entrants, though that certainly has happened in the U.S. experience. It is also a question of how much is paid for the best slots.

To understand the latter aspect, it is helpful to look at experience in the UK, where prices play a major role in rationing scarce runway capacity. The introduction of sizeable peak-period surcharges at the London ports did not result in the established airlines moving out of the peak, to any significant extent. But to keep those peak

slots, the majors had to pay the top prices, while "new airlines sought to occupy shoulder periods ..... [and] to take advantage of lower charges at the progressively less popular airports" (DTC, 1989, p.80).

The benefits for competition policy are obvious. In particular, by using the price mechanism, government establishes a level playing field (level in this regard, at least), and does not have to share slots arbitrarily between incumbents and entrants.

A detailed market mechanism

In devising a detailed mechanism for slot allocation, it seems best to use *both* posted prices (with movement charges set at significantly different levels for peak and off-peak periods) *and* bid prices for individual slots. These bid prices would be in addition to the payment of movement charges; before the FAC called for bids, it would announce the levels of movement charges that are to apply. Thus the total prices (movement charges and slot bids) would approximately clear the market in the slot-constrained periods, the remaining adjustment on any particular day being provided by traffic control rules, in the usual way.

As an alternative, it would be possible to seek market clearance for slot-constrained periods by use of bid prices alone. But that would place great reliance on the bidding process. In a situation in which only three major airlines may be expected together to use a substantial majority of the slots, there must be some question (noted in DTC, 1989, p.112) as to whether the bidding would have all the competitive characteristics required for economic efficiency.

This concern should be reduced, but not eliminated, by the FAC posting substantial movement charges, having as a floor the short-run social costs of each movement (as already discussed). It would be open to the FAC to explore scarcity and demand intensity by setting *peak-period* prices well above the floor. Provided airlines with a minor presence are effective players, bidding outcomes should successfully represent underlying demands, with unused peak-period slots being the only legitimate signal that the posted movement charges are too high for the public interest. (In the U.S., there is concern that an airline hubbing at a particular port, being a major source of financing for that port, may "gain a large degree of bureaucratic control over airport operations" (Berry, 1990, p.394); given the size and strength of the FAC, and the lack of alternative ports in the capital cities, this should be less of a problem here, provided the FAC conducts its affairs competently.)

No doubt the established airlines would exert political pressure against the use of charges to ration peak-period capacity (as happened in the UK when the BAA introduced major peak/off-peak price differentials, and also as happened in the U.S. - see Koran and Ogur, 1983, p.15). The microeconomic reform principles would then require that the FAC be supported by government, to show determination to use the price mechanism.

To hinder bidder collusion (Robinson, 1985), it might be best to use a non-discriminative sealed-bid auction ('non-discriminative' in the sense that the slots go to the highest bidders, while all successful bidders pay a uniform price determined by the level of the lowest successful bid). Before the very first implementation, it may be desirable to have several trial bidding rounds (the number to be announced in advance), to allow the bidders some learning experience. In subsequent implementations, the FAC could adjust posted movement charges for the next bidding period, in the light of the prices previously bid. The aim would be to make the posted charge the major element in total price. Nevertheless the bid prices would help in getting close to a market-clearing outcome in each peak period.

Other slot-system parameters

For many of these parameters, there are alternative choices that seem likely to give equally good results. This brief account reviews the choices summarised in Table 1, and does not attempt to identify all the plausible arrangements.

Time dimensions: identified peak periods may be divided into 30 minute intervals (as in DTC, 1989, p.110), with an allocated slot permitting a movement within the interval; within the week, each such interval may be auctioned separately (eg starting with Monday 06.45 to 07.15); the successful bidder for a slot buys the movement right for each and every week within the duration of the right (see below).

Movement misses slot interval: consistent operation of a movement outside the interval for which the slot has been purchased may be subject to financial penalty.

Duration of the slot movement right: auctions should be held twice a year, with the weekly slot right lasting until the next auction (as in DTC, 1989, p.109); the timing should match airline revision of timetables (cf. discussion of IATA practices, in DTC, 1989, p.87); restriction of a slot right to a few months' duration allows market price to adjust frequently, and avoids some of the major drawbacks of U.S. practice where 'permanent' ownership requires a large up-front payment by an entrant airline, and seems to facilitate anti-competitive blocking of access (see also below).

Transferability of slot right: to increase flexibility (and hence promote economic efficiency) the slot right may be re-sold outright for the balance of its life, or leased for some part thereof; the DTC proposal (1989, p.111) suggests that these deals be for money only, and that they should be done anonymously through a compulsory broker (perhaps the FAC itself), so that an airline is not influenced by the identity of a potential buyer/seller; exchange of slots might be permitted, with cash adjustment defined by the difference (if any) in prevailing bid prices.

Failure to use slot: provided that the slot holder is obligated to pay both the bid price and the movement charge for each and every occasion on which the slot is available, it might be argued that there is no need for additional penalty for non-use; the possibility of behaviour intended to block access, however, suggests that persistent non-use (somehow defined) should lead to forfeit of the slot for the balance of its life,

without any release for the slot-holder from the financial obligation. (In the case of 'permanent' slot rights, a use-or-lose policy can encourage airlines to engage in inefficient use - see Koran and Ogur, 1983, p.14; this should be less of a problem when the duration of the right is limited.)

Movement for which slot-reservation not held: because the suggested scheme aims to get the total price (movement charge plus bid price) up to about the market-clearing level, the possibility of a small amount of idle capacity in a peak-period interval should not be overlooked; additional movements might be accepted whenever it seemed likely that the increment would not delay movements made by slot-holders; it might be possible to arrange reservation for such casual movements, say within 48 hours of the movement time; all such movements would attract the movement charge, while the prevailing bid price might be levied too when prior reservation is made.

Reduced runway capacity: in the event of bad weather or other adverse conditions, priority for use of the reduced number of slots would be given to those bidding the highest prices in the normal-conditions auction; this would give an additional incentive to airlines to bid up to the value of the slot to the airline.

Prices in periods that are not slot-constrained: normal off-peak movement charges would be payable, with landings and take-offs separately charged.

Inter-airport coordination

In the U.S., airlines serving a city-pair where both ports are slot-constrained may have problems in obtaining slots that can be paired (Grether, Isaac and Plott, 1981, pp 169-70). Although administrative intervention is proposed for Sydney (DTC, 1989, p.112), this should not be required: no other Australian port has major congestion; and the use of market-clearing prices at Sydney means that there will be little or no excess demand, making it easier for an airline to get the matching slot it wants.

Competition policy

In Australia too, there is concern about market power and its misuse, a situation that can readily arise when one or more firms each has a large share. The issue prompts the suggestion (DTC, 1989, p.110) that there should be upper limits on the number of slots allowed to any one airline in each slot interval. While the notion is probably sound, it is important not to underestimate the difficulties in arriving at sensible numerical values for the limits. (There may also be interesting consequences for bidding strategies and for the design of the auction rules.) Note that it may be necessary to give the FAC specific legislative authority to limit the shares going to the larger airlines.

Discrimination between user categories at Sydney

Given the economic efficiency context, the demand management arrangements proposed here for Sydney airport envisage that all user categories (international, interstate, intrastate and GA) should compete for the one pool of slots; and that within any one slot interval, all should pay the same movement charge, and the same bid-price supplement (for a reserved slot).

In contrast, many in the industry - together with interested parties outside the industry - advocate separate treatment for at least some users, with a view to providing advantages for some groups. This approach is adopted by the Department which proposes (DTC, 1989, pp 57-60) that the slot allocation system (whether done by auction, scheduling committee, or administrative determination) be "based on pre-determined allocations for major user groups" (p.57), and that any transfer/exchange of slots "between operators in different categories would not be allowed" (p.60) except where the slot is not wanted by anyone in the category to which it was initially allocated. As seen by the Department, such segmentation brings two advantages, which are now reviewed critically:

- in the case of allocation by bidding, segmentation reduces the uncertainty about who will get slots and in what quantity; but, we may note, it creates uncertainty about differences between value in use in the different sectors
- segmentation removes "the effect of differences in buying power between users in different categories" (p.112), the implication being that it reduces predatory opportunities; while this may be so, the efficiency loss may make segmentation less desirable than the direct approach (already discussed) of limiting the share of slots going to any one airline.

Lying behind the Department's general argument is a particular concern about the position of New South Wales intrastate services. Many of these are executed in small aircraft (often 9 to 19 seats, and never more than about 75 seats), with consequent limited capacity to pay full-level peak-period movement charges; see, in particular, Appendix F of DTC, 1989. Recent changes in intrastate route licensing have led to some reduction in the average size of aircraft used, thus aggravating the problem (Appendix IV of Bureau of Transport and Communication Economics, 1988, and pp 28-30 of DTC, 1989). One measure of importance of the issue is the sheer volume of intrastate movements in the peak period. For weekdays in April 1989, the share of intrastate movements in all movements at Sydney is estimated to have ranged from 27% to 43% in the six hourly intervals of the peak (07.00 to 10.00, and 16.00 to 19.00 hours) (DTC, 1989, p.40).

Although it is commonplace to find congested airports having movement charges that are structured so as to favour commuter and regional airlines, with consequent loss of economic efficiency (see Morrison, 1987 for a U.S. example), the sacred cow nevertheless deserves close examination. In the NSW case, the

Department of Transport and Communications implies that services between Sydney and rural areas of NSW are especially valuable. In DTC (1989), note is made of "the social considerations of access by regional and commuter intrastate services" (p.3), while "air links between Sydney and ..... intrastate centres have special significance because of Sydney's role as the State capital" (p.7). But no specific arguments are advanced for giving special weight to these user benefits.

In the calculus of economic welfare that lies behind the microeconomic-reform emphasis on efficiency, there are grounds for favourable consideration of any activity for which the aggregate consumer benefit *greatly* exceeds the aggregate payment that the market mechanism can hope to extract from those consumers. For, in that case, the revenue paid to the supplier is an especially poor representation of social value, and there may be a case for setting aside the market mechanism.

Do these intrastate services fall into this category? In other words, would the users of the service, in aggregate, be willing to pay much more than they do presently pay, if only some arrangement could be found?

There are no obvious reasons for supposing that the answers to these questions are in the affirmative. Indeed, conventional wisdom in the industry includes arguments that suggest a negative answer. Among these industry attitudes is the view that application of full peak-period charging to commuter airlines would push up costs and hence fares to an extent that users would not be willing to pay; for example, DTC (1989) p.103 says "it would be clearly unacceptable if any carrier's viability were adversely affected to the point where a service to a particular town or region ceased".

Less direct, but still relevant, are the conventional views that changes to intrastate services that make them somewhat less convenient (ie. push up time and other costs of the user) would cause significant reductions in the number of air journeys. For example, DTC (1989) p.28 says: "Given Newcastle's close proximity to Sydney and the extent of intermodal competition with road and rail transport, the high service frequency that can be offered by smaller aircraft is particularly important to the viability of [the Newcastle] services". The context suggests this is a plea for recognition of the importance of allowing access at Sydney for frequent Newcastle flights. Yet the evidence adduced carries just the opposite implication: because the Newcastle-Sydney journey is of short distance and relatively well served by road and rail, this air travel has fairly close substitutes, and there are no large user benefits over and above the fare presently paid.

Similarly, consider the use of triangulation (in which an aircraft from Sydney flies through two rural ports before travelling its third sector back to Sydney), a practice that might be more widely used to reduce the number of movements at Sydney; and also consider the aggregation of passengers on separate flights from several small, distant rural towns at a hub such as Dubbo, to bring them in to Sydney in a single, larger aircraft. On these, DTC, 1989, pp.31-32 says "As with hub-spoke operations, it must be recognised that route triangulation may undermine the viability of services where competition from alternative airports and/or transport modes is

significant." Again, it seems that the benefit of at least some intrastate air services does not greatly exceed present fare levels, because of the existence of alternatives.

Hence it seems that many intrastate services are merely marginally profitable under present conditions (which include very modest landing charges), and that there is no significant surplus benefit that might justify setting aside the basic efficiency arguments. Thus the view taken here is that the FAC should introduce a uniform charge for *all* access to runways in congested periods.

A mechanism for subsidy for intrastate services

If nevertheless government wishes to subsidise (some) intrastate airline services, then the only available rationalisation is to argue that the small communities thereby served are of especial importance in society. Without taking sides on that issue, this section considers how that distributional target might be achieved while doing as little damage as possible to the overall objective of economic efficiency.

There are two key questions. How much airline service is to be supported? And what is the most efficient way of providing the target level of service? The second question points to service alternatives such as shifting movements out of the peak periods to less-crowded times, and consolidation of passengers into larger aircraft for carriage between Sydney and NSW hub ports such as Dubbo, Newcastle and Canberra. Of course, these alternative services may be less attractive to many travellers (assuming unaltered fare levels), and any loss of convenience has to be set against the benefit accruing from the reduction in the number of peak-period movements. Thus the two key questions are inter-related.

As a basis for the present analysis, it is supposed that *all* peak-period movements pay a uniform movement charge. (For present purposes, this may be set at the full social marginal cost level, as already considered, or it may be set at some lower level, as a transitional arrangement.) Favourable treatment of the rural interests then requires full or partial reimbursement of the movement charges actually paid, and/or side-payments for each movement no longer made, as a reward for abstention.

One scheme for side-payment (Koran and Ogur, 1983, pp 31-32, where the idea is attributed to a CAB staff paper by R.H. Frank) sees vesting of existing slot rights in the local community, perhaps represented by local government. In the present context, this approach could involve side-payment to the community, equal in amount to the outlay that would be required to cover movements for the existing pattern of services, with the local community deciding whether to pay some or all of this sum to the airline to support continuation or adaptation of existing services. The decision on whether to spend the money on continued service depends in principle on the extent of consumer surplus (the net benefit of travel that remains with passengers after their

payment of fares), while the profit to the airline from continuation of service is probably disregarded.

Conversely, if side-payment is offered to the airline, the response is based on profitability, with little or no regard for the consumer surplus enjoyed by passengers. The previous discussion has suggested that for most intrastate services, profit is small (and consumer surplus is probably small too). Thus even small side-payments to airlines may be sufficient to induce a reduction in the number of peak-period movements, achieved (in part, at least) by re-timing and/or by hubbing at ports outside Sydney. If the small payments offered initially did not result in such reorganisation, then the offered payment level could be increased (though, to discourage strategic behaviour on the part of airlines, the possibility of such increases should be made to seem very uncertain).

Among these schemes, side-payments to the local community (in lieu of subsidised slots) is the intervention likely to cause the least damage to economic efficiency.

Possible adjustments of intrastate services

To explore possible adjustments, first consider the impact of higher movement charges on fares. The present scheme of aeronautical charges is related to aircraft weight: the cost per passenger per movement (landing or departure) is about $2 for passengers in a 9-seat aircraft, and roughly $1.40 in 18, 36 and 50-seat aircraft (all assuming a 75% load factor, which is higher than the average load factor (BTCE, 1988, p.182), but may be about right for the peak-period services considered here).

On the assumptions stated in Table 2, the calculations summarised there show the impact on fares of three alternative charging levels. Specifically, one level corresponds to the $220 charge (per landing) presently applied only to GA, another comprises a uniform $250 charge per movement (landing or takeoff), and an intermediate case has movement charges that vary with aircraft size (for these intrastate movements). Although even the highest of these charging levels probably understates the congestion cost in peak periods (Mills, 1989, p.283 and DTC, 1989, p.43), Table 2 casts light on what may be initially acceptable.

The consequent increases in fares may well end access by all 9-seat aircraft in the peak periods, but otherwise the effects seem likely to be much less dramatic. The reduction in demand levels is not merely that due directly to the working of price elasticities. (Nevertheless, see BTCE, 1988, p.86.) Additional effects follow from the need for airlines to adjust their arrangements. Reduction in frequency and substitution of indirect for non-stop service may both reduce demand. Nevertheless, for most rural centres, it may still be possible to provide what seems to be the most important characteristic of all, viz. same-day return service (in both directions).

Table 2 Some numerical implications of the application of peak-period movement charges to NSW commuter and regional services

Aircraft types (no. of seats)	Piper PA31-350 (8/9)	Bandeirante(18) Jetstream 31(18) Beech C1900 (19)	Saab SF340(34) Short 360 (36) Dash 8 (37)	F50 (50)
No of seats supposed per aircraft	9[1]	18	36	50
Charge per movement[2]	Additional charge per passenger (in $)[3]			
$110	14	7	3	1
$110/200[4]	14	7	6	4
$250	35	17	8	5
	Proportionate increase in fare, for uniform $250 movement charge [6]			
Sample fares [5]	%	%	%	%
Newcastle $55	64	31*	15	9
Bathurst $79	44	22*	10	6
Port Macquarie $125	28	14	6*	4
Ballina $166	21	10	5	3*

Source: Numbers of seats are from BTCE (1988) *Intrastate Aviation: Performance and Prospects* (Occasional Paper 95) Canberra: AGPS

Notes:
(1) Under Australian regulations, 9-seat aircraft may be operated with a single pilot; for all aircraft with 10 or more passenger seats, two pilots are required.
(2) These charges are for each separate movement (landing or takeoff).
(3) The derived *additional* charge per passenger is for a single journey to/from Sydney, supposing a 75% load factor; it is based on the stated movement charge less the FAC aeronautical charge applying in April 1990.
(4) Supposes $110 per movement for aircraft up to 19 seats, and $200 otherwise.
(5) One-way fares in April 1990 between Sydney and the listed ports; the sample brackets short and long intrastate journeys.
(6) Supposes that the increase in the movement charge is passed on in full.

*Denotes aircraft size actually used on each sample journey, April 1990.

Mills

An example of what can be done is to be found in the recently-instituted Hazelton Airlines hub at Dubbo (BTCE, 1989, pp. 74-75; see also the extensive study of alternative networks in Review, 1986, Chapters 7 and 8). It may be possible also to develop hubs at Newcastle (Williamstown) and Canberra. The former could be used to consolidate pssengers travelling between Sydney and those northern NSW ports that have only small passenger numbers, leaving major ports such as Armidale and Coffs Harbour with non-stop (or same-plane) service to Sydney. (It may be possible also to develop limited jet service from Newcastle (Williamstown) to Brisbane, Canberra and Melbourne; see Enviroplan (1990). In that case some of the present intrastate passengers who hub at Sydney would find it convenient to avoid Sydney altogether; however interlining passengers are estimated to be only about 20% of all intrastate passengers (Review, 1986, p.93).) Another useful form of consolidation would result from using only one rural port instead of having service to two (or more) ports that are close together, sometimes only 30 or 40 km apart (Review, 1986, pp.51-53). By all these means, a relatively painless adjustment may well be possible.

Funding the preferential treatment of intrastate services

In the past it has been common for preferential treatment for one group of users of a public-sector enterprise to be paid for (implicitly) by levies on other users. As part of microeconomic reform, however, the cost of such preferential treatment is to be identified explicitly, and then placed upon society, as represented by government.

Furthermore, public sector suppliers that have been corporatised are given a commercial objective; and to the extent that such a corporation is required to meet some non-commercial objective that results in financial detriment, compensation is payable by government. The Federal Airports Corporation Act (No 4, 1986) includes precisely these provisions - see sections 7, 41 and 42. However, application of the commerciality concept in the present context is difficult. Commercial behaviour is prescribed in corporatisation frameworks in the hope that economic efficiency will be pursued more vigorously. In the absence of competition, however, the correspondence between commercial behaviour and efficiency is not exact; and the present case has the additional complication of the congestion externality. Thus the full implications of commerciality are not pursued here.

That still leaves the considerations of transparency and the equity of costs falling on society rather than on the industry. These alone are sufficient to support the propositions that all aircraft movements in peak periods should pay a uniform congestion charge (irrespective of service category), and that if there is to be any side-payment to rural communities or any form of subsidy for intrastate services, then the

interested parties should seek to place the burden on government, rather than on other travellers.

Because the benefits fall mainly within NSW, any such subsidy request might be addressed to the NSW Government, which in any case regulates intrastate services by licensing routes to specified airlines. Integration of decisions about licensing and about whether or not to make payments should help to ensure that sensible overall arrangements prevail (such as licensing patterns that permit consolidation of passenger loads at hubs away from Sydney - cf. DTC, 1989, p.30).

Conclusions

The main conclusion is obvious: the microeconomic reform context prompts the use of a price mechanism for the allocation of the scarce (peak-period) capacity of the existing runways at Sydney airport. The study has examined the details of such a mechanism, and has emphasised that the price charged for each peak-period movement should include a *uniform* component to reflect congestion costs. If intrastate (or any other) services are to receive favourable treatment, this should be done by reimbursement of that component.

This policy may here be put into context. The usual economic principles (Mills, 1989) require that the total movement charge should also include other components to cover runway wear-and-tear costs (and any other directly variable costs), and also noise pollution costs, with *these* components appearing also in off-peak movement charges. In addition to all these costs, it may be necessary to add Ramsey mark-ups to arrive at the movement charges, to the extent that such is necessary to allow the FAC to reach its financial target.

Brief note may also be made of some capacity implications. Because intra-state services are such a large part of total peak traffic, a modest reduction in the number of intrastate movements would bring very considerable reductions in congestion delays. Taken in conjunction with various procedural changes and the construction of high-speed exits (to increase the effective capacity of the present runways - see DTC, 1989, p.13 and Appendix B), this may ensure that, over the years before a parallel runway can be constructed, burdensome levels of congestion do not occur. Indeed, the strategy might well give sufficient time to develop the Badgery's Creek site for airline use, instead of construction of a parallel runway.

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