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Air Capacity for Sydney

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OECD

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TABLE OF CONTENTS

1. INTRODUCTION 5

2. BACKGROUND 7

2.1 History 7
2.2 Institutions 7
2.3 A Second Airport? 8
2.4 Meeting Growing Demand 9

3. LOCATION, HUBBING, CONNECTIVITY AND COMPETITION 13

3.1 Location 13
3.2 Is Sydney a hub? 13
3.3 The Economics of Hubs 14
3.4 Connectivity 15
3.5 Competition- Is it Feasible for Sydney? 15

4. RATIONING EXCESS DEMAND 17

4.1 The Short Run Problem 17
4.2 Light Handed Regulation and Pricing 19
4.3 The Long Run Problem: Timing 20
4.4 Are there Incentives for Efficient Investment? 21

5. EVALUATION OF THE OPTIONS 23

5.1 The Parallel Universe of Two Evaluations 23
5.2 The Roles of CBA and CGE 23
5.3 The Criterion- Welfare or GDP? 24
5.4 Specific Issues: Jobs, Inbound Tourism and Emissions 25
5.5 Benefits and Costs- to Whom? 26

6. EXTERNALITIES 27

6.1 Greenhouse Gas Emissions 27
6.2 Noise 27

7. CONCLUSIONS: WHY SYDNEY AIRPORT IS NOT A DISASTER 29

BIBLIOGRAPHY 30

1. INTRODUCTION: SYDNEY'S AIRPORT PROBLEM[1]

Like most large cities, Sydney has an airport problem. Demand is increasing faster than supply, and additional capacity will be needed if costly rationing, and delays, are to be avoided. However, compared to many cities, the problems facing Sydney are modest. At the moment, demand is only just exceeding capacity. There is a good chance that the available capacity will be rationed efficiently. Options for expanding capacity are being evaluated well. There may be problems in the future- poor options may be chosen over good options.

One issue that complicates investment options are those of location, hubbing and competition. The current Sydney airport (Kingsford Smith Airport or KSA) is conveniently located at 8 km from the CBD. It is difficult to expand this airport, and the likely second Sydney airport (or SSA) will probably be located at between 45 and 65 km from the CBD- this reflects the unpopularity of an airport for both noise and community aspects. It means that it will be distinctly less attractive for passengers and airlines to use. There will be, to some extent, a problem of splitting demand between two and more airports, thus losing the advantage of having a single hub. However this effect will not be as severe a problem as it is in other cities, such those in Europe and the US. Individual airports in Australia do not experience much competition. However the owner of KSA has the right to build the second airport- thus precluding the possibility for competition to develop.

Another issue which will emerge is that of how scarce capacity will be rationed. Sydney airport is not heavily regulated- thus it has more effective options for rationing this capacity. In addition to a slot system, which can work well, (even though there is always the question of how efficiently slots are traded), there are prices. Few airports around the world are able or willing to use prices to ration demand. Thus, in the short run, prospects for efficiency are good. In the long run, there may be a problem of bad incentives- if the airports and the airlines are sharing the slot rents, they will not invest when efficient to do so.

A third important aspect is the evaluation of the options - how well will this be done? Airport investment has been on the agenda for over 30 years, and most of this time it has been done rather well (though not always). The most recent study was the Joint Study (2012) which was a detailed study of the need for expansion and the options for achieving this, done by the Commonwealth and State governments. This study is notable in that it used two types of evaluation- a traditional Cost Benefit Analysis (CBA) but also a Computable General Equilibrium (CGE) analysis. This said, though, the study is something of a missed opportunity, since the two studies analyse what is in essence the same thing, but are not integrated. There are many gains to be had from integrating these two studies. One would be picking up on inconsistencies, such as the different ways the two techniques handle unemployment. Another is measuring the benefits from

1 I am grateful to Karl Flowers and Mike Tretheway for helpful comments and information. All errors are mine.

inbound (and the costs of outbound) tourism, which are important in the case of an international airport- CGE can be used to measure these benefits which CBA has big difficulties with. Finally, CGE analysis can get a handle on the costs of global and national externalities in a way that is beyond CBA.

Apart from these major issues, there are some other issues that are common to airport investments around the world- these include the handling of externalities such as noise and emissions, and the impacts of investments in High Speed Trains (HST). The Sydney experience is not very different to that of other cities.

In this paper, most attention is given to the three major issues identified here. It is necessary to begin with some background on the Sydney situation. This is a paper about Sydney, but it will make some comments on London. This is for several reasons. London's airports are the most fully analysed anywhere (other than, perhaps, New York), and there are many lessons from London. Another is that the Australian institutions, particularly concerning Airports, are similar to (and indeed, modelled on) those of London. Finally, for this Roundtable there is a particular interest in London.

2. BACKGROUND

2.1 History

Currently Sydney airport is the only airport in Sydney for regular public transport. There is also a large general aviation airport (Bankstown), which can, though does not, receive scheduled flights, and there is an Air Force (Richmond) base with a long runway on the outskirts of Sydney. There are some small general aviation airports, but the nearest other airports which can handle jet aircraft are those in Canberra (290km away from Sydney- about the same distance from Sydney as Manchester and Leeds are from London) and Newcastle. Thus there is no extant or likely competition for the airport. The airport has been in operation for over 90 years.

Sydney Airport is close to the city centre at 8 kms. It is a coastal site, which is small, at 907 hectares, and land constrained. It is hemmed in by port developments, light industrial sites and residential uses. Sydney, like other Australian cities, is a car oriented society. Since 2000 there has been a railway to the airport, however this is expensive and not heavily used. It is privately owned, and there have been calls, most recently by the Joint Study (2012), for the prices to be lowered. There is limited public transport competition- a bus to the CBD was in operation till shortly after the railway commenced, when it was removed as it was too effective a form of competition. Private cars and taxis are the main form of access to the airport. Routes to the airport are becoming congested, and it will be expensive to add capacity- thus better use of rail is a priority.

Australia's use of aviation is high. The route between Sydney and Melbourne, at about 800 kms, is the 4th densest in the world. Most traffic is by air or car, with a small proportion using long distance buses. The car journey takes about 10 or 11 hours (some sections of the road have still only two lanes). There is one (slow) train per day on the routes to Melbourne and Brisbane. Over the last 25 years there has been interest in a High Speed Train (HST), which would cover the distance between Sydney and Melbourne in three hours, and that between Sydney and Canberra in one hour. Several studies have been done- so all have indicated that the train would fail to break even, though not by much. At the moment there is a currently a further study being done, and one of the aspects which has been particularly emphasised is that a fast train would delay the need for additional capacity at Sydney airport.

2.2 Institutions

In many respects, the institutional arrangements pertaining to Sydney are very similar to those for the London airports. This in not accidental- for most of Australia's history its institutions have been modelled on those of the mother country. Thus in the 1970s there was the British Airports Authority and the Australian Federal Airports Corporation; BAA was privatised in the 1980s, while the component airports of the FAC were privatised in the 1990s and 2000s; and after privatisation most larger airports were subjected to price cap regulation. There has been a similar pattern in other industries.

Sydney Airport was not privatised until 2002, some time after the privatisation of the other major airports in Australia in 1996-7. The delay in privatising Sydney was a result of several factors- the likelihood that major investments in runway capacity being needed moderately soon being the major one. When the major airports other than Sydney were privatised, they were subjected to CPI-X regulation. This was under review by the Productivity Commission PC in 2001-02 (PC, 2002). Before the Review reported, there was a double shock to air transport- the 9/11 shock and the collapse of the second largest carrier, Ansett- both of these resulted in reduced air traffic for Sydney Airport for several years. Shortly before the privatisation of Sydney the Productivity Commission recommended price caps be replaced by light handed regulation, and the government accepted this recommendation (Forsyth, 2003). It is likely that the top bidder for the airport, Macquarie Bank, understood better than the other bidders that this would lead to greater pricing flexibility for the airport. The price that Sydney airport was sold at was about three times that for Melbourne airport, which is about two thirds the size of Sydney. This is not surprising, since just before privatisation, landing fees were doubled. Sydney is the most expensive airport in Australia for airlines to use (ATRS, 2012), and it is profitable.

The airport does face some restrictions. While it is free to set its prices for landing and terminal use, there are periodic reviews by the Productivity Commission to ensure that it is not making excessive use of its market power (the most recent in 2012). While critical of some aspects of performance, the Commission did not recommend any substantial changes to regulation. An airline (Virgin) used access regulation to force it to moderate its prices- this constraint has now lapsed. The Australian Competition and Consumer Commission (ACCC) has a monitoring role in assessing costs service quality and profits- there has been some criticism of the airport's performance in terms of its service quality. On the other hand, it is recognised as being an efficient performer- it has been the top performer in the Australasian area according to the Air Transport Research Society's Benchmarking Report for the last two years (ATRS, 2012). There is a price cap on services for regional airlines (see below on this).

There are a number of interfaces between KSA, its owner, Sydney Airport Corporation Limited (SACL) and other public and private entities. ATC is controlled by Airservices Australia, a corporatised government agency. Roads surrounding the airport are public (State Government) but there are private toll roads close by. The rail link is provided by a private firm using a state rail system. There is a very high degree of contracting out at the airport. An overriding source of tension is that the Federal Government is responsible for airports and the State Government is primarily responsible for ground infrastructure.

An area of contention is likely to be when should additional airport capacity be provided, and who should provide it. When KSA was privatised, the government granted the owners the right to develop a new airport when it is needed. The owners of KSA will have their own incentives, and they may not coincide those of other parties. There are some parties who would like to have an early start on a major new airport, while others would agree with SACL (the owner of KSA) that this is not urgent, assuming that KSA is permitted to expand its capacity. In the past, the government of the day was pressured into making the third runway investment by lobby groups. SACL may not be able to choose its own timetable when investing in a new airport.

2.3 A Second Airport?

The idea of a Second Sydney Airport (SSA) has been on the agenda for several decades. KSA would be very difficult to expand in a substantive way, but it would be also difficult

to replace completely- the land value of the airport would be of the order of $10bn, and it would be worthwhile keeping it as an airport. There was an extensive study done of the possibilities in the late 1970s, the Major Airport Needs of Sydney (MANS) Study (Mills, 1982). This study was very much influenced by the UK Roskill study into the Third London Airport in the early 1970s- indeed several of the personnel of the latter were involved in the MANS study. It used scientific techniques such as Cost Benefit Analysis extensively. A wide range of sites around the fringes of the urban area were considered (though the Lord Mayor did not suggest an airport in the Hawkesbury River Estuary). As it turned out, this study was particularly concerned (rightly) with whether there should be a third runway built in Sydney. It was recognised that if a third runway were built, the Second Sydney Airport could be postponed for some time.

By the late 1980s there was a growing demand that airport capacity be increased. The governments of the day were persuaded, particularly by business lobbies, that investment in additional runway capacity was needed; otherwise Sydney would lose economic activity. By this time, there was some congestion at the airport, though this was moderated by some pricing. A site had been selected for the SSA, and Badgery's Creek, about 45 km from the CBD. There was a political issue as whether a third runway at KSA, or an early start on a SSA with no third runway at KSA was the better option. Eventually the third runway option was chosen (Fitzgerald, 1998). There was no official CBA done of the third runway, though there was a study done by a community group (Airport Co-Ordinating Taskforce, 1990). The runway was given the go-ahead and it commenced operating in 1995.

The additional capacity at KSA meant that there was no urgent need for the SSA. Over time the demand for capacity grew, and by 2011 the SSA was again back on the agenda. A study was commissioned – it reported in 2012 and it argued that additional capacity would be needed if Sydney was not to be subjected to unacceptable delays and rationing of capacity. The case for investment at a number of sites was assessed using CBA- these sites included Badgery's Creek and a more distant option, Wilton. By this stage Badgery's Creek had gone out of fashion, given that it has been an area of urban growth, leaving the current favourite Wilton.

2.4 Meeting Growing Demand

Sydney has reached the stage where there is no longer spare capacity all of the day. The major airport, KSA, is beginning to encounter periods of excess demand. Passenger demand is forecast to rise at about 3% PA, and the growth of movements will be a little below this. Over a period of 25 years demand is forecast to double from 36m to 77m. Sydney is quite susceptible to weather disruptions, with summer storms and wind often stopping the airport from operating at capacity.

The increase in demand is reflected in the declining availability of slots. By 2020, all slots on weekday mornings from 6AM to 12 Noon, and afternoon slots from 4PM to 7PM will be fully allocated, if there is no increase in slot availability (Joint Study, 2012). By about 2027 there will be no more slots for new flights. Even today it is difficult for airlines to gain slots at some popular times, such as late at night, even when weather conditions are benign. Arrival delays are about six minutes on average in peak periods, and departure delays are about twelve minutes at the peaks. There are further constraints. KSA operates with an Operational Plan which shares noise amongst different suburbs under its flight paths- this is possible as it has two parallel runways, along with a cross runway. By 2015 nine hours of the weekday will have demand levels such that the

parallel runways will be needed to be operated, making it no longer possible to operate with noise sharing.

Currently, KSA has a limit of 80 movements per hour, though there are subsidiary caps to ensure that flights are monitored every 15 minutes. The 80 movement per hour is a policy rather than technical constraint- it is estimated that the airport could cope with 85-87 movements in good weather conditions (Joint Study, 2012). The site is a small one, and this constrains the ability to change things. Thus there are few ways in which the airport can be expanded. Apart from runways there are several other constraints which limit output, (for example aprons) though these can be addressed in the short or medium term, though not necessarily easily or at low cost.

There is a particular regulatory constraint which affects the ability of KSA to handle traffic- this is the regional or intra NSW "ring fence". There is a limit to the slots which may be allocated to non regional flights, and there is a price cap on regional flights. This has the effect that small aircraft pay little to use the airport, even at peak times. This is despite the fact that they are slower and more difficult to accommodate than jet flights. It has been argued that this constitutes a cross subsidy to regional flights (TTF, 2013). With adequate capacity at the airport, this has not been much of an allocative problem- however, as demand exceeds capacity more, it will become inefficient.

Currently there is a general aviation airport, Bankstown, which can handle smaller regional aircraft. It does not do so, since it is cheap for these aircraft to fly into KSA. This airport has a short runway and is on a constrained site. Regional aircraft do not wish to fly to Bankstown since connections between it and KSA are slow, and some of the passengers on regional flights wish to connect to interstate and international flights, and it is more distant from the CBD, and is not on a rail line. As time goes, and as KSA fills up, it is likely that some regional flights will shift, especially if they are not cross-subsidised.

There are a number of other options which can provide some capacity. There is an airport at Richmond, just beyond Sydney. This is an Air Force base, which has a long runway. There is some opportunity for it to be used for passenger and freight services. However, it will be very costly to add to capacity, and it would not be as attractive as a SSA at Badgery's Creek. Other airports, such as Canberra and Newcastle are too far to make a large contribution (furthermore, Newcastle is also an air force base). Canberra airport may have some role as a freight airport- it is curfew free.

As with other developed countries, Low Cost Carriers (LCCs) have emerged and claimed a significant share of the market. As noted, there could some scope for LCCs to use alternative airports if permitted and if facilities were developed. However, in the long run, with their greater reliance on point to point traffic, there would probably provide much of the traffic at a SSA (in much the same way that Heathrow serves the legacy carriers and Stansted serves the LCCs).

A factor which will influence when additional capacity for Sydney is needed is whether a High Speed Rail (HST) is built. This would travel via Canberra to Melbourne – the journey time to Canberra would be about one hour, and the time to Melbourne would be about three hours. The line could also go to Brisbane, perhaps via Newcastle. Such a line would be competitive in the Sydney-Canberra market, and also make a different to the Sydney-Melbourne air market). There have been proposals for a HST over the past 25 years- some of these have been evaluated, and the project has so far been judged to be

marginal. There is now an ongoing evaluation of an HST from Melbourne to Brisbane via Sydney. The growth of LCCs would have made an HST less competitive.

Perhaps the main impact on the Sydney airport issue is that it would delay the need for additional capacity for some years. Proponents of the HST claim that delaying airport investments in Sydney will be an "externality", the benefits of this should be counted in as a benefit of the HST. However, it is not clear that delaying an investment would constitute an externality, especially if prices for the HST and the airport were set efficiently (there is a good chance that this will be the case with the airport, though less of a chance in the case of the HST). Ideally, the two investments of additional airport capacity and a HST should be evaluated jointly. An HST would reduce the demand for capacity at Sydney by lessening the number of flights from Sydney and Canberra and Melbourne, and there will be other smaller impacts- for example, Canberra airport may become more attractive for some destinations.

3. LOCATION, HUBBING, CONNECTIVITY AND COMPETITION

3.1 Location

There is an understanding that Sydney will require a second airport at some stage, though the timing is not settled as yet. While there are some smaller airports which can add to capacity, a major Second Sydney Airport (SSA) will be needed. Currently, there are two sites which are preferred, for different reasons. The Joint Study (2012) made it clear that the Badgerys Creek site was its recommendation, based on economic and other criteria. This was settled on in the 1980s and land was purchased on it, though some of this land has now been sold after the government reversed its commitment to build the airport there. Since the original decision in the 1980s, there has been urban development and thus there is an issue of aircraft noise. Furthermore, the area of Western Sydney has become a much more politically volatile area and thus governments are loath to be seen imposing an airport on the community. As a result, the preferred option for the Federal government is an airport at Wilton, which at 65km from the CBD is some km further away. However the NSW Premier argues for the airport to be sited in Canberra, which is 290 km for the CBD of Sydney and out of the state of NSW. There are several other sites, though each of these has their problems, and none are close to the CBD.

There are two sites which have the potential to provide limited capacity. The first is Bankstown, which is the main general aviation airport. This airport is moderately close to KSA. It can handle regional aircraft, though it does not at present. It is a small constrained site, not really an option for a major airport development. Another option is the Air Force base at Richmond, which has a long runway. It may be possible for this airport to accommodate commercial flights. The site could also be used for a SSA, though this would require moving the air force base- furthermore this site has been assessed and other sites are better.

3.2 Is Sydney a hub?

By virtue of its size and geographical position, Sydney is something of a hub, though its hub role is not as important as that of large European and US airports such as Heathrow, Schiphol and Atlanta (this reflects Australia's concentration of population into few large cities). Sydney serves much point to point traffic. There are some hub roles which Sydney serves. One of these is to act as a hub for regional traffic connecting to trunk and international flights. Another is to act as a hub connecting trunk and international flights. Travellers in regional centres may fly to Sydney when catching an international flights, while they may drive when simply going to Sydney. Most international services use large aircraft, such as Airbus A380s, Boeing 747s and 777s- thus a city such as Adelaide, with over a million residents, has relatively few international flights (only recently has it received flights from Emirates, even though there are no traffic restrictions). The largest Australian airline, Qantas, operates a hub in Sydney and channels much of its international traffic through Sydney, even though Melbourne has about the same population as Sydney. Arguably, the main hub for Australia is Singapore, though it may be replaced by Dubai.

Thus there are several hubbing issues which arise from meeting additional demand for capacity at Sydney. One of these arises in the short to medium term. As demand for KSA grows, to what extent does it make sense to handle this growth by moving regional traffic to Bankstown, or more general traffic to Richmond, rather than speeding up the development of the SSA? Furthermore, if traffic has been shifted to Bankstown and Richmond, does it make sense to keep it there once the SSA has been opened?

The other longer term issue is whether there is a case for shifting KSA to the SSA site and creating a mega airport. This option has not been given much attention, perhaps because of practical difficulties. The advantage would be that it would involve only one airport for Sydney, with attendant hub advantages. On the other hand, it would require a very large site, with all air traffic being required to use a distant airport. This option would free up a moderate amount of valuable land, and it is worth questioning whether this advantage would be worth incurring the high surface access costs. It would presumably be unpopular with travellers. As a result, the option of closing KSA has not been given much attention.

However, the issue of when the SSA opens is a real one, and this has implications for the presence of hub economies. If hub economies are regarded as being modest, it may make sense to fast track the new airport, and not make further major investments in KSA. Alternatively, if hub economies are regarded as very large, it makes sense to maximise the capacity of KSA to make the most of it, only opening the new airport when all capacity expanding options are exhausted. While the Joint Study does not analyse this issue, it takes the latter perspective, and recommends that KSA be expanded as far as possible.

3.3 The Economics of Hubs

To a degree, there is an evaluation problem associated with hubs- to what extent are there gains from having a hub? It is worthwhile to separate out three distinct aspects.

One aspect is that of pricing. If prices are not right, there is unlikely to be an efficient allocation of traffic to the various airports in a system. It is important to get prices right at both the old airport and the new airport. Thus landing charges and slot allocation need to ration the old airport's capacity efficiently. When there is a new airport, it is important to ensure that capacity is priced at its marginal or opportunity cost. This can be a challenge- often there is a desire to ensure that the new, and possibly expensive, airport recovers its average total costs from day one. However, it is likely to be the case that capacity will be ample and marginal costs will be low- well below average costs. If prices are set to cover costs, there will be an efficient allocation of capacity between the two airports- and potentially, benefits of hubbing will be lost.

Indeed one question which can be asked is- is there anything more to hubs than ensuring that prices are right and traffic is allocated efficiently? In other words, can one leave it to the market to allocate traffic to the different airports if capacity is priced efficiently? The extent to which hubs form will be a reflection of market process and no further intervention is needed. This will be an issue when we do an evaluation such as a CBA.

A second aspect is the history of the situation. Some airports have capacity, while others, such as planned new airports do not. It may be cheap to add to airport capacity at one airport, because it is already there (eg Richmond) even though this may mean that gains from better hub opportunities at a new, planned, airport may be lost.

A third aspect is that there may be external economies which come about as a result of hubs. Thus, even when all prices are set efficiently, the allocation of traffic may not be efficient. As a result, there may be a case for intervention- the market will not give rise to an efficient allocation of traffic. An example of this might be with the option of moving regional flights to Bankstown, rather than fast tracking a SSA. The users may be content with this option, but it would lessen the benefits from hubbing, and it may be less efficient overall. (A London example might be choice between additional runways at Heathrow compared to new runways at a new site- the latter may be the preferred option on cost benefit grounds, but it may not take account of the external economies which hubbing brings).

Thus there may be external economies brought about by hubbing, but the difficulty is how to measure them, and include them in CBA or CGE evaluations. It may be possible to develop theoretical experiments to measure the gains that airlines and their passengers make through hubbing opportunities, though as with all externalities, it is difficult to develop direct measures. Policymakers will need to make judgements about how large there externalities are; for example, when choosing amongst options for regional flights at Sydney. Thus is likely to be an important though not critical issue for Sydney.

3.4 Connectivity

Connectivity is an aspect of airports and networks which has seen more explicit attention of late. In this respect, it is similar to hubbing - the two are different though related. By connectivity of an airport we mean how connected it is to other airports or cities. Various measures of connectivity have been devised. An investment in an airport can lead to a city having more connections, and in this respect, it will provide additional benefits. The measurement of connectivity is relatively straightforward, but the measurement of the benefits is not. It has been argued that the benefits are considerable (Smyth and Pearce, 2007).

As with hubbing, there is a question of whether there is an externality or not. If there is no externality, the benefits of connectivity are captured by the benefits which travellers normally pay for- a CBA or a CGE study would not need to measure the benefits separately. On the other hand, if there is an externality, the external benefit needs to be measured and added to the other benefits and costs in an evaluation.

It can be argued that there is an externality present - this would be similar to the externality which has been recognised through connectivity in telecommunications (Forsyth, 2012). The travellers will gain from the benefits which connectivity brings, though they pay for this benefit. However, in addition, others gain- for example business partners on relatives or friends. Thus there is an externality present. There is a problem of measuring how large this externality is (for a suggestion, see Forsyth, 2012).

If there is an externality present, an evaluation of an airport needs to take this into account. The typical CBA of an airport does not do this. The Joint Study (2012) does recognise the relevance of connectivity, though it does not include it in the quantitative analysis.

3.5 Competition- Is it Feasible for Sydney?

Effectively, Sydney airport has little competition for its services. The nearest major airport capable of providing (most of) its services is Canberra Airport, nearly 300km

away. As a result, there is little interest in whether competition for KSA can improve performance. This may change as capacity is increased. There us very little hub competition from Melbourne and Brisbane.

The most obvious may in which this may happen is through a SSA. In principle, the two airports could compete. There is a difficulty however- the owners of KSA have the right to develop the SSA (a legacy of a government keen to maximise the proceeds of privatisation). Given that the regulatory environment in which KSA operates is relaxed, and that the profitability of the airport is high, this curtailment of future competition has a cost. Having two, rather than one, airports will still leave a duopoly, and the gains from additional competition may not be great, but this remains to be seen. One possibility might be that the owners of KSA could be bought out, and relinquish their claims to operate the SSA. This has happened in other industries- for example, the NSW Government bought out licences in the egg industry in the 1990's. However, airport licences will be rather more expensive than hen licences.

There may be some scope for competition from the other airports, Bankstown and Richmond, where the owners are separate from those of KSA (in the case of Richmond, the Defence Department). Neither airport would be likely to provide strong competition, but there might be some positive effects. Thus, in the case of Bankstown, competition would be limited to the regional airlines- but this could be valuable, given that this category of airline is regarded as under financial threat, and airport prices to these are under a price cap. Richmond would be convenient for passengers in the North-West of Sydney, a rapidly growing area.

4. RATIONING EXCESS DEMAND

4.1 The Short Run Problem

With indivisibilities such as airports, there is a period during which there is excess demand- this can be a very long period (Heathrow has been experiencing excess demand for about 40 years). KSA is entering a period of excess demand- after the opening of the third runway, there was ample capacity, and the shocks of 9/11 and the Ansett collapse and the Global Financial Crisis meant that demand grew less rapidly that forecast. However now there is excess demand, in that some demand is being rescheduled- essentially, airlines are having to accept slots at times other than their preferred timing. In addition, there are increased delays. Demand will continue to rise, and while there is some scope to increase capacity, the growth in capacity will fall short of the growth in demand. This means that there will be a capacity rationing problem for many years, at least until the SSA is commissioned, and possibly longer.

There are several ways in which airport capacity can be rationed. The three most commonly used or proposed are allowing congestion and delays, slots and pricing.

The first of these is used with most of the airports in the US. Airport delays have been a growing problem since the late 1960s. The costs are growing, and they are very substantial. In spite of this, little has been done about it- slots have been tried, though most slot systems have been abandoned, and prices have not been used, in spite of considerable scientific support for them. It is unlikely that this approach will be used in the case of KSA.

By far the most extensively used rationing device around the world is that of slots (see Forsyth et al, 2008). Slots are used in Europe, Japan and other places in Asia, and the mechanisms for a slot system are in place for the larger Australian airports, such as KSA. Other things equal, it might be expected that KSA capacity will to be rationed by slots. However, things are not necessarily equal.

The third option, pricing, or the use of landing charges, is very rarely used. Interestingly, one of the few examples of it was at KSA. In the years before the opening or the third runway, there was a minimum charge at peak times, to discourage small aircraft. This was removed when the runway was commissioned and when there was adequate capacity for all. Other airports, such as London's have had experiments with peak prices.

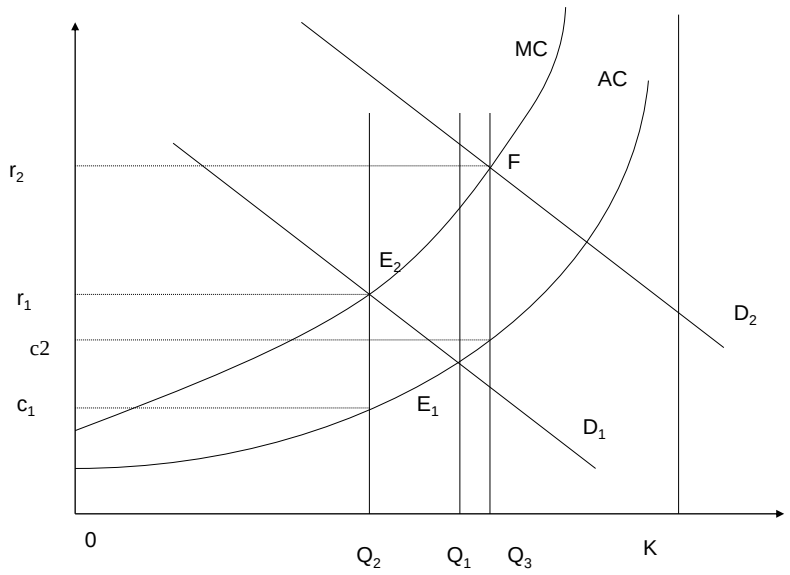
The different options are shown diagrammatically in Fig 1 (see Forsyth and Neimeier, 2008). The airport's capacity is shown as K, and the average congestion cost is shown as AC. With a demand of D1, the US solution is at E1, where price is above c1, and marginal cost, MC, is well above. A pricing solution or a slot solution would give an equilibrium of E2, where there the price or the slot rent will be r1-c1. An efficient solution to the capacity rationing problem would require that there is some congestion- for example, E2 could be a long run efficient solution (and under constant returns to scale, the price or slot price, plus the average congestion cost will be equal to the long run marginal and average cost). Comparing the US and European (and other) countries's solutions, for an

airport of given capacity K, average congestion costs will be higher than in Europe, though the US will be getting more output from the airport. Prices and or slot prices will be higher than in the US. Even though the US appears to be getting more output from its airport, the European airport is more efficient, since it achieves prices at marginal cost (it is sometimes said that the US gets more output from given capacity than Europe- this is true, and it is more efficient).

The situation at KSA is that the airport is currently well to the left of Q2- additional capacity is not needed yet. (It is arguable that the third runway was built too early because of pressure from the business community and politicians).

Over time demand will increase- say to a level D2. If capacity does not increase, the efficient solution will change to F. In this situation, prices or slot prices are clearly higher than before. However, it is notable that average congestion costs are also higher. If it were possible to increase capacity by divisible lumps, it would be efficient to do so, up to the point where the price is restored to r1. The gains from expansion would be (a function of) the slot rents or prices, and this would be set against the capital cost of the additional capacity. In the more likely case where capacity expansion is lumpy, the time when additional capacity is worthwhile will be determined by the slot prices, the congestion costs and the cost of increasing capacity.

Figure 1.



The likely scenario for KSA is that it will be rationed by slots or possibly, a combination of slots and prices. A slot system is already in place, though not slot trading. As with other slot systems, it will develop over time. At the moment, capacity is adequate for much of the time, though more and more hours would become constrained, and over time there will be fewer hours with capacity available.

The important issue is how efficient the slot system will be. An option which attracts attention is that of auctioning slots. This would require some institution to conduct the

auction, and there is an issue of how the proceeds should be allocated. Few slot auctions do exist. An auction is likely to be efficient however. There are other aspects of auctions which also are attractive –in particular, the gainers from auctions do not have a vested interest in lessening capacity, as incumbent airlines do. Most likely, a slot system will evolve which involves some degree of trading, and a slot trading system can be just as efficient as an aucttion. There are some countries, notably the UK, in which slot markets are well established and trading is relatively free. On the other hand, for most countries, slot trading is at best opaque and at worst prohibited. The EU is trying to create and foster slot markets, though progress has been slow.

It would certainly be feasible to create a tolerably efficient slot market for KSA- though there is a question of whether it will come about, given the interests of the airport and airlines. The current arrangements are somewhat opaque- they involve an administrative system, and there does not seem to be any overt trading. At the moment, with little excess demand, this many not be an issue. However, over time it will become an issue, and slot trading will be essential if efficiency is to be achieved. There will need to be a specific structure which facilitates slot trading. While slot trading is not widespread in Australia, it has been suggested in a number of situations, such as slots for ships waiting for coal loaders, and the competition authority, the Australian Competition and Consumer Commission (ACCC) has become interested in the problem.

A particular aspect of the slot trading problem which will become important will be that stemming from the regional ring fence. There is a fixed number of slots which are only available for regional flights (and regional flights pay a lot less to use the airport than flights using larger aircraft). There may be situation whereby there are no spare slots for non regional flights, but there are spare regional slots. Further, even if both types of flights are in excess demand, there can be a much higher slot price for the open slots than for the regional slots. This poses a question- will the regional airlines be permitted to sell their slots? If the objective is the efficient use of the airport, they will be. However there are several other considerations which will influence policy. For example, regional centres will oppose trading as it could result in them losing service to Sydney. This issue will link in with that of to what extent other airports such as Bankstown and Richmond will be developed to take demand pressure off Sydney.

4.2 Light Handed Regulation and Pricing

As mentioned, pricing is not often used as a rationing device at airports. Publicly owned airports are often expected to charge prices which are at average cost- this precludes their use as a rationing device. The same is true for privately owned airports, such as London's, which are regulated (ie, most of them). Regulators set prices which are close to average costs. This results in prices which are above marginal cost when the airport is not heavily used, and which are well below marginal cost, or the efficient rationing price when demand is in excess. In this situation the slot system takes over the rationing function. This can have the effect of slot prices being very high relative to prices to use the airport. Thus in London the regulator, the CAA, regulates airports such as Heathrow so that prices (landing charges) are close to costs, and as a result, British Airways enjoys very substantial slot rents (the value of the slots issued to BA free of charge on the basis of historical aircraft movements)..

Australian airports, such as KSA, have been subjected to a form of light handed regulation since 2002 (after the Productivity Commission Report of 2002), - this means that the airports can set their own prices, subject to some scrutiny by the Productivity Commission and the ACCC. The airports are supposed to be efficient (whatever that

means), but can they charge very high prices when they are in a situation of excess demand? The Productivity Commission has given some thought to this issue (PC, 2002, Appx H), and it has stated that if high prices, say at KSA, are needed for efficiency, then it is permissible for the airport to charge them.

This poses some interesting issues. It suggests that KSA would be permitted to charge prices which are well above average costs as long as they serve an efficient rationing function. KSA may be able to use prices rather than slots. Clearly, it has a strong incentive to do so, since it would be appropriating the rents which normally go to the airlines as slot rents. However, there is ambiguity in the Productivity Commission's statement- high prices do serve a rationing function, but they are not strictly *needed*. After all, efficiency can be achieved with slots.

It may not be the case that KSA would have to charge higher average prices- reform of the price structure is feasible and desirable. Uniform prices, rather than the current weight based prices, will enable more passengers to be served at the peak through the use of larger aircraft. Smaller aircraft may still use the airport, but at less busy times (and if Bankstown and Richmond are available, they are likely to use them, along with LCCs). As demand grows at KSA, there will be more pressure to enable slot trading between regional and other flights, and reform of the price structure.

It is not clear just how much freedom KSA will have in setting its prices. If, over time, prices rise to become well above costs, constraints may be imposed. It is possible that a combination of slots and prices may be used to ration demand. If slots are tradable, this could be quite an efficient outcome, at least in the short run. Other airlines and the airport will be sharing the rents generated by demand being in excess of capacity. However this environment could give rise to problems in the long run, as will be shown below.

4.3 The Long Run Problem: Timing

Pricing is closely related to the timing question. The timing issue comes about because airports are characterised by indivisibilities, and there is discretion as to when they should be built. With large capital investments, there will be large gains to getting timing right- delaying an investment in a new airport by 3 to 5 years will be well worthwhile. Thus there is a choice between gaining the benefits of the new airport sooner and the costs of investing earlier. The benefits of the new airport are the costs avoided when airport capacity falls short of demand. There are several ways in which these costs have been measured.

The Roskill Commission argued that, over time, congestion would develop, and it measured the cost of this congestion. However congestion is neither the efficient or likely way that excess demand would be handled in London- either pricing or slots would be a superior method, and as a result, the costs of delaying construction would be less (Forsyth, 1972). As demand increases over time, there will be some additional congestion (see Fig 1) but a large part of the cost will be the opportunity cost of travellers who are willing to pay to use capacity but cannot since the capacity is not available. A measure of this cost will be a function of the landing price or slot price and the elasticity of demand (the consumer's surplus foregone). Something like this approach is very often used in assessing when to build an airport.

The Joint Study (2012, Part 5) uses a somewhat different approach, though one which has its merits. It uses a CGE model to estimate the value of the lost output (in terms of

GDP and Gross State Product (GSP). The Study mentions that it includes delay costs to passengers, impacts on freight and airports and impacts on commercial developments. What it does not explain is how there effects are integrated. Some of these effects are those which might be counted in a traditional approach, as outlined above. However, others such as the impacts on tourism and commercial development are rather different. Some or all of these effects could be quite valid, and worth including in a study of timing (and more generally in an evaluation of the airport).

The Joint Study also makes an estimate of the impact on jobs- it is argued that delaying the airport will lead to fewer jobs. This is rather implausible. Employment is primarily determined by macro forces rather than micro economic interventions, such as building airports (if this were not the case, unemployment would be pretty easy to fix). There may be some short run effects on employment, but this Study is one for the long run- by which time short run reductions in employment would have had time to correct themselves. Many CGE models assume full employment over this span of time. By including employment impacts, the costs of not building the SSA, as measured, are higher.

The issue of relationship of CBA and CGE is discussed in the next chapter.

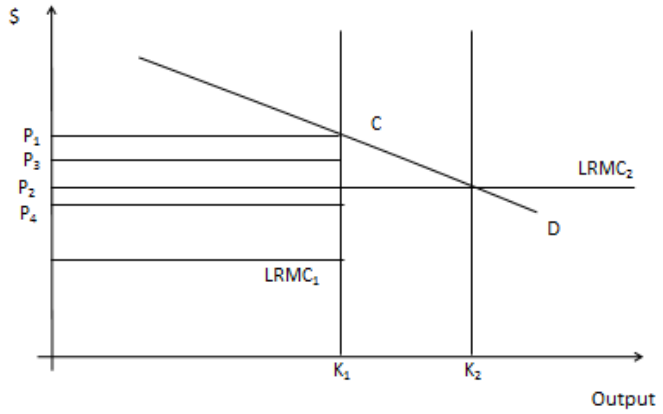
4.4 Are there Incentives for Efficient Investment?

It is one matter to analyse when the new airport *should* be built. It is quite a different matter to determine when it *will* be built. In the Sydney environment, the airport is a private firm subjected to light handed regulation. The airport chooses the time at which it will build the airport- but does it have the incentives to build it at the right time?

There is doubt concerning this. The airport is a private firm, and arguably a profit maximizing one (it is a subsidiary of Macquarie Bank). While the airlines are subjected to some competition, the airport is not. It has some market power, and it has some incentive to use it. It may use market power when it comes to the timing issue.

This situation is shown in Fig 2.

Figure 2



The demand for this airport is D, and with this demand, additional capacity is clearly warranted. At a price P2 the airport will be covering the long run average and marginal cost. If prices were set (eg by a regulator) at this level, there would be excess demand, unless there were an additional mechanism- such as slots. With these arrangements, the airport will be prepared to invest, though the airlines would oppose an addition to capacity, since they would lose their slot rents. Alternatively, if the airport were permitted to set prices such that excess demand were eliminated, the airport would have a strong incentive to keep capacity at K1. The airlines would be indifferent.

Finally, it is very possible that both airlines and airport gain from the restriction in capacity. If the airport were to charge P3, the airport would gain from the profits brought about by the restriction in capacity, and also the airlines would enjoy profits, though these would be less than when they gained all the slot rents.

This simple example shows why it may be difficult to set incentives for the airport to invest at the optimal time. The airport will be aware of the profits it and the airlines enjoy from capacity shortfalls, and will continually argue that "expansion is not needed yet"- certainly the owners of Sydney Airport argue that the SSA will only be needed a long time in the future. This situation may be a factor in London - the airlines gain enormously from the capacity shortfall (to what extent do they realise it?) and possibly, the airports. No matter what they say, do they really want expansion?

5. EVALUATION OF THE OPTIONS

5.1 The Parallel Universe of Two Evaluations

The airport options facing Sydney have been subjected to quite detailed evaluation, and in the main, this evaluation has been quite rigorous. There was extensive use of CBA in the MANS study, though there was no CBA of the Third Runway at KSA in the early 1990's. The recent Joint Study (2012) revisits the issue, and also provides a moderately thorough examination of the need for a SSA. The different site options are subjected to CBA. The CBA is conventional, and seeks to measure the infrastructure costs, including those for land access. The benefits from having the SSA include consumer surplus benefits along with delay reduction benefits (the latter, accruing to passengers and airlines, are about 25% of the passenger consumers surplus benefits, which is consistent with efficient capacity allocation being used- as is likely). The Study makes an assessment of some environmental costs, including Greenhouse Gas Emissions and noise, and makes a qualitative assessment of social and other impacts.

However, what is different, and perhaps strange about the Joint Study is that it presents two, and different, assessments of the need for additional capacity at Sydney (in different sections of its Report). The costs and benefits of additional capacity are assessed using the CBA described above, but in addition, there is also an assessment of the economic costs of not building it- this uses a CGE approach. What is more, the results of this approach are related to the results of the CBA. This poses several questions- the most fundamental being which approach is correct- the CBA, the CGE, both or neither? While it may seem a strange situation to those outside Australia, there are several precedents such as the assessment of Melbourne urban transport options by the Eddington Report (2008), which sets out different CBA and CGE analyses but does not draw any link between the different assessments. Ultimately, there should be a links between the benefits of building the SSA, as measured by the CBA, and the costs of not building it, as measured by the CGE analysis. They are aspects of the same problem. Parallel universes belong to TV shows such "Red Dwarf", not economic evaluation.

5.2 The Roles of CBA and CGE

While CBA and CGE are ways of measuring the same thing, in this case how much better the economy will be if an airport is built, they are not the same thing. Both of the techniques have limitations, as well as advantages. Both involve making approximations. Some of the differences are as follows:

- CBA can measure all aspects of an evaluation problem, while a CGE analysis is constrained by the formal model it uses. Often the model is at a high level of aggregation. This limitation can be addressed by creating sub models to explore more deeply the specific markets that are of interest. For example, a model may have only an overall transport section- but sub models can be created to explore markets of interest- such as an NSW air transport market

- Many effects are location specific, such as noise. It is not easy to incorporate these in a CGE model. Modellers can retrofit particular aspects of interest outside the model.

- CGE models are not adept at handling many externalities- on the other hand, they can be better than CBAs at handling externalities such as global emissions.

- CBA tends to have difficulties in handling macro effects, such as the effects of a project on a state economy, or the impact on employment. While a CGE study does not give you the unambiguous answer, it can prove you with a means of calculating sensitivities, such as the impact of a project on unemployment.

- While CBA can be a general equilibrium technique, its use is effectively partial equilibrium. To determine what the general equilibrium effects of a project are, one needs to employ a CGE model.

The recommendation here is that both CBA and CGE approaches be used, especially in the evaluation of a major investment such as a SSA. The two are complementary- by using both, one can derive a better overall evaluation of the project. The more standard approach is to use CBA, but there are distinct limitations in the case of evaluating airports such as:

- The inevitable partial aspect of CBA;

- The problems with handling key aspects of benefits and costs, such as the benefits of tourism;

- The inability of CBA to handle macro aspects such as unemployment;

- The inability of CBA to handle distributional aspects;

- And the difficulties CBA has in measuring national or global externalities such as greenhouse gas emissions.

In each of these aspects, CGE models can help get a more accurate evaluation of a project such as the SSA. The two analyses of the Joint Study do help in providing information for decision makers, though the fact that they have been done as quite separate exercises limits their usefulness.

CGE models can be used to estimate distributional effects, whereas CBA is very weak on this- CBA can estimate initial incidence, but not ultimate incidence.

5.3 The Criterion- Welfare or GDP?

One of the problems with integrating CBA and CGE assessments is that the results are presented in different ways. Typically, a CBA will yield results in terms if a project's contribution to net present value or welfare in monetary terms, whereas as a CGE assessment, at least in Australia, will measure the contribution to an output measure such as GDP or Gross State Product. This is a presentational rather than a fundamental difference because the two can be converted from one to another. Under certain circumstances (eg no changes in factor supplies) GDP is an approximate measure of net benefit (subject to the way in which the national accounts are measured). Some CGE

models measure welfare in the same way as done by CBAs and also GDP. In other cases, more adjustment needs to be made. When additional labour is being used, the cost of this factor needs to be deducted from the increase in GDP- the wage rate can be used, though it may be necessary to use a shadow wage rate if the wage rate does not measure the opportunity cost of labour. Likewise if additional capital is used, the cost of capital needs to be deducted from the addition to GDP to gain a measure of how much better off a country is as a result of investing in a project, such as the SSA.

5.4 Specific Issues: Jobs, Inbound Tourism and Emissions

One of the advantages of doing things two ways is that inconsistencies become apparent. This is the case with the evaluations of the SSA. The CGE analysis shows that there will be more employment if the SSA goes ahead than if it does not- ie, the project contributes to jobs. If this is the case, GDP is not a good measure of how much better of Australia is if it invests in the SSA- the cost of labour needs to be deducted from the increase in GDP. On the other hand, there is a different story being told by the CBA- this assumes that labour should be costed at the wage rate and that there is no particular advantage in additional jobs being created (in other words, there is no need to shadow price labour). If investing in the SSA avoids job losses, as the CGE analysis says, why does the CBA say nothing about this?

An important way in which a CGE approach has an advantage over CBA is that it can provide a rigorous measure of the benefits to an economy of inbound tourism (and costs of outbound tourism). This is particularly relevant for evaluating airports, since a high proportion of the travellers through it will be foreign nationals- tourists in the broader sense. A normal (essentially partial equilibrium) CBA has problems in grappling with measuring this. Tourists buy goods and services in the home economy, and these have a cost. The gain which the economy makes is from the difference between what the goods and services cost and the price that they are sold to the tourists at the margin will include taxes, profits if any, and other rents, such as airport slot rents. These are effectively impossible to measure in a partial equilibrium analysis. However they are straightforward to measure in a CGE analysis.

There have been a number of studies done of the impacts of additional inbound tourism, either in terms of GDP or welfare (Forsyth, 2006). They suggest that additional inbound tourism is positive for the economy. For Australia, the net gain is about 5-10% of tourism expenditure, while for the UK, it is somewhat higher (consistent with higher taxes such as VAT) in the UK (see Blake, 2005). There have also been some studies done on the cost to and economy of the costs of outbound tourism (Tourism Research Australia, 2011). There is no longer any need to make arbitrary guesses about the benefits (or costs) of inbound tourism.

The Joint Study is interesting on this question- there have been different answers being given to the question of what inbound tourism is worth to the Australian economy. The CBA argues that it is important, and measures tourism benefits at about $3bn, (where total benefits are about 7bn). However, this study makes what appears to be an ad hoc assumption that these benefits are 25% of tourism expenditure. In the light of available studies, this appears to be very high. It does not appear to make any allowance for the costs of *outbound* tourism. The CGE analysis also recognises the importance of inbound tourism and it includes a measure of the tourism expenditure in the inputs to the model. However, there is no breakdown of the various inputs and outputs to the model analysis- all that it provides is a net impact on output and jobs. Most likely, the CGE study would have produced rather lower impacts if earlier studies are anything to go by. Thus there is

likely to be an inconsistency in the different ways tourism benefits are handled in the Joint Study. It must be recognised that research in this aspect of tourism in its infancy, but this is no reason to make distinctively ad hoc assumption when it comes to measuring a quantitatively important aspect of airport evaluation.

Another way in which a CGE analysis has advantages over a partial equilibrium CBA is in handling the costs of greenhouse gas emissions. Measuring these emissions is a classical general equilibrium problem, since it involves measuring the emissions of the whole of the economy (and world?), not just the emissions of a specific industry or project. It is often easy to measure the emissions of a project such as an airport, but such measurements can be quite misleading. For example, additional flights from an airport will lead to additional emissions. However, the overall net emissions could be quite different. More flights may be consistent with more cars on the road, and the net impact could even be negative, though this is not likely. Typically, CBAs will measure the direct impact of emissions, along with its cost. On the other hand, it is a quite straight forward to develop a CGE model which has the ability to measure emissions (and example from Australia is MMRF-Green- see Adams et al, 2000). Using this model it is possible to revaluate the net change in emissions as a result of a project such as an airport.

This is another area where the Joint Study can be improved upon. The CBA makes an estimate of the cost of emissions in its CBA. This appears to be a typical partial equilibrium study. On the other hand, the CGE study does not seem to have allowed for emissions- as noted above, it would have been quite easy for it to have done so.

5.5 Benefits and Costs- to Whom?

When there is a project like an international airport, the question arises as to whose benefits and costs are being counted- is it residents and companies from a State, a nation such as Australia, or the whole world? A thorough evaluation might provide results for all these. The issue becomes relevant because all three are affected.

The CGE modelling takes into account the implications for the state of NSW and Australia. It recognises that there are both local travellers and tourists, though it does not explicitly set out how each of these are affected. It is also the case that airlines and the airports are partly Australian owned and partly overseas owned. If one were to do a study which only takes into account Australian profits and losses, their profits and losses which accrue beyond Australia should not be taken into account. It is not clear whether the CGE study does this or not (and how the profits and losses which accrue to Australia was measured).

The CBA does make an explicit statement that only consumer benefits accruing to Australian were counted. It then measured the benefits accruing to Australia from inbound tourism (though it does not seem to have measured the costs of outbound tourism). Like the CGE analysis, it is not clear on whether the ownership of airlines and airports was taken into account, or whether it was tacitly assumed that all airlines and airports are fully Australian owned.

In this respect the discussion in the Joint Study is distinctly unclear.

6. EXTERNALITIES

6.1 Greenhouse Gas Emissions

Greenhouse gas emissions look like being an important externality of the SSA. As noted above, it has been accounted for in the CBA. The costs are surprisingly large. Infrastructure and maintenance costs for a typical site is expected to be about $3bn, whereas environmental costs, mainly effects of additional flying on gas emissions, are expected to be over $700m. This may well be because emission costs can be expected to rise substantially over time- this will be reflected in taxes or emissions permit charges. As noted above, there are questions surrounding how these costs have been calculated- a CGE approach might give a rather different answer to the question of what the net effect on emissions will be.

Currently, Australia does have an emissions policy, and this will have an impact on the airport. At present, Australia has carbon tax, set at $23 per tonne of carbon emitted. By 2015 this is scheduled to be changed into an emissions trading scheme. Interestingly, this scheme is now planned to allow trading with the EU scheme. Currently, EU prices are well below the Australian tax rate. This may change as the EU economy recovers. The Australian tax/scheme is a general one, covering most industries. However, only domestic aviation is covered- international aviation is not. This policy may not last, as the opposition has vowed to repeal the policy and not have any taxes or ETS.

This poses an issue about how aviation and airports will be treated in the future if international aviation continues to be excluded (this may not happen, as ways may be found of including international aviation). There may be some second-best mechanism which takes international aviation into account, until it is included in the ETS.

At least so far as domestic aviation is concerned, and perhaps later on international aviation, there will be no economic reason why the airport should be subjected to any further imposts or regulation. If the tax or ETS is calculated such that it reflects accurately the expected cost of the externality, it will be efficient to take no further action. Aviation will face the same prices for its emissions as every other industry. Nonetheless it is the case that there are calls for "more to be done" about the emissions produced by aviation, even they are the same as the emissions generated by other forms of activity. Targeting aviation and airports would in this way would raise the cost of reducing emissions without reducing the overall level of emissions.

6.2 Noise

In common with many airports which are close to the CBD, KSA has a noise problem. While this has been the case for many years, it came to a head with the opening of the third runway in 1995, which provoked community anger. There are several ways in which the noise problem is addressed. Most obviously, there is a noise curfew. There have been buy-backs of houses which have been affected by the increase in noise from the third runway. In the past there have been charges on flights to cover these buybacks and to fund insulation. Flight paths are designed to lessen noise nuisance, though these reflect

the technology of the 1990s, and they may not be very effective in reducing noise nuisance. There is not much incentive for airlines to optimise flight paths with a view towards minimising noise and emissions. The number of flights per hour is limited, and to some extent this is a noise reduction measure, though its effectiveness has been questioned.

The second airport will be located where there will be less problem of noise. The original chosen site, at Badgery's Creek, was, at time of its choosing, relatively remote- however, over time urban development has caught up on it. This is one of the reasons why politicians and community groups are arguing for a site at Wilton, which is significantly further out from the CBD. Noise costs have been included in the CBA. The estimated noise costs at all of the possible sites are very small in comparison to other environmental and other costs.

7. CONCLUSIONS: WHY SYDNEY AIRPORT IS NOT A DISASTER

Around the world, airports are difficult pieces of infrastructure to get right. While there have been many disasters in Australian infrastructure provision, Sydney Airport is not one of them. There have been relatively few problems with Sydney airport. Investment in capacity has mainly kept pace with demand, additions to capacity have been evaluated carefully, excess demand has been rationed fairly efficiently, and overbuilding and gold plating has been avoided. So far, so good.

The next few years will challenge this. There will be a need for more investment in KSA, there will be a need for smaller airports in the region to have a greater role, and later on, there will be a need for a major new airport. There is scope for poor decision making. The available airport capacity may not be used. The growing demand for KSA may not be efficiently rationed. There could be effective pressure from lobby groups for capacity increases which are expensive and too early. When the time comes for major expansion of capacity, vested interests may prevent investment. When this investment comes about, it may take place in a poor location. However, the airport needs of Sydney have been well studied, and poor decisions will not be accidents.

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