International Transport Forum

Expanding Airport Capacity in Large Urban Areas

Roundtable Report

OECD

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Executive Summary

1. Introduction

Expanding airport capacity is difficult in large urban areas. Expansion of existing airports is usually constrained by community agreements on noise and local air pollution and by a shortage of land. Finding sufficient land, at feasible prices, to develop or relocate major airports on green-field sites within a reasonable distance of city centres is often very difficult. Creating land for airports in locations less sensitive to noise and land-use conflicts, for example through offshore or estuarine land reclamation, is expensive and most new sites will require extensive investments in surface transport links to city centres. Furthermore, moving an airport imposes costs on airlines and their users as well as on activities located close to and dependent on proximity to the existing one. In multi-airport regions, options for expansion at one airport will impact the others and airlines, operating in increasingly competitive markets, may respond differently to alternative ways in which the region's airport capacity might be increased.

Many major airports are hubs for network carriers at the same time as serving a large local market. The complementarity between these functions is often seen as a prerequisite for viable network operations, suggesting that regulatory controls to distribute services over multiple airports can be costly in terms of connectivity for the local market, as well as the competitive position of the hub carrier(s). Hubbing operations also face competition from network carriers based at other hub airports, often in neighbouring countries. The strategies of network carriers and alliances need to be taken into account in assessing future demand for airport capacity. The requirements of other carriers are also important, but may differ. All parts of the market are experiencing change that will affect the pattern of demand for airport capacity in the future. This includes legacy carriers establishing low cost operations and the development of links between some low cost carriers and network carriers, code-sharing in some cases.

Decisions on expanding capacity for traffic through London's airports exemplify these interactions and constraints, and the UK Airports Commission has been established to examine the options for meeting capacity needs in the short, medium and long term.[1] The Roundtable was convened to review international experience in reconciling planning and environmental constraints with market demand for airport capacity, setting this in the context of the potential benefits – particularly in terms of productivity and economic growth – which flow from an increase in international airline services. In simple schematic terms, the main options for London might be characterised as: expanding capacity at Heathrow (the largest of the London airports); developing a large replacement hub airport in the Thames Estuary (or elsewhere) to minimise noise and land use conflicts, accompanied by the closure of Heathrow; or expanding capacity organically, where most feasible, in some or all of the existing main airports serving London.

The input papers prepared for the Roundtable track planning decisions and operational outcomes in Sydney, and in the multi-airport systems of New York, Tokyo, and Osaka and in Germany. The papers also examine the economics of hub operations and the expansion of airports in relation to multi-hub airline operations and review the way separate airport planning decisions in Germany, along with airline acquisitions, have resulted in Lufthansa becoming a multi-hub carrier. In addition to these case studies, the Roundtable – and this report –benefitted from the emerging findings from an extensive programme of research and analysis which is being taken forward by the UK Airports Commission (see Airports Commission Discussion Papers 1-5). These various lines of evidence are instructive as London now contemplates whether, and how, to best expand its increasingly congested airport capacity.

The case studies considered at the Roundtable show that expanding airport capacity in major urban areas is characterised by a fundamental trade-off between economic and environmental goals. On the one hand, providing additional capacity so that it is highly accessible to central business districts will usually best serve the community's economic goals. On the other hand, environmental goals will (in broad terms) usually be best served by airport capacity which is sited well away from centres of population. The outward spread of major urban areas over the last fifty years, combined with similarly rapid growth in air transport over that period, has only served to sharpen the importance of this trade-off.

Each of the case studies exemplifies this trade-off in different, and distinctive, locations. The studies show that a range of different solutions have been adopted, including:

- Newly established, and distant, airport capacity (in Osaka, Tokyo and, to some degree, Berlin or, prospectively, Sydney);
- Innovative development of existing capacity (for example, at Tokyo Haneda);
- Split development across two hubs (for example, Frankfurt and Munich);
- Maximising the utilisation of existing assets (in New York).

Consideration of the various case studies (and, more broadly, of developments in similar urban areas) does not suggest that any particular one of these solutions is clearly preferable to the others. This is not surprising. The central public policy issues at stake involve complex trade-offs whose nature and value will be shaped differently in each location by the interaction of local geography and the structure of the local economy, by local institutional structures and policy preferences (between various economic and environmental goals), and also by the history of previous capacity and the locational decisions which have been made in response to these (with some degree of path dependence). In consequence, different solutions are likely to be preferred at different locations at different points in time.

Accordingly, the main lessons from the Roundtable are not so much about identifying a generalisable, clearly preferred solution to the airport capacity problem (e.g. "always/never invest in new out-of-town capacity as suggested by experience in Osaka/Montreal"). Rather the main lessons are about what might constitute a successful framework for the development, phasing and co-ordination of airport expansion; a framework that recognises the distinctive features of individual locations and uses evidence on these features to develop successful solutions.

These main lessons are drawn together in part 7 of this synthesis report (and are summarised in section 1.7 below). The preceding parts consider the key building blocks. The structure of the report is as follows:

- This first part provides an overview and summary of the report;
- part 2 considers future demand growth, the key driver of congestion and pressures on capacity;

- part 3 considers hub economies, which shape the increased connectivity – and the associated economic benefits – delivered by additional capacity at congested airports;
- part 4 considers the valuation of increased connectivity, particularly in terms of its impact on productivity and economic growth;
- part 5 considers different methods for comparing these benefits of additional airport capacity with the associated costs, particularly negative environmental impacts;
- part 6 considers environmental constraints in more detail, discussing in particular the issues that arise when (relatively) small numbers of people face (relatively) large negative impacts in ways which may result in a more general sense of unfairness; and
- part 7 considers, on the basis of all of this, a framework for the development, phasing and co-ordination of airport expansion.

Forecasting future airport demand

Growth in air travel signals the importance of the connectivity provided by aviation but also drives increasing congestion and pressures on capacity. Because assets are often long lived, often also with long lead times for planning and construction, forecasts of future demand (and the implications for congestion) are the first essential building block for the consideration of the need for additional capacity.

There is a wealth of high quality research evidence on which to draw to produce robust forecasts (see, for example, the review in Oum, Fu and Zhang (2009)) but significant uncertainties remain, in particular in relation to:

- Understanding fully the drivers of past growth (particularly the relative importance of past regulatory reform, developments in technologies and airline business models, and the longer term trends in incomes, trade, and key prices);
- Understanding how some long term trends – income, trade (including the role of trade barriers), and oil and carbon prices – will develop in the period following the present economic downturn;
- Understanding the effects of future innovations on supply – including developments in high speed rail - and associated changes to airline network structures;
- Understanding whether, and if so when, the strong historic link between income growth and air travel demand might start to weaken (as some argue is now happening for car travel – see OECD/ITF (2013) and Goodwin (2012)).

In addition to these uncertainties, there are also well recognised risks of institutional biases in forecasts (as outlined by Flyvbjerg (2009)). Given these uncertainties and risks, it is important that forecasts:

- Make the best use of high quality, relevant research;
- Are carried out impartially, validated by independent expert peer review, are discussed with key stakeholders and thereby command broad acceptance;
- Recognise uncertainties through using a realistic range of scenarios against which proposed investments can be tested (see e.g. Transportation Research Board (2012)).

Hub economies

Hub economies have been central to the economic benefits delivered by increasingly competitive airline networks. Essentially, hub and spoke networks facilitate higher density, and hence less costly, flows of passengers. This also enables broader levels of air service to be provided in less dense markets, which would not be supported by local traffic alone. And it also means that the hub airport benefits from a particularly favourable array of connections.

Looking forwards this has two particularly important implications for investment in additional airport capacity:

- First, hubbing introduces an additional uncertainty into the forecasts of future demand at individual airports – because this will be shaped in part by the development of airline networks, although this uncertainty is likely to be less great in locations, such as London, where local demand is particularly strong.
- Second, hub economies will be a key shaper of the degree of connectivity – and economic benefit – provided by additional airport capacity.

Valuing connectivity

Improved connectivity is the key benefit from adding to capacity at congested airports, through the provision of enhanced airline services. Valuing connectivity is therefore of central importance in comparing the merits of alternative options for expansion.

Different methods of valuation have been used in practice. For small increases in capacity, a market measure of incremental revenues often gives a reasonable valuation (subject to reasonably competitive aviation markets and the nature of any regulatory controls on prices). In these circumstances, decisions to expand capacity can essentially be driven by commercial considerations, and there will be advantages in leaving this to market decision making (subject to appropriate public policies on negative environmental impacts – see Starkie (2008) for a discussion).

However, for more substantial investments, at airports serving major urban centres, a market measure is less likely to capture the full benefits of connectivity (particularly also if there are regulatory controls on airport charges). And in major urban centres the potential negative environmental consequences of airport expansion are likely to be particularly important. For both these reasons, there will usually be a greater public policy interest in comparing the positive impacts (particularly for productivity and economic growth) with the negative impacts (particularly environmental) of airport expansion.

Comparing the positive and negative impacts of airport expansion

As far as the positive impacts are concerned, there is an extensive body of research evidence which demonstrates the key importance of transport (and good transport infrastructure) for productivity and economic growth (see Crafts (2009) for an overview). The critical – and more challenging – question, in the present context, is to work out what this contribution might look like for particular airport infrastructure investments. The papers discussed at the Roundtable show that a number of different approaches have been used in practice.

The first approach, impact (or input-output) analysis essentially aims to measure the economic activity which results from airport expansion – both in the aviation sector and in sectors which are customers or suppliers. This approach can be useful for understanding how the impact of an airport investment might ripple through the economy. But it carries significant risks of overstating (perhaps substantially so) the overall benefits to the economy of additional airport capacity; essentially this is because this approach usually assumes that all of the resources shifted into aviation-related activities provide an additional benefit to the economy, rather than recognising that in practice much of the resource will be diverted from productive activities in other sectors of the economy. It doesn't test whether resources deployed for capacity expansion could be used more productively elsewhere and, more generally, it ignores the cost side of the equation.

A second approach, cost-benefit analysis (CBA), avoids this weakness. It also helps in comparing the benefits to the economy with some of the negative environmental impacts. Cost-benefit analysis is well established in several areas of public policy, with a particularly strong foundation of research evidence and practical application in transport policy (see, for example, HEATCO (2006), an EU project which developed harmonised guidelines for the assessment of trans-national transport projects in Europe). There are two main limitations to CBA in the present context. The first is that it doesn't always capture the full impact of transport improvements upon productivity and economic growth. Essentially this is because CBA measures these benefits on the basis of the improvement in the prices and quality of transport services provided to travellers and shippers; these improvements then spread across the economy as reduced business costs and improved productivity. Whilst the research evidence suggests that this is usually a reasonable measure of the overall benefit to the economy, this isn't always the case (see HEATCO (2006) or Eddington (2006) for a discussion). In particular, recent research shows that investments that improve the transport links serving the central business districts (CBDs) of major urban areas may show significant additional productivity benefits. This is due to three considerations – agglomeration economies (that is, the advantages that firms might realise from being located closer together), more effective product market competition, and improved labour supply (see Crafts (2009) for a discussion). In one case – London's Crossrail – these three considerations together added broadly 50% to the estimated economic benefits of the project. Although this is very probably an exceptional (but important) example, it is interesting to note that the recognition of the existence of agglomeration economies in this case has helped the introduction of an additional tax – of broadly equivalent value – on businesses in the CBD (see Worsley (2011) for a discussion). However, not all of these three considerations will be of direct relevance to airport investment (not, for example, the labour supply aspects). Whilst some additional benefits might be expected, for example the benefits of reduced international trade costs, the available research evidence is at present inconclusive; it does not provide an accepted empirical view from which to judge whether there are any additional productivity benefits of this kind and, if so, how significant these might be. This issue is an important, and active, area of on-going research (see, for example, GARS – IATA (2013)).

The second main problem with cost-benefit analysis is that it doesn't track the way in which the benefits of connectivity ripple through the economy (including a full understanding of the benefits to the tourist industry of additional visitors).

A third approach, computable general equilibrium modelling (CGE), deals with the latter problem. It may sometimes help with the first, although like CBA it is likely to be limited by the lack of good research evidence on the additional productivity benefits of (very) long distance/international connectivity. And in addition, just like input-output models, CGE models will not provide direct evidence on the negative environmental impacts of airport expansion. CGE models can also sometimes be resource intensive and the results are sometimes quite aggregated.

Overall, this discussion suggests that cost-benefit analysis provides an approach which is both well-grounded in the extensive research evidence available on transport infrastructure investment, and in the practical application of this evidence. But it is important to use realistic scenarios to reflect uncertainties in the evidence. This is particularly the case for benefits to productivity and economic growth, where it will be important to look at scenarios which consider the possibility of the kinds of additional productivity benefits discussed above (both by drawing on evidence from other transport sectors, together with any emerging evidence on aviation, and where it may also be useful to draw on CGE analysis, where this is feasible – an approach consistent with the HEATCO guidelines (see HEATCO (2006)).

In addition, cost-benefit analysis has the advantage of taking a wide ranging consideration of both the positive and negative impacts of airport expansion. In this way it helps draw together the available research evidence on the various different impacts of airport investment.

Environmental constraints

The environmental consequences are usually the biggest cost of an airport expansion (apart, of course, from the costs of construction and operation). These environmental impacts can include noise, local air pollution, loss of wildlife habitats or valued landscapes, and greenhouse gas emissions. The potential significance of these impacts has several implications for airport expansion. First, it will be important to carry out an environmental assessment of the different options for expansion. And it is also important to try to value the cost of these impacts, both so that their significance is understood and recognised and so that these costs can be weighed alongside the economic benefits of expansion in a cost-benefit analysis, as discussed in the previous section. There is now extensive research evidence which suggests a basis for valuing the different types of environmental impact arising from transport (see, for example, HEATCO (2006)). But the significant uncertainties in some of this evidence will need to be reflected by considering scenarios. And the ethical concerns which arise when natural and man-made capital cannot easily be substituted also need to be recognised (see, for example, Helm and Hepburn (2011) for a discussion).

But perhaps the most important characteristic of the negative environmental impacts, in the present context, is that they are often (but not always) concentrated on relatively small numbers of people (in contrast to the benefits of expansion, which are more usually spread wide and thin). Where, as a result, the costs are large for the individuals concerned – and where in addition they are difficult to avoid – this often leads to intense opposition. And this opposition often arises even in circumstances where, in aggregate terms, the impacts are perhaps not that large (when set in the context of the other costs and benefits of airport expansion). That there is opposition from those affected is not surprising. But the papers considered at the Roundtable also suggest that there is often a far wider perception of a lack of fairness; and that this often, in turn, drives more widespread opposition to airport expansion. Developing acceptable solutions to this perceived unfairness is often a key requirement for expansion to move ahead successfully.

Noise is usually the most controversial environmental impact and conforms to this pattern. Valuation evidence on noise impacts is increasingly available, but when this is included in a cost-benefit analysis the impacts are often found to be a relatively minor factor when compared with the other costs and economic benefits of expansion (see, for example, Peter Forsyth's paper for the Roundtable). Rather, the key issue is the impact on those who may face more noise. The basic problem is that households and businesses have made location decisions on the basis of existing noise profiles (with perhaps some expectation of their future path). In these circumstances, a (significant) unexpected increase is regarded as unfair, given that there are often significant costs – both financial and non-financial – of re-location. This has sometimes lead to an approach in which airport expansion is constrained to pre-existing noise levels, with air transport growth provided for by the introduction of quieter aircraft and changes in operating methods. In practice, there has been considerable scope to achieve this through measures such as:

- limiting or banning evening and night time flights, or restricting their use for ultra-quiet aircraft;
- negotiating with airlines to withdraw old, relatively noisy aircraft;
- differentiating landing fees by type of aircraft according to noise characteristics;
- establishing flight paths for aircraft taking off and descending which aim to reduce noise footprints;
- introducing new practices for aircraft whilst on taxiways and aprons to reduce ground running noise.

Developing an acceptable solution to the noise problem will often be critically important to the successful expansion of airport capacity. The key issue here is how best to frame a solution which, on the one hand, is generally perceived to be fair, whilst at the same time getting the best economic value out of the utilisation of the airport (that is, getting the most out of environmental capacity). The potential conflicts between these twin objectives mean that solutions will often be complex and controversial.

Framing a solution which is generally regarded as fair will require addressing a range of issues (see Airports Commission 2013e); these include:

- Establishing what is regarded as a fair noise level. For example, a ceiling at pre-existing levels or one providing for some reduction in noise? This latter might reflect rising expectations, or the possibility of health impacts identified in recent research which are not easily recognised by households and not, for this reason, reflected in their locational decisions.
- Establishing how noise levels should be measured (particularly differentiation by time of day/night).
- Considering what role might be played by amelioration (e.g. provision of noise insulation).
- And, similarly, consideration of what is the best role for compensation in striking an acceptable balance, and how this can best be framed to avoid excessive claims and disputes.

Getting the best value out of environmental capacity – the second half of the twin objective –is likely to require a mix of measures. In some circumstances – for example, relatively noisy aircraft at night – there may be tipping points at which the dis-benefit to households of additional noise rises sharply. In these cases, quantity restrictions – limitations based on aircraft movements – may be the best approach (see Hepburn (2006) for a more general discussion of situations where quantity controls might be expected to work more efficiently than pricing measures and vice versa). But in circumstances where the costs of additional noise are more incremental, then limitations based on noise budgets will usually be more effective at striking the right balance (see the paper to the Roundtable by Hans-Martin Niemeier for a discussion and a practical example). All of this means that, to work effectively, noise policies will usually involve a package of measures, and that these will need to be tailored to the particular local circumstances at the airport. Co-ordination between airlines, the airport and air-traffic control will often be required.

Local air pollution is also an issue. In some cases (for example in the EU) there are established regulatory standards for local air quality and plans for airport expansion must conform to these. This may involve actions affecting both airport and airline operations, as well as surface access traffic, to constrain emissions to the required levels.

Impacts on wildlife habitats are often a relatively minor issue, but can be important where rare or endangered species are at risk. An environmental assessment will be an important input to site selection in these circumstances. In some cases, it may also be possible to effectively internalise these impacts through the construction of a replacement habitat – an approach which has been successfully adopted in container port development in the UK and for waterways development more widely in Europe.

Greenhouse gas emissions obviously have a global rather than local impact but policies towards climate change may influence airport expansion in the future. The importance of greenhouse emissions from aviation looks set to increase for two reasons. First, demand growth is forecast to be greater than in many other sectors of the economy. And, second, the prospective contribution of low carbon technologies looks less promising than in many other sectors. Taken together, this means that greenhouse emissions look very likely to assume a greater importance in the global totals than hitherto (see Sentance (2009) and Airports Commission 2013c for a discussion).

There are two implications of this as far as the consideration of additional airport capacity is concerned. First, potential carbon prices and taxes, or the impact of non-price controls, need to be factored into future forecasts of aviation demand. The impact could be potentially significant if progress on low carbon technologies proves to be slow. Second, a perception that the development of effective climate policies for aviation has not been commensurate with its rising importance has led some to argue that the best way to curb greenhouse emissions from aviation is to stop the expansion of airport capacity. This would be a less efficient approach toward reducing aviation‘s greenhouse emissions than many other measures, such as including aviation in emissions trading schemes (see Sentance (2009) and Airports Commission 2013c for a discussion). But it is sometimes also argued that stopping airport expansion is a way for governments to signal policy commitment to environmental goals. Public concern over aviation‘s role in climate change may also bear upon public support or opposition to airport development. In these circumstances the key question is then whether there are credible ways to demonstrate that additional airport capacity is meeting its climate change costs, for example through an effective emissions trading scheme or through a specific aviation levy – see Keen and Strand (2006 and 2007) for a more general discussion of aviation taxes.

A framework for developing, phasing and co-ordinating expansion

The case studies discussed at the Roundtable (together with broader experience of airport expansion) suggest advantages in an approach which involves the following steps:

a. **Getting the most out of existing capacity**, in terms of utilisation, economic value and environmental impact, which is particularly important in times of austerity. Where regulatory frameworks allow use of all potential pricing and slot trading options, the approach can be summarised as follows:

- Squeeze more out of existing runway capacity through improved air traffic management and optimised landing and take-off patterns;
- Price general aviation at an appropriate cost for scarce runway space at congested commercial airports, so that only users who value the high costs of access remain;
- Use differentiated (e.g. time-of-day) pricing for air-side services, or slot auctioning and trading, both to manage demand at the peaks and to get the best economic value out of

scarce airport capacity. It has also to be recognised that slots carry the risk of anti-competitive hoarding unless they are time-limited.

b. **Undertaking a wide ranging review of where and how capacity could be added**. For example, a review of options for expanding airport capacity could include some or all of the following:

- Develop secondary airports (or share military runways) for operations by low cost carriers, with airport development tailored to the needs of this market segment;
- Add short runways, at the main airport or close by, to free capacity on existing runways for long-haul traffic;
- Add long runway(s) at the main airport(s);
- Develop an additional, or replacement, main airport.

As the experience of Sydney illustrates, the process is cyclical and ideal options rarely exist.

In circumstances where a replacement airport is proposed there will also be questions of co-ordination between old and new airports. The case studies illustrate the considerable uncertainties in such a step change, both in relation to the patterns of demand which emerge and in relation to future development possibilities. And the case study experience illustrates the value of keeping options open, where feasible, to provide for a flexible response to changing circumstances.

c. **Evidence based comparison of the likely impacts (economic, environmental and social) of the most promising options** – using cost-benefit analysis (perhaps supplemented by CGE modelling). Validating the provenance of the analytical evidence is important whilst also recognising the ranges of uncertainty in the evidence by using a set of realistic scenarios.

d. **Adopting flexible (or option based) planning of preferred solutions** to reflect the uncertainties in the evidence, as suggested in Burghouwt (2007). The basic aim is to adopt plans which will work reasonably well over a range of scenarios (even if not necessarily being the best solution on the central forecast) and which have sufficient built-in flexibility in relation to the scale and timing of investment, such that plans can be adjusted if/when the future doesn't match the forecast.

e. **Protecting the interests of those most at risk of significant (negative) environmental impacts.** As noted, taking steps to resolve a perceived lack of fairness to those on the receiving end of localised environmental impacts, particularly noise, may be important to securing more widespread public support for airport investment.

f. **Providing the right investment incentives** – in particular, by:

- enhancing competition in the provision of airport capacity (where feasible) – both to stimulate the right levels of investment and to incentivise the development of innovative solutions. Liberalisation of competition in airline services is generally considered to have been of significant benefit (see, for example, Morrison and Winston (1986)) and is valuable in the airports sector where feasible. The separation of the ownership of the main London airports is in part aimed at benefiting from opportunities for competition (although it needs to be recognised that London offers more opportunities for competition than some other major conurbations);
- greater alignment of public and private interests; as noted, there may be scope to internalise some environmental impacts. And the Crossrail project in London illustrates a case where

the recognition of agglomeration economies – not captured in project revenues – has helped the introduction of an additional tax on businesses in the CBD, providing a source of funding from the prospective beneficiaries;

- providing co-ordination, so that any required expansion of surface access capacity, or of Air Traffic Control, is implemented in parallel;
- ensuring that, in cases where effective airport competition is not feasible, any regulatory price controls on airports provide appropriate signals for investment. This can be done, for example, through a periodically revised price cap based on a regulatory asset base (perhaps using a split rate of return, as suggested by Helm (2009), with the rate allowed on established assets indexed to the market and a higher rate of return allowed on new investment);

g. **Providing for legitimacy and stability of planning decisions** – in particular through consultation and transparency, through assuring the provenance and credibility of the evidence and analysis underpinning decisions, and through protecting the interests of those at risk of material environmental damage.

2. Estimating future demand for airport capacity

Airport capacity investments can often be lumpy and long-lived, meaning that decisions on how much capacity to provide frequently require a view on the development of demand over the long run. Such views can be informed by expert opinion and by systematic projections, where the latter have the advantage of rigour and transparency. In order to project demand for travel at specific airports, a projection is needed of the overall volume of air travel and of its distribution over available airport capacity.

Systematic projection tools usually come in the form of econometrically estimated models of air passenger demand. Econometric estimation requires data on past trends that relate demand to explanatory variables. Econometric projections are vulnerable to error from changes in the relationships between such explanatory variables and air travel demand. If relationships evolve to differ significantly from the past, the projections will be off target. The problem cannot be avoided entirely but can be mitigated, firstly by including a full range of key explanatory variables (GDP and relative prices matter but so do regulation, market structure, availability of other modes, etc.) and second by allowing flexibility in the relation between explanatory and outcome variables (e.g. a declining income effect, so that GDP-growth leads to smaller travel demand increases when GDP is already high). Such a rich econometric model has the benefit of allowing construction of meaningful scenarios on the basis of potential developments in the explanatory variables, including the regulatory environment, fuel prices, growth in various global regions, airport capacity, etc.

Scenario-analysis is likely to prove superior to projections that only consider high and low bounds, without any real understanding of the likelihood of experiencing those bounds. If probabilities can be attached to the different scenarios, projections become more meaningful but achieving this is far from straightforward (see Transportation Research Board (2012) for a discussion).

The UK Airports Commission has published an overview of projection tools relevant to the UK (Airports Commission 2013a). The UK Department for Transport produces air travel demand forecasts based on an econometric model that distinguishes several market segments (business and leisure, UK and foreign and 5 geographic zones). The model is fed with exogenous forecasts for the explanatory variables. The most recent projections are that air travel demand will grow by between 1% and 3% per annum from 2010 through 2050. Projected traffic volumes remain below expectations formed before the great recession, throughout the period.

The allocation of demand to airports is projected with a separate model. This model aims to allow for the choices of passengers among UK airports but not for competition for transfer passengers between UK and non-UK airports. Given the intensity of such competition, and given that transfer passenger levels are not only of direct interest in themselves but also of interest in terms of their impact on connectivity, this is a relevant shortcoming. More generally, uncertainty about airline responses to capacity changes is large and needs to be accounted for in airport-specific responses.

Projections are inherently uncertain; it is not certain that the model will continue to apply in the future, even if initially well specified, and the future values of the exogenous variables needed for projections are uncertain. The task is to limit uncertainty as much as possible and to make explicit what remains. Sensitivity and scenario-analysis help do that, and clarify the effects of policy choices, e.g. on capacity expansion, in various possible future states of the world. Such analysis aims to reveal which policies are more or less robust to alternative states of the world.

Scenario analysis combined with judgment on the likelihood of different scenarios is useful in considering the impact of changes in the timing of adding capacity. For example, if tepid growth in demand is thought to be a persistent rather than temporary condition, delays to building capacity are less costly in the long run, even if there is a shortage of capacity now. Uncertainty then affects decisions on when to expand, rather than whether to expand at all. An approach to decision-making on capacity expansion along these lines, focused on the timing of expansion, is advocated in Jeffrey Zupan's Roundtable paper.

3. Hub economies

Hubbing generates connectivity through its effects on route density of demand. Coordinating flights at a central airport allows higher frequencies of flights, larger planes, or better occupancy rates on busy routes and also allows more long distance destinations to be served by direct flights. How large the effect is, and just how important it is where local demand is very high (as in London), is a subject of debate (see, for example, Airports Commission 2013d for a discussion).

Empirical analysis by Burghouwt (2013), where hub connectivity is measured as quality-weighted[2] transfer opportunities, shows that:

a. Splitting hubs reduces connectivity;

b. Hubs are particularly important for generating long haul direct connections;

c. Liberalisation increases the number of hubs, at least initially, whilst consolidation reduces it;

d. Heathrow shows very strong overlap (80%) in the destinations it serves in the connecting market with Frankfurt, Paris Charles-de-Gaulle and Amsterdam Schiphol.

Without additional runway capacity, Heathrow has few opportunities to add long haul destinations to those already served (except at the expense of short-haul routes, which could then prejudice traffic feed). This limits expansion of British Airways at its core base and denies some of the benefits of hub economies to passengers and businesses in the London area. Equally, it needs to be recognised that the majority of the passengers at the London airports fly point-to-point, and that this is very likely to continue to be the case in the future. Nevertheless, in the absence of additional capacity, frequencies of service will develop more slowly and direct routes to new destinations will be added more slowly than they otherwise would. Valuing the potential benefits foregone is a key issue in determining airport policy.

Beyond a certain hub size, there will be decreasing willingness to pay per passenger as spokes are added, though spokes are not all of equal value and their relative value can change over time. Hub diseconomies also exist, perhaps particularly in the logistics and convenience of passenger transfer (for transfer passengers) and, to some degree, in ground access to the airport for origin/destination (O/D) passengers. Such diseconomies appear less likely at Heathrow, however, with redevelopment of old terminals underway. The improvements to the environment for transfer and access to terminals should outweigh any likely hub diseconomies. In any event, London has a strong O/D market, and this may be one reason why the hub function at Heathrow is less important than, say, in Frankfurt.

Where airlines decide to operate hubs is not determined only by size of the local market. Los Angeles is a very large origin and destination market and sees a lot of transfer traffic but has only limited hubbing functions. Outside of the very large US market, national flag carriers naturally tend to hub out of the largest national airport. Airport capacity and prospects for expansion are important factors for the location of primary hubs. Lufthansa developed a second hub in its home market, at Munich, as a result of restrictions on expansion at its main base, at Frankfurt, that were subsequently eased. Secondary hubs, such as the hubs operated by United, Delta and American Airlines at New York's airports, are more frequent in the US because of the size of the market and its geography.

Markets and the organisation of the airline industry are dynamic and can change rapidly. A rationalisation of US hubs is underway as airlines merge and the industry consolidates, with the number of hubs declining and average inter-hub distances increasing. Mergers have resulted in some European airlines operating multiple hubs. Lufthansa has thus accumulated hubs in Zurich and Vienna in addition to Frankfurt and Munich. For a time it also ran a hub in the UK after acquiring BMI but subsequently sold the airline to IAG (British Airways-Iberia). Rationalisation or specialisation is likely to follow. The Air France-KLM group operates out of two hubs in Paris and Amsterdam but has concentrated on serving different sets of markets from each; only where markets are large enough do both airports serve them (Burghouwt 2013). IAG is expected to similarly differentiate services between Heathrow and Madrid, with the latter focusing on Latin America and southern Europe. Historically, SAS operated more than one hub, reflecting its multi-national ownership.

Some low cost carriers, have begun to provide network type services with through ticketing via their bases and code sharing agreements with network carriers, for example JetBlue's operations through its New York and Boston hubs and its agreements with Aer Lingus, Lufthansa and Star Alliance partners. Airline businesses are in constant evolution. Air Berlin began as a low cost carrier, has become a network service operator, is a member of Oneworld and has an alliance with Etihad, which now holds 29% of its shares. It operates more services out of Berlin than Lufthansa. It is not entirely inconceivable that EasyJet, the UK's largest airline by volume of passengers carried, could develop network services out of the largest of its 23 bases, Gatwick, and evolve into a second UK based hub carrier if Gatwick were to expand (although this would require the development by the airline of both baggage transfer and inter-continental services).

As airline business models change it may be more useful to distinguish between network carriers and point-to-point carriers than between full service carriers and low cost carriers. Some network carriers are beginning to use point-to-point carriers for feeder traffic, through alliances and other business arrangements. If this trend continues, distinguishing between full service carrier airports and low cost, secondary airports will make increasingly less sense.

Multi-hub operations sometimes work. Air France-KLM's twin hubbing out of Schiphol and Charles-de-Gaulle was underpinned by State assurances[3] (between the Dutch government and Air France-KLM) to help safeguard Schiphol's role as an international hub. The arrangements appear to be durable both because of the size of the local markets and because there is sufficient difference in the largest origin-destination markets between the two cities, influenced by language, colonial history and specialisation of local industry. There is thus scope for specialisation without foregoing too many of the benefits of centralising at a single hub. It is not clear this would work in London as it is a single, if very large, local market.

The number of discontinued hubs is large and growing. Hubs do not always work and losing hub status is often irreversible, although London faces a negligible risk in this respect. In practice, London has a very strong foundation of O/D traffic and the current hub operator competes with another airline on most of the destinations that it serves, a situation which is likely to persist whatever decisions are made on additional capacity at the London airports.

4. Measuring and valuing connectivity

The contribution of aviation to connectivity for a region or a country is determined by what destinations can be reached and under what conditions, both for passengers and for freight. More destinations, more direct flights, higher frequency and better reliability all contribute to improved connectivity. It is straightforward that additional capacity can enable better connectivity, at least at congested airports where capacity constraints inhibit the development of airline networks. The more difficult question is whether the benefit is worth the cost of the additional capacity.

In highly competitive air travel markets it is reasonable to assume that airlines more or less make the best use of available capacity, given prevailing demand and that fares are in line with marginal (and average) costs. Under these conditions fares are a good indicator of the marginal benefit of connectivity and standard approaches to estimating economic surplus can be applied. The marginal costs of capacity expansion can be compared to willingness to pay to evaluate the desirability of adding capacity; and the decision on how to use any new capacity can be left to the airlines. The practical challenges in predicting the effect of capacity constraints on future fare levels in different markets need to be recognised.

Airline decisions on capacity allocation will be guided by passengers' or shippers' valuation of different ways of using the capacity. Customers pay for a service, of which the quality depends on several dimensions. Some of these relate directly to connectivity in the sense of increasing the supply of air services for existing destinations or adding new destinations. In order to understand the value of connectivity, it is useful to consider customers' valuation of these separate aspects.

For example, in a model for the USA, Israel, Keating, Rubinfeld and Willig (2012), analyse passengers' valuation of 'route level inconvenience' (the time it takes to get from an origin to a destination relative to the preferred departure time) and 'airport-level network breadth' (the number of direct and one-stop destinations from an airport on a particular airline). The estimates suggest that halving inconvenience (from, say, 6 to 3 hours) is equivalent in value to the passenger to a 7% reduction of the average fare. Adding 25 more destinations has a similar value. The analysis found that the willingness-to-pay for improved connectivity is high enough that quality adjusted fares often are lower at hub airports (where quality dimensions like airport-level network breadth are high) than at airports offering lower quality. Thus hub premiums sometimes reflect a situation where a large hub offers a superior product at a higher price.

There are several reasons why in practice the simple rule of inferring marginal social benefits from fares may not apply. For example, fares can deviate from marginal costs because there is market power, or because there is capacity dumping, or because slots are not put to best possible use for strategic reasons. Careful cost-benefit analysis will attempt to include corrections for these issues where needed. A broader question, however, is whether direct benefits (accruing to airlines and airports and fully or partially passed through to customers via ticket prices) reflect the full benefit to productivity and economic growth of improved connectivity or whether, to the contrary, there are additional benefits. If such wider benefits exist, and are of significant size, then it is possible that more capacity is justifiable than is suggested by direct benefits.

An extensive body of research evidence demonstrates the critical importance of transport (and good transport infrastructure) for productivity and growth (see Crafts (2009) for an overview). The research suggests that, in many cases, the benefits to productivity and growth from better transport links can be measured reasonably well on the basis of the improved prices and service quality to travellers and shippers (see Crafts (2009), Eddington (2006) and HEATCO (2006) for a discussion). But this is not always the case; in particular the research evidence shows that investments in transport links to the central business districts of major cities may show significant additional productivity benefits due to:

- Agglomeration economies. That is, the benefits of knowledge spill overs, access to a wider labour market and access to a wider range of suppliers which firms might realise from being located closer together. In some sense, these benefits might be seen as analogous to the kinds of network externalities seen in the telecoms industry.
- More effective product market competition.
- Improved labour supply (where there will be the benefits of an increased tax take, as well as benefits to the individuals concerned).

In one case, London's Crossrail, these additional productivity impacts were estimated to add broadly 50% to the economic benefits of the project (within a range, reflecting uncertainties in the evidence, of between broadly 25% and 75%). This is very probably an exceptional, although important, example (see Worsley (2011)).

Not all of the above factors will be relevant in the case of aviation, not for example, improved labour supply. But it is possible that some additional productivity benefits might be expected, for example the economic benefit of reduced international trade costs. However, there is not, at present, a body of accepted research evidence to suggest whether these additional productivity benefits might be significant, or how large they might be, see again Crafts (2009) and HEATCO (2006).

A recent report by the Airports Commission (2013b) looks at the evidence on connectivity for the UK. A report by NERA (2010) looks at additional benefits. The NERA study identifies the potential productivity gain associated with exporting as a potentially important channel through which improved connectivity can generate economic benefits but expresses doubt on the extent to which such benefits are additional. If firms take account of the gains in decisions to start exporting, the benefits are not additional to direct user benefits. If they do not take these into account, then there are wider benefits. Combined with (scarce) evidence on the size of the productivity effects, estimates of the wider economic benefits range from zero to moderately small (around 10% of the direct benefits).

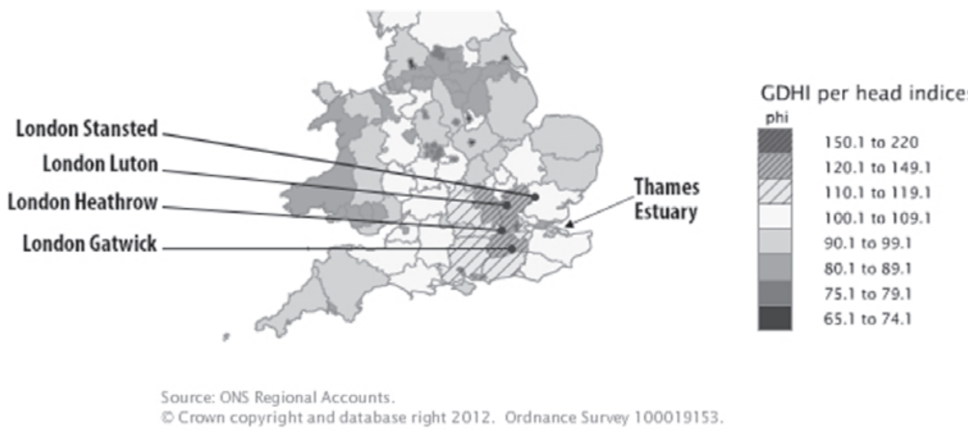
Arguably, even the high end estimates of wider economic benefits from connectivity are below the implicit valuation put on connectivity at the strategic level by some governments. At some airports, airlines may not be in a position to sustain the existing level of connectivity in a context of strong and heavily price-oriented competition. In such circumstances, if government continues to view connectivity as a strategic asset it will need to be funded through non-fare channels. Interestingly, the London Crossrail project (discussed above) is being partly funded through a supplementary tax levied on businesses in London's CBD. The projected tax receipts are of a broadly similar scale to some of the estimates of agglomeration benefits (see Worsley (2011)). There is a need for more evidence on what the value of such additional productivity benefits might be in the case of additional airport capacity and this is currently an active field of research (see, for example, the workshop organised by GARS-IATA in 2013).

The main network carrier operating out of Heathrow, British Airways determines which destinations to serve with the slots available to it according to profitability. Profitability is a good indicator that the direct connections are worthwhile to the London economy as well as to BA as long as connectivity benefits are internalised in ticket prices to a broadly similar degree and the quasi-market in slots works reasonably well. If adding to the frequency of flights to destinations already served is more profitable than adding a new destination for direct flights, this is likely to be the better outcome for London (as well as BA).

A large expansion at Heathrow would probably result in the addition of new O/D services whose viability is dependent on hub economies, and which might therefore not arise as a result of expansion of a secondary airport. Because of hubbing economies, BA (and its alliance partners) can add services to new destinations at lower O/D demand levels than other airlines operating out of London airports. The scale of its Heathrow operations makes BA more competitive than network carriers operating secondary hubs in Heathrow. If a third runway is built at Heathrow, this advantage will be maintained (subject to any possible diseconomies of scale of the kind discussed in the preceding section). If capacity were to be doubled in Gatwick, Luton or Stansted, with no third runway at Heathrow, a rival hub operation might be able to compete with BA, especially if airport charges were lower than at Heathrow. It would need to reach critical hubbing mass by competing for traffic in the most profitable existing markets and only then would it be able to support services to new O/D markets that depend on hubbing economies to be viable. Any such new hub would have to compete for traffic not only with Heathrow, but also with other major European hubs (particularly Paris, Frankfurt and Amsterdam).

One way a second hub airport at an existing or new airport location might emerge is if surface access links were better for a significant part of the local O/D market than Heathrow. This would be analogous to the division of the New York market between Newark airport on the west side of the Hudson River, which has much better accessibility from New Jersey, and JFK and La Guardia airports to the east. However, the London area is not marked by any such physical divide, and accessibility depends on the main road network across the south-east region and connection with London's surface and underground rail network. Heathrow's location may give it some advantages over other sites (depending on surface access costs) in terms of accessibility to centres of economic activity and to higher income households, as Figure 0.1 illustrates.

Figure 0.1 **Principal London Airports and Geographic Distribution of Gross Disposable Household Income in 2011 (GDHI indices, UK average = 100)**



5. Comparing the positive and negative impacts of airport expansion

Evaluating economic impacts and gauging net benefits facilitates making good public policy decisions on how much, where, and when to invest in airport capacity. Producing such evaluations is challenging and care needs to be taken that the tools used are fit for purpose and address key concerns in the decision-making process. The case studies considered at the Roundtable show that three main methods have been used in practice.

The first method, Impact Analysis, is based on input-output analysis and aims to describe the likely effects of an investment on broader economic activity. Input-output models sketch linkages between different sectors of the economy, and so provide insight into the changes in activity levels in these sectors when there is an exogenous change to supply or costs in a particular sector. In their simplest form, input-output models assume that all activity triggered by the exogenous change is additional, i.e. if the change does not take place the resources used would be idle and have no opportunity cost. This is a tenuous assumption at best and although it does not necessarily mean input-output analysis cannot be used for describing impacts, it does indicate that the method is not suited for analysing economic benefits. In the extreme, if resources have no alternative use, then using more inputs is always better (see Niemeier, 2013) and all forthcoming demand is worth serving, which is clearly not a useful principle for decisions on infrastructure capacity or any other project. Other concerns with simple input-output analysis include the use of linear models which tend to inflate multiplier effects[4] and, typically, a regional focus which tends to ignore the importance of displacement of economic activity.

The second approach, Cost-Benefit Analysis (CBA), is specifically designed to estimate a project's net benefits, by comparing costs and benefits now and in the future. The approach is routinely used in the context of transport infrastructure decisions and is particularly suitable for comparing alternative projects, e.g. alternative ways of increasing infrastructure capacity. The evaluation of benefits focuses on 'direct impacts', i.e. the value to transport users of the improvement in services which is facilitated by the investment. These direct impacts are not limited to time savings, but in many cases these constitute the bulk of the direct benefits. Apart from continuing refinements in the evaluation of direct benefits, recent developments in cost-benefit analysis focus on 'wider economic benefits', i.e. benefits that are additional to those occurring directly in transport markets. Within these wider benefits, productivity gains associated with increased accessibility of economic mass (that are not already captured in the direct benefits) are of key interest. For example, estimates for Crossrail and for the Grand Paris metro project find that these productivity benefits increase the direct benefits by around a half (within a range of uncertainty of between broadly 25% and 75%).[5] However, although the consideration of such wider economic benefits is recognised in the HEATCO (2006) and also in the UK guidelines it is not always recognised in the cost benefit guidelines for other countries (see Mackie and Worsley (2013)).

Applying cost-benefit analysis (with evaluation of any wider economic benefits) is likely to differentiate between the various alternatives for airport capacity expansion, including the do-nothing scenario, and will therefore be useful. Limits to the method obviously exist, but they are well understood (if not easy to overcome). Including the wider economic benefits is relevant, because the potential for agglomeration economies can differ between the different options. If relocating an airport is difficult, relocating the economic fabric around it is even more so, and the potential productivity impacts should not be ignored. Cost-benefit analysis for airport expansion will need to address the impacts of the various options on connectivity. This is largely uncharted terrain but is a central concern and necessitates an expansion of the standard toolkit for cost-benefit analysis when examining the expansion of major airports.

Cost-benefit analysis starts from and focuses on the transport project itself, although the technique is being extended to cover broader economic effects. Other tools have complementary functions, notably, computable general equilibrium (CGE) models. This is the third relevant approach to evaluation. These models typically work with more stylised representations of transport supply but are better suited to analysing the transmission of changes in transport conditions throughout the economy at large. They work in a framework that is compatible with the logic of cost-benefit assessment (in contrast to input-output models). Forsyth (2013) advocates combined use of CGE and CBA to establish a comprehensive picture of the economic costs and benefits of various options for airport expansion as, more generally, does HEATCO (2006).

The use of CBA in preparing investment decisions is sometimes questioned: why are decisions on, for example, major industrial infrastructure subject to only financial and environmental appraisal and not to broader CBA? A simple answer would be that planning requires CBA for public investment decisions. But this raises the question is there any good reason to introduce this requirement? The answer is yes. If government is to take a decision it should do so based on information relevant to its role, which is to enhance overall welfare and this is precisely what CBA sets out to test. Commercial feasibility may be compatible with a welfare perspective, but does not have to be, so commercial evaluation (combined with assessment of environmental impacts) is not necessarily sufficient.

6. Environmental constraints and environmental assessment

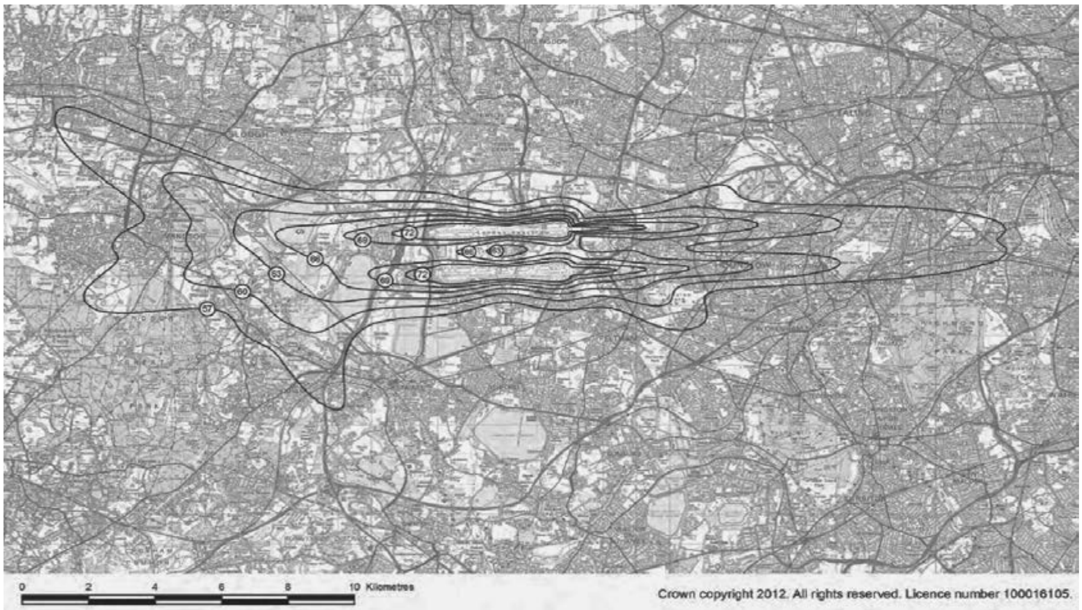
The environmental impacts are usually the main cost of airport expansion (apart, of course, from the costs of construction and operation). These impacts include noise, local air pollution, loss of wildlife habitats and landscapes, and greenhouse gas emissions. Each of these has their individual characteristics and they each raise different issues for airport expansion. Accordingly, we will consider each in turn. But more generally, the potential significance of these impacts means that it will usually be important to carry out an environmental assessment of the different options for expansion. It will also be important to include valuations of the environmental impacts in a cost-benefit analysis – recognising the uncertainties in the research evidence and in its utilisation. And it will be important to understand the consequences for those people, often relatively small in number in comparison with the numbers using the airport, who might face significant environmental costs.

Noise nuisance is the key constraint on expansion for most airports. National practice varies as to the metrics used to measure noise nuisance and on the levels used as benchmarks (see Airports Commission 2013e for a discussion of different metrics and of the different types of dis-benefit which might result from aircraft noise).

In some circumstances – for example, in relation to relatively noisy aircraft at night – quantity restrictions will often be a preferable approach to limiting noise nuisance, see Hepburn (2006) for a discussion of the situations where quantity restrictions might be expected to be more efficient than pricing measures, and vice versa. In more general circumstances, recent research evidence suggests that households typically experience some, small, dis-benefits at quite low levels of noise exposure and that this dis-benefit rises incrementally at increasing levels of noise exposure – but with no evidence of any particular tipping points, see MVA (2007). In these circumstances, restrictions based on noise budgets will usually be more efficient than restrictions based on air traffic movements, see the Roundtable paper from Hans-Martin Niemeier.

At Heathrow, exposure to aircraft noise is usually measured by the number people living and working in the footprint determined by the 57 dBA Leq contour for noise under typical flight patterns (Figure 0.2). Careful management of flight paths on the approach to airports can reduce the footprint. Where prevailing winds require the use of two sets of runways along different axes, or reversal of the direction of take-off and landing, noise nuisance patterns vary with the weather.

Figure 0.2 **Noise exposure contours for Heathrow Airport 2011**
(57-72 dBA Leq contours)



Source: ERCD 2012.

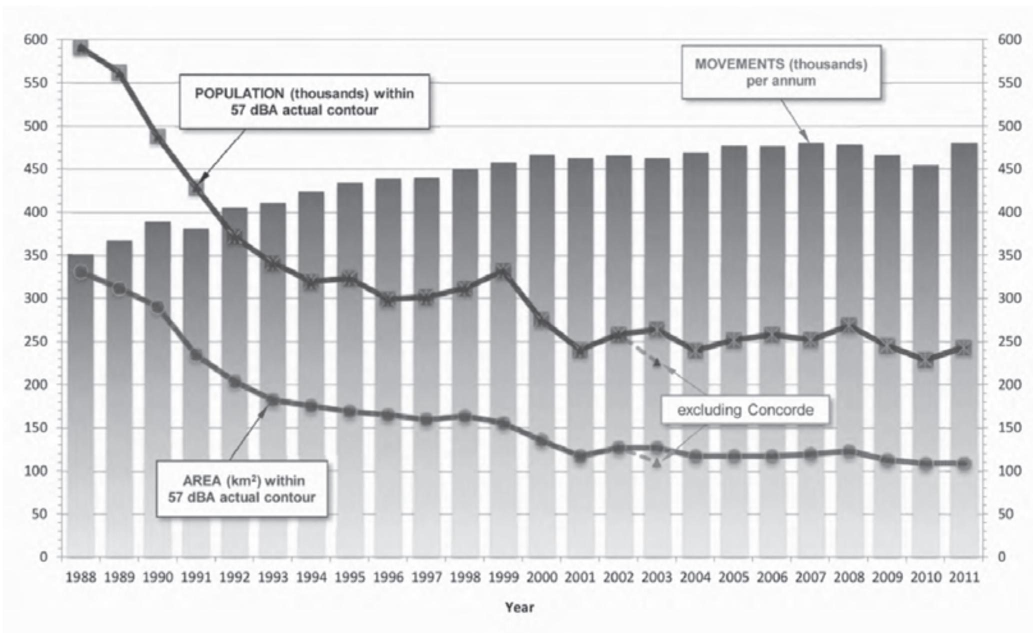
Table 0.1 **Population Living within Key Aircraft Noise Contours 2006**

	Noise level	Area km^2	Dwellings	Population
Heathrow	>55 Lden	244.7	314 350	725 500
	57 Leq	117.4	109 700	258 500
Gatwick	>55 Lden	94.5	4 700	11 900
	57 Leq	44.0	1 550	3 700

Sources: Heathrow 2011; Gatwick 2010.

Aircraft have become substantially quieter over time as a result of technological improvement and regulation. Figure 0.3 illustrates the change in exposure to noise around Heathrow over a period of time during which the number of aircraft movements increased by 35%. In 1980, as many as 2 million people were exposed to 57 dBA Leq or more (see Heathrow 2011). This suggests that noise levels for many people around Heathrow are lower than 20 or 30 years ago (although with little change during the last ten years, during which time a number of those concerned will have re-located to the area). The European Union requires airports to develop noise action plans and requires noise monitoring using 55 dBA 'Lden' noise contours. These measure noise over a 24 hour period, weighting noise occurring during the more sensitive evenings and night periods more heavily in the calculation. Table 1 summarises noise exposure around two of London's airports, illustrating the extent to which location determines noise nuisance; Heathrow sees around 1.85 times the aircraft movements of Gatwick but noise nuisance affects 60 times as many people.

Figure 0.3 **Heathrow traffic, noise contour area and population affected (1988-2011)**



Source: ERCD 2012.

Noise action plans can cover a range of measures to reduce or ameliorate noise impacts (see Airports Commission 2013e for a discussion):

- Limiting or banning evening and night-time flights, or restricting them to ultra-quiet aircraft;
- Negotiating with airlines to withdraw old, relatively noisy aircraft;
- Differentiating landing fees by type of aircraft according to noise characteristics;
- Aligning flight paths for take-off and landing to avoid densely populated zones;
- Establishing flight paths for aircraft taking off so that they climb to reduce noise at ground level as quickly as possible – fining airlines when individual aircraft exceed departure noise limits at monitoring stations located under flight paths;
- Exploring steeper descents and take-offs to minimise noise footprints;
- Introducing new practices for aircraft whilst on taxiways/aprons to reduce ground running noise, e.g. wheel tugs (the pilot can shut off the engines and an inbuilt electric motor powers the aircraft to/from the stand).

Measures taken at one airport can affect others. Withdrawing old, noisy planes from one airport might lead them to be used at other airports. But to some extent other airports will benefit from measures at a major airport that incentivise the use of quieter aircraft. Widespread adoption of noise-differentiated landing fees will incentivise airlines to buy quieter aircraft, and stimulate manufacturers to improve aircraft and engine design.

Local air pollution is also a factor in decisions over expansion for major airports. Many have agreed strategies to cut emissions from aircraft, airport operations and access traffic. A small number, including

Zurich, have experimented with cap and trade emission bubble systems, setting an absolute reduction target and distributing efforts to meet the target according to where mitigation is least costly. NOx emissions are the main air quality issue for aircraft. Air quality standards for NO2 are regularly breached in many large metropolitan areas. Chronic non-attainment of air quality standards could be a reason for airport expansion plans to be refused planning consent. A parallel might be drawn with the freeze on terminal development plans in the maritime ports of Long Beach and Los Angeles until levels of airborne particulate matter are reduced in the Los Angeles basin, see Giuliano and O'Brien (2008).

Policies towards climate change may also influence airport expansions in the future. Climate policies where they exist usually allow for an expansion of aviation. This is because aviation currently accounts for only a small fraction of overall transport emissions and an even smaller proportion of all greenhouse gas emissions from combustion. The rate of growth of aviation is relatively fast but greenhouse gas emissions from aviation are likely to continue to account for a smaller share of transport sector emissions in 2050 than those from vehicle traffic (see ITF/OECD (2012) and Airports Commission (2013c)). Adoption of widely recognised greenhouse gas mitigation policies for aviation, such as emissions trading systems, might make airport expansion less of an issue for climate change policy, although this is far from certain. The European Union's emissions trading system for aircraft using EU airports is currently suspended (for flights outside the EU) in the face of opposition from countries outside the Union. The use of air passenger taxes would usually be a less efficient way of limiting greenhouse gas emissions from aviation. Whilst a fixed tax per passenger will reduce overall demand for air travel somewhat, by making travel more expensive, such a tax would have no steering effect whatsoever in the market; it would provide no incentive to use more fuel efficient aircraft, optimise flight paths or carry more passengers per plane. Greenhouse gas mitigation measures, including taxes and charges, need to focus on achieving these technological and logistical responses if they are to be effective (see Keen and Strand (2006 and 2007) for a more general discussion of air passenger taxes). Indirect approaches to limiting greenhouse gas emissions, such as limiting capacity at major airports, will be less effective than many other potential measures (see Sentance (2009) and Airports Commission (2013c) for a discussion).

Environmental impacts on wildlife and landscapes are often a less important issue, but can be significant in cases where there are risks to rare or endangered species. Coastal sites, in particular, may encroach on significant birdlife habitat. The site initially chosen for a new Lisbon airport in 1971, Rio Frio 40 km south of the city, was rejected because it would have involved felling 50 000 cork oaks, a protected species and habitat (Partidario 2009).

The subsequent evolution of decisions for expanding airport capacity in Lisbon illustrates the potential value of an environmental assessment in determining locations for new airports. A site was selected in 1982 at Ota, 40 km north of the city, on the basis of land availability. The hydrology of the site, however, required expensive civil engineering works threatening the commercial case for the new airport. This prompted the business community to launch a strategic study of the region in 2007 to see if other sites might be identified on the basis of criteria of population, regional development, land transport access, environmental impact, and suitability as a location for commercial and industrial activity. This identified a military firing range, Campo de Tiro de Alcochete which is closer to the city, as the optimal location (subject to ending the military lease). The government commissioned its own environmental assessment, confirming the result. This then seems set to be the site for a new Lisbon airport although the financial crisis has postponed plans for its development, with more efficient use of the existing airport at Portela as the current focus.

EU legislation requires environmental assessment of major transport projects, plans and programmes. Amongst other things, it requires project variants and intermodal alternatives to be assessed for economic and environmental impacts. In practice, the main impact of this has been to steer new transport infrastructure to locate along existing transport corridors wherever possible (ECMT 2004). This reduces "sprawl" of the inevitable negative impacts of transport infrastructure.

7. An approach toward developing, phasing and co-ordinating airport expansion

Getting the most out of existing airport capacity

Given that airport expansion is often so contentious and difficult to implement, there is potentially significant value, particularly in times of austerity, from measures which aim to get the most out of existing assets – in terms of utilisation, economic value and environmental impact. The case studies not only suggest various possibilities but also indicate scope – sometimes prospectively significant scope – to do more.

Getting the most out of existing capacity is likely to involve both operational measures – to squeeze higher passenger throughput out of existing assets – and also pricing (or slot allocation) measures to get the best economic value (and sometimes environmental value) out of the feasible passenger throughput. The discussion which follows considers each of these kinds of measure in turn.

At 15 million passengers per year, London's airports were close to capacity when the 1968 Roskill Inquiry into options for expansion was launched. It identified a potential site for a new airport at Cublington, 65 km NW of the centre of the city, with a minority report recommending an offshore site at Maplin Sands, 70 km east. Forty five years later the airports are still operating at the limits of capacity, but carry 115 million passengers a year (Kay 2012). Terminal buildings have been added, much larger planes introduced and seat occupancy rates enhanced. Patterns of runway use have been optimised and air traffic management improved. The role of hitherto smaller airports in the London region (particularly Stansted) has been significantly enhanced.

Trials of further modifications to the use of Heathrow's twin runways are underway but the margins for further expansion without runway additions here and/or at Gatwick and/or Stansted are tight. Gatwick is the busiest single runway airport in the world. Airports elsewhere have seen similar patterns of getting more capacity out of existing runways. The next generation of air traffic control, with plane-to-plane communications technology, promises further gains although perhaps not as significant as once expected; the increment expected at New York from the introduction of the so-called Next Gen technology has recently been revised downwards (see Jeffrey Zupan's paper for the Roundtable).

Runway capacity translates into the numbers of potential plane movements per hour. Capacity can be increased by optimising the mix and grouping of different types of aircraft using the runway. Larger planes – carrying more passengers – increase the passenger capacity of the airport, although the largest planes require greater separation because of turbulence in their wake, with smaller aircraft being most affected by wake turbulence. General aviation (light aircraft and executive jets) consume many times more runway capacity per passenger than commercial aviation. Under many regulatory regimes, with weight-based charges, they pay much less than commercial aircraft per take-off. Where pricing has been reformed to charge in relation to the value of each aircraft movement to the airport (from landing charges and passenger charges), general aviation has been priced out of the main airports, for example at Heathrow and in New York.

New York's airports are served by much smaller planes on average than Europe's main airports (see the Roundtable paper from Jeffrey Zupan). This reflects the number of connections to domestic destinations with relatively low passenger densities. It might also suggest that there is greater potential to increase airport capacity in New York, through increasing plane sizes, than in Europe's hub airports (although any such conclusion needs to take account of the differences between the types of aircraft used in long-haul and in short-haul markets).

Runway capacity is often limited by agreements and regulations to limit noise. For example, these can impose a limit to the number of take-offs and landings per hour, or impose a noise budget, or a night time curfew, constraining usage well below technical capacity. At Frankfurt, for example, flight restrictions for the airport were introduced that limited the full utilisation of the recent expansion in airport capacity (see the Roundtable paper from Hans-Martin Niemeier). The benefit realised from the additional capacity was in handling aircraft movements in periods of peak demand during the day, reducing delays from congestion. Clearly restrictions could be relaxed in the future to expand capacity without further investment if, for example, aircraft become substantially quieter (or, whilst considered unlikely, if the local community were to change its attitude to the trade-off between noise and economic activity). Heathrow is subject to a night time curfew and to a noise management strategy that limits total capacity.

Whilst some of the various measures discussed above might act to increase utilisation, and the numbers of flights accommodated, equally important is achieving good economic value from the flights that are handled. Key questions here concern how air-side services are priced and how slots for take-off and landing are allocated.

Pricing in relation to congestion is generally resisted by airlines as they see it as a way of extracting economic rent from them rather than managing demand. It has therefore not often been used. Heathrow airport experimented with several approaches to pricing, opposed in court by US airlines. Boston airport has been authorised by the Federal Aviation Authority (FAA) to use peak pricing, should delays exceed a pre-determined level, on condition that revenues would be spent on airport enhancements. For a significant impact on congestion, however, prices would have to be set so high that, short of constructing new runways, it might be difficult to spend the revenues. Sydney appears more likely than other airports to price demand as it is not only permitted under the regulatory regime applied to the airport but was employed prior to addition of its third runway.

Capacity can also be managed by trading slots. A market for trading slots would certainly be more efficient than rationing capacity through delays. At present, however, the use of trading at congested airports is patchy and embryonic – being better established in the UK than elsewhere[6]. Slot trading, or more probably peak pricing, could be used under the regulatory framework in Sydney to manage excess demand efficiently.

The allocation of slots often determines capacity at busy airports. Allocation has usually been determined on the basis of the number of slots being used by each airline when rationing is introduced (grandfathering). Provision for new entrants is usually made when new capacity is added or an existing user withdraws from the airport or ceases to operate.[7] Slots that go unused get re-allocated. Slots are valuable assets, particularly at congested airports. They can sometimes be sold by one airline to another[8], but as noted above the use of trading at congested airports is still embryonic. The potential to get the most economic value out of available capacity through slot allocation hence is not exploited. Even where trading is possible, airlines holding slots may prefer not to give them up or sell them to competitors in order to protect their market position, even when demand falls. Thus the impact at New York's airports of Amtrak improving its services from New York to east coast cities, taking passengers from airlines, was the use of smaller aircraft rather than a reduction in aircraft movements, as airlines prioritised using slots to retain ownership, a practice sometimes referred to as 'baby-sitting' of slots (Zupan (2013)).

In the USA, the primary purpose of introducing slot controls, at a small number of congested airports, was to preserve the reliability of airport operations. US airports generally operate closer to the absolute capacity of the air traffic management system than European airports. They handle the congestion that inevitably results through unscheduled delays. Delays at a major airport have a knock-on effect in the destination airports served; thus delays in New York cause delays in Chicago later in the day and so on. The US FAA introduced slot limits to contain this knock-on effect. There are, however, unintended negative effects from slot allocation, including slot hoarding to prevent competition and unnecessary limitation of runway capacity at airports where delays are primarily the result of knock-on effects from other airports. Periodic review of US policy aims to mitigate such perverse effects but revisions are infrequent.

Slot allocation is also used outside the US to ration airport capacity in busy airports and similarly risks undermining efficiency by creating incentives to hoard under-utilised slots. For an efficient outcome, both efficient slot allocation and an efficient price for landing are needed – the same price for all users (apart from terminal use prices) – see Forsyth and Niemeier (2008).

Differentiated pricing of airside services – reflecting the balance between demand and capacity – might, in principle, achieve finer tuning and a dynamic response to changes in the market. The issue it would raise, however, is how revenues should be spent, at least when investment in new runways is not possible because of physical or planning constraints. This is a more visible and therefore more contentious manifestation of the slot rents that exist today.

Slot rents complicate the incentives towards expansion of airport capacity in an environment where interests between airports, airlines and the users of airline service do not always coincide. As slots are allocated free of charge rather than sold or auctioned, rents accrue to airlines rather than airports. Expansion of runway capacity undermines the value of existing slots.

At hub airports, incentives towards expansion to cater for hubbing services are also complicated by differences in the way airports generate income and apply charges to airlines. Transit passengers generate somewhat less income for the airport than passengers originating or ending their trip at the airport since transit passengers are generally subject to lower air passenger charges. The extent to which such lower charges correspond to lower costs is unclear, as for example baggage processing costs are high for transferring passengers. They also do not generate car parking revenues, which account for a major share of total income for many airports. But on the other hand, transfer passengers are essential for airlines operating hub and spoke operations and enable higher frequencies or larger aircraft or higher occupancy rates on trunk routes, enhancing the competitive position of the both the carrier and the airport and potentially contributing to their profits. Hubbing airlines need to concentrate a large part of their flights on a single airport and the size of their investments in terminal facilities make it difficult to move. Airlines offering mainly point to point services, including most of today's low cost carriers, are more indifferent as to which airport they use. In cases where a city is served by several airports, these airlines can often credibly threaten to switch to where charges are lowest.

Incumbent airlines holding slots profit when airport capacity is short, as they can operate at high load factors where there is excess demand, raise fares and swap economy cabin space for business cabin capacity. The incentives for the airport in these circumstances will depend on the extent to which revenues are shared with the airline, over and above air passenger charges, and on the regulatory context. Airports and airlines make joint investments in terminals in some cases, resulting in more convergent incentives.

The framework for getting the most out of existing airport capacity, where the regulatory framework allows use of all potential pricing and slot trading options, can be summarised as follows:

- Squeeze more out of existing runway capacity through improved air traffic management and optimised landing and take-off patterns (see the Roundtable paper by Katsuhiro Yamaguchi for a discussion of continuous improvement or "KAIZEN") ;
- Price general aviation to reflect the cost of scarce capacity at congested commercial airports – rather than setting a lower price for smaller aircraft (for example, through using weight based charges) – so only those putting a high value on access remain;
- Use differentiated pricing for air-side services, or slot auctioning and trading, both so as to manage demand at the peaks, but also so as to get the best economic value out of scarce airport capacity; as noted, however, slots do carry risks of anti-competitive hoarding unless time limited.

Reviewing a wide range of possibilities for adding to capacity

Investments in airport runways and terminals are sometimes lumpy; and sometimes they are made infrequently in large indivisible units. This makes planning expansion complicated and financially risky and can result in long periods of excess demand followed by periods of excess capacity. Failing to expand airport capacity can have a high cost in terms of lost economic opportunities for airlines and for the economy served by the airport but premature expansion can also have high costs (although perhaps not as great in some cases). Sequencing expansion can reduce these risks. And using pricing and regulatory instruments can (as described above) manage congestion ahead of the point at which a new runway is built or be used to optimise the use of existing airports before building a new airport. The instruments used to help get the best economic value out of existing capacity can also provide indications on the right timing of any expansion.

The development of Sydney airport illustrates the range of options in a regulatory environment that permits the use of pricing to manage demand (see Peter Forsyth's paper to the Roundtable). Locations for a second Sydney airport on a larger site, with fewer people living under flight paths, were examined in the 1970s. In 1986, the Australian Government announced that a location at Badgery Creek, about 45 km west of Sydney's CBD, had been chosen as the site for a second major airport for Sydney. A site of approximately 1 700 hectares was subsequently acquired between 1986 and n1991. However, it was eventually decided that the advantages of the existing airport, located approximately 10 km south west of the CBD, outweighed the advantages of the selected new site, which was located substantially further from the CBD. As a result, a third runway was added to the existing airport in 1995. Demand has since grown to a point where there is some congestion at peak hours. Together with concern over noise, this has prompted another search for a site for a potential new airport, identified at Wilton, located considerably further from the CBD than the previous proposal – reflecting the outward spread of the suburbs in the intervening years.

Sydney airport is subject to a light-handed approach to regulation that permits a range of responses to congestion. The airport could simply allow delays to ration capacity but this is unlikely as the airport is free to set air-side charges as it sees fit, subject to monitoring by the competition authorities (the Productivity Commission and the ACCC). Airlines can also go to court if they believe they have a case to make against the airport for over-charging, using provisions of competition law relating to access to essential facilities The Productivity Commission has recognised that it might be appropriate for airports to charge high prices if this is needed for efficiency (PC 2002). There are now insufficient slots in Sydney at peak times. Average delays increase from 6 to 12 minutes in the peaks and some airlines are unable to find slots at the preferred time. Pricing was used to manage congestion before the third runway was built, through minimum charges for all aircraft, thus discouraging smaller aircraft, ending when the new runway was commissioned. Pricing could be reintroduced.

There are some additional options for optimising the use of Sydney airport with parallels elsewhere. Regional services using small aircraft enjoy privileged access to the airport through a quota of slots reserved for their use. This could be discontinued, auctioning the slots to carriers serving larger markets, with regional flights transferred to a nearby airport, Bankstown, currently serving general aviation. Surface access to Bankstown is poor despite the relatively short distance to the CBD and proximity to the main airport. Despite its limitations, some transfer of regional services appears likely in order to liberate capacity at the main airport. There is also an air force base with a moderately long runway at Richmond, further out from the CBD. This might provide a suitable site for a second airport, perhaps for low cost operations. At the main airport, runway capacity might conceivably be added through further land reclamation in the bay (although at present this seems unlikely).

In summary, a review of options for expanding airport capacity could include some or all of the following:

- Develop secondary airports, or share military runways, in the region for low cost airline operations, with airport development tailored to the needs of this market segment.
- Add short runways at the main airport, or close by, to free capacity on existing runways for long-haul traffic.
- Add long runway(s) at the main airport(s).
- Develop an additional, or replacement, main airport.

As Sydney illustrates, the processes is cyclical and ideal options rarely exist. Unless the existing hub airport is closed when a new, larger airport is built coordination is difficult and outcomes unpredictable and unstable.

Coordinating Operations between Old and New Airports

Persuading airlines – and particularly network airlines – to switch operations to a new site is difficult if the existing, more conveniently located, airport is not closed. Slot pricing and trading might have some potential for coordinating the use of the existing airport with a second airport and lower landing charges at a new airport would encourage some carriers to transfer operations, although there is often pressure to recover investment quickly at a new airport through high charges. Policies on traffic allocation may in some countries be circumscribed by local regulatory rules. This is the case in the European Union, where the European Commission must be notified if a set of airports is to be treated as an airport system and, in the interests of preserving competition, certain conditions have to be met for coordination of traffic to be allowed. In Sydney, current thinking sees a second airport as a base for lower cost carriers rather than as a substitute hub for network service operators. Also prices tend to be lower at old airports – they tend not to cover their long run costs (including the opportunity cost of land).

There are strong reasons for airlines to prefer the existing airport if it is not closed when a larger airport is commissioned on a new site. Not only are they likely to have sunk investments at the existing airport but also invested in relations with a network of local suppliers. For air freight, the logistics companies established around the airport are a critical factor. Heathrow carries a third of UK exports by value and 63% of freight tonnes handled at UK airports. More generally, businesses generating passengers will have located around the airport and along the roads serving the airport. For an airport like Heathrow, large numbers of international companies have located headquarters in areas accessible to the airport. Airlines need to stay close to their customers. Closing the airport to force relocation can have severe effects on the economy of the districts most accessible to it, although it should be acknowledged that any such airport closure would necessarily need to be planned and implemented over a relatively long period of time.

A number of major cities have opened new hub airports and moved airline operations to the new site by largely closing the existing airport to international traffic. Tokyo, Osaka and Seoul all did this as noise nuisance made expanding the existing airports located close to the CBDs problematic. In the cases of Tokyo and Seoul, however, services to international destinations in the region have since resumed at the older airports, driven by the convenience of downtown locations for business travellers in particular. Using Gimpo and Haneda instead of Incheon and Narita to travel from central Seoul to central Tokyo cuts the overall trip from five to three and a half hours for business travellers.

The redevelopment of Haneda airport for international flights has been particularly striking. In the 1970s the airport's small site at a river mouth on Tokyo Bay was constrained by port activity and noise nuisance from planes passing over the CBD. Narita airport was built 45 km away from the CBD and Haneda restricted to domestic flights. A decline in inner port activity and the use of the bay for landfill to dispose of refuse created a large area that could be reclaimed for expansion of the airport. Pressure from businesses to operate more flights from Haneda, and from the main domestic operator ANA to enter the international market from its base at Haneda, resulted in two new runways being built. Noise impacts on Tokyo have been limited by offsetting the runways from the standard orientation dictated by the direction of prevailing winds. A few degrees rotation towards the bay allows flights to take off and land largely over water (see Katsuhiro Yamaguchi's Roundtable paper). Slots for international flights have been awarded to Haneda, exploiting its night time availability in particular (Narita is subject to a curfew). Haneda has capacity to take many more international flights but expansion has been limited in response to concern on the part of local governments over potential loss of business at Narita.

There is relatively little transfer traffic in either of Tokyo's airports, partly because of high domestic and international point to point demand, partly because of high transfer prices and, until recently, generally high costs because of the strong Yen. Separating domestic from international flights also undermined connectivity in Tokyo and Osaka. Whilst Haneda served all domestic airports, Narita operated connecting flights to only a few major cities. Osaka's airports are in similar position. Perhaps in part because of this, some passengers have chosen routes through hubs outside Japan; for example, Korea's Incheon International airport provides international connections to regional airports in Japan. However, the numbers of passengers involved seem to have been quite small. There is, nevertheless, evidence that some of this transfer traffic has reverted to Haneda since the re-introduction of international scheduled operations there (Hayashi 2013; Sugitani and Tansei 2010).

Japan's two main airlines ANA and JAL base their hub operations at Haneda and Narita respectively. Allowing Haneda more international slots will improve the competitiveness of Haneda over rival hub airports in Asia and most likely benefit ANA. The return of international scheduled flights at Haneda has triggered a strategic response from Narita, leading to a fifty percent increase in annual landing slots by 2015 (see Katsuhiro Yamaguchi's Roundtable paper). Award of the 2020 Olympic Games to Tokyo in September 2013 prompted the government to examine options to add slots at both airports, including a possible fifth runway at Haneda[9].

In most cases where cities have multiple airports they tend to serve different market segments, with one providing capacity for network service carriers to operate a hub and others catering mainly to low cost carriers, charter flights, regional aviation and other point to point services. Cities where two airports support hubs for network carriers are unusual. The New York region seems to be an exception, although it can be argued that the two main airports largely serve spatially separate markets on the landward side, east and west of the Hudson river (see Jeffrey Zupan's Roundtable paper).

Haneda may be an exception because of the unforeseen benefits of its location – where the high cost of landfill for off-shore development was reduced by the city's waste disposal policy – but it illustrates the unpredictability inherent in coordinating old and new airports when the old airport is not closed down entirely. In Montreal a new hub airport, Mirabel, was opened in 1975 fifty minutes' drive from the CBD; the largest airport in the world at the time. Slots for international flights were withdrawn from the existing Dorval airport, 20 minutes' drive from the CBD. Public pressure prevented the planned closure of Dorval, which was less expensive and more convenient to use for domestic flights. Passengers taking connecting flights between the two airports were faced with a long bus ride. Passenger numbers did not increase as forecast at Mirabel and international flights were reinstated at Dorval in 1997. Mirabel now only serves freight and general aviation.

In Hong Kong in contrast, the inner-city Kai Tak airport was completely closed when the new airport on Lantau Island was opened with its direct road and rail links to the CBD. The very central location of Kai Tak resulted in rapid redevelopment for prime real estate. In Berlin, the inner-city Templehof airport has been closed down and Tegel will close when the new, expanded Brandenburg International Airport on the site of Shoenefeld airport is opened (see the paper to the Roundtable by Niemeier). Berlin saw a drawn-out planning debate over alternative uses for the Templehof site but coordination in Berlin presents fewer problems than in London; Tegel is not a hub airport and access to the City centre will be no worse at the new airport than Tegel because of investment in road and rail links to the site, which is only 18 km from the CBD.

The process of building a consensus on development of transport infrastructure with the business community is illustrated by the GBP 15.9 billion Crossrail investment, linking west London to the city centre and the financial centres of the City and Docklands (located towards the east). The local business community agreed to the introduction of a supplementary tax on commercial property to cover a quarter of the cost. Reaching this agreement ended three decades of delay in finding finance for the project. Although the business community (represented by London First) is equally convinced that expansion of London's airport capacity is needed, and financing is available for a third runway at Heathrow, aligning airport, airline and business interests on transferring hub operations to a new site at a cost of GBP 40-50 billion or higher would be far more difficult.

In Sydney, the airport's owners have first right of refusal for developing a second airport. It is, however, far from clear that they would exercise this option if a second site were to be chosen as it is not clear that the government would require closure of the existing airport (and in practice this appears unlikely). The right was awarded when the airport was sold so as to protect the price from planning risk. The airport was sold for about five billion AUD whilst bids without the guarantee were expected to be considerably lower. It might be possible to align Heathrow's interests with expansion on a new site through such an arrangement, although Heathrow's owners were recently forced to sell Gatwick and Stansted by the competition authorities. Expansion at Stansted in the late 1980s was financed on the basis of profits at Heathrow while the two were both owned by BAA Plc. Closure of Heathrow would otherwise require compensation, with Heathrow currently valued at around £10 billion on the basis of its regulatory asset base.

Osaka's airports face familiar problems of coordination. The Itami inner city airport, which is constrained by its noise footprint, saw flights restricted when the new, offshore Kansai International Airport was opened. Itami continues to serve as a major domestic airport at Osaka because of the convenience of its location while Kansai International provides a wide range of services, including LCC and global air cargo, taking advantage of its 24-hour operability. Ownership of the two airports was integrated in 2013 to simplify coordination ahead of plans to lease the airports to a private operator. The effect of airport integration is already manifest. For instance, the airport company has reached an agreement with local government to allow Itami slots which were previously limited to turbo-props to be utilised by low-noise turbo jets. Coordination has been complicated, however, by the construction of a third airport in the region in the port of Kobe. The site had been considered as a location for Kansai International and rejected. The 1995 Kobe earthquake overturned regional planning decisions and the go-ahead was given for the airport as part of the reconstruction and economic stimulus package for the city.

Airport planning decisions can also be overtaken by changes in the airline business, including emerging business models like LCC as well as mergers and alliances. They could also be affected by the development of high-speed rail networks.

Evidence based comparison of the likely impacts – economic, environmental and social – of the most promising options

The case studies show that there are no universally applicable conclusions on which options for increasing capacity are likely to work best in practice; this will be shaped by the interplay of local geography, the structure of the local economy, and the structure of airline networks at individual locations.

This suggests that it will be important to carry out evidence based comparisons of the likely impacts (economic, environmental and social) of the most promising options. Different approaches used in practice were discussed in part 5 above. This discussion suggested that cost-benefit analysis (perhaps supplemented by CGE) provides an approach which is well grounded in the available research evidence, and its practical application, and which aims to cover the main positive and negative impacts of airport expansion. However, the significant uncertainties in some parts of the evidence base need to be reflected, and then tested, through a suitable range of realistic scenarios. Given these uncertainties, it is important that the analysis is transparent, impartial, validated by expert peer review and reviewed with key stakeholders – with the aim that, in this way, the findings command broad acceptance.

Flexible strategic planning

Decisions on investment in additional airport capacity face significant uncertainties – in relation both to demand and also to various components of costs and benefits – and this suggests there are likely to be benefits in a flexible approach to expansion. But additional capacity often involves large, long-lived, sunk investments and these characteristics – together with co-ordination issues, particularly with surface access and air traffic control – require detailed strategic planning. There is an obvious dilemma here – too much focus on detailed planning, with insufficient regard to the uncertainties, carries the risks of getting the level of capacity wrong (with either over-building or under-building, and additional costs either way). On the other hand too much focus on flexibility risks ineffective delivery (with time and/or cost over-runs) through failure to adequately plan through the complexities of construction and co-ordination. Burghouwt (2007) characterises this as the three-fold dilemma of airport planning and suggests that flexible strategic planning provides an approach to resolving this dilemma (see Kay (2010) for a more general discussion of some of these issues). In essence flexible strategic planning involves four stages:

- looking at investment proposals across a range of scenarios for the key uncertainties;
- including proposals which are incremental and/or have flexibility to add/subtract capacity;
- comparing these proposals over the full range of scenarios; and
- reviewing plans as new information becomes available.

As far as scenarios are concerned, firstly, the earlier discussion noted key uncertainties in the demand forecasts and these should obviously be reflected in the scenarios. But there will often also be significant uncertainties in at least some of the benefits and costs. For example, in relation to environmental costs there may be uncertainties on valuations (e.g. in relation to greenhouse emissions) and/or in relation to impact (e.g. in relation to the future utilisation of quieter aircraft). Or, in relation to productivity and economic growth there may, for example, be uncertainties in the development and impact of new communications technologies. Some of these risks might be managed, at least partially, through vertical contracts between airports and key customer airlines (see Starkie (2008) for a discussion) – although, to some degree, these will concern managing endogenous risks and risk-sharing, rather than managing exogenous risks.

Second, as far as flexible capacity is concerned, the basic idea is to include investment proposals which either are incremental and/or which provide options to expand or contract capacity as circumstances develop. See Burghouwt (2007) for a case study of Amsterdam airport.

Third, comparing the different investment proposals across the range of scenarios using cost-benefit analysis (and perhaps CGE) will help to establish the potential value of flexibility. Those investment proposals which have built-in flexibility – to expand or to contract a margin of capacity – will generally be more expensive; and so they will tend to perform less well on the central forecasting scenarios. The key question is then whether their flexibility helps them to perform sufficiently well on the less central scenarios so as to suggest that the extra costs of flexibility are worthwhile. Thus it may turn out that the best option is not the one that performs best on the central scenarios but rather the one which performs reasonably well across a range of scenarios (sometimes referred to as multi-future robustness). Formal techniques – such as real options analysis – may be useful to supplement cost-benefit analysis in answering this question, although these methods often have significant information requirements and may be difficult to implement in practice. Again see Burghouwt (2007) for a discussion and also Transportation Research Board (2012).

Finally, it can be expected that new, and better, information on many of the key uncertainties will become available over the timescales of planning and development. So it will usually be worthwhile to review and revise plans at key staging points. It will, however, be important to schedule these reviews for points when there are significant forks in the road, and/or significant new information, and not to unnecessarily exacerbate uncertainty through frequent, unscheduled re-consideration.

Protecting the interests of those most at risk of significant (negative) environmental impacts

The case studies show that the potential for negative environmental impacts often acts as a major constraint on airport expansion. Particularly important are circumstances where there are some people, often small in number compared with the numbers using the airport, for whom the potential environmental costs are significant (for example, in terms of night time noise or the loss of valued wildlife habitats). Even where, in aggregate terms, these costs are relatively small in comparison with the other costs and benefits of airport expansion, these impacts can result in significant public opposition to expansion. It is understandable that those at risk will usually oppose expansion. But what the case studies suggest is that these circumstances often result in a more general sense of unfairness (to those at risk) and that this in turn can prompt more widespread opposition to expansion.

Resolving this problem in a satisfactory way will often be critically important to successfully implementing airport expansion. Solutions will need to provide for an outcome which is generally perceived to be fair, whilst at the same time seeking to achieve the best value utilisation of the airport's capacity; the potential conflict between these twin objectives means that this is far from straightforward.

As discussed in part 6, a solution regarded as fair is likely to involve some blend of:

- assuring present levels of environmental benefit and devising airport expansion around these (for example assuring pre-existing levels of noise or local air pollution);
- providing alternative – equivalent – benefit, where this is feasible (for example, replacement wildlife habitats);
- providing amelioration (for example noise insulation);
- and providing compensation (for example buying-out severely affected households).

Getting the best value utilisation of capacity – the second half of the twin objective – will likely involve (as discussed in part 6) some blend of restrictions on quantities (e.g. night flights by relatively noisy aircraft) and restrictions on prices (e.g. noise budgets or emissions budgets for local air pollution).

Solutions will need to be tailored to the distinctive local circumstances and, for this reason, will often be complex.

Providing the right investment incentives

Evidence on the pattern of airport investment shows a mixed picture. In many cases, there are examples of too much capacity being provided at some locations, coupled with too little capacity in other locations, often where it is most needed (see the discussion in the paper for the Roundtable by Professor Niemeier). This suggests scope for improving the efficiency of investment in additional airport capacity. Improved investment incentives should also help with the difficult public policy choices on new airport capacity, both by enhancing the range and quality of the solutions that are proposed and by enhancing the depth and robustness of their supporting evidence. Getting the right investment incentives is, however, far from straightforward. In particular, there may be problems associated with:

- the risks of stranded sunk assets, a risk which may in turn inhibit investment (the time-consistency problem);
- external costs (particularly environmental impacts) and/or benefits (particularly impacts on productivity and economic growth);
- monopoly, or market power, in circumstances where the urban geography and configuration of airline networks make the development of competing airport facilities problematic.

On the first problem – stranded assets – monopoly supply has sometimes been seen to be a solution – by providing greater certainty on prospective returns. In the UK, this was, to some degree, reflected in the approach to public ownership of the utilities in the second half of the 20th century (see Helm (2009) for a discussion). And it was similarly reflected, in part, in the decision to privatise the three main London airports under common ownership (an approach which it was thought would help facilitate investment in additional capacity).

In practice, this doesn't seem to have worked out as expected. The UK's competition authorities have concluded that the monopoly arrangements provided inadequate incentives for investment in additional capacity (Competition Commission (2009)). They concluded that, instead, the separation of the ownership of the main London airports, to provide the opportunity for competition between them, would provide more effective investment incentives. In the rest of the UK, competition between airports has been allowed to develop, where feasible, and this seems to have worked reasonably effectively, see Starkie (2008). In particular, investment in new capacity has generally been carried forward where there has been market demand; the time-consistency problem has been resolved through long term contracts between airports and key customer airlines (again see Starkie (2008)) whilst the incidence of over-provision is relatively low compared with many other European countries (on which see Professor Niemeier's Roundtable paper). Of course, long term vertical contracts may carry the risk of anti-competitive restrictions, although the risks are likely to be lower where an airport faces effective competition, which is also where, correspondingly, the risks of stranding are greatest. Nevertheless, competition authorities will need to be vigilant and transparency will be important.

On the second problem – the possibility that external benefits and/or costs may be important – there is at the least a role for a public planning framework to consider and resolve conflicting interests. Experience with the London Crossrail project suggests a route toward at least partially internalising some of the impacts on productivity and growth which cannot be captured in commercial revenues. And experience in the ports and waterways sectors in Europe shows how internalisation might be approximated for some important environmental impacts, as do noise-related charges at some airports. However, it is likely that some of the relevant impacts will prove more difficult to internalise in the case of airports. Nevertheless, better alignment of interests has the prospective advantage of focusing resources on the creative development of shared solutions (again the ports and waterways experience is relevant, see for example ECMT 2006) rather than the development of competing, and inflated, claims of benefit or cost (as graphically outlined in Professor Niemeier's paper) which become both difficult and contentious for public policy makers to resolve.

The third issue – monopoly or market power – is particularly relevant to airports in major urban areas. Even where feasible steps are taken to facilitate competition, this may be partly or largely precluded by the interface between the urban geography and airline networks at a particular location. In these circumstances, the regulatory controls hold the key to investment incentives. In broad terms, there are three different models which have been used to regulate airports in cases where market power is an issue:

- Light-handed regulation,
- Rate-of-return regulation,
- Price-cap regulation.

Light handed regulation – as practiced at Sydney airport, for example – essentially involves allowing the airport to set its own structure of charges, subject to some scrutiny by the authorities (see the paper presented to the Roundtable by Peter Forsyth for a discussion). This approach is judged to have worked reasonably well in circumstances where there is a margin of spare capacity – by allowing the airport some flexibility to set the level and structure of prices so as to respond to developments in market demand. However, a key question is whether this approach will provide the right incentives to invest in additional infrastructure as capacity margins tighten. Or whether, alternatively, both the airport and the main incumbent airlines will see an advantage in delaying investment. There must be some doubt about whether light handed regulation will provide the right investment incentives in these circumstances (again see Forsyth (2013) for a discussion).

It is these concerns that have motivated the adoption of more prescriptive regulation of prices at many large airports. The second approach – rate-of-return regulation – provides strong incentives to invest, by warranting the returns to the investment through the price the airport is allowed to charge for its services. The concern here is that this risks excessive levels of investment (or of gold plating) and of promoting inefficient levels of costs.

The third approach – simple price-cap regulation – provides incentives for cost efficiency but at the risk of inadequate incentives to invest.

Research on the implementation of regulation in the airports sector confirms that these concerns have arisen in practice (see Oum, Zhang, and Zhang (2004)). In cases where rate-of-return regulation has been adopted, there is evidence of over-investment and higher costs. Price-cap regulation, on the other hand, tends to be associated with more efficient levels of costs, but also with under-investment. There was insufficient experience with light handed regulation at the time of the study to test its impact empirically.

The question this raises is whether it is possible to modify the application of price-cap regulation so as to provide adequate incentives to invest – an issue discussed by Helm (2009) who makes three suggestions:

- That the calculation of the periodic price cap is based on a regulatory asset base; this resolves the time-consistency (stranded asset) problem in a regulated setting and is becoming increasingly common practice in the implementation of price-cap regulation.
- That the calculations of the price cap are based on a split rate of return – a higher (ex-ante) rate for prospective new investment (to reflect the project risks) and a lower rate for established assets. The basic idea here is to avoid the risk that a single rate will under-incentivise new investment whilst also over-rewarding established assets, and thereby encouraging financial engineering.
- That the rate provided on established assets is indexed to the market rather than pre-specified.

In addition, the study by Oum, Zhang and Zhang (2004) suggests that a dual-till approach – essentially accounting for airside and retailing activities separately – provides better incentives for investment and for productivity than a single till approach.

This discussion perhaps also suggests that once a major addition to capacity has taken place, followed by a period with a margin of spare capacity, then light-handed regulation would be preferred to enable the airport to structure its prices to make the best use of capacity; once, over time, capacity margins tighten a case could be made for re-introducing a price cap based on split rates of return.

Legitimacy of planning decisions and the costs of inconsistency

Many airports in large metropolitan areas suffer long planning delays when expansion is proposed. For example, the paper to the Roundtable on Germany (Niemeier 2013) notes periods of 13 years for Munich and 24 years for Dusseldorf. Deliberations often span decades and political commitments to add runways or to restrict flights are susceptible to being overturned in time. The legitimacy of decision is frequently challenged by protests. Nimbyism[10] is inevitable, as while the benefits of air travel are broadly spread, the negative externalities are concentrated narrowly on the areas neighbouring airports. A sufficiently large number of political constituencies may be affected by noise from large airports close to city centres for opposition to expansion to become a sensitive national political issue. The more extreme, "build absolutely nothing anywhere near anything/anybody" (BANANA), view point gains ground when ineffective procedures undermine the legitimacy of decision making. Legitimacy rests on at least four factors:

- The credibility of demand forecasts. Forecasting with models which overstate demand, and over time tend to be unreliable and biased, will lose credibility if they are not improved.
- The corresponding credibility of financial and economic analysis. The commercial, financial case needs to be assessed as does cost-benefit analysis. Care needs to be taken in assessing wider economic effects to be accounted for in addition to the direct economic benefits included in CBA to identify the impacts on productivity at a sufficient level of detail to understand the mechanisms at play, so as not to overstate benefits.
- Environmental impact assessment is required so as to enable local impacts to be considered in a broader regional or even national context, with a thorough evaluation of alternative options.
- Public consultation is essential. It needs to start with the local community most affected and start early. The most successful consultations begin by involving the public in identifying a full range of alternative options so that to some extent they take ownership of the problems to be solved. Without a basis in early consultation, formal mediation and inquiry procedures in the final stages of the decision making process can suffer from the impression that the decision has already been taken barring revelation of some striking new evidence.

Of course, over long time periods the political environment changes, including in relation to environmental concerns. Even the best environmental assessment and public consultation procedures cannot produce agreements that guarantee conditions for coordinated airport expansions over decades. Niemeier (2013), however, documents the costly effects of inconsistency. Plans for a third runway at Lufthansa's hub in Frankfurt were delayed 22 years and subject to violent protest, opening only in 1984. The difficulties led Lufthansa to develop a second hub at Munich when its new airport opened in 1992. The airport is located 28 km from Munich so that noise affects few people. Munich was originally planned for 4 runways, but this was reduced to 2 by the time it opened in 1992. Plans for a third runway were finally rejected by public referendum in 2012. Meanwhile Frankfurt airport launched an open ended consultation with the public and business interests on the future of the airport in 1998 that led to the opening of a fourth runway (and introduction of a strict night curfew) in 2011. Had the more inclusive planning environment been established earlier in Frankfurt, Lufthansa would probably have foregone a second German hub and the costs and dilution of hub economies associated with it. Had it been able to foresee the growth of opposition to airport operations in Munich it would surely have remained concentrated in Frankfurt.

NOTES

1. See Airports Commission website: https://www.gov.uk/government/organisations/airports-commission.

2. According to transfer and detour time.

3. These assurances included the guarantee that Air France-KLM would continue to operate 42 intercontinental 'key destinations' out of Amsterdam for a period of five years.

4. Cf. e.g. Grady P. and R.A. Muller, 1988.

5. This increase of more than 50% is found by adding the pure agglomeration benefits and the tax revenue impact of the move to more productive jobs (see Worsley, 2011).

6. Airport Coordination Limited operates a web-based trading system for slots at Heathrow (slottrade.aero).

7. At Heathrow, 50% of new capacity is allocated to "new entrants" (i.e. airlines that operate on fewer than 4 flights a week from Heathrow).

8. In February 2013, for example, Jet Airways sold its three pairs of Heathrow slots for US$70 million to Etihad Airways in a sale and lease back agreement, part of a wider commercial partnership including code sharing. Jet Airways will continue to use the slots for its flights from London to Mumbai and Delhi.

9. http://english.kyodonews.jp/news/2013/09/245573.html

10. Not in my back yard.

Bibliography

Note: Listed below are the references explicitly cited in this summary overview; a wider range of research evidence underpins the five input papers prepared for the Roundtable, and is referenced in each of these papers.

Airports Commission (2013a), Discussion Paper 01: "Aviation Demand Forecasting", February 2013.

Airports Commission (2013b), Discussion Paper 02: "Aviation Connectivity and the Economy", March 2013.

Airports Commission (2013c), Discussion Paper 03: "Aviation and Climate Change", April 2013.

Airports Commission 2013d, Discussion Paper 04: "Airport Operational Models", May 2013.

Airports Commission (2013e), Discussion Paper 05: "Aviation Noise", July 2013.

Burghouwt, G. (2007), *Airline Network Developments in Europe and Its Implications for Airport Planning*, Ashgate.

Burghouwt, G., 2013, *Airport Capacity Expansion Strategies in the Era of Airline Multi-hub Networks*, Discussion Paper 2013-5, in Roundtable on Expanding Airport Capacity in Large Urban Areas International Transport Forum, OECD Paris 2013.

Competition Commission (2009), *BAA Airports Market Investigation: Final Report*, London, The Stationery Office.

Crafts, N. (2009), "Transport Infrastructure Investment: Implications for Growth and Productivity", *Oxford Review of Economic Policy* 25(3) 327-43.

ECMT (2004), *Assessment and Decision Making for Sustainable Transport*, OECD Paris 2004.

ECMT (2006), *Inland Waterways and Environmental Protection*, OECD Paris 2006.

Eddington, R. (2006), *The Eddington Transport Study*, December, London, The Stationery Office.

ERCD (2012), ERCD report 1201, *Noise Exposure Contours for Heathrow Airport*, 2011, Lee, Edmonds, Patel and Rhodes, Prepared by the Civil Aviation Authority on behalf of the Department for Transport, September 2012.

Flyvbjerg, B. (2009), "Survival of the Unfittest: Why the Worst Infrastructure Gets Built – and What We Can Do About It", *Oxford Review of Economic Policy* 25(3) 344-67.

Forsyth, P. (2013), *Air Capacity for Sydney*, Discussion Paper 2013-2, International Transport Forum, OECD Paris 2013.

GARS – IATA (2013), German Aviation Research Society Workshop in co-operation with IATA "The Effects of Air Transport on the Economy – How Can We Evaluate Them?" 20th June 2013, Amsterdam

Gatwick (2010), *Noise Action Plan 2010-2015*, Gatwick Airport June 2010.

Giuliano and O'Brien (2008), *Responding to Increasing Port-Related Freight Volumes: Lessons from Los Angeles/Long Beach and other US Ports and Hinterlands*, OECD/ITF Roundtable Discussion Paper No. 2008-12, March 2008.

Goodwin, P. (20120, *Peak Travel, Peak Car and the Future of Mobility*, OECD/ITF Roundtable Discussion Paper No. 2012-13.

Grady P. and R.A. Muller, (1988), "On the use and misuse of input-output based impact analysis in evaluation", *The Canadian Journal of Program Evaluation*, 3, 2,49-61.

HEATCO (2006), *Developing Harmonised European Approaches for Transport Costing and Project Assessment*, IER, Germany.

Heathrow (2011), *Heathrow Noise Action Plan*, Heathrow Airport May 2011.

Helm, D. (2009), "Infrastructure investment, the cost of capital and regulation: an assessment", *Oxford Review of Economic Policy* 25(3) 307-26.

Helm, D., and C. Hepburn 2011, "The economic analysis of bio-diversity: an assessment", *Oxford Review of Economic Policy* 28 1-21.

Hepburn, C. (2006), "Regulation by Prices or Quantities or Both: A Review of Instrument Choice", *Oxford Review of Economic Policy* 22(2) 226-47.

Hyashi, T., et al. (2013), "Study on the Effect of Internationalization of Haneda Airport", *Transport Policy Studies Vol.16* No.2 Summer 2013.

Israel M., B. Keating, D. Rubinfeld, and R. Willig, 2012, "Airline network effects & consumer welfare", mimeo.

ITF/OECD (2013), *Long run trends in travel demand*.

ITF/OECD (2012), *Transport Outlook 2012*: "Seamless Transport for Greener Growth".

Kay, J.A. (2012), "London's new airport held to ransom by folly", *Financial Times*, 7 November 2012.

Kay, J.A. (2010), *Obliquity*, Profile Books.

Keen, M., and J. Strand (2006), IMF Working Paper, *Fiscal Affairs Department, Indirect Taxes on International Aviation*.

Keen, M., and J. Strand (2007), "Indirect Taxes on International Aviation", *Fiscal Studie*s, 28.

NERA (2010), *Representing International Business Impacts in Transport Appraisal* – Report for the Department for Transport, NERA Economic Consulting.

Niemeier, H-M., “Expanding Airport Capacity under Constraints in Large Urban Areas: the German Experience”, Discussion Paper 2013-4, International Transport Forum, OECD Paris 2013.

Mackie, P., and T. Worsley (2013) *International Comparisons of Transport Appraisal Practice: Overview Report*. ITS Leeds.

Morrison, S. A., and C. Winston (1986), *The economic effects of airline deregulation*, Brookings Institution.

MVA Consultancy (2007), “Attitudes to Noise from Aviation Sources in England”; Final Report for the Department of Transport.

Oum, T. H., X. Fu and A. Zhang (2009), “Air transport Liberalisation and its Impacts on Airline Competition and Air Passenger Traffic”, ITF 2009 Forum, Forum Papers.

Oum, T. H., A. Zhang and Y. Zhang (2004), “Alternative Forms of Economic Regulation and their Efficiency Implications for Airports”, *Journal of Transport Economics and Policy*, Volume 38, Part 2 217-246.

Partidario, M. (2009) *Does SEA Change Outcomes?*, Instituto Superior Technico, Portugal, Discussion Paper 2009-31, International Transport Forum, OECD Paris 2009.

Productivity Commission (2002), “Price Regulation of Airport Services”, Report No. 19, Ausfino Canberra.

Sentance, A. (2009), “Developing transport infrastructure for the Low Carbon Society”*, Oxford Review of Economic Policy* 25(3) 391-410

Starkie, D. (2008), *The Airport Industry in a Competitive Environment: A United Kingdom Perspective*, OECD/ITF JTRC Discussion Paper No 2008-15.

Sugitani, A. and K. Tansei (2010), *Transition and Present Situation of International Routes and Passengers from Local Airports*, Technical Note 603, National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure, Transport and Tourism, June 2010.

Transportation Research Board, Washington DC (2012), “Addressing Uncertainty about Future Airport Activity Levels in Airport Decision Making”, Airport Cooperative Research Programme Report 76.

Worsley, T. 2011, *The Evolution of London’s Crossrail Scheme and the Development of the Department of Transport’s Economic Appraisal Methods*, OECD/ITF JTRC Discussion Paper 2011-27.

Yamaguchi, K., *Evolution of Metropolitan Airports in Japan*, Discussion Paper 2013-3, International Transport Forum, OECD Paris 2013.

Zupan, J. (2013) *Upgrading to World Class: The Future of the New York Region’s Airports*, Discussion Paper 2013-1, International Transport Forum, OECD Paris 2013

CHAPTER 1

Upgrading to world class: the future of the New York region's airports

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The New York metropolitan region's three major airports --- Kennedy, LaGuardia and Newark – regularly register the worse delays among airports in the United States. Moreover, the air traffic capacity of these airports is at or close to its limits during peak times, with anticipated growth resulting in either more delays or thwarted air passenger travel. The lack of capacity to handle air passenger volumes, expected to reach upwards of 150 million by the late 2030s from 109 million today, will seriously impact the ability of the region to grow economically. Thus, solutions to this problem are vital to prevent these economic losses.

This report examines the variety of measures that might address the issues of delay and capacity limits. Possible steps include: greater use of other more outlying airports in the region, diversion of passengers to higher speed intercity rail, technological improvements to the air navigation system, management of demand through pricing and other means to shift air traffic from peak periods, and construction of an entirely new airport. The report concludes that intercity rail and navigational improvements, and some diversion to two outlying airports will be of assistance when taken together, but not nearly enough to address the need. Therefore, the addition of one or more runways at Kennedy and at Newark airport is by default the best option to provide the necessary capacity, if the redesign of these airports can be implemented. The report suggests some runway configurations at those two airports for consideration.

1. Introduction

This paper is intended to serve three purposes. First, it presents a slightly abbreviated version of the summary of the book published by Regional Plan Association (RPA)[1] in January 2011 about the serious capacity and delay problems at the three major airports in New York and what might be done about it.[2] Second, the paper provides information on the response by the Port Authority of New York and New Jersey, the owners and operators of the three airports and what has transpired in the two years since the book was published. Third, the paper discusses some relevant emerging issues that will likely further affect the ability to address the growing problem of capacity and delays at these airports.

2. Summary of 2011 RPA report

Intercity travel is at the core of an increasingly interconnected and competitive global economy. Without the ability to efficiently transport business and leisure travellers and time-sensitive cargo, both domestic and international business would grind to a halt. Since virtually all long-distance travel is by air, along with a high proportion of shorter distance travel between cities, metropolitan economies depend on their ability to provide high-quality airline service to many destinations. This is especially true for world-city regions like the New York metropolitan area that are even more dependent on industries with a high propensity for flying. In New York, New Jersey and Connecticut, the leading economic sectors all rely on frequent air travel to many destinations. Indeed, the region's status as a nexus for domestic and international air travel is intricately linked to its role as a premier centre of global commerce.

This crucial link between air travel and economic prosperity is threatened by a lack of adequate capacity in the region's aviation system, including air space, airports and landside connections. This is manifested in flight delays that greatly exceed those of every other major airport in the United States. These delays cost the region hundreds of millions of dollars each year in lost wages and business income. In the future, without additional capacity the impacts will be far more severe. While delays cost valuable time and can inhibit some from flying, having too few flights to handle demand will prevent millions from flying and cost the region thousands of jobs and billions of dollars.

Strained capacity at the airports is more than a local problem. Delays at the region's three major airports – Kennedy, Newark and LaGuardia – ripple through the national aviation network causing delays from Washington, DC, to Los Angeles, CA. Constraining the New York region's capacity for air travel growth would also weaken the nation's ability to compete for global business in finance, media and other industries for which New York is the nation's leading international centre.

Solutions will require both short-term and long-term actions, as well as a coordinated strategy by a number of public and private sector participants, including the Port Authority of New York and New

Jersey, which operates the three airports, the Federal Aviation Administration (FAA), which regulates and controls the nation's airspace, the private airlines that operate terminals and schedule flights, and the city and state agencies responsible for the roads and transit network connecting to the airports.

Today, the region's three airports regularly rank worst delays among the nation's airports, with more flights than the region's constrained airports and airspace can handle. To limit the delays created by the excessive flights scheduled during peak times, the FAA placed a cap on hourly flights at all three major airports. This action limits the ability of the three airports to meet current or projected growth.

The demand for air travel is almost certain to continue to increase substantially over the coming decades. Air traffic has increased in every decade since commercial flights were introduced, and a growing international service economy will drive up demand in the future. It is expected that passenger demand, which was 104 million in 2010, will reach 150 million by as early as 2030, if the capacity is available. The growth is fuelled by global economic expansion, the continuing attraction of the New York region for visitors, and expected growth in the New York region's population.

If they can be accommodated, these additional air passengers represent a major source of growth for the region's economy. In 2009, air passengers and cargo generated USD 16.8 billion in wages and USD 48.6 billion in sales to the region, and supported nearly 415 000 jobs. Without additional capacity, the region will forego an increasing number of jobs, wages and sales each year. By the 2030s, these losses could reach as many as 125 000 jobs, USD 6 billion in wages and USD 16 billion in sales each year.

To both reduce delays and accommodate future demand for air travel, the region will need to expand capacity by 78 additional flights per hour – or one third more than today. This added capacity will be needed to serve an additional 39 million passengers, who without it would be unable to fly into and out of the region's airports with reasonable predictability. Just to maintain the current uncompetitive level of 20-minute delays, there would still be a need for 45 more flights per peak hour to handle an additional 22 million passengers.

Creating this capacity will require a combination of actions, some of which can be implemented in the next few years while others could take two decades or more to complete. RPA examined six categories of potential investments and demand management.

1. Implement *NextGen I* and *II,* a phased implementation of technological investments and operational and procedural changes that would transform the nation's air traffic control system.
2. Encourage the use of outlying airports – Stewart International in Orange County and MacArthur in Suffolk County – to free up capacity at the three major airports.
3. Improve intercity rail service to free up capacity at the airports by shifting passengers from shorter-distance flights.
4. Build a new airport to handle growing demand.
5. Manage demand to reduce peak period flights.
6. Expand runway capacity at the three major airports

These actions vary widely in terms of the capacity potential, cost, timeframes, implementation barriers and environmental impacts. Some actions have benefits beyond their potential to increase the effective capacity of the region's airports, and may be regional priorities even if their ability to relieve airport congestion is limited.

The potential to add capacity or reduce demand for peak-period flights was quantified for each set of actions, and the probable magnitude of costs and other impacts were considered in developing recommendations. Because of the costs and possible environmental impacts associated with runway expansion, all other possible actions were thoroughly examined to determine if, taken together, they could preclude the need to physically expand the airports.

Of all the actions considered, expansion at Kennedy and Newark airports provide the greatest potential for increasing capacity and reducing delays. The implementation of NextGen could potentially address capacity needs in the next five to ten years, but it would not alleviate the need for eventual airport expansion. Other actions would only slightly delay the need for airport expansion, yet many also provide other benefits. To ensure that New York maintains a world-class aviation system, it should strive for the dual objectives of meeting a projected demand of 150 million passengers by 2030 and reducing average delays from 20 minutes to the national norm of 10 minutes.

The only way to meet these objectives is through the expeditious implementation of NextGen and immediate planning for the eventual expansion of Kennedy and Newark airports. Other short-and-intermediate-term actions, especially expanding service at Stewart and MacArthur airports, should be encouraged to serve nearby markets, although they will have little effect on the need for new runways at Kennedy and Newark. Improving intercity rail service should also be implemented to increase traveller options.

The benefits and issues for each set of actions, including the potential of each to expand the capacity to handle peak-period demand is summarised below.

NextGen I and II. The FAA's *NextGen* program is a package of new technologies, such as Global Positioning Systems, that is used to track and guide aircraft, as well as a suite of operational and procedural changes. NextGen, which is being deployed by the FAA over the next few years, is capable of reducing delays and expanding airport landing and take-off capacity. This report concludes that NextGen could have a favourable effect on capacity if deployed for that purpose, but only for the next five to ten years. NextGen I, with full implementation expected by 2018, could add the capacity for 21 flights an hour in the peak period. The impact of NextGen II is more difficult to predict. But even with the most optimistic projections, however, growing air passenger volumes will overwhelm its ability to keep pace with demand.

Expanding the Use of Outlying Airports. The report examined the potential for shifting demand to the region's outlying airports, opening up more capacity at the three core airports. We concluded that Stewart Airport in Orange County, acquired by the Port Authority in 2007, and MacArthur Airport in Suffolk County, each would have a positive but limited effect, attracting only 2.5 million of the 150 million passengers expected in the 2030s, or about 5 of the 80 additional peak-periods flights needed by the 2030s. Expansion of air service at these airports would bring other benefits, including better access for locally generated traffic in the Hudson Valley and Long Island, and give a boost to those local economies.

Improved and High-Speed Intercity Rail. Higher speed intercity rail service is another means to attract air passengers, as it has done in recent years with improved service in the Northeast Corridor. The promise of still faster trains could attract still more customers. The expected progress in rail speeds by 2030 could shift 2 million air passengers, or the equivalent of about nine peak period flights. Truly high-speed trains, which would require significant investments in new rights-of-way, would expand rail's attractive power to over 4 million passengers. A number of factors prevent these estimates from being higher. In particular, only 15 percent of the air passenger trips to and from the airports in the region are to locations within 500 miles, and a large share of air passengers flying short distances are connecting at the New York airports to other places, making their use of rail to reach New York inconvenient for making connections. In addition to these modest improvements in flight capacity, high-speed rail would add a new dimension to intercity travel with a number of other travel and economic benefits.

Build a New Airport. Building an entirely new airport is difficult in a region as densely developed as the tri-state metropolitan area. There must be sufficient land in locations that are both suitable for development and accessible to enough potential passengers that would choose it over existing airports. An exhaustive search for parcels large enough to hold a new airport within 40 miles of the Manhattan central business district (CBD) located no appropriate sites. The possibility of expanding existing small outlying airports was also examined, but these sites were either too small or too far from the region's core. Finally, the concept of constructing an airport island to serve the region was evaluated. It was concluded that the costs for a project of this scale, along with the requirement to close either Kennedy or Newark to open up airspace for the new airport, made this option untenable.

Managing Demand. A number of potential demand management tools have been suggested to use existing capacity at the three major airports more effectively by encouraging higher capacity aircraft and by better utilising the times when airport capacity is not fully used. These include bans of small-sized aircraft (under 50 seats), ban of short flights (under 250 miles), a cap on the frequency in over-served markets, pricing of peak flights to encourage shifts to the off-peak, and auctions. Most of these either proved unworkable or had only a small impact on freeing capacity.

A limited number of recommendations emerged from this investigation, including the possibility of thinning out service in saturated markets. These recommendations, most of which would be resisted by some constituencies, deserve consideration for their beneficial effects on the margin, particularly in the long term at La Guardia, since physical expansion is not feasible there.

Regulation can play another role though. As passengers respond to higher speed rail service or shift to outlying airports, there is no guarantee that airlines will respond by dropping peak-hour flights. The establishment of a process to encourage airlines to drop peak-hour flights would make these other travel options more effective to free up peak airport capacity.

Ground Access and Impact on Airport Capacity. The report concludes that the limitations of ground access, while in need of attention, do not limit growth. While traffic conditions may cause additional delay and may deter some prospective passengers, they will not discourage a large number from flying if the imperatives to fly are there. Collaboration among the transportation agencies is recommended to ease traffic congestion and to develop the promising short- and long-term bus and rail transit options to all three airports outlined in this report.

Expand Existing Airports. After consideration of all the potential capacity-increasing and delay-reducing, this report concludes that expansion of the capacity at Kennedy and Newark will be necessary. Options to expand La Guardia, with a smaller footprint in a more developed area, would be untenable.

The Port Authority should begin to plan now since airport expansion will not happen overnight and serious capacity deficiencies will become even more apparent in the next ten years. At Kennedy, four alternative configurations meet basic airspace and capacity criteria. Each has its advantages and disadvantages. The choice among them, or with possible variations and phasing plans, should be made by the Port Authority, working with the local and environmental communities, in the next few years. At

Newark, one configuration stands out. It is within the airport footprint, minimising impacts off-site, but it would require the redesign and relocations of one or more of three terminals on the airport.

Conclusion. A successful expansion or reconfiguration at Kennedy and Newark, along with NextGen, can meet the twin goals of capacity and delay reduction in the 2030s and beyond. Inaction will result in an economic drain on the region. It will discourage business, limit visits, and prevent our region from fully participating in the global economy.

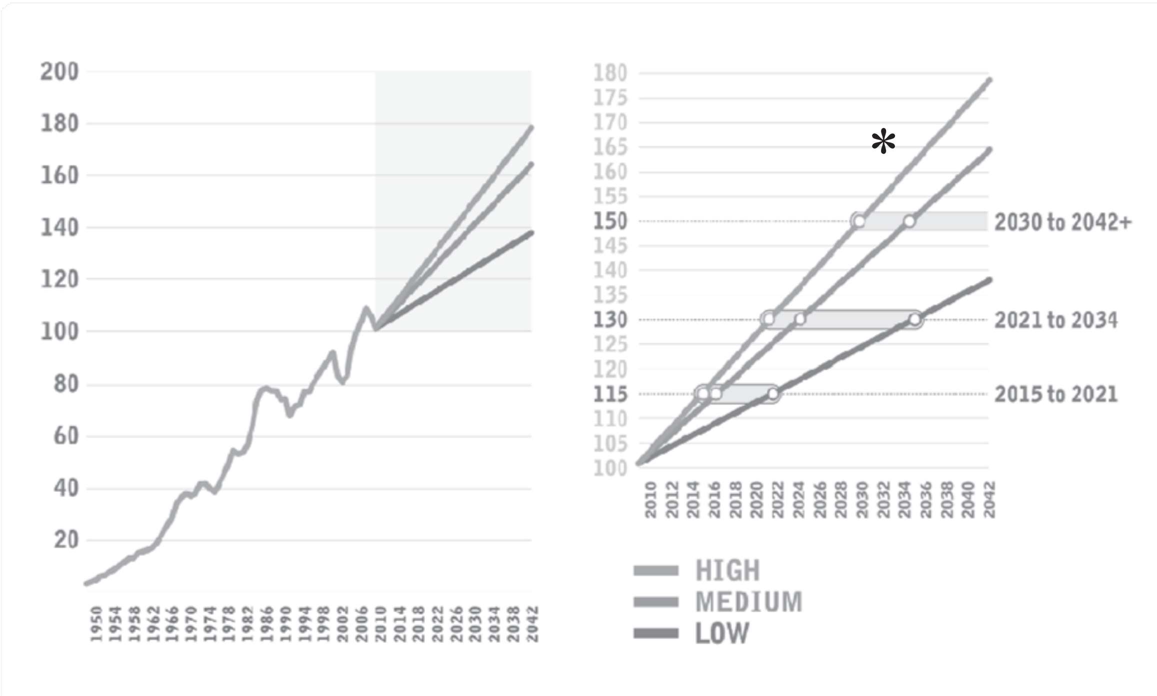
The inability of the combined impacts of NextGen, outlying airports and faster intercity rail to stem the need for eventual airport capacity expansion should not be viewed as a reason to de-emphasise these actions. To the contrary, they are each of great value. NextGen will allow the reduction of delays and the expansion of capacity through more accurate tracking and more flexible airspace opportunities. Outlying airports such as Stewart and MacArthur will serve localised areas, building up local economies and offering air travel options. Faster rail travel, particularly in the Northeast Corridor, will divert travellers from the highways and knit together the economies of the Northeast.

3. Developments since

The Regional Plan Association report summarised above was released in January 2011. Soon after that the Port Authority of New York and New Jersey launched their own analysis, with consultant assistance. The instructions to the consultant: validate the analysis and conclusion of the RPA report, accounting for the interactions of the three airports and of Teterboro Airport, an important general aviation airport in the region. If the findings indicated that runway capacity expansion at Kennedy and/or Newark is needed, develop design options that that met the future needs. This work is underway.

Passenger Projections. In their current efforts, the Port Authority has revised the number of air passengers they are planning for, extending it to 170 MAP (million air passengers). Rate of growth the PA assumed is now higher than the highest of range of three that RPA used in its report. This would result in the 170 MAP being reached by the early 2030s, while the highest RPA projection suggested that 150 MPA would not be achieved until after 2032. These differences are shown in Figure 1.1, taken from the RPA report, with the asterisk added to indicate where the Port Authority projection falls.

Figure 1.1 **Air Passenger Projections**

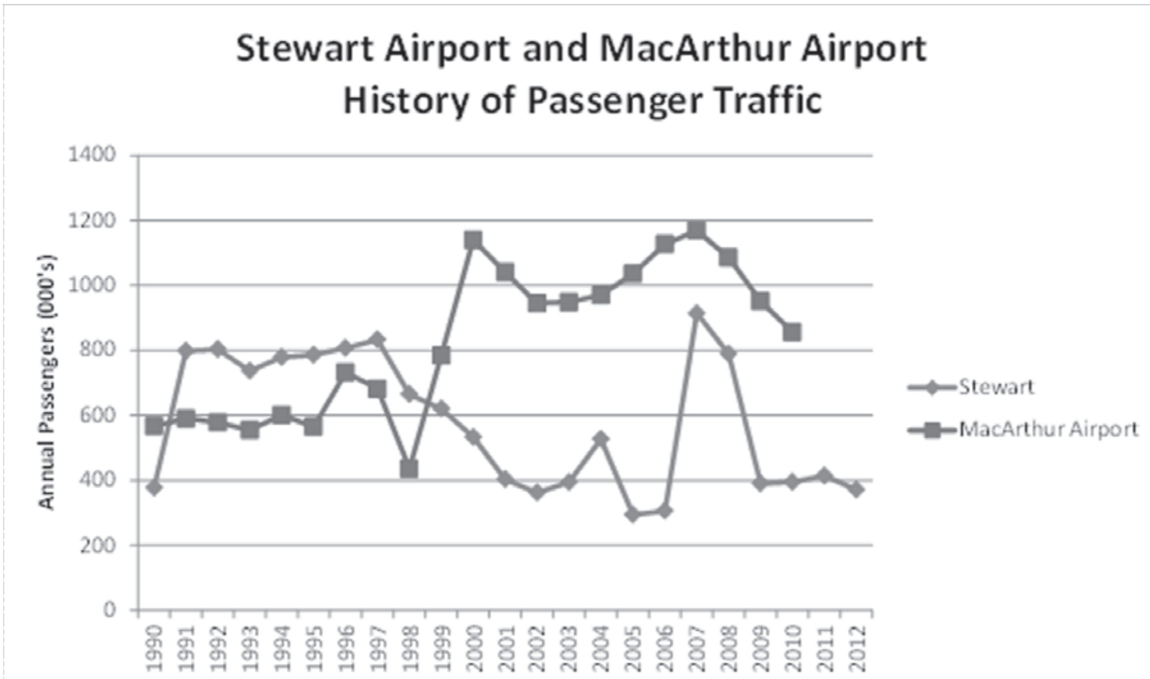


Source: Upgrading to World Class: The Future of the New York Region's Airports; Regional Plan Association

Next Gen. In discussions with the Federal Aviation Administration (FAA), who are charged with implementing NextGen, it has become clear that capacity gains in the near-term are not a given. The Port Authority and the FAA are working together to determine how much additional aircraft operating capacity can be gained over the next several years. This leaves uncertain how much of the gain of 21 flights per hour assumed in the RPA report can be realised by the 2018 implementation timeline for NextGen I. However, in the long term (2025-2035), many of the Next Gen capacity benefits articulated in the RPA report are likely to materialise if airlines are able and willing to equip their aircraft to take advantage of the new technologies.

Validation. The Port Authority consultant has essentially validated the conclusions that RPA reaches regarding the impact of Stewart and MacArthur airports, intercity rail improvements, management of demand at the existing airports, and the viability of a new large airport in the region. None of these options will, even when taken together, obviate the need for new runway capacity at Kennedy and Newark. Figure 1.2 shows the difficulty in attracting demand to the two outlying airports identified in the RPA report.

Figure 1.2 **Passenger Traffic History at Two Outlying Airports**



Source: Port Authority of New York and New Jersey; Landrum and Brown.
Note: MacArthur Traffic is for fiscal years ending on 30 September.

Design of Additional Runways. To date, results of the search for a workable design for new runway capacity at Kennedy and Newark are not yet clear.

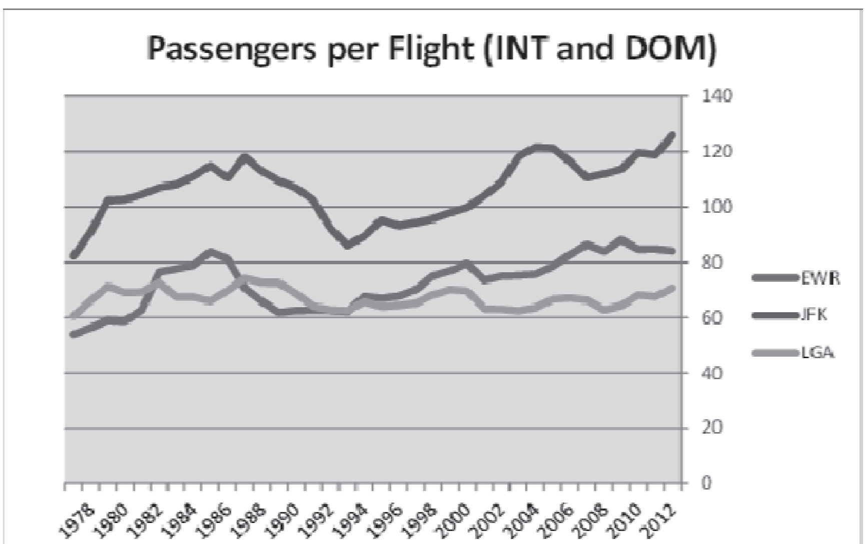
4. Other potentially significant developments

Passenger Demand. The RPA report was produced during a period of deep decline in air passenger demand, a direct result of the recession that began in 2008. In 2007 passenger demand at the three airports reached 109.1 MAP, the culmination of continuous growth since 1991, interrupted only briefly by the flying public's reaction to the terrorist attacks of 2001. By 2009 the passenger volume plummeted to 101.7 MAP, resulting in the largest two-year drop in history in absolute terms (again with the exception of the terrorist attacks period).

Since then traffic has begun to climb and 2012 is expected to almost reach the 2007 levels. The slow but steady recovery of the region's economy over the past two years has led to a surge in air passenger traffic with 2012 almost reaching 2007 levels. However, only if one believes that the rebound will continue more or less indefinitely, then the Port Authority's use of a more aggressive projection of 170 MAP by the early 2030s is justified. One thing is clear; the region has lost almost five years of growth due to the "great recession." One might argue that this reduces the urgency for action, but this is hardly the case. Very little has been accomplished during the past five years and the Port Authority is essentially back where it was during the height of air passenger demand in the region, with essentially the same facilities and constraints that existed in 2007.

Higher Aircraft Occupancy. One of the underlying factors in RPA's projections of aircraft operations at the three airports was the expected increase in the average number of passengers on each flight, following a long term trend of larger aircraft and higher occupancy rates. RPA projected that the average flight taking off and landing would grow from 91.4 passengers in 2007 to 99.8 passengers by the 2030s, driving down the number of projected aircraft movements. This trend has accelerated, even in the last five years; the average occupancy at the three airports has reached 103.9 passengers, already exceeding the RPA projection for the 2030s. Figure 1.3 shows the history of aircraft occupancy at the three airports. As airlines strive for greater profitability (or less loss), using the slots within their control, and as international travel continues to grow faster than domestic travel, these trends should continue.

Figure 1.3 **Passengers per aircraft - three New York airports 1978 to 2012**



Source: Port Authority of New York and New Jersey

Slot Use. At the three New York Airports (and at Reagan National Airport) the FAA limits the number of hourly aircraft movements to reduce likely delays from the overscheduled flights. The US General Accounting Office recently completed an examination[3] of the slot rules and concluded that they have the unintended effect of lowering the passenger carrying capacity of these airports. The current rules require airlines to use their slots only 80 percent of the time, allowing some existing airport capacity to go unused. The rules apply to each airlines pool of slots, rather than individual ones, adding to the number of slots unused and unavailable to other carriers that do not hold them. Furthermore, for those slots that are used there is a tendency to use some of them more inefficiently with smaller aircraft to ensure the carrier meets the "80 percent rule" and does not forfeit any slots. If these rules are changed the New York airports can realise gains in peak capacity that can absorb some of the traffic growth. The FAA is expected to address some of these limitations before the current orders imposing slots controls expire this October (2013).

Consolidation. It can be expected that the consolidation of the airline industry with fewer and larger airlines serving each of the New York airports, will result in fewer larger aircraft in each market. To identify this trend, the 2003 and the 2012 distribution of air passengers by airline was compared for both domestic and international markets at the three airports. Six tables – one for each year for each of the airports are provided in the Appendix. The tables also note whether the airline can be considered a hub or whether the airline is a low cost carrier.

The highlights from these tables:

At JFK (Tables A-1 and A-2)

In 2003 six airlines carried 95.6 percent of all domestic traffic; by 2012 the top six carried virtually all traffic, 99.2 percent. The top three airlines in 2003 carried 27.9 percent of all international traffic and in 2012 they carried 39.6 percent of all international traffic.

At EWR (Tables A-3 and A-4)

In 2003 Continental carried 63 percent of domestic and 51 percent of international traffic: in 2012, with the Continental/United merger, the shares of the new United Airlines carries 72 percent of domestic and 68 percent of international traffic.

In 2012, domestic market "runner up," Delta Airlines carries 1/12 as much as did United.

Today, United has virtually no competition internationally among the American flag carriers.

At LGA (Tables A-5 and A-6)

While there is some consolidation at LGA, it is not as pronounced as it is at the other two airports; the share among the top seven airlines has grown from 88.1 percent to 97.9 percent.

Interchangeability Among Airports. The argument has been made that the three airports duplicate their services and that the some of the airlines can consolidate their operations at one airport rather than two, or even three. To examine this issue, the data in the Appendix tables were used to examine the four largest domestic airlines to determine how there traffic is distributed among the three airports. These airlines carry 70 percent of the passengers at the three airports. In Table 1.1 the 2012 passenger volumes (first eleven months) and the shares by airport are shown for domestic and international flights.

Table 1.1. **Share of Traffic by Airport - Four Largest Domestic Airlines 2012**

			JFK	EWR	LGA	TOTAL
United	**Domestic**	**Number**	**1 002 126**	**16 463 325**	**2 397 616**	**19 863 067**
		Percent	5.0	82.9	12.1	100.0
	International	**Number**	**0**	**7 644 563**	**1 099**	**7 645 662**
		Percent	0.0	100.0	0.0	100
Delta	**Domestic**	**Number**	**7 374 559**	**1 399 455**	**8 943 620**	**17 717 634**
		Percent	41.6	7.9	50.5	100.0
	International	**Number**	**4 074 812**	**115 000**	**129 582**	**4 319 394**
		Percent	94.3	2.7	3.0	100.0
Jet Blue	**Domestic**	**Number**	**9 445 035**	**1 321 512**	**1 128 123**	**11 894 670**
		Percent	79.4	11.1	9.5	100.0
	International	**Number**	**2 381 556**	**0**	**0**	**2 381 556**
		Percent	100.0	0.0	0.0	100.0
American	**Domestic**	**Number**	**4 414 071**	**1 053 795**	**4 793 635**	**10 261 501**
		Percent	43.0	10.3	46.7	100.0
	International	**Number**	**3 442 884**	**0**	**265 352**	**3 708 236**
		Percent	92.8	0.0	7.2	100.0

Source: Port Authority of New York and New Jersey

Table 1.1 indicates that none of the four airlines divides their traffic more or less equally between JFK and EWR. Three of the four – United the exception – have at least four times more traffic at JFK than at EWR. United is overwhelmingly concentrated at EWR, the legacy of their Continental Airlines merger. There are several good reasons why none of these airlines would give up even their minority airport between these two. First, the markets using JFK and EWR are very different. The share of west of Hudson River (New Jersey and some New York counties) based passengers who use EWR over JFK is 83.5 percent. They find access to JFK difficult, either having to negotiate the traffic through much of New York City, or deal with a multiple seat transit ride. If these three airlines dropped airline service to EWR, these passengers would be hard pressed to use JFK and would be further relegated to one airline – United – that largely controls flights to most destinations out of EWR.

The situation in reverse would not be true. In this case a relatively small number of air passengers who fly by United Airlines from JFK would still have their choice among the other three major airlines who carry about 20 times as many passengers combined as United. They would not be forced to travel across the Hudson to reach a flight.

The relationship between JFK and LGA offers a different dynamic since the two airports are about 20 minutes apart. As Table 1.1 shows, Delta and American airlines split their domestic traffic between the two airports about equally. However, this hides the fact that LGA flights are confined to shorter distances, which leads these two airlines to divide the traffic for these two airlines by individual markets based on distance. Removing one airline from LGA, for example, would tend to transfer those flights to JFK where there are fewer flights today. The same would be true if flights and airlines were shifted from JFK to LGA. The effect would not likely lower the number of flights.

One way of showing this is to look at the top-ranked destinations for these two airports. Of the top 14 destinations for JFK only four are also the top 14 for LGA. Seven of the other ten for JFK are western cities, well beyond the LGA distance limit of 1 500 miles.[4] The closer destinations, by necessity have gravitated toward LGA and the longer ones to JFK. In other words, there already is a separation by market. The four exceptions are three Florida cities and Boston. It may be that the added traffic volume from international traffic transferring at JFK keeps these closer cities in play there, even though they are less than 1,500 miles away and are natural LGA market cities.

Improved Ground Access to EWR. The Port Authority has begun a study of extending their PATH rapid transit system to EWR, spurred on by an RPA study which concluded it would be of considerable value as a ground connection from Manhattan's financial district. PATH now connects lower Manhattan to downtown Newark and the extension would be about two miles. The extensions value for addressing the airport capacity problem at EWR and JFK is uncertain. If runway expansion occurs at EWR but not at JFK, the PATH extension could help to shift some demand to the airport with added capacity – EWR. However, if the expansion occurs at JFK but not EWR, the PATH extension would only have value as a ground access improvement.

APPENDIX

Tables of airline use at three port authority airports: 2003 and 2012

Table A-1

JFK International Airport 2003

			Passengers			Percent			Cumulative Percent		
Airline	HUB?	LCC?	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total
JetBlue	Yes	Yes	7,165,455	0	7,165,455	43.6	0.0	22.6	43.6	0.0	22.6
American *	Yes		4,017,328	3,119,034	7,136,362	24.4	20.4	22.5	68.0	20.4	45.1
Delta **	Yes		2,826,529	1,155,761	3,982,290	17.2	7.6	12.5	85.2	27.9	57.6
United			912,200	345,391	1,257,591	5.6	2.3	4.0	90.8	30.2	61.6
British Airways			0	1,256,784	1,256,784	0.0	8.2	4.0	90.8	38.4	65.5
American West		Yes	651,983	0	651,983	4.0	0.0	2.1	94.8	38.4	67.6
Air France			0	650,581	650,581	0.0	4.3	2.1	94.8	42.7	69.6
Lufthansa			0	572,523	572,523	0.0	3.7	1.8	94.8	46.4	71.5
Virgin Atlantic		Yes	0	516,272	516,272	0.0	3.4	1.6	94.8	49.8	73.1
Aer Lingus			0	441,514	441,514	0.0	2.9	1.4	94.8	52.7	74.5
El Al			0	436,179	436,179	0.0	2.9	1.4	94.8	55.5	75.8
Air Jamaica			0	420,223	420,223	0.0	2.7	1.3	94.8	58.3	77.2
Northwest			138,920	226,746	365,666	0.8	1.5	1.2	95.6	59.8	78.3
Alitalia			0	335,288	335,288	0.0	2.2	1.1	95.6	61.9	79.4
KLM			0	274,725	274,725	0.0	1.8	0.9	95.6	63.7	80.2
Korean			0	274,585	274,585	0.0	1.8	0.9	95.6	65.5	81.1
Swiss Air Int'l			0	230,055	230,055	0.0	1.5	0.7	95.6	67.0	81.8
Top 20			15,712,415	10,255,661	25,968,076	95.6	67.0	81.8			
Total Airport			16,434,651	15,297,795	31,732,446	100.0	100.0	100.0			

Table A-2

JFK International Airport 2012

			Passengers				Percent		Cumulative Percent		
Airline	HUB?	LCC?	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total
JetBlue	Yes	Yes	9,445,035	2,381,556	11,826,591	39.1	9.5	24.1	39.1	9.5	24.1
Delta	Yes		7,374,599	4,074,812	9,084,652	30.5	16.3	18.5	69.6	25.9	42.6
American	Yes		4,414,071	3,442,884	7,856,955	18.3	13.8	16.0	87.9	39.6	58.6
Virgin America/Atantic		Yes	1,070,365	546,782	2,641,382	4.4	2.2	5.4	92.3	41.8	63.9
British Airways			0	1,227,697	1,227,697	0.0	4.9	2.5	92.3	46.8	66.4
United			1,002,126	0	1,002,126	4.1	0.0	2.0	96.5	46.8	68.5
Air France			0	903,666	903,666	0.0	3.6	1.8	96.5	50.4	70.3
Caribbean Air			0	735,590	735,590	0.0	2.9	1.5	96.5	53.3	71.8
Cathay Pacific			0	666,474	666,474	0.0	2.7	1.4	96.5	56.0	73.2
US Airways			657,953	0	657,953	2.7	0.0	1.3	99.2	56.0	74.5
Lufthansa			0	543,574	543,574	0.0	2.2	1.1	99.2	58.2	75.6
Emirates Airlines and SK			0	532,648	532,648	0.0	2.1	1.1	99.2	60.3	76.7
Korean			0	424,444	424,444	0.0	1.7	0.9	99.2	62.0	77.6
Turkish Air			0	417,164	417,164	0.0	1.7	0.8	99.2	63.7	78.4
KLM			0	415,670	415,670	0.0	1.7	0.8	99.2	65.3	79.3
Aer Lingus			0	415,452	415,452	0.0	1.7	0.8	99.2	67.0	80.1
Alitilia			0	406,899	406,899	0.0	1.6	0.8	99.2	68.6	80.9
Tam Brazilian			0	399,116	399,116	0.0	1.6	0.8	99.2	70.2	81.8
El Al			0	398,862	398,862	0.0	1.6	0.8	99.2	71.8	82.6
Top 20			23,964,149	17,933,290	40,556,915	99.2	71.8	82.6			
Total Airport			24,153,321	24,968,964	49,122,285	100.0	100.0	100.0			

Table A-3

Newark International Airport 2003

			Passengers			Percent			Cumulative Percent		
Airline	HUB?	LCC?	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total
Continental *	Yes		13,622,664.0	3,937,632.0	17,560,296.0	62.6	51.3	59.7	62.6	51.3	59.7
American			1,951,950.0	5,584.0	1,957,534.0	9.0	0.1	6.7	71.6	51.4	66.3
United			1,468,109.0	111,567.0	1,579,676.0	6.7	1.5	5.4	78.3	52.9	71.7
Delta			1,550,603.0	54.0	1,550,657.0	7.1	0.0	5.3	85.4	52.9	77.0
Northwest			838,284.0	122,652.0	960,936.0	3.9	1.6	3.3	89.3	54.5	80.2
US Airways			550,980.0	-	550,980.0	2.5	0.0	1.9	91.8	54.5	82.1
American West		Yes	487,584.0	-	487,584.0	2.2	0.0	1.7	94.1	54.5	83.8
SAS			-	390,945.0	390,945.0	0.0	5.1	1.3	94.1	59.6	85.1
American Trans Air			336,369.0	4,303.0	340,672.0	1.5	0.1	1.2	95.6	59.6	86.2
Virgin Atlantic		Yes	-	310,140.0	310,140.0	0.0	4.0	1.1	95.6	63.7	87.3
British Airways			-	295,354.0	295,354.0	0.0	3.9	1.0	95.6	67.5	88.3
Alitalia			-	248,322.0	248,322.0	0.0	3.2	0.8	95.6	70.8	89.1
Airtran Airways		Yes	245,359.0	-	245,359.0	1.1	0.0	0.8	96.7	70.8	90.0
Air Canada			-	242,186.0	242,186.0	0.0	3.2	0.8	96.7	73.9	90.8
Lufthansa			-	207,254.0	207,254.0	0.0	2.7	0.7	96.7	76.6	91.5
Air India			-	169,257.0	169,257.0	0.0	2.2	0.6	96.7	78.8	92.1
El Al			-	147,894.0	147,894.0	0.0	1.9	0.5	96.7	80.8	92.6
Air France			-	147,621.0	147,621.0	0.0	1.9	0.5	96.7	82.7	93.1
Air Portugal			-	141,502.0	141,502.0	0.0	1.8	0.5	96.7	84.5	93.6
Top 20			21,051,902.0	6,482,267.0	27,534,169.0	96.7	84.5	93.6			
Total Airport			21,760,266.0	7,668,633.0	29,428,899.0	100.0	100.0	100.0			

Table A-4

Newark International Airport 2012

			Passengers			Percent			Cumulative Percent		
Airline	HUB?	LCC?	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total
United	Yes		16,463,325	7,644,563	24,107,888	72.1	68.2	70.8	72.1	68.2	70.8
Delta			1,399,450	115,000	1,514,450	6.1	1.0	4.4	78.2	69.2	75.2
Jet Blue		Yes	1,321,512	0	1,321,512	5.8	0.0	3.9	84.0	69.2	79.1
US Airways			245,009	0	245,009	1.1	0.0	0.7	85.1	69.2	79.8
Southwest		Yes	1,137,587	0	1,137,587	5.0	0.0	3.3	90.0	69.2	83.2
American			1,053,795	0	1,053,795	4.6	0.0	3.1	94.7	69.2	86.3
Lufthansa			0	534,959	534,959	0.0	4.8	1.6	94.7	74.0	87.8
SAS			0	432,562	432,562	0.0	3.9	1.3	94.7	77.8	89.1
Air Canada			0	397,659	397,659	0.0	3.5	1.2	94.7	81.4	90.3
Virgin Atlantic		Yes	0	375,325	375,325	0.0	3.3	1.1	94.7	84.7	91.4
British Airways			0	341,363	341,363	0.0	3.0	1.0	94.7	87.8	92.4
Porter Airlines			0	334,692	334,692	0.0	3.0	1.0	94.7	90.8	93.4
Alaska Airlines			198,166	0	198,166	0.9	0.0	0.6	95.5	90.8	94.0
Air Portugal			0	180,712	180,712	0.0	1.6	0.5	95.5	92.4	94.5
El Al			0	155,179	155,179	0.0	1.4	0.5	95.5	93.7	94.9
Jet Airways			0	134,556	134,556	0.0	1.2	0.4	95.5	94.9	95.3
Swiss Air Int'l			0	102,832	102,832	0.0	0.9	0.3	95.5	95.9	95.6
Air India			0	97,146	97,146	0.0	0.9	0.3	95.5	96.7	95.9
Alitalia			0	84,950	84,950	0.0	0.8	0.2	95.5	97.5	96.2
OpenSkies			0	84,889	84,889	0.0	0.8	0.2	95.5	98.2	96.4
Top 20			21,818,844	11,016,387	32,835,231	95.5	98.2	96.4			
Total Airport			22,841,456	11,213,266	34,054,722	100.0	100.0	100.0			

Table A-5

LaGuardia Airport 2003

Airline	HUB?	LCC?	Passengers Domestic	Passengers International	Passengers Total	Percent Domestic	Percent International	Percent Total	Cumulative Percent Domestic	Cumulative Percent International	Cumulative Percent Total
Delta *	Yes		5,640,210	145,073	5,785,283	26.3	13.8	25.7	26.3	13.8	25.7
American **	Yes		5,102,228	185,185	5,287,413	23.8	17.7	23.5	50.1	31.5	49.2
US Airways ***	Yes		4,067,604	94,615	4,162,219	19.0	9.0	18.5	69.1	40.6	67.8
United			1,454,981	-	1,454,981	6.8	0.0	6.5	75.9	40.6	74.2
Northwest			1,418,746	-	1,418,746	6.6	0.0	6.3	82.5	40.6	80.5
Spirit Airlines		Yes	955,330	-	955,330	4.5	0.0	4.2	87.0	40.6	84.8
Air Tran Airways		Yes	736,718	-	736,718	3.4	0.0	3.3	90.4	40.6	88.1
American Trans Air		Yes	703,818	-	703,818	3.3	0.0	3.1	93.7	40.6	91.2
Continental ****			702,779	-	702,779	3.3	0.0	3.1	97.0	40.6	94.3
Air Canada			-	558,897	558,897	0.0	53.4	2.5	97.0	93.9	96.8
Midwest Airlines		Yes	235,420	-	235,420	1.1	0.0	1.0	98.1	93.9	97.9
Frontier		Yes	133,245	-	133,245	0.6	0.0	0.6	98.7	93.9	98.5
Top 20			21,151,079	983,770	22,134,849	98.7	93.9	98.5			
Total Airport			21,435,246	1,047,524	22,482,770	100.0	100.0	100.0			

Table A-6

LaGuardia Airport 2012

Airline	HUB?	LCC?	Passengers Domestic	Passengers International	Passengers Total	Percent Domestic	Percent International	Percent Total	Cumulative Percent Domestic	Cumulative Percent International	Cumulative Percent Total
Delta	Yes		8,943,620	129,582	9,073,202	37.1	9.3	35.6	37.1	9.3	35.6
American	Yes		4,793,635	265,352	5,058,987	19.9	19.0	19.8	57.0	28.3	55.4
US Airways	Yes		3,394,697	-	3,394,697	14.1	0.0	13.3	71.0	28.3	68.7
United			2,397,666	1,099	2,398,765	9.9	0.1	9.4	81.0	28.3	78.1
Southwest		Yes	1,892,964	-	1,892,964	7.9	0.0	7.4	88.8	28.3	85.5
Spirit		Yes	1,165,533	-	1,165,533	4.8	0.0	4.6	93.7	28.3	90.1
JetBlue		Yes	1,128,123	-	1,128,123	4.7	0.0	4.4	98.4	28.3	94.5
Air Canada			-	855,634	855,634	0.0	61.2	3.4	98.4	89.5	97.9
Frontier		Yes	395,650	-	395,650	1.6	0.0	1.6	100.0	89.5	99.4
WestJet		Yes	-	146,081	146,081	0.0	10.5	0.6	100.0	100.0	100.0
Miami Air Intl			993	-	993	0.0	0.0	0.0	100.0	100.0	100.0
Top 20			24,112,881	1,397,748	25,510,629	100.0	100.0	100.0			
Total Airport			24,112,881	1,397,748	25,510,629	100.0	100.0	100.0			

Source: Port Authority of New York and New Jersey

NOTES

1. Regional Plan Association (RPA) is an independent, not-for-profit regional planning organization that seeks to improve the quality of life and the economic competitiveness of the 31-county New York-New Jersey-Connecticut region through research, planning, and advocacy.

2. Upgrading to World Class: The Future of the New York Region's Airports by Jeffrey M. Zupan, Richard E. Barone, and Matthew H. Lee. The full report is available online at *http://www.rpa.org/2011/01/major-new-rpa-study-finds-new-airport-capacity-needed.html*.

3. http://www.gao.gov/assets/650/648219.pdf

4 Denver is the one exception, having been "grandfathered" in, despite being more than 1 600 miles away.

CHAPTER 2

Air capacity for Sydney

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Abstract

Sydney has one major airport, and it faces growing air transport demand – the airport is now becoming subject to excess demand, and this will be a major problem in the future. Investment in additional capacity will be required, and several options for a second airport are being considered. Unlike airports in Europe and North America, hub issues are not very important. In the short to medium term, additional demand can be handled using a number of options, such as more use of secondary airports and greater use of existing capacity at Sydney. One issue which will be present is how excess demand will be rationed – by prices, slots or congestion? Australia's light-handed regulation may mean that prices may be used. Another issue is whether the stakeholders will have a strong incentive to invest when it is economic to do so if airlines and the airport both gain from a situation of inadequate capacity, they may have little incentive to invest. A recently completed Joint Study by the Federal and State Governments explored the questions of whether and when a new airport should be built. It did this using both Cost Benefit Analysis and Computable General Equilibrium modelling (a technique which has distinct advantages for evaluating investments such as airports) however this study treated the two techniques as quite separate, and did not take advantage of the potential complementarities from combining the two.

1. Introduction[1]

Sydney's airport problem

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 analysis 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 at what is, in essence, the same thing, are not integrated. There are many gains from integrating these. One would be picking up on inconsistencies, such as the different ways the two techniques handle unemployment. Another is measuring the benefits from inbound (and the costs of outbound) tourism, which are important in the case of an international airport. CGE can be used to measure the 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 externalism, 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 about 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

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 base (Richmond) 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 a 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, and 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.

Institutions

In many respects, the institutional arrangements pertaining to Sydney are very similar to those for the London airports. This is 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 no 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 firm. 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 responsive 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 with those of other parties. There are some parties who would like to have an early start on a major new airports, 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.

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 AUD 10 billion, 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 to 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.

Meeting Growing Demand

Sydney has reached the stage where there is no longer spare capacity all of the day. The major airport, Kingsford Smith 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 6 am 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: flights at KSA have to follow an Operational Plan that shares noise amongst different suburbs under its flight paths; this is possible because it has two parallel runways (as well as a cross runway) allowing flight paths to be shared between two parallel tracks. By 2015, nine hours of the weekday will have demand levels such that both parallel runways will have to be operated all of the time, making it no longer possible to operate 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 on, 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 as 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, these 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 difference 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 a HST from Melbourne to Brisbane via Sydney. The growth of LCCs would have made a HST less competitive.

Perhaps the main impact on the Sydney airport issue is that it will 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, 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

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 governments are therefore 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 kilometres further away. However the NSW Premier argues for the airport to be sited in Canberra, which is 290 km from 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.

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 a 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 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 there, 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 emanate 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, thus 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.

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 rationalise 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: what more is there to hubs than ensuring that prices are correct 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 (e.g. 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.

Connectivity

Connectivity is an aspect of airports and networks which has had 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 or relatives or friends. Thus an externality present is present, although the problem is measuring how large this externality is (for a suggestion, see Forsyth, 2012).

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

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

The most obvious way in which this may happen is through 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 airports rather than one 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 1990s. However, airport licences will be rather more expensive than hen licences (especially when negotiating with Macquarie Bank).

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. This could be valuable, however, given that this category of airline is regarded as being under financial threat, and airport prices to these services are subject to a price cap. Richmond would be convenient for passengers in the North-West of Sydney, a rapidly growing area.

4. Rationing excess demand

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. Following the opening of the third runway there was ample capacity, and the shocks of 9/11, 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 outside of 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 United States. 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 be rationed by slots. However, things are not necessarily equal.

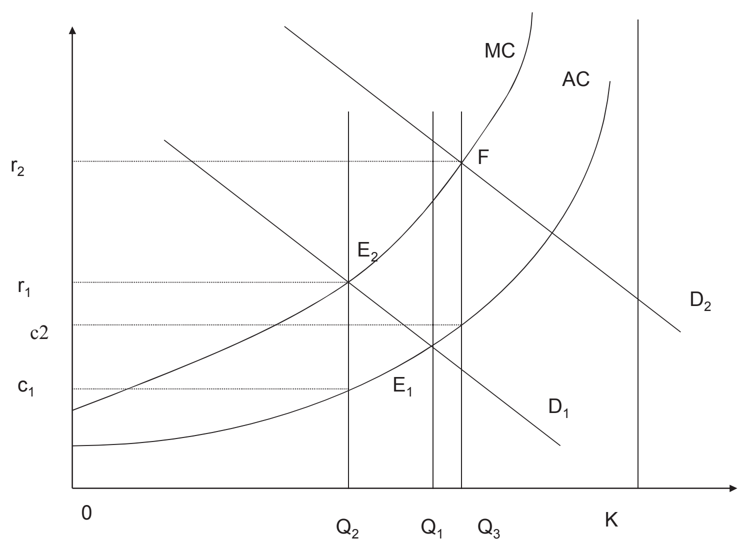
The third option, pricing, or the use of landing charges, is very rarely used. Interestingly, one of the few examples of it was at KSA. In the years prior to the opening of the third runway there was a minimum charge at peak times, in order to discourage small aircraft. This was removed when the runway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

The different options are shown diagrammatically in Figure 2.1 (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 United States and European (and other) countries' solutions, for an airport of given capacity K, average congestion costs will be higher than in Europe, though the United States will be getting more output from the airport. Prices and/or slot prices will be higher than in the United States. Even though the United States 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 United States 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 2.1 **Ways in which airport capacity can be rationed**



Source: Forsyth and Neimeier, 2008

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 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 auction. 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; the question is 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.

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 (i.e., most of them). Regulators set prices which are close to average costs. This results in prices which are below marginal cost when the airport is not heavily used, and which are well above 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 are close to costs, and as a result British Airways enjoys very substantial slot rents.

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 flights of 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 that 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, there may be constraints imposed on it. 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 excess of capacity. However this environment could give rise to problems in the long run, as will be shown below.

The long run problem: timing

Pricing is closely related to the timing question. The timing issue comes about because airports are invisibilities, 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 Figure 2.1) but a large part of the cost will be the opportunity cost of travellers who would be 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 these 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 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 deterred by macro forces rather than micro economic interventions, such as building airports (if this is not the case, unemployment should 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.

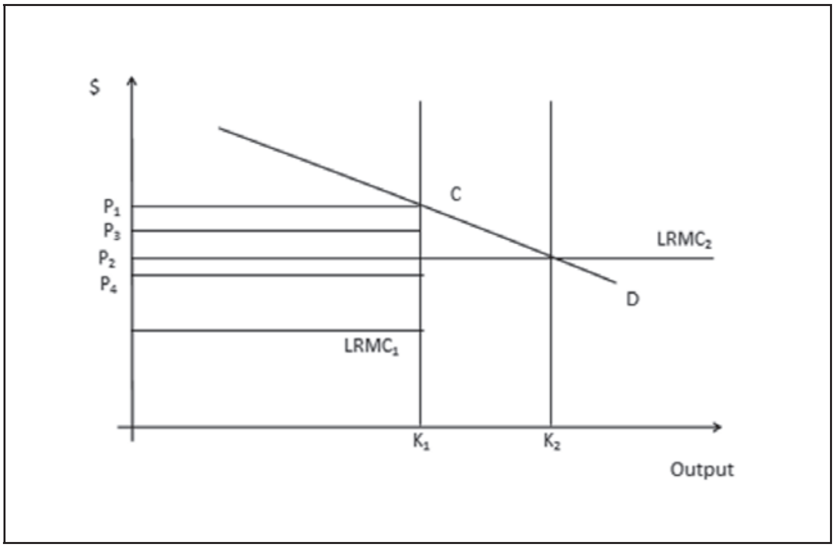
The issue of relationship of CBA and CGE is discussed in the next Section.

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 maximising one (it is, after all, 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 Figure 2.2.

Figure 2.2 **Incentives for investment**



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 (e.g. 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

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 1990s. 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 other, accruing to passengers and airlines, is 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.

The Roles of CBA and CGE

While CBA and CGE are ways of measuring the same thing – in this case how much better off 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 provide 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;
- problems with handling key aspects of benefits and costs, such as the benefits of tourism;
- inability of CBA to handle macro aspects, such as unemployment;
- inability of CBA to handle distributional aspects;
- difficulties CBA has in measuring national or global externalities, such as greenhouse gas emissions.

In each of these aspects, CGE models can help achieve 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 – it can estimate initial incidence, but not ultimate incidence.

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 of a project's contribution to net present value, or welfare, in monetary terms; whereas a CGE assessment, at least in Australia, will measure if there is a contribution to an output measure such as GDP or Gross State Product. This is a presentational, rather than fundamental, difference because the two can be converted from one to another. Under certain circumstances (e.g. 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 it 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.

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 – i.e., the project contributes to jobs. If this is the case, GDP is not a good measure of how much better off 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 them 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 which 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 these 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 United Kingdom, it is somewhat higher (consistent with higher taxes such as VAT) (see Blake, 2005). There have also been some studies done on the cost of, 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 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 AUD 3 billion (where total benefits are about AUD 7 billion). 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 seems 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 is in its infancy, but this is no reason to make distinctively ad hoc assumptions 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 (an 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.

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 is 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, 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 Australia 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

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 AUD 3 billion, whereas environmental costs – mainly effects of additional flying on gas emissions – are expected to be over AUD 700 million. 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 AUD 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 will 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 (subsequently elected) 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.

Under an emissions trading scheme, for domestic aviation and perhaps later on international aviation, there will be no economic reason why the airport should be subjected to any further taxes or regulation in respect of CO2 emissions. 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 if they are the same as those generated by other activities. Targeting aviation and airports would over and above inclusion in and ETS would raise the cost of reducing emissions without reducing the overall level of emissions (as there would be compensatory increases in emissions from other sectors covered by the ETS cap).

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 had 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 thus may not be very effective in that respect. There is little 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 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 this 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.

NOTE

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Bibliography

Adams, P., J.M. Horridge, and B. Parmenter (2000) *MMRF- Green: A Dynamic, Multi-Sectoral Multi-Regional Model of Australia*, Center of Policy Studies, Monash University, Melbourne.

Air Transport Research Society (2012) *Airport Benchmarking Report*, Vancouver.

Airport Co-coordinating Taskforce (1990), "Sydney Airport Third Runway Cost/Benefit Analysis', Final Report, Dec.

Blake, A. (2005) "The Economic Impact of the Olympics", TTRI Discussion Paper 2005/9 Nottingham University Business School, Nottingham.

Czerny, A.I., P. Forsyth, D. Gillen and H-M Niemeier (ed) *Airport Slots: International Experiences and Options for Reform*, Hampshire England: Ashgate Publishing Limited. pp 63-83.

Decisive Consulting Pty Ltd. (2009) "A Better Solution for Sydney Airport Needs", *Submission to the Aviation Policy Review,* Department of Infrastructure and Transport, Canberra.

Eddington (2008) *East West Needs Assessment, Economic Benefits and Costs Analysis - Technical Report* www.transport.vic.gov.au

Fitzgerald, P. (1998) *The Sydney Airport Fiasco*, Hale and Iremonger, Sydney.

Forsyth, P. (1972) "The Timing of Investments in Airport Capacity", Journal of Transport Economics and Policy, Vol, VI No.1.

Forsyth, P. (2003) "Regulation under Stress: Developments in Australian Airport Policy", *Journal of Air Transport Management*.

Forsyth, P. (2006), "Martin Kunz Memorial Lecture: Tourism Benefits and Aviation Policy", Journal of Air Transport Management Dec -3-13. +

Forsyth, P. and H-M Niemeier (2008a), "Setting the Slot Limits at Congested Airports", in Czerny, A.I., Forsyth, P., D. Gillen, and H-M Niemeier (ed) *Airport Slots: International Experiences and Options for Reform,* Hampshire England: Ashgate Publishing Limited. pp 63-83.

Forsyth, P. and H-M Niemeier (2008b) "Prices and Regulation in Slot Constrained Airports" in Czerny, A.I, Forsyth, P., D. Gillen, and H-M Niemeier (ed) *Airport Slots: International Experiences and Options for Reform,* Hampshire England: Ashgate Publishing Limited. pp 127-148.

Forsyth, P. (2012), "The Benefits of Connectivity in Air Transport – A Positive Yet Sober Assessment". Monash University, Australia.

Joint Study on Aviation Capacity in the Sydney Region (2012), *Report to Australian Government and N.S.W. Government,* Canberra and Sydney.

Mills, G. (1982) "Investment in Airport Capacity – A Critical Review of the MANS, (Major Airport Needs of Sydney) Study.

Productivity Commission (2002), Price Regulation of Airport Services, Report No 19, Ausinfo Canberra.

Smyth, M and D Pearce, (2007) *Aviation Economic Benefits*, IATA Economics Briefing 8.

Tourism Research Australia (TRA) (2011) *The Impacts of the Passenger Movement Charge on Tourism Output and the Economy*, Canberra, TRA March.

TTF: Tourism & Transport Forum (2012) *Sydney's Aviation Future: Meeting the Challenge of Growing Demand* (2012), TTF, Sydney.

CHAPTER 3

Evolution of metropolitan airports in Japan: airport development in Tokyo and Osaka

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In Japan, the advent of air transport and rapid urbanisation had developed simultaneously at both Tokyo and Osaka in the 1960s. This made it difficult to plan proactively and, by the time the search for the location of a secondary airport had begun, the original airports, Haneda and Itami, were exasperated with the noise issue. As a consequence the location of the secondary airports, Narita and Kansai respectively, had to be situated far from the city centre. Nevertheless, Narita Airport has long suffered resistance from local residents and environmental groups. In Osaka, Kansai Airport had to be built by reclaiming an island in the bay area that inevitably led to high capital expenditure. Historical path dependence of airport development in large metropolitan area caused significant difficulty in capacity expansion. Simultaneous planning of airport infrastructure and air-space development through KAIZEN – continuous improvement of existing system – enabled step-by-step increase in landing slots at Haneda Airport and Narita Airport, although it has taken time. Institutional integration of Itami Airport and Kansai Airport in 2012 is also an important step in pooling resources of the two airports for financial stabilization and shifting towards private sector management to give more room for strategic airport operation. Stimulating local groups by competitive force among airports would potentially serve as catalyst to mobilize interests of various stakeholders leading to capacity increase. Improving access to/from airport and multi-modal planning are some of the remaining issues to be addressed.

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1. Introduction

If one is asked to give an appraisal of airport development in metropolitan areas in Japan, an unsparing critic may not esteem it highly for three reasons. One, because planning for the secondary airport at Tokyo and Osaka was initiated too late to match growth in demand. Two, due to untimely planning, the original airport was exasperated with the noise issue by the time the search for the location of the secondary airport had begun. As a consequence, the location of the secondary airport had to be situated far from the city centre. Three, because improvements to access transport, to overcome the airport's distant location, were not planned thoroughly enough and have taken too much time to be completed, both the out-of-pocket costs and access time are still unsatisfactory.

Advocates, on the other hand, may be supportive because, considering that both tremendous urban growth and the advent of air transport arose simultaneously in the 1960s and it was literally impossible to plan ahead of time, air transport demand has been met to a certain degrees. As we stand today, Tokyo's two airports, for instance, accommodate approximately 100 million passengers annually, domestic and international combined, which is comparable to the three major airports in London or New York.

In an endeavour to review what has happened and afford prospects of what we see ahead in airport development in Japan's metropolitan areas, this paper covers airport development in Tokyo and Osaka; inter alia, Haneda Airport and Narita Airport in the Greater Tokyo area and Itami Airport, Kansai Airport and Kobe Airport in the Greater Osaka area. The rest of the paper is organised as follows. First, after an overview of Japan and the air transport market, brief history of airport development in Tokyo and Osaka is presented. Second, key factors affecting airport development in large metropolitan area are examined. Third, implications for future airport development in large urban areas are discussed. The paper sums up with concluding remarks.

2. Overview of Japan and the air transport market

Overview of Japan

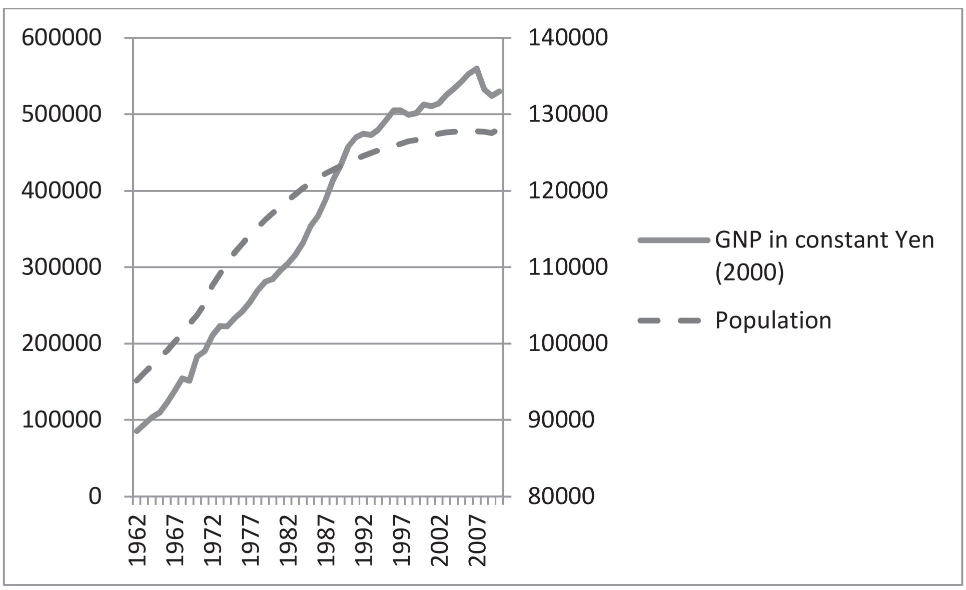
Japan has 338 thousand square-metres of land, of which 121 thousand square-metres are arable. There are an estimated 6 832 square kilometres of arable land in the metropolitan areas[1] of Greater Tokyo and 3 690 square kilometres in that of Greater Osaka.

Of the 128 million population, 33 million (26% of total) and 17 million (13% of total) live in Greater Tokyo and Greater Osaka respectively. The population growth rate had been in double-digits until the 1970s but has since slowed down[2]. According to Demographia[3], Tokyo-Yokohama is the largest urban area in the world and Osaka-Kobe-Kyoto the twelfth largest.

Both Greater Tokyo and Greater Osaka have out-grown other areas of Japan in population size. In Greater Tokyo and Greater Osaka there are 26% and 13% of Japan's total population living on 5.6% and 3.0% of Japan's total arable land respectively. As such, population density in these metropolitan areas is 4 500 per square-kilometre[4].

Figure 3.1 shows that high economic growth was achieved in Japan until 1970, after which there was moderate growth during the 70s and 80s, and a slow down with the burst of the economic bubble in the early 90s. During these years, the economic sector shifted from agriculture to manufacturing and then to the service sector. An agglomeration effect has caused economic activities to be concentrated in urban areas. The four prefectures where Greater Tokyo[5] and Greater Osaka[6] are located have 32% and 14% of total national GDP respectively.

Figure 3.1 **Population and GDP of Japan**



In recent years, Japan has faced a number of challenges: deflation, an ageing society, the high appreciation of the Yen and shocks from the Tohoku Earthquake and the Tsunami in 2011. The high-speed transport system is key in facilitating productivity gains and inter-regional market integration, as well as for promoting leisure activities. It is thus at the top of the policy agenda of the national growth strategy. Ueda et al (2005) identifies the significant benefits of Haneda Airport's re-expansion and Yamaguchi (2007) attempts to capture the macro-economic impact of accessibility improvements from the development of air transport in Japan.

Development of air transport and airports in Japan

Evolution of the airline industry

Civil aviation resumed its service in 1951. In 1953, Japan Air Lines (JAL) was established and assigned to operate on international and domestic trunk routes. A number of other airlines were to operate on local domestic routes. As the demand for aviation increased, airline competition became severe and a framework to secure fair competition became increasingly required. In the early 70s excessive competition was warded off and the service domain of each airline was designated from the perspective of co-existence and co-prosperity; i.e., JAL on international and domestic trunk routes, All Nippon Airways (ANA) on domestic trunk and local routes, Japan Air Systems [JAS, ex-Toa Domestic Airlines (TDA)] on domestic local routes. Industrial activity was conducted for more than ten years under this so-called 45/47[7] framework.

In the 1980s, rapid growth, both in international and domestic aviation, was achieved. In 1985, the Transport Policy Council reviewed the operating framework of the aviation industry and, based on its recommendation, the 45/47 framework was abolished by the Cabinet in December 1985. A new policy was introduced to promote the increasing number of airlines operating on routes with large numbers of passengers. The new aviation policy of 1985 also included the introduction of airlines other than JAL onto the international aviation market and the complete privatisation of JAL.

Introduction of new airlines and further deregulation

In 1996, the incumbent airlines took advantage of the deregulation of air fares and effectively raised the fares on trunk routes. This sparked criticism, and two new airlines, Skymark Airlines and Hokkaido International Airlines (AIR DO) were established in 1998. Apart from subsidiaries of the major three companies, these were the first new entries in 35 years.

By the end of the 20th Century, supply/demand regulation policy was totally abolished. Airfare regulation was also deregulated from approval to prior notification. With regard to the most congested airports, such as Haneda and Itami, a slot allocation rule for domestic service was adopted, subject to review every five years and based on pre-set allocation criteria. New airline start-ups have been introduced since the turn of this century. Most of these airlines, however, have more or less been affiliated to one of the major airlines.

Since the start of this century, the market has been volatile. The 911 terrorist attack in 2001, the Iraq War and the outbreak of SARS (Severe Acute Respiratory Syndrome) in 2003 shook the market. In 2002, JAL and JAS merged. Furthermore, the global financial crisis in 2008-9 hit the Japanese air transport market and in January 2010 JAL went bankrupt and filed for a legal liquidation procedure. The Government bailed-out JAL through a national scheme involving the Enterprise Turnaround Initiative Corporation of Japan, and in September 2012, it was re-listed on the Tokyo Stock Market. JAL retained profitability by cutting less lucrative routes.

Liberalisation in the international air transport market

An international air service agreement (ASA) was renegotiated to allow multiple airlines into the market. In particular, the ASA with the United States was revised in 1998 to achieve a balance of rights between the two nations and allow for more competition. Furthermore, since October 2010 an Open Sky Agreement has been finalised, starting with the USA. As of March 2012, 15 countries, covering 67% of the international passengers to/from Japan, have concluded such agreements.

New era of LCC

The year 2012 marked the beginning of the low-cost carrier (LCC) era in Japan. In October 2012, the first LCC-dedicated terminal was opened in Kansai Airport. The opening of Terminal 2 marked the launch of airport-airline collaboration, giving birth to the first Japanese-based LCC; Peach Aviation[8]. There are currently two other LCCs in Japan: Air Asia Japan and Jetstar Japan, and ten foreign-based LCCs flying into Japan.

The history of airport development

Since 1967, long-term airport construction plans were set every five years. The number of airports more than doubled, from 45 in 1975, to 98 in 2013. There are currently 65 airports with a runway length of more than 2 000 metres.

Airports in Japan are classified into three categories:

a. International airports: Haneda[9], Narita, Itami, Kansai and Chubu Airports.

1. Government agency or special corporation: Narita, Kansai and Chubu airports;
2. Owned directly by the Government: Haneda Airport. Itami Airport, until recently government-owned like Haneda, has been integrated with Kansai Airport.
   - National airports, e.g. Sapporo, Fukuoka and Naha, developed and operated by central government.
   - Local airports: constructed and operated by local governments[10].

One distinctive characteristic of airports in Japan is that – except for Narita, Kansai and Chubu airports – terminal buildings are separately built and managed by private firms or third-sector corporations[11]. In recent years, the integration and privatisation of ramp-sides and terminals have become part of a policy agenda and, in 2011, a law was passed that integrates Kansai and Itami airports under the New Kansai International Airport Company Ltd. (NKIAC). NKIAC is planning to acquire a third-sector terminal operator at Itami Airport. It is also stipulated under the law that NKIAC would sell the operational rights of both airports for a number of years to global investors to reduce debt. This is the first concession involving major infrastructure in Japan. Central government is planning to submit a law that enables the grant for other airports.

3. A brief history of airport development in Tokyo and Osaka

Tokyo

Early years of Haneda Airport

Haneda Airport was one of the first three airports in Japan to be constructed, in 1931. It started off as a single runway, 300 metres long and 15 metres wide, and was located 15 kilometres "as the crow flies" away from Tokyo Station, by the mouth of the Tamagawa-river – one of five major rivers flowing into Tokyo Bay. Haneda is open to one side, compared to Itami Airport in Osaka, which is located closer to the city centre, but 15 kilometres away from the mouth of the Yodogawa-river and Osaka Bay (and locked into an area offering no prospect to develop out towards the bay area). The location of Haneda Airport is described in Figure 3.2. It can be seen that it is close to the city centre, so that the north side of the airport is restricted. However, there is room for air space in the south side. This has resulted in a totally different outcome for their secondary airports.

Figure 3.2 **Airport operation at Haneda Airport**

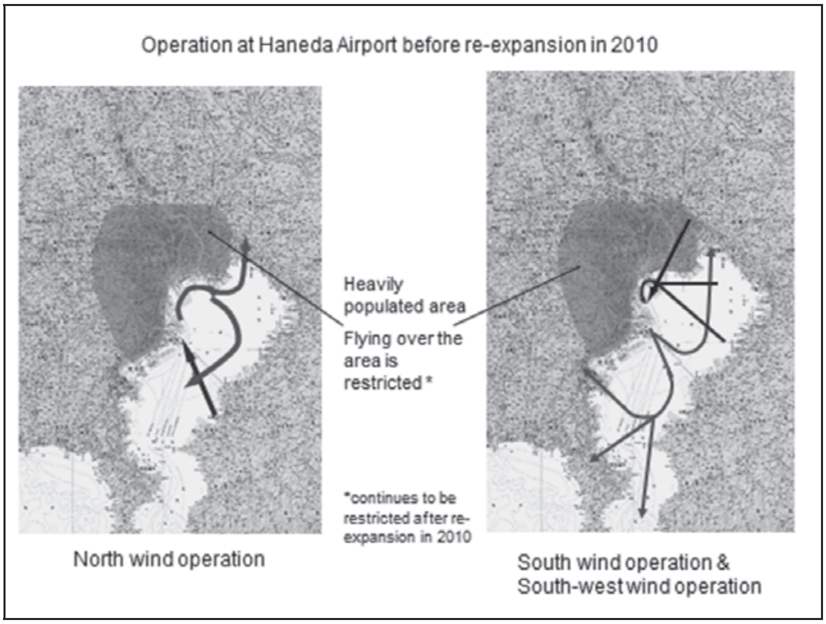


Figure 3.3 **History of Haneda Airport**

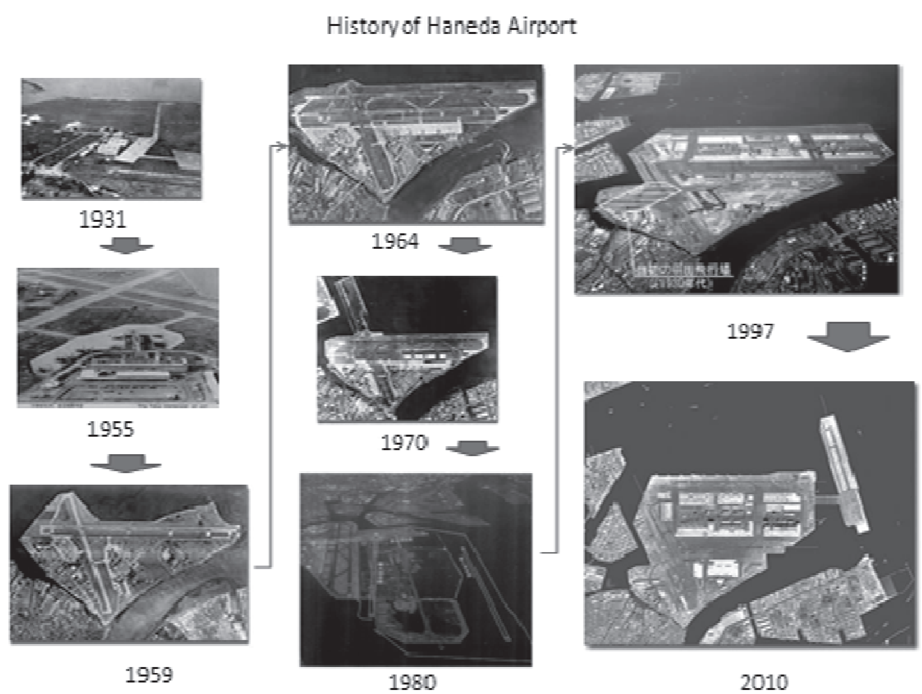


Figure 3.3 shows how Haneda Airport was developed. By the 1950s, Haneda had two runways crossing each other; one of 2 550 metres length (Runway A-old), and the other of 1 676 metres (Runway B-old). It also boasted a new passenger terminal.

In 1964, when the Olympic Games were held in Tokyo, Runway C-old – running parallel to Runway A-old – was built to accommodate growth in demand. However it soon became necessary to convert Runway A-old into aprons for aircrafts to park so that, once again, the airport was constrained to having only two runways.

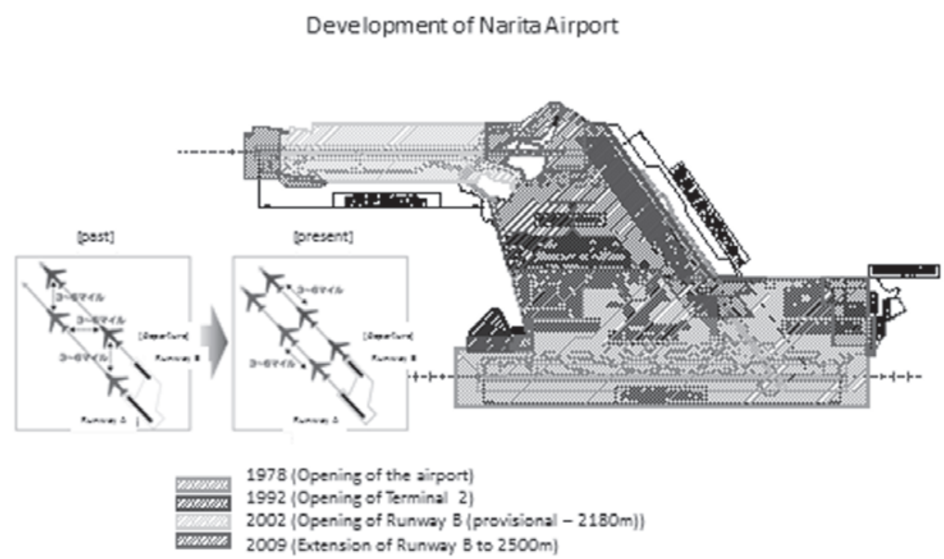
When turbo-jet aircrafts began operating in the early 1960s, the issue of noise in the vicinity of Haneda Airport was raised. Although the government responded by introducing a curfew between 11pm to 6am for turbo-jet aircrafts in 1962, and subsequently legislated a subsidy for noise mitigation measures at designated nearby facilities, the issues of growing demand and noise mandated the government to plan for a totally new airport for Tokyo.

Development of Narita Airport

In 1963, the Ministry of Transport commissioned to consider the location of the new airport. In 1965, from a number of options, the government chose the plan to build a new airport, with five runways, in Tomisato Village, Chiba Prefecture. This decision aroused substantial controversy at Tomisato, because there had been no consultation with the local residents. It was also alleged that the location was selected as a result of a "pork-barrel" by politicians. At the end of the reviewing process, involving numerous ministers, the land size was reduced by half and, seeking to utilise central and local government-owned land, Sanrizuka – located ten kilometres north of Tomisato – was selected as the site. Again, this abrupt decision faced strong opposition from the local land-owners, particularly from the farmers that had settled in Sanrizuka following the hardships of cultivating land in the past decades. Resistance from the farmers was coupled with that of left-wing radical activists, and marked the beginning of the long and difficult history of Narita Airport development[12]. Figure 3.4 shows the history of Narita Airport.

The Government agency had proceeded to acquire land from the local owners, but was confronted with harsh resistance. Opening planned for March 1978 was blocked by unlawful raid into restricted area of the airport and even into the ATC tower by left-wing radical activists. It finally started operation in May, with its single runway that had been completed at that time. We had to wait 24 years to have the second runway operational. Land procurement law became inactive because no one assumed the position of land acquisition committee of Chiba Prefecture. Not only was acquisition of land for the second and crosswind runway delayed, construction of the jet-fuel pipeline also had to wait until 1983 to be completed.

Figure 3.4 **Development of Narita Airport**



The original plan to build the high-speed railway "Shinkansen" between Narita and Tokyo had been rejected by the Governor of Tokyo. The access railway (to accommodate the limited express train which would take an hour to get from Narita Airport to Tokyo Station) had to wait until 1991 to be completed. In 2010, one of the railways providing an express service between Narita Airport and Tokyo was completed and this shortened the trip to 36 minutes[13].

Haneda Airport expanding towards the bay area

The bayside of Haneda Airport had been used as a waste and sludge dumping site. Utilisation of the site was hindered by the paste-like texture of the dump. It was not until sand and paper drainage technology became available that the dump site began to be considered as an area for airport expansion. In 1984, the Haneda Airport "Okiai-tenkai" expansion project was initiated and a pair of parallel runways (A and C) and a single cross-wind runway (Runway B), pushing out towards the Tokyo Bay, was built in stages. Figure 3.3 shows how the expansion took place. These runway constructions were completed in 2000 and this basically resolved the noise issue at Ota-ku, the municipal district where the airport is located. However dependence on the single crosswind runway continued to be a bottleneck to capacity.

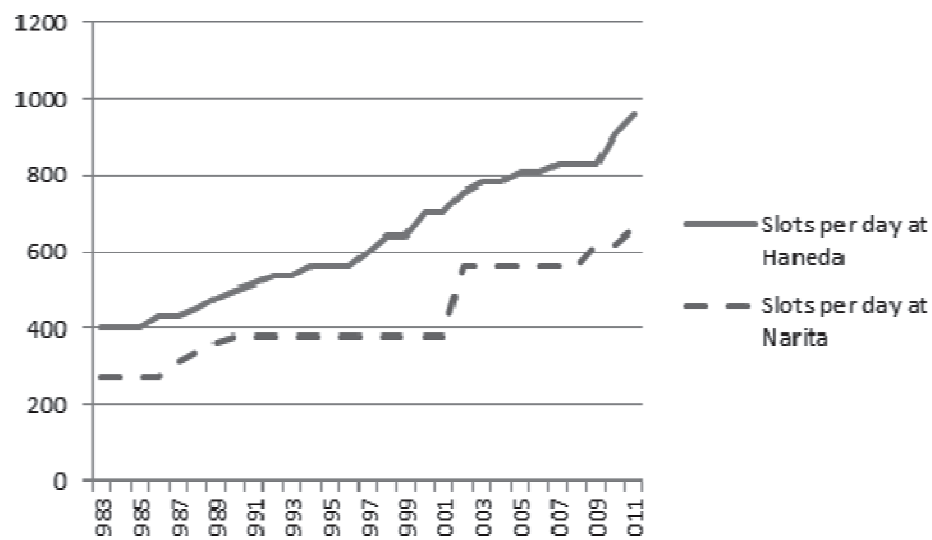
Road to re-expansion and re-starting international flights at Haneda Airport

As we approached the turn of the century, ANA – which held half of the landing slots at Haneda Airport for domestic flights – lobbied to re-expand Haneda Airport and to re-start international flights. There was room for additional flights after midnight, so the initial step was to allow international charter flights during that time. The idea of re-starting international flights at Haneda Airport triggered strong opposition from the Chiba Prefecture (where Narita Airport is located) which claimed that, after all the perseverance and hardship of constructing Narita Airport, it would be an injustice to re-start international flights at Haneda.

New developments at Narita Airport

Occasional attacks by the radical activists continued until the end of the 20th Century. However, by the turn of the century resistance from land owners had become limited. The government therefore decided to shift plans for the second runway to the north and open a provisional Runway B, of 2 180 metres in length[14]. The provisional runway opened in 2002, just before the FIFA World Cup, which was jointly held in Japan and South Korea that year. The capacity increase in 2002 shown in Figure 3.5 indicates the impact of the opening of Runway B at Narita Airport. It was extended north to a length of 2 500 metres in October 2009.

Figure 3.5 **Increase in airport capacity at Haneda and Narita Airports**

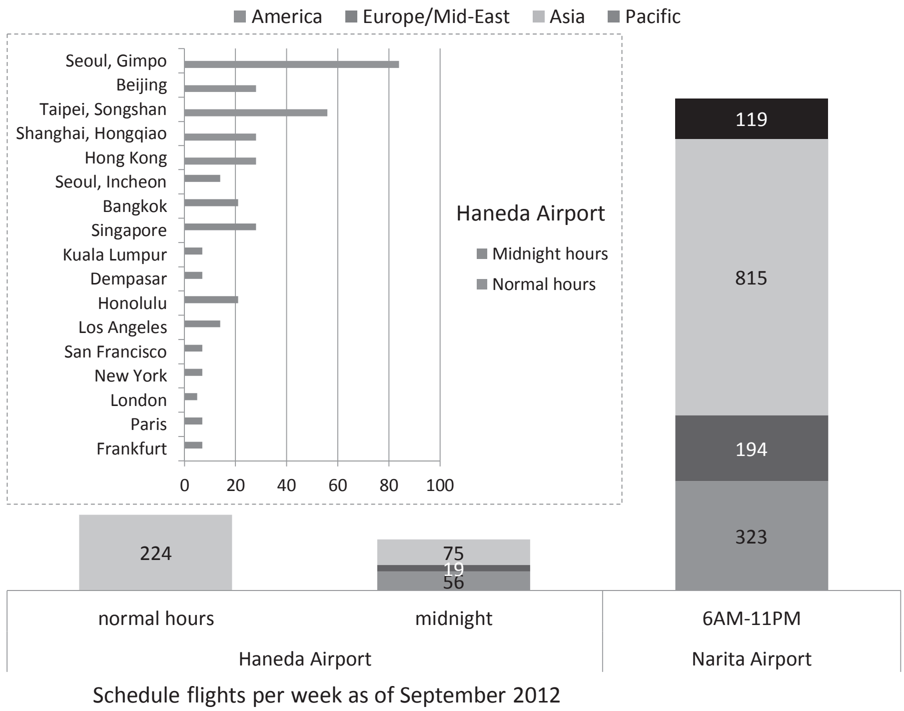


The airport was now equipped with a set of parallel runways; however, the two runways were not separate enough (by normal ICAO standards) to allow simultaneous take-off and landing. Following thorough safety assessment and simulation, simultaneous take-off and landing was initiated in 2011. This allowed for landing slots at Narita Airport to increase to 300 000 per year; equivalent to more than 800 slots per day.

Figure 3.6 depicts international flights at Haneda Airport and Narita Airport as of September 2012. The Haneda and Narita Airports have 1 825 international flights per week: 1 451 (80%) at Narita and 374 (20%) at Haneda. There are 224 flights at normal hours to major nearby Asia cities (Seoul Gimpo, Bejing Capital, Shanghai Hongqiao, Taipei Songshan and Hong Kong) from Haneda. There are also 150 flights during the night connecting Haneda Airport and North America, Europe, etc.

In Table 3.1, a calendar of events for recent interactive development of the Haneda and Narita airports is provided.

Figure 3.6 **International schedule flights at Haneda and Narita Airports**



Osaka

Itami Airport and the noise issue

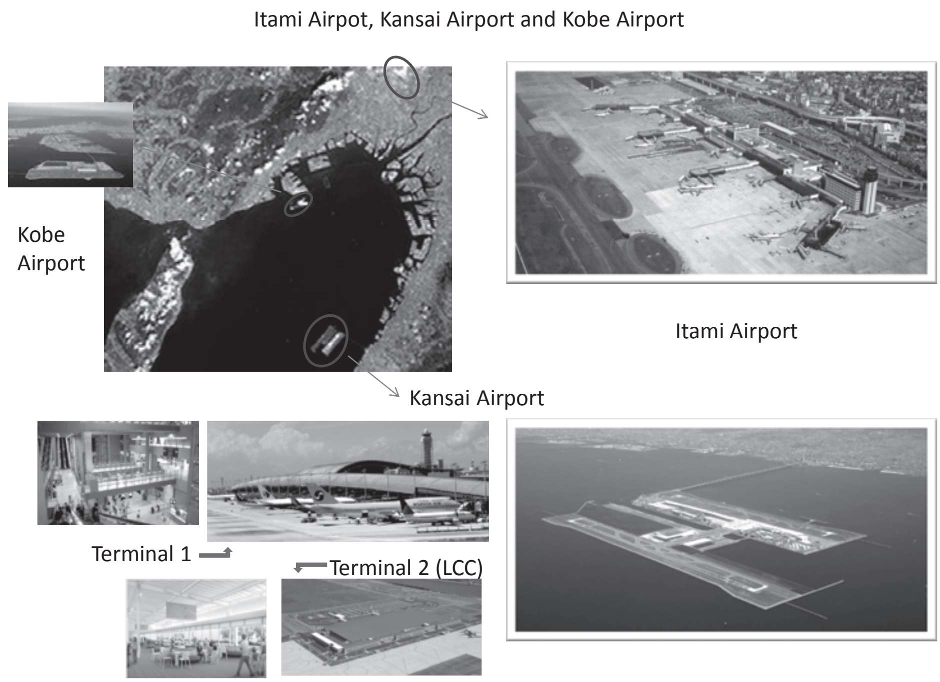
Itami Airport was opened in 1939. It had a single 1 828 metre runway until a parallel, 3 000 metre, runway was built in 1970, when the EXPO was held in Osaka. Figure 7 shows the location of Itami Airport.

Since it was located only 11 kilometres away from CBD of Osaka, in the midst of the residential district, the airport was inundated with complaints from the residents about the noise of the aircraft. The increasing noise (caused mainly by the growing number of turbo-jet aircrafts) led citizens, in 1969, to file law suits to stop evening operations and to claim for compensation. A curfew for turbo-jet aircraft between the hours of 11pm to 6am had been introduced in 1965[15], and this was extended from 10pm to 7am in 1972, and then from 9pm to 7am in 1975. In addition to the curfew, a restriction on the number of take-offs and landings per day was imposed at Itami Airport: a total of 450 per day (of which 260 jet aircrafts) since 1971; and 370 per day (of which 200 jet aircrafts) since 1977[16].

In 1981, the Supreme Court rejected the claim to stop evening operations, although it endorsed government compensation for those that had suffered from noise. The court decision aroused social concerns nationwide and became a national agenda.

Itami Airport marks a significant contrast with Haneda (where the curfew was partly rescinded in 1972) by aircraft flying over the Bay of Tokyo. Since 1976, take-off from Runway B-old in Haneda Airport had been banned between 9pm to 7am, but this restriction ended when Runway B was relocated towards the reclaimed area of Tokyo Bay in 2000. The curfew imposed on Itami Airport, however, remains in place.

Figure 3.7 **Three airports in Greater Osaka area**



Development of Kansai Airport

In 1971, the Ministry of Transport commissioned a study on the location of a new airport to accommodate growing demand at Osaka and, moreover, to put an end to the noise issue at Itami Airport. The planning of Kansai Airport was, in effect, sacrificed to resolve the environmental issue at Itami. Of the five feasible sites in the Osaka Bay area, Senshu – the most southern location and the farthest away from city centre of Osaka – was selected. As shown in Figure 3.7, it is located 37 kilometres in direct distance and 47 kilometres by rail from the CBD[17]. Although it was located far away from heart of Osaka, there was strong opposition from the citizens of Senshu, the airport was therefore constructed on a completely reclaimed island five kilometres from the shore of Senshu.

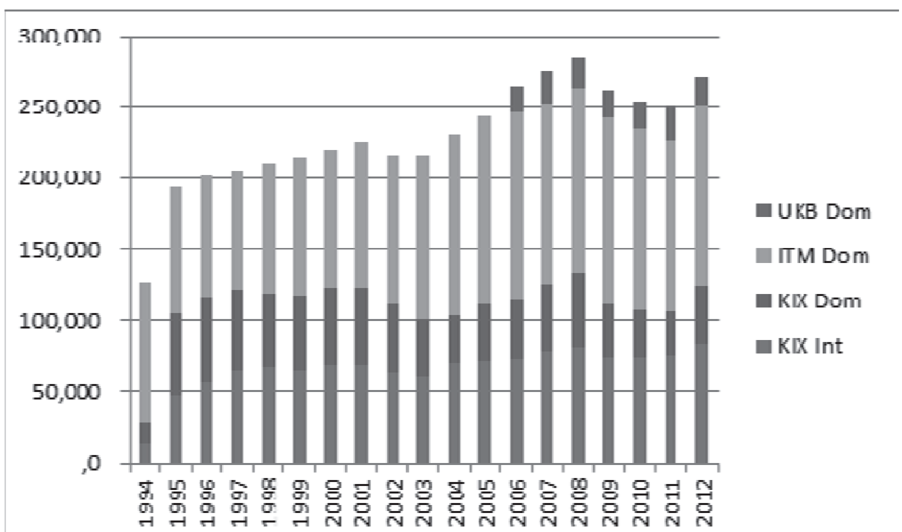
Due to the experience with Itami Airport, strong social sentiments against airports being built close to them had become deeply embedded in the citizens of Osaka. In retrospect, if the plan had been initiated before the noise issue at Itami Airport flared up, the NIMBY sentiment may have not been as strong as it was in the 1970s. In addition, advances in aircraft technology had shrunk the noise footprint by the time Kansai Airport was opened (in 1994) so that it would have been possible to build it closer to the shore.

Financially, constructing Kansai Airport involved not only local government, but also the private sector. This reflected the trend of economic policy during the 1980s to endorse “Minkatsu”, a private finance initiative, in building public facilities. A single 3 500 metre runway airport with a modern terminal building[18] was opened in 1994, and all international flights were transferred from Itami Airport.

In 2007, a second, 4 000 metre, runway was opened, and Kansai thus became a fully-fledged international hub airport.

Although the price paid was high, building the airport away from the residential area enabled Kansai Airport to become a 24 hour-operational international airport. NKIAC was established in 2012 to integrate the Kansai and Itami Airports. Taking advantage of the fully-fledged, 24-hour, operational capability of Kansai Airport, NKIAC took strategic steps to facilitate the start-up of Peach Aviation (Japan's first LCC) by building a dedicated terminal[19]. Construction on a new air cargo terminal is currently underway for Federal Express to locate their North East Asian hub[20]. In order to reduce the size of the debt[21], the government has passed a law to establish NKIAC and integrate the two major airports in Osaka in order to pool the cash-flow, increase the corporate value by strategic investment, and sell the operational rights of the two airports as early as FY2014.

Figure 3.8 **Number of annual take-off and landings at the three airports in Greater Osaka area**[22]



Kobe Airport

Back in the 1970s, Kobe was included in the five options for substituting Itami Airport, but had been rejected by the City of Kobe. Following the Hanshin-Awaji earthquake in 1995, and after considerable debate among its citizens, a local city airport was constructed off the shore of the Port of Kobe. Unlike Itami and Kansai – which are national facilities – Kobe Airport is city owned and classified as a local airport. Due to conflict in air routes with Kansai Airport, the number of take-offs and landings at Kobe is limited, and international flights are not accommodated due to its proximity to Kansai Airport.

4. Key factors affecting airport development in large urban areas

Basic nature of airport development in metropolitan area

Demand and supply function of airport

Airport demand is a function of air transport demand, which in turn is a function of population and economic activities. Population and economic activities require housing and offices, which rely on the supply of land. However, land is limited in urban areas.

In the supply function of an airport, land and air-space are the two major components. A major characteristic of an airport is its externality regarding noise caused by the taking-off and landing of aircraft. Externality of noise graduates with respect to distance from the airport and departure and arrival routes. This gives rise to the so-called NIMBY ("Not In My Back Yard") syndrome. The closer one is to the airport and its departure and arrival route, the greater the magnitude of externality.

From a mobility point-of-view, an airport closer to the CBD would have lower access time and out-of-pocket costs for travel. The benefits of flying would be enhanced where the general cost of access to the airport is lower. So, as long as you are away from noise, the closer you are to the airport the higher the benefit. Aircraft noise correlates negatively to the price of land, whereas accessibility to airports is a positive.

Large three-dimensional space needed to accommodate airport

A tremendous amount of space is needed to accommodate safe take-off and landing of aircraft. An airborne craft causes wake-turbulence and the larger the aircraft the bigger the impact of this turbulence. Therefore, when aircrafts take-off in sequence, a three-to-five nautical mile[23] separation is required; the same applies for sequential landing of aircrafts. This amplifies the capacity constraints of an airport. Parallel runways, adequately separated from each other[24], would accommodate capacity expansion in an accumulative manner. Building a second runway would double the capacity; but even if an airport is equipped with multiple parallel runways – sufficiently separated from each other – capacity would still be constrained if the air-space for take-off and landing is limited. For example, if there is only one route to and from the airport that leads to high altitudes, it would be the same as having only one runway.

Where urban areas exist in the extension of the runway, safety and noise concerns may push the path of take-off and landing away from densely populated areas. An aircraft landing using instrumental procedures glides down at a three degree slope; in severe weather conditions, it is necessary to approach the airport at a three degree slope using ILS[25] for 20 kilometres. A simple trigonometric function yields that at twelve kilometres away from the airport (for instance Roppongi in respect to Haneda Airport) an aircraft would glide down to 630 metres above ground level – lower than twice the height of the Eiffel Tower. As we have seen in Figure 2, noise concerns have historically expelled routes that fly over downtown Tokyo at Haneda Airport. Over in Osaka, aircraft approaching Itami Airport fly over the CBD of Osaka, and demands for the airport to be closed have not diminished.

Weather conditions

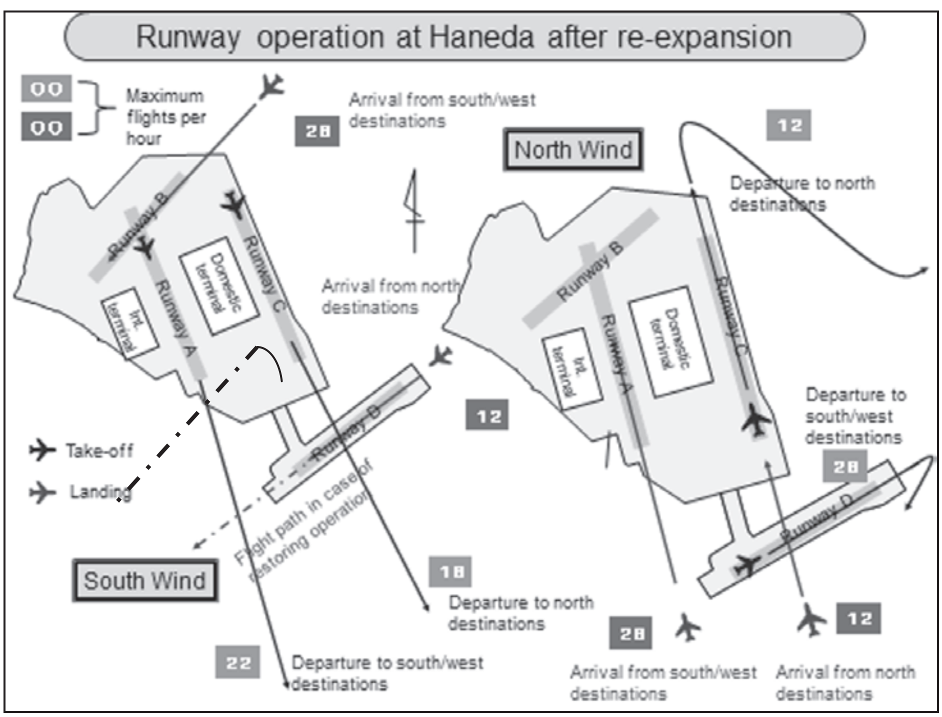
The direction of take-off and landing depends on the prevailing wind at the time. Suppose you have a pair of parallel runways and a single cross-wind runway. Parallel runways need to be operational in all weather conditions for scheduled flights to keep on-time; otherwise the number of flights would be restricted to the capacity of the single cross runway. Until the fourth runway was built, Haneda Airport had accommodated flights with two parallel runways and a single cross-wind runway. Since the crosswind runway has to be used in weather conditions with strong south-west winds, the number of scheduled flights was capped and capacity limited.

Overcoming the difficulties

Simultaneous planning of land-use and air-space

In the land-use market of urban areas, there is friction between inhabitants and airport location. The departure and arrival route design also has a large impact on the land lying beneath. This leads to the necessity to implement simultaneous planning of urban land-use and air-space design.

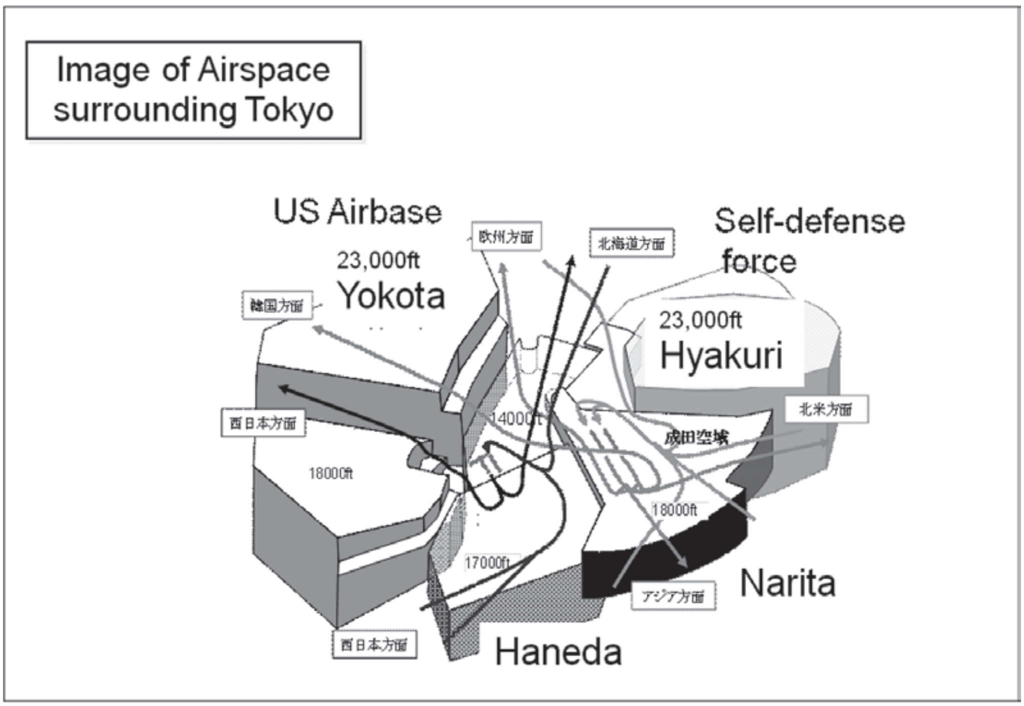
Figure 3.9 **Runway operation at Haneda Airport after re-expansion**



The re-expansion of Haneda Airport is an example of omnibus arrangements. The fourth runway (Runway D), without losing its parallel position vis-à-vis Runway B, was tilted 7.5 degrees to the east and its ILS diverted 2 degrees east-ward, so that altogether of 9.5 degrees swayed towards the east in order to avoid flying over Urayasu-city, one of the growing residential districts in Chiba Prefecture (see Figure 3.9).

Coordination with the United States' Airbase in Yokota, which manages the west-side airspace of Tokyo, was undertaken to trim the eastern edge in a step-wise manner to allow aircraft taking off from Haneda Airport to climb over Yokota airspace more easily (see Figure 3.10).

Figure 3.10 **Air space surrounding Tokyo and coordination with Yokota US Airbase**



It was necessary for one-third of Runway D to be built protruding into the mouth of the Tamagawa River. Therefore, the section interfering with the flow of the river was designed as a bridge-like structure in order to allow sufficient flow of water into Tokyo Bay while the remainder of Runway D was reclaimed.

Taking advantage of avionics innovations

Cities have historically emerged in a self-organising manner. Transport technology, on the other hand, develops at a different pace. Air-space management in particular has developed hand-in-hand with avionics; electronic systems installed in aircrafts composed of communication and navigation systems. Improvement in information and communications technology (ICT) is commonly time-framed as "dog-year" speed – seven times faster than human ageing.

Two counter-forces are at work: centripetal force, to attract the airport as close to the city as possible, and the centrifugal force of NIMBY nature, to push the airport as far from the city as possible. Unforeseeable technology advances in air-space management has caused the interface of urban and airport planning to become an extremely difficult task to tackle.

Coping with diversity of stakeholders

Diversity of stakeholders is another factor that strongly affects decision making in airport development. Airports at major cities have nation-wide effects. Thus, central government is usually heavily involved in airport development in large urban areas. The competiveness of a global city is of great national concern.

Within the central government, The Treasury and Transport Ministries have diverging interests. Since airport development requires significant amounts of capital outlay, the Treasury pushes for the involvement of local government and the private sector. This makes financial arrangements for airport investment a complex task.

When the source of funding depends more on the airport users than on the general tax payer, debt incurred for airport investment causes airport charges to be high. Servicing huge debt inhibits airport operators from adopting marginal pricing and undertaking strategic pricing policies.

Local governments are heavily involved in a mixed way. They have a positive interest in airport investment because accessibility to airports, and thus to air transport services, provides benefits to urban residents and improves productivity of business located in the metropolis. At the same time, they have to deal with the noise issue. This subject, conversely, requires local government to stand against airport development and to protect the citizens that are affected by aircraft noise. Local government is thus often placed in a position of conflicting interests. Land-use planning is mostly managed by local government, while residents press for both convenience and quietness of the region. So at regional level, benefit and non-benefit coexist; benefit from accessible airports for the users and airport industries, and non-benefit from the noise that an airport causes for the residents in the vicinity of it.

NPOs and social activists often play roles in supporting citizens that suffer from noise. Land acquisition had been another target for them in the case of Narita Airport. Not only do they protest from environmental concerns, they sometimes challenge the democratic legitimacy of government action to develop airports. The experience of Narita Airport has left important lessons to be learnt.

Airlines operating at major airports also have a stake in airport development. They are strong stakeholders that lobby in central and local government; and in many instances, different airlines have conflicting interests regarding major airport development. At Haneda Airport for instance ANA, historically, had the lion's share of landing rights, as it has grown as a dominant player in the domestic market. JAL, on the other hand, had a strong presence in Narita Airport, the major international airport. So ANA pressed hard to expand Haneda Airport and utilise it for international flights, while JAL opposed the idea. Influential foreign airlines also come into the picture. Historical rights of landing slots at congested airports provide room for incumbent carriers, dominant airlines in particular, to play a major role in decision making.

Historical path dependence

One of the key features of an airport is that, once constructed, it is basically fixed at its location. Urban areas change over time and, when the sprawl happens before the airport is constructed, it is not possible to wind the clock back and locate an airport beforehand. Airport development is historically path dependent.

Itami Airport was unfortunate in that it had been built in an inland area with no possibility of expansion, or shift-out to an area where the noise issue could be mitigated. Narita Airport is also suffering from the noise issue, as well as its inability to expedite acquisition of remaining land from resisting owners; and, at both airports, the curfew remains.

Haneda Airport, on the other hand, is a rare case in that it had originally being built at the edge of the city facing Tokyo Bay and gradually expanded out by reclamation. Since 1980, capacity has more than doubled. This also enabled the resolving of the noise issue. Although the flight path during night hours is fixed along Tokyo Bay and the number of flights is limited, the curfew has been lifted.

Kansai Airport enjoys 24-hour operation and capacity sufficient to accommodate further growth. Although distance from the CBD and high capital cost accrued due to setting the location five kilometres off-shore cannot be modified, steps are being taken to improve access transport and NKIAC is moving forward to sell the operational rights of the Kansai and Itami airports.

5. Implications for future airport development in large urban areas

The importance of KAIZEN to the existing system

Considering the historical path dependence of airport development, it is imperative to plan ahead of time. In global cities, such as Tokyo and Osaka, it is also necessary to improve the situation given the urban growth and airport development inherited from the past. From such a perspective, it is important to undertake "KAIZEN" – continuous improvement of current system – taking advantage of improvements in aircraft and avionics technology.

It is therefore important to identify bottlenecks and come up with a solution to resolve them. In implementing the solution it is necessary to plan carefully, taking note of the critical pass that would enable the most efficient process in carrying out KAIZEN measures.

Stimulating local interest groups by competitive forces among airports

In recent years, airport competition has started to serve as catalyst. For instance, re-expansion of Haneda Airport and the development of Kansai Airport have caused local interest to be manifested at Narita and Itami Airports respectively. The risk of losing out to other airports is affecting how local citizens think about the balance between capacity growth and the environment. Airports generate jobs, commercial activities, tourism, logistics activities and other positive spillover-effects, that have obvious benefits to local residents.

Improving access to/from airport

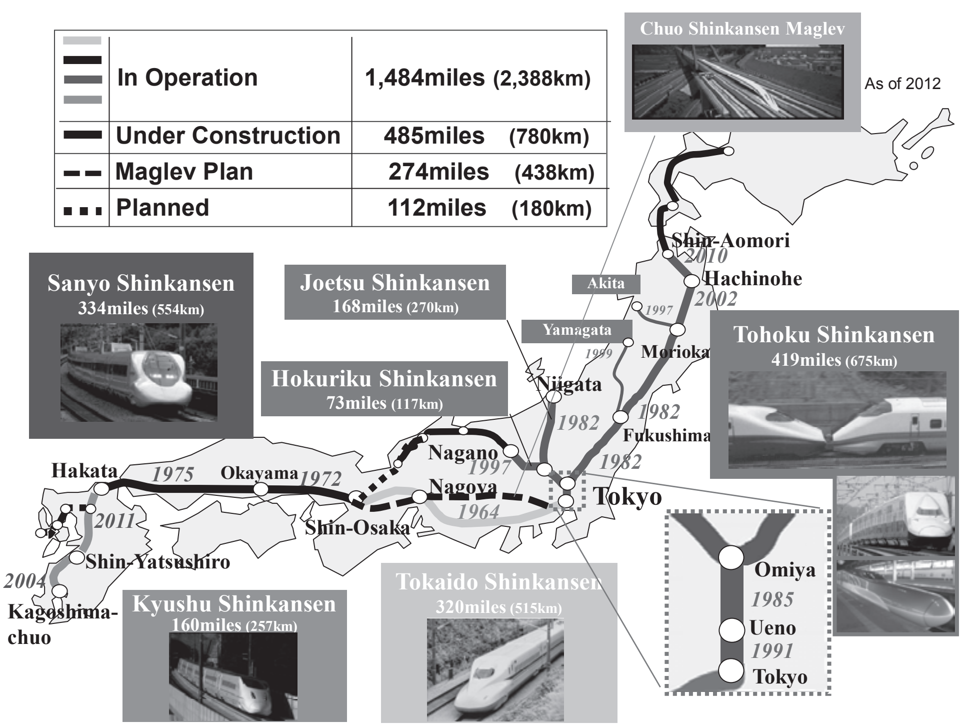
When the location of an airport is set far away from city centre to avoid noise, convenience is sacrificed. One way to circumvent this is to build an alternative airport by reclaiming land on water. Reclamation costs, however, are high. High-speed access transport connecting the airport and CBD is also expensive. This approach of internalising noise cost by high capital cost and high access transport cost is an attractive alternative, but there is difficulty in imposing high costs to airport users. Although it has taken considerable time, high-speed railway access to Narita Airport has improved. At Kansai Airport, significant effort has been exerted through the years to reduce the cost of various modes of transport such as railway, limousine bus, ferry and automobile.

Further improving high-speed access transport to/from airports is of paramount importance. High-speed rail is an ideal mode of transport to develop, but it is another capital intensive infrastructure that requires long-term investment. Thus, cooperation between central government, airport operators, local government and the railway industry needs to be fostered. There are plans to directly connect Tokyo Station and Haneda Airport in less than 20 minutes (currently 30 minutes) and Narita Airport in 36 minutes (currently 60 minutes); and Osaka Station and Kansai Airport in 40 minutes (currently 60 minutes).

Multi-modal planning

Domestic trunk-route transport needs to be viewed from a multi-modal perspective. In Japan, Shinkansen (the high-speed railway network) has been developing since 1964. Figure 3.11 shows its current status. As of 2012, a total network of 2 388 kilometres is operating, and an additional 780 kilometres are under construction. A super-conductivity, magnetic levitated, super express (the so-called "Maglev") is also planned and part of it is under construction. It is planned to be connecting Tokyo and Nagoya in 40 minutes by 2027, and then to Osaka in 67 minutes by 2045. Currently, between Tokyo and Osaka, the fastest Shinkansen takes 145 minutes, while air transport takes 65 minutes. The development of high-speed rail would have a substituting effect on domestic air routes, allowing capacity to be diverted to international flights. See Yamaguchi and Yamasaki (2009) for development of inter-city high-speed transport in Japan and impact of Maglev.

Figure 3.11 **High-speed railway "Shinkansen" network**



Considering use of price mechanism at congested airports

Economic theory says that congestion occurs because capacity is not priced properly. But in congested airports, the optimal market price is usually higher than the cost of building and operating the airport. Airlines, however, have long claimed that landing charges and other user fees should be priced based on cost. Although it is not particularly easy to implement the congestion pricing approach, the economic efficiency and fund raising function achieved from it should be noted.

Table 3.1 **Calendar of events at Haneda Airport and Narita Airport**

		Haneda Airport	Narita Airport
1994	October		Central Government and opposition groups reconcile at the "Roundtable on Narita Airport Issues"
1997	March	Runway C opened	
1998	September	International affinity charter to Honolulu by local commercial group	
	October		Capacity increased to 135 thousand annual operations
1999	September		Runway B decided to be constructed provisionally at 2 170m
2000	March	Runway B opened	
2001	February	International charter flights during midnight and early morning allowed	
2002	April		Runway B (provisional) opened, capacity increased to 200 thousand annual operations
	May	Programmed charter flights operated in daytime between Gimpo (Seoul) during FIFA World Cup	
	June	In the Cabinet Decision Concerning Economic, Fiscal and Structural Reform of 2002, following clause was included: "Ministry of Land Infrastructure and Transport, having prospects been made to financial arrangements by relevant ministries, shall re-enlarge Haneda Airport and introduce international scheduled flights no later than the latter half of the first decade of 2000."	
2003	November	Programmed charter flights operated in daytime between Gimpo (Seoul)	
2004	February	Domestic Passenger Terminal 2 opened	
2005	April	Appropriation for fourth runway granted in the FY 2004 National Budget	
	July		Runway B decided to be extended north to have 2 500m in length
2007	March	Construction of fourth runway begins	
	September	Programmed charter flights operated in daytime between Hongqiao (China)	
2008	April	Programmed charter flights operated in specific morning-evening hours between Hong Kong (China)	
	May	Construction of International Terminal (PFI) begins	
2009	October	Programmed charter flights operated in daytime between Beijing (China)	Runway B extended to 2 500m, capacity increased to 220 thousand annual operations
			Narita Sky Access Railway opened and connects to Nippori, Tokyo in 36 minutes
2010	October	The fourth runway (Runway D) and International Terminal opened, and international scheduled flights begin (30 thousand annual operations in daytime and 30 thousand during midnight & early morning)	
2011	October		Simultaneous take-off and landing procedure introduced to increase capacity to 235 thousand annual operations
2012	March		Capacity increased to 250 thousand annual operations
2013	March		Capacity planned to be increased to 270 thousand annual operations
2015			Capacity planned to be increased to 300 thousand operations

6. Concluding remarks

There is no "crystal ball" that enables airport planners to foresee the future. It is, however, possible to learn from theory and history. We have learnt from new economic geography that global cities evolve in a self-organizing matter with transport cost acting as catalyst for change. Challenging part of metropolitan airport development is to balance the market needs of the users and suppliers of air transport and the externalities that airports impose on land-use. Since there is no a priori answer or a universal pattern in deriving the solution for each and every metropolis, we need to enrich our knowledge of how other airports have managed and contemplate on how to make use of what we have learnt to come up with a customised break-through in the case in front of us.

NOTES

1. Urban Employment Area (UEA) defined by Kanemoto, Y., and K. Tokuoka (2002) is used as "metropolitan area" in this paper. "Greater Tokyo" and "Greater Osaka" shall mean UEA of Tokyo 23 Wards, Yokohama, Saitama and Chiba combined, and UEA of Osaka, Kyoto and Kobe combined, respectively.
2. Total population peaked out in 2004.
3. 8^{th} Annual Edition: Version 2, July 2012.
4. Population density is calculated by UAE population and arable land size.
5. Tokyo, Yokohama, Saitama and Chiba.
6. Osaka, Kyoto, Hyogo and Nara.
7. 45/47 stands for 1970 and 1972 in Japan's Showa era.
8. This development has lead LCC to become a social phenomenon in Japan and "LCC" was chosen one of the Top 10 best vogue words for 2012. In January 2013, Kansai Airport was awarded "LCC Airport of the Year" at a convention in Singapore.
9. The formal name of Haneda Airport is *Tokyo International Airport*, but in this paper, Haneda Airport shall be used for short. Likewise, Narita Airport, Itami Airport and Kansai Airport is used instead of *Narita International Airport* (*New Tokyo International Airport* until 2004) and *Kansai International Airport*.

10. Apart from these three categories of civil aviation airports, there are a small number of military airports controlled by the National Defense Force and the US Air Force that allow use by commercial aircrafts.

11. Land for terminal construction is leased out by the Government.

12. Airport planning needs to identify optimal location, which is often already used by specific entities for specific purpose. Although it is necessary to achieve consent of the existing land owners, it is also imperative to avoid arbitrary movements. Price of land sky-rockets once specific location is announced. Thus, announcement of land acquisition of specific sites for airport development requires confidentiality. This is conflicts with democratic process that asks for laying down options publicly and decided through debate.

13. It is, however, necessary to transfer to another railway and take 10 minutes ride before arriving at Tokyo Station. There is a plan to connect the line directly to Tokyo Station so that it would take the same 36 minutes to arrive at Tokyo Station from Narita Airport.

14. At the southern end of Runway B, a farmer is still making his living in 2013.

15 Curfew had been introduced first at Haneda Airport in 1962.

16 This slot restriction remained the same until recently. In 2013, after 36 years since introduction of this regulation, remaining 170 slots restricted to turbo-prop aircraft is going to be converted in steps into low-noise turbo-jet slots. Curfew, however, remains valid today.

17. Using the subway in downtown and limited express in the suburbs, it takes approximately one hour and costs about USD 15.

18. In 2001, American Society of Civil Engineers awarded the airport as one of ten structures given the "Civil Engineering Monument of the Millennium".

19. The year 2012 marked the beginning of LCC era in Japan. In 28 October 2012, the first LCC dedicated terminal in Japan celebrated the grand opening at Kansai Airport. Opening of the Terminal 2 (T2) was the hallmark of airport-airline collaboration to give birth to the first Japan based LCC; Peach Aviation. This development has lead LCC to become a social boom in Japan and "LCC" was chosen as one of the Top 10 for 2012 by a popular annual "best vogue word of the year award". NKIAC was also awarded "Low Cost Airport of the Year" at Budgie$ & Travel Award at Singapore in January 2013.

20. Kansai Airport was chosen after competition with other NEA airports.

21. As of March 2012, total debt of USD 14 billion outstanding.

22. KIX, ITM and UKB stands for Kansai Airport, Itami Airport and Kobe Airport respectively.

23. One nautical mile is 1 852 metres.

24. Under ICAO rules, No Trespassing Zone (NTZ) required for independent operation of parallel runways is 1 310 metres.

25. Instrument landing system.

CHAPTER 4

Expanding airport capacity under constraints in large urban areas: the German experience

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This paper analyses how German airports have extended capacity. Airport expansion led to conflicts firstly in the sixties. These accelerated in the eighties and are expected to remain in the future, particularly in Frankfurt, Berlin, Munich and Stuttgart. These conflicts have led to long planning processes (including mediation), demonstrations and court decisions but remained unresolved for many stakeholders. While capacity has not been increased as fast as initially planned, it has been increased substantially at all busy airports, sometimes at high costs like in Frankfurt with the removal of chemical plant and in Berlin with cost overruns of more than two billion. The paper argues that the current planning system has led to avoidable transaction costs and to a too costly and inefficiently used infrastructure with avoidable environmental costs. It discusses the pro and cons of reform proposals such as an independent planning authority separated from the owners of airports, open and transparent planning process, compensation of directly negative effected citizens, mandatory Cost Benefit Analysis, market based environmental policy and reforming the organisational structure of the German airport industry.

1. Introduction

Expanding airports is a topic which can easily make it to the first page of the national press. But this is highly unlikely, as "bad news" is "good news", and most often failures and scandals make it to the front page. Berlin airport or the on-going failure to open up a nearly-complete new airport has been the front runner in this regard and gained so much international attention that the association of engineers fears that the worldwide renowned reputation of German engineering might be seriously damaged.

Adding airport capacity is also a topic which goes beyond technical aspects. After all, at some time, in the short or long run, the airport Berlin Brandenburg "Willy Brandt" will be in operation, but it will then be the economist to ask at what price. This will be difficult to assess not only for Berlin, but also for other major airport infrastructure projects of which some were actually built and some not. Fraport opened its new runway on 21 October 2011. In contrast, Munich Airport's plan to build a third runway was voted down by a referendum on June 17 2012. Düsseldorf has two runways, but is only allowed to operate at single runway capacity due to environmental restrictions. In the 90s, the city state of Hamburg resisted the proposal of the Chamber of Commerce to shift all charter traffic to Hannover airport and instead has expanded airport capacity at the inner city airport in Fuhlsbüttel. Plans for a central Northern German Airport never materialised.

In this paper I would like to address the following questions:

1. How have German airports extended capacity? Has capacity been expanded on an optimal scale and time?
2. What are the key problems of airport investment?
3. How have investment decisions been assessed? By what methods?
4. What are the strengths and weaknesses of the German decision process?
5. What can be learned?

This paper draws together the available evidence and literature. Unfortunately, due to data problems and lack of vigorous studies, it is only possible to shed *some* light on these problems.

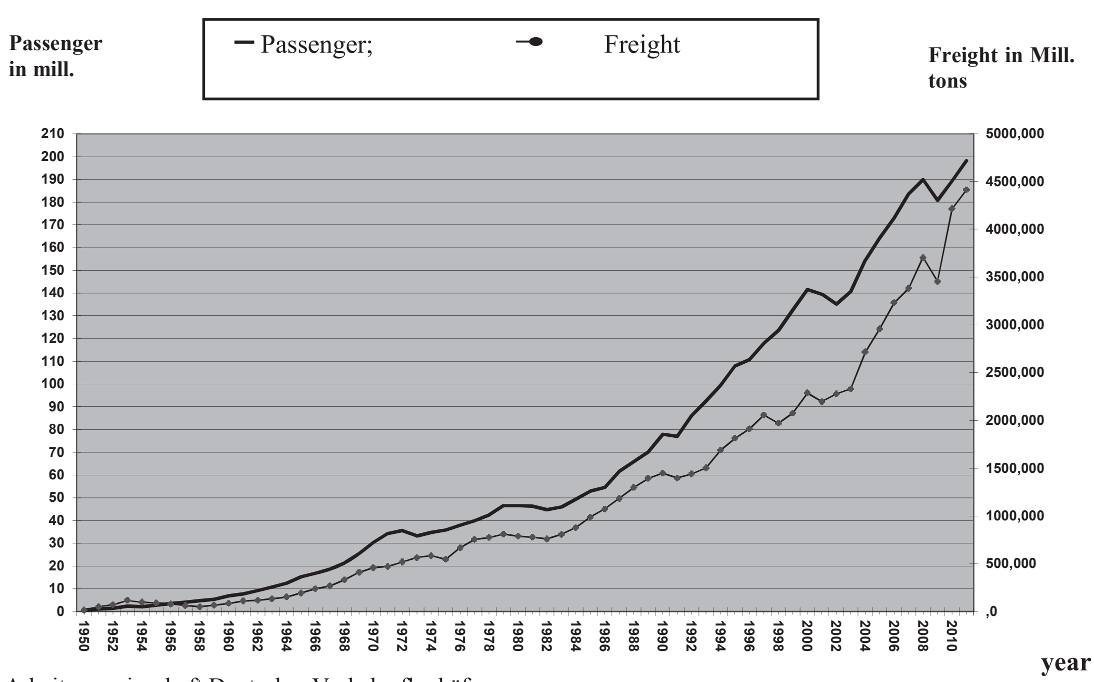
The paper is organised as follows: Chapter 2 and 3 describe and analyse how German airports have extended capacity by providing a historical overview and by presenting some case studies. Chapter IV analyses theoretically the major problems of airport investment. This gives some guidance to analyse how investment decisions have been assessed in public planning processes, which will be outlined in chapter 4. Chapter 5 analyses further strengths and weaknesses of these public planning processes. Thereafter, the results are summarised.

2. Investment of German airports – overview

The map of Germany is full of airports and airfields. This is also the result of the Second World War and the cold war. After the war, German airports were rebuilt. Typically, runways were extended to handle turbo prop and later on, in the early sixties, the new generation of jet aircraft. Air traffic grew steadily (see figure.1). In the early 60s a number of German federal states and municipalities discussed plans to close down existing airports and built new larger airports for intercontinental flights instead. It is worthwhile to recall that even at that time such plans were blocked by opponents that would have been negatively affected. Noise and in particular the noise of the first jet generation was feared by rural farmers and lead to strong protests which were so effective that, for example, the conservative government of Baden-Wurttemberg decided against building a new airport in Stuttgart in 1973. Frankfurt, Munich and Zurich Airport were seen as sufficient to absorb the local demand for intercontinental traffic of the Stuttgart region (Lang, 1969, Bischoff, 1973).

In the seventies and eighties utilisation of capacity at German airports increased, but unevenly, and capacity became scarce only at a few airports. In 1965, Frankfurt airport started to apply for public approval for a new runway west. This process turned into long-lasting political protests and lead to concerns in the eighties and nineties that airport extension was nearly impossible to achieve or only at substantial cost and time (see below). These concerns were also fuelled by the failure to extend Düsseldorf airport. The airport applied for approval of a second parallel runway in 1969. In 1983, 14 years later, the runway was finally approved; and another ten years later, in 1993, the construction was finished, but the use of the two runways was limited to the capacity of one runway (see below).

Figure 4.1 **Passenger and freight of German airports**



Source: Arbeitsgemeinschaft Deutscher Verkehrsflughäfen

Given these problems, the allocation of scarce resource became a topic in the nineties after the liberalization of intra-EU air traffic and forecasts of capacity crises. In the nineties, the widely shared view was that a further expansion of Frankfurt airport and Düsseldorf was impossible and that – given the long planning processes of Munich airport – capacity would become increasingly scarce because a distribution of traffic to other airports and other transport modes was seen as difficult (Knieps 1990). It came, therefore, as a surprise that Frankfurt attempted to build a new runway in 1997 and even more that it succeeded in 2011. Even with new capacity, the allocation of capacity remains a problem currently and in the future. Düsseldorf is full at most times of the day, and the new Munich airport which began operating in spring 1992, and has since become the second hub of Lufthansa, has grown faster than originally forecasted (see below). In the future, demand might reach capacity limits at Munich airport as a further expansion has been ruled out by local politics following the referendum in 2012

The allocation of scarce airport capacity to users (=airlines) will remain an issue in the future. Up to now, scarce capacity has been allocated by the EU slot allocation rules which keeps down congestion more effectively than queuing, but creates nevertheless welfare losses (Forsyth and Niemeier, 2012). Unlike the UK, secondary trading has not been (officially) practised at German airports. The number of coordinated movements had been increased even at Frankfurt – and here even before new runway has been opened. Peak and congestion pricing has never been practised by airports with scare capacity that is Frankfurt and Düsseldorf[1] with excess demand for all day and Tegel, Munich and Stuttgart for excess peak demand (Niemeier, 2004).

In the post-1990 years, the growth of decentralised charter traffic and later Low Cost Carriers has led to an increased interest in small regional airports. Municipalities saw this as an opportunity for their regions and have entered the market for airports with commercial flights. From 1995 onwards, ten airports have been opened up in Germany (see figure 2 below), but market entry has hardly reduced excess demand at busy airports as entry occurred in region with excess supply (Mueller-Rostin et al. 2010 and Niemeier, 2012) and as new markets were developed (LCC city trips etc.) rather than existing flights shifted from large to small airports. The newest and probably most contested market entry is the "new" regional airport of Kassel Calden which will open up 4 April 2013. The airport is located in North Hessen, a relatively structurally weak region which is already close to three regional airports (Paderborn/Lippstadt (88km), Dortmund (153 km) and Erfurt (185 km)) and also well connected by highway and high speed rail to the international airports of Frankfurt (1:38hrs by train) and Hannover (1:30 hrs by train). Critics among them, Lufthansa and neighbours, argue that the airport should not have been built in the first place and operations will only be feasible if subsidised. Building the airport is supposed to have cost EUR 271 million, which is actually 40% more than planned. The project is financially supported by EU funds and from the federal state of Hessen. The management plans to break even in 2018 (Schmidt, 2011; Bamberg, 2013). The extent and degree to which smaller German airports are subsidised is not clear, but remains an issue[2] in particular as the EU Commission has begun to investigate in whether the city of Lübeck has subsidised Infratil, Ryainar, Wizz Air and other airlines (EU COM, 2012).

Figure 4.2 **Market entry and exit of German airport 1995 to 2012**

Source: Niemeier (2012)

The situation in Germany is in many respects similar to Europe. As Button and Reynolds-Feighan (1999) showed for Europe, there has been abundant capacity in areas with lack of demand and underinvestment in those with excess demand. This unbalance has persisted at least over the last twenty years. Scarce capacity could have been better priced and pricing could have been linked to investment. At busy airports, capacity has been slowly increased. Frankfurt (in 2011) and Munich (in 1992), as well as the airports of Amsterdam, Barcelona, Manchester, Madrid, Paris-Charles de Gaulle have built new runways eliminating excess demand. The same could happen in Berlin if the new airport was built in the right size. But some busy airports like Düsseldorf and Paris-Orly could not be expanded in the past and will most likely not be significantly expanded in future. Stuttgart and perhaps even Hamburg might grow into this situation in the long run and make efficient demand management necessary.

At non busy airports there is evidence for German airports and other EU airports to have wasted resources in building runways for intercontinental traffic. According to Martens (2009 and 2010) the investment was not profitable for at least about 74 of the 113 secondary[3] airports with a runway length of more than 2700 metres. Almost 50 per cent of airports had no long distance flights at all in 2007. Compared to the European average, Germany has overbuilt capacity for this market segment on a similar scale. It has performed better than Spain, but worse than UK (see table 1 below). These scores might change if plans to build an intercontinental runway in Münster-Osnabrück materialises. In the mid-nineties, Münster-Osnabrück airport (an airport with then less than 2 million passengers) applied for public approval to extend the runway from 2 170 m to 3 600 metres. Permission was granted in 2004, but the decision was opposed legally in the courts by neighbours and environmental groups, who argued that the extension would damage a biotype. After more than five years, the administrative appeals tribunal in Munster eventually ruled against the extension because the public interest for intercontinental flights was doubtful and could not outweigh the environmental costs. In 2011, the parties agreed on a runway extension of 3 000 metres, which could be realised without any damage to the biotope. Currently, the airport handles about 1 Million passengers – half of what it had in the late nineties (Reichmuth et. al., 2011, Ries, 2012).

Table 4.1 **Profitability of Long haul runways at secondary European Airports 2007**

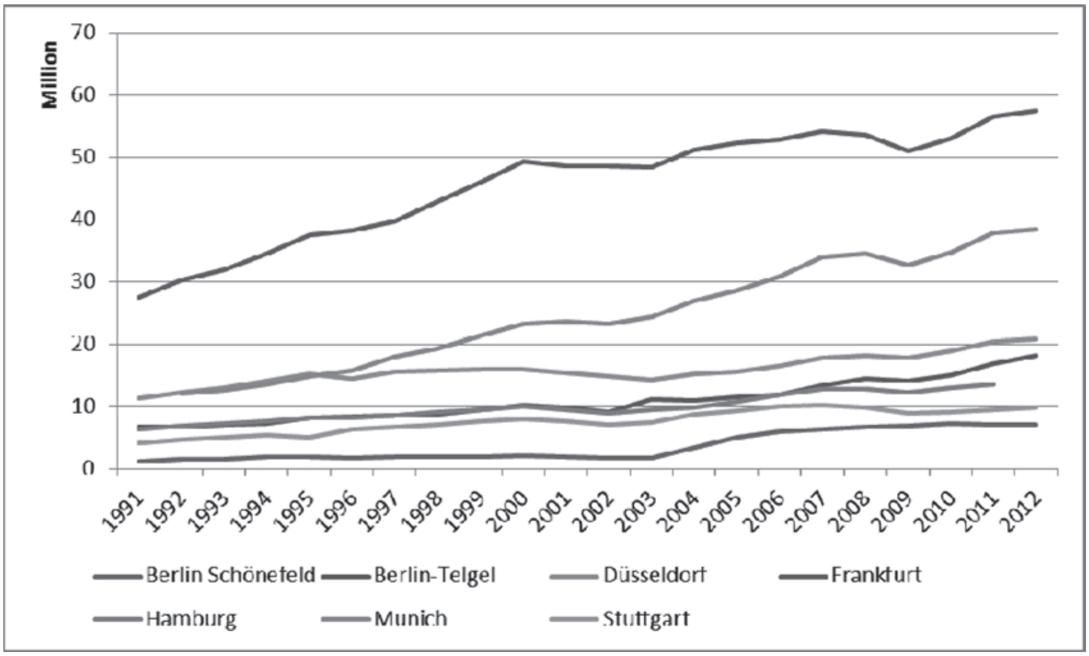
	Germany	Spain	UK	EU
Potentially profitable	30%	19	71.4%	26%
Unprofitable	50%	19	14.3%	27%
No long haul flights at all	20%	62	14.3%	48%
Number of Airports	10	16	7	113

Source: Based on Maertens (2009 and 2010)

3. Case studies of capacity expansion at six German airports

In this section I will review in detail the capacity extension of the six largest German airports measured in terms of passenger throughput (see figure 4.3). The expansion of airports in Berlin, Düsseldorf, Frankfurt, Hamburg, Munich and Stuttgart has in common that in all cases expansion were heavily debated in politics and were contested in courts. After the analysis of these cases I attempt to draw some stylize facts about capacity expansion at German airports

Figure 4.3 **Passenger growth for large German airports 1991 to 2012**



Source: Arbeitsgemeinschaft Deutscher Verkehrsflughäfen

Berlin Brandenburg International Airport "Willy Brandt"

After the German reunification, Berlin had three airports, namely Tegel and Tempelhof in former West Berlin and Schönefeld in East Berlin. Soon afterwards, the plans for a new hub Berlin Brandenburg International Airport (BBI) were started (Bickenbach et al., 2005, p. 71). This hub airport was planned to become the first private airport in Germany. In August 1992, the commission "Air transport of Brandenburg" presented the results of a study on the best location of a new hub. They recommended the area of Jüteborg Ost and Jüteborg West, but not the later chosen location of Schönefeld. A year later in July 1993, a mediation process was officially started to discuss with all stakeholders alternative locations. Parallel to this, the public planning process started with spatial planning on larger scale (Raumordnungsverfahren) followed by a more detailed approval procedure (Planfeststellungsverfahren). In November 1994, regional planning favored the location of Sperenberg, but again not Schönefeld. What happened then was a political decision by the minister of transport of the federal state. The investment bank Barclays de Zoete Wit which was supposed to privatise BBI recommended Schönefeld as Sperenberg would cause additional costs of EUR 50 000 million. The management of the Berlin airports did not support Schönefeld, but was overruled by the agreement between the Prime Minister of Brandenburg, the Mayor of Berlin and the federal Minister of Transport in June 1996 to build the new airport in Schönefeld. In September 1996 mediation was stopped as Berlin airports refused to cover the cost for the dialog with citizens. In December 1999 the more detailed planning for the extension of Schönefeld began. In June 2002, the two Länder Berlin and Brandenburg decided to close the airports of Tegel and Tempelhof and concentrate all traffic at BBI in Schönefeld. In August 2004 the planning approval was given. This was half a year later as planned so that the opening had to be postponed from 2007 to 2008 (ibid, p. 74). In August 2004, it was announced that building would start in 2006 and that BBI would open with the winter flight schedule of 2010. However, as is widely known, this was not the last postponement (Janssen, 2013):

- On 14 June 2010, the opening had to be postponed from October 2011 to 3 June 2012.
- On 8 May 2012, the opening date was postponed again (due to technical problems with the fire safety and smoke exhaust systems) to 17 March 2013.
- In early September 2012, the opening date was postponed to 27 October 2013.
- On 6 January 2013, it was declared that BBI would be even further delayed, with no definite opening date given.

The initial construction costs of EUR 2.83 billion could easily double. While mismanagement, rising costs and postponements dominated political discussions in the last year, the environmental problems remain. Civil groups demand a stricter night curfew (10 pm to 6 am), oppose a future third runway and criticise the planned flight path (Aktionsbündnis ABB, 2013).

Düsseldorf airport

Düsseldorf Airport is the largest airport of North Rheine Westphalia (NRW). The location was chosen by the city council of Düsseldorf and approved by the transport minister, in Berlin, in 1925. In 1952 the runway was extended to 2 475 metres and in 1969 up to 3 000 metres. In 1969, the airport management sought public approval for a parallel runway system. The permission was given in 1983 and the runway was built in 1993 for EUR 61 million. Use of the runway is restricted to the capacity of one runway, due to the so-called “Angerlandvergleich” – a contract between a number of municipalities, the NRW transport ministry and the airport company – signed in 1965 (Historikerbuero, n.d.). This contract initially limited the number of movements, in the six months of a year with the most traffic, to 78 240 movements. The airport management and the transport ministry attempted to increase this movement cap to 91 000 slots in 1976, and to 91 000 movements with a maximum 34 hourly slots in 1983. Later, in 1999, it attempted to change the movement cap to a noise cap, that would have increased the maximum number of movements, which was prohibited by court. In 2003, a court decided that the Angerlandvergleich allows for some flexibility. Currently the airport is allowed to serve 131 000 movements during the six peak months, and a maximum of 43 slots in peak times (Düsseldorf Airport, 2012).

Frankfurt airport

Frankfurt Airport is the main hub of Lufthansa and the largest airport in Germany. It is located in Hessen. The location was chosen by the Nazi government in 1936 and the new airport opened in 8 Juli 1936. The northern runway was extended to the length of 3 300 metres on 28 October 1957. Two years later it was further extended to 3 900 metres and the South Runway was prolonged to 3 000 metres in 1960. In 1965, the airport submitted the planning documents for extensions to existing runways and for the New Run Way West (Rucht and Sauer, 1984). Following a public hearing, permission was given, in 1968, however the decision was contested, successfully, in the courts. In December 1971 the Ministry of Economic Affairs and Transport approved the new plans. The content of the approval was identical to the first one. There followed an 11-year court battle and demonstrations. The conflict was initially about noise and then, later, about an area of protected trees in the Frankfurt City forest. This area was occupied by protestors who erected a camp. On 2 November 1981, as police began to force the protestors to leave the forest, violence escalated to such a level that observers compared it to a civil war. Two weeks later, about 100 000 people demonstrated in the capital of Hessen and 220 000 citizens voted for a referendum, which was later turned down by parliament because the federal state of Germany, and not the Land Hessen, was responsible for air transport infrastructure. The protest movement did not succeed, and in the end violent protestors abused the protest by killing two policemen on 2 November 1987 (FAZ, 2010).

In 1982 the construction of the Runway West began, and on 12 April 1984 the runway was opened (Bickenbach et al. 2005).

Although, following the completion of Runway West, the social democratic president of Hessen declared that no further expansion would be undertaken, about ten years later, in 1997, discussions regarding further expansion of the airport began (ibid). The social democratic government of Hessen proposed an open mediation process without any predetermined results in July 1998. In August 1998 the mediation process began, and in January 2000 it ended (see below). The mediators recommended a package of five measures which should not be broken up. Besides optimisation of existing capacity, an active and passive noise reduction programme, and a regional forum for dialogue, it was also recommended to build a new runway to increase capacity by up to 120 movements per hour and to implement a strict night curfew from 11 pm to 5 am. The three parties in parliament unanimously supported the more stringent night restrictions. As the conservative president of Hessen, Roland Koch, put it: “No expansion without night curfew – no night curfew without expansion” (Handelsblatt, 2003).

In September 2001, Fraport applied for public approval and, on 18 December 2007, the Ministry for Economic Affairs and Transport approved a new 2 800 metre long runway. For legal reasons it approved, not the strict night curfew, but 17 night flights. In 2011 the court decided against this decision and ordered a strict night curfew – a decision which was not well received by airlines. During the approval process, the risks of the chemical plant Celanese were assessed. The plant was relocated and Fraport bought the area for EUR 750 million. Construction of the fourth runway began in May 2009 and finished on 20 October 2011. The capacity will be increased stepwise from the initial 82, to 120 movements per hour.

Building the runway has not stopped the protests. The local citizen action groups have allied (Bündnis der Bürgerinitiativen, 2013) and, for more than a year, citizens gather once a week in a terminal of Frankfurt airport and protest against “excessive airport expansion” and demand among other things “a ban on night-flights between 10:00pm and 6:00 am” (BI Flörsheim-Hochheim, 2012).

Hamburg airport

Hamburg airport opened in January 1911. It is the oldest operating airport in the world. It was initially a private investment but was then subsequently taken over by the state. The crossed runway system was extended stepwise in 1935, 1950, 1955, 1956, 1961 and 1964. It is currently 3 250 metres and 3 666 metres long. While it was built initially on the outskirts of Hamburg, in Fuhlsbüttel, it has become today an inner-city airport.

In the sixties, plans were developed to close down Fuhlsbüttel and build a central Northern German International Airport. Alternative locations were discussed, and finally Kaltenkirchen, an area 40 km north of Hamburg, was selected. Hamburg Airport also acquired land. However, these plans were stopped in the 70s (Die ZEIT, 1976), but have been discussed constantly during periods of strong growth and growing noise emissions. In the beginning of the nineties liberalisation of air transport, together with strong long-term economic growth expectations due to the unification of Germany, coincided with a period of increasing noise emissions. The influential studies of William, Cutler Pickering (1991) and SRI (1991) forecasted an increase from 6.8 million passengers in 1990, to 17 million passenger in 2010. Total movements should rise from 141 000 to 280 000, with commercial rising from 113 000 to 230 000. The Chamber of Commerce suggested shifting all charter and leisure traffic to Hannover. The Mayor of Hamburg suggested Parchim airport, a former military field between Berlin and Hamburg, as an option for a common international airport of North Germany and the Berlin region. However, the northern German conference of Ministers of Economic Affairs in 1995 saw this as an unrealistic option and recommended, in the guidelines for a common northern German air transport policy, that no further planning be undertaken until 2010. Instead of building megaprojects, the existing airports should become less noisy through more effective market-based environmental pricing, including noise and emission budgets (Niemeier, 1998)

In the mid-nineties, privatisation of Hamburg airport began and the airport management applied for public approval to extend the apron, which constrained the airport to 42 movements per hour. In the application the airport forecasts an increase of 195 000 commercial movements in 2010, which would have increased noise and therefore contradicted the guidelines. However Hamburg policy intervened and implemented a noise budget set at the noise emissions level of 1997 (see below). The apron was completed and increased the slot to 51 movements – a level which, up to now, has not been reached.

Compared to the eighties and nineties Hamburg airport has gained acceptance, but of course environmental concerns have remained a key issue regarding its further development. Neighbours are affected and are organised in groups. There is, however, one peculiarity; while at most other airports, the noise affected citizens live in the city – or in neighboring communities within the same federal state – this is not the case with Hamburg. Communities in Schleswig-Holstein are also affected. This is similar to Berlin and leads to political conflicts and cooperation among federal states.

Munich Airport

Munich Airport "Franz Josef Strauß" is located 28.5 kilometres north east of Munich. On 17 December 1960, an aircraft crashed into a tram, killing 52 persons (Kretschmer, 1984). This led to demands for a new airport located in the rural areas, sufficiently far from the city. Planning started in 1963, different locations were assessed and, on 5 August 1969, the regional planning commission selected the current location at Erdinger Moos. Initially four parallel runways (two of 4 000 metres and two of 2 500 metres length) were planned. In 1974, the number of runways was reduced to three, and in 1981 to two, parallel 4 000 metre long runways. This downsizing reflects environmental pressure with appeals to courts, but also the expectation that traffic will grow more slowly than expected. The planning approval of 1979 forecasted 12 million passengers for 2000. In 1984, this was reduced to 10.8 million. After more than 7 years of construction (with stops due to court decisions) the airport opened on 17 May 1992.

Traffic grew faster than forecasted, and in 2000 reached a level of 23 million passengers – almost double than was expected. Munich airport reacted by planning a third runwayn and spatial planning started July 2005. The plans were approved by the government of Upper Bavaria in early 2007 so that the public inquiry could start in August 2007. The government of Upper Bavaria approved the third runway on 26 July 2011, and ordered immediate implementation. The airport management promised not to use this right and to wait for a final decision by the courts (Süddeutsche Zeitung, 2012).

On 17 June 2012 the extensions plans were stopped by a public vote of the citizens of Munich. Of the 32.8% of the public who participated in the vote, 54.3% voted against it (Spiegel Online, 2012). The outcome of this referendum is interesting, in that the city of Munich is virtually unaffected by aircraft noise due to the remote location of the airport.

Stuttgart Airport

Stuttgart airport is the airport of Stuttgart, the capitol of Baden Württenberg, located in the area of the cities Leinfelden-Echterdingen und Filderstadt. The location was chosen in 1936, and the airport began operating in 1939. The runway was extended stepwise in 1951 and 1961. The master plan of 1967 proposed to build a large international airport with three runways in the range of 2 700 to 4 300 metres. This immediately caused strong protests from neighbors (Abel, 1984). The first German initiative against aircraft noise was established within half a year and rapidly gained members (5 000 in autumn 1968). The protest was so strong that alternative locations were analysed, which raised protests there as well. In 1973 the prime minister of Baden Württemberg abandoned these plans, because the people of this area travelled via Frankfurt, Munich and Zurich to their intercontinental destinations so that there was no need for a large international airport. However, an extension to the airport remained on the political agenda as intercontinental flights could not fully operate. On 24 June 1996, after three years of construction, the runway was completed; it had been refigured and extended to 3 345 metres. Given the strong growth of traffic, a second runway was demanded by the airport management in 2000. These plans, however, were not only opposed by the neighbours but also by the Minister, President Ernst Teufel, who reiterated his promise of no further expansion. His follower, Günther Oettinger, did not feel bound to keep this promise, however, and decided, in 2006, to assess the pro and cons of a second runway through independent experts (Siegel and Visintin, 2007). After two years, on 25 June 2008, his conservative government came to the conclusion that no second runway would be built in the future. This promise is fixed for a period of 8 to 12 years (Stuttgarter Zeitung, 2008). In order to cope with the expected growth of passenger demand from 9.2 million in 2010, to 19.5 million in 2025, the apron should be extended. Otherwise, with current peak capacity of 53 movements per hour, only 15.9 million passengers could be handled (Landtag von Baden-Württemberg, 2011).

Some stylised facts about German airport expansion

Case studies show that, with the exception of Berlin and Munich, most locations of major airports have been chosen before the Second World War, very often under non democratic regimes (see table 4.2 below). At that time the economic potential and environmental impact of air transport was not, and could not have been, foreseen. Given the changes in technology and demand, the public airports reacted in the fifties and sixties with an extension of their runways. With the growth of cities, conflicts emerged. Space was needed for housing and the noise around airports increased with stepwise extensions, the growing number of movements and the increased racket of the first jet generation.

These conflicts accelerated at all airports from the seventies onwards, and even caused violent protest in the eighties, leading to long planning processes with court decisions and demonstrations. Length is an indicator of how complicated the processes are, and how difficult it is to gain acceptance and democratic decisions on major airport extensions. Consensus was not achieved, as some groups remain opposed to extensions.

Mediation as part of the public planning and approval process was practiced at two out of the six extensions. While it was of limited use in Berlin, it played a major role in Frankfurt. Mediation reflects also the uneasiness with the traditional planning process. The total length from planning to building is also an indicator of the complexity which easily might lead to additional costs, as with the new BBI airport.

While capacity could not be increased as fast and as much as airport management initially planned, it has nevertheless increased at all busy airports. Peak capacity has increased since 1992 at all airports in the range, from 20 to 80 per cent. Conflicts will remain in the future, but at different degrees: the situation in Frankfurt and Stuttgart is more intense than in Hamburg.

Table 4.2 **Airport Expansion in Germany**

Airport	Berlin Brandenburg	Düsseldorf	Hamburg	Frankfurt	Munich	Stuttgart
Locational choice/opening	1996/ no official date given, but expectations not before 2015	1914/1927	1911	1934/1936	1969/1992	1936/1939
Runway extensions and changes (year and metres)	N.A	In 1952 up to 2 475 m, in 1969 up to 3 000m.	Stepwise in 1935, 1950, 1955, 1956, 1961, 1964 of crossed runways to 3 250m and 3 666 plus extension of apron.	In 1957 north runway up to 3 300 m and in 1 959 up to 3 900 m. South runway 1960 up to 3 000 m	NA	1951 up to 1800 m, 1961 to 2250, in 1996 to 3345m
New Runway	Two runways 3 600 m and 4 000 m	Second parallel runway in 1993	No	Runway west in 1984 Fourth runway in 2011	Third runway for peak capacity of 120 slots voted down in 2012	Promise to build no new way up to 2016 to 2020.
Length of public planning and construction for capacity extensions	At least 19 years	24 years for second runway	3 years for apron extension	22 years for runway West 10 years for fourth runway	13 years	NA
Mediation	Yes	No	No	Yes	No	No
Increase in peak capacity Movements per hour	NA	From 34 in1983 to 43	From 42 in 1992 to 51	From 55 in 1975 via 82 to 90 to stepwise 120	From 68 in 1992 to 90	From 24 in 1972 to 42
Increase from 1992 to 2012	NA	34 to 43 = 26,5 %	42 to 51 = 21,4 %	66 to 91 = 37,8 %	68 to 90 = 32,3 %	24 to 42 = 81,8 %

4. Key problems of airport investment

In this section, I draw together problems of airport investment from different strands of economics and politics. This is not an exhaustive overview and important insights might be left out. Nevertheless I hope that it serves the purpose of offering some guidance to understand the complexities of airport investment.

Transaction cost perspective

Williamson (1985) and others have developed the New Institutional Economics[4] and Wolf (2003) and others[5] have applied it to airports. In this view, major airports are long term relationship specific investments with externalities and with imperfect information. Such good characteristics create problems for pure market solutions as in the real world of densely populated areas no complete contracts can be drawn among the stakeholders. Hold-up problems and opportunistic behaviour easily rise to such a scale that the transaction costs are probably prohibitive for private provision. This also means that no first best solution is possible and policy makers have to choose between feasible second and third best solutions in order to minimise transaction costs. Public planning is necessary. It is part of the solution and it is as well part of the problem in case public planning does not minimise transaction costs and opportunistic behaviour leads to hold up problems and under investment:

- Private and also public airport owners have invested in a relationship specific asset with its users. This relationship is subject to opportunistic behaviour if airlines do not keep their promises, if for example, the state implements stricter and perhaps prohibiting environmentally rules or passes laws preventing market access through restrictive bilateral air service agreements.
- Large hub-and-spoke airlines have erected a base or even a hub which they cannot easily redeploy. They are subject to opportunistic behaviour if for example a stricter night curve few is imposed or other restrictions are increased. However, this does not refer to the new generation of LCC which can easily shift aircraft from one base to another, all of Europe.
- Neighbours might have invested in houses and have built up a neighbourhood with friends which they cannot build up easily at other places. They might be subject to opportunistic behaviour if promises by airport managers and politicians to prevent capacity extensions are not kept.
- Industry has based its locational decisions on the development of an airport. They may find it difficult to switch and might be locked in.
- Airport politics is also open to opportunistic behaviour. The long term nature of airport planning and organisation is in conflict with the limited time period politicians are elected. Governments cannot easily bind future governments to keep promises.

Expansion of airport in densely populated areas creates external costs and benefits. These costs and benefits are unevenly distributed in space which in turn might lead to high transaction costs and even to complete blockages of airport enlargements. The negative effects of a new airport or an expansion are generally confined to the neighbourhood of the airport. This is in particular noise and in some cases other emissions. The neighbours have to bear these costs and have typically only benefits which do not outweigh these costs. The avoidance of noise is a public good and might also lead to free riding (Bickenbach et al. 2005 and 2007, Richman and Boerner, 2007).

The positive effects in from of better connectivity and additional production and income are distributed in the wider region of the airport. For a project with a positive benefit cost ratio the benefits outweigh the costs largely born by the neighbourhood. Neighbours might find generally an airport a good thing, but oppose the project which makes them worse off. Their reaction can be described as NIMBY (*Not In My Backyard*) and airports are typical NIMBY goods. Furthermore, airports might lead to a complete negative reaction of the neighbourhood and other parts of the population. This is called BANANA*: Build Absolutely Nothing Anywhere Near Anything/Anybody* These rational reactions have to be addressed in the public planning process and the institutional settings which have to be designed in such a way to minimise transaction costs. Such institutional contracts have to decide besides the scale and time of expansion and what conditions and restrictions the new capacity is utilised and how the capacity has to be adjusted for technical and economic developments. In particular the contract has to define who is paying what in order to compensate negatively affected neighbours (Bickenbach et al. 2005 and 2007)[6].

Airport economics and regulation

Pricing and investment of airports have been intensively studied by economists. From this literature[7] it emerges that airport investment faces some serious problems compared to a normal industry, in which through the Marshallian adjustment process capacity is increased through investment and market entry until the optimal long term equilibrium is reached. Such a process is guided through short run marginal cost pricing and market clearing price mechanism. Compared to such a well behaved dynamic process the dynamics of the airports do work very differently:

- The EU Slot distribution system leads to scarcity rents for airlines and the slot is not given to the airline with the highest willing to pay (Starkie, 1998).
- Slots and also regulation break the mechanism of short run marginal cost pricing and investment. Prices do not signal to invest at what time and on which scale (Niemeier, 2004).
- The investment decision might be dominated by strategic behaviour. Airport and airlines might collude not to expand and share the scarcity rent (Forsyth and Niemeier, 2012).
- Cost based regulation which dominates in Germany leads to an inefficient choice of inputs resulting in the Averch Johnson effect, gold plating and cost padding and an inefficient price structure resulting in a lack of peak and congestion pricing. Both might lead to costly excessive airport capacity which is badly management (Niemeier, 2004)
- Price cap Regulation only practised at Hamburg and temporarily in some from at other German airports might lead to hold up problems and underinvestment. The regulator must creditable signal that it will not behave opportunistically (Helm, 2009).
- The lack of independent regulators sets incentives for regulatory capture. Airports might erect barriers to entry by planning restrictions to prevent the opening of a competing airport (Niemeier, 2009).

Mega project cost economics

Flyberg et al. (2003) and others[8] have analysed the economics of mega projects. Mega projects are loosely defined as projects which cost at least a hundred million dollar and have the following characteristics that they are long term risky capital intensive projects, technology is new or has to be adapted, stakeholders are locked in at an early stage, the scope of the project changes and risk is neglected (Flyberg 2009, p 345). These factors cause a) “misinformation about costs, benefits and risks is the norm throughout project development and decision-making” (ibid) and b) “cost overrun and/or benefit shortfalls” (ibid.). Despite these problems mega projects are increasingly planned and implemented. This phenomena is called the “megaproject paradox” by Flyberg et al. (2003, p 137).

Flyberg et al. (2003) show that the distorted estimates of cost and benefits “make projects look good in cost-benefit analysis and environmental assessments” (p. 138) which leads then to the “survival of the unfittest” a term coined by Flyberg (2009). Furthermore, demand forecasts were far too optimistic (by more than +- 20%). This holds for a period of 30 years and shows that improvements in forecasting have not been implemented in practice. Flyberg (2009) shows further that these forecast errors are not caused by lack of technical expertise like data problems, limit knowledge of future events and low quality of models. Optimism bias[9] also cannot explain the systematic forecasting errors, but "political-economic explanations and strategic misrepresentations" (Flyberg, 2009, p. 351). In short, "lying pays off" because the governance does not make the project promoters accountable. This is due to the fact that "(i) public-sector accountability through transparency and public control; and (ii) private-sector accountability via competition and the market competition" (ibid. 359) do not work effectively. Regarding the first factor Flyberg et al. (2003) show that no trade-off between democracy and efficiency exist. Instead they recommend more and effective democratic control. Local grants from the federal government should not be project related. CBA and forecasts should be made by independent organisations and be peer reviewed and lying should be prosecuted by criminal law. Regarding the second way Flybert et. al. (2003) recommend an explicitly formulated "regulatory regime and the involvement of risk capital" of more than a third of the total capital costs.

It should be noted that the economics of mega projects rest on large data base including many rail and road projects, but only a few airports. These projects are subject to CBA which is not necessarily the case with airports (see below). Flyberg et. al. (2003) point out that in projects with CBA also economic impact analysis plays an important role. Major projects are supposed to bring the wider benefits of jobs and growth to regions and even the whole economy. Flyberg et al. (2003) show that these claims "are not well founded, the main reason being that in modern economies, transport costs constitute a marginal part of the final pricing of most goods and services" (p. 72).

5. Assessment of decisions on capacity expansion of airports

Decisions on investments in additional capacity have been assessed by public planning and in recent years also by mediation. In this section, I discuss firstly the rationality of both decision processes. Thereafter I discuss how benefits and costs which are created by the investment are assessed in this institutional setting.

Public Planning

All airport expansion have to go a public planning process which consists of regional planning (Raumordnungsverfahren), an approval in terms of air law and a public approval process (Planfeststellungsverfahren) (Zaß, 2008)[10]. The regional planning process evaluates different locations and recommends a location. The recommendation is not binding. This part of the public planning process is an internal planning process of the administration. Citizens cannot directly participate but through their elected representatives in municipalities. The air law approval evaluates also under public interest considerations including noise and safety and security. This part of the process is done by the administration of Land in which the airport is located and in cooperation with the federal state. The public approval process evaluates in detail the planned airport expansion in terms of public interest which includes environmental effects and also negative effects on neighbours. The public approval authority is a body of the Länder. The body is usually part of the Ministry of Economic Affairs and given a quasi-independent status as the minister cannot directly intervene. The approval process is public and all stakeholders are invited to public hearings. Very often the permission is given with conditions and restrictions the airport has to meet in building and operating the added capacity. The planning approval can be challenged in the court which has happened with all airport extensions.

Bickenbach et al. (2005) have evaluated the German planning process and have raised in particular the following criticism:

1. *Lack of full compensation*. The planning process limits itself to active and passive noise measures, but does compensate those directly negatively affected. Therefore it is rational for neighbours to take all legal and political action to get compensation (ibid. 56).
2. *Lack of independent planning authority*. The quasi-independency is not accepted by citizens in the planning process. They see the planning authority as a party[11] and fear that the facts and arguments are not objectively assessed. They fear that the narrow economics interests of the airport managers and owners influences the decision. The public and partial privatised from of airport ownership conflicts with regulator function in planning processes. This leads all parties overestimate the effects in order to get public opinion on their side in order to influence politics (ibid. 57).
3. *Lack of long term commitment*. The planning process is limited to the specific capacity enhancing project. Promises to add no further capacity lack credibility. This leads to longer and very often emotional discussions (ibid.).

Together with other factors the weaknesses of the planning process lead to avoidable polarizing and to policy gaming so that transaction costs increase substantially and might lead to blockage of welfare enhancing investments.

Mediation

As the planning process with the legal conflicts seem to have some weaknesses politicians have added mediation (Gohl and Meister, 2012). The mediator can certainly be more independent than the quasi-independent planning authority, but the mediation results are not legally binding and cannot compensate the lack of long term commitment (Bickenbach et al., 2005, p.82. This also leads to strategic behaviour of the parties as they might either not chose to participate at all like several local citizen action groups in Frankfurt or they might participate only to such a degree that their legal position will not be negatively affected (ibid and Gohl and Meister, 2012, p 84).

The quality of mediation can be diverse. Mediation in Berlin could hardly be called as a serious discourse with citizens and stakeholders. The discussions did not play any role in the locational choice. Location was chosen by the federal minister following the advice of the investment bank for privatisation of BBI (Bickenbach et al., 2005, p. 73). Compared to Berlin mediation in Frankfurt was better designed, but still has serious flaws (see below). According to Thießen (2000) relevant questions such as external effects were completely left out, time was artificially limited and independent reports for example on the reaction of hub decision by airlines were conducted on behalf of stakeholders.

The role of CBA and the role of Impact Analysis

The rationality of the planning process and the mediation process depends crucially how the investment is evaluated. The peculiar method of assessment becomes obvious in the well documented mediation process for Frankfurt airport (Forum Flughafen und Region, 2013). The objective of mediation was to find out "*under which circumstances Frankfurt Airport can help to keep up permanently and enhance the competitiveness of the Rhine-main region with respect to employment and economic* *structure, without neglecting the ecological costs imposed on the region"* (quoted from Hujer and Kokot, 2001, p. 112).

On behalf of the three mediators and the supporting mediation group, studies about the economic, ecological, and social consequences were conducted[12]. Five scenarios were defined, ranging from the status quo, a reduction of aircraft movements to a full-scale expansion. The results of the Input-Output study (Bulwien et al.,1999) were crucial for the final recommendation. The result is, while currently 142 000 jobs directly or indirectly depend on the airport in the State of Hessen, a full-scale expansion would create another 57 000 jobs. For each of the scenarios an input-output model was used to quantify the results. Then the mediation group weighed the different scenarios and came to the conclusion to recommend the full-scale expansion, because of the economic importance of the project for the region, i.e. because of the 57 000 new jobs. Due to the overwhelming economic effects the citizens have to accept the ecological costs.

The mediation group obviously followed the "logic of jobs versus the environment" and decided pro jobs and in favour of a stricter night curfew and better active and passive noise protection.

The mediation logic of jobs versus environment is not conclusive and indeed misleading:

1. Assume that there are two airport projects with the same amount of passengers and freight, but with differences in labour productivity, wages, efficiency, investment costs, and geographical distribution of suppliers. Ceteris paribus, the project with lower productivity and lower wages will be selected because more labour is necessary in the production of the direct and the indirect product. In addition, as workers with lower wages tend to have a higher marginal propensity to consume, the induced effects would be higher as well. If the decision were between a new 'gold plated' traditional terminal and cost efficient innovative terminal, IO-analysis would favour the first one because the direct and indirect effects are ceteris paribus higher as the production needs more resources. If the first project uses only locally produced goods, while the latter uses all the resources of a globalised world economy, IO -analysis would produce greater indirect effects for the first. Obviously, taking IO-analysis as guidance leads to unproductive and inefficient airports.
2. The induced effects are roughly a third of the total effects for the German economy and a fifth of the total effects for the economy of Hessen in each scenario. The induced effect will only occur if excess capacity as well as resources are available for multiplier effects to come into effect. Furthermore, the induced effects are independent of the decision to extend Frankfurt airport. They would also occur if passenger demand which could not be serviced at Frankfurt airport shifts to other airports or a similar amount of income is spend on other projects.

In short, airports might be expanded because job figures which only exist in models not designed to evaluate investment decisions and might create an infrastructure of the "unfittest" that is with negative cost benefit ratios and with long-term ecological damaging effects. As decisions on airport extensions which inevitably will include environmental externalities would be better based on a CBA which needs to made subject to an open ex-ante and ex-post evaluation. The danger is that this will not happen with future investment projects into airports as airports managers and owners have adopted the logic of "jobs versus environment" and mislead the public discourse (see Box 4.1). Such logic might backfire because there is growing evidence that local citizen action groups do not belief in these figures anymore and will find out that they have been intentionally mislead. This will not improve an already highly political question.

Box 4.1 **On the Abuse of Impact Analysis for Airports**[13]

> "Public airports must *compete* for funds with other governmental activities. They are scrutinised during budget preparation and may be subject of public debate, particularly if major improvements or *new constructions* are anticipated. They may *even be the target* of proposed restrictions aimed at *limiting aircraft noise levels*. ... It is important that the public and their representatives appreciate the economic significance of airport if they are to continue to support them. This report is designed to assist analysis of the economic importance of airports. It is *not intended* for use in financial feasibility studies or *cost/benefit analysis*,"

writes the US-DOT in its guidelines for the use of Impact study developed in 1986 and updated in 1992 (USDOT, 2002, p. 1, italics added).

This quotation clearly indicates that:

1. IO-analysis is used for the purpose of supporting airport extensions and for overcoming environmental restrictions in public debate.
2. The authority is aware that these purposes belong to the question how to allocate scarce resources.
3. Instead of guiding the public discourse by a cost benefit analysis, the authority intentionally recommends IO-analysis to analyse problems of efficient allocation including the internalisation of externalities.

AACI-Europe developed similar guidelines for their members in 1992 and published further material in 1998 (York Consulting, 1998). This lead to a widespread use of impact studies with a clear strategy: The US-DOT, AACI-Europe and many of its members such as Frankfurt Airport all used IO-Analysis intentionally to discuss publicly the pro and cons airport extensions and environmental measures in a framework, which is logically not suited for this purpose and which misleads the general public.

6. Strengths and weaknesses of the German decision process

In this section I discuss further weaknesses and strengths of the institutional setting in Germany. The list is not complete, but is hopefully provides a comprehensive overview. The points raised are of different nature – some are technical and others are more political. I start with the strength and continue with a rather long list of weaknesses.

Strengths

The strengths of the German decision process becomes obvious in the light of popular claims that the approval decision takes too long and should be as short as in China in order to enhance investment to stay competitive in global competition. So far less have this quite influential view has not changed the democratic nature the planning process. The democratic legitimation is one of the basic assets of the planning process. Furthermore, it addresses the key problem of such investments, namely the conflict of interest and with approval decision controlled by the court it gives all stakeholders the necessary planning security to invest in long-term relation specific objects (Bickenbach et al. 2005). Nevertheless, the planning process as such and the actual practice has a number of shortcomings.

Weaknesses

In addition to the weaknesses discussed in chapter 3, I will point out further problems, namely doubtful demand forecasts, airport investment and airport competition, pricing of externalities, public acceptance and the question of too many hubs.

Doubtful Demand Forecasts

The quality of forecasts is central for the assessments of benefits and costs of an airport expansion. The economics of mega projects show that there is a tendency to be too optimistic. This raises the question whether this might be also the case for airports.

The quality of demand forecasts for airport investment is difficult to assess and opens up an interesting topic for future research. By its nature the forecasts are long term of 10 to 20 years. This sometimes leads to the view that such forecasts are not possible or useless because of the time length. However, this view overlooks that short term forecasts might be even more difficult than long term forecasts (Tichy, 1994). The exchange rate of the Euro to the US Dollar on 4 May 2013 is certainly harder to predict than the population of Europe in 2015. Another example is the recent economic crisis in 2007, an event which some economists even think of being impossible to predict. A simple comparison of the forecasts with the results does not say much as forecasting assumes certain factors like population and GDP growth, intensity of competition to be constant or of a certain magnitude and value. But these factors might unexpectedly change over time leading, for example, to the result that a forecast predicts exactly the number of passengers because other factors have caused the result and not those of the model. What the planning processes lack is a vigorous ex-ante and ex-post evaluation of forecasts. I will show below how misleading the forecast for the public planning approval for Hamburg was and that it was driven by an ideology of forecasting as much as possible and a narrow view on economics benefits ignoring environmental aspects of welfare (see box 4.2).

Very often this is less and more difficult to detect. There is some evidence that the forecasts for other airports are also of low quality (Thießen, 2000). The ex-ante evaluation is certainly difficult and should be done by a peer review process of independent scientific experts as Flyberg suggests. The complete model and the results should be open for the public. The ex-post evaluation should also be done by scientific experts. But the long term nature causes the specific problem that forecaster might rationally not care to deliver wrong and even intentionally misleading forecasts as it takes a long time to falsify results.

Box 4.2 **Case study on demand forecasting for Hamburg airport**[14]

Hamburg airport seeks permission, through a process of public inquiry, for expanding the apron in 1996 (Flughafen Hamburg GmbH, 1996). This was based on a forecast of passenger demand and movements. In parallel the Ministry of Economic Affairs of Hamburg had commissioned a forecast by MKmetric (Mandel, 1997). In the Ministry both forecasts were compared. Both forecasts expect similarly strong growth of passenger demand in a range between 13 (MKmetric) to 13.85 million passengers (Hamburg airport) in 2010, but the forecasts largely diverge on the commercial movements. Hamburg airport forecasts 195 000 commercial movements in 2010, while MKmetric forecasts 155 000 and 172 000 at maximum.

Also the methods are different. Hamburg airport extrapolates a trend of commercial movements independently from the passenger forecasts while MKmetric derives the number of commercial movements from passenger demand. Given the supply of aircraft orders and the tendency towards rising load factors at the point of forecasting in 1995/6, MKmetric forecasts a relationship of 77 to 86 passengers per commercial movement in the year 2010, while Hamburg airport's method resulted in a marginal rise from 68 to 71 passengers per commercial movement.

Given the orders of aircrafts the latter could have had only happen if the airlines reversed their former decisions and order smaller aircraft and/or reversed their policy of increasing load factors. Neither explanation was realistic at that time when liberalisation lead to a strong growth of leisure traffic. The high numbers of movements showed the inconsistency between the number of movements and the passengers and thereby the inconsistency of the forecast.

Viewed from today, the forecast of MKmetric is more in line with actual figures of 2010 (12 962 917 million passengers and 137 290 commercial movements), but as argued above many of the given factors developed differently as for example economic growth and the rise of Low Cost Carrier with its intense competition.

The airport management insisted on the validity of its forecast and based the airport expansion on this over-optimistic forecast. It seemed to follow the logic of predicting and demanding as much growth as possible with the hope that politics will follow the expertise of the airport neglecting environmental concerns and provide permission for the expansion.

Furthermore, this strategy increased the risk of losing the acceptance of the airport in the adjacent neighbourhoods. Noise emissions, based on the movement forecast of the airport, were rising dramatically. The policy in Hamburg reacted by accepting the forecast of MKmetric and implemented a noise budget (see below).

Airport expansion and airport competition

The conflict between airport expansion and airport competition can be illustrated at best with the case of the new Berlin airport. The old airport system consisted of three airports Tegel, Schönefeld, and Tempelhof. Together they offered as much capacity as the new BBI airport:

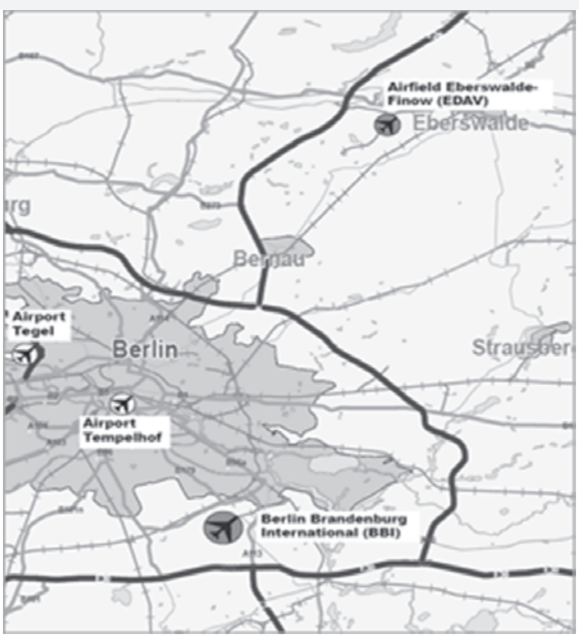
- Tegel airport currently serves 18 million passengers, is slot coordinated and has peak problems.
- Schönefeld is a non-busy airport and can handle more than the current 7 million passengers.
- Tempelhof could handle up to 5 Mio. It had 4.7 M in 1973 and 1 mill in the nineties where it was used by regional jets.

In total, the old airport system probably was designed at least for more than 30 million passengers. The new airport has been planned for 27 million and there are talks to increase capacity further. This shows how expensive the new airport is. An investment of initially 2.83 billion Euro, which increased to 5 billion Euro, did not add any new capacities and offered less differentiated quality for airlines (Tegel for traditional scheduled airlines, Schönefeld for charter and low cost carrier, Tempelhof for high yield business). But the old system had an important disadvantage. Tegel is an inner-city airport with noise problems. These externalities might tip the benefits and cost in the direction of a new airport in

Schönefeld. But such a cost benefit study have never been performed, because the decision for the new BBI airport was decided by the minster for transport based on a study of the investment bank to privatise the new BBI airport. Privatisation did not happened later on, but it is clear that the rent seeking of private owners goes into the direction of creating an airport monopoly. The same is true for the new BBI airport under public ownership. Also, the public owners try to monopolise the market. BBI has less competition than what could have been achieved. This is obvious and gained much publicity with the closure of Tempelhof. Competition, however, from Tempelhof would have been limited to quality competition. What is less obvious and has not been openly discussed in German politics is that the planning process has erected legal barrier for the entry of a low cost carrier airport with ample capacity in Eberswalde-Finnow. This airport has tried to get permission to operate since the mid-nineties. It has neither got it under the regime of privatisation nor under the regime of public ownership (see box 4.3). The lack of independent planning authorities encourages rent seeking, erects legal barriers of entry, lessens airport competition and leads to expensive and excessive airport infrastructure.

Box 4.3 **Airport competition in the larger Berlin region**

Figure 4. **Map of Berlin Airports**



Eberswalde-Finnow airport is an airport 55 km south east of Berlin (see Fig 4). It has a runway of 2520 metre length and could technically serve flights of Boeing 737-800. However it is permitted only for flights with a maximum take-off weight of 14 tons. The EU funded project has studied the "potential future role of Eberswalde-Finow airfield/airport against background of upcoming structural changes" (Levsen, 2007, slide 2) and concluded that the airport "will be the only suitable airport location for the business model of True Low Cost Carriers (TLCs) in Berlin and Brandenburg in 2011" (ibid. slide 4).

The airport company has taken the Land Brandenburg to court. A final decision will be expected within a few years (Döll, 2009).

Airport expansion and environmental policy

As noise and other emissions are key obstacles for the expansion of airports and are prolonging the planning process and lead to tedious court cases, one might expect that German airports with their mixed private and public owners have carefully assessed the benefits and costs in order to design an efficient environmental policy along the lines of Gillen (2000). However, that has generally not happened over the last decades. No doubt, environmental management has improved (Schmidt, 2000) but there is still a tendency towards more or less effective command and control measures combined with ineffective (hardly inefficient) market based instruments[15]:

- *Goal setting and noise budgets*. Economist would prefer to minimise noise by balancing the marginal benefits and marginal costs. However, this approach has hardly been possible in the period of German airport expansion. Fichert (1999) doubts that in the nineties a marginal benefit function of noise reduction could have been estimated at a particular airport. To my knowledge, it has generally not happened with the exception of a recent study on Schiphol Airport [16]. Lijesen et al. (2010) recommend lessening noise by 3 dB to reach the optimal level of noise reduction. Given this lack of knowledge, environmental quantitative goals for airports are usually not set by politics and very often politics tries to avoid this although it increases the risks for all stakeholders of airports. Even with a willingness to set such quantitative goals, it is difficult to achieve compromises given the limits of knowledge of the future (see box 4.4). Nevertheless, noise budgets should be the preferred policy option for airport and in turn the lack of effective noise budgets combined with permits (Brechet and Picard, 2010) is a sign of the risks for future airport expansions and the lack of efficient environmental policy.
- *Noise protection programmes.* According to ADV (2012), German airports have invested more than 500 Mill Euro in noise protection programs over the last decades. This is, at first sight, an impressive figure, but with about three billion passengers it boils down to less than 20 cents per passenger. During the second phase of airport expansion from 1975 onwards to 1995 the airports had to pay 257 mill German Marks for legally binding noise protection. In addition, they paid voluntarily almost the double sum, namely 408 mill German Marks, which is in total about 30 Pfennig or 15 Euro cents per passenger (Fichert, 1999, p 173). This was due to the fact that a reform of the noise protection law was blocked by the military and airports had to implement voluntarily more effective programs in order to gain public support. The reform of the initial law of 1971 was achieved in 2007, but it has been heavily criticised by environmental groups. ADV (2012) claims that it will have to spend another 400 to 600 million Euro which again easily boils down with 200 million passengers within a few years to less than one Euro per passenger. A full assessment of noise protection programs would analyse the benefits and costs which is beyond the scope of the paper. According to the German Advisory Council on the Environment (2008) the thresholds for noise protection norms have been improved, but no legal binding exposure thresholds (emission limits) have been defined.
- *Night curfew.* The setting of night curfews has always been critical and sensitive issue. This is the case with Frankfurt as well with other airports. Local citizen's initiatives demand a nationwide strict night curfew from 10 pm to 6 am. In Brandenburg they collected 20 000 more signatures than the threshold of 80 000 signatures for a petition, while in Berlin they failed. Matthias Platzeck, the minister president of Brandenburg, promised to support this initiative although this conflicts with his role as a chairman of the board of BBI.

Table 4.3 **Night curfews at German airports**

Airport	Berlin Brandenburg	Düsseldorf	Hamburg	Frankfurt	Munich	Stuttgart
Night curfew hrs	23:00 to 5:00	24 to 6:00	24–6 pm	23:00–5:00	24:00–5.00 Noise and movement budget	24.00 – 6:00.
Restrictions for louder aircrafts	NA	23:00–06:00 bonus class,	23:00–24 delayed Chapter 3 aircrafts		Bonus aircrafts 22–24; 5- 6	23:30–24:00 delayed Chap. 3
Noise surcharge	NA	Yes	Yes	Yes	Yes	Yes
Demand of local initiatives	22:00–06:00	22:00–7:00	22:00–.00	22:00–6.00	22:00–6.00	22:00–7:00

Source: Boeing data base, Website of local initiatives

There are several problems with the politics and economics of night curfews:

- Nationwide night curfews are inefficient as the local noise externalities and the danger of health risk differ from airport to airport.
- The night curfews for the core time are not flexible and are only efficient if a certain number of movements with the least noisy aircrafts leads to health risks.
- A noise budget would be more appropriate than a night ban. Such a night budget should be efficient or set at a politically acceptable level. Munich Airport has noise budget at night. It has not been utilised up to now. Frankfurt Airport had a noise budget from 2001 to 2009, but no airlines have been penalised.
- The evening and morning time times are subject to restrictions and noise surcharges. The categorisation in ICAO chapters has proven to be unacceptable and biased by industry interests. The bonus class has similar problems though to a lesser extent. Therefore, it is reasonable to differentiate noise by classes defined by each airport and make this the basis for time related noise surcharges. Fraport noise surcharges rise for an A 318 from 37,70 Euro to 90,50 € for the time from 22 to 23 and 5 to 6 (B 747-2002 from 1.450 to 4.400 Euro). The effects have not been assessed. The alternatively instrument to noise surcharges has not been tested.

In summary, it remains to be seen whether German airports will implement a politically acceptable noise budget for the time from 10 pm to 6 am which puts an effective price tag on these flights and leads to measurable substitution effects.

- *Ineffective noise surcharges.* Noise charges are a cost efficient way to reduce noise to an optimal level or to the level set by politics. They have been slowly implemented in the eighties and nineties. There were several problems with these charges (Niemeier 1998 and 2009, Fichert, 2009). First of all, the differentiation was based on a classification by ICAO. These categories were criticised as too broad and biased towards specific interests of air craft producer. Second the charges should not be based on weight but just on noise. Third, the effectiveness on reducing noise by substitution processes was doubted. Around 2000 Frankfurt

Airport and Hamburg Airport reformed and implemented their charges based on noise differentiated in five classes. Their effectiveness has not been carefully assessed. Evangelinos et al (2013) found no short term substitution effects for the airport of Zurich which has one of the strongest differentiated charges in Europe. Fichert (2012, p 5)[17] also doubts the effectiveness as "the share of the noise surcharge within the total airport charges is rather small, in most cases significantly below 10%." The problem with unilateral noise surcharges is that there is an externality which leads to free riding. This might be partly circumvented if a country sets the noise surcharge, but even then other countries might free ride. Another problem is that noise charges are set in a political process. The outcome might not so much be determined by welfare considerations, but reflect a political equilibrium determined by the political powers of the stakeholders (Evangelinos et al, 2013).

Box 4.4 **Noise budget of Hamburg Airport**

In the eighties, passenger growth lead a significant rise of noise level measured in the area of an equivalent noise measure. This trend was reserved in the nineties. 50 per cent passenger growth was combined with a 50 per cent reduction in noise due to the fact that the share of Chapter 2 aircraft in total jet movements decreased from 60 % to 10 %. A crucial question in 1997 for the acceptance of Hamburg Airport by the local community was whether the strong expected growth from 9.2 million to 13 million with 50.000 more aircraft movements will eventually increase noise levels again? These questions were debated at election time when the airport was going through a mandatory planning process to obtain permission from the local community to increase apron and terminal capacities.

In the political discussion some parties demanded a freeze on movements at current level in its election program. But such a measure might be inefficient compared to a noise budget combined with effective charges or permits (see table 4.4).

Table 4.4 **Noise budget versus movement restrictions**

	Noise Budget	Movement Restrictions
Advantage	▪ incentives for ➢ less noisy aircraft ➢ higher load factors ▪ planning security	▪ Incentives for ➢ larger aircraft ➢ higher load factors
Disadvantage	▪ minimal operational disadvantages	▪ no incentives for less noisy aircraft ▪ increase of noise ▪ unnecessary economic loss

Movement restrictions have the advantage that airlines would have to use larger aircraft and utilise the seats effectively, but there are several disadvantages. There are no incentives to use modern, less noisy, aircraft, nor is there any incentive to utilise noise reduction potentials. In a situation with high excess demand and high noise differences of aircraft fleets movement, restrictions might even lead to an increase in overall noise levels.

A noise budget has a number of advantages. First, there are incentives to use larger aircraft combined with higher load factors. Secondly, it has the advantage of promoting the use of less noisy aircraft at minimal operational cost for airlines. Overall, these advantages were seen decisive and from the year 1999 onward the noise level at Hamburg has not been allowed to exceed the level of 1997. This noise budget has improved the acceptance by the neighbours and by politics in general. Local initiatives have positively reacted to the noise budget. According to Hoffmann (2011), Hamburg Airport has substantially improved its acceptance which is also due to better communication.

As of today it has become obvious that setting a noise budget is complicated. It is not enough to fix the noise level for a certain period of time. The several crises of the last ten years lead to a different growth than expected (see above). Movements and also noise are below the expected level. It seems therefore, appropriate to reduce the noise level and combine it with a noise budget for night times.

Single or multi hub strategy

In the mediation process for the extension of Frankfurt airport the question was raised whether a dual hub operation is possible and how the competitive position against the hubs of London, Amsterdam and Paris might be affected. Unlike other questions no vigorous study was conducted and the issue was discussed only qualitatively in the expert meeting. Nevertheless, the mediation group reached the conclusion that shifting of traffic to other hubs like Munich will reduce the efficiency to such a degree that the competitive position of Frankfurt would be endangered (Mediationsgruppe Flughafen Frankfurt/ Main, 2010, p 22).

While this claim is rather bold, one has to admit that empirics of multi versus single hubs are not well researched (see Wojahn, 2001). As long as there is free capacity, a single hub strategy is preferable as a doubling of destinations multiplies the transfer destination by four. At what stage the network economies run out and diseconomies set in has not been studied to my knowledge. Since the decision of the Mediation group in 2000 Lufthansa and other European alliances have adopted a multi-hub strategy. This might be due to the fact that hubs might face capacity restraints with delays which propagate faster in a single hub system. Airlines might also want to increase their bargaining power. After the expansion of Frankfurt, Lufthansa has now four hubs with ample capacity and it remains to be seen how intense hub competition will be[18].

7. Summary and concluding recommendations

This paper analysed how German airports have extended capacity. The process has the following characteristics:

- German airports expanded capacity to the demands of passengers and shippers and to the requirements of new (jet) aircrafts after the second wold war.
- Conflicts over the use of land have emerged firstly in the Sixties, accelerated in the Eighties and are expected to remain in the future, particularly in Frankfurt, Berlin, Munich and Stuttgart. These conflicts have led to long planning processes (including mediation), demonstrations and court decisions but remained unresolved for many stakeholders.
- German airports have been utilised differently. Capacity has become scarce only at a few airports. Existing capacity has not been allocated efficiently due to a lack of pricing. There is evidence for excessive investment in intercontinental capacity and in regional airports.
- While capacity has not been increased as fast as initially planned, it has been increased substantially at all busy airports, sometimes at high costs, like in Frankfurt with the removal of a chemical plant and in Berlin with cost overruns of more than two billion.

Expanding airport capacity, Germany has faced problems which are deeply rooted in the nature of the industry.

- Airports are long term relationship specific investments plagued with hold up problems, opportunism, externalities and imperfect information. Costs and benefits are unevenly distributed in space and lead to NIMBY reactions in the direct neighbourhood of airports.
- German airports have expanded their capacity under a regime of cost based regulation and slot coordination. Regulation and slots break the link between scarcity and pricing so that prices lose their signalling function for investment. Cost based regulation sets incentives for inefficient pricing and for excessive and too costly investment. The lack of independent regulation might easily lead to regulatory capture and rent seeking.
- Airport investments might turn into mega projects with benefit shortfalls and/or cost overruns. The failure of mega project is due to a lack in public or private sector accountability. Public control and transparency are not implemented or competition does not work effectively. Cost Benefit Analysis and forecasts should be made by independent organisations and be peer reviewed. Private risk capital should be involved in the project.

Airport investments have been subject to the approval by public planning and in some cases to mediation. Public planning has its strengths and weaknesses:

- The planning process is democratically legitimatised. It addresses the conflict of interest. The approval decisions are controlled by the courts. It provides stakeholders with planning security to invest in long term relation specific objects.
- The planning process lacks:
    - full compensation for those directly negatively affected. It therefore encourages neighbours to take all legal and political action to get compensation.
    - an independent planning authority. The quasi-independency is not accepted by citizens in the planning process.
    - long term commitment. As the planning process is limited to the specific capacity enhancing project, promises to add no further capacity lack credibility.
- Mediation can compensate partly the lack of independency of the planning institution. Its recommendations are not legally binding. The quality of mediation was poor in the case of Berlin Brandenburg airport and better though not of sufficient quality in Frankfurt.
- Investment decisions are not assessed by Cost Benefit Analysis, but by Impact Analysis. The direct and indirect effects of impact analysis are greater the more costly and unproductive an airport is and the induced effect is independent of the investment object. Hereby, impact Analysis creates the wrong image that jobs can only be created if noise and environmental burdens are accepted. Impact Analysis has been misused by airports to legitimise investment and to delude the public.
- The planning process of airports lack a vigorous ex-ante and ex-post evaluation of forecasts.
- The planning process of airport expansion might reduce airport competition as the lack of independent planning authorities encourages rent seeking to erect legal barriers of entry.
- The negative external effects of airport expansion are not efficiently addressed by the planning process and by the environmental policy.

  - Efficient or acceptable noise budgets are not implemented at German airports.
  - Noise protection programs have been implemented in most cases on a voluntary basis. The German law for noise protection has been reformed after 36 years of debate with improved thresholds for noise protection norms, but with no legal binding exposure thresholds.
  - There is a growing tendency to strengthen night bans. Noise budgets set at an efficient or at a politically acceptable level have not been implemented although they seem to be suitable for the time between 22.00 to 24.00 and 5.00 to 7.00 hrs.
  - Noise surcharges have been reformed, though rather late. At most airports they do not lead to any measurable substitution effects.
- The question whether limiting capacity expansion at Frankfurt hub does endanger the competitive position has not been well assessed.

With the expected growth of demand investment in airport, capacity will remain an important issue for Germany. The current planning system has led to avoidable transaction costs and an infrastructure which is too costly, inefficiently used and leading to unnecessary environmental costs. Hence investment in airports has been criticised by a large group of citizens and has not been confined to those living under the flight paths of airports and therefore being directly affected. It is recommended to reform the system along the following lines which involve more than a narrow reform of the planning process:

1. A clear distinction between tasks and responsibilities of airport management with an independent planning authority separated from the owners of airports (Bickenbach et al., 2005). The quasi-independency in the current system invites rent seeking by all stakeholders. Rent seeking can be limited by an independent planning authority which should report to parliament. Bickenbach et al. (ibid) additionally demand a complete privatisation of airports, but this not necessary as long as the planning authority is completely independent from the airport management[19].
2. *Open and transparent planning process.* As Flyberg (2009) argued mismanagement does not come from too much democracy. The final decision on the location of the new Berlin airport should not have been made by the transport minister but should be the result of a transparent and not predetermined planning process.
3. *Compensation of directly negative affected citizens*. Compensation should be restricted to those who are seriously affected by noise. Legal binding exposure thresholds should be defined. The planning authority must then assess the damage and determine the compensation (Birkenbach et al. 2005).
4. *Mandatory Cost Benefit Analysis*. It should be mandatory to assess investment decisions by Cost Benefit Analysis and not by Impact Analysis. The quality of forecasts should be carefully scrutinised. Cost Benefit Analysis including passenger forecasts should be subject to ex-ante and ex-post evaluation. Lying of forecasters should be prosecuted.
5. *Market based environmental policy.* Airports should adopt market based instruments like noise budgets with permits or effective noise charges. These instruments should be made effective.
6. *Reforming the organisational structure of the German airport industry.* Instead of monopolising markets, airport competition should be fostered by prohibiting joint ownership of potentially competing airports. Subsidies for regional airports should be carefully assessed. An independent authority should regulate airports with market power and set incentives for efficiency. Secondary trading of slots combined with an efficient structure of charges should be implemented for a better allocation of given capacity.

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NOTES

1. It should be noted that Düsseldorf airport has introduced digressive landing fees, i.e. small aircraft pay more (per weight unit) than larger aircraft, but not a fixed movement charge (Forsyth and Niemeier, 2008).

2. For example, subsidies for airports are difficult to assess as - otherwise comparable - airports might be completely differently financed. If airport investments are financed by loans taken by the operator, cost of capital and interest rates will be transparently included in the profit-loss-account. If an airport which is financed this way does not generate enough revenues to pay for all costs – operating and capital – resulting losses usually have to be compensated by the owners / state – which is then often regarded as subsidies. In other cases, however, parts of the airport infrastructure are directly – from the start - being paid for by the owners / state and "handed over" to the airport operator for free. In this case, capital costs tend of course to be lower, which makes it easier for the airport operator to generate an annual surplus.

3. The airports of Amsterdam, Frankfurt, London, Heathrow, Madrid, Munich, Paris Charles de Gaulle, Rome FCO, Vienna and Zurich are regarded as major hubs and thus excluded.

4. For an overview see Menard and Shirley (2005) and for public utilities in particular Gomez-Ibanez (2003).

5. See Biggar and for infrastructure provision Bickenbach et al. (2005 and 2007).

6. For a review on Nimby goods see Richman and Boerner (2007) and Schively (2007).

7. For an overview see Button (2005), Forsyth et al. (2004), Czerny et. al. (2008) and Czerny and Zhang (2012).

8.. For an overview see Sanderson (2011). To my knowledge the authors on mega projects seem not to be influenced by transaction cost literature.

9.. Managers are too optimistic and involuntary ignore risks and overestimate the benefits. This theory was developed by Kahneman, Tversky and Lovallo. For an overview see Lovallo and Kahnemann (2003).

10. For legal details see Ronellenfitsch (2006).

11. According to Gohl and Meiste (2012, p. 87) the planning authority helped intensively Fraport to improve their planning application.

12. Interestingly Hujer and Kokot (2001) report that in the mediation group it was unanimously agreed that a study on the economic significance should be conducted as the supporters based their study on an outdated study.

13. Based on Niemeier (2001).

14. Based on Niemeier, 2003 and 2004.

15. I confine myself to a discussion of the most important instruments. For an overview see Conradi et. al. (2013) and Fichert (1999).

16. Lijesen et al. writes: "It is surprising to see that such an obvious finding has not yet lead to any practical use of a cost-benefit analysis based approach to noise nuisance near airports (ibid. p. 51).

17. For further evidence see Ehmer (2010).

18. Another reason might be that the airline can reap higher profits from feeder traffic into hubs.

19 There are good reasons for full privatisation as partial privatised airports are operational inefficient compared to state-owned or fully privatised airports.

Bibliography

Abel, R., D. Lauber, K. Oßwald, D. Rucht (1984) "Fallstudie: Flughafenerweiterung Stuttgart-Echterdingen, in D. Rucht (ed.), *Flughafenprojekte als Politikum*, Frankfurt, Campus, pp. 39 -99

ADV German Airports Association (2012): Positionspapier des Flughafenverbandes ADV zum Thema: „Umsetzung der Umgebungslärm-Richtlinie an den deutschen Verkehrsflughäfen", Berlin ADV http://www.adv.aero/fachbereiche-themen/umwelt/fluglaermschutz

ADV German Airports Association (2010): *Umwelt im Blick. Verantwortungsvoll handeln und wachsen,* Berlin ADV http://www.adv.aero/fileadmin/pdf/Umwelt/ADV-Umwelt_im_Blick_web.pdf

Aktionsbündnis ABB (2013): *Website*, http://www.fluglaermber.de/gemeinsam-gegen-fluglaerm/index.php

Bamberg, F (2013): "Ein Flughafen, den in Deutschland keiner braucht", *Die Welt*, 23 Jan 2013, http://www.welt.de/113083487

Boeing (2013), *Airports with Noise and Emissions restrictions*, http://www.boeing.com/commercial/noise/frankfurt.html

Biggar, D. R. (2008): *"Is Protecting Sunk Investment by Consumers a Key Rationale for Natural Monopoly Regulation?",* Australian Competition and Consumer Commission, January 24, 2008, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1086866

Bickenbach, F., Soltwedel, R., Wolf, H. (2005): Ausbau der Flughafeninfrastruktur: Konflikte und institutionelle Lösungsansätze. Berlin: Springer.

Bickenbach, F., Soltwedel, R., Wolf, H. (2007): "Institutionelle Reformen für eine rationale Flughafeninfrastrukturpolitik", *Zeitschrift für Wirtschaftspolitik*, 56, 108-134

Bischoff, J. (1973): "Flughafen Stuttgart Schwäbische Bescheidung", *DIE ZEIT*, 9.November 1973 Number 46, www.zeit.de/1973/46/schwaebische-bescheidung

BI Flörsheim-Hochheim (2012): What's this demonstration? http://www.fluglaerm-protest.de/warum-dieser-protest-why-this-protest/

Brechet, T and M. Picard (2010): "The Price of Silence: Markets for Noise Licenses and Airports", *International Economic Review* 51, 1097-1125

Bündnis der Bürgerinitiativen (2013): *Website*. http://www.flughafen-bi.de/

Button, K. (2005): "A simple analysis of the rent seeking of airlines, airports and politicians", *Transport Policy* 12, 47-56

Button, K.J., and A.J. Reynolds-Feighan (1999): "An assessment of the capacity and congestion levels at European airports", *Journal of Air Transport Management*, 5 (3), pp. 113–134

Bulwien, H., R Hujer, S. Kokot,C. Mehlinger, B. Rürup, and T. Voßkamp (1999), *Einkommens- und Beschäftigungseffekte des Flughafens Frankfurt/Main*, Frankfurt.

Czerny, A and A. Zhang (2012): "Airports and Airlines Economics and Policy: An Interpretive Review of Recent Research", *Economics of Transportation* 1 (1-2), 15-34

Czerny, A., P. Forsyth, D. Gillen, H-M. Niemeier (eds.) (2008): *Airport Slots. International Experiences and Options for Reform*, Ashgate, Burlington

Conrady, R., F. Fichert and R. Sterzenbach (2013), *Luftverkehr. Betriebswirtschaftliches Lehr- und Handbuch*, 5 ed. München Oldenbourg

Die ZEIT (1976), Bauchlandung in Kaltenkirchen, 10 Sept. 1976, http://www.zeit.de/1976/38/bauchlandung-in-kaltenkirchen

Döll, W. (2009): "Rechtsstreit um Flugplatz Eberswalde-Finow geht weiter", *FORUM - das Wirtschaftsmagazin für Ostbrandenburg*", 6 May 2009 http://www.wirtschaftsmagazin-ostbrandenburg.de/html/1409-Rechtsstr

Düsseldorf Airport (2012): *Die genehmigungsrechtliche Entwicklung am Düsseldorfer Flughafen: Ein chronologischer Überblick*, 16.11.2012 http://www.duesseldorf-international.de/dus/medieninfo_detail

Ehmer, H. (2010): *Environmental Airport Charges – a multidisciplinary approach*, G.A.R.S. Workshop Airports and the Environment Dresden, November 23-24, 2010

EU COM (2012): "State aid No SA.27585 and SA.31149 (2012/C) (ex NN/2011, ex CP 31/2009 and CP 162/2010) Alleged State aid to Lübeck airport, Infratil and airlines using the airport (Ryanair, Wizz Air and others)", *Official Journal of the European Union*, C 241/04, 56-94

Evangelinos, C., R. Püschel and H-M Niemeier (2013): Special Interest Groups and Price-Structure: An Application to Noise Charging at Zurich Airport, mimeo

Fichert, F. (1999): *Umweltschutz im zivilen Luftverkehr*, Berlin Duncker & Humblodt

Fichert, F. (2012): Noise Surcharges at European Airports – An Overview. mimeo

Flughafen Hamburg GmbH (1996): Antrag der Flughafen Hamburg GmbH auf Planfeststellungsbeschluss gemäß 8 Abs. 1 LuftVG für die Änderung des Flughafens Hamburg durch Errichtung und Betrieb eines Vorfeldes 2 nebst damit im Zusammenhang stehenden und im Antrag konkretisierten Maßnahmen und durch eine neue Lärmschutzhalle vom 23. Dezember 1996, Hamburg.

Frankfurter Allgemeine Zeitung (2010): „Startbahn West Die Waldbürger", *FAZ*, 05.11.2010, http://www.faz.net/aktuell/politik/inland/startbahn-west-die-waldbuerger-1623748.html

Flyvbjerg, B (2009): "Survival of the unfittest: why the worst infrastructure gets built—and what we can do about it", *Oxford Review of Economic Policy*, 25, 344–367

Flyvbjerg, B, N. Bruzelius and W. Rothengatter (2003): "*Megaprojects and Risks – An Anatomy of Ambition*", Cambridge University Press, Cambridge, UK.

Forsyth, P. and H.-M. Niemeier (2008): "Setting the Slot Limits at Congested Airport", in A. Czerny, P. Forsyth, D. Gillen, H-M. Niemeier (Hrsg.): *Airport Slots. International Experiences and Options for Reform*, Ashgate, Burlington, p. 63- 83

Forsyth, P. and H.-M. Niemeier (2012): "European Airport Reform: Slots and the Implicit Contract between Airlines and Airports", Paper presented at the Kuhmo Nectar Conference, Berlin, June 21-22, 2012.

Forum Flughafen und Region (2013): *Dokumentation Mediationsverfahren* http://www.forum-flughafen-region.de/service/archive-mediation-rdf/Flughafen Frankfurt

German Advisory Council on the Environment (2008): *Lärmschutz*, http://www.umweltrat.de/DE/Themen/Laermschutz/laermschutz_node.html

Gillen, D. (2000): "Benefits and Costs of Alternative Noise Management Strategies", in: T. Immelmann, W. Pfähler, H.-M. Niemeier, and O. Mayer (eds.), *Aviation versus Environment?*, Frankfurt am Main, Lang Publisher, pp. 71- 100

Gómez-Ibáñez, J.A. (2003): *Regulating Infrastructure: Monopoly, Contracts and Discretion*. Cambridge, MA: Harvard University Press

Gohl, C. and H.-P. Meister (2012): *Politische Mediation bei Infrastrukturprojekten*. Münster: LIT Verlag

Handelsblatt (2003): "Streit um Flughafenausbau vor heißer Phase", 2 Jan. 2003, http://www.handelsblatt.com/archiv/startschuss-fuer-einen-marathon-der-juristen-streit-um-flughafenausbau-vor-heisser-phase/v_detail_tab_print/2217826.html

Helm, D. (2009): "Infrastructure investment, the cost of capital, and regulation: an assessment, *Oxford Review of Economic Policy*, 25, 307–326

Historikerbuero (n.d.), Flughafen Düsseldorf, http://www.historikerbuero.de/indextexte/Flughafen.htm

Hoffmann, B.D. (2011): The influence of strategies used to communicate sustainable corporate responsibility on a reputation of a major airport, Diss. Walden Univ.

Hujer, R. and S. Kokot (2001): "Frankfurt Airport's impact on regional and national employment and income", in: W. Pfähler (ed.), *Regional Input-Output Analysis, Baden-Baden*, Nomos, pp. 111-155

Janssen, H. (2013): "Münchhausen-Check Klaus Wowereit und der Pannenflughafen", *Spiegel online*, 26 January 2013 http://www.spiegel.de/politik/deutschland/fakten-check-klaus-wowereit-und-der-berliner-grossflughafen-a-878797.html

Knieps, G (1990): "Überlastung des Luftraums - Potentiale der Marktsteuerung", *ORDO*, Vol. 41, pp. 195-205.

Kretschmer, W. (1984): "Fallstudie: Großflughafen München II", in D. Rucht (ed.), *Flughafenprojekte als Politikum*, Frankfurt, Campus, pp100 -194

Landtag von Baden-Württemberg (Parliament of Baden-Württemberg) (2011), Antrag der Fraktion der SPD und Stellungnahme des Ministeriums für Umwelt, Naturschutz und Verkehr zur Zukunft des Luftverkehrs Drucksache 14 / 7444 of 13. 01. 2011. www.landtag-bw.de/Dokumente

Lang, N. (1969): „Die Angst vor den Düsen," *Die Zeit*, 9. May 19691969, Number 19/ www.zeit.de/1969/19/die-angst-vor-den-duesen

Levsen (2007): *EUROPLANE: Airport Systems Study The Case of Berlin-Brandenburg*, Presentation of 15 November 2007, www.europlane.net

Lijesen, M., W. van der Straaten, J. Dekkers, R. van Elk and J. Blokdijk (2010): "How much noise reduction at airports?", *Transportation Research Part D* 15, 51–59

Lovallo, D. and Kahnemann, D. (2003): "Delusions of Success: How Optimism Undermines Executives` Decisions", *Harvard Business Review*, July, 56-63

Maertens, S. (2009): Das Potenzial europäischer Sekundärlughäfen im Interkontinentalverkehr, Diss. Münster Vandehoeck

Maertens, S. (2010): "Drivers of long haul flight supply at secondary airports in Europe", Journal of Air Transport Management 16, 239–243

Menard, C. and Shirley, M.M (eds.) (2005): *Handbook of New Institutional Economics*, Dordrecht: Springer

Metzner, T. (2012): "Platzeck für bundesweites Nachtflugverbot", *Tagesspiegel*, 4 Dec. 2012, www.tagesspiegel.de/berlin/brandenburg/nach-erfolgreichem-volksbegehren-platzeck-fuer-bundesweitesnachtflugverbot/7474914.html

Mediationsgruppe Flughafen Frankfurt /Main (eds.) (2010): *Bericht Mediation Flughafen Frankfurt /Main*, Frankfurt, www.forum-flughafen-region.de

Mueller-Rostin, C., H. Ehmer, H.-M. Niemeier and J. Müller (2010): „Market entry and market exit in the European airport market", in P. Forsyth, D. Gillen, J. Müller and H.-M. Niemeier (eds.), *Airport Competition. The European Experience*, Ashgate Burlington, 2010, pp. 27-46

Niemeier, H.-M. (1998): "Praktische und theoretische Probleme einer Wirtschaftspolitik für den Flughafen Hamburg", in B. Priddat and A. Vilks (eds.), *Wirtschaftswissenschaft und Wirtschaftswirklichkeit*, Marburg, Metropolis, pp. 181-206

Niemeier, H.-M. (2000): "Towards an efficient market-based environmental aviation policy – A view from the Hamburg Region", in: T. Immelmann, W. Pfähler, H.-M. Niemeier, and O. Mayer (eds.), *Aviation versus Environment?,* Frankfurt am Main, Lang Publisher, pp. 47-67

Niemeier, H.-M. (2001): "On the use and abuse of Impact Analysis for airports: A critical view from the perspective of regional policy," in: W. Pfähler (ed.), *Regional Input-Output Analysis*, Baden-Baden, Nomos 2001, pp. 201-220

Niemeier, H.-M. (2003): "Kapazitätsengpässe auf deutschen Flughäfen und Entgeltregulierung: Brauchen wir neue Regeln für eine effiziente Flughafeninfrastruktur?", in: G. Knieps (ed.), *Investitionsentscheidungen und Kostenmanagement in Netzindustrien*, Schriftenreihe der DVWG, Reihe B, Bergisch-Gladbach, 2003, pp. 108-151

Niemeier, H.-M. (2004): "Capacity Utilisation, Investment and Regulatory Reform of German Airports," in P. Forsyth, D. Gillen, A. Knorr, O. Mayer, H.-M. Niemeier and D. Starkie (eds.), *The Economic Regulation of Airports*, German Aviation Research Society Series, Aldershot, Ashgate, 2004, pp. 163- 189

Niemeier, H.-M. (2009): "Economy Regulation of Large Airports: Status Quo and Options for Reform," Paper given at the Workshop Gateway Airport Investment & Development of Airline Services for a Global Economy at the International Transport Forum Leipzig Congress Centre, Germany 26 May 2009

Niemeier, H.-M. (2012), "*How do airports compete?",* Presentation at Conference on Airports Competition Barcelona, November 19, 2012, Faculty of Economics and Business of the University of Barcelona

Reichmuth, J.,S. Maertens, P. Berster, M. Gelhausen, W. Grimme, H. Nieße, H. Pabst, H. Pak, D. Wilken (2011), Stellungnahme zu den Gutachten zur verkehrswirtschaftlichen und verkehrspolitischen Begründung des Ausbauvorhabens am Flughafen Münster/Osnabrück im Hinblick auf den Interkontinentalverkehr, Cologone Deutsches Zentrum für Luft- und Raumfahrt DLR-IB-326-2011/1

Rucht, D. and S. Sauer (1984): "Fallstudie Startbahn West", in D. Rucht (ed.), *Flughafenprojekte als Politikum,* Frankfurt, Campus, pp 195- 272

Ries, E. (2012): "Vormaliger Streitpunkt Startbahn: FMO und Nabu untermauern Einigkeit", *Westfälische Nachrichten*, 13 June 2012 http://www.wn.de/Muensterland/2012/06/

Ronellenfitsch, M. (2006): "Die Planfeststellung bei Verkehrsvorhaben", in W. Spannowsky (ed.), *Erscheinungsbilder eines sich wandelnden Verwaltungsrechts,* Günter Püttner zum 70. Geburtstag, Köln: Heymann, pp. 75–90

Richman, B. and Boerner, C. (2006): "A Transaction Cost Economizing Approach to Regulation: Understanding the NIMBY Problem and Improving Regulatory Responses," *Yale Journal on Regulation*, 23, 29-76

Sanderson, Joe (2011): "Risk, uncertainty and governance in megaprojects: A critical discussion of alternative explanations", *International Journal of Project Management*, 30, 432-443.

Schmidt, A. (2000): "Hamburg Airport – Environmental Management System", in: T. Immelmann, W. Pfähler, H.-M. Niemeier, and O. Mayer (eds.), *Aviation versus Environment?*, Frankfurt am Main, Lang Publisher, pp. 123- 128

Schmidt, K. (2011): "Kassel-Calden Flughafen wird noch teurer", Frankfurter Rundschau 26 August 2011 http://www.fr-online.de/rhein-main/-kassel-calden-flughafen-wird-noch-teurer,1472796,9676808.html

Schively, C. (2007): "Understanding the NIMBY and LULU Phenomena: Reassessing Our Knowledge Base and Informing Future Research", *Journal of Planning Literature* 21, 255-266

Siegel, S. and G. Visintin (2007): “Die zweite Startbahn Eine absurde Idee“, Schutzgemeinschaft FILDER e.V. (ed.), *40 Jahre und kein bisschen leiser, Filder*, www.schutzgemeinschaft-filder.de

Spiegel Online (2012): *Bürgerentscheid in München Startbahngegner stoppen Flughafen-Ausbau*, 17. Juni 2012 http://www.spiegel.de/wirtschaft/soziales/flughafen-muenchen-startbah

Süddeutsche Zeitung (2012): *Fakten-Karte zu Münchens geplanter dritter Startbahn Drehkreuz, Dreckschleuder, Wachstumsmotor*, 26. September 2012 http://www.sueddeutsche.de/muenchen/fakten-karte-zu-muenchens-geplanter-dritter-startbahn-drehkreuz-dreckschleuder-wachstumsmotor-1.1375607

Starkie, D. (1998): “Allocating Airport Slots: A Role for the Market”, *Journal of Air Transport Management*, Vol. 4, pp. 111-116.

Stanford Research Institute (1990), A European Planning Strategy for Air Traffic to the Year 2010, Menlo Park

Stuttgarter Zeitung online (2008): “Keine zweite Startbahn für Stuttgart Oettinger: Mehr Flüge ab Baden-Airport,“ dpa/lsw, veröffentlicht am 25.06.2008 http://content.stuttgarter-zeitung.de/stz/page/1744128_0_2147_stuttgart-flughafen-bekommt-keine-zweite-startbahn.html

Thießen, F. (2000): Die Mängel des Mediationsverfahrens zum Ausbau des Frankfurter Flughafens: Ein Systematisierungs- und Bewertungsversuch, Chemnitz: TU Chemnitz, Fakultät für Wirtschaftswissenschaften (Ms. WWDP 31/2000)

Tichy, G. (1994): *Konjunktur: Stilisierte Fakten, Theorie, Prognose*, 2nd edition, Berlin: Springer

United States of America Department of Transport, Federals Aviation Administration [USDOT] (1992): *US-DOT Estimating the Regional Significance of Airports, Washington*, DC, DOT/FAA/PP-92-6

William, Cutler & Pickering (1991*), Deutschlands Flughafen-Kapazitätskrise*, Frankfurt/Main 1991

Williamson, O.E. (1985): The Economic Institutions of Capitalism. Firms, Markets, relational Contracting. New York, Free Press

Wojahn, O.W. (2001): Airline Networks, Peter Lang, Frankfurt

Wolf, H. (1996): “Privatisierung der Flughäfen? – Zu den Rahmenbedingungen für eine effiziente Flughafenpolitik nach der Liberalisierung des EU-Luftverkehrs“, *Die Weltwirtschaft*, 123, 190-218

Wolf, H. (2003): *Privatisierung im Flughafensektor*. Eine ordnungspolitische Analyse Berlin, Heidelberg, New York, Hongkong; Springer

Wolf. H. (2004): “Airport Privatisation and Regulation: Getting the Institutions Right”, in P. Forsyth, D. Gillen, A. Knorr, O. Mayer, H. M. Niemeier and D. Starkie (eds.), *The Economic Regulation of Airports*, Aldershot: Ashgate, pp. 201- 21

York Consulting (1998), ACI Europe. The Economic Impact of Airports, York

Zaß, S. (2008): Handlungsstrategien für eine nachhaltige Flächennutzungspolitik in Flughafenregionen, Diss. Humboldt-University, Berlin.

CHAPTER 5

Airport capacity expansion strategies in the era of airline multi-hub networks

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Abstract

Many major airports are hubs for network carriers at the same time as serving a large local market. The complementarity between these functions is often seen as a prerequisite for viable hub operations, suggesting that spreading the hub network over multiple airports can be very costly and damages the corner stone of the hub operation: the creation of scope and density economies. The objective of this paper is to add to the understanding of the network strategies followed by (multi)hub network carriers; and to draw conclusions from this understanding for the capacity expansion strategies of airports, in particular for the London Metropolitan Area

1. Introduction

There is certainly scope for substitution of some airport services by alternative hubs, as the rise of multi-hub airline networks shows. The multi-hub network strategy is an increasingly important phenomenon in today's air transport industry. Due to the consolidation of both the European and US air transport industry, more and more network carriers operate out of multiple connecting hubs.

Hence, the strategies of network carriers need to be taken into account in assessing future demand for airport capacity. The requirements of low cost and other primarily point-to-point carriers are equally important, but different.

Based on our understanding of the network strategy of multi-hub airlines and hub operations in general, what can be said about airport expansion strategies in multi-airport regions? To what extent is a single airport expansion strategy to be preferred over a more decentralised capacity growth in the same metropolitan region?

The paper is outlined as follows. We start our discussion with the benefits of hubbing, both from the perspective of the network carrier as well as from the perspective of the metropolitan region. We then shift our attention to the question why airlines decide to operate out of multiple hubs. Next, empirical evidence will be provided on the actual specialisation patterns in European airline multi-hub networks. Finally, the paper concludes by discussing different airport expansion strategies from the perspective of multi-hub airline network strategies.

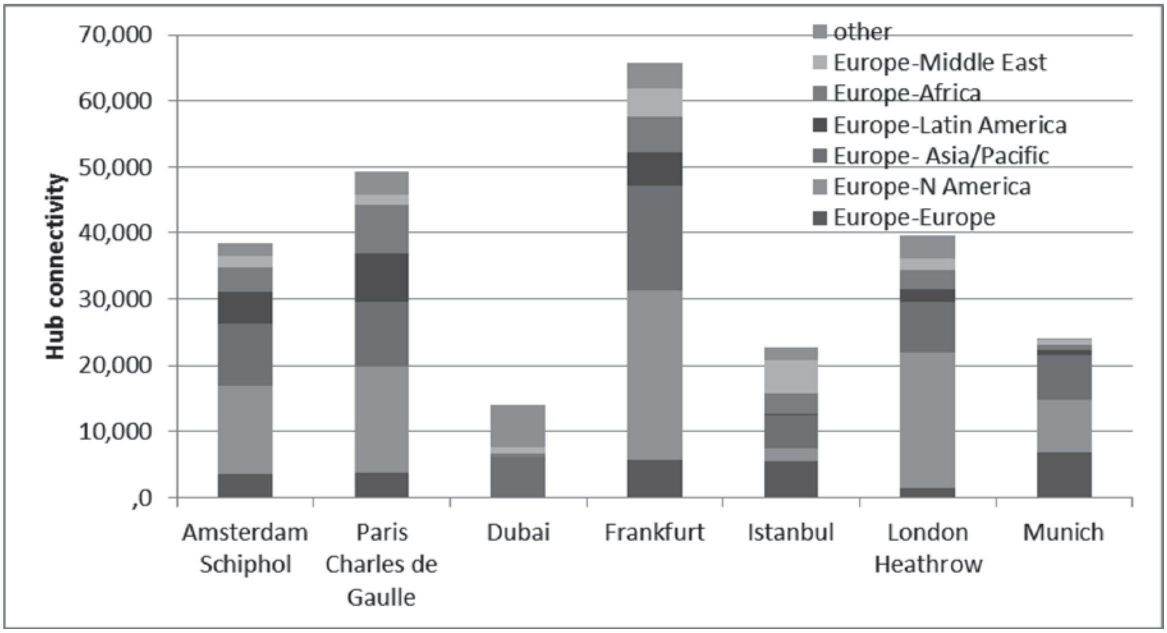
2. Hubs, network service airlines and their value for society

Hubs: factories to create route density

Liberalisation of air transport markets worldwide has contributed significantly to the rise of airline hub-and-spoke networks. Deregulation of the US domestic market in 1978 stimulated many legacy airlines to convert their networks into hub-and-spoke networks, spatially and temporally concentrated around one or multiple hubs. Liberalisation of the intra-EU market during the 1990s resulted in the adoption and intensification of airline hub-and-spoke networks in Europe.

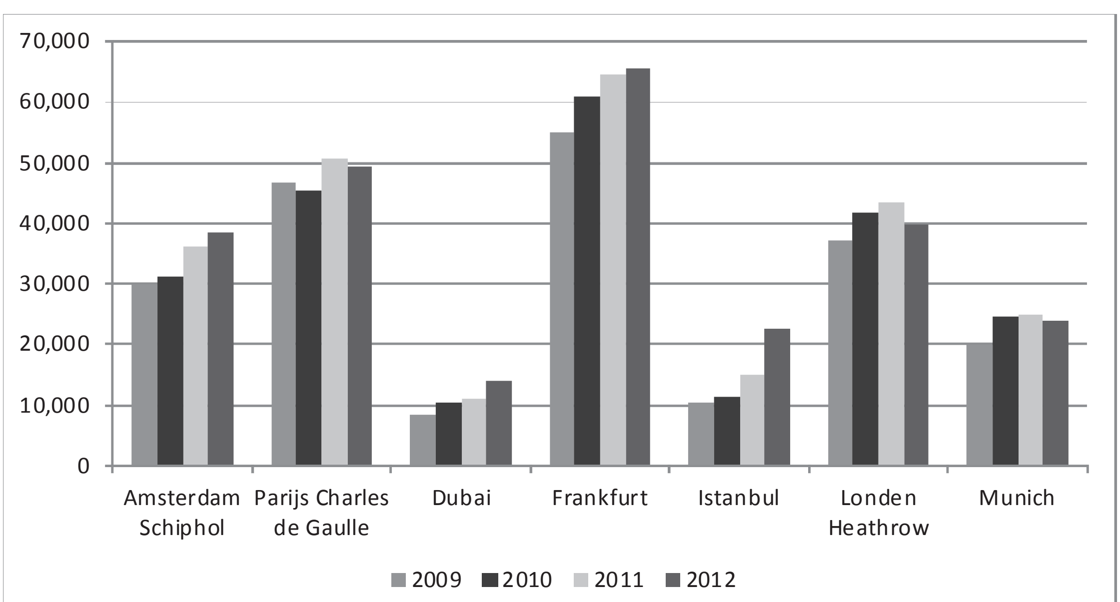
Also elsewhere in the world, the hub-and-spoke network is quickly gaining grounds. The largest hubs in Europe in terms of connecting opportunities are Frankfurt, Paris CDG, Heathrow, Amsterdam and Munich (figure 5.1). Relatively nearby hubs such as Istanbul and Dubai are quickly gaining ground (figure 5.2). This new generation hub carriers competes increasingly with the European network carriers on markets between Europe and Asia/Middle East/Africa, in addition to the already established competition from hubs in Europe and North-America (figure 5.3). Given the fleet orders and airport investments under way, their role in the long-haul market to and from Europe can be expected to grow substantially during the next decade

Figure 5.1 **Hub connectivity of selected European and Middle East hubs**[1]



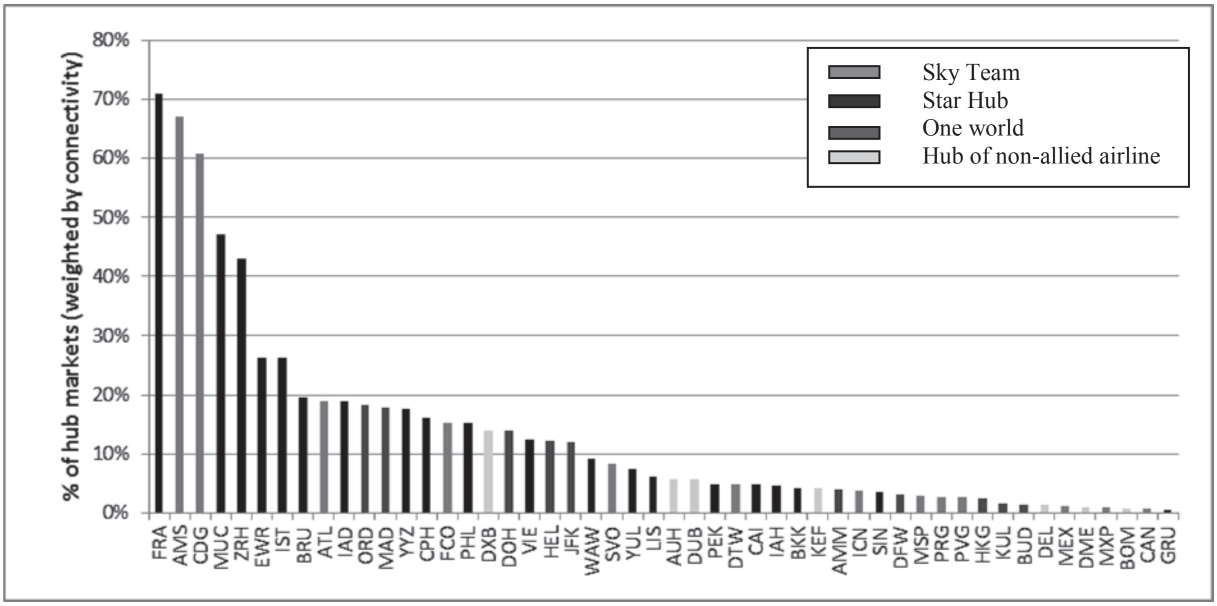
Source: SEO Netscan, 3rd week September 2012

Figure 5.2 **Development of hub connectivity**
2009-2012



Source: SEO Netscan, 3rd week September 2012

Figure 5.3 **Percentage of overlap of the connecting market via Heathrow by competing/alternative hub**



Source: SEO Netscan; OAG (2011);

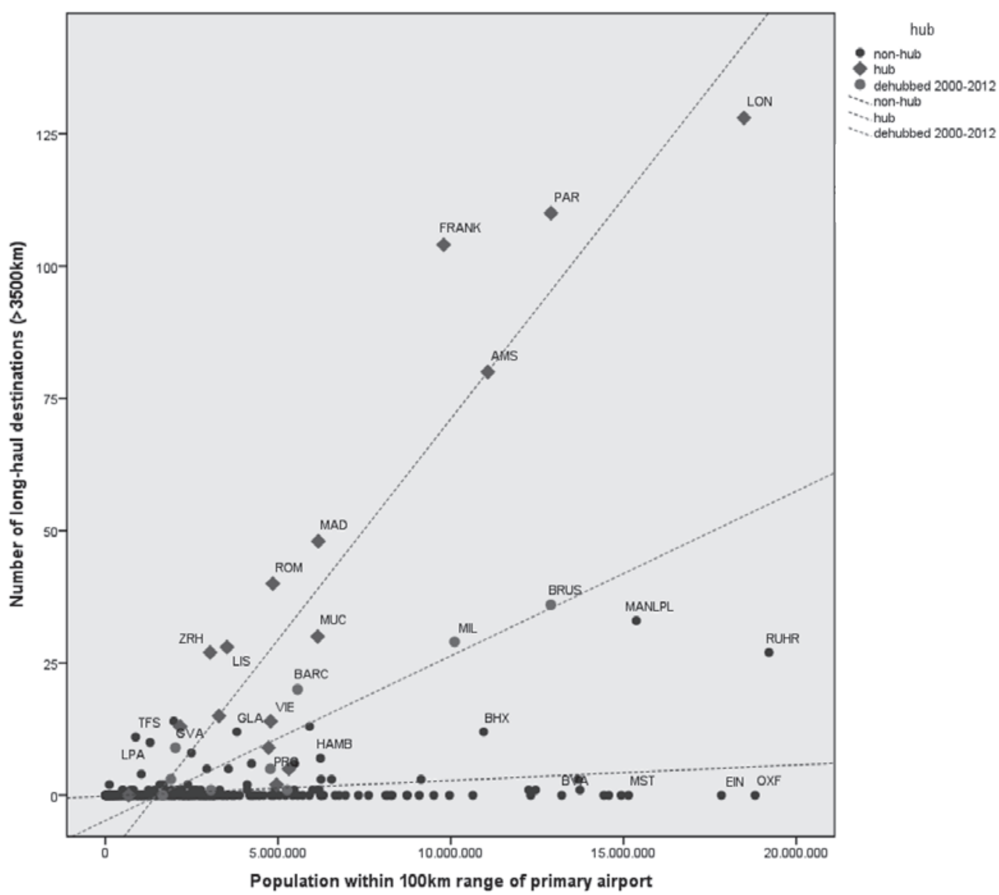
For airlines, hubs are not a goal in themselves. They are a means for airlines to add value to on both the demand and cost side. They are "factories to create route density" according former Northwest executive Mike Levine. Airlines combine different origin-destination flows on a single route using their hubs as consolidation points. In general, hubs add value to an airline through beyond market access. Moreover, they average out natural peaking of demand, can generate rents and provide opportunities for mixing prices (Button 2002; Gillen & Morrison 2005). As Nero (1999) points out, the advantages of hubbing become stronger with a growing network, because of the externalities and spill over effects of additional spokes.

Hubs are factories to create connectivity

Hubs provide local consumers with a much wider network scope at higher frequency than would be possible based on local origin-destination demand alone (figure 5.4). In other words, they generate connectivity for local consumers travelling to and from the hub's metropolitan area. Hub-and-spoke operations allow metropolitan regions to grow beyond the size of their own local market in terms of connectivity.

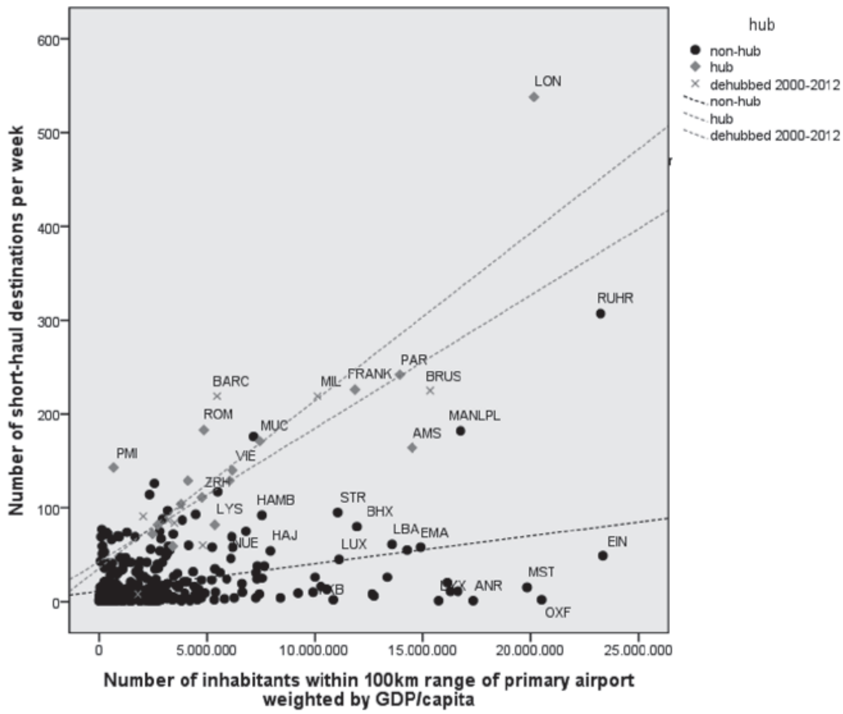
Figure 5.4 shows that for large metropolitan areas, hubs add substantially to the long-haul direct connectivity of the metropolitan area. It is mainly in the field of long-haul direct connectivity where hubs add value for metropolitan regions. The difference regarding short-haul connectivity between metropolitan areas with and without large hub operations is more diffuse and smaller (figure 5.5). Note that available capacity and the presence of a hub operation are closely interlinked for most large European metropolitan regions: Large metropolitan areas without a substantial hub operation have low levels of long-haul connectivity. At the same time, available peak-hour capacity does may not allow for a substantial hub operation.

Figure 5.4 **Hubs allow metropolitan areas to grow beyond the size of their local market**[2]



Source: catchment area database

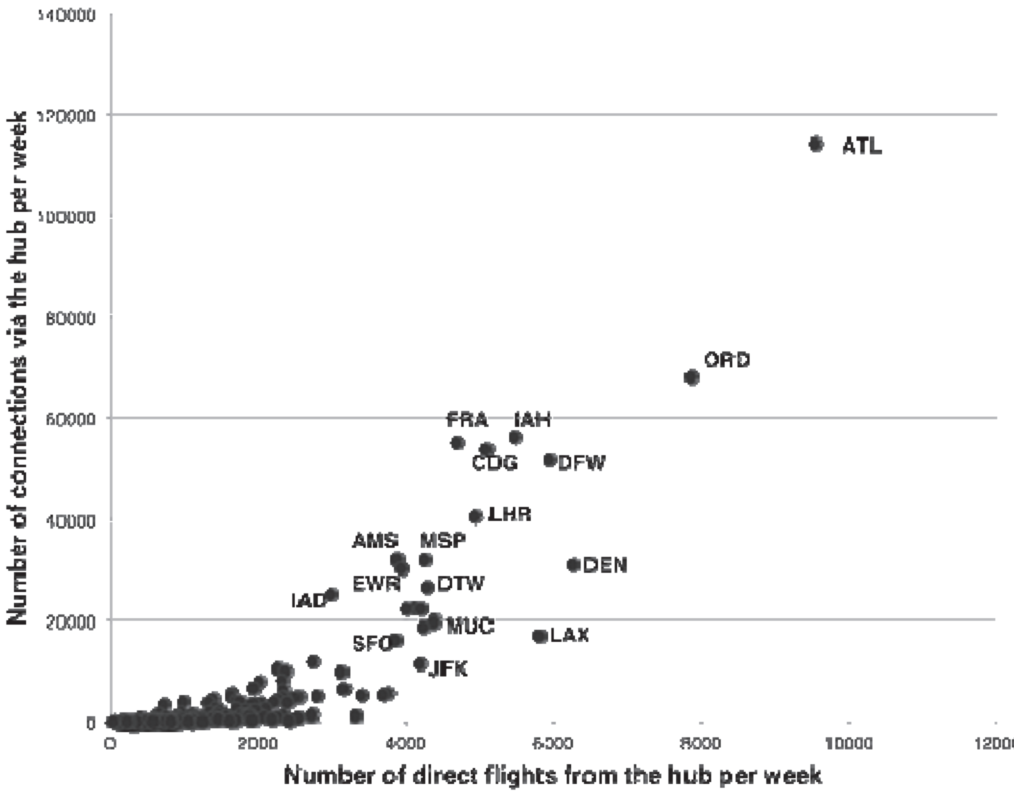
Figure 5.5 **Short-haul direct connectivity versus catchment area size**



Source: catchment area database

In general, hubs reduce time travel costs for consumers by providing more direct and more frequent links, with the main distinguishing effect being present in the supply of direct long-haul connectivity. By providing connectivity to transfer passengers, hubs generate connectivity for local consumers. These connectivity advantages for local and connecting passengers tend to get bigger when hubs grow larger. They increase in a nonlinear way. One large hub generates more connectivity than the sum of two hubs of half the size (figure 5.6). The dominance of the hub carrier at the airport, spatial centrality of the hub and the quality of the wave-system further influence the performance of hub airports as depicted in figure 5.6.

Figure 5.6 **The multiplier effect of hubs: connections via the hub increase in a non-linear way with a growing direct network**[3]



Source: SEO Netscan 2009

Having a broad portfolio of direct routes resulting from hubbing activities delivers economic benefits. The direct benefits of reduced travel costs "ripple" through the rest of the economy. Some of the indirect effects are really additional (such as agglomeration effects) others are merely passed on from stakeholders in the air transport sector to players outside the industry. Worthwhile mentioning in the European context is the study of Bel & Fageda (2009). They find that a 10% increase in intercontinental direct routes results in a 4% growth in international headquarters in European metropolitan areas. Vinciguerra et al. (2012) conclude that connectivity by air contributes significantly to the performance of European regions in R&D activities, confirming the role that airports play for integrating cities in global networks. Furthermore, homebased hub carriers generate more employment than non-home based carriers, at least at the regional scale.

The downside of hubbing for local consumers is mainly found in the hub premiums charged by the hub carrier (Borenstein 1989; Leijsen et al. 2001) because of the market power in local markets to and from the hub. Yet, besides a form of market power, hub premiums may also reflect 'the monetary value of a direct versus a layover flight' (Leijsen et al. 2001) and the scarcity in airport capacity (Starkie 2006).

Success factors of hubs

Only few European airports have a hub status. This small number of airports takes account of a relatively large proportion of the direct, non-stop connectivity available to European consumers. The number of European non-hub airports is much larger, but their relative contribution to direct, non-stop connectivity is smaller. As demand is spread unequally in a geographical sense, successful hubs are nearly always located close to large urban areas: a large local O&D market gives a strong and captive demand basis on which to build the hub network, with higher yields than in the transfer segment.

Besides a strong and large O&D market, other factors play a role as well for performance of airports as a hub. The literature brings forward a list of typical hub success factors (e.g. Bootsma 1997):

- Central geographical location vis-à-vis the most important traffic flows and feeder airports
- Peak-hour capacity to facilitate an efficient wave-system structure of the hub airline
- Strong hub carrier being part of a global airline alliance
- Availability of traffic rights (market access)
- Short Minimum Connecting Time
- One terminal concept
- Competitive visit costs
- Good landside accessibility
- Available options for future growth
- Airport amenities

A strong path dependency is present in the development of hubs over time: there are clear cost, demand and connectivity advantages for the hub carrier to add new flights to an already established hub. Every new flight to the hub generates an increasing number of connections via the hub. In addition, moving a hub or establishing a new one is a costly operation. The other way around, airports that have lost their hub status do not easily regain it. According to a study of Redondi et al. (2012), only very few dehubbed airports have actually regained their hub status within a five-year time period after dehubbing, and their traffic growth has been slower than airports still having a hub status.

On the optimality of the single hub solution

Multi-hub networks are not an optimal solution compared to the single hub solution, as a number of theoretical studies on airline network choice have pointed out: each additional hub in the network reduces the corner stone of the hub strategy, the density economies. Furthermore, additional hubs bring in additional complexity costs (Duedden 2006; Wojahn 2001a&b).

Some studies provide empirical support for the optimality of the single hub solution: consolidation in the US and European airline industry has forced airlines to close down secondary hubs in relative close proximity to primary hubs (Burghouwt 2005; Dennis 1994; Redondi et al. 2010). Examples in Europe include the dehubbing of Barcelona by Iberia (consolidation at Madrid), the dehubbing of Gatwick by British Airways (consolidation at Heathrow) and the dehubbing of Milan Malpensa by Alitalia (the consolidation at Rome FCO).

In a network simulation study for Europe, Adler and Berechman (2001) find that multi-hub networks with an effective geographical division tend to have the best ability for airlines to generate profits. O'Kelly (1998, p.177) states that 'a pure single hub allocation model would result in an efficient system, but one with great inconvenience for the passenger'.

Given the multiplier effect of hub growth, one large hub attract significantly more transfer passengers than two hubs of half the size (Goedeking 2010) and one large hub generates more connecting opportunities than two hubs of half the size (figure 3). Zuidberg (2012) finds in an empirical study that a larger number of hubs contributes positively to airline units cost, all other things being equal: the more hubs, the more costly the network is to operate.

A split hub operation -spreading a hub operation of a single carrier over two airports within the same metropolitan area- generally turns out not to be a feasible solution. One the one hand, the hub carrier will not be able to serve the same amount of connecting markets/connections as would be the case with a single hub solution. Hence, by splitting the hub operation over more airports, the carrier will lose economies of density, and is likely to lose market share in the connecting market because less connections can be offered. In addition, the carrier will need to duplicate at least part of its short-haul network on both hubs. Finally, long-haul services can be made more profitable by simply moving them from the secondary to the primary hub, without occupying to many scarce slots. Dennis (2005) provides an overview of the disadvantages of the split hub operation of British Airways at Heathrow and Gatwick until 2000/2001.

Multi-hub networks

Yet, the theoretical arguments for the single hub solution 'do not leave room for the kind of multi-hub networks that many major carriers operate' as Wojahn states (2001a, p. 268). The multi-hub network structure is an increasingly important phenomenon in today's airline networks, mainly driven by the ongoing consolidation in the airline industry.

Hence, there are reasons for airlines to deviate from the single hub solution in practice:

- *Spatial coverage and market access:* airlines need multiple hubs to increase spatial coverage and serve thin markets, either through multiple hubs in their own networks or through alliance hubs (Tretheway & Oum 1992). Single hub systems reach a natural ceiling when too many important transfer connections require excessive detours (Goedeking 2010). In addition, most of the world's origin-destination markets can only be served with connecting service through hubs. Many of the world's aviation markets are even too small for a single connect service and can be served profitably with multiple hub transfers only.
- *Level of demand:* Swan (2002) states that the natural development of airline networks is from skeletal to connected. Early airline network developments build passenger loads at hubs to use larger airplanes and achieve density economies. The focus is then on a minimum number of hubs. As demand grows, later network developments bypass initial hubs. Bypassing saves the costs of connections and establishes secondary hubs. Here, frequency development outweighs the loss of density economies.
- Duedden (2006) further supports Swan's argument for the long-haul market. He demonstrates that long haul, direct services from non-hub airports can grab a major share of the premium market. If additional revenues from direct services from a secondary hub are larger than the additional costs of direct services, the profit maximising network configuration can take the shape of a multi-hub network. An example of such a development is Lufthansa's intercontinental route development at Düsseldorf.
- *Frequency game:* airlines can use a multi-hub system to play the 'frequency game', if total demand to an intercontinental destination allows for daily service from multiple hubs. By well-synchronising the flights to the same destination from both hubs, the airline can offer competitive, complementary services on many connecting markets linked to this particular

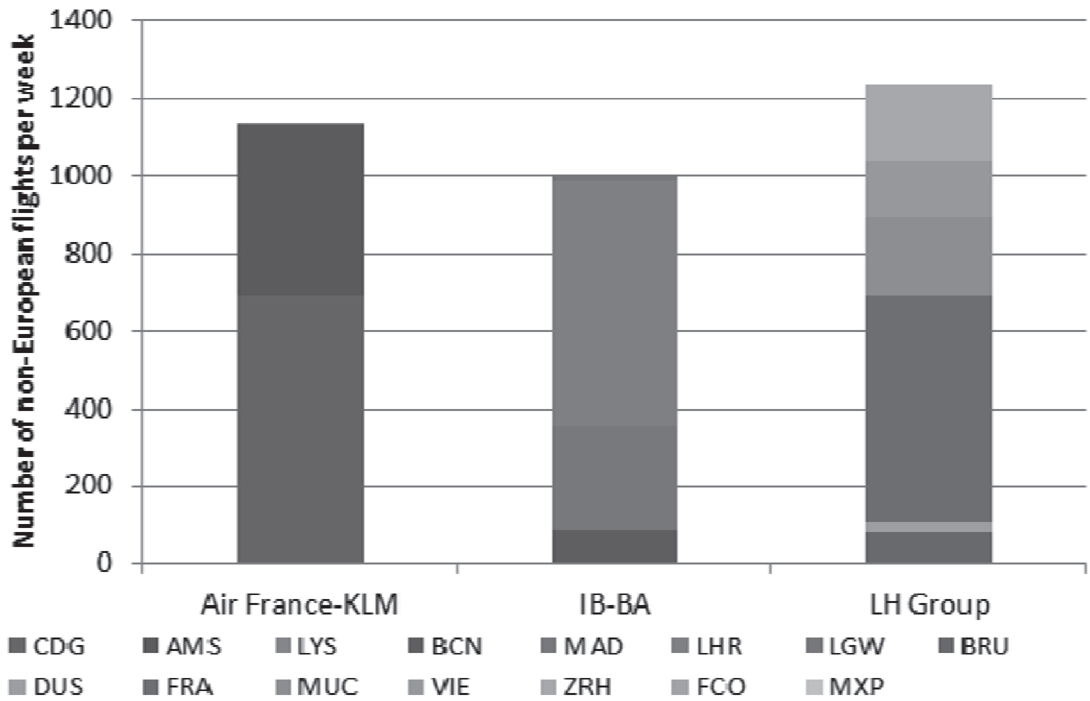
destination at different times of the day (Goedeking 2010). In addition, the airline will benefit from the high-yield local market at both hubs.

- *Capacity shortages at the primary hub*: Airlines may decide to open a secondary hub in order to accommodate market growth, when capacity constraints restrict growth at the primary hub's infrastructure (Goedeking 2010). Examples are Lufthansa's secondary hub at Munich, BA's (dismantled) hub at Gatwick and Turkish Airline's transfer of a number of operations from Istanbul Atatürk to Istanbul Sabiha Gökcen Airport.
- *Strategic positioning and entry deterrence:* Strategic positioning can be a reason for airlines to continue or start operating a secondary hub. A secondary hub can be used to deter entry by 'baby-sitting' scarce slots. In addition, operating out of multiple hubs gives the airline bargaining power over the airport operators (in terms of visit costs and airport development issues), because the hub carrier has an outside option for its hub operation.
- *Better aircraft utilisation:* the use of multiple hubs allows hub airlines to schedule an aircraft departure from one hub and return to hub two. From an aircraft utilisation perspective such aircraft routings can be more attractive than returning to the same hub. This type of routing is often used in the US but less in Europe (Dennis 2005).
- *Bilateral restrictions and aviation law:* the hybrid aviation regime may force airlines to operate long-haul services out of multiple hubs, although from a network point of view, consolidation on a single hub is more attractive. The worldwide aviation regime is a mosaic of liberalised air service agreements, open skies treaties, regulated and deregulated national/ regional aviation markets and traditional Bermuda-type air service agreements. Until EU-US Open Skies, for example, British Airways served partner hub Dallas from Gatwick instead of Heathrow due to bilateral restrictions (Wojahn 2001b; De Wit & Burghouwt 2005). In addition, as long as the Community clause is not accepted in all relevant bilateral agreements between the EU and third countries, EC member states must rely on such traditional nationality clauses. These clauses limit the extent to which a multi-national airline can shift non-EU services between their European hubs (Mendes de Leon 2009). Finally, access to many markets is only possible by making use of hubs of alliance partners. For example, European network carriers can only access most cities in China by means of an alliance with Chinese carriers and create connections through their hubs.
- *Unions:* pressure from unions of merged airlines can be a reason for airlines to continue to operate multiple hubs, although such a decision may not be optimal from a demand and cost side perspective.

Multi-hub networks in Europe

In Europe, three major multi-hub airline networks could be distinguished in 2012, consisting of networks of multiple hubs belonging to the same airline: the Air France-KLM network centred around Paris CDG and Amsterdam, the IAG network around Heathrow, Madrid and Barcelona and the Lufthansa Group using a various European hubs. These three networks are quite comparable in size of their aggregate long-haul network, with the Lufthansa Group being the largest of the three (figure 5.7).

Figure 5.7 **Number of non-European direct connections per week by hub carriers from the respective hubs, 3rd week September 2012**[4]



Source: OAG

The Air France-KLM network is a rather balanced network with respect to long-haul connectivity supply. In the Lufthansa Group network, Frankfurt dominates, supplemented with a number of secondary and tertiary hubs. In the IAG network, Heathrow is dominant but Madrid serves largely a unique network to Latin America.

3. Specialisation patterns in multi-hub airline networks: some empirical evidence

Although various scholars have simulated the development of multi-hub networks to search for the most profitable/optimal multi-hub network combination and hub location (see e.g. Adler & Berechman 2001; Martín & Román 2004; O'Kelly 1998), empirical evidence on actual specialization patterns in multi-hub networks in Europe remains limited.

De Wit & Burghouwt (2009) show in a brief study that the combined network of Air France and KLM is specialized along two axes: (1) the size of total passenger demand between Europe and a certain final destination and (2) the relative size of the local origin-destination markets. Air France-KLM serves destinations with a sufficiently large demand from the European market from both hubs. At such destinations, Air France-KLM can play the dual hub frequency game: the connecting markets involved can be served at different moments of the day via either of the hubs, thereby benefitting from the local demand at both hubs. The European market size is large enough to feed passengers to both hubs and justify a daily frequency from both. Either Paris CDG or Amsterdam Schiphol serve the smaller destinations uniquely, which do not have enough demand (local and transfer) to justify at least a daily frequency from both hubs. The hub with the largest local origin-destination market is generally the preferred hub for a smaller intercontinental destination. Further long-haul specialisation has taken place along these two axes during the last few years.

To gain a better understanding of multi-hub networks, let us briefly discuss the hub specialisation in the Air France-KLM network and Lufthansa long-haul network along the two axes of total passenger demand and the relative size of the local origin-destination markets.

The complementary multi-hub system of Air France-KLM

In 2003, the merger between Air France and KLM was announced. The new airline entity operated a dual hub system consisting of the intercontinental hubs of Paris Charles de Gaulle (CDG) and Amsterdam Airport, supplemented with a regional hub at Lyon. The hub operation at Paris CDG is about 1.5 times as big as the one at Amsterdam, measured in number of connecting possibilities per week. However, in terms of the share in long-haul destinations, the difference between the two hubs is smaller. Air France-KLM announced publicly that it would continue to operate both bases as intercontinental hubs under the motto ‘natural flows via natural hubs’.

The Dutch government perceived a risk that Amsterdam might lose part of its intercontinental network to Paris CDG on the longer term, mainly because of the short distance between both airports (400km) and a competitive advantage of Paris CDG over Amsterdam: the larger physical capacity of Paris CDG and the larger local market of Ile-de-France.

Therefore, the Dutch state agreed with Air France-KLM upon the so-called State Assurances in order to safeguard Amsterdam’s role as an intercontinental hub. These assurances entailed the guarantee that Air France-KLM would continue to operate 42 intercontinental ‘key destinations’ out of Amsterdam for a period of five years. In addition, the assurances included the guarantee that Air France-KLM would develop the hubs of Amsterdam and Paris CDG in ‘an equal way’.

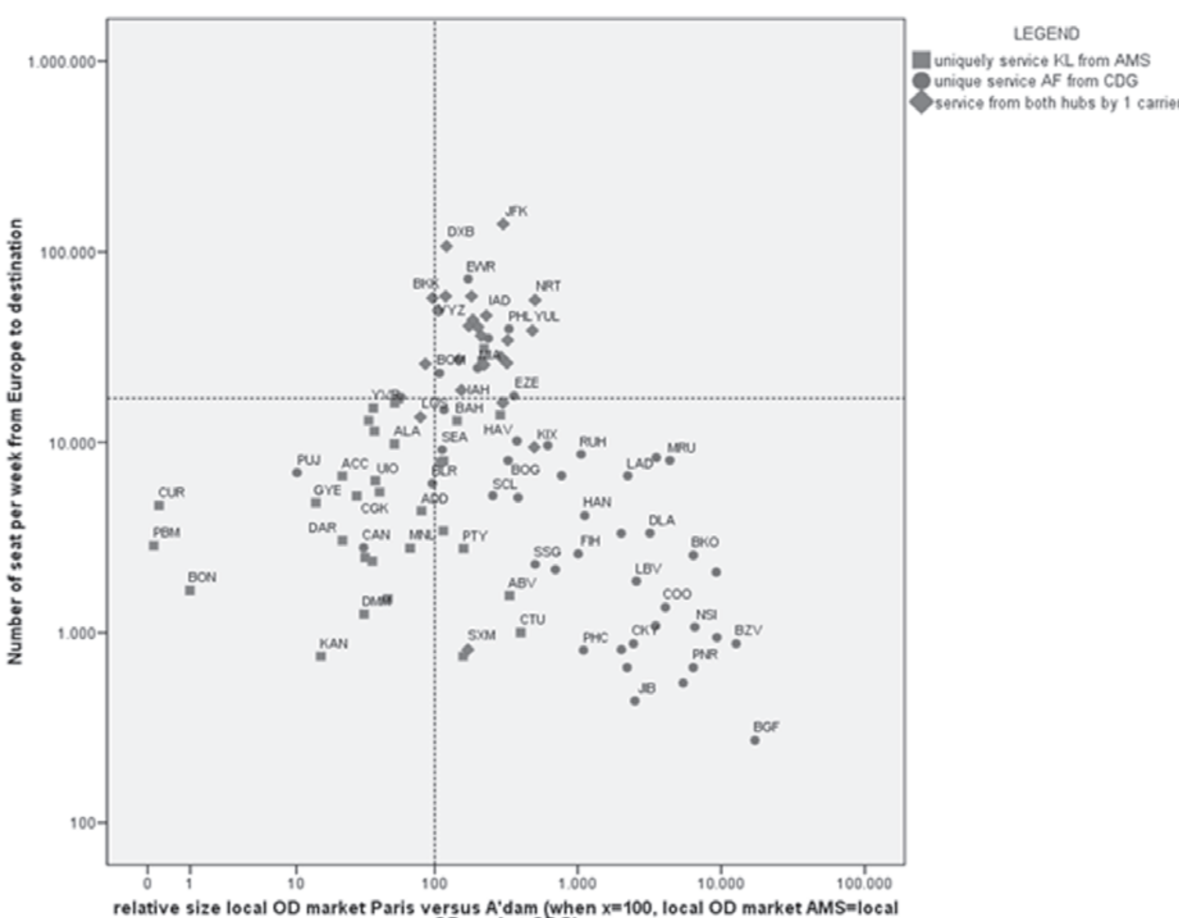
Against this background, figure 1 shows the specialization pattern of the hub system, based on the two axes of total European seat capacity to a certain long-haul destination (as a proxy for total passenger demand out of Europe to the long-haul destination) and the origin-destination ratio. The origin-destination ratio is the size of the O&D market to a certain long-haul destination at the primary hub, divided by the O&D market to the same destination at the secondary hub[5].

The horizontal axis shows that large European markets with more than 20 000 seats per week are generally served with direct flights from both Amsterdam and Paris CDG. In other words, the market from Europe to a certain destination is sufficiently large to serve it with at least a daily frequency from two hubs. The large European market allows the carrier to fill the flights with transfer demand from all over Europe, in addition to local origin-destination demand. The airline benefits from the high yield local origin-destination demand at both hubs and gives consumers more choice for departure/arrival time because connections are possible at different times of the day via different hubs. Finally, dual hub service allows the carrier to increase the number of connecting markets served as Amsterdam and Paris have partly a unique European feeder network (with Paris CDG focusing slightly on Southern Europe and Amsterdam on Northern Europe).

Destinations with a smaller European market potential (below 20 000 seats per week) are served uniquely from one of the hubs. The watershed between unique service from either Amsterdam or Paris CDG is in the relative size of the origin-destination market. When the market size is larger at Paris CDG, Air France-KLM serves the intercontinental destination from Paris. It is more attractive for the airline to place smaller destinations at the hub with the largest (and higher yielding) origin-destination market. Many Francophone destinations belong to this category. When the origin-destination market is larger at Amsterdam, Air France-KLM serves the destination from Amsterdam. Because the local origin-destination market of Amsterdam is on average smaller than the one of Paris, Air France-KLM serves more destinations uniquely from Paris than from Amsterdam.

Hence, from a static point of view, the Air France-KLM motto 'natural flows via natural hubs' makes sense. But also from a dynamic point of view, this holds true, looking at the shifts of destinations between both hubs over time. The destinations Amman, Beirut, Damascus, Caracas and Casablanca were all served from both hubs in 2003. These destinations are however relatively small in terms of European market size. As the origin-destination size for these destinations is larger at Paris than at Amsterdam, the airline cancelled the Amsterdam service. The reverse was true for destinations such as Manila and Jakarta. These destinations were served from both hubs before the merger and were concentrated at Amsterdam after the merger.

Figure 5.8 **Hub specialisation profile Amsterdam versus Paris CDG (Air France-KLM) (long-haul routes)** [6]



Source: OAG and MIDT; own calculations

The tertiary hub in the Air France-KLM system is Lyon. In 2008, Air France-KLM served no long-haul destinations from Lyon and just one non-European destination (Casablanca). Even the largest intercontinental markets have no direct service. The main reason seems are the availability of excellent landside access (TGV connection between Lyon and Paris CDG), a limited local market, a small European feeder system and limited peak-hour capacity at Lyon. For virtually all long-haul destinations, origin-destination demand at Paris is much larger than at Lyon[7]. Hence, the Lyon-hub fulfils a role as a European origin-destination airport and regional hub between the French regions and Europe, in a geographical market that Paris CDG cannot cover because of its location or too lengthy transfer times.

Overflow hubs in the Lufthansa system

Does the same pattern hold for the multi-hub system of the Lufthansa Group? We will consider the specialisation between Frankfurt and Munich, as well as Frankfurt and Dusseldorf.

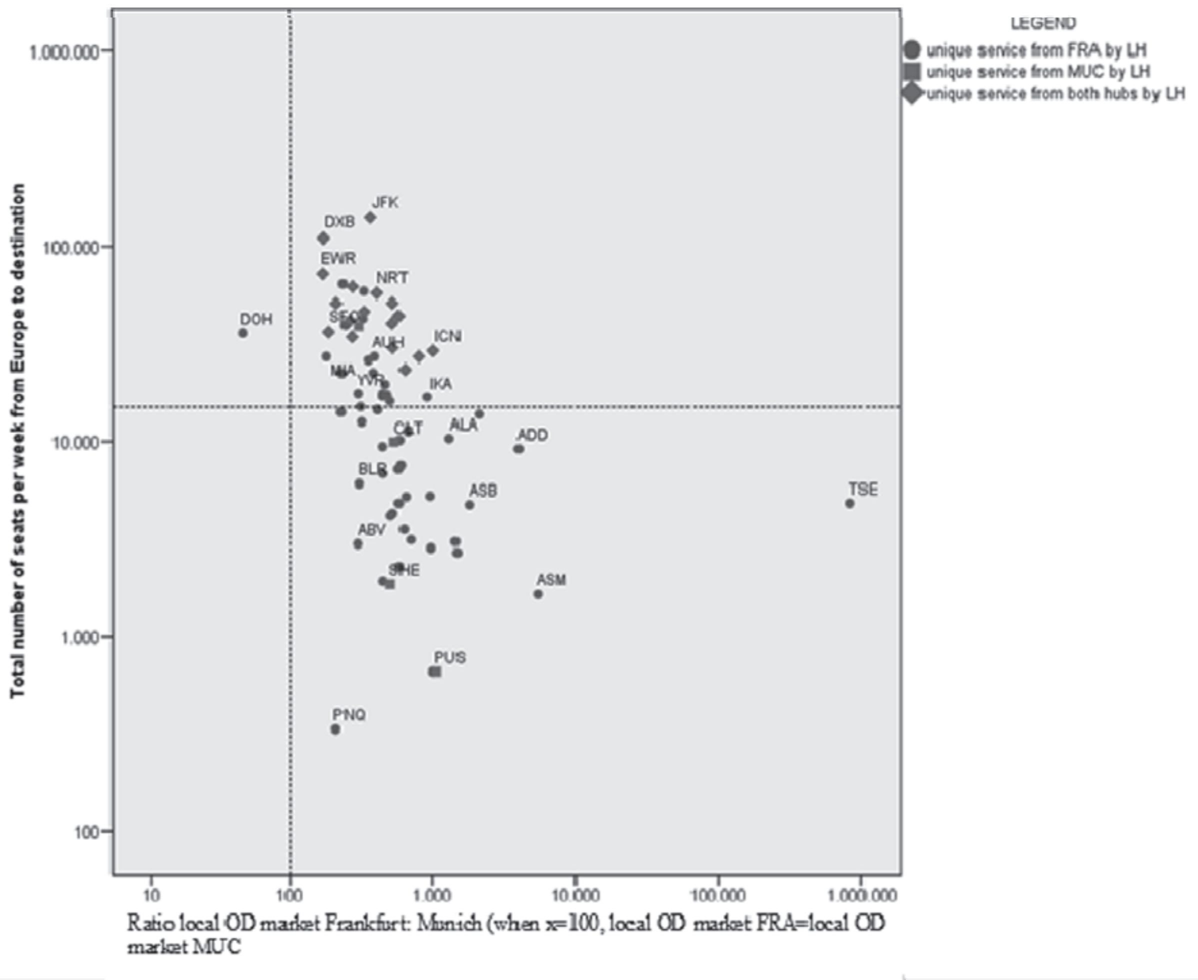
In 2008, the multi-hub system of the Lufthansa Group consisted of four hubs: a primary intercontinental hub at Frankfurt, two secondary intercontinental hubs at Munich and Zurich and a tertiary hub at Dusseldorf. The development of Munich was mainly because of capacity restrictions at Frankfurt and the development of the new Munich airport during the 1990s. Zurich was added to the system as a result of the merger between Lufthansa and Swiss in 2005. In 2009, Vienna and Brussels were added to the multi-hub system as a result of the mergers with Austrian and Brussels Airlines. Here, we consider briefly the Frankfurt, Munich and Dusseldorf hubs.

Munich and Dusseldorf have a small unique long-haul network. They mainly play a role as 'overflow' hubs to Frankfurt. In contrast to the Amsterdam-Paris CDG multi-hub system, 'natural' origin-destination flows seem to lack at Munich[8] (figure 5.9). Only in markets with a high demand between Europe and the long-haul destination (such as New York JFK and Dubai), Lufthansa provides direct, non-stop service from both Frankfurt and Munich. In addition, the threshold for direct service is higher than for the Amsterdam-Paris system.

Dusseldorf is a tertiary hub in the Lufthansa system and has few long-haul direct services. The threshold for direct service at Dusseldorf is higher than at Munich (60.000 seats per week). This can be explained by Lufthansa's much weaker feeder system at Dusseldorf, which in turn can be understood by the limited peak-hour capacity at Dusseldorf. These limitations do not allow developing an extensive feeder network. Hence, long-haul flights are constrained to the largest, premium origin-destination markets. Furthermore, dual hub service is likely to be first provided at a competitive frequency from Munich and only when total European market is large enough, at Dusseldorf as well. Finally, excellent high-speed rail connections are available between Dusseldorf and Frankfurt Airport[9], reducing the need for direct long-haul flights from Dusseldorf in particular as far as leisure and VFR passengers are concerned.

In sum, Munich and Dusseldorf are *overflow hubs* for Frankfurt as far as the long-haul network is concerned. This contrasts with the role of Amsterdam as a strong *complementary hub* in the network of Air France-KLM, having its own specific role in smaller markets.

Figure 5.9 **Hub specialisation profile Frankfurt versus Munich (Lufthansa) (long-haul routes)**



Source: OAG and MIDT; own calculations

The consolidated multi-hub specialisation pattern

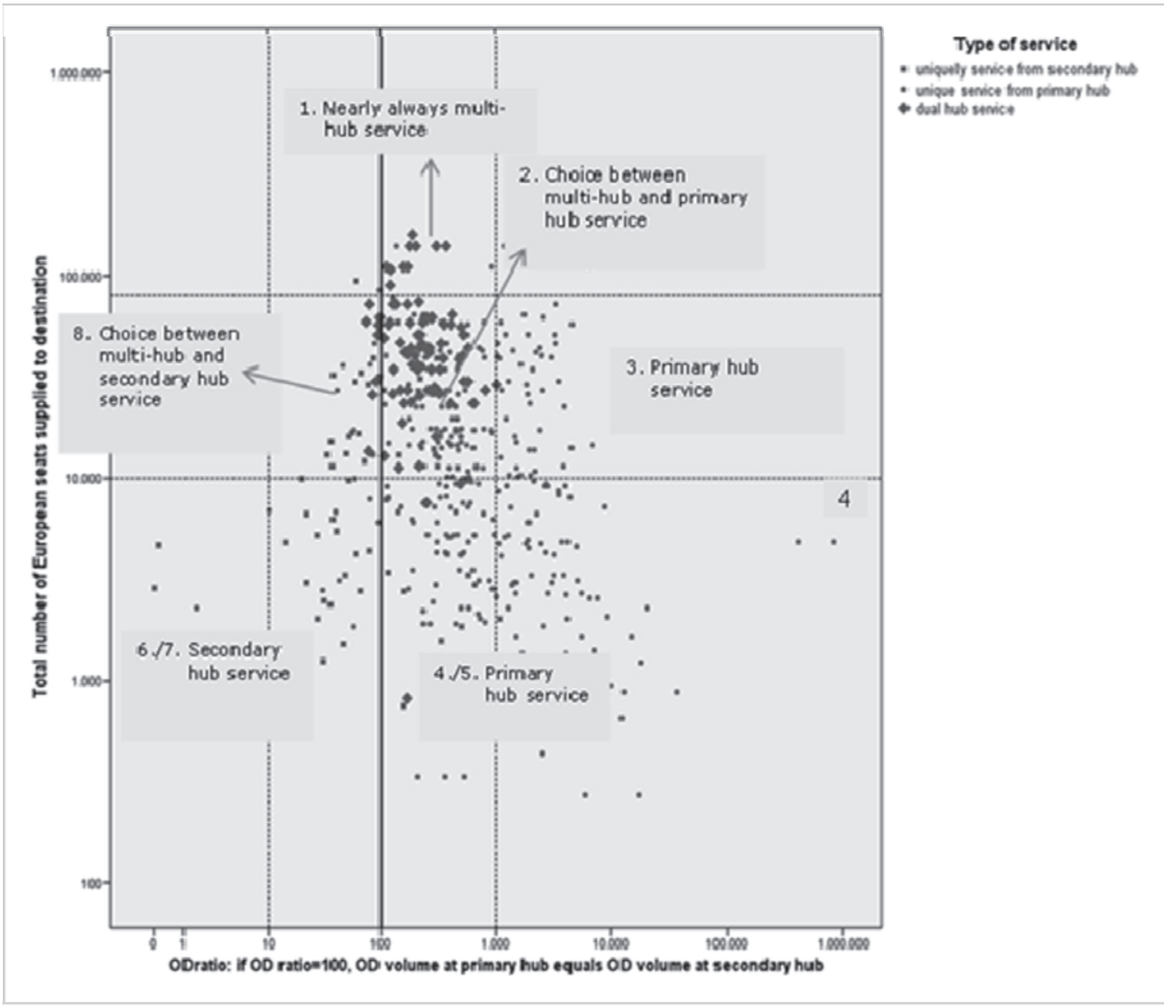
We have consolidated the results for the various individual multi-hub specialisation profiles into one aggregate profile (figure 5.10). In other words, the destinations in Air France-KLM system, the Lufthansa system, the Iberia system and Alitalia system have been put together in one hub specialisation profile. For each destination for a combination of two hubs part of the same multi-hub network (e.g. AMS-CDG or FRA-MUC), it is shown if the destination has single hub service from the primary hub (the largest of the two), single hub service from the secondary hub (the smallest of the two) or dual hub service.

From the consolidated figure, a number of conclusions can be drawn:

- Multi-hub service is the case for long-haul destinations with a large demand from/to Europe (vertical axis) and where the size of the local origin-destination market of the primary hub is less than 10 times larger than the secondary hub (quadrant 1). These markets have enough European demand to tap into through feeder flights. They are also the markets with strongest local origin-destination demand (for example, New York).

- in markets where the primary hub has an advantage in the local market and the size of the destination is somewhat smaller, either primary hub or dual hub service is the case (quadrant 2). The larger the European market size, the higher the chance of multi-hub service. The size of the feeder network at the hub, its geographical location and possibly the strength of the yield on the local origin-destination market are likely to be important factors that influence the choice between single or multi-hub service.
- when the advantage of the primary hub becomes larger (quadrant 3), unique service from the primary hub seems to be the rule. In markets where the local market advantage of the primary hub is over 10 times larger than that of the secondary hub, primary hub service is the case. The same holds true for destinations with a very small European market potential and an advantage of the primary hub in the local market (quadrants 4 and 5).
- on destinations with a smaller European market size potential and an advantage of the secondary hub in the local origin-destination market, service from the secondary hub only is generally the case (quadrant 6/7). Note that the destinations in these quadrants are mainly found in the Amsterdam- Paris Charles de Gaulle and Frankfurt-Zurich multi-hub combinations.
- for destinations with a larger European market potential, secondary hub service tends to dominate, but primary hub and multi-hub service are possible as well.

Figure 5.10 **Consolidated multi-hub specialisation profile**



Source: OAG and MIDT.

4.Multi-hub network services and the implications for airport capacity expansion strategy

From the discussion on hub systems follow a number of considerations and discussion items regarding airport capacity expansion strategies for the London area:

Split hub operation results in connectivity loss

Spreading one airline's hub operation over multiple airports in the London metropolitan area will result in a disproportionate loss of the hub connectivity potential, as well as associated economies of scope & density. This implicates that for a globally operating hub airline, sufficient peak-hour capacity needs to be available at a least one of the airports in the London metropolitan area. If this capacity is not supplied, it will sustain an underperformance of direct long-haul connectivity vis-à-vis other European hub airports. Consumers in the London metropolitan area will need to transfer via hubs inside and outside Europe to reach to their final secondary (long-haul) destinations, resulting in additional travel costs. Long-haul traffic from other UK airports will increasingly leak away via hubs inside and outside Europe.

Hub operation less important for short-haul connectivity level in the Metropolitan area

For short-haul operations, the size of the hub operation is important but to a smaller extent. For the short-haul segment, a large local O&D market may still translate into a large short-haul connectivity level provided by various carriers at different airports in the metropolitan area, even without a large hub operation. Given the large local market in the London area, it is likely that the short-haul network will be supplied in both a concentrated and deconcentrated airport capacity expansion scenario.

Large London O&D market likely to make London the preferred hub in a multi-hub network, provided that sufficient capacity is available

Given the fact that the London area has the largest O&D market in Europe, an airport in the London area with sufficient peak-hour capacity can be expected to become the primary hub in the multi-hub system of a transnational multi-hub carrier for the majority of the long-haul destinations. That means that most long-haul destinations will be at least served from the London hub, and in case of larger destinations, also from the secondary hub. Only for markets where the secondary hub has a specific geographical and/or O&D advantage, the secondary hub may have a preference. Given the large O&D market between Spain and Latin America as well as the better geographical location for accommodating Europe-Latin America traffic, Madrid is likely to be the preferred hub for Latin American destinations within IAG.

Second hub carrier?

Given the vast O&D market from the London area, it could be argued that London is one of the few metropolitan areas in Europe where expansion of multiple airports with a peak-hour capacity sufficient to sustain a long-haul hub operation -or a new airport sufficiently large to support two hub carriers- could possibly give room to a competing hub operation in the London area besides IAG. The fact that the main markets to/from London hub are fully liberalised (Europe and North-America) does at least not constrain such a scenario.

Selectivity policy to enhance connectivity

Geographical concentration of an airline's hub operation at a single airport in the Metropolitan area is essential condition for a successful hub. Yet, this condition does not necessarily hold for point-to-point operations. Carriers that mainly carry point-to-point traffic can (and do) use alternative airports in the Metropolitan area.

Hence, when a choice is made for expansion of the existing London airports instead of building a new airport, one could think about ways to further optimise the use of the current airport system by influencing the airport traffic distribution. Ideally, network operations with a high connectivity contribution will make use of the primary airports (Heathrow and Gatwick), whereas point-to-point operations use mainly the other airports elsewhere in the area.

Such a selectivity policy is currently explored in the Netherlands with the aim to use Amsterdam Schiphol mainly for network-related and business traffic when capacity problems arise in the future. Market-based and administrative demand management tools can be used to influence the traffic distribution between the airports in the Metropolitan region[10]. On the market-based side, pricing, airport incentives and slot are options. On the administrative side, one could think of local rules in the slot allocation, traffic distribution rules based on EU Regulation 1008/2008 and traffic quota. However, especially an administrative selectivity policy is not without risks. Government interventions in the traffic distribution between European airports do not have a particularly strong track record in achieving the desired results[11] and they may limit downstream competition.

Sticky airlines

When a decision would be taken to construct an entirely new airport, the question remains what to do with the capacity at the already existing airports. Opening a new airport while keeping the old one open bears the risk of severe under-utilisation of the new facility, even if the old facility is close to capacity. The existing primary airports are located more conveniently vis-à-vis the city centre, with better landside infrastructure in place and firmly embedded in the regional economy. When airlines have the choice, they may not want to move to the new facility.

The airport planning cases of Milan Malpensa versus Linate, and most notably the planning disaster of Montreal Mirabel illustrate very well the risk of building greenfield airports far away from the city centre, while keeping the old facility open. In contrast, closing the old airport when opening a new one has proven to be much more successful as the cases of Denver, Kuala Lumpur and Hong Kong illustrate.

NOTES

1. Hub connectivity is defined here as the number of connecting opportunities per week, weighted for the quality of each individual connection in terms of transfer and detour time, and meeting the MCT criterium as well as being an online connection within a single airline or alliance. See Redondi & Burghouwt (2013) for a discussion of connectivity measures

2. This figure has the purpose to show the power of hubs in terms of connectivity. Many methodological remarks can be made: population within a 100km range for metropolitan areas with multiple airports is an underestimation of the real catchment area potential, as only the population has been counted within 100km range from the primary airport. For London, this means that the airport is underperforming in long-haul connectivity relative to its local market. It is also acknowledged that a 100km range gives only a first rough indication of the catchment area as other factors such as airport competition (route overlap), time sensitivity, segmentation of airport traffic and landside access quality (travel time) play a role.

3. Hub connectivity is defined as the number of connecting opportunities per week, weighted for the quality of each individual connection in terms of transfer and detour time, and meeting the MCT criterium as well as being an online connection within a single airline or alliance. See Burghouwt & Redondi (2013) for an overview of connectivity measures.

4. Services of alliance partners not included.

5. Note that our data only give insight into actual demand volumes, not into market stimulation. A new direct intercontinental service from a hub reduces travel costs for consumers and will generate additional passenger demand. In addition, the data we had at our disposal only provide insight into demand volume, not into passenger yield.

6. The cases in the 'wrong' quadrant (such as Newark and Mumbai) are slightly misleading: most of them were actually served by SkyTeam alliance partners from Amsterdam.

7. This may partly reflect the availability of high-speed rail feeder system. Local passengers travelling from Lyon to Paris CDG by TGV are counted as local Paris passengers in our data.

8. Note that our data only give insight into actual demand volumes, not into any market stimulation as a result of a direct flight out of Munich. In addition, passengers travelling by high speed rail from Munich to Frankfurt Airport to take their long-haul flight are counted as local Frankfurt passengers.

9. A 75-90 min train journey

10. See e.g. Gillen (2007)

11. See e.g. the traffic distribution rules for the Milan airport system

Bibliography

Adler, N. and J. Berechman (2001), "Evaluating optimal multi-hub networks in a deregulated aviation market with an application to Western Europe". Transportation Research Part A 35 (2001), 373-390.

Bèl, G. and X. Fageda (2008), "Getting there fast: globalization, intercontinental flights and location of headquarters", *Journal of Transport Geography* 8, 471-495.

Burghouwt, G. (2007), *Airline network development in Europe and its implications for airport planning*, Aldershot: Ashgate.

Burghouwt, G. and J. de Wit (2009), "De netwerkkwaliteit op Schiphol", *Economisch-Statistische Berichten*, 94 (4555), 148-151.

Burghouwt, G. and R. Redondi (2013), "Connectivity in air transport networks. An assessment of models and applications", *Journal of Transport Economics and Policy* 47(1), 35-53.

Button, K. (2002) "Debunking some common myths about hub airports", *Journal of Air Transport Management*, 8(3), 177-188.

Dennis, N.P. (1994), "Airline hub operations in Europe", *Journal of Transport Geography*, 2(4), 219-233.

Dennis, N.P. (2005), "Multi-hub networks: airport capacity, network structures & scheduling issues", Presentation at Airneth workshop multi-hub strategies, 28 October 2005, The Hague.

Duedden, J-C., (2006), "Multi-hub network configurations- a temporary or permanent outcome of airline consolidation? " *Review of network economics*, 5(4), 421-434.

De Wit, J. and Burghouwt, G. (2005). "Strategies of multi-hub airlines and the implications for national aviation policies", Airneth report 1. www.airneth.nl

De Wit, J. and G. Burghouwt (2009), *De netwerkkwaliteit op Schiphol*, ESB 94 (4555), 148-151 (in Dutch).

Gillen, D. and W.G. Morrison (2005), "Regulation, competition and network evolution in aviation", *Journal of Air Transport Management*, 11(3), 161-174.

Gillen, D. (2007), "Demand management: options for ensuring the efficient use of airport capacity", Presentation on the 1st Airneth Annual Conference, 11-13 April 2007, The Hague.

Goedeking, P. (2010), *Networks in aviation*, Heidelberg: Springer Verlag.

Lijesen, M., P. Rietveld and P. Nijkamp (2001), "Hub premiums in European civil aviation", in: *Transport Policy*, 8(3), 193-199.

Martín, J.C. and C. Román (2004), "Analyzing hub competition for hub location in intercontinental aviation markets", *Transportation Research* Part E, 40(2), 135-150.

Mendes de Leon, P. (2009), "Establishment of air transport undertakings – Towards a more holistic approach", *Journal of Air Transport Management*, 15(2), 96-101.

Nero, G. (1999), "A note on the competitive advantage of large hub-and-spoke networks", *Transportation Research* Part E, 35(4), pp. 225-239.

O'Kelly, M. (1998), "A geographer's analysis of hub-and-spoke networks ", *Journal of Transport Geography*, 6(3), pp. 171-186.

Redondi, R., P. Malighetti, and S. Paleari (2012), "De-hubbing of airports and their recovery patterns ", *Journal of Air Transport Management* 18(1), 1-4.

Smyth, M. and B. Pearce, (2007), "Aviation Economic Benefits", IATA Economics Briefing 8.

Starkie, D. (2006), "The dilemma of slot concentration at network hubs", IATA-paper.

Suau, P., G. Burghouwt and M. Pallares (2012), Catchment area database.

Suau, P. and G. Burghouwt (2011), "The geography of the Spanish airport system: spatial concentration and deconcentration patterns in seat capacity distribution, 2001-2008", *Journal of Transport Geography*, 19(2), pp. 244-254.

Swan, W.M. (2002). "Airline route developments: a review of history", *Journal of Air Transport Management*, 8(5), 349-353.

Tretheway, M.W. and Oum, T.H. (1992). "Airline economics. Foundations for strategy and policy", Vancouver: University of British Columbia.

Wojahn, O.W. (2001a), "Airline networks", PhD thesis.

Wojahn, O.W. (2001b), "Airline network structure and the gravity model", Transportation Research Part E 37, 267-279.

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Expanding Airport Capacity in Large Urban Areas

Expanding airport capacity in large metropolitan areas is difficult. Community agreements on noise constrain growth at existing airports. Land prices can be prohibitive for relocating airports. Most new sites require extensive investment in surface transport links to city centres. In multi-airport regions, options for expansion at the airports are to an extent interdependent, complicating assessment of whether to build new runways.

Many major airports are hubs for network carriers at the same time as serving a large local market. The complementarity between these functions may be a prerequisite for viable network operations, suggesting that distributing services over multiple airports instead of expanding the main hub would be costly. Hub airports and their network carriers often compete with hubs in neighbouring regions. The strategies of network carriers and potential new entrants to this part of the market need to be taken into account in assessing future demand for airport capacity. The requirements of low cost and other point-to-point carriers are equally important, but different.

This report reviews international experience in reconciling planning and environmental constraints with demand for airport capacity and the potential benefits in terms of productivity and growth from developing international airline services. Experience is compared in London, New York, Tokyo, Osaka, Sydney and in Germany's main airports with particular attention to the dynamics of airline markets and implications for airport planning in multi-airport cities.

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