

Niemeier, Hans-Martin

Working Paper

Regulation of large airports: Status quo and options for reform

OECD/ITF Joint Transport Research Centre Discussion Paper, No. 2009-10

Provided in Cooperation with:

International Transport Forum (ITF), OECD

Suggested Citation: Niemeier, Hans-Martin (2009) : Regulation of large airports: Status quo and options for reform, OECD/ITF Joint Transport Research Centre Discussion Paper, No. 2009-10, Organisation for Economic Co-operation and Development (OECD), Joint Transport Research Centre (JTRC), Paris

This Version is available at:

<https://hdl.handle.net/10419/68800>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



JOINT TRANSPORT RESEARCH CENTRE

Discussion Paper No. 2009-10
May 2009

*Regulation of Large
Airports: Status Quo and
Options for Reform*

Hans-Martin NIEMEIER
University of Applied Sciences
Bremen

REGULATION OF LARGE AIRPORTS – STATUS QUO AND OPTIONS FOR REFORM

Hans-Martin NIEMEIER,
University of Applied Sciences, Bremen*

“Practice, which is evolving rapidly, continues to outstrip theory, providing challenges to the profession in modelling, testing, and proposing superior and workable alternatives.”
(Newberry, 2003)

Executive Summary

Over the last 25 years the governance structure of airports has changed in many parts of the world. Privatisation and commercialisation of airports together with the intense airline competition have put the airline/airport relationship under stress. The OECD has invited all stake holders to engage in a **rational dialogue** on airport regulation. Economics can provide criteria for such a dialogue. Regulation should be designed to increase **economic welfare in a fair and democratic process**.

- Airport users should be protected from prices above competitive levels.
- Airports should produce technical and cost efficiencies.
- Airports should ration demand efficiently.
- Airports should invest an optimal amount.
- Regulation should be based on a legislative democratic mandate and should not be dependent on special interests.
- The regulation should be a fair, accessible and open process without high bureaucratic costs.

Currently airports do not perform well in terms of cost efficiency, allocative efficiency and investment behaviour.

- There is evidence of **poor cost control**, particularly at partially privatised airports. The cost reducing potential of outsourcing terminal operation and ground handling has not been fully exploited, particularly at many European airports.
- **Allocative efficiency** requires different pricing regimes depending on cost characteristics and capacity utilization.

* School of International Business, Werderstr. 73, 28199 Bremen, Germany,
Email: Hans-Martin.Niemeier@hs-bremen.de

- For airports with **ample capacity**, weight based landing fees are not correlated to runway damaging costs. The weight based structure is an imperfect Ramsey pricing scheme. Both imperfections lead to an inefficient traffic mix.
- At **capacity constrained** airports capacity is rationed inefficiently. While the IATA system does not rely on queuing like the US system, it does not confer slots to users that could make the highest productive use of them. Market based slot allocation could result in double-digit billion welfare gains in Europe. Currently the slot limit is not set at a level where the marginal congestion costs equal the value of an additional slot. Most busy airports have kept their traditional weight based charges. This discriminates against large aircraft resulting in an inefficient traffic mix. A uniform charge per movement would be appropriate.
- **Over-investment** occurs in areas with lack of demand and under-investment at places with excess demand. This may be due to the non existence of price signals for excess demand as well as a lack of cost benefit approach at airport expansions.

Market power can arise from a **locational monopoly**, as it is often not possible to build airports next to a gateway airport due to planning restrictions. Another reason might be that airports are **natural monopolies with sunk costs**. Empirical evidence suggests that economies of scale might range from 3 to 12 perhaps even 90 million pax. It seems that market power is not held by the *airport industry*, but by *some airports*. Regulation must be complementary to a slow developing process of competition and not restrictive.

However, the intensity of competition even in Europe is not strong to make regulation completely redundant. The intensity of hub competition is limited by the high switching costs for airlines due to specialised investment and non-tradable slots. Competition between hub and secondary depends on traffic rights, aircraft technology and hub congestion. If catchment areas overlap, as in London or Bratislava/Vienna, competition might work well. The strength of airport competition has to be assessed on a case-by-case basis. It could be intensified by horizontal disaggregation of BAA, ADP and preventing airport alliances (ADP/Schiphol) and open skies.

If competition is often not strong enough, **regulation** is an important tool to increase economic welfare and needs to be **assessed**.

- **Regulatory institutions** need independence and democratic control like in the UK. The vast majority of European countries lack independent regulatory institutions, an indication of high internal rents as a dependent regulator undermines the position in case of conflicts with airlines.
- The **scope of regulation** is both too narrow and too large. It is too narrow in that the central infrastructure for ground handling is not covered. It is too large in that potential competitive activities are indirectly regulated by the single till principle. At busy airports, single till results in too low a level of airport charges and rents for slot owners.
- **Cost-based regulation** is dominant in Europe and elsewhere. It results in incentives for gold plating, high costs and inefficient price structures leading to allocative inefficiency. It is a major cause for the poor performance of airports.
- Although **price caps** are used only in hybrid forms, which set the cap on the cost base at the beginning of the regulatory period, they have substantially lowered price levels in Australia, UK and at some European airports. Price caps leave the structure of charges unregulated, setting incentives to balance price structure in the direction of efficiently

rationing peak and excess demand. Hybrid caps could be improved by benchmarking, with better data adjusted for the heterogeneity of airports.

- **Monitoring** is practised with mixed results in Australia and New Zealand. A major weakness is that the objectives are not clearly defined, with the risk of being practised as a loosely defined cost plus regulation. It needs an independent regulator with sufficient power to provide a credible threat to re-regulate.
- **Investment regulation** is of growing importance as major airports face persistent excess demand. The regulation of airport investment becomes more complex as prices do not carry information on the strength of excess demand. Slot rents are the consequence of scarce capacity and accrue to airlines under current slot allocation rules. Airports and regulators are ignorant of slot prices. Additional capacity often comes at a higher cost. Price caps must allow for higher charges and can lead to optimal investment but do not necessarily achieve it. A price cap might lead to underinvestment if when regulators fail to provide credible guarantees against opportunistic behaviour.
- Regulation must be designed to be **compatible with airport competition**. Therefore it is necessary to establish independent regulators in order to avoid regulatory capture and create a fair playing field. Cost regulation as well as cost-based monitoring and revenue sharing agreements are not compatible with competition. These should be reformed as pure price caps which allow firms to react to competition by changing the price structure. Price caps set upper limits but firms can also lower price levels in order to compete.

In a **nutshell**, airport regulation is in need of reform. Regulate less, but more effectively, with fair and democratic processes and institutions. Use a credible threat of regulation. Second, regulate and increase competitive forces. Implement simple price caps with strong incentives for cost savings and efficient pricing and investment. Design a competitive landscape with open skies, less horizontal integration and slot markets.

Introduction

Over the last 25 years, the governance structure of airports has changed in many parts of the world. Today airports are no longer a homogenous group of public utilities, but a heterogeneous group with ownership structures ranging from state-owned to partial and even full privatisation, with regulatory systems ranging from cost regulation to price cap and even to complete deregulation and with different degrees of competition, ranging from pure monopolistic to oligopolistic markets. Airports, even publicly owned airports, have become more commercialized and more profit oriented. Thus, the upstream markets within the vertical air transport supply chain followed the trend set by the downstream markets, as the airline industry underwent these changes earlier and many (“downstream”) air transport markets are now characterized by fierce competition between airlines (Winston and de Rus, 2008).

These changes have put the airline/airport relationship under stress. The vertical relationship of the aviation industry does not resemble the smoothly operating supply chains of other industries, but more like the opposite of a perfect supply chain that managers learn to operate in their MBA courses. It has led to a heated debate over airport regulation and the rules that determine the quality, quantity and price of airport services for airlines. IATA claims that airports are natural monopolies which are ineffectively regulated and which “are exploiting, in many cases, their natural monopoly position” (IATA, 2007, p. 2.). The ACI response to this is that airports are a competitive industry which should not be regulated at all. The Association of German Airports argues for example that today, in Germany, “airports are in tough competition and therefore the level of airport charges is determined by market mechanisms” (translation by author) (ADV, 2007, p 2).

The OECD has taken up this issue and asked for some scientific guidance. The objective of this paper is to provide criteria, information and concepts for an objective discussion and dialogue between airports, airlines, regulator, governments and the general public but with specific reference to gateway airports. The focus is on gateway airports which provide access to a country for international passengers and/or cargo. Therefore the analysis confines itself to the regulation of hubs and secondary airports. The latter are included because they provide some competition to hubs, although they are not gateways in the strict sense. On the contrary, no small airports, nor those that serve only regions with a small population density, nor secondary ones within metropolitan regions, will be considered.

In the first section the paper develops the criteria to evaluate regulation. It then provides an overview on the performance of airports. In the third section rationale for airport regulation are discussed. Thereafter the alternative to regulation will be analysed. Can competition among airports substitute regulation, or is the competition between gateway airports not sufficiently intense? In the fifth section, the strength and weaknesses of different regulatory regimes are evaluated and options for a reform are discussed. The paper closes with a summary.

1. Criteria for a dialogue on airport regulation

In a dialogue on airport regulation airlines, airports and other partners of the aviation industry argue from their own perspective and self-interest. This is not to be criticized or even condemned, as market economies rely on self-interest and managers rent seeking as a normal process of maximizing shareholder value. However, entering a dialogue on public policy implies that it is not sufficient to argue only in one’s own interest, as a particular proposal might be beneficial to one party but more costly for another. Therefore it is necessary to define criteria for a rational dialogue on airport regulation which are acceptable to all parties and to which not only lip service is paid.

Regulatory economics provides here a widely shared set of criteria (see Baldwin and Cave, 1999; Brunekreeft and Neuscheler, 2003; Forsyth, 1997; Kunz, 2000). The basic idea is that regulation should lead to the same results as perfect competitive markets. It will later become obvious that regulation can only achieve such results if regulators are perfectly informed, which they are typically not. Although only second best solutions are feasible this does not make the criteria useless as they define what a perfect system might achieve. Similar competition is not perfect in most industries, but competition policy tries to correct these imperfections to achieve outcomes for competitive markets.

The criteria of airport regulation consist of a set of economic welfare and institutional criteria.

Economic welfare

Airports maximize economic welfare under the following conditions:

- A. Airport users should be protected from prices above competitive levels. Charges should be set at marginal cost or, if marginal costs are below average costs, at prices minimising the welfare loss.
- B. Airports should produce technical and cost efficiencies; that is, they should use only the minimum of resources to produce a given level of output, and should select from these technical efficient combinations those which minimize the cost of producing this output level.
- C. Airports should ration demand efficiently. If demand exceeds capacity, output should be distributed to those with the greatest willingness to pay.
- D. Airports should invest an optimal amount; that is, the marginal benefit of additional capacity should equal its marginal costs.

In order to maximize economic welfare, it is necessary to price environmental externalities correctly. As this paper confines itself to economic regulation it does not deal with this issue and leaves it to environmental regulation. But it should be noted that at many large airports environmental externalities are ineffectively priced, leading to the problem of political acceptance for urgently needed new capacity (Gillen, 2000 and Niemeier, 2000).

Fairness and democratic acceptance

Regulation is a process in which the involved parties interact with each other and with the regulator. This process presupposes some notion of fairness and democratic acceptance¹. Regulation should fulfil the following criteria (Baldwin and Cave, 1999, Vass, 2005):

- A. Legislative mandate from elected legislature. Parliament should define objectives of regulation, such as above economic criteria.
- B. Independency and accountability to democratic bodies. The regulator should not be dependent on special interests. The function of regulator and ownership should be separated. Parliament should control the regulator if he fulfils his statutory obligations. It should not intervene directly in day-to-day business.

1. In this context fairness is not defined by the outcome. The outcome should be efficient, as defined above.

C. The regulation should be a fair, accessible and open process. It should be carried out with expertise and aim at appropriate non-biased decisions.

D. The legislative mandate is efficiently implemented without high bureaucratic costs.

These criteria are widely shared². The European Union and many other jurisdictions have accepted the criteria of efficient pricing in their principal concept of transport policy in general, and their airport policy in particular (European Commission, Transport Directorate, 1995).

2. How have airports performed?

Given the above criteria for economic efficiency, the question arises as to how well or poorly airports perform. This is a question which has only recently been studied by economists because of the changes in government regimes. These changes which make the airport industry so interesting for economists also make performance analysis so difficult.

2.1. Evidence on Cost inefficiencies

Obviously airports differ from one another depending on the economic characteristics of the markets they serve (and the markets which serve the airports) and the institutional framework within which they have to provide their services. Cost inefficient production might not always be due to bad performance by airport management; it may also result from imperfect markets and government regulation. For example inefficiency may result from:

- Legal and structural barriers to market entry that prevent competition (see section 3).
- Inadequate ownership structures that create inefficient incentives for management.
- Inadequate regulatory rules (e.g. how to provide security) that force management to produce inefficiently.
- Low-density hinterland that the airport serves which prevents management from fully exploiting potential economies of scale and density.
- Operational and environmental factors such as unattractive location, scarcity of land, bad weather and inefficient, but costly, environmental constraints.

Some of these factors are beyond the control of management and politics either in the short, or long, run. For example, the takeoff and landing system is beyond managerial control in the short run, but in the long run it can be changed. Noise problems might be mitigated in the short run by noise surcharges, and in the long run by land use planning. Measuring efficiency requires a lot of data, particularly in order to establish the causes of inefficiency. Data problems are not easy to overcome; the measurement of capital and the degree of vertical integration being particularly difficult.

A number of studies attempted to measure airport performance using different methods³ to try to control the differences between airports that may have an effect on airport performance but

2. It should be noted that objectives such as fair sharing of revenues, strengthening international competitiveness and creation of new jobs are not appropriate criteria for a dialogue on airport regulation, as they create unintended consequences which result not only in less efficiency and welfare, but sometimes even in higher unemployment and loss of competitiveness.

which are outside the control of management (for an overview see Kamp *et al.*, Francis, *et al.* 2002). Of particular interest here are studies that take into account governance structures that vary between airports

- While Parker (1999) found no impact on the technical efficiency of BAA airports prior to, and following, privatization, Hooper and Hensher (1997) for Australian airports, and Barros and Dieke (2007) for Italian airports, show that commercialisation and privatization improves performance.
- Oum *et al.* (2006, 2008) compared worldwide airports with different ownership structures and concluded that public and fully privatised airports operate more efficiently than other ownership forms. Interestingly, the Continental European model of partially privatised airports failed.
- The Air Transport Research Society (ATRS 2008) investigated the impact of different management strategies. By outsourcing of services such as the operation of terminals airports achieve higher efficiency scores. Substantially different degrees of vertical integration can be observed between Europe and North America. Whereas the terminal operation and often ground handling is provided by the airport operator (*e.g.* Germany), both activities were contracted out in North America leading to higher performance ratings. Of course, there are large differences among European airports: German airports have so far achieved only low ranking (for a discussion see Kamp, *et al.* 2007).

Studies on the effects of privatisation on performance have not isolated the effects of different forms of economic regulation supporting or rejecting the hypothesis that incentive regulation tends to improve the airport's efficiency rather than cost-plus regulation. Here, further research needs to be done.

2.2. Allocative inefficiency

Allocative efficiency requires that airport services are correctly priced. This requires different pricing regimes for airports depending on their cost characteristics and their capacity utilization. Two broad cases can be distinguished. Airports might have ample capacity and have to cover fixed costs. Alternatively airports might have scarce capacity, either at peak times or all day long. Efficient pricing requires different price structures and levels (see below for the leading two regulatory cases). The evidence is that airports are inefficiently priced, in particular because airports have a weight-based landing fee and do not change the price structure should demand and cost conditions change.

Because of lumpy investment the demand curve might cut the average long-run cost function in the range of falling average costs (see below). Such airports have ample capacity and

-
3. The underlying quantitative methodology varies with some studies using parametric approaches such as Stochastic Frontier Analysis (SFA) to estimate a production or cost function. For simplicity, a greater number included the non-parametric Data Envelopment Analysis (DEA), which constructs the efficient frontier with linear programming. A limited number of studies focused on Total Factor Productivity (TFP) using index numbers because input prices, in particular capital of, are rarely available for airports. The selection of inputs and outputs is different according to the data availability and research focus. Some studies include only physical data, such as the number of gates as an input and the number of passengers as an output, whereas other studies prefer to incorporate financial measures, such as operating costs and revenues.

no rivalry exists for the users. For such airports first best marginal pricing is not feasible as marginal costs are below average costs. Airports must adopt second best pricing; that is, setting price and quantity at a level that maximize economic welfare subject to the airport at least breaking even. For simplifying the case of independent demand, the Ramsey rule is that the airport should mark up the price above marginal cost inversely to the price elasticity of demand. The traditional weight-based system can be interpreted as an attempt to find such a second best solution, because larger aircrafts with lower price elasticity pay more than small ones. However, two inefficiencies arise:

- Hogan and Starkie (2004) show convincingly that weight is not correlated to the damaging cost of the runway, taxiway and apron pavement and hence does not reflect marginal damage costs.
- The current weight based structure is an imperfect Ramsey pricing structure (Morrison, 1982) as “current fees increase too rapidly with aircraft size” and “do not increase with distance flown by the aircraft.” (ibid., p. 158, see also Martin-Cejas, 1997).

Both imperfections lead to an inefficient traffic mix and use of capacity with repercussions in the airline and aircraft manufacturing market. However, these welfare losses are smaller⁴ than the welfare losses at busy airports.

There are growing numbers of busy airports which face excess demand for a small part of the day, and very busy airports which face excess demand all day long. In both cases, rivalry exists for the users and the problem arises as to how to ration demand for a given capacity.

Allocative efficiency requires that scarce capacity should be given to those airlines with the highest willingness to pay and that, assuming intense airline competition,⁵ will make the best productive use of it. Excess demand can be either efficiently rationed by price or by quantity. Another option is to ration inefficiently through queues and administrative measures. So far, airports have implemented only inefficient options.

At most US airports charges are weight based and, unlike in Europe and elsewhere, scarce capacity is given on a “first come, first served” basis. At high density airports, national (not international) slots are allocated through a secondary trading system in combination with administrative measures. Overall, this system has performed inefficiently. Morrison and Winston (2005) estimate an annual welfare loss of \$ 6 billion for US-airports. While there is debate over the correct level of congestion charges, economists agree that peak and congestion pricing is one option to increase efficiency (Brueckner and Van Dender, 2008; Czerny *et al.* 2008).

In other parts of the world, airports have adopted the IATA slot allocation system. It has the advantage that congestion is not inefficiently rationed by queuing. This leads to less welfare decreasing congestion than the US system, as it coordinates ex-ante flights, but generally the slots are not given to users with the highest willingness to pay. In a study for the EU Commission, Mott Mac Donald (2006) estimated that secondary trading would lead to 7,2 % more passengers, 17.1 % more revenue passenger kilometers and 51.6 Mio more passengers, resulting in a gain in consumer surplus of + € 31bn and producer surplus + € 1.2 bn at current rates in 2025. It is therefore necessary to reform the distribution mechanism through such methods as well designed auctions and secondary trading. While this aspect has been intensively discussed two perhaps equally important factors of efficient rationing have been overlooked. An efficient

4. The welfare loss due to imperfect Ramsey pricing is small relative to the loss due to cost inefficiencies if demand is inelastic in countries with a low density of airports, such as New Zealand.

5. See Gillen and Morrison (2008) and Starkie (2008c)

allocation of given capacity requires, besides an efficient slot allocation mechanism, the correct choice of slot capacity and an efficient structure of airport charges. Currently, the slot limit at airports is set by some administrative process involving airline and airports. The authorities will seek to provide enough capacity at an acceptable level of delay. Most likely it will not be set at an efficient level, where the marginal congestion costs equal the value of an additional slot (Forsyth and Niemeier, 2008). Most busy airports have kept their traditional weight-based charges. This discriminates against those airlines which can use scarce slots efficiently. In particular, large aircraft pay relatively more than small aircraft, causing an inefficient mix at busy European hubs. A uniform charge per movement in the case of excess demand would be efficient. Unfortunately, few airports have adopted such a charge (Forsyth and Niemeier, 2008).

2.3. Suboptimal investment

The inefficient allocation of given capacity has important implications for the long-term adjustment from building new airports and expanding existent ones. In both respects the airport industry has not performed well. There is abundant capacity in areas with lack of demand and underinvestment in those with excess demand. This is a situation which has persisted over decades, has become more severe, and has created a bottleneck for the rapid expansion of air transport (Button and Reynolds-Feighan, 1999; Eurocontrol (2006); Morrison and Winston 2008).

In competitive markets, excess demand drives prices up, makes these activities profitable and signals the level and timing of adjustment. This has obviously not happened in the airport industry, and relates very much to short term inefficiencies. There are no prices reflecting short time excess demand. Peak and congestion pricing is generally not practised by airports. Slots are traded at no European airport with the exception of London. While trading there seems to work well, prices might be still inefficient due to arbitrary slot constraints and an inefficient structure for charges.

The current IATA system has another negative implication. It breaks the linkages between short- and long-term adjustment. It has created rents which do not fall to the airport, but to the airline companies. Some of these rents must have been dissipated and used for cross-subsidizing unprofitable routes or higher wages, as the major slot holders are not very profitable (Forsyth, 2008). The system has also created a quite stable coalition of slot creating airports and rent seeking airlines which, so far, has stopped any effective reform of airport pricing. Busy slot creating airports have abstained from efficiently pricing their assets and instead engaged in a political process of capacity expansion. The question of airport expansion is a political question, as it involves the assessment of environmental externalities such as noise and other local emissions. In this political process many airports have developed a “predict and provide” strategy based on the logic of “jobs versus the environment” (ACI, 1998). Airports hope that high growth promises, based on optimistic forecasts and employment effects generated by input output models, will lead to an acceptance of the negative effects of growth – namely noise and pollution – in the neighbourhood. However, such a strategy is logically flawed because expansion is a question of social net return on investment, which cannot be answered by input output analysis, but only by Benefit-Cost-Analysis. The strategy of airports, therefore, is very risky as not only the economics of airport extension but also the politics of airport extension become irrational. It is doubtful whether a political consensus on airport expansion will ever create an optimal amount of capacity for airports (Niemeier, 2001).

3. Why regulate airports?

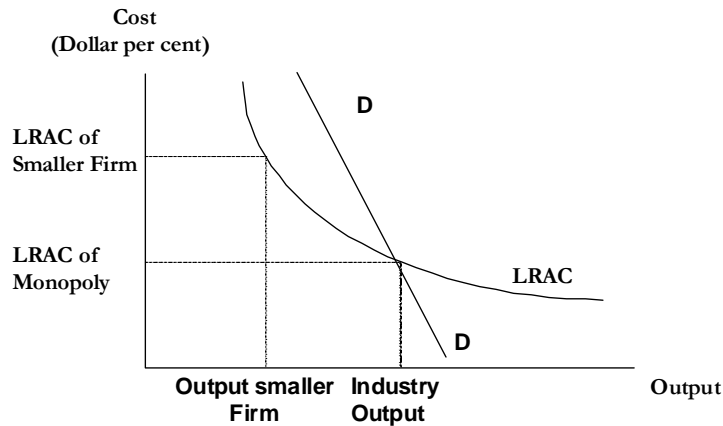
There are basically two⁶ rationales: a theoretical and a more pragmatic one.

The pragmatic one argues that for most airports there are no close substitutes, as attractive locations are limited (Forsyth, 1997). It seems next to impossible to build a competing airport next to hubs like Frankfurt or Paris airports. Such airports have a *de facto* monopoly reflecting planning and environmental restrictions, and they have market power in the provision of aviation services which should be regulated.

The theoretical rationales are rooted in the general theory of market failure applied to public utilities and to airports (for an early treatment see Bator, 1958; for a recent textbook treatment see Church and Ware, 2000). Airports might have such production and cost characteristics that competition cannot work because they are natural monopolies that is an industry “whose cost function is such that no combination of several firms can produce an industry output vector as cheaply as it can be provided by a single supplier” (Baumol *et al.* 1977, p. 350). For the simple case of a single product (see Figure 1) this is the case if the demand curve D intersects the long run average cost curve LRAC in its decreasing part and because a portion of the fixed costs of airports are sunk.⁷ In such a case, the airport which could attract more traffic realizes economies of scale due to density, and would have such a cost advantage that it would drive out the other airport and have a monopoly. As a new airport requires specialized investment while the capital costs of the incumbent monopolists are sunk, this airport cannot be challenged by a new entrant. Such a natural monopoly is efficient as two or more airports would lead to higher average costs, but the efficiency gains might be lost due to market power. A profit maximizing airport would charge prices well above average costs. Therefore the market power of the natural monopolist has to be reduced either by public ownership or, in the case of a private operator, by a regulator.

-
6. Positive network effects are another factor which has been discussed, but which is not very well researched. There are benefits to airlines and passengers to concentrate their operation at one airport, thereby creating economies of density due to higher frequencies, larger aircrafts and joint usage of common facilities such as lounges. As part of these costs are sunk costs *e.g.* costs of building up hub operations for the airlines, lock-in effects might occur and switching costs might be substantial. Although there are no estimates on this entry barrier they should not be overlooked. It may be that such positive network effects “create a more significant barrier to entry than do airport supply characteristics” (Australian Productivity Commission, 2001, p. 105)
 7. The concept of a natural monopoly can be extended for the case of multiproduct firms (see Baumol *et.al.* 1997). Economies of scope occur when it is less costly to produce different services jointly than separately. However there are few estimates on the strength of economies of scope in the airport industry. It is plausible that economies of scope might arise from the use of runways for scheduled, charter and freight traffic as well as from jointly offering aeronautical services (Australian Productivity Commission, 2001, p. 102) Furthermore, rising average costs are consistent with natural monopoly (see, the discussion on weak natural monopoly in Church and Ware, 2000, p. 759)

Figure 1. **Natural Monopoly**



Both rationales have to be carefully applied and thereby face major challenges. The pragmatic one faces the problem that it might misinterpret the performance of an airport. The profits of an airport might not reflect monopoly, but locational rents. It is not easy to disentangle location and monopoly rents, as planning restrictions might result from successful rent seeking of public or private airport operators. Nearby public airports are very often kept in one hand, which might reflect a preference for less competition. Private investors demand that the public should not allow new airports to be operated within the catchment area. As economists have traditionally taken planning decisions as given, these questions have not been well studied.

The theoretical rationale must acknowledge that there is no clear evidence on the shape of the long run cost function. Therefore estimates differ substantially at what level economies of scale are exhausted (see below table 1). Average costs might fall up to a level between 3 and 12.5, or even up to 90 million passengers, and hubs might experience diseconomies of scale. Furthermore, it is unclear if the cost curve is very flat so that the cost disadvantages of small airports may not be so large.

Table. 1. Economies of Scale at Airports

Study	Observed period	Sample of Airports	Output	Method	Results
Doganis and Thompson (1973)	1969-70	18 UK airports	WLU	Parametric	L-shape cost curve with decreasing average costs up to three million.
Tolofari <i>et al.</i> (1990)	1979-1987	7 BAA airports	WLU	Parametric	Economies of Scale until 20.3 million WLU
Doganis <i>et al.</i> (1995)	1993	25 airports thereof 12 European airports	WLU	Parametric	L-shape cost curve with decreasing average costs up to five million
Salazar de la Cruz (1999)	1993-95	16 Spanish airports	Passenger	Non-Parametric	Decreasing average costs up to 3.5 million passengers, increasing from 12.5 million
Main, Lever and Crook (2003)	1988 –2001	27 UK airports	WLU and passengers	Parametric	Sharp decreasing costs up to 4 million passengers and 5 million WLU and weak decreasing costs up to 64 million and 80 million passengers.
Main, Lever and Crook (2003)	1998- 2001	44 airports of TRL data set	WLU	Parametric	L-shape cost curve with decreasing average costs up to 90 million WLU
Pels (2000)	1997	35 European airports	Air traffic movements (ATM) and Air Passenger Movements (APM)	Non-Parametric	Average airport with 12.5 Mio. APM passengers and 150 000 APM operates under constant returns to scale for ATM and increasing returns for PTM.
Vogel (2005)	1990 to 1999	47 European airports	Passenger	Non-Parametric	Increasing economies of scale of up to 4 million terminal passengers
Jeong (2005)	2003	94 US airports	WLU and passengers	Parametric	Economies of Scale present until 2.5 million pax or 3 million WLU
Martin and Voltes-Dorta (2007)	1991-2005	41 worldwide airports	ATM and WLU	Parametric	Economies of scale do not exhaust at any output level

It may also be the case that airport policy may change and new planning regimes might allow entry. 'Natural' does not mean that circumstances never change. Many former public utilities, especially within the aviation sector, have been transformed into competitive firms. The production technology can change and, in particular, the demand curve might shift to such a level that two or even more airports can be sustainable. Liberalization may be possible and could lead to substantial welfare gains (Winston, 1993)

These problems have important implications for the design of regulation. First of all, it is important that *the airport industry as a whole* has market power, but only some airports have market power. Second, regulation should carefully assess the industry structure with their particular circumstances. If, for historical reasons as in the UK, there are many former military airports in one region and the public gives them for free to private investors, economies of scale are not an issue and airport competition might work so that regulation is only temporarily required, if at all (Starkie, 2008). However, this might be not the case in many regions of the

world. Therefore, in the third place, regulation must be complementary to a slowly developing process of competition. A form of regulation should be designed which can be combined with competition. Finally, the rationale for regulation must be revisited in time: is it necessary at all? Which airports should be designated and which airports should be subject to the threat of regulation?

4. How strong is airport competition?

With liberalization of the airline market and the commercialisation and privatisation of airports, competition between airports has certainly begun to develop in many parts of the world. It has taken many forms (Air Transport Group Cranfield, 2002, Forsyth, 2006). In particular, low cost carriers are now serving many airports which did not play any role at all. Today, many small airports are competing for this type of traffic (Lei *et al.*, 2009). For some regions, such as the Manchester/Liverpool region or the Düsseldorf/Cologne region, airport competition has become (or at least could be) so intense that regulation is not necessary (Starkie 2008, Malina, 2009). In Australia, New Zealand (Forsyth, 2009c) and Greece (Papatheodorou, 2009) the distance between airports is too large. For gateway airports four forms of competition⁸ are relevant.

- a) Hub competition: Passengers and shippers can choose between different airlines to fly through different hubs to their long haul destination. Airports compete through the airlines to win this traffic. The intensity of hub competition has with a few exceptions (Schiphol versus ADP, Heathrow versus Gatwick) not been intensively studied (Burghouwt, G. and Veldhuis, J. (2006). If hubs were close substitutes, hub airports could easily win new hub carriers. While in the US some airlines have switched hubs, Europe has relatively stable hub and spoke networks (Burghouwt and de Wit, 2005). Hub competition is limited by a relatively high switching cost for airlines because hub operation is a specialised investment. In some cases air service agreements restrict traffic rights, making switching unattractive. Most relevant, as many hubs are slot coordinated, slot trading is not possible so that airlines are locked in (Wolf, 1999). Nevertheless, the alliance of Schiphol and ADP is an indication that airlines might shift traffic and airport managers try to reduce this competition (De Wit 2009, Forsyth *et al.*, 2009) Overall, hub competition is currently rather limited – partly because regulation of air service agreements prevents it from realizing its potential.
- b) Hub and secondary hub: The intensity of competition (for example Heathrow versus Manchester, Fraport versus Munich versus Stuttgart versus Düsseldorf versus Hamburg) depends in particular on traffic rights, aircraft technology and hub congestion. Traffic rights may play an important, but very often underestimated, role. In many countries, particularly in Europe, only certain airports were designated as landing points in air service agreements. They gained economies of scale and scope in the past and are today offering high connectivity. Although today open sky agreements are not as important, as landing points are no longer specified (with the notable exception of Stuttgart airport in the bilateral with the United Arab Emirates) secondary airports are at a disadvantage (Gillen *et al.*, 2000). So far, no secondary airport in Europe has become a major hub – which might have happened if competition were intense.

8. Airports are competing in other markets with other firms. The shopping mall of an airport competes with the local shopping mall. How this affects competition among airports and how it might restrain monopoly power are questions demanding further research. See Starkie 2001 and 2002, Gillen, 2009

- c) Primary and secondary airport: There are few regions where a relatively large airport competes against a mid-sized secondary airport. For example, most recently Luton won traffic from Stansted (Starkie, 2009c). Vienna and Bratislava are competitors, indicated by the attempt of Vienna to buy Bratislava which was blocked by the *Slovak Competition Authority* (Forsyth *et al.* 2009). Overall, this type of competition is currently not strong enough as airport products differ and access costs might be high (Forsyth *et al.* 2009).
- d) Potential competition: In competitive markets with strong growth and persistent excess demand, entry would occur and competition would be intense. In Europe, only a few market entries were observed but not in areas with strong demand – with the exception of Manchester (Müller-Rostin *et al.*, 2009). Unlike the airline industry, potential competition has no disciplinary force.

In summary, Forsyth (2009) is certainly correct in his review on European airport competition that “there does not seem to be much evidence of strong competition between the airports of medium to large cities”. The intensity of competition even in Europe is not strong enough to make regulation completely redundant. However, it is necessary to assess the forces of competition on a case-by-case basis. Such an analysis should include the different types of traffic, for example cargo versus passengers and intermodal competition from high speed trains (see Mandel, 1999 and Kouwenhoven, 2008). It should also include the potentials of competition by horizontal disintegration in cases like BAA and ADP (see Starkie and Thompson, 1985), abstaining from alliances such as ADP/Schiphol Alliances, further liberalisation of air service agreements and by slot trading.

5. How to regulate airports?

As competition is currently not strong enough to limit the market power of airports in such a way that airports become cost and allocative efficient, the question arises if effective regulation can achieve this. Given the cost, but more important the allocative inefficiencies of airports (see section 2), regulation of airports might be more complex than regulation of other public utilities. Regulation is very often thought of as reducing the level of prices and thereby forcing the firm to become more efficient. This is certainly also an issue with airport regulation as airports show signs of gold plating and too high costs. But regulation of airports faces another problem. Reducing the level of charges at busy airports will increase the excess demand. Therefore regulation of airports faces the additional problem of rationing demand efficiently and setting incentives for investment. Hence the structure of charges, the allocation mechanism and the incentives for investment become a major issue for airport regulation.

This section analyses the strengths and weaknesses of airport regulation by analysing the institutional design of regulation, its scope, the different types of regulation, and specific problems such as incentives for optimal investment. Finally, the relationship between competition and regulation will be discussed.

5.1. Institutional design of regulation

The issue of good governance has been a major economic issue in developing countries but, surprisingly, when it comes to airport regulation in industrialized countries it remains an issue (for US airports see Morrison and Winston, 2008). The regulator and also the monitoring agency⁹ should be independent but accountable to democratic bodies and regulation should be a fair,

9. Independency is important for all types of regulation, in particular for monitoring. See 5.3. below.

accessible and open process. These self evident principles have not been widely practised in Europe (see below) and are therefore part of the new directive on airport charges.

Table 2. Regulation of large European Airports, 2007

Rank	City	Code	PAX Mio	Regulation Form	single/dual till	Regulator	Private share %
1	LONDON	LHR	68,1	Incentive	single till	independent	100
2	PARIS	CDG	60,0	Incentive	single till	dependent	32.5
3	FRANKFURT	FRA	54,2	cost based	dual till	dependent	47.2
4	MADRID	MAD	52,1	Cost-based	single till	dependent	0
5	AMSTERDAM	AMS	47,8	cost based	dual till	independent	0
6	LONDON	LGW	35,2	Incentive	single till	independent	100
7	MUNICH	MUC	34,0	Cost-based	single till	dependent	0
8	ROME	FCO	32,9	Cost-based	dual till	dependent	97
9	BARCELONA	BCN	32,8	Cost-based	single till	dependent	0
10	PARIS	ORY	26,4	Incentive	single till	dependent	32.5
11	ISTANBUL	IST	25,6	Cost absed	n.a	dependen	14
12	MILAN	MLP	23,9	Cost-based	dual till	dependent	0.88
13	LONDON	STN	23,8	Incentive	single till	independent	100
14	DUBLIN	DUB	23,3	Incentive	single till	independent	0
15	PALMA DE MALLORCA	PMI	23,2	Cost-based	single till	dependent	0
16	MANCHESTER	MAN	22,7	Incentive	single till	independent	0
17	COPENHAGEN	CPH	21,4	Incentive	dual till	dependent	77.3
18	ZURICH	ZRH	20,7	no regulation			42
19	OSLO	OSL	19,0	Incentive	single till	dependent	0
20	VIENNA	VIE	18,8	Incentive	dual till	independent	50

Source: 2007 ACI-EUROPE, GAP data base.

So far, independent regulators have been established only in Austria, Ireland, the Netherlands, and the United Kingdom. Interestingly, very often countries are privatise their airports without addressing clashes of interest. In Austria, Vienna airport was privatised in three steps in 1992, 1995 and 2001. Up to the last step the central government held a major share and regulated the airport charges (for further discussion see Wolf, 2003). German airports are regulated by the federal states that have a minority or majority share in the partial privatised airports of Frankfurt, Hamburg and Hannover (Müller *et al.*, 2008).

A fair, accessible and open process requires at minimum a consultation process. In the past 15 years, an increasing number of European states have implemented a consultation on airport charges, and today it has become standard (ACI, 2003). There is still room for improvement, as often the airports fail to provide the necessary information to make a decision on airport charges transparent and plausible to the airlines. The standards of transparency in UK

regulation, with parliamentary control and openness for the general public, are rarely met in continental Europe. One example is the recent price cap regulation of Aereports de Paris, in which key figurers such as the value of the regulated asset base were not made public (Morgan Stanley, 2006, p. 4). It is also reflected in the minority share Lufthansa holds in their main hub Frankfurt in order to be better informed.

Given the likelihood of more intense conflicts between both parties, a dependent regulator undermines the position of (in particular privatised) airports. Therefore, the lack of support from many European airports for independent regulators is surprising and can be explained as by short sighted behaviour, a lack of incentives or as an indication of high rents. All these explanations are clearly signs of inefficiencies and show how important it is to avoid regulatory capture (Stigler, 1971).

5.2. Scope of regulation

Regulation should be confined to those activities in which the airport has persistent monopoly power. This is the case where the airport services are essential for downstream users and cannot be duplicated without substantial costs. Traditionally, the starting and landing system with the apron and the passenger and freight handling terminals are regarded as such services. Non aviation activities and ground handling are seen as activities in which the airport might have some market power, but at least potential competition could discipline the airport (Kunz 1999b, Templin, 2009). Liberalization of ground handling allowed self handling and third party providers to enter the market. Ground handling services should not be regulated, but central infrastructure services, such as baggage handling systems, should be part of the regulated activities. This is not an issue in countries like the UK, where airports do not offer ground handling, but in others like Austria, Germany, Italy, Spain and France. In Germany, the regulation of charges does not – with some notable exceptions like Düsseldorf – cover the central infrastructure fee, so that some airports which were not able to raise their charges found an easy way out by shifting costs to their users. At Amsterdam and Rome Flumicino the central infrastructure fee is regulated, while in Paris Charles De Gaulle and Madrid Barajas this is not the case (Templin, 2009).

Besides the direct regulation of certain activities of an airport, all activities can be regulated indirectly through the single till principle under a price cap as well as under a cost-based regulation. It is one of the most debated issues among airports and airlines and the pro and cons in this debate are summarized in the table below (for an excellent overview see Starkie and Yarrow, 2001).

Table 3. **Single Till**

Pro	Con
Shifts monopoly rents to the users	No increase in efficiency
Non aviation revenues are created by airline passengers	Tax on non aviation
Windfall profits	No direct regulation of profits
Simple to control	Less information, but allocation of common costs is difficult
Improves Ramsey pricing	Decreases level of charges at busy airports

The single till passes potential monopoly rents from non aviation activities to the users through lower charges, but thereby it does not prevent the creation of market power. As most probably monopoly rents are lower than locational rents, the single till shifts rents without increasing efficiency. Airlines argue that non aviation revenues and passenger throughput are closely correlated and that therefore the revenues should be shared. However, this argument neglects the fact that the decision is taken by the consumer and the airport is the supplier of the services. The single till principle acts like a tax on the supply of airport services, as the airport has to pass parts of its revenues to the users. Therefore it reduces the incentives to develop the non-aviation business. The airlines fear that a shift from the dual to the single till principle raises charges and creates windfall profits for the airport. This is most probably the case, but regulation should not try to regulate profits directly as this reduces incentives for cost savings from which the airlines also gain. The single till is by no means easier to implement and control than the dual till. However, the dual till has the disadvantage of separating the regulated from the non regulated activities, which implies the need to allocate common costs in a pragmatic way. Subsequently it needs less information. At airports with ample capacity the single till might be part of Ramsey pricing to cover fixed costs. However at airports with excess demand at peak times it reduces the level of charges, thereby lowering the scope for the airport to ration efficiently by price differentiation. In these circumstances rationing can only be achieved by slot allocation. Relying on the inefficient IATA slot allocation schemes does not make much sense. Overall the arguments for a dual till carry more weight and seem to prove the principal that regulation should not intervene in workable competitive markets and to restrict itself to the monopolistic bottleneck.

The single till principle was recommended by ICAO and has been widely used in Europe, but this long tradition is slowly breaking up. The UK was obliged to regulate UK airports by a bilateral air service agreement, but this is not the case. The CAA recommended a dual till in 2001, but surprisingly the Competition Commission rejected the proposal with dubious arguments (Starkie, 2008). Australian airports were price capped on a dual till principle (Forsyth, 2004). In Europe the price cap for Hamburg Airport was one of the first to be set on a dual till (Niemeier, 2002). Since then, more German airports have adopted the dual till – however on a cost plus basis resulting in higher charges without any efficiency gains.

The distortions due to the single till are only obvious at some airports. At ADP the retail and real estate business is, relative to other European Hubs, underdeveloped and ADP has roughly the size of London Heathrow to develop this business. The regulatory framework is a single till, with a vaguely defined option to take part of real estate and retail income out of the till in the next regulation period from 2011 to 2015. Morgan Stanley (2006) values the ADP in different scenarios between € 38.1 and € 127.1 per share. The differences are mainly due to different degrees of non-aviation business left out in the till. These differences give a rough idea of the magnitude of the distortions caused by the single till principle.

5.3. Types of airport regulation

The central problem for regulation is that the regulator has asymmetric information about the demand and cost functions and that the regulator must design a contract to set incentives for the regulated firm¹⁰. While high powered regulation sets incentives for cost reductions and productive efficiency and an efficient price structure, low powered regulation does not. Given the information asymmetry, the regulated firm will provide the regulator with the information only if it can keep some of its informational rents. Therefore all types of regulation will not achieve first best

10. In addition, the airport also has asymmetry information about the regulator. The airport does not know how the regulator will regulate prices in the future on which the profitability of investment depends. See below 5.4.

outcomes. Also, so-called “light handed regulation”, a term used for monitoring, faces this asymmetry and should be evaluated as to whether it can set strong incentives for efficiency.¹¹

Traditionally, in Europe and elsewhere,¹² airport charges have been regulated on a rate of return or cost plus basis. This is a rather low powered type of regulation as it sets no incentive for cost reduction. Littlechild (1983) tried to overcome these deficiencies with price cap regulation. While the following discussion showed that many of the original claims of superiority were exaggerated and that there might be better regulatory systems, there remain important differences among the practical regulatory regimes for airports. The paper differentiates between cost based regulation, pure price caps, hybrid price caps, revenue sharing agreements and monitoring.

Cost based regulation

The vast majority of authorities in Europe regulate airport charges according to principles of cost relatedness. The charges should create just enough revenues to cover total costs including the depreciation of capital and a normal rate of return on capital. The structure of charges should also be cost related, namely each charge should reflect its costs. Charges are supposed to be set to ICAO principles of cost relatedness.

The problems with cost based regulation are well known (see for example Sherman, 1989). Firstly, the incentives are set for *inefficient choice of inputs*. If the allowed rate of return on capital is above the cost of capital the airport has an incentive to expand the capital base to increase profits (Averch Johnson effect). Furthermore, there are high incentives for cost-padding leading to productive inefficiency. Secondly, cost based leads to an *inefficient price structure*. Under cost based regulation the airport has no incentive to adopt peak pricing, but instead may overprice off-peak demand and under-price peak demand in order to justify capacity expansion. The incentives at cost based regulated airports are leading to uniform pricing without peak and congestion pricing. Cost based regulation sets prices in such a way that relative prices will lose the function to give guidance to the question at what time and to what extent airports should be extended. When excess demand exists, it is not rationed away efficiently, but rather, expensive additional capacity is provided which raises environmental and political concerns. The question of airport expansion becomes more and more a political question. In short, cost based allocation is a cause of cost and allocative inefficiencies and not the solution.

Pure and hybrid Price caps

Price cap regulation sets charges over a certain period in accordance with the rate of inflation (PRI) minus productivity gains (X). Unlike cost based regulation, price caps do not regulate profits, but set incentives to cost reduction. The gains from cost reduction can be kept by the regulated airport within the regulation period and might be then passed to the users via lower charges. Quality might be monitored or regulated as cost reductions might be achieved by lowering quality¹³.

-
11. In the following, the term “light handed” is not used because it is a rather misleading category. “Light-handed regulation” is a trendy expression, but also an empty one. However, price caps are light-handed constraints because they mimic competitive pricing ceilings and identify a wide range of pricing sets which are *ex ante* permissible” (Kunz, 1999 b, p 46)
 12. The US system has some similarities with price cap, but does not set any incentives for cost efficiency. See Graham (2004), Gillen (2009).
 13. See CAA, 2006, and Niemeier, 2002.

Pure and hybrid price caps differ in the way that the X is set in the price cap formula. The X should reflect the productivity growth of the regulated industry in excess of the rest of the competitive industry. Pure price caps set the X without reference to the costs of the regulated firm by benchmarking while hybrid set the X with reference to the regulated cost base. Hybrid price caps provide less incentives for cost reductions as for e.g. the regulated could be a high cost firm at the regulated period in order to raise prices and profits. Hybrid price caps have been used for UK airports, temporary for Australian airports and for some European airports. Overall the experience in terms of efficiency is positive, certainly better than cost based regulation (Graham, 2008, Forsyth, 2008). Price cap regulation is superior to cost based regulation because it is forward looking, while cost plus regulation relies on historic costs. The regulatory lag of typically 5 years is sufficient to set at least some incentives towards cost reduction. In addition, price cap regulation does not regulate the charges structure according to some arbitrary cost allocations based on historic costs. A well defined price cap sets incentives for Ramsey prices as well as for a reform of weight related charges at airports with excess demand.

The current practised systems of price cap regulation are certainly not perfect and could be reformed in many ways (see Forsyth 1997; Niemeier, 2002). One option is to set the X by benchmarking. This type of yardstick regulation has been successfully practised in the electricity (Netherlands, Norway, UK) and water industry (UK). The Irish regulator conducted a benchmarking but found, during the consultation process, that the results were not robust. Also, the CAA reached this conclusion and is using benchmarking only for specific processes to obtain information on productivity potentials, thereby trying to increase incentives for cost reductions. As there are no systematic reasons, preventing regulators from robust comparison benchmarking remains an interesting option (Bouf, and Léveque, 2004, Reinhold *et al.*, 2009).

Revenue sharing arrangements

Revenue sharing arrangements in the European airport industry take the form that the level of charges is inversely related to the passenger growth over a certain period. These so-called sliding scales can be combined with price cap regulation, as in the case of Hamburg, Vienna and regional Austrian airports, but do not have to be. At the German airports Fraport and Düsseldorf, they are the result of a Memorandum of Understanding between Fraport and airlines on the level of airport charges for the period 2002 to 2006. Thereafter a public contract between Fraport and the regulator, in the case of Frankfurt the Ministry of Economic Affairs and Transport of Hessen, in case of the Düsseldorf the Ministry of transport of North Rhine Westfalia, was signed. (Klenk, 2004). In case of disagreement the charges would be fixed according to cost based regulation. Most interestingly this contract has to date not been renewed for Frankfurt airport, indicating that major investments might lead to hold-up problems and high transaction costs not easily reduced by long term contracts (see below).

The core of these contracts is a revenue sharing agreement. The average charge per passenger will be determined by the future passenger growth rate. Both parties agreed that with a projected growth rate, for example 4 per cent, average charges could be raised by 2 per cent. Note that these are nominal prices as the agreement is not related to the price level. In the case of a higher growth rate airlines participate with a 33% share in additional revenues. With lower growth rates the airport cannot fully compensate revenue losses through higher charges. Only 33% of the loss can be compensated.

Such agreements have the important advantage that they break with the tradition of low powered cost plus regulation. Within the contract period, the airport may behave as though it is subject to a price cap, though not of the CPI-X form. Furthermore, they seem to offer some stability if demand fluctuates, as in the current economic crisis. A demand shock leads to higher charges so that the airport can cover average costs and that the airport will not face bankruptcy,

which would also undermine the political stability of regulation. However, there are disadvantages, too. Firstly, in cases of Frankfurt and Düsseldorf the incentives for cost reduction and for traffic increase are rather mild as the level of charges is stabilized at a high level reflecting more the limited countervailing power of airlines. Secondly, a flat linear sliding scale guarantees the airport nearly the same revenue irrespective of output. This reduces the incentives to change the historically grown price structure and to manage efficiently capacity problems. Thirdly, it most likely creates inefficiencies and non market clearing prices. Prices move in the opposite direction of demand shifts. This can only be efficient if short run marginal costs are decreasing. This might be the case for airports with ample capacity, but most gateway airports are highly utilized so that marginal operating costs are constant or rising and opportunity costs of delays are created. Sliding scales reflect more the behaviour of a sleepy monopolist preferring a stable revenue basis at whatever cost. They lead to inefficient price structures and to the unintended consequence that a macroeconomic recession is prolonged as charges do not fall and airlines cannot adjust to a new market clearing equilibrium.

Monitoring

Monitoring is a system of oversight with the threat of sanctions for poor behaviour. Monitoring differs from abolishing *ex-ante* regulation insofar as the behaviour of airports is closely followed. The most interesting examples are Australia and New Zealand (Forsyth, 2008). On 13 May 2002 the Australian transport minister decided to phase out price cap regulation and to adopt a more light handed regulation – namely monitoring of the main airports for a period of five years – with an independent review and the right to reverse powers of price control in case of abusive pricing. In New Zealand the approach is more general and looser, as the relevant minister can undertake a review of pricing behaviour in any industry. In 1998 the airports of Auckland, Christchurch and Wellington were subject to a review of pricing. The Commerce Commission recommended price regulation of Auckland in 2001, but the ministry did not follow up and left airports unregulated.

The strength and weaknesses depend on three aspects. Firstly, monitoring needs a credible threat (Kunz, 1999). This is first of all an institutional question. Is there an independent regulator with sufficient information and democratic support? This might be the case in Australia and, to a lesser extent, in New Zealand (Australian Productivity Commission, 2001), but it is not in those cases in which an independent regulator has never been established. Secondly, the guidelines have to be clearly and precisely stated. This has been not the case and is criticised by Forsyth (2008). Thirdly, the incentives towards efficiency depend on whether the guidelines demand cost based pricing or are incentive based. Forsyth shows that both systems are vague in this respect, but nevertheless “generally perform well in promoting efficiency” (ibid, p. 96).

Adopting monitoring might be an attractive option for other countries but, as Forsyth points out, the situation in both countries is very special in many respects. Airports are not busy due to overinvestment in the past and neither do they compete for geographical reasons. Airline competition is not as intense as in Europe or the US. Under these circumstances, traditional weight based charges are fairly efficient and have not to be reformed to manage capacity. Therefore it remains to be seen if monitoring can set incentives towards efficient pricing if capacity is scarce and airlines oppose such changes as they cannot pass higher charges to passengers as easily as with ample airport capacity.

5.4. Regulation of investment

The assessment of regulatory options focused so far on the short run cost and allocative problems with given capacity. Given the expected strong demand regulation of investment

becomes more and more important and creates a number of challenging problems (Forsyth, 2008, Guthrie, 2006):

- Risk of too low or too high demand. Uncertainty and risks of future demand is common to all industries, but airports and regulators face the additional problem that prices do not signal the strength of demand, scarcity rents are created for airlines but not for airports and that the inefficiencies of airlines usage of slots might be substantial. False prices affect the level and the structure of demand in terms of share of LCC versus FSA, choice of destination, aircraft size and so on. A vertically integrated air service provider would know these prices but, unlike in other network industries, these services are vertically unbundled in air transport. Regarding this problem, price caps and incentive based monitoring are superior to cost based regulation and revenue sharing agreements because of their incentives for efficient pricing especially if combined with slot markets (Niemeier, 2006).
- Cost of new capacity. The costs of adding new capacity are not known to the regulator but fairly well to the airport. Very often new capacity is costly. If the regulator triggers the new price level to the costs of new capacity, like for BAA and ADP, there are incentives for a price capped airport to invest. If the regulator underestimates these costs the airport will not invest¹⁴. If the regulator overestimates the costs and sets the regulated charges too high overinvestment might occur (Forsyth, 2008).
- Hold up problem. Building new terminals or a new runway are long-term projects with sunk costs characteristics. The costs of adding new capacity are not known to the regulator but fairly well to the airport. Very often new capacity is costly. Price caps have a shorter period than the revenues stream of the investment. After the investment decision of the airport the regulator might opportunistically lower prices to short run marginal costs. Anticipating this risk the airport might under invest (Helm and Thompson 1991). Therefore the investment decision depends on the credibility of regulation (Vickers and Yarrow, 1988). Cost-based regulation guarantees a safe return on the assets, but leads to overinvestment and gold plating. Hence it is hardly superior. The hybrid price cap regulation of the CAA established a clear framework that clearly signals to the airports that the regulator will leave the airport a fair return on investment for cost effective investments (Andrew and Hendricks, 2004).

Overall, there is little conclusive evidence on the empirical question if price cap leads to underinvestment. The Competition Commission has argued that BAA has not pursued investment in new capacity at Heathrow aggressively enough. This could be interpreted as an example of underinvestment. Starkie also acknowledged the incentives for underinvestment, but argues that these effects were outweighed by three factors, namely the preference of the management to avoid congestion and quality problems with users, the preference of managers to be managers of large firms and the strategy to deter entry (Starkie, 2006). Starkie provides evidence for overinvestment at regulated UK airports. One reason why it is difficult to provide a definite answer is that capacity enhancing investments create a number of externalities. The investment is ultimately decided by politics, typically basing their decision not on cost benefit rationale, but on dubious impact analysis.

14. An interesting example is the different approaches of the CAA and the CC in the UK. Yarrow (2009) defends the CAA and criticizes the CC for price capping at lower long run incremental costs.

5.5. Regulation and competition

It was argued above that regulation should be compatible with slow developing competition among airports and this raises some interesting problems.

In general competition creates positive effects, but it does not have to. The notion of competition defined as “the racing of one person against another, with special reference to bidding for the sale or purchase of anything” (Marshall, 1920, p. 5) does not imply good results, and competition has to prove its beneficial effects. Forsyth (2009) has argued convincingly that competition from new entrants might decrease welfare because economies of scale and scope are lost at the main airport. Competition might also result in tight oligopolistic markets with tacit collusion and constrained capacity due to planning restrictions. The hopes that a break up of BAA is the magic bullet are certainly unrealistic (Forsyth and Niemeier, 2009). However, airport competition can certainly increase welfare in many cases. Littlechild (1983) developed price cap regulation as an instrument to protect consumers, for a short time, from the monopolistic power of a privatised public utility. As it turned out regulation has had to play a longer role in the organization of infrastructure of network industry. Nevertheless it seems reasonable to think of regulation as a temporary device to transform a natural monopoly into a more or less competitive industry. Starkie (2008) argues that the UK airport industry has been transformed into a competitive industry with the exception of Heathrow. Regulation was part of this transformation and can play an important role as it safeguards private investors from opportunistic behaviour of the state (Wolf, 2003) and reduces transactions cost in the form of conflicts and litigations among the partners of the aviation supply chain (Niemeier, 2004). This is certainly relevant for European countries with a relatively high density of airports, but not for Australia or New Zealand.

Firstly, price regulation and other forms of regulation have to be independent, democratic and fair. This is important in two respects.

- A. If airports are exposed for the first time to some form of mild competition they have the incentive to engage in rent seeking. Airports might influence regulation to receive subsidies, erect barriers to entry, or increase costs of rivals in order to keep the quiet life of a monopolist or to avoid reductions in revenues and profits. Rent seeking is not confined to private airports. Also public airports are quite successful. Competition needs a fair playing field and regulatory capture distorts it.
- B. The regulation of investment showed that the system must be credible in order to avoid underinvestment. Competition increases these risks. Generally competition creates risks that airports fail as traffic shifts from one airport to another and risk that airports become very profitable. In such cases regulators might come under strong pressure to intervene and regulate profits which sets negative incentives for efficiencies.

Secondly, increasing competition implies that regulators have to decide carefully over time which airports should be subject to regulation and which are left unregulated with the credible threat to reregulate. This decision is not a matter of size and not something to be determined uniformly over markets and across countries like in the EU. Furthermore, the decision on designation should not be taken by the regulator as he might have an interest in prolonging regulation unnecessarily. In a study for the Federal government of Germany, Wolf (1997) developed a simple system of checks and balances as early as 1997. Unfortunately this was never taken up or seriously discussed - a clear failure of policy. It would also have reduced direct regulatory costs (Niemeier, 2002).

Thirdly, the currently dominant form of airport regulation is not compatible with competition (Vogelsang 1998, Niemeier, 2003). Cost regulation does not set any incentives to compete for

traffic through the price structure. This is also the case for cost orientated monitoring and for revenue sharing agreements. The latter tends to neutralize revenue losses from decreasing market shares due to competition. Price caps leave the structure unregulated and allows airports to react to competition by lowering prices for competing services. This form of competition is particularly relevant for competition among capacity constrained airports in London (Forsyth and Niemeier, 2009). Furthermore, price caps set only upper limits, and firms can lower price levels in order to compete, as Stansted has done in the past to win low cost carrier traffic from Luton (ibid.).

Fourthly, competition among airports in the long run relies on the ability to provide enough capacity for traffic from other airports. Therefore the regulation of investment, environmental management and planning restrictions become important. It might be necessary to provide more flexibility for negotiations between airlines and airports on investment and quality and to price noise and other externalities efficiently. However, it certainly is not necessary to give the regulator, as the Competition Commission (2008a and b) suggests, more powers to intervene in the regulatory period for the reform of regulating London's airports, as this contradicts incentive regulation and might cause gaming (Forsyth and Niemeier, 2009).

6. Summary

Given the changes in governance of airports and the stress in the supply chain of aviation, it is time to engage in a rational dialogue on regulation of airports. Economics can provide criteria for such a dialogue. Regulation should be designed to increase economic welfare in a fair and democratic process. It is argued that airports have a large potential to increase welfare. Currently airports do not perform well in terms of cost efficiency, allocative efficiency and investment behaviour. There is evidence on X-inefficiency and poor cost control. At capacity constrained airports capacity is rationed inefficiently due to IATA slot distribution rules, inefficient price structures and suboptimal slot constrains. Over investment occurs in areas with lack of demand and underinvestment at places with excess demand, indicating a wrong timing due to the non existence of price signals for excess demand and a lack of cost benefit approach at airport expansions.

These welfare losses might be at least partially due to unregulated market power. Market power can arise from a locational monopoly, as it is often not possible to build airports next to a gateway airport due to planning restrictions. Another reason might be that airports are natural monopolies with sunk costs. There is some evidence that even airports are natural monopolies, as economies of scale might range from 3 to 12, perhaps even 90 million, pax. Some Hubs are most likely constrained by scarce land leading to rising marginal and average costs. This issue requires more research as the shape and form of the long run average is not known. This lack of knowledge leads to the conclusion that the airport industry as a whole does not have market power, but some airports do have market power. Regulation must be complementary to a slow developing process of competition and not restrict competition. The rationale for regulation must be revisited periodically to assess whether it is necessary at all, which airports should be regulated and which airports should be subject to the threat of regulation.

Regulation might be substituted by competition for certain types of market structure. In this paper, the strength of airport competition was assessed for large airports. While in the US some switching of hubs occurred, hub and spoke networks have been relatively stable in Europe. The intensity of hub competition is limited by high switching cost for airlines, as hub operation involves specialised investment and scarce slots cannot be traded. Competition between hub and secondary depends on traffic rights, aircraft technology and hub congestion. It appears to be increasing, albeit from a low level. If catchment areas between large primary and secondary airports overlap, like Luton and Stansted or Bratislava and Vienna, competition might work

depending on access costs and product differentiation. Unlike with airlines, potential competition has hardly any force as only few market entries occurred, generally not in areas with strong demand. The strength of airport competition has to be assessed on a case-by-case basis. There is potential to increase competition by horizontal disaggregation of BAA and ADP, by preventing airport alliances such as ADP/Schiphol, through further liberalisation of air service agreements and through slot trading.

When competition is not strong enough, regulation is an important tool for increasing economic welfare. The need for regulation should be assessed on this basis. Regulation needs well-designed institutions. It needs independency and democratic control and backing. Only a few countries have followed the UK regulatory model. The vast majority of European countries lacks independent regulatory institutions, an indication of high internal rent as a dependent regulator undermines position in case of conflict with airlines.

The scope of regulation is too narrow as, for example, central infrastructure for ground handling is not covered and, at the same time, too large – as potential competitive activities are indirectly regulated by the single till principle. The rationale for dual till is a case of second best pricing to cover fixed costs in case of decreasing average costs. This is irrelevant if economies of scale are exhausted or marginal costs are rising due to factor scarcity. Hence the single till is most probably not relevant for large airports in metropolitan areas like London or Frankfurt. The dual till forces airports with ample capacity to Ramsey pricing by weight-based as well as more sophisticated charging schemes. Therefore the welfare gain of including non aviation revenues is limited and should be balanced against the risk of distorting other markets by taxing non aviation revenues. At busy airports, single till results in a too low level of airport charges and rents for slot owners.

Regulation has to address the problem that the regulator never has as much information on costs and demand as the airport. Successful regulation sets incentives for the airport to provide this information, allowing the airport to keep part of the information rent. The various types of airport regulation address this problem very differently.

Cost based regulation, which is the dominant form in Europe and elsewhere, sets incentives for gold plating, high costs and inefficient price structure leading to allocative inefficiency. It is a major cause of the poor performance of airports.

Although price caps are only used in hybrid forms, which set the cap on the cost base at the beginning of the regulatory period, they have substantially lowered price levels in Australia, UK and at some European airports. Price caps leave the structure of charges unregulated, setting incentives to balance price structure in the direction of efficiently rationing peak and excess demand. Hybrid could be improved by benchmarking with better data adjusted for the heterogeneity of airports. Unlike with other public utilities this is currently not possible, but this might change in the future.

Monitoring is practised with mixed results in Australia and New Zealand. A major weakness is that the objectives are not clearly defined, with the risk of being practised as a loosely defined cost plus regulation. It needs an independent regulator with credible threat to reregulate.

Revenue sharing agreements in the form of sliding scales try to cope with demand shocks by allowing higher prices with lower demand and vice versa. This is efficient only if short run marginal costs are declining, which is hardly the case at busy gateway airports. It stabilizes revenues, thereby reducing incentives to manage capacity efficiently. Revenue sharing agreements seem difficult to achieve if airports invest in major new runways and terminals.

Investment regulation is of growing importance as major airports face persistent excess demand. The regulation of airport investment faces the major problem that prices do not carry

information on the strength and magnitude of excess demand. Slot rents are the consequence of scarce capacity and accrue to airlines under current slot allocation rules. Unlike in other public utilities, air transport is not vertically integrated so that airports and regulators do not know slot prices. Additional capacity often comes at a higher cost. Price cap must allow for higher charges and can but not necessarily lead to optimal investment. Price cap might lead to underinvestment if the regulator cannot credibly commit to not behaving opportunistically. So far there is hardly any evidence for this type of regulatory failure in the airport sector.

Regulation must be designed to be compatible with airport competition. Therefore it is necessary to establish independent regulators in order to avoid regulatory capture and create a fair playing field. Cost regulation as well as cost based monitoring and revenue sharing agreements are not compatible with competition. These should be reformed to pure price caps, which allow firms to react to competition by changing the price structure. Price caps set upper limits and firms can also lower price levels in order to compete.

To sum up, reform of airport regulation is needed. Regulate less, but more effectively, with fair and democratic processes and institutions. Use a credible threat of regulation. Second, regulate and increase competitive forces. Implement simple price caps with strong incentives for cost savings and efficient pricing and investment. Design a competitive landscape by liberalization of air service agreements, less horizontal integration and slot markets.

Acknowledgement

I am grateful to Peter Forsyth, David Gillen, Vanessa Kamp, Nicole Adler, Jürgen Müller, David Starkie and Hartmut Wolf for extensive comments on earlier drafts of the paper. I am indebted for excellent research assistance to Xuan Hoa Bui and Christoph Prühn. Mark Winzler has carefully revised the English style. The research builds on data and analysis of the research project GAP (German Airport Performance) supported by the Federal Ministry of Education and Research. The responsibility for any remaining shortcomings remains the author's.

REFERENCES

- Airports Council International-European Region [ACI] (1998), *Creating Employment and Prosperity in Europe*, Brussels.
- Airports Council International-European Region [ACI] (2003), Airport charges in Europe, URL: <http://www.aci-europe.org/>
- Air Transport Research Society (ATRS) (2008), Airport Benchmarking Report – 2008: Global Standards for Airport Excellence, ATRS, Vancouver.
- Air Transport Group, Cranfield University (2002) *Study on Competition between Airports and the Application of State Aid Rules, Final Report, Vol 1*, September European Commission, Directorate-General Energy and Transport, Directorate F-Air Transport.
- Andrew. D. and N. Hendricks, (2004), Airport Regulation in the UK, 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. 101-116.
- Arbeitsgemeinschaft Deutscher Verkehrsflughäfen [ADV] (2007), *ADV sieht im Flughafenpaket" der EU-Kommission wichtige Initiative*, Pressemitteilung 01/2007, Berlin.
- Australian Competition and Consumer Commission (2001) *Price Regulation of Airport Services*, Submission to the Productivity Commission's draft Report October 2001, [www. pc.gov.au](http://www.pc.gov.au).
- Baldwin, R. and M. Cave (1999), *Understanding Regulation – Theory, Strategy, and Practice*, Oxford, Oxford University Press.
- Barros, C.P. and P.U.C. Dieke, (2007), Performance Evaluation of Italian Airports with Data Envelopment Analysis. *Journal of Air Transport Management*, 13 (4), pp. 184-191.
- Baumol, W. J., J. Panzar and R. D. Willig (1982), *Contestable Markets and the Theory of Industry Structure*, New York, Harcourt.
- Bator, F. M. (1958), The Anatomy of Market Failure in *Quarterly Journal of Economics*, 72 (3), pp. 351-379.
- Bouf, D. and J. Léveque, (2004), Yardstick Competition for Transport Infrastructure Services, in: ECMT: Transport Services: *The Limits of (De)Regulation*, Round Table 129, Paris, ECMT. 2006. pp. 63-108.
- Brueckner J.K. and K. Van Dender (2008), Atomistic congestion tolls at concentrated airports? Seeking a unified view in the internalization debate, *Journal of Urban Economics*, 64 (2), pp 288-295.

- Brunekreeft, G. and T. Neuscheler, (2003), Regulierungsregime in Theorie und Praxis, in: G. Knieps and Brunekreeft, G. (eds), *Zwischen Regulierung und Wettbewerb, Netzsektoren in Deutschland*, Verlag: Physica-Verlag, 2nd ed., Heidelberg.
- Burghouwt, G. and J. de Wit, (2005), Temporal Configurations of Airline Networks in Europe, *Journal of Air Transport Management*, 11 (3), pp.185-198.
- Burghouwt, G. and J. Veldhuis (2006), The Competitive Position of Hub Airports in the Transatlantic Market, *Journal of Air Transportation*, 11 (1), pp.106-130.
- 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.
- Church, J. and R. Ware, (2000), *Industrial Organization: A Strategic Approach*, New York, McGraw-Hill.
- Competition Commission (2008a) *BAA Market Investigation Emerging Thinking*, April, www.competition-commission.org.uk
- Competition Commission (2008b) *BAA Market Investigation Provisional findings report*, August, www.competition-commission.org.uk
- Czerny, A., P. Forsyth, D. Gillen and H. M. Niemeier, (eds.) (2008), *Airport Slots: International Experiences and Options for Reform*. Ashgate, Aldershot.
- Doganis, R. and G.F. Thompson, (1973), *The Economics of British Airports*, Report of an Investigation sponsored by the Social Science Research Council, London.
- Doganis, R., A. Lobbenberg and A. Graham (1995), *The Economic Performance Of European Airports*, Research Report 3, Dept of Air Transport, Colleague of Aeronautics, February 1995, University of Westminster, London.
- European Commission, Transport Directorate (1995) *Towards Fair and Efficient Pricing in Transportation*, Policy Options for Internalizing The External Costs of Transport In the European Union, Brussels.
- Eurocontrol (2006): *EUROCONTROL Long-Term Forecast*, IFR Flight Movements 2006 – 2025; European Organisation for the Safety of Air Navigation.
- Forsyth, P. (1977) Price Regulation of Airports: Principles with Australian Applications, *Transportation Research-E*, 33 (4), pp. 297-309.
- Forsyth, P. (2006), Airport Competition an: Regulatory Issues and Policy Implications, in: Lee, D. (ed.), *Advances in Airline Economics: Competition Policy and Antitrust*, Amsterdam, Elsevier, pp. 347-368.
- Forsyth, P. (2004) Replacing Regulation: Airport Price Monitoring in Australia, in: P. Forsyth, D. Gillen, A. Knorr, O. Mayer, H. M. Niemeier and D. Starkie (eds.), *The Economic Regulation of Airports*, Aldershot, Ashgate, 2004, pp. 3-22.

- Forsyth, P. (2008 a), Airport slot: Perspectives and Policies, in: A. Czerny, P. Forsyth, D. Gillen and H. M. Niemeier, (eds.), *Airport Slots: International Experiences and Options for Reform*. Ashgate, Aldershot, pp. 379-405.
- Forsyth, P. (2008 b), *Infrastructure Regulation and Investments*, 7th Conference on Applied Infrastructure Research (INFRADAY) TU Berlin October 10-11, 2008.
- Forsyth, P. (2008 c), Airport Policy in Australia and New Zealand: Privatization, Light-Handed Regulation, and Performance, in C. Winston and G. de Rus (eds.), *Aviation Infrastructure Performance A Study in Comparative Political Economy*, Washington, Brookings Institution Press, pp 65-99.
- Forsyth, P. (2009), Airport Competition: A Perspective and Synthesis, in: P. Forsyth, D. Gillen, J. Müller and H. M. Niemeier (eds.), *Competition in European Airports*, Ashgate, Aldershot, forthcoming.
- Forsyth, P. and H. M. Niemeier, (2009), Competition and the London Airports: How Effective will it be?, in: P. Forsyth, D. Gillen, J. Müller and H. M. Niemeier (eds.), *Competition in European Airports*, Ashgate, Aldershot, forthcoming.
- Forsyth, P., H. M. Niemeier and H. Wolf (2009), International Airport Companies and Airport Alliances – The Implications for Competition, in: P. Forsyth, D. Gillen, J. Müller and H. M. Niemeier (eds.), *Competition in European Airports*, Ashgate, Aldershot, forthcoming.
- Francis, G., Humphreys, I. & Fry, J. (2002). The benchmarking of airport performance. *Journal of Air Transport Management*, 8 (4), 239-247.
- Gillen, D. (2000), in: Benefits and Costs of Alternative Cost Management Strategies, in T. Immelmann, W. Pfähler, H. –M. Niemeier, and O. Mayer (ed.), *Aviation versus Environment ?*, Frankfurt am Main, Peter Lang Publisher 2000, pp. 70-110.
- Gillen, D. (2009) *The Evolution of the Airport Business: Governance, Regulation and Two-Sided Platforms*, Martin Kuntz Memorial Lecture, Hamburg Aviation Conference, February 2009, www.hamburg-aviation-conference.de
- Gillen, D., H. Hinsch, B. Mandel, and H. Wolf, (2000b), *The Impact of Liberalizing International Aviation Bilaterals on the Northern German Region*, Aldershot, Ashgate.
- Gillen, D. and H. M. Niemeier (2008), *The European Union: Evolution of Privatization, Regulation, and Slot Reform*, in C. Winston and G. de Rus, eds., *Aviation Infrastructure Performance A Study in Comparative Political Economy*, Washington, Brookings Institution Press, pp. 36 – 64.
- Gillen, D. and W. G. Morrison (2008), Slots and Competition Policy: Theory and International Practice, in A. Czerny, P. Forsyth, D. Gillen and H. M. Niemeier, (eds.), *Airport Slots: International Experiences and Options for Reform*. Ashgate, Aldershot, pp. 173 -191.
- Graham, A. (2004), The Regulation of US Airports, in P. Forsyth, D. Gillen, A. Knorr, O. Mayer, H. M. Niemeier and D. Starkie (eds.), *The Economic Regulation of Airports*, Aldershot, Ashgate, pp. 63 -74.

- Graham, A. (2008), Airport Planning and Regulation in the United Kingdom, in C. Winston and G. de Rus (eds.), *Aviation Infrastructure Performance A Study in Comparative Political Economy*, Washington, Brookings Institution Press pp. 100 -135.
- Guthrie, G. (2006), Regulating Infrastructure: the Impact on Risk and Investment, *Journal of Economic Literature*, 44 (4), pp. 925-972.
- Helm, D and D. Thompson (1991) "Privatised Transport Infrastructure and Incentives to Invest", *Journal of Transport Economics and Policy*, 25 (3), pp. 213-246.
- Hogan, O. and D. Starkie, (2003), Calculating the Short-Run Marginal Infrastructure Costs of Runway Use: An Application to Dublin Airport, in: P. Forsyth, D. Gillen, A. Knorr, O. Mayer, H.-M Niemeier, and D. Starkie (eds.), *The Economic Regulation of Airports: Recent Developments in Australasia, North America and Europe*, Aldershot: Ashgate Publishing, pp. 75–82.
- Hooper, P. and D. Hensher (1997), Measuring total factor productivity of airports - an index number approach, *Transportation Research Part E: Logistics and Transportation Review*, 33 (4), pp. 249-259.
- International Air Transport Association IATA (2007), *Economic Regulation*, IATA Economics Briefing no. 6, Montreal.
- Jeong, J. H. (2005), *An investigation of operating costs of airports: focus on the effects of output scale*, Master Thesis, University of British Columbia, Vancouver, Canada.
- Kamp V., H. M. Niemeier and J. Müller (2007) What can be learned from benchmarking studies? Examining the apparent poor performance of German airports, *Journal of Airport Management* 1 (3), pp. 294-308.
- Kouwenhoven, M. (2008), The Role of Accessibility in Passengers' Choice of Airports, *OECD Discussion Paper No. 2008-14*, Paris.
- Kunz, M. (1999) Airport Regulation: The Policy Framework, in: Pfähler, W., H. M. Niemeier, and O. Mayer (eds.), *O. Airports and Air Traffic – Regulation, Privatisation and Competition*, Peter Lang Verlag: Frankfurt New York, pp. 11-55.
- Kunz, M. (2000) Regulierungsregime in Theorie und Praxis, in: Knieps, G. and G. Brunekreeft (eds.) *Zwischen Regulierung und Wettbewerb – Netzsektoren in Deutschland*, Heidelberg, Physica, pp. 45-79.
- Lei, Z., A. Papatheodorou and E. Szivas (2009), The Effect of Low-cost Carriers on Regional Airports' Revenue: Evidence from the UK, in P. Forsyth, D. Gillen, J. Müller, and H. M. Niemeier (eds.), *Competition in European Airports*, Ashgate, Aldershot forthcoming.
- Littlechild, S. (1983), *The Regulation of British Telecommunications Profitability*, London, Department of Industry.
- Main, B., B. Lever, and J. Crook, (2003), Central Scotland Airport Study, *Hume Occasional Papers*, vol. 62, Edinburgh.

- Malina, R. (2009), Competition in the German airport market – An empirical investigation, in P. Forsyth, D. Gillen, J. Müller, H. M. Niemeier (eds.), *Competition in European Airports*, Ashgate, Aldershot forthcoming.
- Marshall, A. (1890/1920) *Principles of Economics*, 1st edition 1890, 8th edition 1920, London, Macmillan.
- Mandel, B. (1999), Measuring Competition –Approaches for (De)Regulated Markets, in: W. Pfähler, H. M. Niemeier, O. Mayer (eds.), *Airports and Air Traffic, Regulation, Privatisation and Competition*, Peter Lang Frankfurt, pp 71-92.
- Martin-Cejas, R. R. (1997), Airport Pricing Systems in Europe and an application of Ramsey pricing to Spanish airports, *Transportation Research-E*. 33(4), pp. 321-327.
- Martín, J.C. and Voltes-Dorta (2007), *Stochastic Frontier Efficiency Estimation Airports A Bayesian Approach*, Air Transport Research Society (ATRS), 2007 Annual World Conference.
- Morgan Stanley, (2006), *Aeroports de Paris Attractive Catalysts... But in 2010*, July 31, London.
- Mott Mac Donald (2006), *A Study on the Introduction of Secondary Trading at Community Airports* commissioned by the EU Commission, <http://ec.europa.eu/transport>
- Morrison, S.A. (1982) The Structure of Landing Fees at Uncongested Airports, *Journal of Transport Economics and Policy* 16, pp. 151-159.
- Morrison, S. and C. Winston (2008), Delayed! U.S. Aviation Infrastructure Policy at a Crossroads, in C. Winston and G. de Rus, eds., *Aviation Infrastructure Performance A Study in Comparative Political Economy*, Washington, Brookings Institution Press pp. 7-35.
- Müller, F., C. König and J. Müller (2008), *Regulation of Airport Charges in Germany* Presentation at 1st Madrid Workshop on Transport, economics (fedea) Madrid, October 09, 2008 http://www.fedea.es/mwte/doc/3b_Mueller%20Presentation.pdf
- Müller-Rostin, C., H., Ehmer, H. M. Niemeier and J. Müller (2009), Market entry and market exit in the European airport market, in P. Forsyth, D. Gillen, J. Müller, H. M. Niemeier (eds.), *Competition in European Airports*, Ashgate, Aldershot forthcoming.
- Newberry, D. (2002), Rate-of-return regulation versus price regulation for public utilities, in E. Newman (ed), *The New Palgrave Dictionary of Economics and the Law*. 3, Palgrave MacMillan.
- Niemeier, H. M. (2000) Towards an efficient market-based environmental policy – a view from the Hamburg Region, in T. Immelmann, O. G. Mayer, H. M. Niemeier,., Pfähler, W., (editors), *Aviation versus Environment?*, Frankfurt M., New York, Peter Lang Verlag, pp. 47-68.
- 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 Verlag, pp. 201-220.

- Niemeier, H. M. (2002) Regulation of Airports: The Case of Hamburg Airport – a View from the Perspective of Regional Policy, *Journal of Air Transport Management* 8 (1), pp. 37-48.
- Niemeier, H. M. (2003), Price Cap Regulation of German Airports- should German Airport Policy follow the Littlechild approach?, in I. Bartle (ed.), *The UK Model of Utility Regulation: A Retrospective of the 20 years since the Littlechild Report*, CRI Proceedings 31, 2003, pp. 131-171.
- 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 (ed.), *The Economic Regulation of Airports*, Aldershot, Ashgate, 2004, pp. 163- 189.
- Oum, T.H., Adler, N. and Yu, C. (2006). Privatization, corporatization, ownership forms and their effects on the performance of the world's major airports, *Journal of Air Transport Management* 12 (3), pp. 109-211.
- Oum T.H., Yan J. and Yu C. (2008). Ownership Forms Matter for Airport Efficiency: A Stochastic Frontier Investigation of Worldwide Airports. *Journal of Urban Economics*, 64 (2), pp 422-435.
- Parker, D. (1999), The Performance of BAA Before and After Privatization, *Journal of Transport Economics and Policy* 33 (2), pp. 133-146.
- Papatheodorou, A. (2009), Airport Competition in Greece: Concentration and Structural Asymmetry, in P. Forsyth, D. Gillen, J. Müller, H. –M. Niemeier (ed.), *Competition in European Airports*, Ashgate, Aldershot forthcoming.
- Pels, E. (2000), *Airport Economics and Policy Efficiency, Competition and Interaction with Airlines*, Tinbergen Research Series 222, Amsterdam.
- Productivity Commission (2002), *Price Regulation of Airport Services; Report No 19*, AusInfo, Canberra.
- Salazar de la Cruz, F. (1999), A DEA approach to the airport production function, *International Journal of Transport Economics* 36 (2), p. 255-70.
- Sherman, R. (1989), *The Regulation of Monopoly*, Cambridge UK, Cambridge University Press.
- Starkie, D. (2001), Reforming UK Airport Regulation, *Journal of Transport Economics and Policy*, 35 (1), pp. 119-135.
- Starkie, D. (2002), Airport Regulation and Competition, *Journal of Air Transport Management* 8 (1), pp. 63-72.
- Starkie, D (2006), Investment Incentives and Airport Regulation, *Utilities Policy*, 14 (4), pp. 262-265.
- Starkie, D. (2008a), The Airport Industry in a Competitive Environment: A United Kingdom Perspective, *JTRC Discussion Paper No 2008-15*.
- Starkie, D. (2008b), A critique of the single-till, in D. Starkie, *Aviation Markets*, Ashgate, Aldershot, pp. 123-130.

- Starkie, D. (2008c), The Dilemma of Slot Concentration at Network Hubs, in Czerny, A., P. Forsyth, D. Gillen and H. M. Niemeier (eds.), *Airport Slots: International Experiences and Options for Reform*. Ashgate, Aldershot, pp 193-203.
- Starkie, D. (2009), *Airports policy: backing the wrong horse*, IEA, February 26th, 2009 <http://blog.iea.org.uk/?p=293>
- Starkie, D and D. Thompson, (1985) *Privatising London's Airports*, Institute for Fiscal Studies, Report 16, London.
- Starkie, D. and Yarrow (2000), *The Single Till Approach to the Price Regulation of Airports*, London, www.caa.co.uk.
- Stigler, G. (1971), The Theory of Economic Regulation, *Bell Journal of Economics* 2 (1), 3-21.
- Tolofari, S. N., J. Ashford, and R.E. Caves (1990), *The Cost of Air Service Fragmentation*, Loughborough University.
- Templin, C. (2009), Competition for Airport Services – Ground handling services in Europe Case studies on six major European Hubs, in: P. Forsyth, D. Gillen, J. Müller, H. M. Niemeier (eds.), *Competition in European Airports*, Ashgate, Aldershot forthcoming.
- Vass, P. (2005), Accountability in the Regulatory State' revisited, in: P. Vass, *Regulator Review 2004/5*, University of Bath, Bath pp. 213-238.
- Vickers, J. and Yarrow, G. (1988) *Privatization, An Economics Analysis*, MIT Press, Cambridge, Mass.
- Winston, C. (1993), Economic Deregulation: Days of Reckoning for Microeconomists, *Journal of Economic Literature*, 31 (3), pp. 1263-1289.
- Winston, C. and G. de Rus (2008), *Aviation Infrastructure Performance A Study in Comparative Political Economy*, Washington, Brookings Institution Press.
- Vogelsang, I. (1998), *Optimal price Regulation for Natural and Legal Monopolies*. Paper Prepared for CIDE Seminar on Structural Reform and Regulation in the Energy Sector.
- Vogel, H.-A. (2005), *Privatisation and Financial Performance of European Airports*, 4th Conference on Applied Infrastructure Research, 8 October 2005 at TU Berlin, URL:<http://wip.tu-berlin.de/workshop>
- Wolf, H. (1997), *Grundsatzfragen einer Flughafenprivatisierung in Deutschland*, Kiel.
- Wolf, H. (2003), *Privatisierung im Flughafensektor. Eine ordnungspolitische Analyse* Berlin, Heidelberg, New York, Hongkong; Springer.
- Yarrow, G. (2009), The links between capacity scarcity, competition and market power – a note prepared by George Yarrow, adviser to the CAA, in CAA UK, *The Competition Commission's Market Investigation of BAA Limited The Civil Aviation Authority's response to the Provisional Decision on Remedies*, January 2009 Annex B. <http://www.caa.co.uk/default.aspx?catid=5>