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Airport slot allocation

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Airport Slot Allocation

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Airport Slot Allocation°

Jörn Sickmann*

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° The paper on hand contains a shortened and updated version of the author's diploma thesis written at the Universität Freiburg, Institut für Verkehrswissenschaft und Regionalpolitik.

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1 Introduction

Despite the effects of 9/11 and SARS[1], air traffic is growing worldwide. The IATA[2] Passenger Forecast expects international passenger traffic to increase at an average of 5.6% a year between 2005 and 2009.[3] Due to this development, however, capacity shortages and congestion result at many airports worldwide.[4]

The current slot allocation regimes were developed in a regulated air traffic environment decades ago. While deregulation of air traffic can be considered as almost completed both in the US and the EU, a fundamental reform of slot allocation has not taken place yet. An efficient and discrimination-free allocation of airport capacity is, however, essential to guarantee competition in the downstream market for air traffic services.[5]

Lately, some impetus towards reforms can be observed. The European Commission already suggested a two-phase reform in 2001.[6] While phase one, aimed at optimising the administrative allocation process, has been completed with the adoption of Regulation EC 793/2004 on 21st April 2004, phase two is to consider a shift towards market based instruments. A decision toward a specific instrument is yet not reached.[7]

In light of this, the paper on hand contains an analysis of different slot allocation regimes. In section two an analysis of the status quo will be given. Section three considers possible market-based solutions. These include congestion fees, auctions and secondary trading. The US example in slot trading will also be analysed. Section four compares the three instruments including positive economic analysis. The paper ends with a conclusion and an outlook.

2 The Current Slot Allocation Regimes

Airlines require access to airport infrastructure in order to offer their services. Two different slot[8] allocation mechanisms exist worldwide: the IATA- Approach, which is the basis for slot allocation in the EU and most other countries, and the US- Approach.

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1 Severe Acute Respiratory Syndrome

2 International Air Transport Association

3 See IATA (2005a).

4 See AEA and IATA data and also Wendlik (1995), p. 165; Wolf (2003), pp. 62 ff.

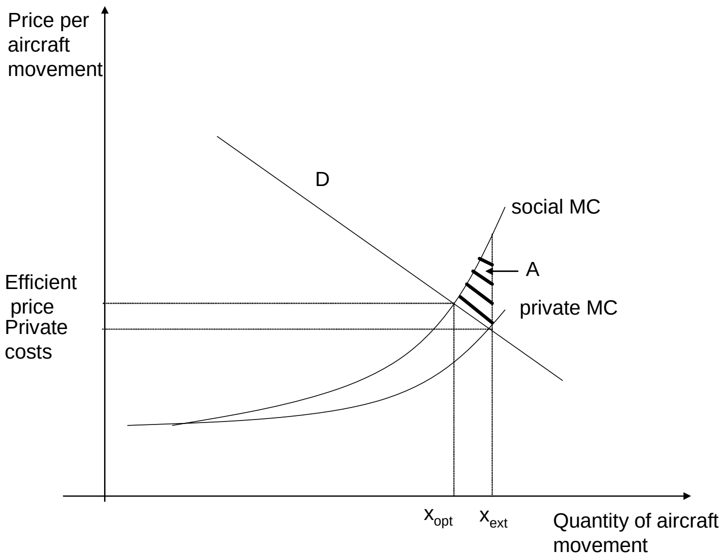
5 See Hardaway (1986), p. 14.

6 See European Commission (2001a) and (2001b).

7 In September 2004 the European Commission launched a consultation on the subject. The responses are now being analysed. On the basis of this consultation the commission is preparing a communication, setting out issues regarding modification of the slot regime. See European Commission (2005a) and (2005b), p. 6.

8 An airline requires access to a bundle of facilities, such as runways, gates and aprons. These facilities can be considered to 100% as compliments. A suitable definition of a slot must therefore include these facilities. This paper, however, primarily focuses on the award of take-off and landing rights.

Slots in the US are allocated on a first-come first-serve basis – reserving take-off and landing rights in advance is currently impossible.[9] This allocation system leads to economic inefficiencies, as it is inadequate to deal with the current high level of airport traffic. As slot demand is rationed by queuing, delays will arise at a non-optimal level once demand outstrips airport capacity. This is because an airline´s decision to use capacity is based solely upon its own delay costs, and does not take into account the external congestion costs it imposes on all other airlines.[10]



D = Demand; MC = Marginal Cost; x_{opt} = optimal Quantity; x_{ext} = inefficient Quantity

Figure 1: Inefficiencies caused by negative externalities.

Source: Author.

Figure 1 shows that the quantity of take-off´s and landings will be too high (x_{ext}) because of this externality. A price that would internalise congestion would reduce the quantity to an optimal level (x_{opt}). Area A equals welfare loss due to external congestion costs.

An exception to the allocation mechanism described above within the US is the so-called "High Density Rule" at four American airports, introduced by US regulators in 1968.[11] Until 1985, the allocation process was dealt with within the regulatory administrative process. Any reallocation was bound by the agreement of all airlines at a given airport.[12] Beginning in 1986, with the introduction of the "Buy-Sell Rule", banks, airlines and other interested institutions have been permitted to trade slots on an open secondary market.[13]

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9 See Starkie (2003), p. 53.
10 See Czerny and Tegner (2002), p. 9 and generally Baumol and Oats (1988).
11 FAR 14 CFR §93 subpart K; also see GAO (1998), p. 4; Hardaway (1986), p. 4.
12 See Sened and Riker (1996), pp. 429 ff.; Kleit and Kobayashi (1996) pp. 3 ff.
13 See section 3.3.

Council Regulation (EEC) 95/93 on common rules for the allocation of slots at Community airports forms the legal frame for the award of slots in the European Union. It is based on guidelines set by IATA.[14] The aim stated in the directive is to provide efficient use and non-discriminatory access to airport slots.[15] The core of the directive is an administrative allocation of slots by a fixed priority order.[16] The most important award criterion is the historical right, the so-called Grandfather Right. This means that an airline has the right to use slots it was assigned at the same time during the preceding equivalent season.[17] In other words, once an airline gets a surcharge, it keeps the right as long as it uses it.

The advantage of the present directive is that the complexity connected to an allocation regime is handled well. Grandfather rights reduce the number of slots to be newly allocated in every flight schedule period to a minimum, since the largest part of user rights is simply passed on to the next period. For incumbent airways a large degree of planning safety is reached, which makes investment decisions easier.

The European slot allocation approach does, however, not conform to the criteria of economic efficiency. Firstly, the scarce airport capacity is not used by those airlines who value it most (allocative inefficiency).[18] The present allocation system is orientated at historical priority and not at willingness to pay. Secondly, competition in the downstream market of airline services is prohibited (competitive inefficiency).[19] Incumbent airways have an incentive to hoard slots to prevent market entrances and can do so almost free of charge. In addition, the regulation is to be judged as infrastructurially inefficient since scarcity rents do not fall to the airports who could enlarge capacity by investments.[20]

Therefore, in the next section, market-based approaches are introduced that can potentially lead to an efficient allocation of and a discrimination-free access to airport capacity.

3 Market-based approaches

Because of the problems described above, the introduction of efficient allocation instruments is urgently required to fully exploit the competition potentials in the air traffic sector. For the allocation of slots three market mechanisms seem appropriate:

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14 See IATA (2005b).
15 See EEC 95/93, preface.
16 See EEC 95/93, article 8.
17 See EEC 95/93, article 8, paragraph 1a.
18 See e.g. Nera (2003), p. 22.
19 See Knieps (1996a), pp. 4 ff.
20 See Ewers et al. (2001), p. 10.

1. Optimal user charges
2. Auctions
3. Secondary trading

Optimal user charges and auctions are instruments for a primary allocation of slots. Slot trading is a secondary mechanism which can improve efficiency by correcting an inefficient primary allocation. It can be used in conjunction to administrative and market instruments.[21] An optimal user charge must be set to a level that elevates supply and demand. The market mechanism endogenously determines the optimal number of take-offs and landings. A reversed procedure is carried out for auctions and slot trading. Here, the capacity is determined exogenously while the market mechanism determines the market price. The market mechanisms introduced here aim to assign a slot to the airline with the highest willingness to pay. If willingness to pay and aggregate benefit correlate, an efficient allocation is secured. This is assumed from hereon. [22]

3.1 Optimal user charges

The current airport charges are mainly cost-related and set to finance airport capacity.[23] If fees are to be used for the allocation of scarce resources, the relationship to cost must be abolished. Efficient congestion fees have already been developed in economic literature since the beginning of the 20th century. The focus of this work lay on efficient fees for the use of road infrastructure.[24] A transfer of these results to airport infrastructure is principally possible and was done by Morrisson (1983), e.g.

Airport fees should reflect marginal costs resulting from additional flights - costs affecting the airport and the operations of other airlines. This includes the marginal costs of runway use and delays. The fee should be determined by the time an aircraft intends to take-off or land, and differentiate between take-offs and landings by different user categories.[25] Optimal congestion fee and capacity must be determined simultaneously to achieve efficiency.[26] It can be shown that optimal capacity occurs when the savings in delay costs of all users during all time periods due to additional airport capacity equal the cost of that capacity.[27] If excess demand exists even with congestion costs built into airport fees, a mark-up is necessary to the level

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21 See Nera (2003), p. 29.

22 For a dissenting opinion, see Borenstein (1988).

23 Some incentives e.g. for the reduction of aircraft noise exist, however. See for an Overview on current charges: Wendlik (1995), p. 157; Giesberts and Geisler (1998), p. 36; Doganis (1992), pp. 62 ff.

24 See Pigou (1912); Walters (1961); Mohring and Harwitz (1962).

25 See Morrison and Winston (1989), p. 10.

26 See Knieps (1993), p. 9.

27 See Morrison and Winston (1989), p. 112.

required to correlate supply with demand. This mark-up reflects economic rent due to scarcity of airport capacity.[28]

Morrison and Winston (1989) estimate the annual net benefit of the introduction of time-variable charges in the USA at a simultaneously determined optimal investment level to at least 11 billion dollars.[29] The sole introduction of optimal charges would save at least 3.82 billion dollars. These results have validity under the assumption of a complete deregulation of the air traffic sector. The net benefit would increase by 1.15 billion dollars in a regulated environment, assuming a 20% lower traffic volume. The considerable net profits can be explained by a great discrepancy between present weight based and optimal user charges. Because capacity should only be increased until the use corresponds to costs, delays will persist even with optimal charges and infrastructure.[30] Another interesting result of the study shows that the sole elevation of optimal user charges leads to considerably stronger distribution effects than the introduction of optimal charges at an optimal investment level.[31]

An examination of the UK Civil Aviation Authority (CAA) also shows how big the discrepancy turns out to be between present and optimal charges.[32] Airport charges per passenger at the London airports Heathrow and Gatwick must be increased by approx. 150% to bring supply and demand into harmony. The distribution effect is a shift of the scarcity rent from the airline companies to the airports or the state.

Brueckner (2002a, 2002b and 2005) stresses that congestion fees derived from road pricing might not be transferable to the airport sector without modification. This is because passengers use airlines for transportation and do not appear as atomistic users of infrastructure.[33] To illustrate the consequences of this fact, one could assume an airline possessing market power at a specific airport. Furthermore, the airline should be the exclusive user of the given airport. Because an airline will maximise its overall profit, it would internalise the congestion externality resulting from all of its airplanes. Thus, in our extreme case, all delay costs would be included in the profit maximization. Brueckner therefore argues that a congestion fee should only include the remaining congestion costs that are not born by airplanes of the same airline.[34]

Another specific feature of the airline sector that might limit the transferability of road pricing models has been analysed by Mayer und Sinai (2002). They argue that most delays are not

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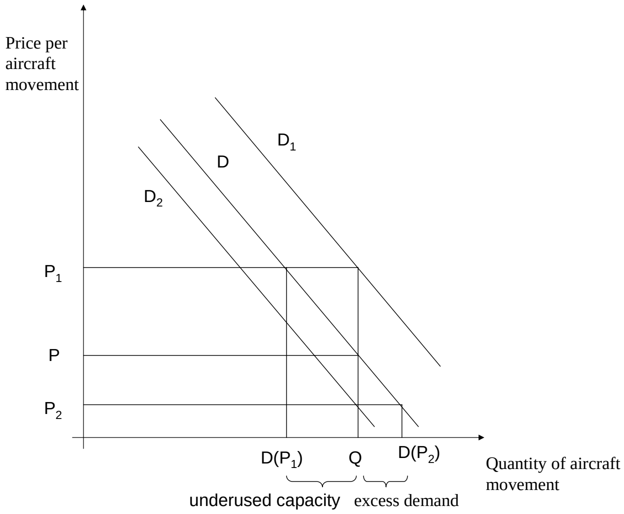
28 See Knieps (1993), pp. 6 ff.
29 See Morrison and Winston (1989), p. 84 and pp. 92 ff.
30 See Morrison and Winston (1989), p. 94.
31 See Morrison and Winston (1989), p. 93.
32 See CAA (1989), Appendix 9.
33 See Brueckner (2002a), pp. 143 ff.
34 Brueckner (2002a), p. 146.

caused by delay externalities but by positive network effects at hub airports. The existing delays may present an equilibrium solution of the marginal benefit of the hub-effect and the marginal cost of delay.[35] Since network airlines can only exhaust network effects if passengers have feasible transfer times, they will bundle all flights at hub-periods while other airlines can use different time periods. Therefore network airlines will bear most delay cost at hub-periods.[36] Mayer and Sinai (2002) conclude that congestion fees will not have much influence on delays and might even result in welfare loss, since positive network effects are not taken into consideration.[37]

Optimal airport fees can, in theory, internalise the congestion externality, optimally allocate airport capacity, and stimulate competition in the downstream market of airline services by insuring non-discriminatory access for all airlines. There exists, however, a major obstacle to an optimal airport fee structure. Information about the position of airline´s demand curves are highly imperfect.[38] This is illustrated in the following graph:



Q = Airport Capacity, D = True demand, D 1; D2 = Imagined demand 1 / 2

Figure 2: Market Clearing Prices.

Source: In analogy to Jones and Viehoff (1993), p. 6.

If demand is incorrectly assumed to be higher than it actually is, airport fees would be set too high with underused capacity as a consequence. If imagined demand were below true demand, prices would be set too low and excess demand would continue. Because of a periodic resetting of prices on the basis of observed outcomes a convergence towards the efficient market clearing level, P, could be assumed. However, in reality, all sorts of external influence can be found resulting in constant shifts in the true demand.[39]

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35 See Mayer and Sinai (2002), p. 2.
36 See Mayer and Sinai (2002), p. 3.
37 See Mayer and Sinai (2002), p. 35.
38 See Wolf (1999), p. 10; Jones and Viehoff (1993), pp. 6 ff.; Nera (2003), pp. 41 ff.
39 See Jones and Viehoff (1993), p. 7.

3.2 Auctions

Due to the information problems arising when setting optimal user charges auctions are often suggested as an alternative pricing method.[40] Auctions establish a price at which demand equals supply, thus assuring that the airline with the highest willingness to pay receives the slot. In addition, price signals can create incentives for the change between peak and off-peak periods. Since auctions can find prices for congestion and scarcity, information about the optimal investment level is revealed.[41] Condition for an auctioning of airport slots is the withdrawal of grandfather rights. The competitive advantage of established airlines would be lost, a discrimination-free access to the airport infrastructure guaranteed. Slot auctions can both accompany congestion fees by determining the scarcity surcharge required for market clearance and be used for the determination of the complete optimal user charges.
The auctioning of airport slots is, however, highly complex and extremely demanding of the auction design.[42] Firstly, airport capacity is not an external variable, but depends on variables such as the mix of aircraft and the order of take-offs and landings.[43] Secondly, actual capacity is not an exogenous variable but depends on factors such as the airplane mix, the sequence of take-offs and landings and the flight approach direction.[44] Also, airlines need access to a broad array of infrastructural components. Therefore, without knowing how airlines intend to use a slot, the capacity cannot be calculated.[45] The use of small aircraft could, for example, lead to scarce runway capacity while the use of larger aircraft can lead to terminal and stand scarcity. Airport slots are highly complementary; an airline needs at least one take-off and one corresponding landing slot to offer a service.[46] With slots allocated by auctions, an airline faces the risk of receiving only a single slot without the corresponding take-off or landing right. Also, an airline must transfer the value it places on a route or even a network to values of individual slots. A last problem stems from the requirement, that any auction process must be compatible with the IATA Time Schedule. An auction model must therefore assure a termination at a given time.[47]

As with congestion fees, auction models for airport slots have been suggested by economic scholars for quite a while. In the following, four prominent auction models will be presented and compared briefly.

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40 See e.g. Wolf (1999), pp. 10 ff., Jones and Viehoff (1993), pp. 7 ff.; Cornelius (1994), pp. 143 ff.
41 See Boyfield (2003), p. 41.
42 See Wolf (1995), pp. 20 ff.
43 See Urbatzka (1991), pp. 15 ff.
44 See Urbatzka (1991), pp. 15 ff.
45 See Nera (2003), p. 34; DotEcon (2002), pp. 46 ff.
46 See Balinski and Sand (1985), p. 182; DotEcon (2002), pp. 46 ff.
47 See Wolf (1995), p. 21.

Grether, Isaac and Plott (1989) [GIP] already developed an auction model for the American Civil Aeronautical Board (CAB) in 1979.[48] The allocation of take-off and landing rights is carried out in a two-step proceeding. In a first step, slots are being auctioned using a uniform-price auction. Airlines receive full property rights for a duration of six months. After that a new auction is carried out.[49] The auctions take place independently for all airports. The problem of complementarity is taken into account in the second step by the establishment of a secondary market. This shall be organized as an anonymous, centralised computer trade.[50]

Rassenti, Smith and Bulfin (1982) [RSB] choose a second price sealed bid combinatorial auction as auction form. The airport capacity is determined exogenously and all slots are auctioned simultaneously. The problem of interdependency is taken into consideration by two measures. Firstly, the airlines can place conditional bids for whole slot packages. An individual bid is only binding when the bids of the other slots were also successful. Secondly, a bid for a slot package can be linked to the successful acquisition of a further slot package. This measure secures that only routes or networks that are useful for an airline are aquired and no valueless individual slots.[51] The auction is completed after one round. The price to be paid for a slot package is determined by the marginal "shadow prices" of the individual slots, these are calculated from the conditional bids[52] with the help of an algorithm developed by RSB.[53]

The missing practicability of the RSB system was the starting point for the development of a "second best" auction model by Wolf (1995). A simultaneous auctioning of all slots is rejected because of high transaction costs. Instead, the efficiency losses which arise from a deviation from a "first best" auction model shall be minimised.[54] The English auction is chosen as an auction format because of its high degree of information disclosure. To further deal with the problem of complementarity, airlines may combine complementary slots into "cores" and bid on these packages.[55] Bidding on individual slots is also possible. To determine the winner, the highest bid on a "core" must be compared to the sum of the highest bids on individual slots. Because the maximum capacity of an airport also depends on the mix of the airplane types and movements, charges dependent on the duration of the flight movement are levied in addition to the auction price. To safeguard a punctual auction end, one last auction round is carried out after expiry of a "regular auction time". The auction format chosen for

[48] See Grether, Isaac and Plott (1981), p. 171, references and Cornelius (1994), p. 172.
[49] See Grether, Isaac and Plott (1989), p. 69.
[50] See Grether, Isaac and Plott (1989), pp. 56 ff.
[51] See Hüschelrath (1998), p. 325.
[52] See Rassenti, Smith and Bulfin (1982), p. 404.
[53] See Wolf (1995), p. 28.
[54] See Wolf (1995), p. 35.
[55] See Wolf (1995), p. 45.

this is a second price auction.[56] For the auction sequence a decentralized solution is suggested which should grant the airlines the right to determine autonomously when to bring specific slots into an auction. Every slot must be auctioned at least once within a specified time period though.[57] For the correction of the primary allocation a secondary market is recommended. A specification on a certain institutional form is declined.[58]

The auction model of DotEcon (2002) [59] suggests a Simultaneous Multiple Round Auction format (SMRA).[60] For the definition of a slot DotEcon (2002) recommends defining a time period between 15 and 30 minutes as a window. Within this base unit (lot) the coordination of the individual slots shall be left to air traffic control.[61] The airplane mix and the routing direction shall be taken into account since these influence the capacity. Terminal and stand capacity, as potential bottleneck factors, shall also be included.[62] A bidder hands in a composite bid containing both willingness to pay and information about usage, e.g. whether take-off or landing, which direction, size and maximum passenger load factor are planned.[63] After every auction round the auctioneer selects those bidders who generate the highest value of a lot under consideration of capacity and usage factors.[64] The auctioneer then sets minimum bids for the next round, arising from the highest bids plus a surcharge.[65] The auction is completed if, for all lots, no more bids are made. A stop rule is suggested in form of a concealed second price auction.[66] The combined auctioning of whole slot packages is rejected in the model because the complexities connected to this and transaction costs seem too high to the authors.[67] Corrections could, if necessary, be made over a secondary market which shall be organized centrally.[68]

It can be concluded that the GIP model seems least suitable for an efficient allocation of airport slots. This is because it neglects the problem of complementarity at the primary allocation as well as endogenous factors of capacity determination. Terminal and stand capacities are also neglected. Although, in theory, the RSB model can produce an efficient allocation by consideration of complementarities, it imposes high transaction costs.

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56 See Wolf (1995), p. 48.
57 See Wolf (1995), pp. 52 ff.
58 See Wolf (1995), pp. 53 ff.
59 The model was developed for HM Treasury and the Department of the Environment, Transport and the Regions.
60 See DotEcon (2002), p. 75 ff.
61 See DotEcon (2002), p. 63 ff.
62 See DotEcon (2002), pp. 68 ff.
63 See DotEcon (2002), p. 71.
64 See DotEcon (2002), pp. 77 ff.
65 See DotEcon (2002), p. 75.
66 See DotEcon (2002), p. 84.
67 See DotEcon (2002), pp. 79 ff.
68 See DotEcon (2002), pp. 90 ff.

Simultaneous Multiple Round Auction formats seem most suitable for the allocation of airport slots. Because of its open format, bidders can observe each other's behaviour and cross-check their own valuations. Combinatorial bidding can also be allowed to further reduce risks due to synergy between slots. Runway, gate and terminal capacity can be combined into flexible bundles and airlines can be required to nominate usage factors for a particular slot.[69] Experiences with SMRA formats at the auctioning of frequencies in the US and Europe show that the concrete auction design is frequently only developed in the course of time. The aim should therefore be to check an implemented auction model for its efficiency periodically in order to carry out necessary modifications. In conclusion, Table 3 summarizes advantages and disadvantages of the different auction models.

	Allocative efficiency	Time requirement	Complementarity	Collusion	Transaction cost	Endogenous capacity determination	Infrastructural components
GIP	-	--	--	-	0	-	-
RSB	+	++	+	+	--	-	-
Wolf	++	-	+	-	0	+	+
DotEcon	++	-	+	-	-	++	++

-- very bad, - bad, 0 neutral, + good, ++ very good

Figure 3: Comparison of different auction models.

Source: Author.

3.3 Secondary trading

Slot trading is a secondary allocation mechanism that can improve an initial allocation of airport slots. It can be used in conjunction with administrative and market approaches as well. The idea of tradable rights is not new in economic literature and is based on work by Coase (1960). In a market free of distortions (i.e. free of transaction costs) and with well defined property rights, the market will achieve economic efficiency regardless of the primary allocation.

The aim of secondary trading is, as that of auctions, to allow the users with the highest willingness to pay to receive the slot and therefore guarantee an efficient allocation.[70] The introduction of secondary trading would generate opportunistic prices at market price level for the incumbent slot users. If an inefficient primary allocation existed, gains from trade could be achieved. The market mechanism would assign the slots to the parties with the highest willingness to pay. An efficient allocation would result. Market entrance for potential

69 See DotEcon (2002), pp. 68 ff.

70 See Ewers et al. (2001); CAA (2001); Knieps (1996a) and (2003).

competitors would be possible since they could buy slots and also observe a market price that reveals the cost of entry. Information required to identify an efficient investment level in airport infrastructure would be revealed. A contribution to infrastructure financing is, however, not made.

While most economic scholars favour secondary trading, actual market design remains a topic for heated debate.[71] At issue is who should be permitted to trade[72] and whether trading should occur in a centrally organised or a bilateral market[73]. Should modern financial instruments such as options and futures be allowed?[74] Other issues yet to be resolved include market transparency[75] and the need for anonymous trading[76]. Another question is, whether terminal and stand capacities should also be included in trading and whether these infrastructural components should be unbundledly tradable.[77] Another controversial point is whether slot trading can prevent slot hording. Therefore, the necessity of a “Use-It-Or-Lose-It” provision remains contentious.[78] There is a very controversial debate about who “owns” airport slots.[79] Government, airlines, and airports have all claimed ownership. In an efficient market, clearly defined property rights would reduce uncertainty among market participants and promote trading. Since establishing ownership in airport slots might be difficult due to political and legal obstacles, tradable rights without freehold rights could be defined.[80]

Experience with slot trading exists in the US at the four High Density Traffic Airports (HDTAs) Chicago O’Hare, New York LaGuardia, John F. Kennedy and Reagan Washington National. To a smaller extent, this also applies to the EU where non-monetary slot trading and a gray market exist.[81] The US experience with slot trading will now be examined more intensely in order to draw some conclusions on the feasibility of secondary trading.

Starting in April 1986, an FAA[82] final rule (the so called “Buy-Sell Rule”) allowed the trading of slots at the four HDTAs.[83] In the initial allocation, slots were grandfathered to the carriers which previously used them.[84] Thereafter, slots became tradable and leasable without

71 See Nera (2003), p. 51; Knieps (1996a), p. 8; CAA (2001), pp. 14 ff.
72 See Ewers et al. (2001), p. 25; CAA (2001), pp. 14ff.
73 See DotEcon (2002), p. 91; Grether, Isaac and Plott (1989), p. 56; Wolf (1995), p. 54.
74 See DotEcon (2002), p. 91.
75 See CAA (2002), p. 21.
76 See CAA (2001), p. 16; Nera (2003), p. 52.
77 See CAA (2001), p. 17.
78 See Ewers et al. (2001), p. 26; Knieps (1996a), pp. 11 ff.
79 See Boyfield (2003), pp. 29 ff.
80 See CAA (2001); NERA (2003).
81 See Nera (2003), pp. 24 ff.; CAA (2001), p. 33; Boyfield (2003), pp. 35 ff.
82 On April 1, 1967, FAA's name changed from Federal Aviation Agency to Federal Aviation Administration.
83 FAR 14 CFR §93 subpart K, also see Hardaway (1986), p. 4; Czerny and Tegner (2002), pp. 5 ff.
84 See FAR 14 CFR §93.215.

restriction by any party, including financial intermediaries.[85] An organised central slot market was not established and did not accrue over time.[86] Any slot not used for at least 65% of the time had to be returned to the FAA ("Use-It-Or-Lose-It Rule"), and was redistributed by lottery, with 25% of the slots distributed to new entrants.[87] The FAA rule highlighted that slots were not considered property rights and that the FAA could withdraw and reallocate them for operational and competitive reasons.[88]

In June 1999, the US House of Representatives passed the Aviation Investment and Reform Act for the 21st Century (H.R. 1000). The Act lifted all slot constraints at Chicago O'Hare from July 2002 on, and from JFK and LaGuardia beginning in 2007. Hence, the slot trading regime will be replaced by a first-come-first-serve principle.[89]

The effects of the "Buy-Sell-Rule" on airline competition were extensively empirically analyzed by the General Accounting Office.[90] The most recent analysis is of March 1999. The results of the study can be summarised as followed:

1. At the four slot constrained airports, major established carriers have expanded their slot holdings.
2. The slot share held by airlines that started after deregulation remains low.
3. Airfares at the high-density airports are consistently higher than at airports of comparable size without slot constraints.

At a first glance the above results seem to support the position of those opposed to secondary trading of airport slots. Higher concentration and higher fares could be the result of the airlines' anticompetitive behaviour, i.e. hoarding of slots to keep competitive airlines out of the market and raise passenger fares to earn a monopoly premium.

But neither higher concentration nor higher fares necessarily imply anticompetitive behaviour. They can also be the result of market efficiency. Kleit and Kobayashi (1996) argue that fares at slot constrained airports must be higher than at unconstrained airports, since fares must reflect the slots' associated scarcity rent.[91] Starkie (1994) additionally notes that higher fares might include a network premium.[92] Secondly, Kleit and Kobayashi (1996) argue that high concentration might be a result of larger airlines being more efficient than smaller airlines.

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85 See FAR 14 CFR §93.221(a).
86 See Nera (2003), p. 128.
87 In January 1993 the utilisation rate was modified to 80 percent. See FAR 14 CFR §93.227 and also Starkie (2003), p. 68.
88 See FAR 14 CFR §93.223.
89 See Czerny and Tegner (2002), p. 10.
90 See GAO (1999), p. 91 for a list of GAO publications in this field from 1985 to 1999.
91 See Kleit and Kobayashi (1996), pp. 5 ff.
92 See Starkie (1998), p. 115.

High concentration might be the result of network effects associated with hub-airports. Thirdly, they argue that the high concentration at the four slot-restricted airports might overstate the potential for anticompetitive behavior, since each of them is located near one or more regional airports lacking slot constraints. Kleit and Kobayashi (1996) empirically analyzed the effects of the Buy-Sell-Rule using data from the airport O´Hare. Using slot usage data, regression analysis revealed a positive and statistically significant relationship between slot share and rate of use. The two largest air carriers at O'Hare were among the airlines that used slots the most intensely.[93] This is inconsistent with anti-competitive abuse and supports a pro-competitive explanation of efficiency causing concentration. Secondly, dominant carriers were almost always found to be net lessees and not net lessors of slots at O´Hare.[94] An anti-competitive behaviour would imply a reciprocal result; airlines could avoid the sale of unused slots and hinder the market entry of potential competitors. Additionally, Kleit and Kobayashi analyzed the capacity usage of airlines, because anti-competitive slot hording would require dominant airlines to use small airplanes. Results based on capacity usage were ambiguous - allowing both hoarding and efficiency explanations.[95] Overall results support a pro-competitive explanation of concentration at O'Hare, and do not support the hypothesis that concentration at O'Hare caused anti-competitive behaviour.

The results of Kleit and Kobayashi are supported by empirical work by Sened and Riker (1996) based on data from 1972-1981 and 1985-1989 from Washington Reagan and Chicago O'Hare. The data set contained observations on 15 carriers in two different airports for 16 years.[96] The effect of profitability was found to be significantly negative before and significantly positive after allowing slot trading.[97] Most importantly, the analysis revealed that before secondary trading load factors had no effect on slot allocation while after implementing the rule there was a significant positive effect. The higher the load factor on each of an airline's planes, the more likely it was to obtain new slots.[98] Starting from the assumptions that profitability and load factor are good indicators of efficient slot use, Sened and Riker (1996) also support the efficiency-increasing effect of slot trading.

[93] See Kleit and Kobayashi (1996), pp. 9 ff. and 13 ff.
[94] See Kleit and Kobayashi (1996), pp. 11 ff.
[95] See Kleit and Kobayashi (1996), pp. 18 ff.
[96] See Sened and Riker (1996), p. 435.
[97] See Sened and Riker (1996), pp. 436 ff.
[98] See Sened and Riker (1996), p. 438.

4 Comparison of the Instruments Including Elements of Positive Theory of Regulation

The inefficiencies arising from today's slot allocation both in the EU and the US (and worldwide) have been well known among economic scholars for decades.[99] The current push for reform of the European Commission lets hope for chances of the implementation of market instruments. It has to be suspected, however, that economic criteria won't decide exclusively. Rather, the commission wants to analyze and take into account the expected effects of the implementation of different market instruments on different interest groups of the air traffic sector and on international air traffic besides competition-relevant aspects.[100]

The Positive Theory of Regulation analyzes the persistence of inefficient regulation. It provides explanations for the emergence, application, supply and demand of regulation as well as for the phenomenon that even harmful regulation to the society is not removed.[101] Private pressure groups have influence on the air traffic policy.

Fundamental work on pressure groups was done by Olson (1965). The starting point of Olson´s theory is that free riding also plays an important part in the organisation of interests, i.e. potential members try to profit from lobbying without contributing themselves.[102] An important application of Olson´s theory results from the comparison of organizability of producers´ vs. consumers´ interests. It can be assumed, that producers´ interests are better organizable. Reasons are:

1. The number of producers of a good is smaller than the number of consumers.
2. The consumers´ interests are more concentrated because specialization occurs in production, but not in consumption. (Political) change of a single price therefore has a large influence on the budget of this good´s producers, but only a slight influence on every consumer´s budget.

Therefore, the fundamental problem of free riding is much smaller on the producers´ side than on the consumers´. This implies that pressure groups of airlines and airports have a greater influence on economic decision makers than consumer lobbies.

An implementable slot allocation regime must be compatible with national, European and international law. The Chicago Convention, bilateral air traffic agreements, as well as the European Open-Sky Rules have to be considered among others. A new allocation mechanism has to be consistent with the IATA Schedule, especially. To judge the implementation

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99 See e.g. Koran and Ogur (1983); Knieps (1987).
100 See European Commission (2001b), p. 2.
101 See Köberlein (1997), p. 132.
102 See Olson (1992), p. 8.

chances of different market mechanisms, the effects on the different pressure groups and the consistency with the existing institutional framework will therefore be of great importance.

Optimal user charges require a surcharge on the marginal costs of the infrastructure in height of the delay costs and, if there is a shortage, of scarcity rent.[103] The ICAO[104] Policies on Charges for Airports and Air Navigation Services require that airport fees are cost-related.[105] Similar prescriptions are contained in bilateral agreements, for example between EU member states and the US.[106] These would have to be renegotiated once optimal user charges are introduced. Although the ICAO rule isn't legally obligatory, it creates considerable moral pressure and might therefore hamper the necessary negotiations.[107] The distribution effect of optimal user charges depends on to whom the revenues are awarded. If capacity is expandable, they should be awarded to the airports since only they can invest in the required infrastructural extensions.[108] As shown above, the revenue will exactly equal the optimal investment level if constant economies of scale exist. If the delay and scarcity surcharges were awarded to the airports, it could be expected that these would support such charges. The windfall profit would be withdrawn from the incumbent airlines, however. Therefore, there is a good chance for heavy resistance of incumbent airways against the introduction of optimal user charges. New entrants, however, frequently offer their services at not capacity-constrained less central airports.[109] They would consequently profit from the introduction of optimal charges since the cost difference between the use of capacity-constrained and non-coordinated airports increases.

The introduction of auctions would require the withdrawal of grandfather rights. Therefore, a modification or abolition of the present EC directive 95/93 would be necessary.[110] The question whether grandfather rights imply ownership rights remains controversial in literature.[111] At least incumbents will have some rights due to protection of confidence.[112] Therefore compensation payments would be required if grandfather rights would be withdrawn without notice.[113] Relatively long transition periods therefore become mandatory.[114] Moreover, auctions would oblige the renegotiation of some bilateral air traffic agreements that are based on the IATA allocation proceedings, including grandfather

[103] See section 3.1.
[104] International Civil Aviation Organization
[105] See ICAO (2001), Art. 21 and 22; also: Nera (2003), p. 40; Bass (2003), p.88.
[106] See Nera (2003), p. 40.
[107] See Nera (2003), p. 40.
[108] See section 2.
[109] See e.g. Ryanair serving less central airports such as Altenburg, Frankfurt Hahn and London Stenstead.
[110] See Nera (2003), p. 46.
[111] See Boyfield (2003), pp. 22 ff.
[112] See Ewers et al. (2001), p. 9.
[113] See Tegner (2002), p. 111 and bibliographical references there.
[114] See Ewers et al. (2001), p. 13.

rights.[115] Incumbent airways can be expected to strongly oppose this market instrument since they want to protect their priviliged position. New airlines would gain access to required infrastructure. Airways which predominantly use not capacity-limited airports would profit from auctions. If revenues would be awarded to airports, airports would also gain from the introduction of auctions. If this were not the case, they would very likely oppose the introduction of this instrument because the status quo does not include any punctuality guarantee which could lead to compensation payments. In this scenario, they would be interested in the retention of the present regulation.

The introduction of a secondary slot market requires a modification of EC directive 95/93 since it forbids the monetary trade of slots.[116] The award of clearly defined property rights would promote the efficiency of this mechanism. However, as the US experience reveals, it is not absolutely required. Except for this there are no further legal modifications required.[117] If a slot market should be implemented under retention of the present grandfather rights, then there would be a good chance for lower resistance of incumbenet airways. Revenues for the financing of new infrastructure, however, could not be obtained. The airport operators can therefore be expected to be more sceptical about slot trading than about auctions and optimal user charges. Altogether, this mechanism seems to be most easily implementable because of the little requirement for legal modification and distribution effects.

The following figure summarizes the results of the analysis of the three market mechanisms.

	Allocative Efficiency	Symmetrical access	Infrastructural efficiency	Transaction costs	Legal consequence	Distribution effect
Optimal charges	+	+	+	-	-	-
Slot trading	+	-	-	+	+	+
Auctions	+	+	+	-	-	-

- bad, + good

Figure 4: Comparison of different allocation mechanisms.

Source: Author.

5 Conclusion and outlook

Airlines require access to airport infrastructure, specifically to runways, gates, and terminals, in order to offer their services. The lack of an efficient upstream market for airport capacity will harm overall performance of all players in the airline industry. The Buy-Sell Rule

115 See Boyfield (2003), pp. 47 ff.
116 See Nera (2003), p. 52.
117 See Nera (2003), p. 52.

implemented in 1986, which would make the allocation of scarce airport capacity possible, gained world-wide attention for being the first real-world experience using market mechanisms. There is evidence that the US market for airport slots increased overall market efficiency. Market failure resulting in anti-competitive behavior of incumbent airlines cannot be proved. The misconceptions about the results of the US experience in secondary trading are likely to reduce chances of implementing efficient market-based allocation systems in the US and world-wide.

Today, airport slots do not correspond to the concept of public goods any more, but are linked to shortage and externality. Administrative allocation mechanisms are unable to ensure an efficient allocation and a discrimination-free market access. The requirement for implementing market instruments therefore arises. Slot trading is relativly simple to implement and can lead to an efficient allocation of airport slots. Regarding discrimination-free access and an efficient financing of infrastructure, optimal user charges and auctions are superior. However, they lead to higher distributional effects and require an adjustment of EU and bilateral law. The choice of the allocation mechanism will therefore not only be influenced by economic reasons but will also depend on the "courage" of the politicians.

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