

Slot allocation and use at hub airports, perspectives for secondary trading

Jaap de Wit^{***1} and Guillaume Burghouwt^{**}

* University of Amsterdam

Faculty of Economics and Business Studies

Roetersstraat 11

1018 WB Amsterdam

The Netherlands

tel: +31 20 5254161

fax: +31 20 5251650

e-mail: j.g.dewit@uva.nl

** SEO Economic Research

Roetersstraat 29

1018 WB Amsterdam

The Netherlands

tel: +31 20 5251642

e-mail: g.burghouwt@seo.nl

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The growing excess demand for airport capacity makes an efficient use of capacity at congested airports in Europe an increasingly urgent issue. The key question addressed here focuses on the perspectives for a more efficient use of existing airport capacity through various market based options, especially with regard to hub airports in Europe.

To that end the following steps are taken. First, the existing allocation system for scarce airport capacity is described and the inefficiencies in the system are identified. More efficient market based approaches are introduced, ranging from congestion pricing to primary slot auctioning and secondary slot trading. The exemption of the 'grey' slot trading market in London is explained.

Thereafter, we describe the controversy between the two objectives of slot allocation, i.e. efficient use of slots in the upstream market and sufficient competition in the downstream air transport markets. The substantially different approaches chosen by the US and the EU with respect to preferred market based slot allocation options is analysed in this context of conflicting objectives. We also take account of the Commission's decision to tolerate slot trading at coordinated airports in Europe.

¹ Corresponding author

Finally, we discuss the impact of secondary slot trading at hub airports in Europe. We confront the slot trading approach with the hubbing system operated at major congested airports in Europe. Since hubbing results in a daily sequence of peak and off-peak periods, the use of hub airport capacity is inefficient, especially during periods of idle capacity. Finally, we address whether slot trading will improve an efficient use of hub airport capacity and if so, how will the hubbing system adapt to these new conditions. We will use Amsterdam Airport as an example.

Key words: hub redesign, slot allocation, slot trading, slot auctioning, congestion pricing, slot mobility, slot property rights, slot concentration

1. The growing problem of airport congestion

The substantial growth of the air travel market is not only based on traditional growth stimuli such as price, income and international trade but also on specific ones. The on-going market liberalization for example, such as the new EU-US open sky agreement, will generate new growth. As a spin-off of this market liberalization, low cost carriers continue to unbundle the airline product and create an unprecedented price competition in short to medium haul markets. The low fares generate new demand and divert existing demand from other transport modes. International travel will be further stimulated on the longer run by the growth of the BRIC countries (Brazil, India and China). These strong upward trends will probably partly be countered by restrictions that result from the reduction of green house gas emissions. But for the time being, growth in air travel demand is here to stay.

However, there is a strong contrast between the growth in the downstream market of air travel and the developments in the upstream market of airport capacity. Many reasons can be furnished why the supply of infrastructure capacity fails to keep pace with the demand for capacity: time consuming planning procedures (Werson and Burghouwt 2007), environmental concerns of noise abatement, political whims and the inability to start up new green field projects in the densely populated Western European region. The difference in growth between air travel demand in the downstream market and the supply of airport capacity in the upstream market increasingly results in a capacity crunch. Eurocontrol (2004) estimates that more than 60 airports in Europe will be congested in 2025. The top-20 airports will become saturated for at least 8-10 hours per day. The seven largest airports will need an hourly capacity of 201 IFR movements on average, whereas they can only handle 110 movements.

Therefore, one of the key economic issues in the European air transport industry for the next two decades concerns a more efficient allocation of increasingly scarce airport capacity. However, this is not an isolated problem, since scarce airport capacity is also an important market entry barrier and as such protects incumbents from competition. In other words, the upstream market issue of airport capacity allocation is related to the downstream market issue of market access and airline competition. The EU slot regulation 95/93 on common rules for the allocation of slots at Community airports provides an instrument that should create a more efficient allocation and use of scarce airport capacity as well as a better market access to new entrants. However, according to the Tinbergen principle that basically states that for each policy objective only one

instrument should be applied, one might wonder whether these conflicting objectives can be reconciled through one and the same slot allocation mechanism. In this article we primarily focus on the upstream market problem of a more efficient airport capacity allocation.

2. The current EU slot allocation system

2.1 The IATA scheduling guidelines

The current EU system of allocating scarce airport capacity (Council Regulation No 95/93 amended by Regulation 793/2004) is broadly based on the IATA Worldwide Scheduling Guidelines.²

If airport congestion becomes structural, the aviation industry has to find solutions through the airline scheduling process. For this purpose, the IATA Guidelines distinguish three types of airports (IATA 2005, p.3):

- At level 1 non-coordinated airports airport capacity adequately meets demand of the users.
- At level 2 schedules facilitated airports demand is approaching the capacity limitations at some periods. At level 2 airports airlines submit schedules to a schedules facilitator appointed by the airlines. The facilitator seeks cooperation and voluntary schedule changes to avoid congestion. The main forum for the interaction between the airlines and the schedules facilitator is the twice yearly Schedules Conference. Prior to the conference, airlines submit their schedules.
- If congestion worsens the government must decide on a change from self regulation to an explicit government regulation as a level 3 coordinated airport. Based on the specific capacity bottlenecks, the annual and hourly declared capacity have to be established in terms of available slots.³ Each airline needs a slot to operate an air service at the coordinated airport. The coordinator allocates the slots each season to the airlines in an independent, neutral and non-discriminatory way. The slot coordinator is appointed by the government.

It should be noted here that congestion and slot allocation at level 3 airports can be a seasonal affair. For example Salzburg and Innsbruck will be coordinated during the winter season, whereas a number of Spanish and Greek airports are subject to slot allocation during the summer

² Airports in the USA are not subject to these IATA Guidelines: the ‘first come, first served’ principle is being maintained even for highly congested airports. Scarcity of airport capacity is mainly reflected in waiting queues during starts and landings. Only four ‘high density’ airports were coordinated, i.e. subject to slot allocations based on declared capacity, whereas in Europe 73 airports are indicated as par time or full time coordinated based on IATA Guidelines.

³ A slot is ‘the scheduled time of arrival or departure available for allocation by a coordinator for an aircraft movement on a specific date at a coordinated airport. An allocated slot will take account of all the coordination parameters at the airport, e.g. runways, aprons, terminals etc.’ (IATA 2005, p.11). A slot allocated at the so-called US High Density Airports only refers to runway use. At US airports separate negotiations are necessary to acquire gates, check-in desks, baggage handling systems, etc.

season.⁴ Slot allocation may play a role at either partially congested airports during specific periods of the day, such as Amsterdam Airport, or fully congested airports during the whole day, such as London-Heathrow. Slot allocation is not exclusively based on runway congestion but may reflect other operational or environmental capacity dimensions. For example, Rotterdam Airport has been coordinated due to an apron capacity shortage. Amsterdam Airport's declared capacity is based on the maximum allowable noise levels.

2.2 The EC Slot Regulation

At Europe's coordinated airports the slots are allocated according to the EC Regulation mentioned earlier, in compliance with the IATA guidelines. Additionally, the EC Slot Regulation defines some specific provisions to protect for PSO routes and to encourage new entrants on intra-Community routes. The general principles of the slot allocation process in the EU can be summarized as follows.

Under the EC Slot Regulation slots can only be allocated to and held by operators (air carriers as well as general aviation). The primary allocation⁵ of the slots is made by the slot coordinator, subject to historical precedence –so-called grandfather rights- and retimings of historical slots for operational reasons. Obviously, the allocation in this system is dominated by the grandfather rights: if the series of slots (a minimum number of 5) are used in the previous equivalent season for at least 80% of the time the incumbent carrier has the right to use that slot in the next season as well (the 'use it or lose it' rule).

A slot pool is created by the slots remaining after this initial allocation and by newly created slots as a result of extra available capacity. These slots are allocated free of charge by the slot coordinator in a twice yearly coordination process of the IATA slot conferences. In order to encourage competition and new entry, up to 50% of the slot in the pool is set aside for new entrant airlines.⁶ However, one should be aware of the fact that usually the slots pool is very small. As a result, the objective of encouraging competition and new entry appears to be quite severely constrained by the other objective of a more efficient use of airport capacity. In the allocation of the remaining slots, priority is given to year-round commercial air services. If air carriers do not need an allocated slot anymore they can return their slots at the so called slot return dates (31st Jan and 31st Aug) as that date is the baseline for the calculation of the 80/20 rule. Returned slots can be reallocated to air carriers that still have outstanding requests. Thereafter and during the actual season available slots are mostly allocated on an ad hoc basis.

⁴ Summer peak airports like Kos are also nicknamed as hedgehog airports due to the traffic pattern which is a combination of a summer peak and a regular peak on one or two particular days of the week (Eurocontrol 2007).

⁵ The primary allocation of the slots concerns the vertical allocation by the coordinator to applicants for slots or slot holders, whereas the secondary (re)allocation concerns the horizontal transfer of allocated slots among air carriers without interference of the slot coordinator. Secondary trading concerns the transfer of slots including a monetary compensation between the carriers involved.

⁶ The definition of the term 'new entrant' has been revised in Regulation 793/2004 such as to increase potential competition on intra-Community routes. This did however not solve the problem of the small size of the slot pool, mentioned earlier.

2.3 Slot mobility under the Regulation

Under the EC Slot Regulation, exchange and transfer are allowed under specified circumstances:

- Slots may be transferred by an air carrier from one route or type of service to another route or type of service operated by the same air carrier;
- Slots may be transferred unilaterally within the same “commercial family”, i.e. between:
 - parent and subsidiary companies;
 - between subsidiaries of the same company;
 - as a part of acquisition or control over capital of an air carrier;
 - in the case of a total or partial take-over when the slots are directly related to the air carrier taken over;
 - in franchise or code-sharing operations carriers involved can use each others’ slots.
- Slots may be exchanged one by one, subject to confirmation by the slot coordinator.

With respect to this definition of a slot exchanges, the question may rise whether either an illegal unilateral slot transfer or a legal slot exchange is involved if a valuable slot is exchanged for a so-called ‘junk slot’ in an ‘artificial exchange’. A junk slot concerns a slot at a commercially less attractive time, for which there is no demand and which is allocated by the slot coordinator to an airline on request. After the exchange the other airline involved in the exchange will return this slot to the slot coordinator. The question about the legality of this artificial exchange played a role in the Guernsey case.⁷

The English High Court held that the artificial exchanges were exchanges in the ordinary meaning of the language and not unilateral slot transfers and this meaning was not qualified by the provisions of the Regulation, in spite of Art 14,3. ‘The coordinator is not in a position to judge whether to what extent such an exchange is “artificial”, as the Court stated.

Artificial exchanges are believed to be often accompanied by monetary compensation. The EC Regulation remains silent as to monetary consideration and in the Guernsey case the Court found that there was nothing to prohibit monetary compensation accompanying slot exchanges and transfers. Therefore, the Guernsey case is said to have further encouraged the ‘grey market’ for secondary trading at the London airports.

In a reaction to the Court’s decision in the Guernsey case the Commission proposed amendments of the Slot Regulation in 2004 that exchanges should only be permitted where each party to the exchange intends to use the slots it receives from the other. This proposal was not adopted by the Council. Due to the Commission’s opinion the uncertainty about the legality of these artificial exchanges continued to exist until the end of April 2008. Then the Commission clarified that instead of persisting in its earlier opinion the Commission now ‘does not intend to pursue infringement proceedings against Member States where such exchanges take place in a transparent matter respecting all the other administrative requirements...’.⁸ Allowing for

⁷ In the Guernsey case Air UK ceased to serve the Heathrow- Guernsey route as from the end of the Winter season ‘97/’98. It exchanged its historic Summer 1998 slots with slots from British Airways, which it then returned to the slot pool. The Guernsey government then brought judicial review proceedings in the English High Court against the Heathrow slot coordinator.

⁸ COM (2008) 227, 31-4-2008

secondary slot trading implicitly also addresses the key issue of the property rights of slots that we discuss later.

3. The need to change the current slot allocation system

3.1 Inefficiencies

Pursuant to the Regulation 95/93, the current EU slot allocation system applied by the slot coordinator at a coordinated airport takes into account the principles of transparency, neutrality and non-discrimination as well as historic precedence of the slots, public service obligations, market access opportunities for new entrants, the IATA guidelines and possible local rules.

It is quite obvious that under these conditions existing airport capacity will not be allocated efficiently. Although grandfather rights and the ‘use-it-or-lose it’ rule create the advantage of schedule continuity in successive schedule seasons, these elements are also strong incentives for airlines to hold on slots. The result is slot immobility as reflected in ‘slot babysitting’, i.e. poorly using the slots by operating low load factors and/or small aircraft at a highly congested airport.⁹ Sometimes an alliance partner ‘baby sits’ the slots for example in order to keep out newcomers.

Furthermore, if the slot coordinator is able to allocate a limited number of commercially attractive slots, he can hardly take into account the question which airline can make the most valuable and beneficial use of the slot to be allocated. He can mainly prioritize the category of scheduled year-round services on a first come, first serve basis.

From the point of view of efficient allocation it can also be doubted whether a new entrant as defined by the Commission¹⁰ will have any serious impact on competition at a congested airport. DotEcon (2001), Matthews and Menaz (2003) and Starkie (1998) expect mid-sized incumbents to be a stronger competitive threat to the dominant carrier than these smaller start-ups.

3.2 Market-based efficiency

In theory an efficient allocation of scarce airport capacity would require charges to airlines that are set equal to marginal social cost (MSC), i.e. the sum of the marginal operating cost of the airport operator –which is relatively small- and the marginal cost of delay to the airline and its passengers. In this approach, all airlines are assumed to operate no more than one flight in each time period without considering whether an aircraft operated by a given airline was delaying other flights operated by the same operator. This results in so-called atomistic tolls comparable to road congestion pricing.

More recently it has been questioned to which extent such pricing would reduce delays. Brueckner (2002) has pointed out that because an air carrier bears the cost of delay that it imposes on its other flights, it should be charged only for the delay it imposes on other carriers’

⁹ KLM for example operated Fokker 50s on the Rotterdam – Heathrow and Eindhoven-Heathrow routes. KLM has transferred these slots to Northwest to start up new Transatlantic routes from Heathrow after the coming into force of the EU-US Open Sky Agreement on March 30th, 2008.

¹⁰ See also footnote 6.

flights and not for the delay they impose in themselves. For example, a dominant carrier with a 75 percent share of the operations at an airport should only be charged for 25 percent of the delay costs. At a hub, this percentage of the delay costs may even become negligible for the hub carrier, since he clusters his operations in connection waves and fully internalizes the delay costs whereas the non dominant carriers operate their flights at off-peak times. Brueckner's approach fully focuses on the efficiency of scarce airport capacity and not on the distributional aspects it creates. Should, for example, operators with a small share of flights pay higher tolls than those with a large share, even if both operated during the same time period? However, Morrison and Winston (2007) find small differences between the net welfare gains of the atomistic and optimal congestion pricing policies. So, taking into account both efficiency and equity aspects of congestion tolls, implementation of the atomistic tolls seems to render a more feasible solution without substantially infringing efficiency objectives.

Another market based approach to allocate scarce airport capacity among the users concerns the capping the airport capacity through a declaration of the total number of slots and pricing them through secondary trading. The MSC of a slot is expected to reflect the opportunity costs of the service provided by the selling air carrier. Only those air carriers will buy such a slot if their willingness to pay is high enough to compensate for the price.

Mott MacDonald (2007) stresses that the introduction of a market based approach results in an economically efficient slot use in an allocative as well as a productive way. Allocative efficiency means that slots are used for those destinations that provide the highest social value in terms of generalised travel costs. Productive efficiency means that the total number of slots at an airport is maximised and that each slot is being used by moving the maximum amount of passengers (aircraft size) and maximum route distance possible. However, allocative and productive efficiency are not such straightforward concepts if secondary slot trading is introduced at a congested hub airport, as we will discuss later in this paper.

It should be stressed that the efficient slot use can be affected by the number of available slots, i.e. by the capping of the available slots through a capacity declaration. Since it is likely that declared capacity will usually be determined below the level of economic capacity, this opens the possibility for extra scarcity rents. Probably, these rents primarily materialize in the hub carrier's operations, so it may be in the hub carrier's interest to keep the declared capacity lower than optimal. Therefore, an efficient use of the slots at least requires a neutral and transparent determination of the declared capacity.

4. Towards an amended allocation system

4.1 Primary auctioning and/or secondary trading

The current slot allocation system in Europe can be made more efficient in either a more rigorous or a more adaptive way with respect to the existing IATA Scheduling Guidelines applied world wide.

The rigorous way implies the one-off suspension of all grandfather rights and the new entrants rule, i.e. returning all slots into the slots pool. From the slots pool all slots are then allocated

through a market based system. For example an auction is used for this primary allocation.¹¹ Different types of auctions have been proposed in the literature, ranging from a simple clock auction or sealed bid auction (NERA, 2004) to a simultaneous ascending auction including package bidding (NERA, 2004), or even a Simultaneous Multiple Round Auction (SMRA) (DotEcon 2001; Sickmann 2006). Gruyer and Lenoir (2003) prefer an even more advanced combinatorial bidding procedure based on the Vickrey-Clarke-Groves mechanism. However, especially in a one-off event auction design should be made as simple as possible in order to enable bidders to apply the auction rules correctly.

A more advanced auction design can only be applied if a less rigorously different allocation system is chosen that requires a annual auction based primary allocation. Such an approach can be effectuated by limiting the life time of the grandfather rights and by introducing a rolling programme in which a fixed percentage of the grandfather rights is being withdrawn annually while the reclaimed slots are auctioned each year. It should be stressed here however, that each of these two approaches would be incompatible with the current IATA guidelines in which the continuity of airline schedules is a key issue.

A more adaptive approach implies that the historical precedence of the allocated slots is maintained but that only secondary trading of grandfathered slots between airlines is allowed for. In that case it is expected that an air carrier may decide to sell slots to other airlines willing to pay the price involved if one is confronted with the opportunity costs of the slots in comparison with the value derived from operating these slots. In this way the efficient use of airport capacity will increasingly improve, be it at a slower pace than in a one-off auction.¹² This increased efficiency is expected to be reflected in a switch from short-haul to long-haul services, a switch from smaller to larger aircraft and correspondingly an increase in the average number of passengers per slot as well as a marginally improved utilisation of the number of available slots with less slots remaining in the slots pool. (NERA 2004; Mott McDonald, 2007).

4.2 The choice of a market based option and the issue of the slot property rights

Taking into account the recent publications of the EC and the US DoT/FAA¹³ it seems that the European Commission and the US DoT/FAA are at cross roads now where each of them is pointing in another direction with respect to fundamental issue of the slot property rights and the related market based allocation mechanisms.

Although from the beginning the EC slot regulation was based on the IATA principle of the incumbent airlines' grandfathering rights, the EC has also continually underlined that slots do

¹¹ Such a one-off event also manifests itself when a new runway is opened at a congested airport where excess demand is not dissolved by the extra capacity.

¹² From the optimal efficiency point of view the difference between primary and secondary trading is only gradual and not fundamental: primary trading will bring forward the long-run effects of secondary trading. It should be kept in mind however that also primary trading of all slots as a one-off event requires secondary allocation rules like secondary trading as a follow-up for slots returned.

¹³ COM(2008)277 and the supplemental notice of proposed rule making on the congestion problems at New York's LaGuardia Airport (Docket No. FAA-2006-25709; Notice No. 08-04)

neither belong to airlines nor to airports. According to the latest EC definition¹⁴ a slot is not a property right but a permission to the airline to use the airport infrastructure. However, the recent Commission's decision in COM(2008)277 to tolerate secondary trading at coordinated airports implicitly confirms the indefinite slot property rights of the airlines.

The US DoT/FAA on the contrary has chosen a different approach for LaGuardia Airport, by more explicitly defining the property right of a slot as the government's.¹⁵ Instead of revitalizing the old Buy-Sell Rule at the High Density Airports, US DoT/FAA proposes to grant access to the public facility of the airways via a slot lease for a defined period. In other words, each year a limited number of slots -10 or 20%- is intended to be auctioned off by a Package Clock auction or an single sealed Bid, Second Price auction (see Berardino, 2008)

These EU and US approaches reflect substantially different appreciations of the downstream market effects of secondary slot trading. The EC now points at the 'grey' slot trading market that according to the Commission, would have enabled new levels of competition at the London airports after the coming into force of the EU-US aviation agreement (at the same time ignoring the increased dominance of the incumbents). In the USA secondary slot trading under the High Density Rule is diagnosed as encapsulation of the incumbents that value their slot holdings much higher as a means of precluding entry by competitors onto high yield routes (Berardino, 2008).

If this diagnosis is correct, the size of the secondary slot market in Europe may rapidly shrink after the initial trading stage. This corresponds with the figures of NERA (2004) that estimated a 5-10 percent of slots at coordinated airports in Europe to be traded each year based on an extrapolation of the initial stage of trading at Heathrow. More recently however, Mott McDonald (2006) identified only 499 slots traded at Heathrow (some of them more than once) between 2001 and 2006 or an average fraction of around 1.2% per year of the total operations. According to (Mott McDonald (2006) a major part of these slots were sold as a result of the demise of Sabena and Swiss Air. The main buyers were the incumbents BA and Virgin (73% and 13% of the slots traded). This increase was also driven by British Airways' de-hubbing of Gatwick. Slot consolidation among major hub carriers corresponds with the findings of the GAO (1999) at the four High Density Airports in the US, where slot trading has been allowed since 1986 for domestic operations.

4.3 Secondary trading and downstream market concentration concerns

The position of the dominant carrier as a net slot buyer at a congested airport will result in a further slot concentration. This may result in an efficient capacity use providing new travel opportunities, if the dominant carrier launches new destinations and increases frequencies on existing routes. However, increased airport dominance also gives greater scope for anti-competitive behaviour of the dominant carrier. The carrier may engage for example in predatory bidding for slots, pre-empting competition in downstream origin-destination markets and

¹⁴ According to the EC Regulation 793/2004 a slot means 'a permission given by the coordinator ... to use the full range of airport infrastructure necessary to operate an air service at a coordinated airport on a specific date and time for the purpose of landing or take-off....'

¹⁵ The US DoT/FAA has always claimed a residual right to withdraw and reallocate slots at any time they think fit.

pursuing discriminatory practices among potential slot buyers See for example CAA/OFT (2005) and European Competition Authorities (2005).¹⁶

The diagnoses of the consequences of this slot concentration are quite different. Kleit and Kobayashi (1996) concluded from their analysis of slot use at the most slot concentrated airport in the US (Chicago O'Hare), that the slot concentration more likely resulted from efficient airport use rather than from ant-competitive behaviour. In that respect higher fares mainly reflect the scarcity rents of congestion which are necessary to clear the market.

Borenstein (1989) and the GAO (1999) relate the higher fares at congested US airports to hub premiums as the dominant carriers exploit their dominance at individual routes. Starkie (2007) on the contrary, points out the possibility that, since the airports do not apply efficient charging schemes, the airlines are keeping their fares at market clearing levels. In other words, these fares do not reflect monopoly rents but scarcity rents (and these rents can be manipulated through a tighter declared capacity, as indicated earlier). Furthermore, it is the hub and spoke system that provides the origin-destination market at the hub with a excellent accessibility product of direct connections to a disproportionate set of world wide destinations compared to the size of the local demand. These higher fares may correspond with a differentiated and more costly network quality. The higher costs of such a network may be the net result of the diseconomies of scale in hub operating costs (baggage handling systems, peak capacity of ground staff, check-in facilities, long turn round times of aircraft, etc.) on the one hand and the benefits of hub and spoke network economies, (i.e. economies of size, density and network scope) on the other hand. Furthermore, De Wit and Burghouwt (2007) doubt if the relationship between secondary slot trading and concentration at 'high-density' airports in the US is a causal one: other factors such the consolidation in the US airline industry may also be at stake here.

Anyhow, the level at which overall airport dominance is passed on to consumers strongly depends on the interaction between airport dominance and route dominance as well as the presence of inter-airport competition. Abuse of monopoly power at the route level can be countered by adequate EU competition policy and close market investigation on a case-by-case basis.

Although it is obvious that slot concentration at congested airports is likely to occur if secondary slot trading is introduced, it is also important to take account of the fact that the congestion patterns at individual airports can be very different. For example at London Heathrow carriers have to cope with a continuous congestion all over the day, whereas other major airports in Europe operate as traffic pumps to provide connections between incoming and outgoing traffic waves in a hub and spoke system of the hub carrier. Congestion at these hub airports is a discontinuous phenomenon of alternating peak and off-peak periods. So the question in the final section is whether the dominant carrier at a hub such as Paris CDG or Amsterdam will behave differently from a dominant carrier such as BA at Heathrow.

¹⁶ Examples are: reluctance to sell slots to competing carriers; selling only at excessive prices; with non-compete clauses, only to certain airlines; at higher prices to stronger competitors; tying the buying airline to other services as well.

5. Secondary slot trading and hubbing: the Amsterdam airport case

5.1 Scarce airport capacity at London Heathrow and Amsterdam

The question is whether the lessons learned from the grey slot market of London Heathrow (LHR) are fully applicable at for example the KLM hub in Amsterdam (AMS) and the Air France hub in Paris CDG. The continuous congestion at British Airways' home base Heathrow also partly reflects the focus of BA on the high yield O-D market of the London metropolitan area itself. The primary role of LHR as a gateway is reflected in the low dominance level in table 1 compared to the other three hub airports.

Table 1. Concentration at selected European hubs (% in total scheduled flight movements) in 2004

	KLM at Amsterdam	Air France at Paris CDG	Lufthansa at Frankfurt	British Airways at Heathrow
Home carrier (H)	46.9	56.4	57.7	39.7
H+Regionals (R)	49.4	63.2	59.9	41.3
H+R+Global Partners	62.0	70.9	71.1	51.3

Source: OAG data (2004)

The substantially lower transfer rates of London Heathrow in the range of 30-35% also contrast with the 40-45% range at Amsterdam and the transfer rate at Frankfurt even over 50%. A hub such as Amsterdam shows successive periods of slot scarcity during the day due to the connection traffic peaks of the hub carrier, whereas Heathrow demonstrates a continuous excess demand of capacity during the whole day. Figure 1 illustrates this process of alternating peaks of connecting arrivals and departures for the KLM operations at Amsterdam.

The earlier discussed symptoms of productive efficiency in slot use to be expected after the introduction of slot trading are not so self evident in this setting anymore. For example, the hub carrier cannot simply continue to substitute short-haul narrow body flights by long-haul wide body flights in the scarce peak slots. Both types of operations are indispensable in the hubbing process. On the average, 75% of the seats on KLM's intercontinental flights is fed by European operations and vice versa. So the question rises how hub carriers may react on secondary slot trading at their hub airport.

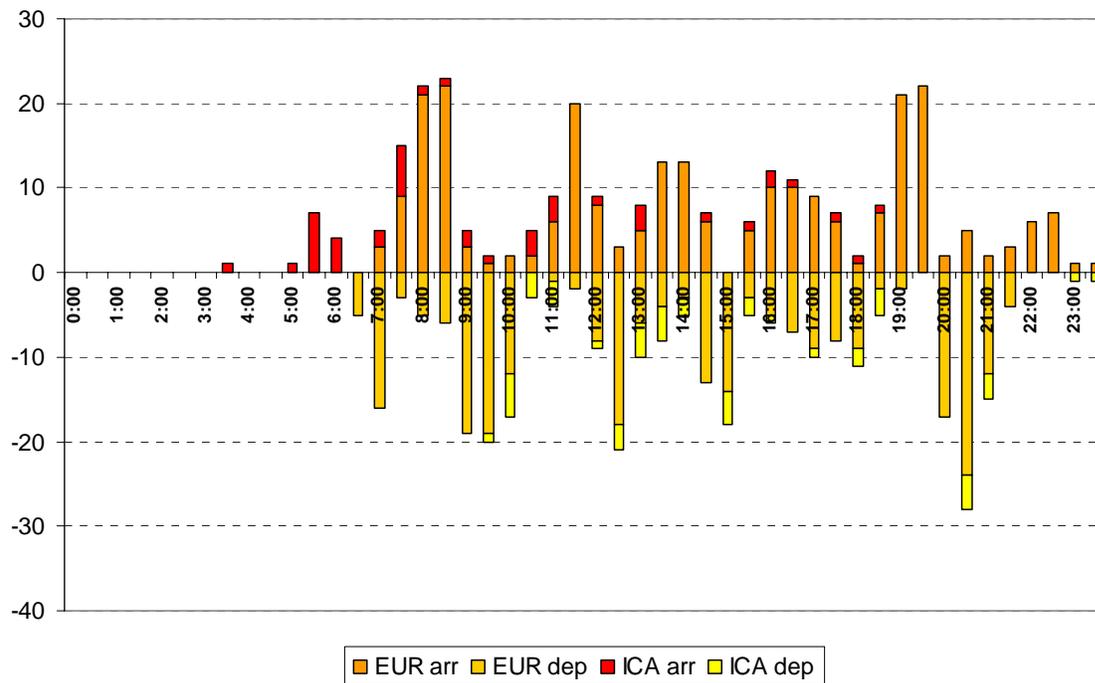


Figure 1. European and intercontinental movements of KLM per half hour at Amsterdam (OAG, 20-09-2006, local time)

Source: OAG 2006

5.2 Hubbing and secondary trading at Amsterdam

First of all, it remains likely that the hub carrier will show a higher willingness to pay for scarce peak slots than low-cost carriers, charter airlines and freighter carriers. However, it is not likely that this will be the case for the slots of foreign European hub carriers. Their opportunity costs derived from their peak slots at Amsterdam are connected with the opportunity costs of the related slots that fit in their own hub and spoke system at their respective home bases.

Figure 2 provides some interesting information on the composition of the traffic peaks. The scarcity in the arrival and departure peaks is predominantly caused by the hub carrier and its alliance partners at Amsterdam. However, even in the peaks a number of slots is used by low-cost carriers as well as charter airlines. These carriers will be willing sellers of peak slots.

The question then is, which carriers will be willing peak slot buyers. Will the hub carrier take the opportunity to extend the wave capacity of his hub and spoke system if slots can be traded?

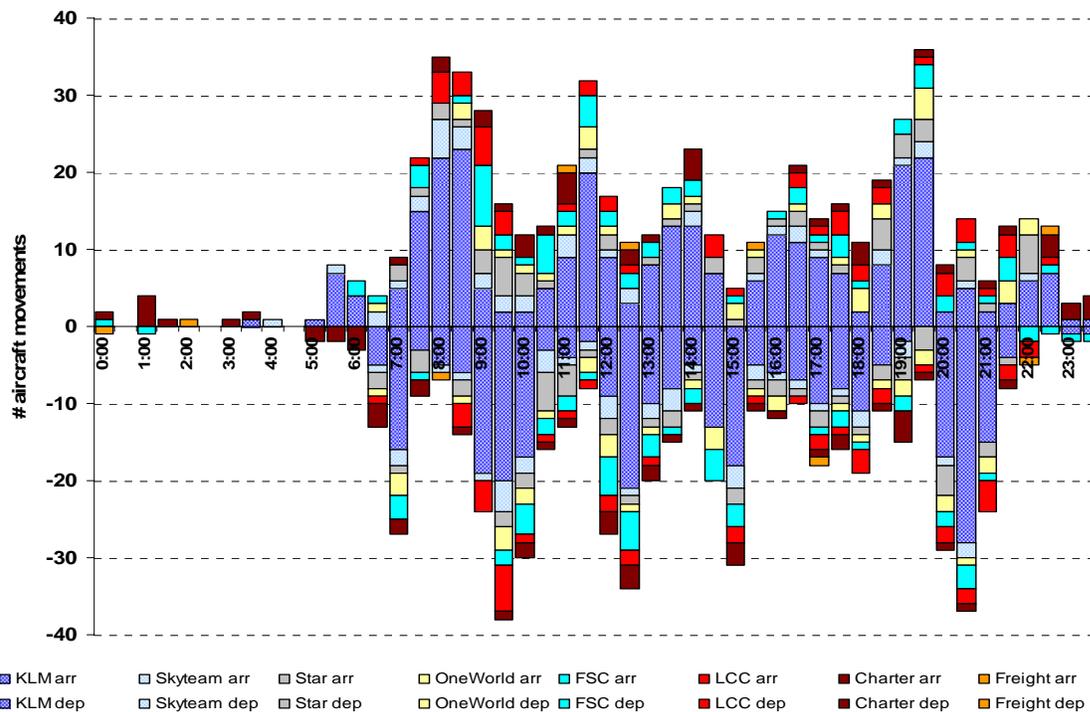


Figure 2. Total numbers of arrivals and departures per half hour and per traffic category at Amsterdam (OAG, 20-09-2006, local time)

Source: OAG (2006)

Since congestion costs are already internalized by the hub carrier in addition to his high marginal operating costs in the peaks, it is not likely that the hub carrier will be a willing buyer that intends to structurally expand its traffic peaks any further. On the contrary, since secondary slot trading reveals the opportunity costs of peak slots, this information will primarily stimulate the hub carrier to optimise its traffic peak pattern of connecting waves. Those connecting spokes that the hub carrier operates with a substantial monopoly power can be reallocated from the peak centre to the peak shoulders. Although the total travel time increases due to longer transfer times, the airline revenues will not substantially diminish since the passengers involved can hardly choose an alternative travel option. In contrast, competitive spokes will be better centred in the peaks.

The introduction of secondary slot trading may not only stimulate adaptations within the existing waves but it may also be an extra incentive to reconsider the design of the existing wave system.

5.3 Optimising the wave system

Although economies of scope in hub and spoke systems have often been identified as strong incentives to expand the connecting traffic peaks, hubbing comes at a rapidly increasing cost of idle capacity in the off-peak periods at the hub. If the introduction of secondary slot trading also adds the growing opportunity costs of the peak slots in expanding peaks to these operational

hubbing costs the sum of the two costs may start to outweigh the scope economies of ever-growing peaks.

In other words, the opportunity costs of the peak slots will disproportionately increase with the height of the peaks. In addition, this will further aggravate the diseconomies in the hubbing costs. Since the slot prices are only one component in the total hubbing costs, the decreasing returns to scale in the hubbing costs as such are probably reflected already in several hubbing restructuring projects initiated by various hub carriers. Slot trading can be expected to further stimulate peak stretching. The internal delay costs and operational peak costs as such have been already sufficient triggers for stretching the connection waves in the examples discussed below. Secondary slot trading system would become an additional trigger for hub redesign.

Frank et al. (2005) describes the 'depeaking' of Lufthansa operations at Frankfurt airport using Lufthansa's own schedule to adapt the overall declared capacity as well as the declared capacity for arrivals and departures in such a way that the daily variability of operations can be adequately handled and the past flight delays are no longer incorporated in the constantly lengthening of planned inbound block times.

Another example is the further-reaching transformation of Delta's banked hub at Atlanta into a continuous hub that combines the revenue generating power of the traditional banked hub with the operational efficiencies from a smooth continuous schedule, as described by Petroccione (2007). In other words, the network economies derived from the connectivity in highly peaked connection banks at the central hub no longer outweigh the operational and congestion costs of the hubbing process. The continuous hub at Atlanta was designed by careful selection of the top revenue producing markets as the foundation for a continuous pattern of flight options to these markets. These key markets approximately generate 80% of the connecting traffic and 70% of the originating traffic. The competitiveness of this redesigned hub was achieved through a trade-off between slightly increased connecting time of 3 minutes - except the key markets where elapsed connecting time remained at current level or less - and higher frequencies.

Other US carriers have also redesigned their major hubs in recent years, such as American Airlines at Dallas Ft. Worth and United at Chicago O'Hare. This redesign primarily focused on the operational efficiencies as such, i.e. the hubbing costs. The result is a set of smaller well defined directional banks, often referred to as a rolling hub.

All in all secondary slot trading at hub airport may further contribute to a hub redesign since the opportunity costs of the peak slots will be an extra incentive for the hub carrier to redesign the connection waves.

6. Concluding remarks

In the previous sections, we analyzed the existing EU slot allocation system and the need to introduce market based approaches such as primary slot auctioning and/or secondary slot trading to enable an efficient use of slots at congested airports. However, we observed that the envisaged efficiency can be affected by the way the declared capacity is established as the total number of available slots. Also the tension between the two objectives of the slot allocation, i.e. efficient use of scarce airport capacity and sufficient competition in the downstream air transport

markets, cannot easily be solved due to the inevitable slot concentration that will emerge after the introduction of secondary slot trading as confirmed by the slot trading results at Heathrow. In contrast with these figures the EC has indicated now its willingness to tolerate slot trading at other coordinated airports in Europe according to the London model. This appreciation of secondary slot trading appears to be fundamentally different from the US experience with slot trading under the High Density Rule during the last few decades. Due to the resulting slot concentration and its impact on downstream markets, secondary trading is no longer seen as a viable market based option for congested airports. The A fundamental difference between the US and EU views on slot property rights also plays a role in the US DoT/FAA preference of slot auctioning combined with congestion pricing at the New York airports. Finally, the introduction of secondary slot trading at hub airports in Europe may result in a different behaviour of the respective hub carriers compared to BA's behaviour at Heathrow. Secondary slot trading becomes an additional incentive to restructure the connection waves systems at these hubs.

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