

The Potential Effects of Market-based Slot Allocation Schemes on Airline Networks in the European Union

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1 Introduction

Airport slots, or the permission for an airplane to land or take-off at a specific time and date, have become increasingly difficult for airlines to attain at major airports in Europe. This brings about serious consequences both for the airline business as well as for the passenger. To understand the causes, implications, and, ultimately, what can be done to solve this dilemma, a closer look at the development of the air transport sector as a whole must be taken at first.

The European air transport sector has experienced major changes in the past two decades. Successful efforts towards liberalization have opened up new opportunities in the airline business and have led to a surge in passenger numbers. However, the road to liberalization was difficult. The market was characterized by very restrictive bilateral agreements between European countries. Flights between individual countries and the resulting revenues were usually split up 50-50. Airlines were often heavily subsidized and had to be controlled by the government to enter a foreign country. Price competition was virtually non-existent. (Button 2004: 95-99).

This heavily regulated sector was liberalized through three “packages” on a very gradual basis within the European Union (formerly European Community). The first package, introduced in 1987, gave the European Commission the power to apply antitrust articles to airline operations in respect to inter-state flights. This package slightly relaxed the rules on setting air fares and the equal split up of flights between countries. In the second package, which came into effect in 1989, the split-up of flights was abolished in stages and fare-setting became based on a system of double-disapproval, in which both states would have to reject a fare in order for it to go out of effect. Furthermore, rules on state ownership and control

were scrapped and airlines were able to enjoy the 5th freedom¹ as long as they were registered in a country of the European Community. The 3rd package was enforced in 1993 and created a free market in the airline business within the EU, with the main focus being on lifting barriers to entry for newcomers (Button 2004: 102-105).

Not only the airline sector, but also the airport sector has been experiencing big changes in regards to liberalization. Airports are being commercialized and privatized: they are being run as profit-seeking business entities instead of as public facilities. Furthermore, an airport globalization is occurring as a selected few companies are operating more and more airports worldwide (Graham 2003: 6-7).

These liberalization efforts have proven to be very fruitful. The number of scheduled airlines has risen from 77 in 1992 to 139 in 2000. The air transport sector has seen strong reduction in ticket prices while the number of air routes has increased by 30% since 1993 within the union. The sector has also seen a major structural change through the introduction of Low Cost Carriers (LCC), which operate primarily on a point-to-point basis and provide very low prices (European Commission 2006b). Although the industry experienced a strong downturn after the September 11th terrorist attacks, the SARS crisis, the war in Iraq, as well as continuously high oil prices, the industry has managed to rebound tremendously (“Forecasts 2006 summary”).

However, all this growth has led to serious capacity problems in the air transport sector. These problems are causing delays and are already hindering growth in certain regions. The attention has mainly been put on air traffic control, where the Single European Sky initiative was taken in 2004 to tackle some of the

¹ “5th freedom. The right of an airline of one country to carry traffic between two countries outside its own country of registry as long as the flight originates or terminates in its own country of registry” (Button 2004: 121).

major airspace problems (European Commission 2006a). More focus is now being put on airports as the main bottleneck. To accommodate growth, a study undertaken by Eurocontrol in 2004 comes to the conclusion that 10 new major hubs as well as 15 new mid-sized airports will be necessary in Europe. The use, expansion, and building of new airports are, however, limited for various reasons, such as environmental protection (“Capacity crunch”). The number of slots that can be dealt out to airlines is, therefore, limited at several European airports, and supply is not able to meet demand.

Considering the strong growth that the airline industry has been experiencing as well as the problems of expanding strained capacity to deal with this growth, discussions on how to use already existing slots in a more efficient manner have arisen. Currently, the allocation of slots in the European Union is laid down in the 1993 European Union Slot Allocation Regulation EC 95/93 as well as in the amendment 793/2004. The problem with this regulation is that a scarce resource (a slot) is being allocated through a purely administrative process, which inherently leads to inefficiencies (Gallistl). A key feature of this regulation are the so-called “grand-father rights”, which allow incumbent airlines to retain their slots if they have used them in the previous season to a certain degree. This system does not create an incentive to use slots efficiently and makes it difficult for new airlines to enter congested airports. The European Commission is thus discussing market-based alternatives to allocating slots, especially in the light of the positive effects that deregulation and market orientation have had on the air transport sector. There are several market-based slot allocation schemes that have been suggested. These range from minor incursions to a complete overhaul of the present system (“The slots game”).

The aim of this thesis is to examine three different types of market-based slot allocation schemes and whether or not airlines and ultimately passengers would benefit from these. While implementation issues will be addressed, the primary focus lies in the impact of market-based slot allocation schemes. To

begin with, a theoretical foundation will be built up by explaining the nature of passenger air services, the demand dilemma faced by airlines, as well as the different types of airline networks. This will help to understand the potential effectiveness and restraints of market-orientated slot allocation schemes. Next, the extent of the slot problem, the way in which the European Union deals with this at present, and the resulting shortcomings will be discussed. Then, three alternative market-based slot allocation schemes will be introduced: secondary trading of slots, higher posted prices, and the auctioning of slots. Finally, the impacts of these will be analyzed.

The research method undertaken for this thesis was primarily based on a study of the literature. This was complemented by interviews with members of the airline and airport industry as well as the aviation authority and slot coordination company in Austria.

2 Theoretical background

2.1 Passenger air service

2.1.1 Attributes of the passenger air service

The purpose of passenger air services is to bring the passenger from a point of origin to a point of destination. While this is the airline's primary objective, there are numerous other service features that add up to create the complete passenger air service (Maurer 2003: 89). Although the airline plays a central role in this, the airport and other players also complement the product and its over-all quality.

There are several general characteristics which airlines must focus on to ensure their competitiveness in the market (Eniko). First and foremost, the airline must operate a safe and modern fleet. Fulfilling this requirement does not necessarily provide the airline with a competitive edge; however, not having one would be a serious disadvantage. Three further important elements are the punctuality of the airlines, optimal flight allocations (point-to-point routes and hub-and-spoke systems), as well as optimal departure and arrival times. The flexibility offered to the passenger is also of high importance.

Maurer (2003: 86, 87) sees the passenger air service, which he refers to as passage service, as a chain of services. First of all, the service begins with the pre-airport part, which includes how the tickets are booked and what means of transportation can be used to reach the airport. Upon arrival at the airport, the check-in phase begins. Various means of checking in exist, such as the automated check in, the possibility of checking in the night before an early flight or checking in directly at the gate. The next link in the chain is the stay at the airport before boarding the plane. Here the airlines may offer special waiting rooms to highly

valued customers in the form of VIP, business, or frequent flyer lounges. Then, the actual boarding is also regarded as a service element. The aim is to bring the passengers on board comfortably, giving attention to travellers with children or other special needs. This process may be complimented by providing newspapers or a wardrobe service. The actual flight sees a variety of services offered to the passenger. For one, there are different seating classes, such as economy and business class, in which the level of catering, seat comfort, in-flight entertainment or the choice of meals varies. The last link in the chain of the passenger air service is the disembarkation. Services such as connection flight information, dry disembarking, rapid transfer possibilities for passengers pressed for time, and baggage delivery all add to the total quality of the product.

2.1.2 Segmentation of the passenger market

Now that the general characteristics of the passenger air service have been introduced, the focus will be placed on the passenger. To begin with, it is important to note that the consumer, i.e. the passenger making use of the air transportation, is not necessarily the customer. While the passenger is easy to identify, it is not always clear who the customer really is. The customer of the airline, for example, could be a travel agent that purchases a block of seats or a company that sends its employees out on business trips. Often, there is a conflict of interest between what the consumer and the customer see as an ideal passenger air service. For example, while a company experiencing financial troubles might choose the airline with the lowest air fare, the employee prefers the airline with the lowest transfer times on the way to the destination. These discrepancies are important to keep in mind when considering the following features and requirements of the passenger, as the airline solely regarding the wishes of the passenger will not necessarily be as successful (Shaw 1999: 8-11).

Generally, there are two types of passengers that can be distinguished: the business traveller and the leisure traveller. Both make use of the air service but

have different needs and display different characteristics. According to Eniko, the business passenger segment consists mainly of employees, entrepreneurs, incentive travellers, and conference participants, while the leisure passenger segment is made up primarily of tourists and visitors of friends and relatives.

Eniko argues that the business passengers segment is characterized by a different seasonality than the leisure traveller. Business travellers tend to travel more at the beginning and end of the month, at the beginning and end of the week, as well as outside the summer months. Although they travel relatively frequently, they tend to book flights on a very short term basis. When travelling, they display a high amount of time sensitivity, which means that the exact time of departure and arrival as well as waiting times play an essential role. There is a tendency to show up very late for flights, often requiring special check-in counters just for this segment. In general, the price sensitivity is relatively low, as the air fares are mostly covered by the companies for which the business traveller works. In terms of the schedule, business travellers prefer low connection times and flights which will bring them to their business engagements at the proper time. What comfort is concerned, business travellers request a much higher standard: they want to be relaxed when they arrive at their destination of business and upon returning from a stressful meeting, for example. A higher degree of comfort can be achieved by wider seats, separate waiting lounges at the airport, onboard entertainment, full catering and the like. Furthermore, Sterzenbach and Conrady (2003: 11, 12) identify flexibility, the density of the network, and flight frequency as the most important criteria in passenger air services.

The leisure traveller, on the other hand, has a different set of priorities when choosing an airline. According to Eniko, passengers of this segment travel only a limited amount of times each year, especially during the holiday seasons. Their preferences are less focused on the exact timing of the flight, the check-in time required, or the route to the destination. Instead, the focus is on the price, as the trip is paid for privately. The financial burden is increased by the fact that the

air fare must be paid for all family members on the trip (Shaw 1999: 36). The demands towards comfort are, thus, also much lower than in the case of the business traveller.

2.2 The demand dilemma

The passenger air service forms a part of transportation services in general. The transportation service exhibits a special characteristic that distinguishes it from many other types of services in the tertiary sector. Essentially, transportation is a derived demand. This means that the demand for transportation results almost entirely because of the demand for other products or services (Cole 2005: 5). For example, the demand for the transportation of non-durable products to supermarkets arises in order to meet the demand of the customer, wanting filled shelves with fresh food in the outlets. Another example would be a family, desiring to spend a holiday abroad. To be able to spend the holiday abroad, i.e. consume the service, they would need transportation of some form to bring them there. The act of consuming the service of transportation is, therefore, secondary in nature. Many more reasons exist that create the need for transportation. Aberle (2003: 6) categorizes the need for transportation into six different groups: Transportation for the sake of getting to the place of education and work, doing business and shopping, and getting to free-time and holiday destinations. However, there is also transportation taking place where it is the final product (Cole 2005: 6). This could be, for example, a scenic flight over interesting landscape.

Considering that demand for transportation is of a derivative nature, the control that transport operators have over certain demand-related issues is limited. The main problem is the peak problem. To begin with, there are peaks during the day, especially when office hours start and end. (Cole 2005: 17). This effect is

visible in Figure 1, which depicts the demand in percent of available seats for regional flights within the hour of the day.

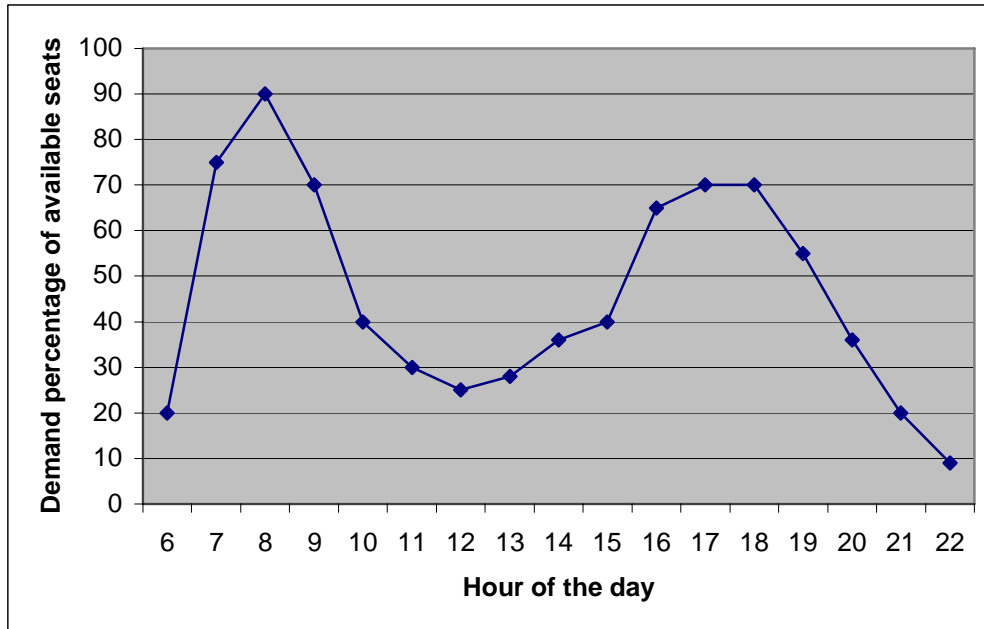


Figure 1: Daily Demand Fluctuations. Source: Sterzenbach and Conrady (2003: 17).

There are also peaks during the week, where differences can be seen in transport utilization between the weekend and specific week days. Furthermore, seasonal peaks exist as the proportion shifts between transport being used for work and transport being used for holiday trips (Cole 2005: 17). In Figure 2, the differences in the amount of passengers being transported by Lufthansa each month in 1998 are depicted (the total amount of passengers for the entire year was 40.5 million).

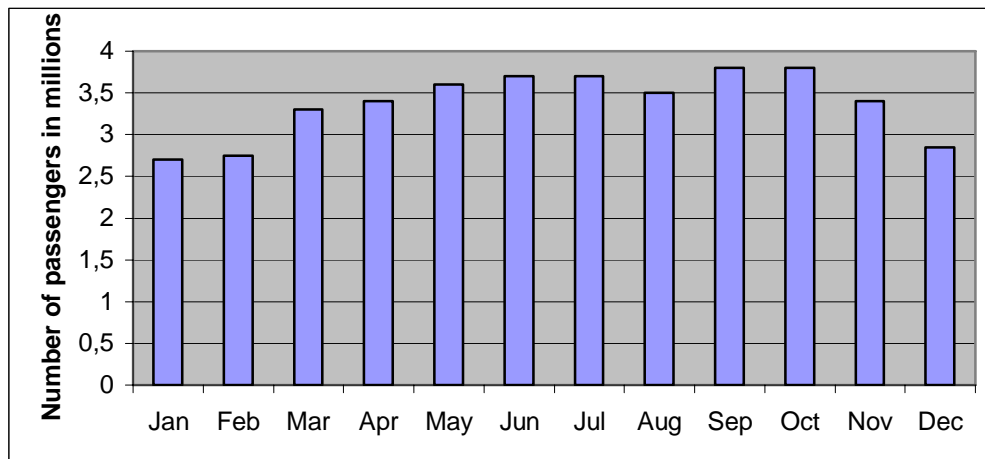


Figure 2: Monthly change in demand for Lufthansa. Source: Sterzenbach and Conrady (2003: 16).

The resulting problem of these peaks in demand is that there is either a shortage of transportation during peak demand times or a surplus of demand outside the peaks. As the service of transportation cannot be saved up there will invariably be an inefficient use of capacity outside peak hours or there will be demand which cannot be met during peak hours. In the case of the airline business, there is a strong tendency for overcapacity (Joppien 2003: 111). And as the transport demand is a derived demand, it is very hard to create incentives for the passengers to use transport outside these peak hours. To make things worse, a lot of traffic during peak times tends to be one-way. For example, different forms of transportation will have a high capacity utilization when bringing passengers into town during the morning rush hour, while they may be empty on the way back out of town (Cole 2005: 21,22). Other factors that cannot be influenced by the transport operator include changes in social preferences (such as when and where people choose to take their vacation), a shift in demography (for example, different age groups have different transportation needs), or changes in the prices or services that the competition offers (Cole 2005: 18-19).

The high degree of price elasticity is another difficult issue that airlines are faced with. Since the quality of the passenger air service often only differs marginally between airlines, customers are prone to switching carriers very quickly if a competing airline offers a slightly lower price. The same is true for the cross price elasticity, wherein passengers react to the price of other goods not relating to the flight itself when deciding whether they should purchase the air ticket or not (Joppien 2003: 112-114).

Another problem that the air transport sector faces is that it is often at the mercy of the general state of the economy and oil prices as well as being extremely sensitive to external crises, such as the September 11th terrorist attacks, SARS, or the war in Iraq. This seriously complicates the airlines' ability to plan ahead. To make things worse, the airline business has a very low profit margin (Malanik).

There are further matters affecting especially the air transport sector. For one, it is difficult to adapt to changes in demand patterns in the short run since the production of new aircraft, which are ordered, takes a substantial amount of time. By the time the highly expensive aircraft are actually in operation, the market situation may have already changed (Sterzenbach and Conrady 2003: 11, 12). In addition to this, investments cannot be gradually increased; a whole airplane has to be bought at once or not at all. This is referred to as "batch production" and means that the airline cannot gradually increase its investment; instead, it can only do this in big steps (Joppien 2003: 115,116). Another element that reduces flexibility is the fact that fixed costs are very high in air transportation (Sterzenbach and Conrady 2003: 11, 12). This implies that the operating ratio is very high for airlines. Additionally, airlines display a high sensitivity towards changes in fuel prices as well as foreign exchange rates, since a large amount of the generated revenue by airlines active on an international level is in the form of foreign currencies (Joppien 2003: 116).

2.3 Airline networks

In the following, different types of airlines providing passenger air services will first be introduced. Next, different route and network types will be described. Then, some important considerations in choosing a network will be discussed. And finally, more detailed attention will be given to the hub-and-spoke concept.

2.3.1 The different types of airlines and operations

The types of services airlines provide and the operations they undertake are very heterogeneous. Thus, there are many different ways of categorizing airlines. Joppien (2003:117-122) suggests a whole range of possibilities of doing so: by size, legal status, operating rights, service level, business strategy, structure of ownership, cost structure, marketing strategy, and network structure, to name a few. In the following, however, a classical categorization of airlines into four basic types will be given: Network, charter, regional, and low cost carriers.

The category of network carriers, which operate major hub-and-spoke systems, can be split into three subgroups according to Pompl et al. (2003: 460): majors, flag carriers, and continental carriers. Majors are characterized by global presence and a strong market share in their home markets. They tend to be in the high price range and have a very strong market share in the business traveller segment. Furthermore, they operate complex networks. These types of airlines are also referred to as international passage airlines (Maurer 2002: 28). National flag carriers were originally owned by the state. Many of them have been either fully or partially privatised. The national flag carriers usually have their main hub based at an airport in their home country (Maurer 2002: 28, 29). Continental carriers are of similar size as the previous two subtypes and simply focus on continental networks (Pompl et al. 2003: 460).

The regional carriers, also referred to simply as “regionals”, are airlines that operate aircraft with usually less than 100 seats and provide short flights in the domestic or intracontinental markets. They function as feeders between regional centres and hubs and also run point-to-point traffic. Regionals usually operate only one seating class. Examples of regionals are Lufthansa CityLine and American Eagle Airlines (Maurer 2002: 35-37). In Europe, many regional carriers are members of the European Regions Airlines Association (ERA), which protects and promotes their interests (ERA 2005).

Charter carriers (or leisure carriers) are focused on bringing passengers to major tourist destinations. The product of this airline type experiences very high price elasticity. Charter carriers usually operate on a point-to-point basis on routes where there is fairly high demand and try to ensure a high aircraft utilization. The seat category is usually limited to economy class (Maurer 2002: 32, 33).

Low cost carriers are characterized by low operating costs, a far reaching reduction of customer service, scheduled services, and point-to-point short haul traffic. They have a cost advantage over the majors for a number of reasons besides onboard service reduction. A higher seating density is achieved by scrapping the business class and reducing the distance between seats. For example, the LCC EasyJet provides 148 seats on its Boeing 737-300 while British Midland's, a conventional carrier, offers between 124 and 132, depending on business class configuration, on the same airplane type. This reduces the costs per seat. The daily aircraft utilization is also an improvement. LCCs have lower turnaround times (time between arrival and take-off) at airports due to less time needed for cleaning (there is no free catering which would increase the need to clean), lower boarding times due to free choice of seats, as well as a lack of non-passenger freight which would increase loading time. Further savings are made possible by the reduced need for cabin crew as well as no over-night stopping of

aircraft away from the home-base airport. They also outsource maintenance and lease most of their airplanes. LCCs usually stick to one type of aircraft, reducing the need for a higher variety of spare parts. When possible, LCCs make use of cheaper secondary airports. When it comes to ticket sales, no travel agents are used (Doganis 2001: 127,142-149). In Europe they have sprung up as a result of the liberalization efforts of the 90s and have been very successful in the last few years, experiencing double digit growth figures. The fact that they offer scheduled air services is what distinguishes them from the charter traffic (Fernández and Kropac 2004: 407).

It is important to note that the delineation between these airline types is becoming more and more difficult (Fernández and Kropac 2004: 408). For example, Air Berlin, a successful German LCC traditionally focusing on point-to-point traffic, has established mini-hubs in Nuremburg and Palma de Mallorca and is planning to do so in Standsted as well (“Air Berlin to begin UK domestic routes from London”).

2.3.2 Types of networks and routes

Before going into import considerations in designing networks, an overview of the different types of networks and routes will be given. One way of differentiating networks is given by Hanlon (1999: 83), who presents three fundamental network types: the line, the grid, and the hub-and-spokes network. The line is simply a series of destinations that are served after each other, where the origin and final destination are not the same. A grid consists of a series of destinations being connected with no real central point from which flights are made. Finally, the hub-and-spoke network is one in which there is a point in the network to which all flights in the network go to. Passengers coming from one point can be transferred to all other points in the networks by transferring at the central point, called a hub. The routes connecting the outer points to the hub are referred to as the spokes.

Another way of discerning network types is by distinguishing between point-to-point traffic (or decentralized traffic) and hub-and-spokes traffic (Maurer 2003: 333,334). Point-to-point traffic is characterized by being uncoordinated or independent of other routes offered by the airline. Point-to-point routes are economically justified by the traffic being generated alone on this route. Hub routes, on the other hand, are coordinated with connecting flights at the hub. The main advantage that a hub-and-spoke network offers is that many more origin-to-destination flights can be offered to the passenger than if unconnected point-to-point flights were offered. This will be described in Chapter 2.3.4 in more detail.

Different types of routes can also be discerned. Holloway (2003: 368) distinguishes three different types: First of all, there are non-stop routes which simply bring passengers from point A to point B in one flight. The second category is that of the direct, multi-stop or through-plane routes. Here, the passenger air service is executed with one and the same aircraft and flight number from origin to destination via one or more points (airports) on the way. The entire journey is referred to as the flight-leg while the individual flights on the way are called segments. The third category of route is the connecting route. Holloway divides this category into three subtypes: Online connections, code-share connections and interline connections. On online connections, passengers change from one plane to another on the way, but using the same airline. Code-share connections are flights on which passengers change aircraft as well as the airline on the way from origin to destination. The entire journey, however, is conducted under one flight number. Finally, on interline connections passengers switch aircraft and airline on the way as well as benefiting from being able to use one ticket for the entire journey.

2.3.3 Important considerations when building a network

The network of an airline, which refers to the “routing pattern of planes” (Lederer and Nambimadon: 1998), serves several purposes. It is “a key source of brand identity” for the airline and indicates the airline type. Furthermore, networks are drivers of revenue, as the network is the main element of the passenger air service. It also helps to determine the airline’s competitive strength or weakness and can be a “potential hedge” against economic downturns as well as currency fluctuations (Holloway 2003: 366).

When an airline builds up or manages a network, several critical decisions must be made. For one the airline must decide which markets and routes it will serve. A fundamental question is whether it should build up a centralized network with a hub-and-spoke system or whether it should remain decentralized, focussing on point-to-point traffic. Certain routes may be offered non-stop while others might be directed via a hub. Specific flights might not appear profitable; however, they might fulfil an important role as feeders for connecting flights and hence give them an economic justification. The airline must also decide on the frequency of the flights it offers and on the size of the fleet and the aircraft for each route. At all times it must keep an eye on the development of the competition (Maurer 2002: 303).

Farkas et al. (1997: 180) argue that it is necessary to achieve optimal network routes and not just focus on the profitability of individual routes. That is to say that the traffic between the origin and destination (OD) of passengers within a network must be the focus instead of the individual point-to-point flights or segments. Farkas et al. believe there are four “levers” which are essential to ensure the success of network management. First, destinations, schedules, and flight connectivity must be strategically coordinated in a network. Flights to hubs must be followed by proper connection flights leaving the hub. Also, the time required to wait for the connection flight is vital. The reason for this is that when

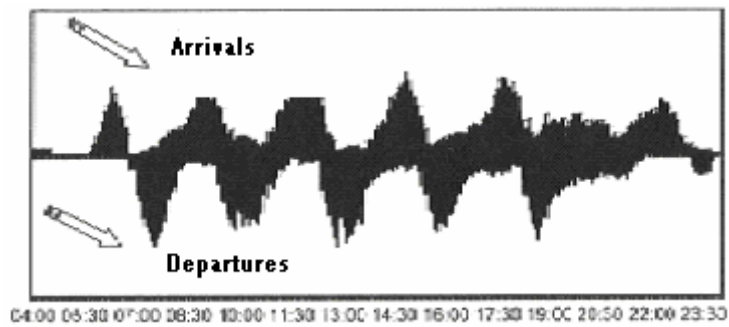
customers book flights over agents using a computer reservation system (CRS) to check the availability of seats, the flights with the least amount of total travel time from origin to destination are listed first. In fact, about 80% of all bookings made are based on the results shown by the CRS on the first page of the monitor. Therefore, the more effort airlines put into reducing the total OD flight time, the higher up in the list their flights will appear, and the higher the chance is that their flight will be chosen by the customer. (Maurer 2002: 327,328). Currently, the biggest CRS provider is Amadeus, which is used by about 11,000 airline sales offices and 75,000 travel agencies (“About Amadeus”). Farkas et al. argue that the second lever in network management is that resources must match demand. As was previously discussed, this is a difficult task due to the peaking problem. Thirdly, the attractiveness of the location of transfer, i.e. the hub, can be improved. Baggage-handling, location of the gate, as well as comforts offered to the transferring passenger, are all qualities that can increase competitiveness to this regard. The fourth lever is the establishment of alliances between airlines, which strongly increase the amount of available connecting flights to the passenger (Farkas et al. 1997: 180-182). The importance of alliances will be mentioned in more detail further down.

2.3.4 The hub-and-spoke concept

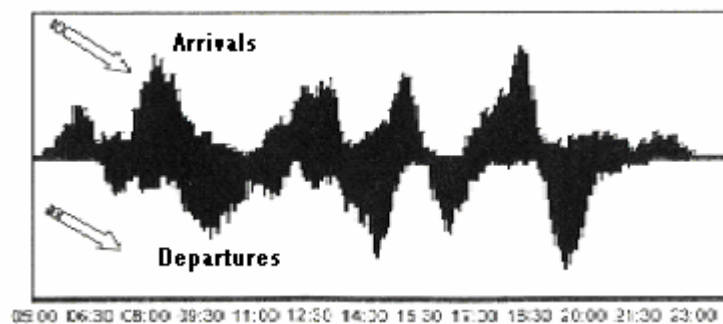
The hub-and-spoke concept is an integral part of air transportation. However, as it also adds to the peaking dilemma and, hence, congestion at many major airports, it deserves special attention.

The purpose of hub-and-spoke networks is to bundle incoming traffic with subsequent outgoing traffic at a specific airport within a certain time frame, thus enabling passengers to transfer to a variety of different destinations in an acceptable amount of time. These time frames, during which air traffic is especially high, are referred to as waves (also schedule banks or arrival/departure banks). Figures 3a and 3b visualize these waves at London-Heathrow and

Amsterdam, two major hubs. The visible shift between arrivals and departures is the time required to bundle and transfer passengers and luggage. The relevant attributes of these waves are the amount of waves in a day, the timing of the wave, as well as the time span of each wave (Maurer 2002: 322-325).



a) British Airways, London-Heathrow



b) KLM, Amsterdam

Figure 3: The arrival and departure wave patterns of British Airways at London Heathrow and KLM at Amsterdam in the course of a day. Source: Maurer (2002: 353).

There are several types of hubs. In an hour glass hub, traffic is funnelled from one geographic area towards another, giving the hub an hour glass shape. An example for this is the air traffic from Europe to Australia, using Singapore as a hub. In a hinterland hub, short haul passengers are accumulated from several short haul origins for a connecting long haul flight. In the case of multi hubbing, an airline operates more than one hub. A secondary hub is an additional hub that an airline creates. This is the case for Lufthansa, which built up Munich as a

secondary hub next to its main hub, Frankfurt. A mega hub is an airport at which several airlines operate a hub and spokes system. Frankfurt am Main, London Heathrow, Amsterdam, and Paris-Charles de Gaulle are all examples of this. A fortress-hub is one at which one airline dominates and possesses a high amount of slots, making it difficult for competitors to build up a rival hub at that airport (Maurer 2002: 317-319; Hanlon 1996: 71, quoted in Pompl 2002: 402-403).

The major advantage of hub traffic over point-to-point traffic in terms of the number of OD flights provided to the passenger will be highlighted through an example. Maurer (2003: 344,345) exemplifies this by showing two contrasting cases: one with pure point-to-point routes and the other operating a pure hub-and-spoke network. This can be seen in Figure 4. Each offer the same amount of flight segments and have the same capacity. The former airline offers flights between 5 city pairs (i.e. 10 cities are served) and is completely decentralized. The latter airline also serves 10 cities but all journeys are completed via a hub where passengers can transfer. With the hub-and-spoke principle, the airline can now offer 55 city pairs. Furthermore, adding cities to the hub-and-spoke system would lead to exponential growth of the network. This effect can be further strengthened by connecting two hub-and-spoke systems via the hubs.

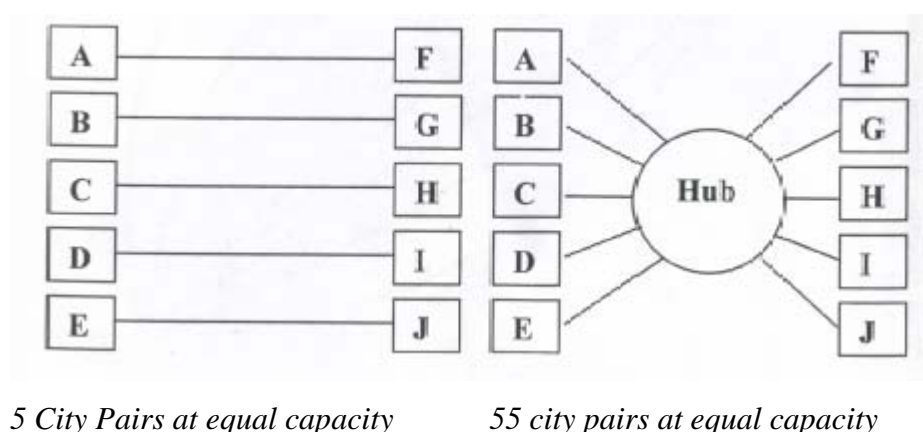


Figure 4: Increased number of possible destinations by transferring at a hub. Source: Maurer (2003: 344).

Hubs lead to economies of scope. They can be used as a central place for maintenance, since all airplanes of the network need to pass through it. Another advantage presented in this type of network is that airlines can increase the seat load factors on certain flights by bundling passengers. Specific flights to peripheral regions that seem uneconomical at first sight do become so when passengers are bundled at a hub for a connecting flight to a common destination, thus leading to economies of density (Maurer 2003:365; Holloway 2003: 370). The airline can afford to introduce larger aircraft which have lower costs per seat than smaller aircraft on a similar technological level. Passengers from various origins are channelled onto a big aircraft at the hub onto a route that would otherwise not be justified. In an analysis of network structures and airline scheduling, Brückner (2004: 293-294) further argues that hub-and-spoke networks lead to a higher frequency due to the fact that certain destinations become economical. He adds that higher frequencies result even despite bigger aircraft sizes being used. The higher flight frequency in turn leads to a higher willingness of the passenger to pay as the quality of the product is increased. Brückner also concludes that hub-and-spoke networks are beneficial in times of low demand. Pompl (2002: 403) argues that a further advantage of operating a hub is the “fortress effect”: If an airline operates a hub with a strong network and many waves, it will have a clear competitive advantage over other airlines at that specific hub since they will encounter high costs in building up a similar network as well as a lack of available slots at the airport. The holding of these slots is a competitive edge that gives the airline room to manoeuvre.

There are, however, also numerous disadvantages at hand which must be taken into account. For one, any airline offering a flight from origin to destination that operates via a hub will be at a disadvantage when competing with one offering a direct connection since this implies longer flight times as well as a hassle when transferring from one plane to the next. Longer flight times as well as transfer infrastructure and service also imply higher costs. A further major issue is that the waves created by this network type inevitably lead to an uneven

usage of capacity, adding further strain to airports especially during peak hours. Additionally, the network is very sensitive to disruptions. The delay of an incoming flight can lead to the delay of several outgoing flights since these must wait for transferring passengers (Maurer 2002: 334). An airline also faces serious trouble if it needs to downsize its hub-and-spoke system. According to the aeronautics professor Peter Belobaba at the Massachusetts Institute of Technology, "it's very difficult to incrementally dismantle a hub" (quoted in "The airlines"). Furthermore, the fact that many airlines attain a dominating position at their hub airports may lead to less competition and higher air fares (Pompl 2002: 204).

2.3.5 Airline Co-operations

Co-operations between airlines have become ever more popular and their number has tripled since the beginning of the 1990's (Knorr and Arndt 2001:11). There are several ways in which airlines can co-operate with one another on a technical, operational, and commercial level to achieve synergies. Airlines, can conclude agreements on ground handling, maintenance, the sharing of data as well as the technology that goes along with it, royalty agreements, general sales agreements, pooling agreements, as well as code-sharing and interlining amongst others (Maurer 2003: 50-51). It is important to note that there are many variations of co-operations that range from the most basic forms of co-operation all the way to the merger of airlines (Ehmer and Berster 2002:12). Further determinants besides the depth of co-operations are its geographical extent (co-operations can take place on a local, regional, continental, or global level) and its duration (Ehmer and Berster 2002:14-20). In the following, however, the focus will be put on the advantages of a special type of co-operation, the strategic airline alliance, which leads to the virtual extension of an airline's network. Strategic alliances are characterized by the co-operation between former competitors, strategic co-operation in several business fields as well as production of the service, and the longevity of co-operation (Ehmer and Berster 2002:22).

When entering an alliance, the airline hopes to benefit in the form of economies of scale and scope through various synergies (Ehmer und Berster 2002: 34). First and foremost, an airline can increase the size of the network it offers to the passenger by linking its hub-and-spoke system with that of another airline. It can offer flights to destinations under its own flight number (code sharing), which are in reality executed by a partner within the alliance. This has a high marketing value for the airline, and all the hub-and-spoke networks in the alliance complement one another. With a bigger network, there are higher incentives for the customer to enter frequent flyer programs and, hence, be bound to the airline and alliance. Certain routes, which were previously economically inefficient, may regain importance due to the increased feed all the alliance partners can offer to a specific transit point from which a peripheral destination can be reached. Moreover, the seat load factor can be increased on certain routes where more than one airline operates. If the seat load factor is too low, the airlines can take out redundant flights and operate a single one under the code-sharing principle. This also eases the capacity management in times when there is a general decline in demand on a certain route (Ehmer and Berster 2002: 45-49).

In addition to benefiting in terms of network and capacity management, alliances also facilitate market entry for their members. This is especially the case for flights to countries having restrictive bilateral agreements on the total number of flights. An airline with no or limited possibilities to enter a country can thus use an alliance partner, based in a third country, to offer flights to that country with the help of code-sharing. A further case in which market entry is eased through alliances is when airlines can serve further destinations through code-sharing at which they would otherwise have no access due to a lack of available slots. Through code-sharing, the market presence of the airline is increased. Since the airline will virtually offer more flights through the alliance, its ranking in the CRS will also tend to improve. All these factors help to protect the airline's

market share and create market barriers for new entrants (Ehmer und Berster 2002: 50-54).

While strategic airline alliances certainly offer advantages, there are several disadvantages to be considered. For one, there is a high degree of coordination that has to take place between alliance members. The deeper the level of cooperation is, the higher the chance of incompatibilities, such as conflicting IT systems, getting in the way. It will usually be the smaller airline or the new entrant to the alliance who has to adapt to the alliance's system. Further areas of conflict could be clashing corporate philosophies which must be dealt with or overcome. Under certain conditions, the forming of alliances can lead to capacity constraints and coordination problems at certain hubs. The complexity of the network offered to the passenger by airlines is increased through alliances. Thus, a delay of a flight can have an impact on the alliance partner's networks and once again raise coordination requirements. A further disadvantage is the potential loss of an airline's image. An airline offering a flight to a passenger is often not the actual airline carrying out the flight. If, in this case, there are differences between the product and service quality of the cooperating airlines, the passenger might feel misled. A further image loss may occur if alliance airlines are accused of abusing their strong market power. An airline must ponder these disadvantages which come about through giving up a piece of their sovereignty (Ehmer und Berster 2002: 56-61).

3 The slot problem

The lack of slots at many international airports in the EU forms the basis of this thesis. In the following, the causes and effects of the lack of slots will be shown. Then, the way in which the EU defines a slot and the way it is dealing with the slot problem will be described. Finally, a criticism of this system is presented, highlighting the need for its reform.

3.1 Growth of the air transport market and resulting capacity problems

The air transport market is currently experiencing high growth rates on a global level. The market has managed to rebound from the major set back caused by September 11th as well as the SARS problem in East Asia. The year 2004 saw an extreme surge in passenger volumes by about 14% compared to 2003, as can be seen in Figure 5. The forecast for 2005 lies between 7% and 8%. The growth rate is possible mainly due to the state of the world economy as well as price competition among airlines, which is the result of deregulation. On the downside, high fuel prices and cost competition leave airlines with major financial burdens. As can be seen in Figure 6 below, growth is clearly not a guarantee for profits in the airline business (IATA 2005a: 1; IATA 2005b: 2). This is even true for the year 2004.

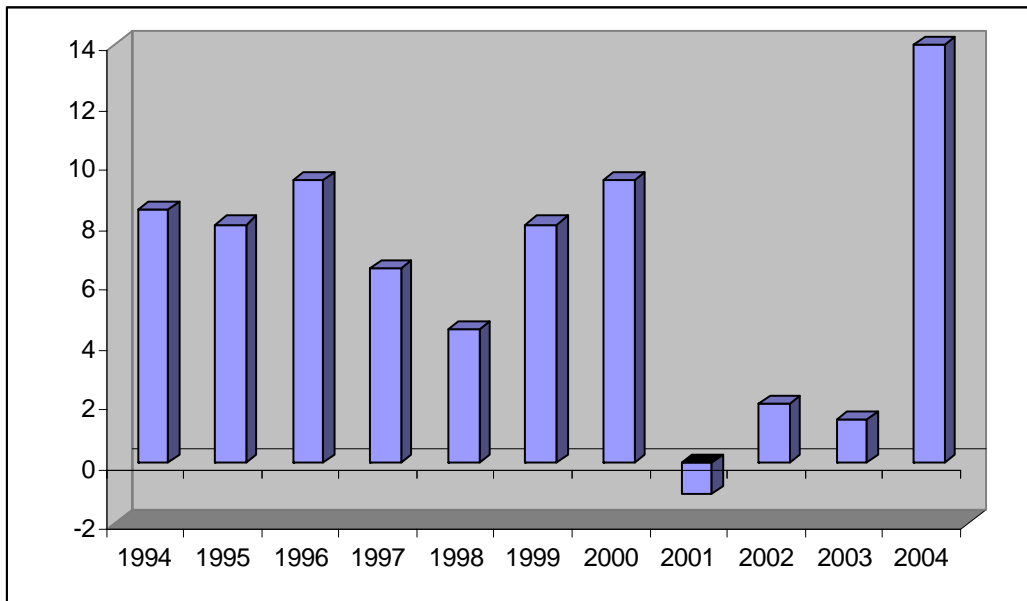


Figure 5: Annual percentage change in global passenger traffic between 1994 and 2004. Adapted from IATA (2005b: 2).

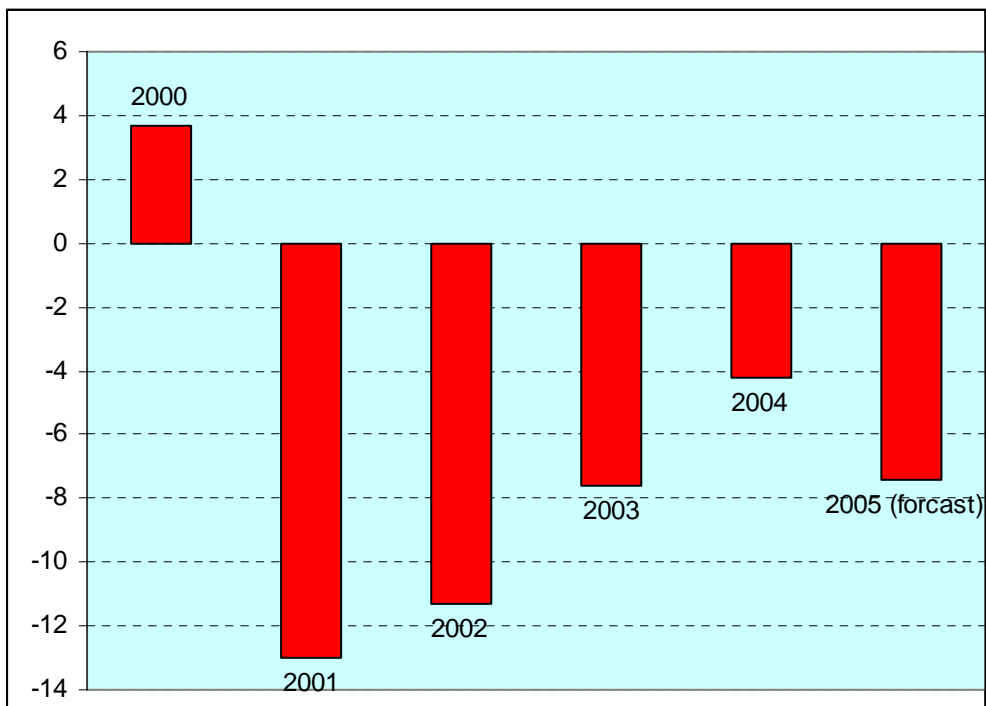


Figure 6: Annual profit of airlines in \$ Billions. Based on Data from IATA (2005a: 1).

Within the airline industry, the main contributors to growth were the development of the low cost carriers and regional carriers as well as the Chinese economy. The LCCs saw a growth rate of 30% in 2003. While this rate has decreased, it is still an important factor in overall growth of the industry. The regional carriers have seen a boost of 28% in traffic in 2004. This, however, is partly due to the fact that they have taken over traffic from the majors, especially in the USA (“Traffic analysis: Growth spurt”). Figure 7 shows that all European top 20 airports have experienced growth in 2005.

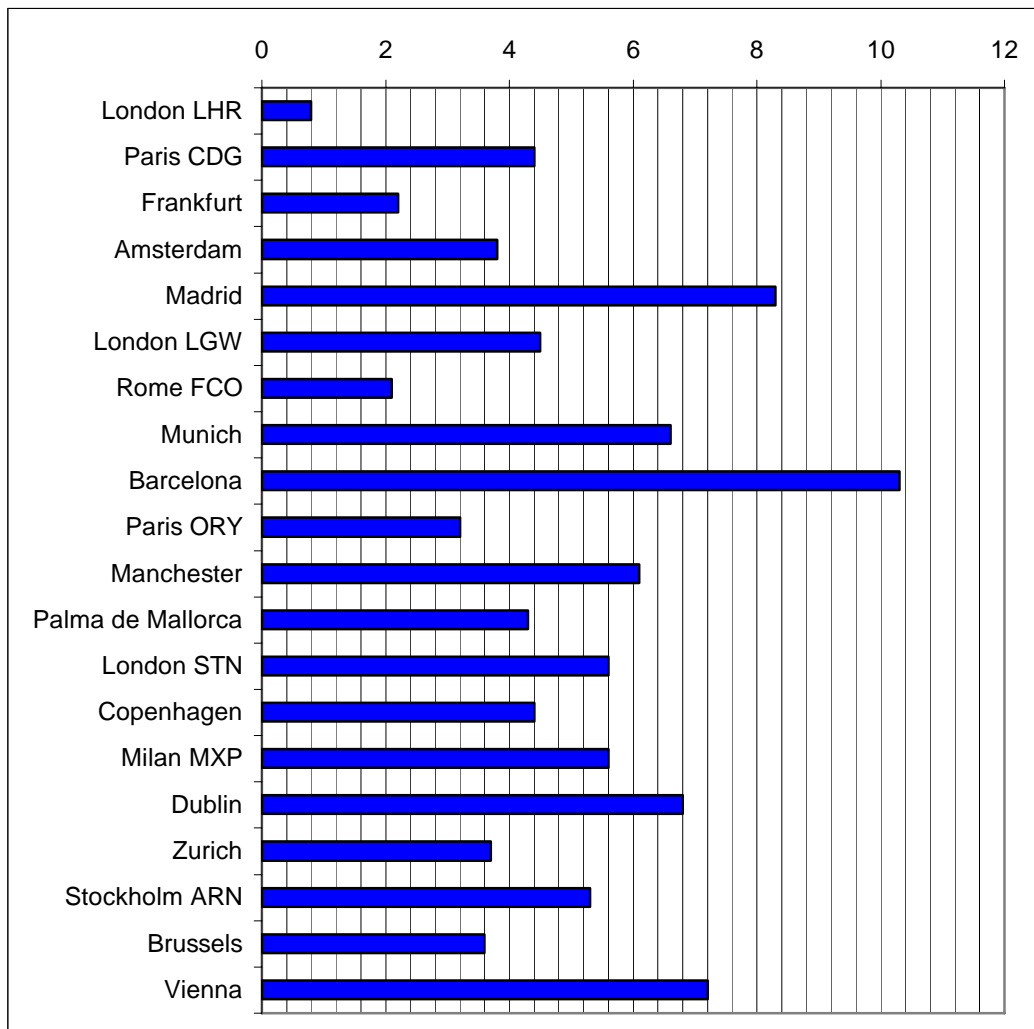


Figure 7: Growth rate in percent of top 20 European Airports. Source: Airports Council International quoted in Jäger.

All this growth, however, is leading to serious capacity problems. The expansion of infrastructure required for air travel cannot quite keep pace with the growth of air traffic. As the aim of this thesis is to elaborate the possible effects of market-based slot allocation schemes on airline networks, the focus will lie on the problem of airport congestion. The determinants of airport capacity and the resulting slot problem will be dealt with in the following subchapter.

3.2 Airport capacity and restraints

The capacity restraints that airports encounter lead to a shortage of slots required by the airlines to complete the passenger air service. The lack of slots leads to congestions: Airlines need to spend time in holding patterns in the air or in queues on the ground. This leads to delays for the passengers as well as higher costs for the airlines due to requiring more fuel and causes additional environmental damage. This in turn creates a market entry barrier for new comers at airports, since there are not enough available slots (Pompl 2002: 438-439).

The capacity shortages faced by European airports will lead to a major impediment of growth in air traffic. According to the commissioner of European transport, Jaques Barrot, efforts to reduce other restraints in air travel, such as the single-sky reform, will be fruitless if the problem of airport capacity is not tackled. Currently, 70% of the largest 50 airports in Europe have reached their maximum capacity. Even with an expected increase of airport capacity of 60% by the year 2025, the demand for slots cannot be met. Assuming that the demand for traffic in 2025 would be two and a half times higher than in 2003, 17% of possible flights would not take place. (“EC sounds airport capacity warning”).

The capacity of an airport is viewed by Reynolds-Feighan and Button (1999: 116) as “the ability of a component in the airport system to handle aircraft”

and “a measure of supply”. Reynolds-Feighan and Button (1999: 116) name four different factors that influence airport capacity in terms of the number of aircraft that can take off and land at an airport in a certain amount of time: air traffic control, demand characteristics, environmental conditions, as well as design and layout of the runway system.

The control of air traffic in Europe is managed by Eurocontrol, which is the European Organisation for the Safety of Air Navigation. It consists of 35 members and aims at promoting safe and coordinated air traffic throughout Europe (Eurocontrol 2005a). Reynolds-Feighan and Button mention that the size of the aircraft, the sequencing of operations, radar availability, and the time an aircraft occupies the runway are all elements of air traffic capacity. Based on these factors, Eurocontrol proposes certain minimum distances between aircraft. These minima are the main reason that capacity is limited at airports (Reynolds-Feighan and Button 1999: 116). Another organization involved in the setting of common safety standards and procedures on a European level is the Joint Aviation Authority (JAA 2005). Their members consist of the civil aviation regulatory authorities of 40 European countries. Furthermore, a voluntary association called Group of Aerodrome Safety Regulators (GASR) has been formed in Europe to promote the standardization of safety procedures specifically at airports (GASR 2005). Together, these organizations have created the “European Action Plan for the Prevention of Runway Incursions”. And The European Commission itself is interested in seeing standardized safety procedures being set (European Commission 2005). Effects on slot availability can thus be expected.

The capacity is further strained by the characteristics of airline operations. Different aircraft sizes will lead to different kinds of minimal separation requirements as small aircraft need to keep a greater distance between large aircraft due to the problem of the wing-tip vortices. These vortices can be described as miniature horizontal tornadoes created behind an aircraft, which

would be very disruptive to any plane flying through it. An aircraft must, therefore, wait until the vortices of a preceding aircraft have calmed down to a certain degree before being able to utilize the runway. Figure 8 below shows required minima between different aircraft types based on their size. A Boeing 757 would, for example, need to keep a minimum distance of 4 nautical miles as well as 102 seconds to another Boeing 757 flying ahead of it. Furthermore, the amount of time that an aircraft occupies the runway depends on its speed, braking capability, and manoeuvrability. These two factors further influence the available number of slots in a given amount of time. Another problem is that for air traffic coordination reasons, a free departure slot cannot just simply be filled in by a landing slot. There are several environmental components which also affect the availability of runway capacity. The weather conditions can affect landing rules and braking distances, such as when the runway is wet. Cross-winds can limit the use of multiple runways. Furthermore, the time of day during which runways may be used is often limited for noise reduction reasons. The design factors refer to the infrastructural restrictions faced by an airport. The number, orientation, and length of the runways as well as the number of taxiways and runway exit and entry points all influence the required separation between aircraft (Reynolds-Feighan and Button 1999: 116-117; National Economic Research Associates 2004: 338).

Trailing Aircraft:				
Leading Aircraft:	Small	Large	B757	Heavy
Small	2.5/80	2.5/68	2.5/66	2.5/64
Large	4/164	2.5/73	2.5/66	2.5/64
B 757	5/201	4/115	4/102	4/101
Heavy	6/239	5/148	5/136	4/104

Figure 8: Wake Vortex separation standards under IMC conditions (nautical miles / seconds). Source: Loan et al. (2003: 12).

While these issues directly relate to the number of aircraft that can land or take-off at a given airport and present the main bottle-necks at airports, there are further limitations caused by the facilities available at an airport. All infrastructure related to terminals is also vital for air traffic. While the limitations for building new terminals are lower than for runways, huge investments are nonetheless required. Another important factor is the connection that the airport offers to and from the airport on the land side through other forms of transportation such as trains and busses (Sterzenbach and Conrady 2003:155).

Reynolds-Feighan and Button (1999: 129) suggest three basic ways of coping with these problems: An expansion of an airport's capacity, the construction of new airports, and the application of demand-management techniques. The former two are limited for various reasons. A major factor is that aircraft noise and emissions cause considerable resistance in the population to the expansion of airports. The EU even identifies these environmental issues as the main reasons why airports do not grow (Upham et al. 2004:199). Considering this, demand-management becomes an essential tool in dealing with this problem. It is the aim of this thesis to explore to what degree the market could "manage" this demand and what influence it would have on the airlines' networks.

3.3 The definition of a slot

Various causes leading to the shortage of slots have been given in the previous subchapter. A clear definition of a slot, however, has not been given so far. In very general terms, a slot is the right given to an airline to take off or land at an airport. However, there are other airport facilities required for the airline to fulfil the passenger air service, such as embarking and disembarking passengers as well as refuelling. Defining a slot becomes all the more important if it is to be held and traded like a commodity. If a slot becomes an airport's guarantee for an

airline to use runways and facilities it is worth a lot more than if it were just a mere right to land (Knieps 2003:3,4).

The European Commission has developed its own definition of a slot. The following definition of a slot is based on the latest amendment, No. 794/2004 to the Council Regulation 95/93 on a common slot allocation scheme in the EU:

“‘Slot’ shall mean the permission given by a coordinator in accordance with this Regulation 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 as allocated by a coordinator in accordance with this Regulation” (“Regulation (EC) No 793/2004 of the European Parliament and of the council”: 2).

This in turn requires a definition of a “coordinated airport”:

“‘Coordinated airport’ shall mean any airport where, in order to land or take off, it is necessary for an air carrier or any other aircraft operator to have been allocated a slot by a coordinator, with the exception of State flights, emergency landings and humanitarian flights” (“Regulation (EC) No 793/2004”: 3).

While the European Commission offers this formal definition of a slot, it is important to keep in mind that not all slots are of equal duration in practice, as was mentioned in chapter 3.2. At the moment, larger aircraft are indirectly charged more for the longer slot time they use by paying a higher landing fee based on their heavier weight. Furthermore, there are two different types of slots: the airport slot and the airway slot. The airport slot, on which the focus of this thesis lies, is allocated by the national airport coordinator and planned usually well in advance. The number that can be given out on a day is linked to the airport infrastructure. The airway slot is an adjustment of the airport slot to the actual weather and traffic conditions on the day the slot is to be used. The Central Flow Management Unit

(CFMU) of Eurocontrol, located in Brussels, oversees the latter process (Maurer 2003: 275).

3.4 The slot situation in Europe

As air traffic in Europe rises and strong growth rates are predicted, the number of airports affected by congestion as well as the extent increases. In 2004, 7 category one airports (i.e. fully coordinated airports) saw excess demand over the course of a whole day, while 14 airports could not fulfil the slot demand during parts of the day (National Economic Research Associates 2004: i). These are depicted in Figure 9. Furthermore, the capacity problem is predicted to increase in the future, further aggravating the slot problem. The discrepancy between demand and available slots is predicted to be especially high for slots at London-Heathrow in 2007, which will see an average excess demand per hour of 75 slots, as can be seen in Figure 10. Figure 11 shows that capacity increase between 2002 and 2007 will not be met by infrastructure expansion, except in the case of airports with capacity restraints throughout the day. Figure 12 highlights the slot problem: only 12% of category 1 airports in Europe experience no problems of excess demand throughout the day.

Airports with Excess demand at peak times of day	Airports with excess demand throughout the day
AGP	DUS
AMS	FRA
BRU	LHR
CDG	LGW
CPH	LIN
DUB	ORY
FCO	MAD
LIS	
MUC	
MLP	
PMI	
STN	
TXL	
VIE	

Figure 9: Categorisation of airports. Source: National Economic Research Associates (2004: 24).

	Estimated average demand (Air traffic movements per hour)	Capacity (ATMs per hour)	Hours per day with excess demand	Average excess demand (ATMs per hour with excess demand)
LHR	145	86.25	16	75
LGW	67	45.5	15	40
CDG	125	120	15	26
MAD	68	95	5	6
VIE	39	72	4	11

Figure 10: Projected extent of excess demand in 2007. Source: National Economic Research Associates (2004: 338).

Airport demand in 2002	Average capacity increase	Average increase in air traffic movements by 2007
Airports with little or no excess demand	17%	38%
Airports with excess demand at peak times of the day	5%	20%
Airports with excess demand throughout the day	16%	16%

Figure 11: Changes in capacity and the number of movements between 2002 and 2007.
Source: National Economic Research Associates (2004: 44).

Type	Share of passengers
Airports with little or no excess demand	12%
Airports with limited excess demand	67%
Airports with severe excess demand throughout the day	21%

Figure 12: Estimated share of passengers of category 1 airports in 2007. **Source: National Economic Research Associates (2004: 100).**

As mentioned, the slot situation is particularly bad at London Heathrow airport, which sees about 63,000,000 passengers a year and can handle about 86 air traffic movements, i.e. slots, per hour (National Economic Research Associates 2004: 22). The excess slot demand as well as the actual usage of slots at this airport can be seen in the Figures 13 and 14. The situation is particularly bad during peak hours.

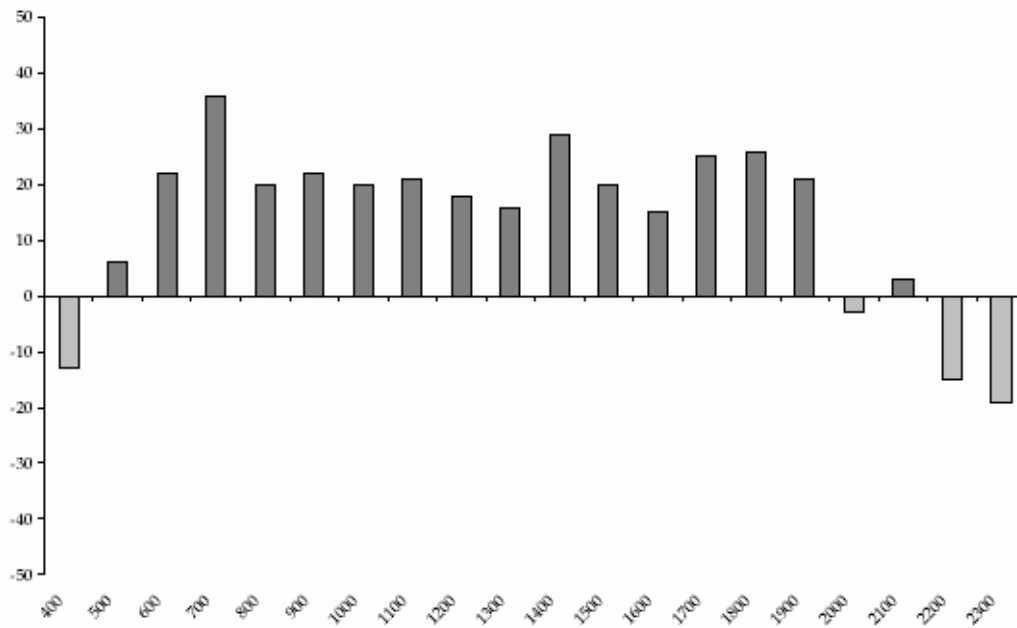


Figure 13: The difference between the number of slots requested and capacity per hour on a typical summer day at London Heathrow in 2002. Source: Airport Coordination Limited; Quoted in National Economic Research Associates (2004: 27).

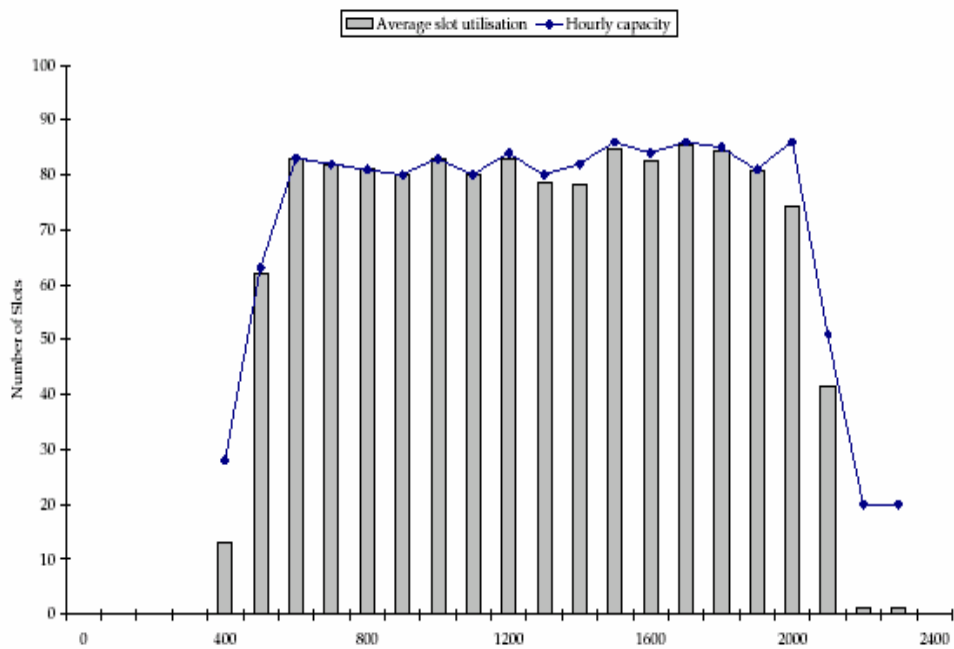


Figure 14: Slot utilization at London Heathrow. Source: Airport Coordination Limited; Quoted in National Economic Research Associates (2004: 28).

The lack of slots experienced in Europe is one of the major causes of delay. Besides being a nuisance for passengers, major financial implications for the airlines are a result. In 2001, the lack of slots lead Lufthansa to experience a worldwide delay of 19,600 hours and burning 48,900 tons of extra fuel (Maurer 2003: 274). The charts in Figure 15 show the growing problem of delay in the last three years in Europe, split up between arrival and departure related delays.

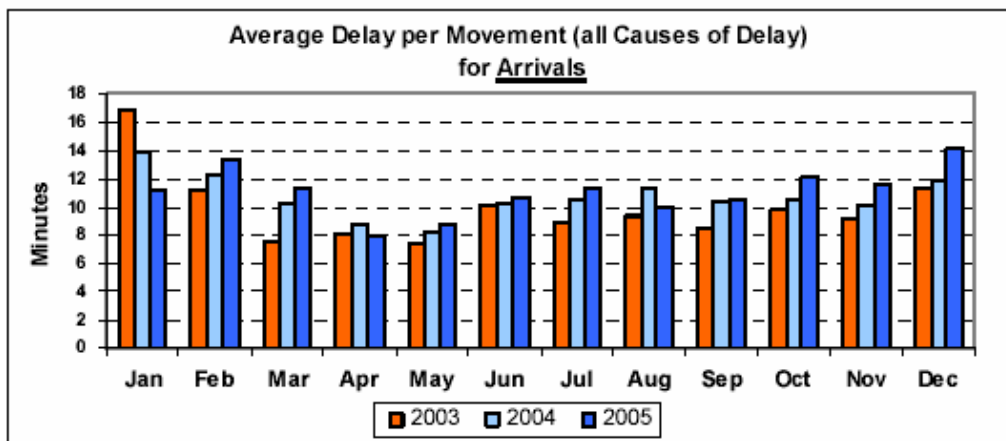
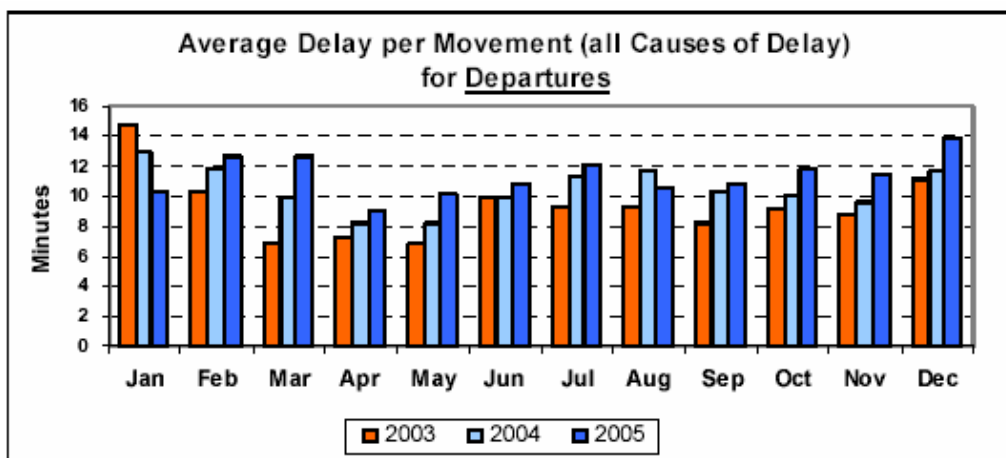


Figure 15: Average delay per movement for departures and arrivals from 2003 to 2005. Source: Eurocontrol (2005b: 11).

3.5 The Current System of Slot Allocation in the EU

There is obviously a clear link between air traffic growth and a lack of slot availability. A variety of factors are responsible for these capacity restraints that cannot be solved in the short run. The divergence between slot availability at European airports and the demand for slots, and, thus, the relevance of the slot problem have been displayed. After a general introduction on how slots can be dealt out, the way in which slot allocation is handled within the European Union will be explained in this subchapter.

To begin with, there are several ways in which slots can be distributed among airlines. Pompl (2002: 439, 440) mentions four methods in which this is done. First, a pure administrative distribution of slots is a possibility. Second, commercial trade could take place, in which case slots are sold and traded between airlines. A third method is through scheduling committees, in which case airlines administer and distribute slots amongst each other, as is done through IATA scheduling meetings. The fourth method is the council regulation 95/93 on a common slot allocation scheme in the EU. This regulation applies to all European airlines as well as airlines landing and taking off in Europe. It comes into action only at airports that have been declared as a “coordinated airport” by an EU member state. The European regulation is largely based on the IATA Worldwide Scheduling Guidelines; however, it is more restrictive than IATA’s regulation (Maurer 2003: 280).

The council regulation 95/93 on common rules for the allocation of slots at Community airports has been in effect since 1993 and was recently amended by the regulation 793/2004, which clarified certain aspects of the allocation scheme. The so-called “grandfather rights” form the basis of the regulation. These are historical rights, meaning that an airline which has used a slot in the past season

can retain it in the next season. The condition for this is that the airline made use of at least 80% of a series of slots in a season. A series of slots is defined in the amending regulation 793/2004 as “at least five slots having been requested for the same time on the same day of the week regularly in the same scheduling period” (“Regulation (EC) No 793/2004”: 3). This rule is meant to promote the regular use of slots and ease the fulfilment of international obligations as well as the ability for airlines to plan ahead (since these can rely on retaining their slot in the future if they use it). Airlines need a form of security when opening up a new route. This can be seen as a long term investment that only pays off after a certain amount of time. The “grandfather rights” give airlines the certainty that they will retain that route, and, hence, are able to secure their investment (Pompl 2002: 440).

All of the slots which are not reserved by the “grandfather rights” fall into a slot pool. 50% of those slots must then be distributed amongst “new entrants”, assuming there is sufficient demand among these. A new entrant is an airline that holds less than 5 slots at a certain airport per day. Furthermore, the airline may not hold more than 5% of total slots available at the airport per day or more than 4% of slots available per day at an airport system, i.e. two or more airports serving the same city or local area (Pompl 2002: 440; Regulation (EC) No 793/2004”: 2-4). Another fundamental rule is that slots may be swapped, but “can only take place without monetary compensation” (Regulation (EC) No 793/2004”: 8). When allocating slots, different types of flights have different priorities. Daily flights are preferred to occasional flights. Flights taking place throughout the entire season are preferred to those only taking place during only a part of it (Maurer 2003: 281).

The slots are monitored by airport coordinators. The airport coordinators are assigned by the individual member states to ensure a neutral, transparent, and non-discriminatory distribution of slots. In Germany, for example, 17 airports require a coordinator (Pompl 2002: 440,441). When slots are allocated, they are

first assigned by the above priority rules on a national level. Then, the airport coordinators and the representatives of airlines from all over the world, whether they are IATA members or not, meet at the IATA Schedule Co-ordination Conferences held twice a year, where the upcoming winter or summer season is planned respectively. Over 260 airports require this type of scheduling worldwide. Depending on the capacity restraint, airports are categorized into “schedule facilitated”, if the constraints allow voluntary resolution of slot distribution, or “fully co-ordinated”, if demand is higher than supply (Maurer 2003: 284; Graham 2002: 121; Ewers et al. 2001: 9).

This regulation was originally welcomed by almost all airlines and affected airports, providing several advantages. First of all, the allocation in advance makes it possible to avoid further congestion through uncoordinated or unannounced flights at airports whose capacity is already strained. Second, the system of grandfather rights increases the ability of airlines to do long-term planning. And finally, no incentive is given to the airports to artificially limit their capacity for the sake of making a profit (Wolf 2003: 262-263).

3.6 Deficiencies of the current system

The main problem with the current slot allocation system is that a scarce commodity is being administered. This inherently leads to inefficiencies in the system. Currently, the airlines have no market incentive to make efficient use of their slots, i.e. the slot does not go to the airline which is willing to pay the most for it (Gallistl). Knieps (1990: 195-205, quoted in Ewers et al. 2001:9) names three different types of inefficiencies that occur through regulation: allocational, competitive, and infrastructural inefficiency.

An allocational inefficiency arises because the slot does not go to the airline that is necessarily willing to pay most. The slot does not go to the airline

that is willing to pay the highest price for it and, hence, likely to make better use of it (Knieps 1990: 195-205, quoted in Ewers et al. 2001:9).

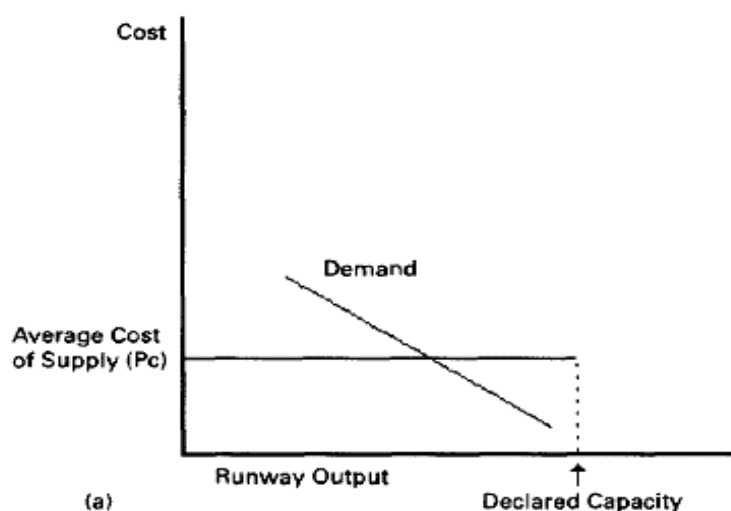
A competitive inefficiency is present because the access to slots at attractive airports is very difficult for newcomers. This furthermore reduces the pressure on incumbents to use their slots more efficiently. Many of the slots that fall into the slot pool, of which 50% go to new entrants, are located at peripheral times and are of no use to the airlines. At the Vienna International Airport, about 90% of slots allocated to airlines each season are already secured through grandfather rights (Pfeffer). Also, the new entrant definition itself already excludes many airlines that only have a marginal presence at an airport, despite having been expanded in the amendment 793/2004. This makes it quite easy for dominant airlines to hold on to their position (Pompl 2002: 441; European Commission 2004: 4, 5). The grandfather rights make it rather easy for the airlines to retain slots. The use-it-or-lose-it rule, which states that 80% of slots must be used, is often not as effective as it sounds for assuring that slots are actually used; whether or not an airline can be held accountable for not using a slot is often not very easily discernable. The slot coordinators who decide this are not always fully independent in practice (Ewers et al. 2001:8). Furthermore, there is no incentive for airlines to return unused slots in time before the season starts. To the contrary: for the sake of holding on to a slot for future seasons or blocking out competition, airlines can resort to reserving slots by running an unprofitable line or operating small aircraft on it. This practice is also known as “baby-sitting” (Czerny and Tegner 2002:8; ACI Europe: 2004: 4). Figure 16 shows the misused slots at major airports in the EU in the winter season 2002/2003. These “misused” slots are split into three categories: Late hand-backs before the season, late hand-backs during the season, and no-shows. No-shows, which are the worst form of misused slots, were particularly high in Paris where they constituted 4.6% of all available slots.

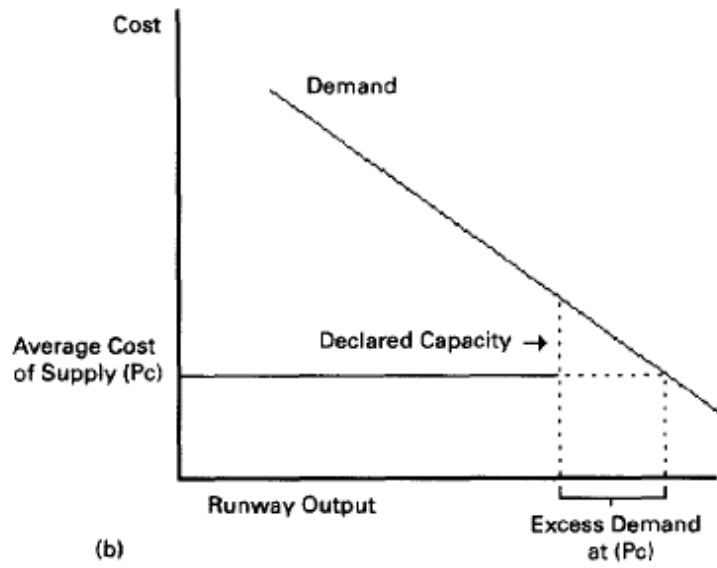
Airport:	Misused slots:		
	Late hand-backs before season	Late hand-backs during season	No-shows
Barcelona	-	3.7%	0.4%
Copenhagen	10.0%	2.7%	0.7%
Dublin	-	2.6%	-
Düsseldorf	7.7%	6.4%	0.1%
Frankfurt	2.3%	3.2%	-
Gran Canaria	-	11.0%	-
London Gatwick	3.7%	3.8%	1.5%
London Heathrow	2.3%	1.1%	0.3%
London Stansted	1.7%	-	1.6%
Lyon	-	-	4.3%
Madrid Barajas	0.3%	4.3%	0.7%
Malaga	0.6%	5.0%	-
Milan Linate	2.3%	5.9%	1.5%
Milan Malpensa	13.5%	3.3%	0.8%
Munich	3.5%	4.7%	-
Palma de Mallorca	-	5.2%	-
Paris Charles de Gaulle	10.3%	3.4%	4.6%
Schiphol	3.3%	9.5%	2.6%
Stockholm Arlanda	-	3.7%	0.2%

Figure 16: Percentage of total available slots that were handed back before or during the season, or not all, in the winter season of 2002/2003 at major European airports. Adapted from ACI Europe (2004: 11-12).

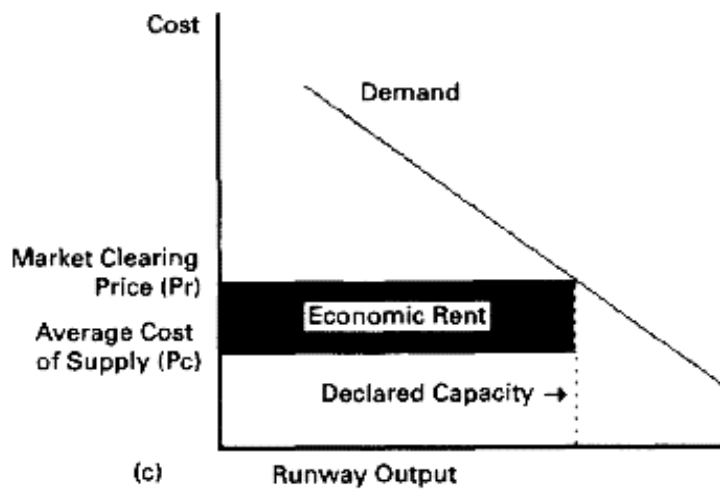
The current system also has its drawbacks for incumbents. Certain airlines who wish to increase their number of slots in order to improve their network and ultimately provide higher value for the customer may not be able to do so because these are reserved for newcomers. To receive slots, incumbents may be forced to outflag part of their airline. This newly outflagged airline would then be in the position to gain new slots (being termed a newcomer) which the incumbent could otherwise not attain, thus bypassing the regulation (Sandvoss 1996: 91).

Finally, infrastructural inefficiency occurs because airports do not have the opportunity to profit from the fact that their slots are a “scarce resource”. This means that airports cannot use any income from the scarcity of slots in order to reduce infrastructural capacity restraints (Knieps 1990: 195-205, quoted in Ewers et al. 2001:9). Figures 17a, b, and c below visualize the situation that occurs through a lack of slots. In Figure 17a, demand and supply are matched. The price of runway usage is set to cover the costs. In Figure 17b, the price for slot usage is not changed, yet the demand has grown and exceeds supply. Figure c shows the economic rent which could be achieved if the price for runway usage is raised to balance supply and demand. The price charged in Figure 17c is also referred to as the market clearing price. The fact that airlines do not pay this market clearing price, which would balance out supply and demand, does not, however, imply that the passenger ends up paying less. The airlines reap the profits by charging more until there is a balance between the seats they can supply and the seats demanded by passengers. This makes it extremely important for airlines to retain slots at airports where demand exceeds supply. Through the mechanism of grandfather rights and the 80% rule, the airlines can secure their slot and achieve this. Evidence of this behaviour can be seen at London Heathrow, where 95% of slots in 1994 were held by incumbents, i.e. airlines that held these slots in the previous flight season. (Starkie 1998: 111-113).





(b)



(c)

Figure 17: Demand and supply for runway capacity. Source: Starkie (1998: 112).

4. Suggested market-based slot allocation schemes

The constraints caused by the lack of slots at European airports combined with the inefficiencies brought about by the current EU regulation form the basis of the discussion around market-based slot allocation schemes as a viable alternative. The hope is that the airline that is willing to pay the most for a slot is also the one who will make best use of it and would be able to attain it under a market-based system. This does leave open a definition of “optimal” slot allocation, which differs greatly depending on the airline’s goals and type of operation.

In this chapter, these potential slot allocation methods will be introduced. Three different approaches towards a non-administrative distribution of slots, which have been discussed in the literature, will be presented. These methods range from an only slight incursion into the present system to a radical overhaul: A monetary form of secondary trading, higher posted prices, and the auction of slots. It is important to mention at this point that these methods are not mutually exclusive. Instead, it is possible to use combinations of them. Furthermore, there are various ways to go about laying out and enforcing each method. These different methods of market-based slot allocation schemes will have varying degrees of impact on the industry depending on their scopes of application and will be discussed following the introduction of the schemes.

4.1 Secondary trading

A monetary form of secondary trading presents a minor incursion into the present system of slot allocation. At present, slots may already be traded or swapped, but only in a non-monetary fashion, as the EU explicitly forbids any monetary form of slot trading. Secondary trading implies that trading may take place after slots have been dealt out through another process in the primary stage

(which is the administrative process described in Chapter 3 at the moment), as can be seen in the figure 18.

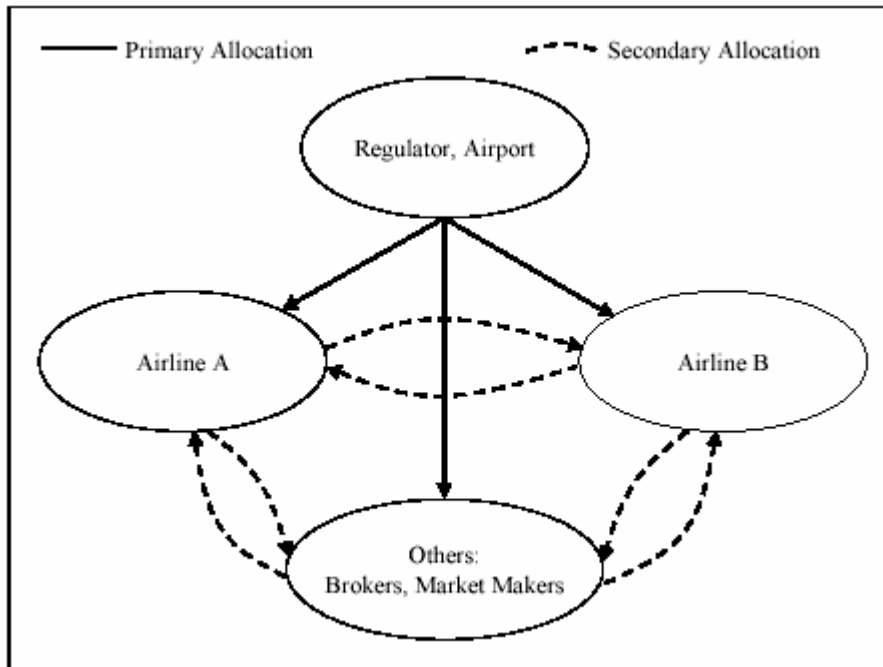


Figure 18: Primary vs. Secondary Allocation of Runway slots. Source: Czerny and Tegner (2002: 4).

A monetary form of slot trading would have the effect of putting an opportunity cost on each slot. In theory, an airline would sell a slot to another airline if it could make more profit through this transaction than by running its own service with the slot. The airline purchasing that slot would only enter the deal if it can make better use of it than the seller. The opportunity cost would reflect the market price of the slot and lead to a more accurate picture as to what a specific slot is actually worth. An airline, which holds a slot thanks to grandfather rights at a precious time of day and only makes limited use of it, would feel more pressure to sell if the opportunity cost becomes “visible” (Knieps 2003: 7; “Secondary trading in airports slots”: 1). This opportunity cost would also create an incentive for airlines to return slots in a timely fashion. However, for

secondary trading to be effective and to remove doubts amongst sellers and buyers, transparency is essential (European Commission 2004: 7).

The UK's Civil Aviation Authority suggests 5 different scenarios under which secondary trading could be organized. "Market provider" would mean providing a forum of exchange in which bid and ask prices are posted and updated by interested airlines. "Market brokers" could be used to facilitate bringing together interested parties. "Market maker" services could be introduced to increase price stability and reduce volatility over time. In this case, a third party could buy, sell and hold slots in its own right. They could then lease the slots to airlines, which would be helpful in cases where airlines are reluctant to buy. The fourth option would be "bilateral trading with an obligation to publicize [the] proposed transaction". Here there would be no formal market, but airlines would have to publicize planned slot transactions. The fifth option is similar: "bilateral trading with no obligation to publicize in advance of trading" ("Secondary trading in airports slots": 2-3).

The option of the "market maker" mentioned above would be a big step in secondary trading. If a third party could acquire slots, it becomes evident that a definition of a slot is required that guarantees the holder a minimum amount of ownership rights. The slot definition provided by the EU would have to be modified and be more than a mere permission to use certain facilities. Questions such as who exactly should be permitted to buy slots as well as under what circumstances and for what amount of time must also be dealt with. The question arises whether or not slots could be bought by parties that do not have the optimal usage of slots as a goal. For example, an environmentalist party could retain a slot with the goal of insuring that not too many flights are being undertaken at a certain time of day. Similarly, airlines could buy expensive slots for the sake of blocking out competition and not for optimizing their operations. Especially large carriers with very strong purchasing power could get hold of more slots in order

to strengthen their positions at certain hubs. (European Commission 2004: 7; ACI 2004: 5).

4.2 Higher posted prices

In the case of higher posted prices, the price of a slot is raised until demand reaches supply. The slot price would then consist of the airport charge plus the scarcity rent and would be set a season or two in advance. This will lead to strong differences in price set per slot according to the time of day and the airport at which a slot is desired. Higher posted prices thus incorporate the idea of congestion and peak hour pricing, which has already been in effect to some degree at London Heathrow and other airports (Lott 2005: 46): the higher the congestion, the higher the fee that is to be paid. The revenue generated at peak times through the scarcity rent could be used in part to subsidize and create an incentive for usage of non peak slots, though this would only make sense if the airport is not congested throughout the entire day. It will, however, be a difficult task for the airports to set the charges correctly, as it is hard to forecast at what level exactly the market will be “cleared”. If the price is set too high, slots might be left unused. If they are set too low, the slot problem will not be alleviated. In the latter case, administrative criteria or a “mini” slot auction could take place to settle who the slot goes to. Generally, it will be more wise for airports to set the charge slightly too low to avoid leaving the slot unused. In addition, prices could change from season to season, reflecting a change in the demand structure. It will take a trial and error process to find prices that match demand (European Commission 2004: 10; National Economic Research Associates 2004: 148-149, 154; Ewers et al. 2004: 33,36). Higher posted prices would be complemented by secondary trading in order to deal with inefficiencies left over after primary trading.

Higher posted prices would put pressure on the benefactors of grandfather rights, as these would lose their slots if they are not willing to pay the scarcity rent, even if they do not make (full) use of the slot. It would also decrease the incentive to hoard slots through this regulation. Hence, this system could complement an administrative slot allocation system. It could, however, also complement other market mechanisms (Knieps 2003: 7, 8).

If higher posted prices are introduced, the question of what is to be done with the revenues must be settled in order to avoid one party, i.e. the airport, to retain “wind fall profits”. Part of the income could be used by the airport to invest into the improvement or expansion of infrastructure. Projects to better protect the environment and to reduce negative effects of air travel could also be financed with the additional revenues (“Introducing commercial slot allocation mechanisms”: 7).

4.3 Slot auctions

Slot auctions as a form of primary trading would bring about a major change to the present system. In an auction, the slot is attained by the party that values the slot most and is, hence, willing to pay the most for it. This eliminates the problem of not knowing the market value of a slot in the case of the higher posted prices. Before going into the actual process of slot auctions, some general reservations that are voiced in the literature must be mentioned due to demand interdependencies, the attributes of capacity restraints, and the heterogeneity of slots (National Economic Research Associates: 2004: 174).

First of all, slots must be acquired at least in pairs by airlines. For every take off slot, there must be an appropriate landing slot at another airport. One slot would be useless without the other. The situation becomes more complex if a whole network must be built up. If slots would thus be put up for auction

individually, it could wreak havoc on the current networks and greatly reduce efficiency. Another problem in regard to slot auctions is that the ability to plan routes in advance may be reduced. This is especially true for hub-and-spoke networks. If an airline is uncertain of whether it will be able to hold on to relevant slots by the time the next slot auction comes around, it will have a lower incentive to make investments as these are directly related to their ability to plan ahead. A further worry is that peripheral regions might be cut off from important hubs as the airlines operating on these routes with small planes might not have the same purchasing power as airlines requiring the slot for major routes from that airport with large planes. These types of fears could be counteracted if those regions would purchase slots which they would reserve for air services to their region. The question of who should receive the proceeds from the auction must also be answered, as in the case of higher posted prices. If the airports would be able to retain all the profit from the auctions, they might have an incentive to artificially restrain their capacity in order to keep the value of slots up (Wolf 2003: 270-275).

There is also the question of how airlines should be compensated when they lose their grandfather rights and who they would be compensated by (National Economic Research Associates 2004: 202). Perhaps the money earned through the auction process could go in part to the airline losing its “grandfathered” slot. This would mean, however, that there is less money left for infrastructural expansion (Langner 1996: 176).

As the aim of the auction is to create an allocation of slots that is as efficient as practically possible, factors that could distort the optimal distribution of slots, such as strategic bidding, must be mitigated (Wolf 2003: 348). To ensure this, the following questions have to be dealt with:

- How will demand interdependencies be dealt with (i.e. a take-off slot must be coupled with a landing slot)?
- What auction mechanism is to be used to determine the price?
- Should slots be allocated sequentially or simultaneously? The allocation of one set of slots could influence the auctioning of further slots and could lead to a different result than through a simultaneous auction
- Who will be responsible for executing the slot auction?
- How should a slot be defined?
- Can bids be conditional or withdrawn?
- How much time will an auction take and will there be more than one round?
- How much information is provided in terms of the status of other bidders during the auction (National Economic Research Associates 2004: 173-176; Wolf 2003: 352-353)?

There is no single correct solution to how a slot auction should be conducted. However, one possible auctioning procedure that was developed by Wolf (2003: 374) will be summarized here as an example: Before the auction starts, all slots that are to be auctioned will be reported by the owners of the slots to the organizer of the auction. Slots may also be offered in the form of bundles or packages. Slots will then be allocated in a first round through the English auction, which means that the price is raised step by step in an open auction until the highest bid and bidder are determined. Slots bundles may only be broken up if the sum of the bids for individual slots exceeds that of the bid for the entire bundle. In the second phase, slots which were not sold in the first phase are auctioned away in a closed auction, where the winner pays the sum offered by the second best bidder. The third step of the auction would allow bidders to withdraw their bids; however, only against a fee, being the difference between the highest and second highest bid. After the auction is over, the slot holders will be allowed

to use, sell, or trade the slots in question freely for the duration of a specified amount of time, until the next auction begins.

The auctioning off of all slots at once may cause too many implementation problems and too much uncertainty. That is why the following restriction is suggested: Every year only 10% of all slots at an airport would be redistributed through an auction mechanism in an ongoing process so that after 10 years every slot has been auctioned off once. Thus, grandfather rights would only last for 10 years. The slots up for auction each year would be chosen in such a way that they are evenly distributed throughout the day. Monetary secondary trading would be allowed under this mechanism, but the expiry date (i.e. the time at which the slot must be put up for auction again) would not be affected if slots are traded. This mechanism will put pressure on carriers who have a high percentage of slots at a given airport as they will be forced to give back a considerably high amount of slots, opening up the opportunity for new comers to buy interesting slots (European Commission 2004: 12).

4.4 Scope of application

Now that the three market-based slot allocation methods have been introduced, possible scopes of application will be discussed. The main question is, whether all slots should be open to everyone, or whether slot pools should be created from which only certain types of airlines may choose from. In the following, several possible scenarios of slot pooling based on geographical criteria will first be introduced in each of which market-based slot allocation could take place. Then, further criteria for dividing slots into pools will be given. These considerations are important to keep in mind when dealing with slot allocation schemes and shall be addressed, but they will not, however, form a basis for analysis in Chapter 5.

In the most extreme scenario, all slots are put up for the market mechanism, and all airlines, regardless of their type of operation or national origin, will draw slots from a single slot pool through the same market mechanism. This, however, seems quite unfeasible, since it would require the compatibility with slot allocation systems of non-EU countries. With incompatibility, retaliatory action can be expected by countries who feel that their national air carriers are paying too much in their eyes for valuable slots. This could have a negative impact on the structure of European airlines (National Economic Research Associates 2004: 153). Furthermore, regional carriers could be strongly disadvantaged, as will be discussed below.

In another scenario, domestic (intra-EU flights) and international flights are distinguished to avoid the above mentioned retaliatory action by non-EU countries. Only the slot pool for domestic flights would be affected by a revised regulation. This could, however, put EU carriers at a potential disadvantage against international competition.

In the third scenario, slots could fall into three different slot pools. First of all, a distinction between slots for domestic and international flights can be made as in the previous case. The second distinction is made within the domestic slot pool: Regional flights are separated from all other flights. They would be “ring-fenced” as they are economically more vulnerable and serve an economic purpose to regions which need access to specific hubs. Regional services require small aircraft, meaning that the additional cost through more expensive slots would imply a disproportionately higher cost per passenger than for larger aircraft (National Economic Research Associates 2004: 82). It will be very hard to determine the crossing line between regional and non-regional flights. Larger carriers may feel that ring-fencing is an unjustified form of subsidy. These points would undoubtedly cause a lot of controversy in practice and will be left open in the course of this thesis. In addition to ring-fencing, all international flights will be excluded from market-based slot allocation schemes. Two slot pools thus

remain in which market-based schemes are applied separately within this scenario.

There are two ways in which ring-fencing slots for the purpose of protecting regional flights can be implemented. One is to simply reserve a certain amount of slots within each time period for such flights. The other is to scrap the forming of separate slot pools for regional flights as well as for non-regional flights, but instead to provide a slot discount to regional flights. The Nera study suggests that regional airlines could attain slots for a discount of 25%. If the regional airline were to attain a discounted slot and then sell it on to a non-regional airline, the discount would have to be repaid to the airport to avoid abuse (National Economic Research Associates 2004: 158-159).

Now that three major scenarios under which slot allocation schemes could be applied have been presented, further issues will be addressed. Slot pools could be created for each of the four different airline service types that were discussed in Chapter 2: network, charter, regional, and low cost carriers. Another question is at which type of airports new slot regimes should be implemented. In Chapter 3.4, airports that face capacity constraints throughout the day as well as during peak hours were introduced, and these would come primarily into question. Another point to be considered is that certain flights must remain exempt from slot allocation schemes, such as sanitary, rescue, and governmental flights as well as general aviation. The different scopes of application are summarized in Figure 19 below.

<i>Scope of application based on:</i>	<i>Slot pools:</i>			
Geography	Regional	Intra-EU	International	
Service type	Network carrier	Regional carrier	Charter carrier	LCC
Airport category	Congested throughout the day	Congested during part of the day	No congestion	
Operation type	General aviation	Sanitary/ Rescue flights	Governmental/ military flights	Commercial flights

Figure 19: Different scopes of application.

Finally, it is important to note that deciding how many and which slots should fall into each slot pool will be a difficult process. Finding a right balance is extremely important because competition and efficient use of slots is supposed to be fostered, not artificially restricted, by new slot allocation schemes. In the following chapter, the case of ring-fencing slots for regional carriers will be addressed when examining the effects of each market-based slot allocation scheme as this issue seems to be causing the greatest concern in the EU, based on the review of the literature.

5 Effects of market-based slot allocation schemes

Several obstacles must be overcome for market-based slot allocation schemes to be introduced. For one, severe resistance is to be expected by the airlines as well as the airports interested in reserving the status quo. The process of changing to a new system would require large efforts to be undertaken and uncertainties may arise. This is not something airlines are easily willing to accept, especially when considering the already low profit margins of the industry (Gruber; Gallistl). At airports, where capacity problems exist only during parts of the day, such as at the Vienna Airport, the will to change seems to be particularly little. Airports especially do not welcome a system in which their best client is “punished”. As the best client of a major airport is usually the sole carrier operating a major hub, this carrier would pay the most under a system where valuable slots are priced highly, as is the case for slots located around the peaks of waves. These wave slots would be more expensive than regular slots, thus potentially burdening the hub carrier more than other airlines (Jäger).

Besides these psychological factors, new slot regimes could require high implementation and transaction costs. An optimal solution might thus fail to be introduced simply because the cost and time of doing so is not practical. A lack of transparency may also result. Furthermore, a major legal issue will be the protection of confidence when slot legislation is changed. As mentioned in the previous chapter, some of the proceeds from slot sales may go into compensating those who lose grandfather rights; however, a monetary solution may not suffice. Finally, new slot regimes must comply with political goals and without these no major change from the present system can be expected (Ewers et al. 2001: 11).

In the following subchapters, the focus will not, however, lie on issues concerning the implementation process. Instead, the effects that each of the three

proposed slot allocation will have on the network structure of airlines as well as on passenger air services after the implementation process will be investigated.

5.1 Secondary Trading

5.1.1 General Impact

Secondary trading may lead to some general problems, reducing the effectiveness of this slot allocation scheme. First of all, airlines may simply not trade slots and continue to do business as before. The opportunity cost may not provide enough incentive for the airline to actually trade their slots. In contrast to primary trading, secondary trading of slots does not present the airline with a cash cost, i.e. a very “tangible” value. The lack of perfect information will lead to doubt on behalf of the selling airlines, who may not want to take the risk of losing a slot and its associated grand-father rights. This is especially true in a very volatile industry, where the future price of a certain slot is very hard to predict. The profit achieved by the sale of a slot must thus be discounted by this uncertainty factor. If airlines are in a comfortable financial position, they may simply not have a need to sell the slot. Furthermore, airlines may be aware of the option value of a slot, thus stalling the slot transaction until a future moment in time. Slots may be seen as an asset altogether. Slots for profitable routes and times could, therefore, be kept for the sole sake of the asset value attached to it. Similarly, slots might be held on to if airlines run routes for non-profit reasons, such as for prestige (National Economic Research Associates 2004: 135-138; Ewers et al. 2001: 26).

Another major problem besides that of the opportunity cost is that airlines may be unwilling to sell their slots to competitors. This would seriously question the purpose of secondary trading in slots. However, there is nothing that stops a third party from first acquiring that slot from the selling airline and then selling to

its competitor. Also, competitors may be able to obtain similarly valuable slots (perhaps one that is located five minutes on); thus, the slot-retaining airline would lose the proceeds from this deal (Economic Research Associates 2004: 139).

Before continuing with the speculation of what effects secondary trading may have in Europe, a look will be taken at the situation in the United States. There, secondary trading has been in effect at a few select airports. The situation is not quite compatible with that of Europe; nonetheless, lessons may be drawn from it.

5.1.2 The US Experience

In the US, slots are generally allocated on a first-come-first-serve basis. The major exception to this rule are the four airports LaGuardia, Reagan Washington, Kennedy Airport and Chicago O'Hare. In 1969, the so-called "high density rule" was imposed due to severe slot shortage. This rule put a lid on the total number of slots that could be distributed to airlines. In 1986, a monetary secondary slot trading was permitted. Furthermore there are administrative criteria: 80% of the slots must be used within two month periods or else returned to the slot pool. 25% of the slots that go to the slot pool are allocated to new entrants, the rest distributed by lottery. Thus, this system is very similar to the European one except that secondary slots may be sold or leased. The application of this rule is, however, limited to domestic slots. Furthermore, slots for commuter flights were also exempted (Czerny and Tegner 2002: 5-7; Starkie et al. 2003: 67-68).

The EU has been rather sceptical towards the US example of secondary trading. It argues that already dominant incumbents have been able to strengthen their position at all four airports, as can be seen in Figure 20. However, there are efficiency reasons why these dominant airlines were able to expand their dominant position. For one, a hub carrier can expect more benefits for its network

by adding an additional route than an airline operating a point to point route. Thus, the slot will have more value for it, increasing the amount it is willing to pay. Also, evidence suggests that there is a strong link between market share and the frequency of slot usage, as well as between the average seat load factor of an airline and the likelihood of it to buy further slots (Czerny and Tegner 2002: 5-8).

Airport	Holding entity	1986	1991	1996	1999
O'Hare	American and United	66	83	87	84
	Other established airlines	28	13	9	10
	Financial institutions	0	3	2	3
	Post-deregulation airlines	6	1	1	3
Kennedy	Shawmut Bank, American, and Delta	43	60	75	84
	Other established airlines	49	18	13	14
	Financial institutions	0	19	6	1
	Post-deregulation airlines	9	3	7	1
La Guardia	American, Delta, and US Airways	27	43	64	70
	Other established airlines	58	39	14	14
	Financial institutions	0	7	20	10
	Post-deregulation airlines	15	12	2	6
Reagan Washington	American, Delta, and US Airways	25	43	59	65
	Other established airlines	58	42	20	18
	Financial institutions	0	7	19	14
	Post-deregulation airlines	17	8	3	3

Figure 20: Percentage of domestic air carrier slots held by selected groups. Source: Czerny and Tegner (2002: 5).

Another example for monetary trading can be found in one of the member states of the European Union. Although the EU is not happy about this, a “grey market” has developed in the UK. This “grey market” was established in 1999, when a complaint was launched against British Airways who traded some of its almost worthless slots against high value slots from Air UK to cover up the real deal: Reportedly, BA paid 16 million pounds for 4 daily slot pairs on the Heathrow-Guernsey route. However, an English Court of Appeal rejected this

complaint, thus opening up a “back door” for airlines to sell and buy slots (“Secondary trading in airports slots”: 17).

5.1.3 Impact on airline networks and the passenger air service

The overall effect of secondary trading would probably be rather limited. However, giving the airline an opportunity to cash in on slots will increase the likelihood of trades being made for economic benefit. Uneconomical slots that were previously used in order to fulfil the 80% rule may now be more likely to be sold as the airline can profit from the slot sale. Yet it will still be difficult for new entrants to establish themselves. These would need to attain a whole series of slot pairs at two given airports (Jones et al. 1993: 49-50). The potential buyer of slots could have a very difficult time to find enough sellers to set up a viable air service. The problem of only invaluable slots being put up for sale, while the valuable slots are retained by the incumbents through grand-father rights, remains. Secondary trading could, however, be useful for airlines which have already established themselves and are seeking to improve efficiency. The evidence from the US market given in chapter 5.1.2 suggests so. Furthermore, there seems to be a strong interest for airlines to enter these types of trades, clearly visible on the UK grey market. One may thus conclude that new entrants will have a difficult time earnestly improving their slot holdings, while passengers nonetheless profit from the hub carrier’s improved efficiency.

The number of passengers flying in and out of airports could increase slightly through secondary trading through this increased efficiency. If implemented, the NERA study (National Economic Research Associates 2004: 141) predicts an increase in passenger volume by 4% in 2007 through secondary trading at Category 1 airports throughout the EU. If regional flights were to be ring-fenced, this number would probably be lower. However, regional airlines would have to face less competition. An increase in total passenger volume is sacrificed for the maintaining of regional access in that case.

Passenger fares would rise slightly because airlines are in a bit of a better position to provide a service to passengers which will create more revenue (Starkie 1998: 115). It is important to note, however, that this does not automatically imply a higher number of passengers or a higher seat-load factor for a given slot. It may well be that an airline could transfer much less passengers and yet generate higher revenues. A typical case could be if a slot for an air service used mainly by business passengers replaces one used for a charter flight to a tourist destination. On the other hand, if services are similar, higher revenue would go hand in hand with higher seat-load factors and the transport of more passengers.

5.2 Higher Posted Prices

Through the introduction of higher posted prices, airlines would suddenly be confronted with a situation in which the importance of grandfather rights is greatly reduced (Ewers 2001: 20). They would, as such, no longer function so strongly as an asset. The only requirement now is the airline's willingness to pay the increased slot price in the future season in order to retain it. Initially, this new system of slot allocation may make scheduling very difficult for airlines. As it is not clear how airlines will exactly react to the new slot prices, it will also be hard for airports to set slot prices for the upcoming seasons. Changes in infrastructure, which lead to a sudden influx of new slots, may greatly distort the value of slots. For example, the 3rd runway planned to come into operation at the Vienna International Airport in the next decade, would increase the total number of slots per hour from about 66 to 90 (Pfeffer: 2006). This will lead to a high amount of price volatility, further making planning difficult. The uncertainty created through future changes in price can be reduced through secondary trading. Depending on how an airline predicts the slot price to evolve, it can either hold on to or sell it if this would mean a higher profit for airlines.

Higher posted prices will impose strong pressure on all airlines using slots that were previously in excess demand, since the slot would now consist of not only the airport charges (such as the landing fee), but also the scarcity rent. First and foremost, this is a powerful mechanism to make those airlines attain the slot who are convinced of being able to wreak the highest profit from it. In addition, the incentive for airlines to get rid of unused or underused slots will be very high, enabling other airlines, such as new entrants, to acquire them.

On the downside, many previously established routes may become uneconomical all of a sudden. If the slot is not given to an airline which can operate more efficiently on a specific route, the airline, especially if it has strong purchasing power, could finance the slot anyhow by cross-subsidizing it through its other flights. However, it is more likely that the price will to a large part be passed on to the passenger. The resulting shift of many passengers away from the flights using expensive slots, i.e. a move away from the peaks, would then require high price elasticity (Abeyratne 2000: 17). Many leisure travellers might be pushed away from the peaks. However, high elasticity is not given amongst the group of (high-paying) business travellers, who would be forced to simply pay more if they want to use the air service at a particular time. If the airport experiences capacity problems throughout the day, passengers will not be moved away from the peaks, but away from the airport altogether. The option of moving passengers to the troughs is thus not an option because these are also fully congested. The first graph in Figure 21 exemplifies this type of situation. The second graph shows an only partly congested airport where a full displacement of the demand occurs to the non-congested times of the day, under the unrealistic assumption of complete price elasticity.

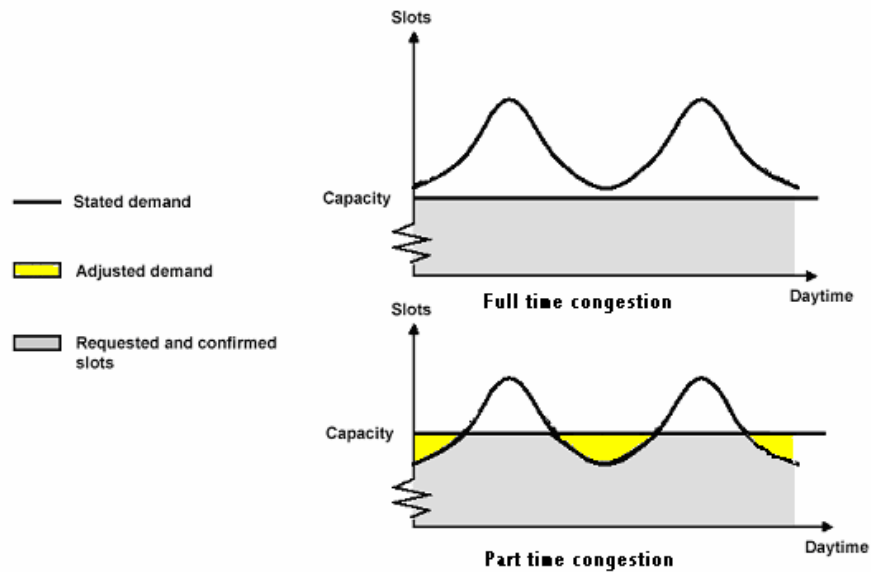


Figure 21: Fulltime and part time congestion. Adapted from: Ewers et al. (2001: 33).

Morrison (2001: 48) believes that a reduction of passengers or at least of flights through higher slot prices, where only those passengers are left who value the flight most in economic terms, is the only solution. This would simply mean putting a lid on the increasing number of people being able to afford the passenger air service. Shank (2005: 424) believes that it will be absolutely necessary for alternative forms of transportation to be available to accommodate displaced passengers, and that Europe has good chances of providing the necessary intermodal competition. Without this alternative, Shank believes higher posted prices cannot be implemented due to too much political resistance.

In contrast to Shank and Morrison, who believe that higher posted prices could and should reduce the number of passengers using congested airports, the authors of the Nera study (National Economic Research Associates 2004: 164, 169) come to the conclusion that higher posted prices will indeed raise the number of passengers at congested airports due to the more efficient use of slots. They argue that higher posted prices will be more effective than secondary trading

on its own since the opportunity cost becomes a cash cost. The authors predict that in 2007, 36 million more (or 5% more) passengers would be able to travel under a system of higher posted prices in combination with secondary trading.

However, this strong rise in passengers seems questionable. For one, the slot price would become very high at airports that are heavily congested. This is already evidenced by the experience of south eastern England, where peak pricing has been in effect. There, peak prices exceeded off-peak prices by 230% at Heathrow and by 300% at Gatwick (Ewers et al. 2001: 24). It is important to keep in mind that these peak prices are not as high as market clearing prices would be. Thus, higher posted prices would be even greater and would create an even stronger burden for airlines flying at peak hours. Prices would be highest when congestion is highest. In essence, this would affect hub-and-spoke systems the most as these require a high concentration of flights within a specified amount of time. The more connection flights a hub-and-spoke system offers (within a reasonable period of time), the higher the congestion. Especially the feeder flights, which are already cross-subsidized, will become even more uneconomical if viewed on their own. The authors of the Nera study, nonetheless, believe that the large aircraft employed to take the feeder flight passengers to long distance destinations will make up for this (National Economic Research Associates 2004: 85). Abeyratne (2000: 15), however, argues that large or wide body aircraft are actually a “mixed bag”. The larger aircraft carry more passengers, but also take up more runway time and require other aircraft to leave a higher safety distance. It is true that the number of passengers per unit of slot time is increased through large aircraft, but not quite in proportion to the increase in the number of seats on that aircraft.

Major hub-and-spoke systems might thus be placed under severe pressure at airports where higher posted-prices may lead to extreme price increases. The result may well be that passengers pay significantly more. On the other hand, airlines operating major hubs may reduce the complexity of their hub-and-spoke

networks, focusing only on the most profitable routes. This would in turn lead to a reduction of passenger air service quality in terms of available destinations.

Regional flights, to which many feeder flights can be grouped, will be put under even greater pressure. Some of these regional flights could be grouped to the flights which hub carriers would scratch from their network for financial reasons. Evidence of this and the resulting economic effects can be seen in Gatwick and Heathrow. Between 1990 and 1993, several regional flights, including those to Norwich, were closed due to prices being too high. The lack of access to these major hubs resulted in major oil companies moving away from the Norwich area. The CAA was not able to intervene as its sole purpose in this matter was to provide efficient use of slots in microeconomic terms (Shank 2005: 423). If regional flights were to be ring-fenced, the damage done to this category of flights could be limited. It could also help hub-and-spoke operators to retain certain feeder flights to make their networks more attractive.

5.3 Primary Trading – slot auctions

If the auction process is conducted in the right manner, slot auctions will manage to be much more precise than higher posted prices in matching supply and demand. While economic efficiency may be achieved at first, many of the problems encountered with higher posted prices will arise in an even stronger form.

At first sight, hub-and-spoke systems may seem to be put under strong pressure. Every year when 10% of the slots are put up for auction again, any new entrant will have the same opportunity of acquiring a slot from that slot pool, formerly belonging to an incumbent, as long as it is willing to pay the price. It is thus always a gamble, which routes in the hub-and-spoke system large carriers can retain and which not. Even if hub carriers were to retain their dominant

position, the ability of airlines to plan their schedules would be seriously disrupted, having a negative impact on their willingness to make investments. Considering that a functioning hub requires dozens of slots on any particular day, the withdrawal of 10% of all slots for re-auctioning would mean that chances are very high that the airline would lose some slots each year, with no guarantee of regaining them. Since slots at other airports will need careful coordination with the slots in the waves at the hub airports, significant changes in schedule on a yearly basis might be the outcome. This problem could be alleviated to some degree by trading with or using slots of an alliance partner. This would help increase a carrier's flexibility (National Economic Research Associates 2004: 207).

Incumbents operating a hub-and-spoke network may have more flexibility for another reason. They "own" more slots at an airport and this will facilitate rescheduling if important slots are lost in an auction. New entrants are less flexible as they, once again, will probably have to attain a whole series of slots to start a feasible operation. In addition, a new entrant might fear retaliatory measures by the incumbent if it were to attain their valuable slots (National Economic Research Associates 2004: 202, 205; Sentance 2003: 55); A powerful incumbent could, as a retaliatory measure, bid for a slot that would be very valuable for the new entrant's network. It could then force a trade with the incumbent to regain its original slot.

Nonetheless, the Nera study estimates that an additional 29.5 million more passengers will fly at category 1 airports in the EU in the year 2007 as a result of auctions of 10% of all slots on a yearly basis (National Economic Research Associates 2004: 208). This implies that a shift to larger aircraft and long-haul flights will be necessary to achieve this. As discussed in the case of higher posted prices, it is unclear where the passengers will come from to transfer to these long-haul flights. Feeder flights would have to be subsidized more than ever before,

since they will tend to be located in the waves. And since waves imply higher congestion, wave slots can be expected to become very expensive.

Regional carriers will be at a high risk of losing their slots and ultimately withdrawing from congested airports (National Economic Research Associates 2004: 205). The ring-fencing of regional carriers could prevent this form of carrier and service from being pushed out of airports, especially those airports with high demand throughout the day. Once again, defining rules for which airlines qualify for regional protection and which airlines do not could lead to strong disputes.

6 Conclusion

The air transport sector is facing serious capacity constraints at major airports throughout Europe. One of the main bottlenecks, to which more and more attention is being turned to, is the availability of slots that airports can provide to the airlines. Constraints are either limited to certain parts of the day or throughout the day. The strong growth rate predictions for the next two decades will only exacerbate this problem.

Plans to alleviate slot shortages by expanding airport infrastructure face several restraints. For practical as well as environmental reasons, the expanding of infrastructure is not always an option. Furthermore, hub airlines cannot simply move their operations to secondary airports, where congestion is less of a problem, since taking flights away from the hub airport would undermine the hub-and-spoke concept. Furthermore, secondary airports may be located too far away from economically relevant areas. Capacity restraints and the limited options for expanding infrastructure or bypassing overstrained airports have thus speeded up the debate of finding a method for making more efficient use of available slots. Currently, these slots are allocated through an administrative process, which cannot assure that whoever attains the slot makes the best use of it. Market-based slot allocation schemes are suggested as an alternative to this administrative process, the logic being that slots will be bought by the user who values the slot most and, thus, will make most efficient use of it.

Three market-based slot allocation schemes were introduced as an alternative to the present EU regulation on slot allocation. It is important to note that these mechanisms are neither mutually exclusive nor the only possible market-orientated allocation schemes. They are simply three very different suggestions. The first mechanism introduced was secondary trading. This presents only a minor incursion into the current system, and slots would be dealt

out as before. However, airlines would then have the possibility to sell and buy these slots amongst each other, instead of merely barter trading them. The fact that an opportunity cost appears could create an incentive for airlines to let go of slots which have little economic value to them and could cash in on the slot sale. On the other side of the deal, the buyer would only pay for the slot if he can expect to make a profit with it. The fact that there is a clear potential for a secondary market can be seen by the UK grey market of slots. Specific problems with secondary trading are that sellers and buyers may not be able to identify one another, that uncertainty remains about the future value of the slot to an airline, and that the opportunity cost is not clear.

The second market-based allocation scheme introduced was higher posted prices combined with secondary trading. This form of primary trading included the idea of congestion or peak pricing. In the case of higher posted prices, slot prices are raised until demand is roughly equal to supply. Prices would be set a year in advance so airlines could plan which slots they want to repurchase. Grandfather rights would only be valid as long as airlines are willing to pay the higher posted prices. Higher posted prices would put a direct cash cost on slots, thus placing strong pressure on airlines operating expensive slots to use them only if they pay off. On the one hand, strong pressure will be put on airlines operating hub-and-spoke networks. As their flights need to take place within a short period of time so passengers can transfer in a reasonably, congestion will be higher during these periods, also referred to as waves. Thus, the slot price could increase painfully for certain hub carriers. On the other hand, regional airlines and other carriers operating small aircraft could be at a disadvantage when slot prices are increased during certain times of the day and could be pushed out of interesting markets.

The auctioning off of 10% of slots every year, so that all slots would have undergone auctioning after 10 years, is the final and most radical suggestion to slot reform presented in this thesis. Slots won in an auction would go to the best bidder and could be retained or sold on by the bidder for a period of 10 years. This system could benefit the airlines with strong purchasing power, usually being the ones operating hub-and-spoke systems. As with higher posted prices, operators of small aircraft could be at a major disadvantage. While the ability of hub carriers to plan their networks might be effected by uncertainty as to whether or not a slot that falls back into the auction pool can be reclaimed, they also enjoy a higher amount of flexibility because they can more easily make up for a lost slot due to their large slot holdings.

All three methods are attempts to achieve economic efficiency through the allocation of slots by market-orientated means. Economic efficiency does not automatically mean, however, that new entrants have an easier time, passenger numbers increase at congested airports, or fares sink. Often, airlines will have non-monetary motives to hold on to a slot or may act “irrationally” in other ways. An aircraft with a higher seat-load factor does not necessarily make more profit than the same plane type with a lower seat-load factor, for example if the latter carries more passengers from the business segment.

While some of the negative effects on operators of small aircraft, such as regional carriers, can be offset by ring-fencing slots for these, it is still questionable what the result of these market-orientated slot allocation schemes will ultimately be. It is very hard to predict the effects of secondary and primary trading (higher posted prices or slot auctions) on the structure of the airline business. Huge differences in slot prices could be expected between airports in the case of primary trading. Furthermore, the implementation costs of primary trading would be very high. Even secondary trading may have adverse effects if incumbents would be able to increase their share of slots through their purchasing power, further making it difficult for new entrants.

The huge implementation costs, the question of who should retain the scarcity rent, and the fact that so many uncertainties remain as to the effectiveness of the market-orientated slot allocation schemes have in terms of promoting competition and creating higher passenger volumes are issues that remain unsolved, making the introduction of radical reforms seem doubtful (Sentance 2003: 57). Hence, the scepticism amongst airlines and airports in the EU is very high. The interviews undertaken for this thesis at the Vienna International Airport and Austrian Airlines, its major hub carrier, have shown that the interest in radical alternatives to the current slot regime is very low. The resulting planning difficulties would simply outweigh the benefits (Jäger; Gruber). The strongest advocates of changing the current system in the European Union are to be found in the UK, where the grey market has been a reality for several years (Zulinski 2005; “Introducing commercial slot allocation mechanisms”: 6-7).

While overall resistance to primary trading is still very high, secondary trading seems have realistic chances of being implemented in the near future. The Association of European Airlines (AEA) as well as the Airports Council International (ACI) generally have a positive stance towards the European Commission’s reform proposals, as long as they are not too radical (ACI 2004: 7-8; “EC pushes for secondary slot trading by year-end”).

The aim of this thesis was to show the implications and potential impacts of market-orientated slot allocation schemes. Three alternative methods were demonstrated, of which secondary trading seems to have the highest chances of being implemented in the near future. However, even if such demand management techniques are successfully introduced to ease the slot problem at major airports in Europe, their result can only have a limited impact. To meet the ever growing demand in the air transport sector, infrastructure must ultimately be expanded. This includes enlarging airports and building new ones as well as fostering other forms of transportation capable of acting as viable substitutes for air transportation, especially trains. These might be in the position to replace

services by regional carriers as well as feeder flights by hub carriers (“Airways railroaded”). In conclusion, the allocation of slots through market-based schemes in the European Union is a remedy, but not a cure.

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